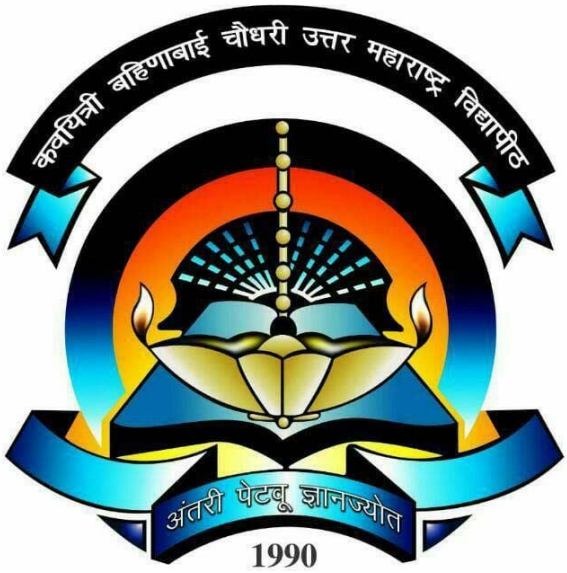
FACULTY OF SCIENCE & TECHNOLOGY

KAVAYITRI BAHINABAI CHAUDHARI NORTH MAHARASHTRA UNIVERSITY, JALGAON



'A' Grade
NAAC Re-Accredited
(3rd Cycle)

SYLLABUS
FOR
T. Y. B. Sc. (PHYSICS)

(AS PER CHOICE BASED CREDIT SYSTEM PATTERN OF UGC)

(With effect from June - 2020)

Preamble

The University Grants Commission (UGC) has initiated several measures to bring equity, efficiency and excellence in the Higher Education System of country. The important measures taken to enhance academic standards and quality in higher education include innovation and improvements in curriculum, teaching-learning process and examination and evaluation systems.

In that context in the last decade, North Maharashtra University, Jalgaon has taken several initiatives to upgrade and enhance the academic excellence, examination reforms and developing the skilled minds and skilled hands. As per the directions of UGC, from last year our KBC North Maharashtra University, Jalgaon has implemented the Choice Based Credit (CBCS) pattern to undergraduate programs run by various colleges affiliated to NMU, Jalgaon. As per the directions given by the Honorable Vice Chancellor, Pro-Vice Chancellor and Dean of the Faculty of Science and Technology of our university, one day workshop was organized for syllabus framing. The teachers of the affiliated colleges and university department were participated in the workshop of re-structuring the syllabi of T.Y.B.Sc. (Physics) as per the CBCS pattern and it has been finalized during the workshop and the same will be effectively implemented from the academic year 2020-21.

The main objective of the re-structuring the syllabus of T.Y.B.Sc. (Physics) is to create skilled minds and therefore expectation is to equip the students with the knowledge and understanding of concepts of physics rather than the ability to remember facts so that they may have a reasonable comprehensive and complete grasp of principles of physics. It is expected that the students should study physics with keen interest, develop their experimental skill and problem solving ability. The students should communicate their knowledge of Physics to the Society, to make them to understand physics around us. The students should use their knowledge of Physics for betterment of our Society, our nation and the World.

Board of Studies (Physics),

North Maharashtra University, Jalgaon

OBJECTIVES

1. To provide education in physics of the highest quality at the undergraduate level and generate graduates of the caliber sought by industries and public service as well as academic teachers and researchers of the future.
2. To acquire deep knowledge in fundamental aspects of Physics and basic knowledge in the specialized thrust areas like Thermodynamics, Basic electronics, Waves, Sound, Optics, LASERS, Energy harvesting and electrical circuit skills.
3. To develop ability among the students to identify, remember and grasp the meaning of basic facts, concepts and principles of Physics.
4. To develop observational skills, confidence in using scientific equipment and relate the knowledge of scientific concepts to quantitative and physical measurement.
5. Acquire knowledge, skills, working methods and ways of expression which will reflect on all round development of the students' attitudes towards scientific thinking and its applications.
6. To develop attitudes such as concern for accuracy and precision, objectivity, and Enquiry.
7. The overall aim is to provide comprehensive knowledge and understanding in the relevant fields and enable students to pursue the physics subject at an advanced level later and to attract outstanding students from all back grounds.

BOS (PHYSICS)-Faculty of Science & Technology

Kavayitri Bahinabai Chaudhari
North Maharashtra University, Jalgaon

Class: **T. Y. B. Sc.** Subject: **Physics**

Choice Base Credit System (With effect from June 2020)

The Board of Studies in Physics has unanimously accepted the revised syllabus (as per CBCS pattern) prepared by different committees, discussed and finalized in the **Online Workshop on Curriculum Development in Physics at T. Y. B. Sc.** held on15th and 16th May 2020.

The titles of the papers for T.Y.B.Sc. (Physics) are as given below:

Sem	Course type	Course code	Course title	Credits	Total hrs /week	Total teaching periods	Total marks	
							CA	UA
V	Discipline specific Course (DSC)	PHY 501	Mathematical Physics	3	3	45	40	60
		PHY502	Solid State Physics	3	3	45	40	60
		PHY 503	Atomic and molecular physics	3	3	45	30	60
		PHY 504(A) Or PHY 504(B)	Electronics-II Or Instrumentation -II	3	3	45	40	60
	Skill Enhancement course (SEC)	PHY 505	Solar Energy and applications	3	3	45	40	60
	DSE Elective course (Any one)	PHY 506(A) PHY 506(B) PHY 506(C) PHY 506(D) PHY 506 (E)	Technical Electronics- I or Refrigeration and Air conditioning- I or Vacuum Technology-I or Microprocessor-I or Programming in C++ I	3	3	45	40	60
	DSC CORE Practicals	PHY 507	Physics Practical I	2	4 (per batch)	60	40	60
		PHY 508	Physics Practical II	2	4 (per batch)	60	40	60
		PHY 509	Physics Practical III or Project	2	4 (per batch)	60	40	60
	Non credit audit course (Any one)	AC 501(A)	NCC	No credit	2	30	100	
		AC 501(B)	NSS					
		AC 501 (C)	Sports					
			Total credit	24				

Sem	Course type	Course code	Course title	Credits	Total hrs /week	Total teaching periods	Total marks	
							CA	UA
VI	Discipline specific Course (DSC)	PHY 601	Quantum mechanics	3	3	45	40	60
		PHY602	Material Science	3	3	45	40	60
		PHY 603	Nuclear Physics	3	3	45	30	60
		PHY 604	Modern Physics	3	3	45	40	60
	Skill Enhancement course (SEC)	PHY 605	Basic Instrumentation Skills	3	3	45	40	60
	DSE Elective course (Any one)	PHY 606 (A) PHY 606 (B) PHY 606 (C) PHY 606 (D) PHY 606 (E)	Technical Electronics- I or Refrigeration and Air conditioning- II or Vacuum Technology-II or Microprocessor-I or Programming in C++ II	3	3	45	40	60
	DSC CORE Practicals	PHY 607	Physics Practical I	2	4 (per batch)	60	40	60
		PHY 608	Physics Practical II	2	4 (per batch)	60	40	60
		PHY 609	Physics Practical III or Project	2	4 (per batch)	60	40	60
	Non credit audit course (Any one)	AC 601(A)	Soft skill	No credit	2	30	100	
		AC 601(B)	Yoga					
		AC 601(C)	Practicing Cleanliness					
			Total credit	24				

Note: The industrial/study tour is compulsory for students of T. Y. B. Sc. (Physics).

Semester V: (DSC): Physics paper I
PHY 501: Mathematical physics
(Credits: 03) :(45 Lectures 60 Marks)

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Course description:

This course is aimed at introducing the concepts of Mathematical physics to Under Graduate students.

Course objectives:

1. To impart knowledge of basic concepts in Mathematical physics.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.

Course outcome:

Learner will be able to ….

1. Apply the concept and knowledge of Mathematical physics to understand and solve real life problems.
2. Understanding of the course will create scientific temperament.

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Unit 1: Vector Analysis

Gauss divergence theorem, Stokes' theorem, Green's first and second theorem, Green's theorem in the plane. (Statements, proofs and problems) **(5P, 6M)**

Unit 2: Differential Equation

Introduction to Cartesian (X, Y, Z), Spherical polar (r, θ, φ) and Cylindrical (ρ, φ, z) co-ordinate systems and their transformation equations, Degree, order, linearity and homogeneity of partial differential equation, Method of separation of variables in Cartesian, Spherical polar and Cylindrical co-ordinate system (Wave equation and Laplace's equation), Singular points, Singular points of Legendre and Hermite differential equation, Statement of Fuche's theorem, Frobenius method of series solution, series solution of linear simple harmonic oscillator and Legendre differential equation **(11P, 16M)**

Unit 3: Special Functions

Generating functions for Legendre Polynomial $P_n(x)$, Hermite polynomial $H_n(x)$,and Bessel functions of first kind $J_n(x)$. Proof of following properties

1) $(n+1)\,P_{n+1}(x) = (2n+1)\,x\,P_n(x) - n\,P_{n-1}(x)$. 2) $P_n(x) = P'_{n+1}(x) - 2x\,P'_n(x) + P'_{n-1}(x)$.

3) $H_{n+1}(x) = 2\,x\,H_n(x) - 2n\,H_{n-1}(x)$. 4) $H'_n(x) = 2n\,H_{n-1}(x)$.

5) $J_{n+1}(x) + J_{n-1}(x) = 2n / x\,J_n(x)$. 6) $J_{n-1}(x) - J_{n+1}(x) = 2\,J'_n(x)$. **(8P, 10M)**

Unit 4: Complex Analysis

Complex numbers and their graphical representation, Argand diagram, Conjugate of a complex number, Basic mathematical operations with complex numbers, Euler's formula, De-Moivre's theorem, Roots of complex numbers, Functions of complex variables, Analyticity and Cauchy - Riemann conditions, Singular functions, Examples. **(10P, 14M)**

Unit 5: Special Theory of Relativity

Newtonian relativity, absolute space, Galilean transformations, Michelson-Morley experiment, postulates of special theory of relativity, Lorent'z transformation equations, Length contraction, time dilation, relativity of simultaneity, variation of mass with velocity, addition of velocities, mass-energy relation, energy momentum relation. **(11P, 14M)**

(Total: 45 Periods, 60 Marks)

References:

1. Mathematical Physics: B.S. Rajput, Pragati Prakashan (19th Edition, 2007).
2. Mathematical Physics: B. D. Gupta.
3. Mathematical Methods for Physics: G. Arfken, Hens Weber (4th Edition, 1995).
4. Mathematical Methods in the Physical Science: Mary L. Boas.
5. Vector Analysis: Murray R. Spiegal, Schaum's series.
6. Introduction to Special theory of Relativity – Robert Resnick, Wiley Eastern Ltd.
7. Mathematical physics: Ghatak
8. Complex variables and applications: J. W. Brown

Semester V: (DSC): Physics paper II

PHY 502: Solid State physics

(Credits: 03) :(45 Lectures 60 Marks)

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Course description:

This course is aimed at introducing the fundamentals of Solid state Physics to Under Graduate students.

Course objectives:

1. To impart knowledge of basic concepts in Solid state Physics.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.

Course outcome:

Learner will be able to ….

1. Apply the concept and use of knowledge of Solid state Physics understand and solve the real life problems.
2. Understanding of the course will create scientific temperament.

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Unit 1: The Crystal Structure

Classification of solids, Lattice, Basis & crystal structure, translational vector, Unit cell, Primitive unit cell, symmetry operations, Types of lattices (2D & 3D), Miller indices, Interplaner spacing, Number of atoms per unit cell, co- ordination number, atomic radius and packing fraction for SC, BCC and FCC structures, Study of CsCl, NaCl and ZnS structures, Concept of reciprocal lattice and its properties with proofs. **(10P, 14M)**

Unit 2: X-Ray Diffraction

Crystal as a grating for X-rays, Bragg's diffraction condition in direct lattice and reciprocal lattice, Ewald's construction, X-ray diffraction methods: Laue method, Rotating crystal method and Powder method, Analysis of cubic crystal by powder method, Brillouin zones (1D & 2D). **(08P, 10M)**

Unit 3: Cohesive energy and Bonding in solids

Cohesive energy and formation of molecules, Definition of dissociation energy of molecule, Types of bonding, Ionic bond, Covalent bond, Molecular bond, Metallic bond and Hydrogen bond, Madelung energy, Madelung constant for one dimensional ionic crystal. **(09P, 12M)**

Unit 4: Lattice vibrations and Thermal Properties

Lattice heat capacity, Classical theory of specific heat, Einstein's theory of specific heat, Vibrational modes in one dimension monoatomic lattice, Debye's model of specific heat of solids, Limitations of Debye model. **(09P, 12M)**

Unit 5: Free electron theory of metals and Band theory of solids

Drude-Lorentz classical theory, Sommerfield's quantum theory: Free electron gas in 1-D and 3-D, Fermi level and fermi energy, Density of states, Formation of Energy band, Distinction between metals, semiconductors and insulators, Hall Effect, Hall co-efficient and mobility. **(09P, 12M)**

(Total: 45 Periods, 60 Marks)

References:

1. Introduction to Solid State Physics: Charles Kittle.
2. Solid State Physics: A.J. Dekkar
3. Solid state Physics: R. L. Singhal
4. Solid State Physics: S.L. Gupta, V. Kumar.
5. Solid State Physics: S.L. Kakani, C. Hemrajan
6. Solid State Physics: C.M. Kachhava
7. Solid State Physics: R.L.Singhal, Kedar Nath, Ram Nath & Co.
8. Fundamentals of Solid State Physics: B.S. Saxena, R.C. Gupta, P.N. Saxena, Pragati Prakashan, Meerut
9. Concepts of Solid State Physics: J.N. Mandal, Pragati Prakashan, Meerut.
10. Solid State Physics: R. K. Puri and V. K. Babbar
11. Solid State Physics, H.Ibach and H Kutha, Springer (Online available book)

Semester V: (DSC): Physics paper III

PHY 503: Atomic and Molecular physics

(Credits: 03) :(45 Lectures 60 Marks)

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Course description:

This course is aimed at introducing the fundamentals of Atomic and Molecular Physics to Under Graduate students.

Course objectives:

1. To impart knowledge of basic concepts in Atomic and Molecular Physics.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.

Course outcome:

Learner will be able to ….

1. Apply the concept and knowledge of Atomic and Molecular Physics to understand and solve the real life problems.
2. Understanding of the course will create scientific temperament.

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Unit 1: Vector Atom Model

Introduction, Quantum numbers, Physical interpretation of quantum numbers, Electron spin, Larmor precession of electron orbit, Pauli's exclusion principle, Definition of L-S coupling and j-j coupling, Spin-Orbit interaction, Spectral terms, Selection rules, Spectra of single valence electron system (sodium), Problems. **(08P, 11M)**

Unit 2: Two Valence Electron System

Introduction, Spin-spin and orbit-orbit interaction, L-S and j-j coupling schemes, Singlet triplet separations, s-p and p-d configuration in L-S coupling and j-j coupling, Lande Interval rule, Spectra of Helium, Problems. (**10P, 13M)**

Unit 3: Zeeman & Paschen Back effect

Introduction, Magnetic dipole moment, , Zeeman Effect: Experimental set up, Normal and Anomalous Zeeman Effect for single valence electron system, Lande 'g' factor for two valence electron system (L-S and j-j coupling), Paschen Back effect for single valence electron system, Problems. **(10P, 13M)**

Unit 4: X-ray spectra

Origin and nature of X-ray, Characteristic X-ray spectra, Moseley's law and its importance, Energy level of Cadmium, Regular and Irregular doublets and their laws, Applications of X-ray (List only) **(07P, 10M)**

Unit 5: Molecular spectra

Introduction, Regions of electromagnetic spectrum, Types of molecular spectra, Rotational spectra of rigid diatomic molecule, Rotational energy levels of rigid diatomic molecule, Vibration of atoms in a diatomic molecule, Vibrational energy levels for Diatomic molecule, Raman spectra – Experimental set up, Explanation of Stoke's and Anti-stoke's lines, Applications of Raman effect. **(10 P, 13M)**

(Total: 45 Periods, 60 Marks)

References:

1. Introduction to Atomic Spectra: H.E. White, McGraw Book Company, Inc.
2. Fundamental of Molecular spectroscopy: C.N. Banwell, Tata McGraw hill, 3rd edition.
3. Spectra of Diatomic Molecules: G Hertzberg, D Van Nastrand compony, Inc., NewYork.
4. Perspectives of Modern Physics: Arthur Beiser, McGraw Hill Kogakusha Ltd, Tokyo.
5. Atomic spectra and Molecular spectra: Raj kumar, Kedarnath Ramnath Prakashan.
6. Introductory Raman spectroscopy: Elsevier publication.
7. Theoretical Atomic physics (Fourth Edition): Harald Friedrich.
8. Physics of Atoms and Molecules(Second edition):B. H. Bransden & C. J. Joachain.
9. The fundamentals of Atomic and Molecular Physics: Robert L. Brooks.

Semester V: (DSC): Physics paper IV
PHY 504(A): Electronics-II
(Credits: 03) :(45 Lectures 60 Marks)

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Course description:

This course is aimed at introducing the fundamentals of Electronics and Digital Electronics to Under Graduate students.

Course objectives:

1. To impart knowledge of basic concepts in Electronics and Digital Electronics.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.

Course outcome:

Learner will be able to ….

1. Apply the concept and use of knowledge of Electronics and Digital Electronics to real life problems.
2. Understanding of the course will create scientific temperament.

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Unit 1: Transistor biasing and Transistor amplifiers

Need of biasing, Different methods of biasing (only list), Voltage Divider bias method in detail, Single stage RC coupled Common emitter amplifier: Working, voltage gain, frequency response and bandwidth, Definition of Voltage amplifier and Power amplifier, Class A, B , C and AB power amplifiers (only load line diagram and explanation) and application list of each type. **(09P, 11M)**

Unit 2: Transistorised Sinusoidal Oscillators

Types of feedbacks, Barkhausen Criterion, Oscillatory circuit (tank circuit), Types of Oscillators (List only), Hartley oscillator, RC phase shift Oscillator **(04P, 07M)**

Unit 3: Semiconductor switching devices

FET: Types (n-channel and p-channel), Constructional detail, electronic symbol, working principle and I-V Characteristics, FET parameters, Introduction to MOSFET, Applications: FET as a VVR, FET as an amplifier.

UJT: Constructional detail, Equivalent circuit, symbol, working principle and I-V Characteristics, Applications: UJT as a switch, UJT as a relaxation oscillator

SCR: Constructional detail, symbol, Equivalent circuit of SCR, working principle and I-V Characteristics, Transistor analogy and its working, Important terms (break over voltage, holding current, forward current rating), Applications: SCR as a switch, Controlled rectification using SCR. **(09P, 12M)**

Unit 4: Digital Electronics

A) Flip-flops: Logic circuit, truth table, working and symbols of R-S Flip Flop, J-K Flip Flop. **(06 P, 08M)**

B) Counters: Types of counters (Asynchronous and Synchronous), 3 bit Asynchronous up counter (Serial counter), 3 bit Asynchronous down counter, 3-bit Asynchronous Up-down counter, 3 bit Synchronous up counter (Parallel counter), modulus of counter, mod-3 counter, mod-5 counter, and mod 10. **(07P, 10M)**

C) Data Processing circuits:

Multiplexer (2 to 1 & 4 to 1 line), De-multiplexer (1 to 2 & 1 to 4 line), Decoder (1 to 2 & 1 to 4 line, BCD to decimal decoder), Encoder (Decimal to BCD encoder). **(05P, 6M)**

D) Timer: Functional block diagram of IC-555 (Timer), Pin configuration, Astable, Monostable and Bistable multivibrator using IC 555, Application: Square wave Generator **(05P, 6M)**

(Total: 45 Periods, 60 Marks)

References

1. Principles of Electronics – V. K. Mehta, S. Chand Publications, New Delhi.
2. Basic Electronics: B. L. Theraja, S. Chand Publications, New Delhi.
3. Digital Principles and Applications – Malvino and Leach, McGraw-Hill Publication.
4. Electronic Principles – A. P. Malvino, Mc-Graw-Hill Publishing House.
5. Modern Digital Electronics – R. P. Jain, Tata McGraw-Hill Pvt. Ltd., New Delhi.
6. Integrated Circuits - K. R. Botkar, Khanna Publishers (2004).
7. Electronic fundamentals and applications – J. D. Ryder, Prentice Hall 4th Edition.
8. Electronic Devices and Circuits – Allen Mottershead, Good year publishing Company.

Semester V: (DSC): Physics paper IV
PHY 504(B): Instrumentation-II
(Credits: 03) :(45 Lectures 60 Marks)

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Course description:

This course is aimed at introducing the fundamentals of Instrumentation to Under Graduate students.

Course objectives:

1. To impart knowledge of basic concepts in Instrumentation.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.

Course outcome:

Learner will be able to ….

1. Apply the concept and use of knowledge of Instrumentation to understand and to solve real life problems.
2. Understanding of the course will create scientific temperament.

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Unit 1: Introduction to Instrumentation

Definitions: Resolution, Threshold, Range and span, Hysteresis, Dead band, Backlash, Drift, Impedance loading and matching. Functional elements of measurement system (Brief description), Classification of instruments- Deflection and Null type, Manually operated and automatic type, Analog and Digital types, Self-generating and power-operated types, Contacting and Non-contacting types. Dynamic Characteristics of Instruments: Dynamic response of zero order, First order, & Second order instrument.**(10P, 12M)**

Unit 2: Transducers

Introduction, Analog transducers- Electromechanical type, Potentiometric Resistance-type, Inductive type, Self-generating type, Non-self generating type, Capacitance type, Piezo-electric type, Resistance-strain gauges, Opto-electric transducer, Digital transducers: Frequency domain transducers, Digital encoders, Optical encoders, Shaft encoder. **(11P, 16M)**

Unit 3: Data Acquisition Systems

Introduction, Data converters, Digital to analog converters- Binary weighted and R-2R ladder. Analog to digital converters - Successive approximation method, Single and dual slopeintegration type ADC. Data transmission elements-Electrical-type, Pneumatic-type, Positiontype,Radio-Frequency type. **(12P, 16M)**

Unit 4: Data Presentation Systems

Indicating elements- Digital voltmeters, Digital Multimeter, CRO (Analog & Digital),Recorders- Strip chart, X-Y recorder,Digital data recording (CD Recording system).Display elements- Classification of displays, Display devices- LED, LCD, 7-segment display, Dot matrix display, Electro luminescent display. **(12P, 16M)**

(Total: 45 Periods, 60 Marks)

References:

1. Instrumentation: Measurement and analysis - Nakra and Chaudhary
2. Electronic Instrumentation – H.S. Kalsi
3. Electronic Instrumentation and Measurement Techniques - Helfrick and Cooper
4. Instrumentation: Device and system - Rangan, Mani, Sharma
5. Transducers & Instrumentation- D.V.S. Murty, PHI Publication.
6. Electrical and Electronic Measurement & Instrumentation - A.K. Sawhney
7. Transducers and display systems: B. S. Sonde, Tata McGraw-Hill Publishing Company.
8. Data Converters– B. S. Sonde, Tata McGraw-Hill Publishing Company Limited.
9. Audio and Video Engineering System: R.G. Gupta, Tata McGraw-Hill Publishing Company.

Semester V: (SEC): Physics paper V

PHY 505: Solar energy and applications

(Credits: 03) :(45 Lectures 60 Marks)

Course description:

The aim of this course is not just to impart theoretical knowledge solar energy fundamentals and applications to the students but to provide them with exposure and hands-on learning wherever possible.

Course objectives:

1. To impart knowledge of basic concepts of clean, safe and affordable energy.
2. To provide the knowledge about variety of solar energy applications.
3. To provide the knowledge and methodology of conversion of solar energy into heat& electricity.

Course outcome:

Learner will be able to ….

1. Apply the concept of use of knowledge of energy resources, solar radiations and conversion to real life problem.
2. Understanding of the course will create scientific temperament.
3. To impart knowledge of basic concepts of solar cell fundamentals.
4. To provide the knowledge and methodology of conversion of solar energy into electricity.

Unit 1: Solar Radiation:

The Sun, structure of the sun, solar constant, spectral distribution of extra-terrestrial radiation, Solar radiation at the earth's surface (terrestrial radiation), solar time and equation of time, Definitions: air mass, beam radiation, diffuse radiation, global radiation, irradiance, solar insolation. Solar radiation geometry, Empirical equation (derivation not expected) for Monthly Average: 1) Daily global radiation, 2) Daily diffuse radiation, 3) Hourly global radiation, 4) Hourly diffuse radiation. Solar radiation on tilted surfaces. Instruments for measuring solar radiation: Pyranometer, Pyrheliometer. **(05P, 08M)**

Unit 2: Solar Collectors:

Flat plate collector: Types (Liquid flat-plate type, Evacuated Tube collector type, flat-plate with Al-insulator, Polymer solar collector), materials for collectors (Absorber plate, Insulation and Cover plate),Efficiency of flat plate collector, Loss coefficients and Heat transfer, Heat Removal Factor, Improvement in efficiency.

Solar Concentrating Collectors: Flat plate collector with reflector, Cylindrical parabolic collector, Thermal analysis, Performance analysis. **(10P, 12M)**

Unit 3: Solar Photovoltaics:

A P-N junction, Energy level diagram of semiconductors, Fermi level in doped semiconductors, Photovoltaic principals, Materials for Solar cell, Single crystal silicon cell: Principle, construction, working, equivalent circuit, I-V characteristics of solar cell, Fill factor, Power-voltage characteristics of solar cell, Maximum conversion efficiency, Actual conversion efficiency, Limitations to cell efficiency, Multicrystalline silicon cell, Thin Film Solar Cell, Short circuit current, Open circuit voltage, Maximizing the performance, Cell size. **(10P, 12M)**

Unit 4: Solar Thermal Applications:

Solar water heater: Direct natural circulation type, Direct forced circulation type, Design consideration of solar water heater, Series and Parallel Arrays, Solar drying of food (Direct type and Indirect mode type),Solar cooling and refrigeration, Solar thermal power generation, Solar furnace (Direct incident type). **(10P, 14M)**

Unit 5: Solar PV Applications:

PV Systems: Classification, Basic Photovoltaic power system, Stand-alone PV system, Solar Cell Modules (Solar PV arrays), Series and Parallel combination of PV Modules, Grid-connected system, Solar power satellite, Power conditioning and control. Design of PV System: Array size and Battery size.

Energy storage: electro chemical batteries, large capacity approaches.

PV Applications: Industrial applications, Social applications, Consumer applications. **(10P, 14M)**

(Total: 45 Periods, 60 Marks)

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Demonstrations and Experiments:

(Note: Total 4 experiments are expected to be taken in the LAB by the teacher of this course while teaching the course.)

A) Solar Thermal Applications (Any two of the following)

1. Study of Solar Box Cooker
2. Study of Concentrating type Solar Cooker.
3. Solar Energy Measurements using Pyranometer.
4. Solar Energy Measurements using Pyrheliometer.
5. Study of Solar still for Water distillation.
6. Study of Solar Dryer: Hot air collector.

B) Solar PV Applications (Any two of the following)

1. Measurement of V_{OC} and I_{SC} of a Solar cell.
2. Determination of I-V & P-V Characteristics of a Solar cell.
3. Determination of I-V & P-V Characteristics of Series and Parallel combination of PV Modules.
4. Effect of Shading on Solar PV Module Output Power.
5. Study of Power versus load characteristics of Solar Photovoltaic panel
6. Study of Solar Lantern/ Street light

Note: For Solar energy modelling techniques, the software used for simulation in solar energy field, comparative review of software for solar photovoltaics, solar thermal systems and buildings. Use of software such as TRNSYS, PVSYST, PVSOL, SAM, SOLTRACE, HOMER, Meteonorm etc is advised.

References:

1. Solar Energy- S. P. Sukhatme and J K Nayak, Fourth Edition, Tata Mac Graw Hill Co. Ltd.
2. Solar Energy Fundamentals and Applications – H P Garg and J Prakash, Tata McGraw Hill Co. Ltd.
3. Solar Energy Utilisation – G D Rai, Khanna Publishers.
4. Solar Engineering and Thermal Processes – Duffie J. and W. Beckman (1991), John Willey and Sons Inc.
5. Solar Power Engineering – Magal B. S. (1990), Tata Mac Graw Hill Co. Ltd.
6. Renewable Energy Sources and Conversion Technology – Bansal N. K., M. K. M. Meliss (1990), Tata Mac Graw Hill Co. Ltd.

Semester V: (DSE): Physics paper VI

PHY 506(A): Technical Electronics-I

(Credits: 03) :(45 Lectures 60 Marks)

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Course description:

This course is aimed at introducing the fundamentals of Technical Electronics to Under Graduate students.

Course objectives:

1. To impart knowledge of basic concepts in Technical Electronics.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.

Course outcome:

Learner will be able to ….

1. Apply the concept of use of knowledge of Technical Electronics to real life problems.
2. Understanding of the course will create scientific temperament.

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Unit 1: Components and devices

Resistors, Capacitors, Inductors (Types, construction and specification), Identification of resistor and capacitor values, Transformers: Types, (Single phase power transformer, auto transformer, isolation, AF, RF, IF), Switches, Types of switches, Relay: Types (list only), Electromagnetic relay: Principle, Construction and Working. [Ref. 1 to 6] **(06P, 09M)**

Unit 2: Optoelectronic Devices

LED (Construction, Working & Applications), Seven Segment Display, Liquid Crystal Display (LCD), Photodiode (Construction, working, characteristics & applications), Introduction to phototransistor. [Ref. 2 to 5, 8] **(05P, 08M)**

Unit 3: Printed Circuit Board

Idea of PCB, advantages, copper clad, Etching processes, Different steps for making PCB, Precautions while making PCB, Principle of Photolithography (For PCB).[Ref.2,3 & 4] **(06P, 7M)**

Unit 4: DC Power Supplies

Block diagram of unregulated and regulated power Supply, their merits and demerits, Series regulated power supply, Voltage regulation (Load and Line). Study of Monolithic voltage regulators: Precision voltage regulator (IC 723), Three-terminal general purpose regulators ICs- 78xx and 79xx.[Ref 1 to 3, 15] **(07P, 10M)**

Unit 5: Operational amplifier and its applications

Introduction to differential amplifier, Block diagram of Opamp, Schematic symbol and Pin diagram of IC 741, Important terms of OPAMP such as input impedance, output impedance, input offset voltage, open loop voltage gain, input bias current, slew rate. Ideal and practical parameters of Op-Amp, Concept of virtual ground, inverting and non-inverting amplifier with gain expressions, off-set null, Applications: Adder, Subtractor, Integrator, Differentiator, Comparator. [Ref 2, 3, 13,14] **(12 P, 14M)**

Unit 6: Data Converters

D to A Converters: Resistive divider network, Binary ladder network. A to D Converters: Successive approximation type, Single slope, Dual slope, Voltage to Time, Voltage to Frequency. [Ref. 7 to 12] **(09P, 12M)**

(Total: 45 Periods, 60 Marks)

References:

1. Principles of Electronics – V. K. Mehta, S. Chand Publications, New Delhi.
2. Basic Electronics (Solid State): B.L. Thereja, Publisher:S. Chand &Company, New Delhi.
3. Basic Electronics: B. Grob, Publisher: McGraw Hill Book Co. New York,
4. A Textbook of Applied Electronics – R S Sedha, Publisher: S Chand & Company, New Delhi.
5. Electronic Instrumentation: H.S. Kalsi, Tata McGraw-Hill Publishing Company Limited,New Delhi.

6. Electronic components and Materials-Principles, Manufacture and Maintenance: S. M. Dhir, Tata McGraw-Hill Publishing Company Limited, New Delhi.
7. Measurement and Instrumentation Principles: Alan S. Morris., Publisher: Butterworth-Heinemann.
8. Transducers and display systems: B. S. Sonde, Tata McGraw-Hill Publishing Company Limited, New Delhi.
9. Digital Principles and Applications: A.P. Malvino and D. P. Leach. Tata McGraw-Hill Publishing Company Limited, New Delhi.
10. Data Converters–: B.S. Sonde, Tata McGraw-Hill Publishing Company Limited, New Delhi.
11. Modern Electronic Instruments and Measurement techniques: Albert D. Helfrick, Willam D. Cooper, Prentice Hall India Pvt. Ltd, New Delhi.
12. A course in Electrical and Electronic Measurements and Instruments: A. K. Sawhney, Dhanpat Rai and Sons.
13. Op-Amps & Linear Integrated Circuits - R. A. Gaikwad, Publisher: Pearson.
14. Operational Amplifier - G. B. Clayton
15. Integrated Circuits - K. R. Botkar, Khanna Publishers (2004).
16. Optoelctronics: J. D. Ryder
17. Power supplies: B. S. Sonde

Semester V: (DSE): Physics paper VI

PHY 506(B): Refrigeration and Air conditioning-I

(Credits: 03) :(45 Lectures 60 Marks)

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Course description:

This course is aimed at introducing the fundamentals of Refrigeration and Air conditioning to Under Graduate students.

Course objectives:

1. To impart knowledge of basic concepts in Refrigeration and Air conditioning.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.

Course outcome:

Learner will be able to ….

1. Apply the concept and use of knowledge of Refrigeration and Air conditioning to understand and solve the real life problems.
2. Understanding of the course will create scientific temperament.

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Unit 1: Heat Transfer:

Introduction, Conduction through slab, pipe, hollow sphere, Convection, Heat transfer by convection, Expression for heat transfer coefficient ,combined conduction and convection heat transfer, Fins and their applications. (Ref. 1: Chapter -15) **(6L, 10M)**

Unit 2: Air Refrigeration system:

Introduction, Reversed Carnot cycle and as most efficient refrigerator, C.O.P. and its dependence on source and sink temperature, Bell-Coleman air refrigeration system, Advantages and disadvantages of air refrigeration system. (Ref. 1: Chapter - 3) **(7L, 10M)**

Unit 3: Vapour Refrigeration system:

i) **Simple Vapour Compression Refrigeration system**:

Vapour compression refrigerator, Construction of various lines on T–S chart, P- H diagram for vapour compression refrigeration, Analysis of vapour compression system Advantages and disadvantages of vapour compression refrigeration over air refrigeration system. (Ref.1: Chapter-4)

ii) **Absorption Refrigeration system:**

Introduction, Simple absorption system, Practical ammonia absorption system, C.O.P. of the absorption refrigeration system, Domestic Electrolux refrigerator, Advantages and disadvantages of absorption refrigeration over compression refrigeration system. (Ref. 1: Chapter -6) **(14L, 16M)**

Unit 4: Refrigerants:

Classification of refrigerants: primary and secondary refrigerants, Desirable thermodynamic, safe working and physical properties of refrigerants, important refrigerants, refrigerant nomenclature, selection of refrigerant. (Ref.1: Chapter -11) **(06L, 8M)**

Unit 5: Refrigeration equipments:

Compressors: Functions, Reciprocating compressor, hermetically sealed compressor, Rotary compressor with sealing blade and eccentric motor. **Condensers:** Functions, Air cooled and water cooled condensers, Evaporative condensers, Cooling towers. **Evaporators:** Functions, Primary and Secondary evaporators, flooded evaporators, Dry expansion systems, Shell & coil evaporators.

Expansion Devices: Functions, Automatic expansion valve, Thermostatic expansion valve, Solenoid control valve, Low side and high side float valves. (Ref.1: Chapter -13)

(12 L, 16M)

(Total: 45 Periods, 60 Marks)

Reference Books:

1. A course in Refrigeration and Air –Conditioning: S.C. Arora & S. Domkundwar. Dhanpat Rai & Co. 7th Edition
2. Basic Refrigeration and Air –Conditioning: P.N. Ananthanarayanan , Tata Mcgraw Hill, New Delhi 3rd Edition
3. Principles of Refrigeration: Roy J Dossat , Pearson Education (Singapur) Ltd. 4th Edition

Semester V: (DSE): Physics paper VI

PHY 506(C): Vacuum Technology-I

(Credits: 03) :(45 Lectures 60 Marks)

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Course description:

This course is aimed at introducing the fundamentals of Vacuum technology to Under Graduate students.

Course objectives:

1. To impart knowledge of basic concepts in Vacuum technology.
2. To introduce the concepts and offer a fundamental insight to vacuum technology, the principles involved, pumps and gauges used.
3. To provide the knowledge and methodology necessary to create and maintain vacuum.
4. The course also involves the related experiments based on the theory.

Course outcome:

Learner will be able to ….

1. Apply the concept and use of knowledge of Vacuum technology to understand and solve real life problems.
2. Get knowledge of which pump to use to create vacuum.
3. Knowledge of which gauge to use for measuring vacuum.
4. Understanding of the course will create scientific temperament.

……

Unit 1: Basics for Vacuum

Atmosphere and Vacuum, Gas pressure, Equations of ideal gas, Fundamental assumptions of kinetic theory of gas, Mean free path, Gas diffusion, Viscosity of gas, Thermal conductivity, **(7P, 8M)**

Throughput and Speed, Different units of measurement of vacuum, Ranges of vacuum, Vacuum circuits: Impedance and Conductance, Mechanism of gas flow, pumping speed of vacuum pump. **(10P, 12M)**

Unit 2: High vacuum pumps

Rotating vane type rotary pump: principle, construction, working, ultimate pressure attainable, factors on which the optimum performance of the pump depends, pump characteristics. Oil diffusion vapour pump (single stage, multistage): principle, construction, working, ultimate pressure attainable, factors on which the optimum performance of the pump depends, pump characteristics. **(8P, 12M)**

Unit 3: Ultrahigh vacuum pumps

Turbomolecular pump, Sorption pump, Ion pump, Cryogenic pump: principle, construction, working, ultimate pressure attainable. **(10P, 14M)**

Unit 4: Vacuum gauges

U-tube manometer, Mc-Leod gauge, Thermal conductivity gauges- Thermocouple gauge, Pirani gauge, Semiconductor gauge, Ionization gauges- Hot cathode and Cold cathode gauge, Bayard-Alpert gauge. **(10P, 14M)**

(Total: 45 Periods, 60 Marks)

References:

1. Introduction to Theory and Practical of High Vacuum Technology : L.Ward & J.P. Bunn, Butterworths.
2. High Vacuum Techniques : J. Yarwood.
3. Design and Construction of Vacuum systems : G.W. Green.
4. Vacuum Sealing Techniques : A. Roth
5. High Vacuum Engineering : A.E. Barrington
6. Handbook of Vacuum Technology: Karl Jousten
7. Vacuum Physics and Techniques, T. A. Delchar, Chapman and Hall.

Semester V: (DSE): Physics paper VI

PHY 506(D): Microprocessor-I

(Credits: 03) :(45 Lectures 60 Marks)

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Course description:

This course is aimed at introducing the fundamentals of Microprocessor to Under Graduate students.

Course objectives:

1. To impart knowledge of basic concepts in Microprocessor.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.

Course outcome:

Learner will be able to ….

1. Apply the concept and use of knowledge of Microprocessor to understand and to solve real life problems.
2. Understanding of the course will create scientific temperament.

……

Unit-1: Fundamentals of Microcomputer

Simple microcomputer architecture, Microcomputer operation, Address bus, Data bus, control bus, memory, Semiconductor and Magnetic memory, Cache memory, RAM and ROM, High level and Low level language, Assembler, Compiler and Interpreter. **(12P, 16M)**

Unit-2: Architecture of 8085 Microprocessor

The 8085 pin diagram and function of each pin, Microprocessor communication and bus timings, Demultiplexing the bus AD7- AD0, Microprocessor Architecture and function of each block.

(12P, 16M)

Unit-3: Instruction Set of 8085 Microprocessor

Study of addressing mode for 8085:- Implied addressing, Register addressing, Immediate addressing, Direct addressing and Indirect addressing. Instruction set: Data transfer instructions, Arithmetic instructions, Logical instructions, Branching instructions, Stack/PUSH and POP instructions, I/O and Machine control instruction. **(15P, 20M)**

Unit-4: Stack and Subroutines

Stack, Subroutine, types of Subroutine and Macro **(06P, 08M)**

(Total: 45 Periods, 60 Marks)

References:

1. Fundamentals of Microprocessors and Microcomputers – Badri Ram, Dhanpat Rai& Sons, Delhi.
2. Microprocessor Fundamentals – Roger L. Tokheim.
3. 8085 Assembly Language Programing – L. A. Leventhal.
4. Microprocessor Architecture programming and Applications 8080 & 8085 – Ramesh Gaonkar.
5. 8086 Microprocessor programming and Interfacing – Gibson.
6. Advanced Microprocessor and peripherals (Architecture, programming and interfacing) – A. K. Ray, K. M. Bhurchandi.
7. Microprocessors and Microcomputers- Soumitra Kumar Mandal.

Semester V: (DSE): Physics Paper VI

PHY 506 (E): Programming in C ++ - I

(Credits: 03) :(45 Lectures 60 Marks)

Course description:

This course is aimed at introducing the fundamental Concept of Computer Programming language C++.

Course Objectives:

1. The course is designed to provide basic knowledge of C++ Programming.
2. C++ Programming is intended for software engineers, system analysts, program managers.
3. To learn how to design programs and applications using C ++.
4. To develop problem-solving skills and their implementation through C++ Programming.

Course Outcome: At the end of the course, the student will be able to

1. Explain basic principles of C ++ programming language
2. Concept of Variable, Operators, Control structure, Functions used in C++ programming.
3. Develop skills in writing a simple C++ program using a different statement.
4. Apply the best features of mathematics, engineering, and natural sciences to program real-life problems.

Unit 1: Elements of C++ **[L: 04 M: 8]**

What is C++?, applications of C++, comments, I/O streams, the structure of the C++ program.

Unit 2: Variable and Expressions **[L: 08 M: 12]**

Variables, tokens, keywords, identifiers and constants, basic data types, user-defined data types & derived data types. Declaration and initialization of variables.

Unit 3: Operators in C++ **[L: 08 M: 14]**

Scope resolution operators, member dereferencing operator, memory management operators, manipulators, type cast operator, expressions and their types**.**

Unit 4: Control structure **[L: 10 M: 10]**

If, if-else, else-if, switch, break, continue.

Loop structures: while, do-while, for, nested for loop.

Unit 5: Functions in C++ **[L: 10 M: 10]**

Introduction, function prototyping, call by value & call by reference, Inline functions, reference arguments and default arguments. Math library functions.

Unit 6: Introduction to arrays, structures & union in C++ **[L: 05 M: 6]**

Definition, declaration, examples.

[Total: 45 Periods, 60 Marks]

References :

1. Master in C++ - K.R.Venugopal
2. C++ Programming - E.Balaguruswami
3. Turbo C++ Programming - Robert Lafore
4. C++ Programming - Yashwant Kanitkar.

Semester V: (LAB): Physics paper VII

PHY 507: Physics practical -I

(Credits: 02): (60 L, 100M (40 Internal + 60 External))

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Perform any ten experiments:

1. Moment of Inertia by Bifilar suspension.
2. Y and η by Searl's method.
3. Y by Koenig's method.
4. Y by Newton's rings.
5. Searl's Goniometer.
6. Lloyd's single mirror.
7. To estimate temperature of Na flame.
8. Measurement of resistivity by four probe method.
9. Frequency of AC/ Tuning fork by stroboscope.
10. Variation of resistance of a filament of a bulb with its temperature.
11. Determination of velocity of sound using ultrasonic Interferometer.
12. Electromagnetic Pendulum.
13. Determination of circular aperture of LASER.
14. Measurement of self-inductance of a coil by Anderson's bridge.
15. To determine the human audibility.
16. Study of I-V characteristics of solar cell.
17. Determination of fill factor and efficiency of solar cell.
18. To determine the solar constant.

Semester V: (LAB): Physics paper VIII

PHY 508: Physics practical -II

(Credits: 02): (60 L, 100M (40 Internal + 60 External))

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Group A: Perform any five experiments (Solid state physics, Electronics, Instrumentation):

1. Hall effect.
2. Analysis of XRD pattern.
3. Measurement of resistivity by two probe method.
4. Characteristics of JFET.
5. UJT characteristics.
6. UJT as relaxation oscillator.
7. Study of RC/LC filter(Low pass and High Pass)
8. Study of Heartly oscillator. (Calculation of frequency and verification of frequency from sinusoidal output waveform)
9. Measurement of self inductance using Maxwell's induction bridge.
10. Multiplexer (2 to 1 or 4 to 1) and/or De-multiplexer (1 to 2 or 1 to 4).

{For more knowledge and understanding, one can help the students to study, understand and use the VESTA software for determination of crystal structure on the basis of given data.}

Group B: Perform any five experiments from the following any one optional courses:

A) Technical Electronics:

1. To make two PCB's i) Using discrete components ii) Using IC components.
2. To study inverting and non inverting configuration of Op amp.
3. To study of OP AMP as an adder.
4. DAC (R- 2R ladder, without OP- AMP).
5. To study reverse bias characteristics of photodiode.
6. To study characteristics of photo transistor.
7. To design and study of regulated power supply using IC 723.
8. Designing and fabrication of transformer.
9. Triangular, square wave generator using OP AMP.
10. V to F converter using IC-741.
11. V to T converter using IC-741.
12. Study of function generator.
13. To study fixed voltage regulator using 78XX and 79XX.

{For more knowledge and understanding, one can help the students to study, understand and use the SKYLAB software to write and execute programs to study out put of inverting or non- inverting configuration of OPAMP, Opamp as adder or subtractor etc}

B) Refrigeration and Air conditioning:

1. Study of different tools used in Refrigeration and Air Conditioning.
2. To carry out the following operations on Copper tube i) Cutting ii) Bending iii) Flaring.

3. Study of hermetically sealed compressor used in refrigeration systems.
4. To carry out Swaging and Brazing of Copper tubes.
5. Study of thermostatic switch, LP/HP cut out switch and filters used in Refrigeration and A. C. systems.
6. Leakage testing and charging of a refrigeration system.

C) Vacuum technology:

1. To describe function of various parts of Rotary pump (with schematic diagram).
2. To describe the constructional details & working of vapour diffusion pump.
3. To measure the pumping speed of vacuum system by steady state method.
4. Study of McLeod gauge.
5. To calibrate & study the function of Pirani gauge.
6. To evacuate a system with a rotary pump (measurement of vacuum with & without ballast using McLeod gauge).

D) Microprocessor:

1. Diode matrix ROM.
2. Application of DAC (square/triangular sweep wave).
3. Up-down counter (4-bit).
4. Hexadecimal/decimal counter.
5. Multiplexer/Demultiplexer (using IC).
6. Study of shift register (using IC).
7. Shift an 8-bit and 16-bit number left by one bit.
8. One's and Two's Complement of number.

E) Programming in C++:

1. Write a C++ program to display the string "T. Y. B. Sc. Physics"
2. Write a C++ program to make addition, subtraction, multiplication & division
3. Write a C++ program to demonstrate the use of scope resolution operator
4. Write a C++ program to check whether given no. is palindrome or not
5. Write a C++ program to demonstrate the use of the inline function for finding a maximum of two numbers
6. Write a C++ program to accept array elements as positive and negative nos. & only print positive nos. as output (use continue statement) e.g. {10, -20, 3, 5,-7} O/P: {10,3,5}
7. Write a C++ program to generate Fibonacci series up to 20 terms e.g. 1, 1, 2, 3, 5, 8,…… (20 terms)
8. Write a C++ program to create the following structure Roll-No. Stud-Name Class. Enter at least five records

Semester V: (LAB): Physics paper VII

PHY 509: Project -I

(Credits: 02): (60 L, 100M (40 Internal + 60 External))

ASSESSMENT OF PROJECT- FIRST TERM:

Student should submit a Progress Report on the work done by him/her during the First Phase of the project i.e. on the topics :

1. Project Selection
2. Literature Search Strategy
3. Literature Review
4. Project Planning.
5. Experimental work (30 to 40 %)

Instructions:

1. The topic of project of the first term must be continued in the second term.
2. The project report of first term should be maintained and should be produced to examiner of second term.
3. The student will have to give a seminar on the project topic in the practical exam.
4. The student must perform his project presentation by PPT on LCD projector.

Semester VI: (DSC): Physics paper I

PHY 601: Quantum Mechanics

(Credits: 03) :(45 Lectures 60 Marks)

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Course description:

This course is aimed at introducing the fundamentals of Quantum Mechanics to Under Graduate students.

Course objectives:

1. To impart knowledge of basic concepts in Quantum Mechanics.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.

Course outcome:

Learner will be able to ….

1. Apply the concept and use of knowledge of Quantum Mechanics to real life problems.
2. Understanding of the course will create scientific temperament.

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Unit 1: The Schrodinger Equation

Introduction to Quantum Mechanics, Wave function and its Physical interpretation, normalized and orthogonal wave functions, Requirements of wave function, Formulation of time dependent and time independent Schrödinger equation (Steady state equation), Probability current density and equation of continuity, Solution of Schrodinger's equations, Energy eigenvalues and eigenfunctions, Expectation value, Ehrenfest's theorem, Postulates of Quantum Mechanics. (Ref:1, 2 and 9)

(14P, 14M)

Unit 2: Applications of Schrödinger steady state equation

Particle in a one dimensional rigid box (derivation of energy eigenvalues and eigenfunctions), Step potential (Probability of reflection (R) and transmission (T)), Linear Simple Harmonic oscillator (derivation of energy eigenvalues and eigenfunctions) (1D). (Ref: 2,6 and 7) **(12P, 16M)**

Unit 3: Quantum theory of Hydrogen atom

Schrödinger equation in spherical polar co-ordinate system, Schrödinger equation for Hydrogen atom-separation of radial and angular part, Solutions of R,Θ,Φ equations, Significance of quantum numbers n, l, m_l and m_s. (Ref: 1). **(09P, 14M)**

Unit 4: Operators in Quantum Mechanics

Operators and linear operators, Position, Momentum operator, angular momentum operator, and total energy operator (Hamiltonian), Commutator bracket, Commutator algebra, Commutator brackets using position, momentum and angular momentum operator, Commutation relations and Hamiltonian operator; Commutation rules for components of orbital angular momentum; Commutation relations of L^2 with components of orbital angular momentum; Commutation relation of components of orbital angular momentum with position operator, Ladder operators L_+, L_- Concept of parity, parity operator and its eigenvalues.(Ref: 2 and 4) **(10P, 16M)**

(Total: 45 Periods, 60 Marks)

References:

1. Perspectives of Modern physics : Arthur Beiser.
2. Advanced Quantum Mechanics: Satya Prakash, Kedarnath Ram Nath, Meerut
3. Quantum Mechanics: Gupta, Kumar, Sharma. Sultan Chand & Sons
4. Quantum Mechanics: Chatwal and Anand. Himalaya Publ. Co.
5. Quantum Mechanics: L.I.Schiff.
6. Quantum Mechanics: Powell and Crasemann, Addison-Wesley Pub. Co.
7. Introduction to Quantum Mechanics: D. Griffiths Published by Prentice Hall,
8. Quantum Physics: 2nd Ed. H.C. Verma, Surya Publications, Ghaziabad (UP), 2009.
9. Quantum Mechanics: Concepts and Applications, Nouredine Zettili, Wiley Publications.

Semester VI: (DSC): Physics paper II
PHY 602: Material Science
(Credits: 03) :(45 Lectures 60 Marks)

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Course description:

This course is aimed at introducing the fundamentals of Material Science to Under Graduate students.

Course objectives:

1. To impart knowledge of basic concepts in Material Science.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.

Course outcome:

Learner will be able to ….

1. Apply the concept of use of knowledge of Material Science to real life problems.
2. Understanding of the course will create scientific temperament.

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Unit 1: Introduction to materials

Classification of materials

Properties of Materials: **Mechanical Properties**:. Interpretation of tensile stress – strain curve, Stress, strain (tensile, compressive and shear), strength, elasticity, plasticity, ductility, malleability, hardness, toughness, creep, fatigue, stiffness, Isotropy, Anisotropy, Deformation, Elastic and Plastic deformation, factor affecting the mechanical properties, **Thermal Properties**: Heat capacity, Thermal expansion, Thermal conductivity, **Electrical Properties**: Conductivity, resistivity, dielectric strength, piezoelectricity. **Optical Properties**: Wavelength spectrum of electromagnetic waves. Refraction, Reflection, absorption and Transmission of non-metallic materials. **(12P, 15M)**

Unit 2: Atomic disorder in materials

Solid solution: Types of solid solution - Substitutional and Interstitial solid solution, Hume Rothery Rules of solid solubility. **Imperfections or defects in solids**: (i) Point defects: vacancies, Frenkel defect, Schottky defect, (ii) Line defects (Dislocation): Edge dislocation, screw dislocation**,** (iii) Surface defects or interfacial defects and (iv)Volume defect. **Plastic deformation**: Mechanism by slip system. **(06P, 10M)**

Unit 3: Diffusion of solid material

Atomic diffusion- Introduction, Classification of Diffusion.

Diffusion mechanism – Vacancy mechanisms, Interstiitial mechanism, Direct interchange mechanism. Diffusivity, Self diffusion in nickel, Steady state Diffusion (Fick's first law of diffusion) and Non steady state Diffusions (Fick's second law of diffusion), variation of diffusivity with temperature ,Activation energy for diffusion, factor affecting the diffusion. **(09 P, 12M)**

Unit 4: Phase Diagram

Phase diagram, Phase equilibrium, Construction of phase diagram, Interpretation of phase diagram, Gibb's Phase rule, classification of phase diagram - Unary Phase diagram, Binary Phase Diagram, Binary Phase Diagram for: i) Sugar-Water, ii) NaCl-water, Eutectic reaction, lever rule, Sb-Bi phase diagram, Pb-Sn phase diagram**.** **(10 P, 13M)**

Unit 5: Organic Materials:

Polymers: Properties of polymer, Molecular weight, Molecular structure, **Types of Polymers**: Plastics and elastomers, Plastic: Thermoplast, Thermosets Polymerization, Mechanism of polymerization, Degree of polymerization, Addition Polymerization, Co-Polymerization, and Condensation Polymerization. **(08P, 10M)**

(Total: Periods 45, Marks 60)

References:

1. Materials Science & Engineering: An Introduction (6th Edition): William D. Callister
2. Elements of Materials Science & Engineering: Van Vlack
3. First Course in Materials Science & Engineering: V Raghavan.
4. Material Science: S. L. Kakani, Amit Kakani. New Age International Publishers.
5. Material Science : G.K.Narula and K.S.Narula, Tata McGraw Hill.
6. Material Science and Processes : S.K.Hajra – Chaudhari, Indian Book Distributing company.

Semester VI: (DSC): Physics paper III

PHY 603: Nuclear Physics

(Credits: 03) :(45 Lectures 60 Marks)

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Course description:

This course is aimed at introducing the fundamentals of Nuclear Physics to Under Graduate students.

Course objectives:

1. To impart knowledge of basic concepts in Nuclear Physics.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.

Course outcome:

Learner will be able to ….

1. Apply the concept and use of knowledge of Nuclear Physics to understand and solve the real life problems.
2. Understanding of the course will create scientific temperament.

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Unit 1: Nucleus and Nuclear Forces

Nuclear compositions:- Constituents, charge, size, density, atomic mass of nucleus, nuclear magnetic moment, concept of parity(even and odd), classification of nuclei, mass defect and binding energy, stability of nuclei, packing fraction, Problems. Nuclear forces: Nuclear force, features of nuclear forces, saturation and short range nuclear forces, charge symmetry and charge independence, spin dependence of nuclear force, Meson exchange theory of nuclear forces, Elementary particles (List only). **(9L, 12M)**

Unit 2: Radioactivity

Introduction, Law of radioactive decay, half life, mean life, specific activity, partial radioactive decay, successive disintegration, Applications of radioactivity (Agricultural, Biological, Medical and industrial), Problems. **(06L, 08M)**

Unit 3: Nuclear Models

Types of nuclear models (List only), Single particle shell model**:** Introduction, Assumptions, Evidence of shell model, Theory of nuclear shell potential, nuclear spin and parities, limitations of shell model. Liquid drop model**:** Introduction, assumptions, semi-empirical mass formula. Limitations of Liquid drop model, Problems**.** **(07L, 09M)**

Unit 4: Nuclear Reactions

Introduction, Theories of nuclear reactions, conservation laws, Q-value equation, Energetic of exoergic reactions, Energetic of endoergic reactions, Threshold energy, Problems. **(07L, 09M)**

Unit 5: Nuclear Energy

Introduction, Nuclear fission, Explanation on the basis of liquid drop model, energy available from fission:- Estimation of energy from masses of fission fragments and from binding energy, Nuclear chain reaction, Nuclear Fusion, Nuclear Reactor: Basic principle, classification, constituents parts, Heterogeneous reactor, Swimming pool reactor, Power reactor, Problems. **(10L, 14M)**

Unit 6: Nuclear Detectors and Accelerators

Types of detectors, Geiger-Mueller counter, Scintillation counter, Classification of accelerators**:** Cyclotron and Betatron. **(06L, 08M)**

(Total: 45 Lectures, 60 Marks)

References:

1. The atomic Nucleus: R D Evans, McGraw Hill Book Company.
2. Nuclear Physics: D C Tayal, Himalaya Publishing House, Bombay.
3. Nuclear Physics: Irving Kaplan, Narosa Publishing House, New Delhi.
4. Basic Nuclear Physics and Cosmic Rays: B N Srivastava, Pragati Prakashan, Meerut.
5. Concepts of Modern Physics – Arthur Beiser (5th Edition).
6. Atomic Physics: J.B. Rajam.
7. Introduction to Nuclear Physics: H.A. Enge (Addition Wesely Co.)

Semester VI: (DSC): Physics paper IV
PHY 604: Modern and Applied Physics
(Credits: 03) :(45 Lectures 60 Marks)

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Course description:

This course is aimed at introducing the fundamentals of Modern and Applied Physics to Under Graduate students.

Course objectives:

1. To impart knowledge of basic concepts in Modern and Applied Physics.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.

Course outcome:

Learner will be able to ….

1. Apply the concept and use of knowledge of Modern and Applied Physics to understand and solve the real life problems.
2. Understanding of the course will create scientific temperament.

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Unit 1: Plank's Quantum theory:

Planck's quantum theory, properties of photon, Planck's constant and light as a collection of photons; photo-electric effect and Compton effect, Experimental verification of Compton's effect. **(04 P, 06 M)**

Unit 2: Bohr's and Sommerfield theories of hydrogen atom

Introduction of atomic spectra, Inadequacy of classical planetary model of hydrogen atom, Bohr's theory of hydrogen atom, Extension of Bohr's theory, Experimental verification of discrete atomic energy levels, correspondence principle, Bohr's Sommerfield model and relativistic effects, Limitations of quantum mechanical model. **(09 P, 12 M)**

Unit 3: Matter Waves (Foundation of Quantum mechanics)

Need of quantum mechanics, Wave particle duality of matter, de-Broglie hypothesis, Expression for matter waves, Electron diffraction , Davission and Germer experiment, concept of wave group , phase velocity, group velocity, particle velocity and relations between them, Uncertainty principle, Thought experiment (Gamma ray microscope), different forms of uncertainty principle, applications of uncertainty principle (Non existence of electron in nucleus, determination of ground state of electron and size of hydrogen atom). (**09 P, 12 M**)

Unit 4: Fiber Optics

Introduction, construction of optical fiber, principle of operation, concept of acceptance angle, numerical aperture, attenuation in optical fiber and attenuation limit, preparation of optical fiber, optical fiber materials, types of optical fiber Single mode and multimode fibers, advantages and disadvantage of optical fiber, communication, Applications of fiber optics, Detail discussions on following applications: Temperature sensor, displacement sensor, fiber optic endoscopy, fiber optic communications.

(07P, 09 M)

Unit 5: Holography and its application

Concept of monochromatic and coherent source, basic idea of hologram, construction and re-construction hologram, types of hologram (list only), application of holography in microscopy and character recognition. **(07P, 09 M)**

Unit 6: Introduction to bioelectricity

Electricity observed in living systems, examples and origin of bioelectricity, sodium and potassium transport, Nernst equation, resting and action potential, conduction velocity. **(09 P, 12 M)**

Total: (45 Periods, 60 Marks)

References

1. Concepts of Modern Physics: S. L. Gupta, S. Gupta, Third Edition-1989, Publisher: Dhanpat Rai and Son's.
2. Modern Engineering Physics: A. S. Vasudevan, Publisher: S Chand.
3. Physics for Engineers: M.R. Srinivasan, Publisher: New Age International.

4. REFRESHER COURSE IN PHYSICS, VOLUME-II, C. L. Arora, Publisher: C. Chand and Company Ltd., New Delhi.
5. Modern Physics – B. L. Theraja, Publisher: C. Chand and Company Ltd., New Delhi.
6. Elementary Modern Physics - Atam P. Arya, Publisher: Addison Wesley Longman Publishing Co., New edition
7. An Introduction to Lasers -Theory and Applications - M. N. Avadhanalu, Publisher: C. Chand and Company Ltd., New Delhi.
8. Introduction to Fiber Optics: Ajoy Ghatak, K. Thyagarajan, Publisher: Cambridge University Press, 1998.
9. From Neuron to brain - Kuffer & Nicholas, Publisher: Sinauer Associates is an imprint of Oxford University Press; 5 edition (2011).
10. Biomedical Instrumentation and Measurements (II Edition) - L. Cromwell, F. J. Weibell, E. A. Pfeiffer (Pearson Education Singapore Pvt. Ltd.).

Semester VI: (SEC): Physics paper V

PHY 605: Basic Instrumentation Skills

(Credits: 03) :(45 Lectures 60 Marks)

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Course description:

This course is aimed at introducing the fundamentals of Basic Instrumentation skills to Under Graduate students.

Course objectives:

1. To impart knowledge of basic concepts in Basic Instrumentation skills.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.

Course outcome:

Learner will be able to ….

1. Handle and use various basic mechanical and electrical measuring instruments
2. Understanding of the course will create scientific temperament.

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(This course is to get exposure with various aspects of instruments and their usage throughhands-on mode. Experiments listed below are to be done in continuation of the topics.)

Unit 1. Use of basic measuring instruments:

Instruments accuracy, precision, sensitivity, resolution range etc. Errors in measurements and loading effects. Study of Vernier calliper, Screw gauge, travelling microscope and their utility to measure the dimension of a solid block, volume of cylindrical objects, diameter of a thin wire and capillary tube, thickness of metal sheet, etc. Use of Sextant to measure height of buildings, mountains, etc.

(04 P, 06M)

Unit 2. Electrical quantity measuring instruments:

PMMC, Voltmeter (D.C. and A.C), specifications and their significance. Ammeter (D.C. and A.C), specifications and their significance. Ohmmeter (Series and Shunt type), specifications and their significance. Multimeter, Steps of measurement of dc voltage and dc current, ac voltage, ac current and resistance using multimeter, Specifications of a multimeter and their significance. **(12 P, 14M)**

Unit 3: Cathode Ray Oscilloscope

Block diagram of basic CRO, Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only– no mathematical treatment), brief discussion on screen phosphor, visual persistence and chemical composition. Time base operation, synchronization. Front panel controls. Specifications of a CRO and their significance, Use of CRO for the measurement of voltage (dc and ac), frequency, time period and phase. Introduction of Dual trace CRO and digital oscilloscope, probes. **(12P, 14M)**

Unit 4: Signal Generators and Analysis Instruments

Block diagram, explanation and specifications of low frequency signal generators, pulse generator, and function generator. Brief idea for testing, specifications. **(07P, 10M)**

Unit 5: Digital Instruments

Principle and working of digital meters. Comparison of analog and digital instruments. Characteristics of a digital meter. Block diagram and Working principle of digital voltmeter (Ramp type only). Block diagram and working of a digital multimeter, Digital Frequency meter: Block diagram and Working principle: frequency and period measurement, accuracy and resolution.

(10P, 16M)

Total: (45 Periods, 60 Marks)

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The test of lab skills will be of the following test items:

1. Use of an oscilloscope.

2. CRO as a versatile measuring device.
3. Circuit tracing of Laboratory electronic equipment,
4. Use of Digital multimeter for measuring voltages
5. Trouble shooting a circuit

Laboratory Exercises:

1. To observe the loading effect of a multimeter while measuring voltage across a low resistance and high resistance.
2. To observe the limitations of a multimeter for measuring high frequency voltage and currents.
3. Measurement of voltage, frequency, time period and phase angle of a wave using CRO.
4. Measurement of time period, frequency, average period using universal counter/ frequency counter.
6. Measurement of rise, fall and delay times of a wave using a CRO.
7. Measurement of distortion of a RF signal generator using distortion factor meter.

Open Ended Experiments:

1. Using a Dual Trace Oscilloscope
2. Converting the range of a given measuring instrument (voltmeter, ammeter)

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Reference Books:

1. Principles of Electronics – V. K. Mehta, S. Chand Publications, New Delhi.
2. Basic Electronics (Solid State): B.L. Thereja, Publisher: S. Chand and Company, New Delhi.
3. Electrical measurements and measuring instruments: R K Rajput, S. Chand and Co. New Delhi.
4. Digital Principles and Applications: A.P. Malvino and D. P. Leach. Tata McGraw-Hill Publishing Company Limited, New Delhi.
5. Modern Electronic Instruments and Measurement techniques: Albert D. Helfrick, Willam D. Cooper, Prentice Hall India Pvt. Ltd, New Delhi.
6. A course in Electrical and Electronic Measurements and Instruments: A. K. Sawhney, Dhanpat Rai and Sons.
7. Digital electronics, R P Jain
8. Basic Electronics: B. Grob, Publisher: McGraw Hill Book Co. New York,
9. Electronic Instrumentation: H.S. Kalsi, Tata McGraw-Hill Publishing Company Limited, New Delhi.
10. Digital instrumentation by A J Bouwens
11. A text book in Electrical Technology - B L Theraja – S. Chand and Co.
12. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
13. Logic circuit design, Shimon P. Vingron, 2012, Springer.
14. Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
15. Electronic Devices and circuits, S. Salivahanan and N. S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill
16. Electronic circuits: Handbook of design and applications, U.Tietze, Ch.Schenk, 2008, Springer
17. Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India

Semester VI: (DSE): Physics paper VI
PHY 606(A): Technical Electronics II
(Credits: 03) :(45 Lectures 60 Marks)

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Course description:

This course is aimed at introducing the fundamentals of Technical Electronics to Under Graduate students.

Course objectives:

1. To impart knowledge of basic concepts in Technical Electronics.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.

Course outcome:

Learner will be able to ….

1. Apply the concept of use of knowledge of Technical Electronics to real life problems.
2. Understanding of the course will create scientific temperament.

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Unit 1: Sound System

Microphones: characteristics, types (list only), carbon microphone and dynamic type microphone (Principle, construction and working), Loud speakers: Characteristics, Dynamic (Moving coil type) speaker, Multiway speaker system (woofer and tweeter), Connection type of speakers (series, parallel and series-parallel type). [R1, R2, R9]. **(08P, 12M)**

Unit 2: Public Address System

Block diagram of Public Address (P.A.) system and its explanation, requirements of P. A. system, typical P.A. Installation planning (Auditorium having large capacity, college sports), Volume control, Tone control and Mixer system, Concept of Hi –Fi system, Monophony, Stereophony, Quadra phony, Dolby A and Dolby B system, CD- Player: Block diagram of CD player and function of each block. [R1, R2, R9]. **(10P, 14M)**

Unit 3: Medical instruments.

Biopotential, Types of electrodes, ECG (principle, block diagram, features) Ultrasonography: working principle [R 3, 4, 5] **(07P, 8M)**

Unit 4: Transducer

Definition, Classification, Selection of transducer, Electrical transducer: Thermistor, Thermocouple, Pressure Transducer: Strain gauges (wire, foil, & semiconductor), Displacement transducer: LVDT, Peizo-electric Transducer, Optoelectronic transducers: LDR, Chemical sensors: pH sensor, Gas sensor (Fundamental aspects), Humidity sensor (Resistive). [R7, R8]. **(10P, 14M)**

Unit 5: Modern appliances

Remote Control: Operating principle, block diagram, features.

Microwave Oven: Operating principle, block diagram, features.

Cellular Phone: Operating principle, Block diagram, specifications, features, and functions performed.

Washing Machine: Operating principle, block diagram, features, Fuzzy Logic (Idea only),

Electronic Weighing Systems: Operating principle, Block diagram, features. [R8].

Infrared Thermometer: Operating principle, Block diagram, features. **(10P, 14M)**

(Total: 45 Periods, 60 Marks)

References:

1. Audio and Video Engineering System: R.G. Gupta, Tata Mc-GrawHill Publishing Company Ltd, New Delhi.
2. Basic Electronics: B. L. Thereja, S. Chand Publications, New Delhi.

3. Introduction to Bio-medical Electronics: Joseph-Du-bary, Tata Mc-Graw Hill Publishing Company Ltd, New Delhi.
4. Medical instrumentation Application and design: J. C. Wobster
5. Biomedical instruments and measurements: L. Cromwell, F. J. Weibell, Printice Hall of India of India Pvt. Ltd, New Delhi.
6. Transducers and display systems: B.S. Sonde, Tata McGraw-Hill Publishing Company Limited, New Delhi.
7. Solid state Gas sensors- edited by P. T. Moseley and B.C. Tofeld, Harwell, Adam Hilger and Philadelphia
8. Measurement and Instrumentation Principles: Alan S. Morris, Butterworth-Heinemann.
9. Consumer Electronics: J.S. Chintode, Technical Publication, Pune.

Semester VI: (DSE): Physics paper VI
PHY 606(B): Refrigeration and Air conditioning II
(Credits: 03) :(45 Lectures 60 Marks)

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Course description:

This course is aimed at introducing the fundamentals of Refrigeration and air conditioning to Under Graduate students.

Course objectives:

1. To impart knowledge of basic concepts in Refrigeration and air conditioning.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.

Course outcome:

Learner will be able to ….

1. Apply the concept and use of knowledge of Refrigeration and air conditioning to understand and solve the real life problems.
2. Understanding of the course will create scientific temperament.

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Unit 1: Psychrometry:

Introduction, Meaning of air conditioning, Five main factors of comfort air conditioning, Psychrometry and psychrometic properties, psychrometic relations: Dalton's law of partial pressure; relation between partial pressure & specific humidity; relation between degree of saturation & relative humidity, Types of psychrometers, Psychrometic processes, Bypass factor and its relation, Summer air conditioning systems for Hot & Dry; Hot & Humid out door conditions, Summer air conditioning with evaporative cooling, Winter air conditioning system for mild cold weather. (Ref. 1: Chapter -16) **(12L, 16M)**

Unit 2: Cooling load calculations & design of air conditioning systems:

Different heat sources, Heat flow due to conduction, Sun load, Occupants load, Equipment load, Infiltration load, Miscellaneous heat sources, Design aspects of air conditioning system, Cooling load and air quantities. (Ref. 1: Chapter -19) **(7L, 10M)**

Unit 3: Air Conditioning equipments:

Air cleaning and Air Filters: Functions, Types, Wet filters, Electronic filters, and Centrifugal dust collector. Cooling Coils: Bypass factor of multidepth coils. Humidifiers: Functions, Atomization type humidifiers, Impact type humidifiers, Pan & coil type humidifiers. Dehumidifiers: Functions, Refrigeration humidifiers, Spray type humidifiers, De-humidifying air washers. Fans and Blowers: Functions, Axial flow fans, Centrifugal fans. Grills and Registers. (Ref. 1: Chapter -25) **(10L, 14M)**

Unit 4: Air Conditioning Control systems:

Basic elements of control systems, Temperature control elements: Bimetal type thermostat, Sealed bellow type thermostat, Electrical resistance and thermocouple type thermostat. Humidity Control Elements: Hair type humidistat, Absorption type thermostat, Water vapour recorder. Actuators: Relays Introduction to Transmission systems:Pre heat and humidification control systems, Cooling dehumidification and reheat control system, Face and bypass control system. (Ref. 1: Chapter -26) **(10L, 12M)**

Unit 5: Solar Refrigeration System

Vapour Compression Refrigeration system using solar energy, Vapour absorption refrigeration system using solar energy, Solar refrigeration using a solid absorption cycle, Solar refrigerators sing Photovoltaic panels, (Ref.1: Chapter -28) **(6L, 8M)**

(Total: 45 Periods, 60 Marks)

Reference Books:

1. A course in Refrigeration and Air –Conditioning: S.C. Arora & S. Domkundwar.Dhanpat Rai & Co. 7th Edition
2. Basic Refrigeration and Air –Conditioning: P.N. Ananthanarayanan , Tata Mcgraw Hill, New Delhi 3rd
3. Principles of Refrigeration: Roy J Dossat , Pearson Education (Singapur) Ltd. 4th Edition

Semester VI: (DSE): Physics paper VI

PHY 606(C): Vacuum Technology-II

(Credits: 03) :(45 Lectures 60 Marks)

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Course description:

This course is aimed at introducing the fundamentals of Vacuum technology to Under Graduate students.

Course objectives:

1. To impart knowledge of basic concepts in Vacuum technology.
2. The course should prepare the student for operating, simulating and construction of vacuum systems.
3. The course also involves the related experiments based on the theory.

Course outcome:

Learner will be able to ….

1. Apply important laws of physics which govern how a vacuum system works.
2. Account for which components are used in a vacuum system, their construction, function and use.
3. Account for troubleshooting a vacuum system.
4. Run simulations and write a specification for a simple vacuum system.

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Unit 1: Vacuum materials and components

Adsorption, Absorption, Desorption. Diffusion and penetration of gases through solid surfaces, Vapour pressure of different materials, Outgassing of materials, Desired properties of materials used for fabrication of vacuum system. **(7P, 8M)**

(i) Vaccum Seals: (a) Permanent seals- Welding, Brazing, Soldering (b) Demountable seals- Waxes, Resins and Adhesives, Gaskets seal: Elastomer, metal. Feedthroughs: Electrical Feedthroughs, Motion Feedthroughs: Wilson seal, Bellows seal. **(8P, 11M)**

(ii) Valves: (a) Roughing and For-line valves: Disk valve, Ball valve. (b) High vacuum valves: Gate valve, disk valve, flap valve, Butter-fly valve. (c) Gas admittance valves: disk valve, Needle valve. **(8P, 11M)**

Unit 2: Leak detection

Real and Virtual leaks, Leak detection method: (a) Over pressure method- Bubble method, Halide torch, Sniffer technique. (b) Low pressure method- Blocking (sealing) method, Tesla coil, Halogen leak detector, Organic vapour and gas probe with suitable pressure gauge as detector. **(11P, 14M)**

Unit 3: Vacuum system fabrication

General consideration of designing, Construction of High vacuum system (Combination of Rotary and Oil diffusion pump), Its operational procedure, Construction of Ultrahigh vacuum system and its operational procedure. **(8P, 11M)**

Unit 4: Application of Vacuum Technology

Applications of Vacuum technology in Research and Industry. **(3P, 5M)**

(Total: 45 Periods, 60 Marks)

References:

1. Introduction to Theory and Practical of High Vacuum Technology : L.Ward & J.P. Bunn, Butterworths.
2. High Vacuum Techniques : J. Yarwood.
3. Design and Construction of Vacuum systems : G.W. Green.
4. Vacuum Sealing Techniques : A. Roth
5. High Vacuum Engineering : A.E. Barrington
6. Handbook of Vacuum Technology: Karl Jousten
7. Vacuum Physics and Techniques, T. A. Delchar, Chapman and Hall.

Semester VI: (DSE): Physics paper VI

PHY 606(D): Microprocessor- II

(Credits: 03) :(45 Lectures 60 Marks)

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Course description:

This course is aimed at introducing the fundamentals of Microprocessor to Under Graduate students.

Course objectives:

1. To impart knowledge of basic concepts in Microprocessor.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.

Course outcome:

Learner will be able to ….

1. Apply the concept and use of knowledge of Microprocessor to understand and to solve real life problems.
2. Understanding of the course will create scientific temperament.

……

Unit 1: Assembly Language Programming

Masking of 4- MSB and LSB of given number, One's and two's complement of 16- bit numbers, Shift 16- bit numbers left by one bit, 8- bit addition, 8- bit subtraction, Decimal addition and decimal subtraction of two 8 bit numbers, 8- bit multiplication, Find largest and smallest numbers from a series of given number, Find square root of given number from Look up table. Code conversion programs:-Hex to ASC II conversion, BCD to binary conversion, Decimal to seven segment conversion. **(15P, 20M)**

Unit 2: Interfacing of Memory and Peripheral Devices

Introduction, Interfacing with RAMS & ROMS, I/O interfacing basics, Interfacing with practical I/O memory mapped I/O and I/O mapped I/O schemes, Direct Memory Access (DMA). Data transfer.

(09P, 12M)

Unit 3: Programming Peripheral Interface (PPI)

Architecture of Intel-8255, Pin diagram of Intel-8255, Functions of each pin, Control word format, Operations of Mode-0, Mode-1 & Mode-2**.,** Single-Bit Set/Reset (BSR) Mode and Applications of 8255 PPI (list only) . **(10P, 13M)**

Unit 4: Programming Communication Interface and Counter/Interval Timer

Architecture of Intel-8251, Pin diagram of Intel 8251, Functions of each pin, Mode word format, Control word format, Status word format, Architecture of Intel-8253, pin diagram of Intel-8253, Functions of each pin, Operations of Mode-0, Mode-1, Mode-2, Mode-3, Mode- 4 and Mode-5.

(11P, 15M)

(Total: 45 Periods, 60 Marks)

References:

1. Fundamentals of Microprocessors and Microcomputers – Badri Ram, DhanpatRai& Sons, Delhi.
2. Microprocessor Fundamentals – Roger L. Tokheim.
3. 8085 Assembly Language Programing – L. A. Leventhal.
4. Microprocessor Architecture programming and Applications 8080 & 8085 – Ramesh Gaonkar.
5. 8086 Microprocessor programming and Interfacing – Gibson.
6. Advanced Microprocessor and peripherals (Architecture, programming and interfacing) – A. K. Ray, K. M. Bhurchandi.
7. Microprocessors and Microcomputers- Soumitra Kumar Mandal.

Semester VI: (DSE): Physics paper VI

PHY 606 (E): Programming in C+ + - II

(Credits: 03) :(45 Lectures 60 Marks)

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Course description:

This course is aimed at introducing the object-oriented concept Programming language C++.

Course Objectives:

- To learn Object-Oriented Design with C++ Programming
- Ability to write a computer program to solve a specific program
- To handle abnormal termination of a program using exception handling

Course Outcomes:

1. Acquire knowledge of Object and Class.
2. Explore polymorphism using function overloading and operator overloading.
3. Understand the different aspects of the hierarchy of classes and their extensibility
4. Understands the concept of Virtual function, streams, and files, Generic Programming.
5. Write programs for handling run time errors using exceptions

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Unit 1: Objects & Classes **[L: 06 M: 08]**

Simple classes (class specification, C++ objects, accessing class members), constructors and destructors, constant member functions.

Unit 2: Functions and operator overloading **[L: 10 M: 12]**

Overloading functions, introduction to operating overloading, overloading unary and binary operators, overloading arithmetic assignment operator.

Unit 3: Inheritance **[L: 10 M: 10]**

Derived class and base class, derived class constructors, public and private inheritance, multiple inheritances, hierarchical inheritance, multilevel inheritance, containership (classes within classes).

Unit 4: Virtual functions **[L: 06 M: 10]**

Virtual functions, pure virtual functions, friend functions, Static functions, copy constructor, this pointer.

Unit 5: Generic programming **[L: 05 M: 10]**

Introduction to a template, function within a template, introduction to exceptional handling.

Unit 6: File and streams **[L: 08 M: 10]**

Input/Output streams, classes for steam operation, opening and closing files, file pointers and their manipulations, error handling during file operations.

(Total: 45 Periods, 60 Marks)

References:

1. Master in C++ - K.R.Venugopal
2. C++ Programming - E.Balaguruswami
3. Turbo C++ Programming - Robert Lafore
4. C++ Programming - Yashwant Kanitkar.

Semester VI: (LAB): Physics paper VII

PHY 607: Physics practical -I

(Credits: 02): (60 L, 100M (40 Internal + 60 External))

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Perform any TEN experiments:

1. Surface tension by Quinke's method.
2. Surface tension by soap bubble method.
3. Characteristics of G.M. counter.
4. Diffraction by straight edge/cylindrical obstacle.
5. e/m using Thomson's method.
6. Viscosity by rotating cylinder method.
7. Determination of 'g' by conical pendulum.
8. Study of oscillatory charge and discharge through an inductance and resistance.
9. To determine value of Boltzmann Constant using V-I characteristics of PN diode.
10. To determine work function of material of cathode using photocell.
11. To determine value of Plank's constant using LEDS of at least four different colours.
12. To study intensity response of photocell and verify inverse square law of radiations.
13. To measure the numerical aperature of an optical fiber.
14. Study of bending loss in optical fiber.
15. Study of I-V characteristics of photocell.
16. Determination of Plank's constant of Photocell.
17. Study of Solar still for water distillation.
18. Study of box type Solar cooker.

Semester VI: (LAB): Physics paper VIII

PHY 608: Physics practical -II

(Credits: 02): (60 L, 100M (40 Internal + 60 External))

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Group A: Perform any Five experiments (Material Science, Electronics, Instrumentation):

1. Determination of curie temperature of Ferrite.
2. Determination of specific heat of graphite at different temperature
3. To study characteristics of thermisters.
4. Determination of thermoelectric power.
5. Study of Astable Multivibrator using IC 555.
6. Binary weighted DAC (R-2R ladder) using OP-AMP.
7. Determination of Core losses in transformers.
8. To study of clocked RS flip flop using NAND gates.
9. Study of IC 7490 as mod 2, mod 5 and mod 10 counter.
10. To study RC coupled Single stage transistor amplifier. (Voltage gain , Frequency response)

Group B: Perform any Five experiments from the following optional courses:

A) Technical Electronics:

1. To study characteristics of LDR.
2. Study of P. A. system (series and parallel connection of two speakers) and measurement of equivalence resistance.
3. Use of C.R.O as a measurement tool for different electrical parameters (frequency, a. c./d. c. voltage, pulse height, pulse width, rise time and fall time).
4. Use of thermocouple for measurement of temperature.
5. Study of OP AMP as substractor.
6. Study of OP- AMP as a differentiator.
7. Study of OP- AMP as an integrator.
8. Displacement measurement using LVDT.
9. Frequency response of loudspeaker (twitter, woofer, mid-range).
10. Study of E.C.G .
11. Thermister as a thermometer using IC 741.
12. Half wave precision rectifier using OP AMP.
13. Full wave precision rectifier using OP AMP.

B) Refrigeration and Air conditioning:

1. To find the COP of a domestic refrigeration system.
2. Detection of trouble/faults in a refrigerator and window air conditioner.
3. Dismantling of Window type A.C. and testing after assembly.
4. Visit to a cold storage plant.
5. Visit to a centrally air conditioned building.
6. Visit to a Ice plant.

C) Vacuum technology:

1. To measure the pumping speed of vacuum system (use of Gaedes equation).
2. Demonstration of oil diffusion pump & to evacuate the system & to measure the ultimate vacuum.
3. To study the effects of conductance of pumping speed of oil diffusion pumping module.
4. Deposition of metallic thin film.
5. To investigate the variation of pumping speed of vapour diffusion pumping module with the pressure in vacuum system.
6. Pumping speed measurements using the constant volume method.

D) Microprocessor:

1. Find square root/square of number using look up table.
2. 8-bit decimal addition/subtraction.
3. Find largest/smallest number from series of 8-bit numbers.
4. Conversion of Hexadecimal to ASCII code.
5. 8-bit binary multiplication.
6. LED interface (Time delay generation).
7. Interfacing of thumbwheel switch.
8. Conversion of 8-bit Hexadecimal number to binary number.

E) Programming in C++:

1. Write a C++ program to implement string operations i) strlen ( ) ii) strcat ( ) as class members. Write a C++ program to display the string "T. Y. B. Sc. Physics"
2. Write a C++ program to swap two integers, two floats and two-character variables using function overloading.
3. Write a C++ program to demonstrate the use of constructors and destructors.
4. Write a C++ program to overload + operator to add two complex nos.
5. Write a C++ program to implement hierarchical inheritance.
6. Write a C++ program to implement multiple inheritances.
7. Write a C++ program to implement virtual functions.
8. Write a C++ program to demonstrate the use of function templates

Semester VI: (LAB): Physics paper VIII

PHY 609: Project II

(Credits: 02): (60 L, 100M (40 Internal + 60 External))

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ASSESSMENT OF PROJECT- SECOND TERM:

Student should submit a Final Project Report on the work done by him/her during the First and Second Phase of the Project i.e. on the topics:

1. Experimental work. (remaining further work in continuation with the work in the first term)
2. Characterize the samples, if any.
3. Discussion of the results.
4. Conclusions.

Instructions:

1. The topic of project of the first term must be continued in the second term.
2. The project report of first term should be maintained and should be produced to examiner of second term.
3. The student will have to give a seminar on the project topic in the practical exam.
4. The student must perform his project presentation by PPT on LCD projector.

CAREER OPPORTUNITIES FOR B. Sc. PHYSICS STUDENTS

B.Sc. Physics students can find jobs in public as well as in private sectors. There are many opportunities available for B. Sc Physics students in technical as well as scientific fields. They can work as Science and Mathematics Teachers, Quality Control Manager, Laboratory assistant, Laboratory Technician, School Science Technician in any government or private organization.

Private Sector:

There are many opportunities available in IT field for B. Sc (Physics) graduates. Many IT companies such as Infosys, Wipro and TCS are recruiting B. Sc. Physics graduates for software jobs. They can also get jobs in Energy Plants. Another jobs available for these graduates is Technician in Electronic Industry. They can apply for jobs in many companies in automobile industry. Some of those companies are Maruti Udyog, TATA Motors and Tech Mahindra. The B. Sc. (Physics) graduates can apply and secure their job in Solar devices production industries, electrical or electronic industries with their skills developed while syudying.

Government Sector:

There are vast opportunities available for B. Sc graduates in Government sector. They can apply for jobs in Scientific Research and Development Organizations such as The Defense Research and Development Organization (DRDO), CSIR, Physical Research Laboratory (PRL) Ahmedabad, Saha Institute of Nuclear Physics Kolkata and Nuclear Science Centre New Delhi. They can also apply for various jobs in popular government organizations such as Bhabha Atomic Research Centre (BARC), Atomic Energy Regulatory Board (AERB), Oil and Natural Gas Corporation (ONGC), Bharat Heavy Electricals Limited (BHEL), National Thermal Power Corporation (NTPC).

They can also apply for the various competitive exams conducted by Union Public Service Commission such as IFS, IPS and IAS. Several other government exams conducted for recruiting B. Sc Physics graduates are Tax Assistant Exam, Statistical Investigator Exam, Combined Graduate Level Exam.

Another option available for B. Sc Physics graduate is to apply for jobs in public sector banking. Several banks are conducting exam every year for recruiting graduates to the post of Probationary Officers. They can also find many jobs in Railway sector. They should qualify the exams conducted by Railway Recruitment Board to get a job in Railway sector. These graduates can also apply for Combined Defense Services Exams conducted for recruiting candidates to various posts in Defense Department.

Kavayitri Bahinabai Chaudhari
North Maharashtra University, Jalgaon

'A' Grade
NAAC Re-Accredited
(3rd Cycle)

SYLLABUS

For

M.A. / M. Sc.- Ist YEAR (Sem. Ist and IInd)

Subject: Geography

Under

Choice Based Credit System

(With Effect from June - 2021)

Summary of Distribution of Credits under CBCS Scheme for M. A /M.Sc. (Geography)

Sr. No	Type of course	Sem I	Sem II	Sem III	Sem IV
01	Core	**16**	**16**	**16**	**12**
02	Skill based	**04**	**04**	**-**	**-**
03	Elective	**-**	**-**	**04**	**04**
04	Project	**-**	**-**	**-**	**04**
05	Audit	**02**	**02**	**02**	**02**
06	Total Credits	**22**	**22**	**22**	**22**

Subject Type	Core	Skill based	School Elective	Project	Audit	Total
Credits	**60**	**08**	**08**	**04**	**08**	**88**

Total Credits = 88

Kavayitri Bahinabai Chaudhari North Maharashtra University Jalgaon

M.A / M. Sc. Geography

Choice Based Credit System (Outcome Based Curriculum) with effect from 2021 -2022

Course credit scheme

Semester	(A) Core Courses			(B) Skill Based / Elective Course			(C) Audit Course (No weightage in CGPA)			Total Credits (A+B+C)
	No. of Courses	Credits (T+P)	Total Credits	No. of Courses	Credits (T+P)	Total Credits	No. of Courses	Credits (Practical)	Total Credits	
I	4	8 + 8	**16**	1	4 + 0	4	1	2	2	**22**
II	4	12 + 4	**16**	1	0 + 4	4	1	2	2	**22**
III	4	8 + 8	**16**	1	4 + 0	4	1	2	2	**22**
IV	4	8 + 8	**16**	1	4 + 0	4	1	2	2	**22**
Total Credits	**64**			**16**			**8**			**88**

(T, Theory; P, Practical)

Structure of Curriculum

		First Year				Second Year				Total Credit Value
		Semester I		Semester II		Semester III		Semester IV		
		Credit	Course	Credit	Course	Credit	Course	Credit	Course	
	Prerequisite and Core Courses									
(A)	Theory	4	2	4	3	4	2	4	2	36
	Practical	4	2	4	1	4	2	4	2	28
(B)	**Skill Based / Subject Elective Courses**									
1	Theory /Practical	4	1	4	1	4	1	4	1	16
(C)	**Audit Course (No weightage in CGPA calculations)**									
1	Practicing Cleanliness	2	1							2
2	Personality and Cultural Development Related Course			2	1					2
3	Technology Related + Value Added Course					2	1			
4	Professional and Social + Value Added Course							2	1	2
	Total Credit Value	14	6	14	6	14	6	14	6	88

***List of Audit Courses** (Select any ONE course of Choice from Semester II; Semester III and Semester IV)*

Semester I (Compulsory)		**Semester II** (Choose One) **Personality and Cultural Development**		**Semester III** (Choose One) **Technology + Value Added Course**		**Semester IV** (Choose One) **Professional and Social + Value Added Course**	
Course Code	**Course Title**	**Course Code**	**Course Title**	**Course Code**	**Course Title**	**Course Code**	**Course Title**
AC-101	Practicing Cleanliness	AC-201A	Soft Skills	AC-301A	Computer Skills	AC-401A	Human Rights
		AC-201B	Sport Activities	AC-301B	Cyber Security	AC-401B	Current Affairs
		AC-201C	Yoga	AC-301C	Rainwater Harvesting	AC-401C	Green Audit
		AC-201D	Music	AC-301D	Geo-Tourism	AC-401D	Review of Research Paper.

Semester-wise Course Structure of M.A M.Sc. Geography

Semester I

Course	Course Type	Course Title	Teaching Hours/ Week			Marks (Total 100)				Credits
			T	P	Total	Internal		External		
						T	P	T	P	
GG.-101	Core	Principles of Economic Geography	4	--	4	40	--	60	--	4
GG.-102	Core	Principles of Population Geography	4	--	4	40	--	60	--	4
GG.103	Core	Practical in Interpretation of SOI Topographical maps and Surveying by GPS	--	4+4	8	--	40	--	60	4
GG.-104	Core	Practical in Human Geography	--	4+4	8	--	40	--	60	4
GG.-105	Skill Based	Tourism Management	4	--	4	40	--	60	--	4
AC-101	Audit Course	Practicing Cleanliness	-	2	2	--	100	--	--	2
Total Credit for Semester I: 22 (T = Theory: 8; P = Practical:8; Skill Based:4; Audit Course:2)										

Semester II

Course	Course Type	Course Title	Teaching Hours/ Week			Marks (Total 100)				Credits
			T	P	Total	Internal		External		
						T	P	T	P	
GG.201	Core	Geographical Thoughts	4	--	4	40	--	60	--	4
GG.-202	Core	Social and Cultural Geography	4	--	4	40	--	60	--	4
GG.-203	Core	Remote Sensing	4	--	4	40	--	60	--	4
GG.-204	Core	Practical in Cartographic Techniques with the help of GIS	--	4+4	8	--	40	--	60	4
GG.205	Skill Based	Practical in Geo-Statistical Methods.	--	4+4	8	--	40	--	60	4
AC-201 A/B/C/D	Audit Course	**(Choose one out of Four)** AC-201A - Soft Skills / AC-201B - Sport Activities/ AC-201C -Yoga / AC-201D- Music	--	2	2	--	100	--	--	2
Total Credit for Semester II: 22 (T = Theory: 12; P = Practical:4; Skill Based:4; Audit course:2)										

Semester III

Course	Course Type	Course Title	Teaching Hours/ Week			Marks (Total 100)				Credits
			T	P	Total	Internal		External		
						T	P	T	P	
GG. -301	Core	Regional Geography of India	4	--	4	40	--	60	--	4
GG.-302	Core	Research Methodology	4	--	4	40	--	60	--	4
GG.303	Elective	**(Choose one out of Three.)** **GG.303 A** Watershed Management and Planning **GG.303 B** Geographical Information System **GG.303 C** Agricultural Geography	4	-	4	40	-	60	-	4
GG. -304	Core	Practical in Remote Sensing - Interpretation of Aerial Photographs and Satellite Imageries	--	4+4	8	--	40	--	60	4
GG. -305	Core	Practical of Computerize Data Analysis Techniques in Geography	-	4+4	8	-	40	-	60	4
AC-301 A/B/C/D	Audit Course	**(Choose one out of Four)** AC-301A - Computer Skills / AC-301B - Cyber Security / AC-301C – Rainwater Harvesting / AC-301D- Geo-tourism		2	2		100	--	--	2
Total Credit for Semester III: 22 (T = Theory: 8; P = Practical:8; Skill Based:4; Audit Course:2)										

Semester IV

Course	Course Type	Course Title	Teaching Hours/ Week			Marks (Total 100)				Credits
			T	P	Total	Internal		External		
						T	P	T	P	
GG. -401	Core	Geomorphology	4	--	4	40	--	60	--	4
GG.-402	Core	Climatology	4	--	4	40	--	60	--	4
GG.-403	Elective	**(Choose one out of Three.)** **GG.403 A** Geography of Rural Settelments. **GG.403 B** Geography of Resourses. **GG.403 C** Industrial Geography	4	-	4	40	-	60	-	4
GG.-404	Core	Practical in Physical Geography	--	4+4	8	--	40	--	60	4
GG.405	Core	Project work	-	4+4	8	-	40	-	60	4
AC-401 A/B/C/D	Audit Course	**(Choose one out of Four)** AC-401A Human Rights / AC-401B Current Affairs / AC-401C Green Audit / AC-401D Review of Research Paper		2	2		100	--	--	2
Total Credit for Semester IV: 22 (T = Theory: 8; P = Practical:8; Skill Based:4; Audit Course:2)										

Program at a Glance

Name of the program (Degree)	: M.A / M. Sc. (Geography)
Faculty	: Science and Technology
Duration of the Program	: Two years (four semesters)
Medium of Instruction and Examination	: English
Exam Pattern	: 60 : 40 (60 marks University exam and 40 marks continuous internal assessment)
Passing standards	: 40% in each exam separately (separate head of passing)
Evaluation mode	: CGPA
Total Credits of the program	: 88 (64 core credits including 4 credits of project/dissertation, 08 skill enhancement credits, 08 subject elective credits and 08 audit credits)

➢ Program Objectives:

1. To produce skilled experts with varies aspects of Geography employable for positions in the field of education, industry, and government and non-government organizations.
2. To impart knowledge on advances and challenges in Geographical challenges.
3. To enhance the quality and standards of Geography Education.
4. To provide a broad common framework, for exchange, mobility, and free dialogue across the Indian Geography and associated community.
5. To prepare our graduates to become effective scientific communicators/collaborators in multidisciplinary teams providing technical leadership to engage with the challenging Geographical problems of local, national, and global nature.

➢ Program Outcomes:

Upon successful completion of the M.A/M.Sc program in Geography, student will be able to;

1. Understand the unifying themes of both human and physical geography as well as have a working knowledge of the discipline's diverse conceptual and methodological approaches.
2. Demonstrate an ability to develop research questions, critically understand quantitative and qualitative data sources, data bias, and data analysis and presentation, and conduct research using primary and/or secondary source material.
3. Students will be able to apply geographical knowledge for the exploration of GIS, Remote Sensing, and geographical resources.
4. M.A / M. Sc. Geography programme is structured for providing advances and by considering the overall development of students.
5. Students will able to work in public and private sector companies working in the field of GIS, Tourism, and Cartographer.

Equivalences for old courses of M. A / M. Sc Geography (Part I)

Semester – I st

Old Courses (June 2017)		New Courses (June 2021)	
Code of Courses	**Title of the courses**	**Code of Course**	**Title of the courses**
Gg.111	Principles of Economic Geography	GG. 101	Principles of Economic Geography
Gg.112	Principles of Population and Settelement Geography.	GG.102	Principles of Population Geography
Gg.113	Principles of Climatology.	GG.402	Climatology
Gg.114	Principles of Geomorphology.	GG. 401	Geomorphology
Gg.115	Practical in Geography	GG.103	Practical in Interpretation of SOI Topographical maps and Surveying by GPS

Semester – II nd

Old Courses (June 2017)		New Courses (June 2021)	
Code of Courses	**Title of the courses**	**Code of Courses**	**Title of the courses**
Gg.211	Geographical Thoughts	GG. 201	Geographical Thoughts
Gg.212	Social and Cultural Geography	GG.202	Social and Cultural Geography
Gg.213	Remote Sensing.	GG.203	Remote Sensing
Gg.214	Geo-Statistical Methods	GG. 205	#
Gg.215	Practical of Computerize Data Analysis Techniques in Geography	GG.204	Practical in Cartographic Techniques with the help of GIS

 # No equivalent course is available for this paper, so students may be allowed to appear by old course.

Distribution of Course papers for M.A / M. Sc. Part I (Geography)

Subject Code	Title of the Paper		Duration (Hrs./Wk)	Max. Mark	Exam. Time (Hrs.)
M.A / M.Sc. Part I					
Semester I : Theory Courses					
GG.-101	Principles of Economic Geography	Core course	04	100	03
GG -102	Principles of Population Geography	Core course	04	100	03
GG -105	Tourism Management	Skill based	04	100	03
Semester I : Practical Courses					
GG -103	Practical in Interpretation of SOI Topographical maps and Surveying by GPS	Core course	**04+04**	**100**	06
GG -104	Practical in Human Geography	Core course	**04+04**	**100**	06
AC-101	Practicing Cleanliness	Audit Course	**02**	**100**	
Semester II : Theory Courses					
GG -201	Geographical Thoughts	Core course	**04**	**100**	03
GG -202	Social and Cultural Geography	Core course	**04**	**100**	03
GG -203	Remote Sensing	Core course	**04**	**100**	03
Semester II : Practical Courses					
GG -204	Practical in Cartographic Techniques with the help of GIS	Core course	**04+04**	**100**	06
GG -205	Practical in Geo-Statistical Methods	Skill based	**04+04**	**100**	06
AC-201A/B/C/D	**Choose one out of Four** AC-201A - Soft Skills / AC-201B - Sport Activities/ AC-201C -Yoga / AC-201D- Music	Audit Course	**02**	**100**	

Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon
New Syllabus M.A./M.Sc. Geography
Semester-I (CBCS Pattern)
Core-Course

Gg. 101: Principles of Economic Geography

(With Effect from June 2021)

Total Marks-100 **Credit Points- 04** **Teaching Hours/Week: 04**
Clock Hours : 60

Course Objectives:

1) To understand concept Economic Geography in different walks of the life.
2) The students are able to explain the role of economic landscape in economic development.
3) To understand the economic measures and problems of economic development.
4) To acquaint the students with fundamental knowledge of international trade and impact of globalization on economic development of India

Course Outcomes:

After completion of this course, the students will be able to

1. Evaluate the applicability and importance of economic geography in analyzing the modes of societies and economies' operation.
2. Establish and analyze spatial patterns of economic development.
3. Explain the role of natural and cultural factors in determining economic development of India.

Unit No.	Units	Sub-units	Lectures
I	**Introduction to Economic Geography**	A) Definition, Nature and Scope. B) Approaches to Economic Geography. C) Recent trends in Economic Geography.	**06**
II	**Resources and Economic Development**	A) Meaning of the term 'Resources' B) Classification of Resource. C) Significance of natural and human Resources (Suitable Examples and Characteristics) D) Role of resources in economic development E) Models of economic development. i). Rostow's Model. ii) Myrdal Model	**14**

III	**Economic Landscape**	A) Land, labour, capital, organization. B) Significance of land, labour and capital in different economic activities. C) Spatial variation in the factor cost. D) Location of economic activity- Von Thunen's Model of agricultural location.	**10**
IV	**Economic Measures and Economic Development Region**	A) Measures of economic development. B) Problems of economic development. C) Economic development in developed and underdeveloped countries. D) Economic Regions; i) Definition and concept, types of economic region. ii). Stages in the development of economic regions iii) Economic development regions in India.	**10**
V	**International Trade**	A) Definition of international trade. B) Role of international trade in world economic growth. C) Factors affecting international trade D) India's foreign trade. E) Changing forms of international trade.	**10**
VI	**Economic Development in India**	A) Natural and cultural factors influencing economic development in India. B) Impact of green revolution on economic development in India. C) Impact of globalization on economic development of India. D) Free trade initiatives.	**10**

Weightage

Marks	
Internal Assessment	**40** marks
External Assessment	**60** marks

Suggested readings:

1) Alexander, J. W. (1977) : 'Economic Geography', Prentice Hall of India Pvt. Ltd., New Delhi.
2) Chorley, R. J. and Haggett, P (1970) : 'Socio Economic Models in Geography', Methuen.
3) H. M. Saxena (2013) : 'Economic Geography', Rawat publication, Jaipur.
4) Mitra, A (2002) : 'Resource Studies', Sreedhar publishers, Kolkata.
5) Kanan Chatterjee (2015) : 'Basics of Economic Geography', Concept publishing Company Pvt. Ltd., New Delhi.
6) Ray, P. k. (1997) : 'Economic Geography', New Central Book Agency (P) Ltd., Calcutta.
7) Shelar S. K. (2013) : 'Principles of Economic Geography' Chandralok Prakashan, Kanpur.
8) Garnier, B. J. and Delobez, A (1979), : 'Geography of Marketing', Longman.
9) Janaki V.A(1985) Economic Geography, Concept Publishing Co.
10. Sharma T.C.(2013) Economic Geography of India , Rawat Publication, Jaipur

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Syllabus for **M.A. /M.Sc. Geography**
Semester-I (CBCS Pattern)
Core-Course
Gg. 102 : Principles of Population Geography.
(With Effect from June 2021)

Total Marks-100 **Credit Points- 04** **Teaching Hours/Week: 04**
Clock Hours : 60

Course Objectives:

1) To enable students to acquire knowledge of Population Geography.
2) To study the population structure and characteristics of population.
3) To study the various theories in Population Geography.
4) To understand the World and Indian Population distribution.

Course Outcomes:

After completion of this course, the students will be able to,

1) To undesrstand the concepts in Population geography.
2) Students able to evaluate differet theories of population growth.
3) Students compare different population zones.
4) Students know the various problems of population.

Unit No.	Units	Sub - Units	Lectures
I	**Introduction to Population Geography**	A) Definitions and Meaning. B) Development of Population Geography as discipline. C) Nature and Scope of Population Geography. D) Population geography and Demography. E) Approaches to study the Population Geography.	**08**
II	**Population Distribution**	A) Factors affecting on distribution of population. i) **Physical factors –** topography, climate, soil, availability of water, natural vegetation , geographical location. **ii) Cultural/ Human factors –** religion, family system, Industrial development, transportation , economic factors, government policy, political and	**10**

		agriculture system. B) Population Density - Definitions and meaning. C) Types of density – arithmetic, economic, agricultural, physiological and critical. D) Population distribution in India (According to census 2011). E) World population distribution. F) Problems of over, optimum and under population.	
III	**Population Structure and Characteristics**	A) Sex structure. B) Age structure (importance of age composition and determinants of age structure, age pyramid and age groups.) C) Sex ratio in India, causes of decreasing sex ratio and its impact D) Marital status. E) Literacy and educational attainment. E) Literacy in India. F) Religions in India ((According to census 2011).	**10**
IV	**Fertility and Mortality**	A) Fertility – definitions, social and cultural factors affecting fertility, crude birth rate. B) Mortality – definitions, measures of mortality- Crude death rate, Infant mortality, levels and trends of mortality.	**12**
V	**Dynamics of Migration- Trends and Pattern**	A) Definitions and importance of migration. B) Types of migration – internal migration and types, international migration. C) Causes and effects of migration. D) Brain drain of human resource. E) Lee's theory of Migration.	**10**
VI	**Population Theories**	A) Theory of demographic transition. B) Malthusian theory of population growth. C) Karl Marx's theory of population.	**10**

Weightage

Marks	
Internal Assessment	**40** marks
External Assessment	**60** marks

Suggested readings:

1) Mohammad Hassan (2005) – Population Geography, Rawat publication, Jaipur.
2) Asha A. Bhende and Tara Kanitakar (2006) – Principles of Population Studies, Himalaya Publishing House, Mumbai.
3) Chandana R.C. and Jagjit S.S. (1980) – Introduction to Population geography, Kalyani Publishers, New Dehli.
4) Majid Hussain (1991) – Anmol Publication, New Dehli.
5) Sawant S.B and Athavale A.S. (1994) – Population Geography, Mehat publishing house, Pune.

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Syllabus M.A./M.Sc. Geography
Semester-I (CBCS Pattern)
Core-Course
GG-103 : Practical in Interpretation of SOI Topographical Maps and Surveying by GPS.
(With Effect from June 2021)
(10 Students Per Batch)

Total Marks-100 **Credit Points- 04** **Teaching Hours/Week: 08**
Clock Hours : 96

Course Objectives:

1. To introduce the students with basic knowledge of topographical maps.
2. To know the importance and techniques of interpretation of topographical maps.
3. To introduce the students with basic principles of GPS and it's functioning.
4. To give practical knowledge about survey using GPS receiver and to prepare the survey layout using post-processing software.

Course Outcomes:

After completion of this course, the students will be able to,

1. Enhance interpretative skills of the students.
2. Identify the physical and cultural features in SOI topographical maps.
3. Adopt the knowledge of drawing profiles.
4. Understand the GPS and its functions, work, types and components for a filed survey.

Unit No.	Units	Sub-Units	Lectures
I	**SOI Topographical Maps**	A) Arrangement of toposheet on map of India i) Indexing of topographical map. B) Marginal information and grid references . i) Marginal information . ii) Grid references: four and six figure. C) Conventional signs and symbols on SOI topographical map.	**14**
II	**Relief Features by Contours**	A) Relief features by contours. i) Conical hill ii) Plateau iii) Ridge iv) Gorge. v) U Shaped valley vi) V Shaped valley. vii) Waterfall. B) Slopes: Concave and Convex Slopes, Gentle and Steep Slopes, Terraced Slope.	**17**
III	**Profiles**	A) Drawing of Longitudinal Profile, Cross Profile. B) Intervisibility.	**14**

IV	**Interpretation of SOI Topographical Maps**	**(Any Three)** A) Plain Region. B) Plateau Region. C) Mountainous Region . D) Coastal Region. E) Desert Region.	**17**
V	**Fundamental Concepts of GPS**	A) Introduction, Components, types and applications of GPS. B) GPS Satellites. C) Constellation of GPS Satellites. D) Segments.	**14**
VI	**Data Collection and Mapping Using GPS**	A) GPS Survey on field. B) Area measurement using GPS. C) Data Import. D) Processing and Mapping. E) Project work using GPS.	**20**

Weightage

Marks	
Internal Assessment	**40** marks
External Assessment	**60** marks

Suggested readings:

1. Tamaskar B.G. and Deshmukh V.M. (1974), Geographical Interpretation of Indian TopographicalMaps. Orient Longman Limited Bombay
2. Petrie N. (1992), Analysis and Interpretation of Topographical Maps. Orient Longman LimitedCalcutta.
3. Meux A. H. (1960), Reading Topographical Maps. University of London Press Limited
4. Wheeler K.S. Ed (1970), Geography in the field. Blond Educational, London.
5. Gupta, K. K. and Tyagi, V. C. (1992): Working with maps, Survey of India Publication, Dehradun
6. Ramamurthy, K. (1982): Map Interpretation, Rex Printer, Madras
7. Vaidyanadhan, R. (1968): Index to a Set of Sixty Topographic Maps: Illustrating Specified Physiographic Features From India, Council of Scientific and Industrial Research, Ministry of Education, Government of India
8. Gupta, K. K. and Tyagi, V. C. (1992): Working with Maps, Survey of India Publication, Dehradun
9. Basudeb Bhatta (2014): Remote Sensing and GIS, Oxford University Press, New Delhi.
10. Atiqur R. & Shahab A. (2017): Global Positioning System: Concept, Technique and Application, New Age International Publisher, New Delhi
11. Ben L. & Lawrence H. (2016): GPS Systems: Technology, Operation, and Applications, Discover Net Publishing, Walnet Street, USA

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New Syllabus M.A./M.Sc. Geography
Semester-I (CBCS Pattern)
Core-Course

GG-104 : Practical in Human Geography.
(With effect from 2021)
(10 Students Per Batch.)

Total Marks-100 **Credit Points- 04** **Teaching Hours/Week: 08**
Clock Hours : 96

Course Objectives:

1. To introduce some basic research method to the students to be applied to various themes in Human Geography.
2. To indicate the assumptions, limitations, and interpretation of these methods and results.

Course Outcomes:

After completion of this course, the students will be able to,

1. Evaluate and investigation the population data.
2. Understand the data analysis techniques in Human Geography
3. Understand the various basics statistical Techniques for analysis of the geographical data.

Unit No.	Units	Sub-Units	Lectures
I	**Introduction to Research Data in Human Geography and Data Collection Techniques**	A) Introduction to research data. B) Questionnaire: meaning and types. C) Planning, designing of questionnaire for field work. D) Data compilation and analysis.	**15**
II	**Data Analysis Techniques in Population Geography**	**A). Density:** i) Arithmetic density of population. ii) Economic density of population. iii) Nutritional density of population. iv) Agricultural density of population. v) Critical density of population. **B) Measures:** I) General fertility rate. II) Crud death rate. III) Infant mortality rate. **C) Sex Ratio:** i) Sex ratio of all groups of population.	**18**

		ii) Age- sex pyramids.	
III	**Data Analysis Techniques in Settlement Geography**	**A) Rural Settlement Geography** i). Dispersion of rural settlements: Bernhard's method, Demangeon method, Debouvrie's method. **B) Urban Settlement Geography** i) Nearest neighbour analysis- Clerk and Evan's method. ii) Rank size rule.	**16**
IV	**Data Analysis Techniques in Agricultural Geography**	A) Crop concentration by Bhatia. B) Crop diversification by Bhatia. C) Crop combination by Weaver's method. D) Agricultural efficiency by Jasbirsing's method.	**16**
V	**Data Analysis Techniques in Transport and Industrial Geography**	**A) Transport Geography** i) Graph theoretic measures of transport Network, Ratio Measures: a) Alpha b) Beta c) Gamma. **B) Industrial Geography** **i)** Measurement of industrial activity. a) Location Quotient. b) Lorenz curve.	**15**
VI	**Cartographic Techniques Maps**	A) Literacy Rate (Choropleth method). B) Dispersion of settlements (Dot method) C) Functional classification of towns (Use different signs and symbols) D) Land use and Land classification.	**16**

Weightage

Marks	
Internal Assessment	**40 marks**
External Assessment	**60 marks**

Suggested readings:

1. R.B.Mandal: “Statistic for Geography and Social Science”.
2. Monkhouse: “Maps and Diagram”.
3. Masjid Husen “: Agricultural Geography”.
4. Hudson F.S. (1976): “Geography of Settlement”.
5. Yeats, M.H. (1974): “An Introduction to Quantitative Analysis in Human Geography”.
6. Sing J. and Dhillon (1984) “Agricultural Geography”.
7. Sing R.L. “Readings in Rural Settlement Geography”.
8. Michaele E. and E. Hurse: ‘Transportation Geography”.
9. Edward Arnold: “The Study of Urban Geography”.
10. George Omura: Mastering Auto CAD, BPB Publication, b14 Conneaut place, New Delhi
11. Grini Courter and Annette Marquis (1999): “OFFICE 2000” BPB Publication
12. Dr. Sanjay Bhaise and Prof. Devendra Maski: ‘LoksankhyaBhugol’

Pattern of question paper

1. All questions will be compulsory.
2. A mark for Viva-voce is 10 marks.

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New Syllabus M.A./M.Sc. Geography
Semester-I (CBCS Pattern)
Skill Based Course
GG: 105, Tourism Management
(With effect from June 2021)

Total Marks-100 **Credit Points- 04** **Teaching Hours/Week: 04**
Clock Hours : 60

Course Objectives:

To understand concept of tourism management:

1. To provide training, skill development and education needed to prepare individuals for effective job in the tourism and entertainment industries.
2. To understand the management functions of tourism industry including human resource management, financial management, marketing and technology applications.
3. To identify potential career opportunities of our students through internship programs.

Course Outcomes:

After completion of this course, the students will be able to,

1. Tourism Management graduates are hired by both private and government sector companies.
2. Tourism Management course helps students specialize in the industry-specific knowledge and make them business ready for fields such as hotels, vacation resorts, retreat hotels, campgrounds,

Unit No.	Units	Sub-Units	Lectures
I	**Introduction to Geographical Tourism Management**	**A)** Concept of tourism and geo-tourism. **B)** Need and importance of tourism management. **C)** Scope and future of tourism management. **D)** Types of tourism management. General problems of tourism management.	10
II	**Tourism Planning**	**A)** Types of tourism planning. **B)** Problem of tourism planning. **C)** National and International Tourism planning. **D)** Components of tourism planning. Programme implementation.	10
III	**Tourism Marketing & Management**	**A)** Defining of tourism marketing. **B)** Need of marketing in tourism. **C)** Components of Tourism Marketing	12

		& Management- **i)** The tourist product, ii)Special features of tourism marketing, iii) Marketing process, iv) Marketing research, **v) The segmentation, targeting, positioning (STP) marketing model.** vi) Tourism promotion, vii) Advertising.	
IV	**Role of Infrastructure and Transport in Tourism**	**A)** Infrastructure facilities. **B)** Tourism accommodation & Food Services. **C)** Resort and Event Management. **D)** Transportation-Tourism management.	08
V	**Sale Services in Tourism**	**A)** Sales and marketing and Public relations. **B)** Tour and travel documentation services. **C)** Language skill and Business communications. **D)** Tourism management information system. **E)** Customer care and interpersonal skills. **F)** ICT in tourism management.	10
VI	**Tourism impact and Tourism Policy of India**	**A)** Tourism impacts. **B)** Sustainable and green tourism. **C)** Role of Travel agency & Tour operations. **D)** National tourism policy in india-2016.	10

Weightage

Marks	
Internal Assessment	**40 marks**
External Assessment	**60 marks**

Suggested readings:

1) A. K. Bhatia. (1908): Tourism Management and Marketing
2) Alston, A., (1979): Working in the Travel Business, Batsford Publications, London.
3) Anthony, Edwards (1985) International Tourism Forecasts to 1995, EIU, 40 Duke Street, London WIM 5 DG, UK.
4) Balsdon, J. P. V. D. (1966): Life and Leisure in Ancient Rome, London, Bodley Head.
5) Beazely. E. (1970): Designed for Recreation, London: Faber.
6) Bernecker, Paul, Methods and Media of Tourist Publicity, Vienna, Austrian National Tourist Office, 1961.
7) Bhatia, A.K. : Tourism Development, Sterling Publishers Pvt. Ltd., New Delhi110016
8) Brownell. G. G., Travel Agency Management, Birmingham, Southern University Press, 1975
9) Lancaster G. and Massingham, L. (1988) *Essentials of Marketing*. Maidenhead, Berkshire, England. McGraw-Hill.
10) Law B. C. (1968 ed) - Mountain and Rivers of India, Calcutta
11) Mill and Morrison (1992) : The Tourism system an Introductory Text , Prentice Hall
12) P.S. Gill: Dynamics of Tourism (4 Vols) Anmol Publication. New Delhi,
13) R. M. Desai (1988) : Strategy of food and agriculture – Bombay
14) Robinson H.A.A. -Geography of Tourism, MacDonald and Evans, London.
15) Seth: Tourism Management : Sustainable Tourism Development, Guide for Local Planners by WTO, Sterling Publishers Pvt. Ltd., New Delhi-110016
16) Smith, W. R. (1956). Product differentiation and market segmentation as alternative marketing strategies. *Journal of Marketing*. (Vol. 21, Issue 1, July). p3-8.

Model Question Paper Format

For

GG. 103 Practical in Interpretation of SOI Topographical Maps and Surveying by GPS

Note: All questions are compulsory.

Que. 1 – Interpretation of SOI topographical map with the help of following points. (09 Marks)

(a)

(b)

(c)

Que. 2 (A) – Drawing of relief features and slopes with the help of contours. (06 Marks)

(a)

(b)

(c)

(B) Drawing and identification of conventional signs and symbols of SOI topographical maps. (03 Marks)

(C) Drawing of profile. (05 Marks)

(D) Write short note on (any one out of 03). (Chapter I and III) (02Marks)

Que. 3- Survey the given area with the help of GPS (as per instructions of examiner given to you.) (12 Marks)

Que.4-(A) Write shorts notes (any three out of 05) (Chapter V and VI (09 Marks)

(B) Descriptive Question (Chapter V and VI) (04 Marks)

Que. 5 Journal (05 Marks)

Oral (05 Marks)

Model Question Paper Format

For

GG-104 : Practical in Human Geography.

Note: All questions are compulsory.

Que. 1 Solve Example (Attempt any 01 out of 02) **(10 Marks)**

Que.2 Solve Examples (Attempt A and B)

(12 Marks)

(A)

(B)

Que.3 Solve Example(Attempt any 01 out of 02) (12 Marks)

Que.4 (A) Solve Example(Attempt any 01 out of 02) (10Marks)

(B)Write short notes on(Attempt any two out of 04) (06 Marks)

Que. 5 Journal (05 Marks)

Oral (05 Marks)

M.A / M.Sc. Part I

(Semester I)

Subject: *Audit Course*

AC-101: Practicing Cleanliness **(Compulsory; Audit Course; Practical; 2 Credits)**
Course Objectives (COBs): • To make students aware of Clean India Mission and inculcate cleanliness practices among them.

• Awareness program on
  o Swachh Bharat Abhiyan (Clean India Mission)
  o Clean Campus Mission
  o Role of youth in Clean India Mission
• Cleaning activities inside and surroundings of Department buildings.
• Tree plantation and further care of planted trees
• Waste (Liquid/Solid/e-waste) Management, Japanese 5-S practices
• Planning and execution of collection of Garbage from different sections of University campus
• Role of youth in power saving, pollution control, control of global warming, preservation of ground water and many more issues of national importance.
• Cleanest School/Department and Cleanest Hostel contests
• Painting and Essay writing competitions

Course Outcomes (COts):

On completion of this course, the student will be able to:

CO No.	CO	Cognitive level
AC101.1	Identify need at of cleanliness at home/office and other public places.	**2**
AC101.2	Plan and observe cleanliness programs at home and other places.	**4**
AC101.3	Practice Japanese 5-S practices in regular life.	**3**

Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon

Syllabus M.A./M.Sc. Geography
Semester-II (CBCS Pattern)
Core- Course
GG-201: Geographical Thoughts.
(With Effect from June 2021)

Total Marks-100 **Credit Points- 04** **Teaching Hours/Week: 04**
Clock Hours : 60

Course Objectives:

1. To understand the evolution of geographical, concept, ideas and knowledge.
2. To generalize the valuable contribution of pioneers in the geography
3. To study the major schools of geography in ancient and modern period.
4. To elaborate the trends of historical development of geography.

Course Outcomes:

After completion of this course, the students will be able to,

1. Appreciate the contribution of the thinkers in Geography.
2. Strengthen point presentations on different schools of geographical thought.
3. Know relationship of geography with other disciplines and man-environment relationships.

Unit No.	Units	Sub-Units	Lectures
I	**Nature of Pre- Modern Geography**	A) Impact of 'Dark Age' in Geography. B) Development of Geography: i) Greek Geographers- a) Homer b) Aristotle c) Erastothenis ii) Arabian Geographers- a) Ibn Batuta b) Al Idrisi c) Al Masudi iii) Indian Geographers - a) Aryabhatta b) Varahamihira c) Brahamgupta d) Bhaskarachrya	**12**
II	**Role of Ancient Explorers & Discoveries in Geography**	A) Marco Polo. B) Christopher Columbus. C) Vasco da Gama. D) Captain James Cook.	**08**
III	**History of Modern Geographical Thoughts**	Contribution of modern geographers in the world: A) Contribution of modern geographers- i) Alexander Von Homboldt ii)	**12**

		Fredrich Ratzel iii)Vidal-de-La-Blache iv) Grifith Taylor B) Roman Geographers- i) Strabo ii) Ptolemy.	
IV	**Dualism in Geography**	Dualism/ Dichotomies in Geography. i) Physical Geography v/s Human Geography. ii) General Geography v/s Regional Geography. iii) Determinism v/s Possibilism.	**08**
V	**Evolution of Critical Geography**	Trends in geographic thoughts and methodology. i) Quantitative revolution. ii) Behavioural approach. iii) Humanistic approach. iv) Human welfare approach.	**10**
VI	**Post Modern trends in Geography**	A) Structuralism in Geography. B) Historical materialism. C) Changing concept of 'Space' (with special reference to Harvey) D) Geography in the 21st Century : towards post modernism.	**10**

Weightage

Marks	
Internal Assessment	**40 marks**
External Assessment	**60 marks**

Suggested readings:

1) Taylor G. (1951): Geography in 20th Century, Methuen & Co. London.
2) Husain Majid (1984): Evolution of Geographical Thoughts, Rawat Publication, Jaipur
3) David Harvey: Explanation in Geography
4) Hart M.G. (1986): Geomorphology- Pure and Applied, George Allen & Unwin.
5) Robert E Dickinson: The Makers of Modern Geography.
6) Peter Hagget: Geography, A Modern Syntesis.
7) Saroj K Pal: Statistical Techniques, A Basic Approach to Geography, Mc. Graw Hill.
8) Floyd Sabins: Remote Sensing, Principles and Application, Freeman and Co. New York

9) Hartshown T A & Alexander (1988): Economic Geography, Prentice Hall, International Inc.
10) Brian P Fit Gerald: Development in Geographical Method" Science in Geog. Oxford Uni. Press
11) Kang- tsung : Introduction to Geographic Information System (2002) McGraw Hill.
12) George Joseph : Fundamentals of Remote Sensing (2004) ,University Press Pvt. Ltd. Hyderabad.
13) J.R. Jensen : Remote Sensing of Environment, An Earth Resources, Perspective (2003) ,Person Education Pvt. Ltd. New Delhi.
14) Dr. Sawant,Prakash (1999) Thought and Concepts in Geography, Phadake Prakashan, Kolhapur
15) James, P.E.(1980) All possible Worlds: A History of Geographical ideas, Sachin Publication Jaipur (Indian Reprint)
16) Free Man, T.W, (1965) : Geography as Social Science, Harper International Edition, Harper & Row Publishers, New York.
17) Adhikari, S. 2015. Fundamentals of Geographical Thought, Orient Black swan.
18) Clifford, N. Holloway S.L., Rice, S.P., Valentine, G. 2009. Key Concepts in Geography, 2nd ed, Sage.
19) Couper, P. 2015. A Student′s Introduction to Geographical Thought: Theories, Philosophies, Methodologies, Sage.
20) Cresswell, T. 2013. Geographic Thought: A Critical Introduction, Wiley-Blackwell.
21) Dikshit, R.D. 2004. Geographical Thought: A Contextual History of Ideas, Prentice Hall India.
22) Holt-Jensen, A. 2011. Geography: History and Concepts: A Student's Guide, Sage

Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon

New Syllabus M.A./M.Sc. Geography
Semester-II (CBCS Pattern)
Core-Course
GG. 202 : Social and Cultural Geography.
(With Effect from June 2021)

Total Marks-100 **Credit Points- 04** **Teaching Hours/Week: 04**
Clock Hours : 60

Course Objectives:

1) To study the Social as well as Cultural situation in the different parts in the world.
2) To analyze the relationship between the geography and socio-cultural factors.
3) To aware the students about various socio-cultural phenomenon.

Course Outcomes:

After completion of this course, the students will be able to,

1) Acquire skills related with socio-cultural factors.
2) Familiar to information about various social factors.
3) Identify various types of cultural landscape of the world.

Unit No.	Units	Sub Units	Lectures
I	**Introduction to Social & Cultural Geography**	A) Meaning B) Definitions C) Nature and Scope of Social & Cultural Geography D) Development of Social & Cultural Geography	**08**
II	**Social Theories**	A) Classical Social Theory i) Modern Social Theory ii) Post Modern Social Theory iii) Social Structure	**08**
III	**The Cultural Complex**	A) Cultural landscape i) Development of cultural landscape ii) Cultural Regions of the world	**08**
IV	**Tribes**	A) Definition, Tribal social formation B) Nomenclature, Language variation C) Distribution at state and district level D) Distribution of the tribes i) Gond ii) Naga iii) Bhill iv) Bushmen	**10**

V	**Themes in Cultural Geography**	A) Themes in cultural geography i) Cultural region ii) Formal cultural region iii) Functional cultural region iv) Cultural diffusion v) Cultural ecology	**12**
VI	**Cultural System**	A) Geography and religion B) Geography and language C) Cultural Nationalism D) Globalization and cultural change E) Cultural Convergence & divergence	**14**

Weightage

Marks	
Internal Assessment	**40 marks**
External Assessment	**60 marks**

Suggested readings:

1) Ajaruddin Ahmad- “Social Geography”, Rawat Publication Jaipur, New Delhi.

2) Emrys Johns (1975) - "Readings in Social Geography", Oxford University Press.

3) Rajit Tirtha: "Geography of India", Eastern Michigan University, U.S.A. & Region.

4) Spencer J.E. and W.L. Thomas: "Introducing Cultural Geography"

5) Wagner P.L. and Mi Kesell M.W.: "Reading Cultural Geography"

6) Majid Husain: "Cultural Geography", Anmol Publication Pvt. Ltd., New Delhi.

7) John Emrys: "Regions in Social Geography"

8) John Emry and Eyles John: "An Introduction of Social Geography"

9) Dr. Jain: "VishwakaSanskrutikBhugol"

10) Majid Husain - Social Geography

11) Kaushik, Chavan, P.K. Pande - Social Geography

Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon

Syllabus M.A./M.Sc. Geography
Semester-II (CBCS Pattern)
Core- Course
Gg. 203 : Remote Sensing.
(**With Effect from June 2021**)

Total Marks-100 **Credit Points- 04** **Teaching Hours/Week: 04**
Clock Hours : 60

Course Objectives:

1) To introduce students with advance techniques of survey and data collection.
2) To acquaint the students with fundamental knowledge and principles of Remote Sensing.
3) To familiar students with variety of applications of Remote Sensing.
4) To acquaint the students with fundamental concepts and importance of Aerial Photographs and satellite imageries.

Course Outcomes:

After completion of this course, the students will be able to,

1) Recognize and explain basic principles of remote sensing including electromagnetic spectrum; the emission, scattering, reflection and absorption of electromagnetic radiation (EMR); variations in EMR interactions with many substances.
2) Recognize and explain properties of remote sensing data acquisition, storage and processing.
3) Recognize properties of aerial photographs and satellite imageries.
4) Recognize and describe applications of remote sensing data in different fields.

Unit No.	Units	Sub units	Lectures
I	**Introduction to Remote Sensing**	A) Introduction. B) Definitions of remote sensing. C) History of remote sensing. D) Process of remote sensing' E) Applications of remote sensing techniques in different fields.	**10**
II	**Fundamentals of Remote Sensing**	A) Concept of energy. B) Electromagnetic energy and radiation. C) Properties of electromagnetic waves. i) Wave velocity. ii) Wave length. iii) Wave frequency. D) Electromagnetic spectrum. E) Interaction of EMR with atmosphere:	**12**

		absorption, scattering [Selective (Rayleigh, Mie and Raman Scattering) and Nonselective], reflection, refraction, and transmission of energy. F) Interaction of EMR with earth surface - Reflection, Absorption, Emission.	
III	**Types of Remote Sensing and Platforms.**	A) Types of remote sensing. i) Based on energy source. a) Passive remote sensing. b) Active remote sensing. ii) Based on use of wavelength regions of electromagnetic spectrum. a) Optical. b) Thermal. c) Microwave. B) Remote sensing platforms. i) Definition of platform. ii) Types of platforms. a) Ground based platform. b) Air borne platform. c) Space borne platform.	**10**
IV	**Aerial Photographs**	A) Introduction to Aerial Photographs. B) Types of aerial photographs. C) Types of camera. D) Types of film. E) Geometry of aerial photographs. F) Iquipments used for the interpretation of aerial photographs (Parallax bar, Stereoscope (Mirror and Pocket Stereoscope). G) Stereoscopic overlapping. H) Methods of scale determination. I) Average scale of aerial photographs. J) Elements of interpretation of aerial photographs.	**12**
V	**Satellite Remote Sensing**	A) Satellite orbit. i) Definitions. ii) Types of orbit. a) Geostationary / Geosynchronous. b) Polar / Sun synchronous. B) Satellite swath. C) Scanning techniques. i) Across-track ii) Along track. D) Sensor - definition and types of Sensor.	**08**

		E) Resolution of sensors (Spectral, Spatial, Radiometric and Temporal). F) Elements of image interpretation.	
VI	**Development of Indian Remote Sensing.**	A) History of IRS development. B) NRSA organization (NRSC). C) Satellites launched by India and their functions. D) Recent development of India in Space Technology.	**08**

Weightage

Marks	
Internal Assessment	**40 marks**
External Assessment	**60 marks**

Suggested readings:

1. Abbasi S.A., K.B. Chari K.B. (2005): Applications of GIS and Remote Sensing in Environmental Management, Discovery Publication House, New Dehli.
2. Agarwal C.S.and Garg P.K. (20020: Text Book on Remote Sensing, Wheeler Publishing Delhi.
3. Prithvish Nag and M. Kudrat (1998): Digital remote Sensing, Concept Publishing Company,
   New Delhi.
4. Bhatta Basudeb (2011): Remote Sensing and GIS, Oxford University Press.
5. Chang, Kang-Taung (2000): Introduction to Geographic information System, Tata McGraw Hill.
6. Joseph George, 2003, Fundamentals of remote sensing. Universities Press.
7. Lillesand, Thomas M. & Kiefer Ralph (2000): Remote Sensing and Image Interpretation, Jonh Willey.
8. Prithvish Nag and M. Kudrat (1998) : Digital remote Sensing , Concept Publishing Company,
   New Delhi.
9. Sabbins, F.F., 1985, Remote sensing Principles and interpretation. W.H. Freeman & Company
10. American Society for Photogrammetry and Remote Sensing, 1999, Remote Sensing for the Earth Sciences, Manual of Remote Sensing,3rd ed.,vol. 3, Wiley, New York.

Kavayitri Bahinabai Chaudhari North Maharashtra University Jalgaon

New Syllabus for M.A./M.Sc. Geography

Semester–II (CBCS Pattern)

Core- Course

Gg. 204 : Practical in Cartographic Techniques with the Help of GIS

(With Effect from June 2021)
(10 Students Per Batch)

Total Marks-100 **Credit Points- 04** **Teaching Hours/Week: 08**
Clock Hours : 96

Course Objectives:

1) To acquaint the students with basic concepts of GIS.
2) To familiar the students with open-source software, QGIS and its importance in cartography.
3) To acquire the skill of georeferencing process in QGIS.
4) To enable the students to create different political and physical maps using QGIS
5) To acquire the skill of making chloropleth maps based on attribute tables.

Course Outcomes: After completion of this course, the students will be able to,

1) Explain the importance concept of GIS and importance of QGIS in Cartography.
2) Undertake the process of georefencing a toposheet or a scanned map.
3) Create different Political and Physical maps using QGIS.
4) Create chloropheth maps based on attribute data tables.

Unit No.	Units	Sub - units	Lectures
I	**Introduction to GIS**	A) Introduction to GIS: Definitions, Evolution, Components and Objectives. B) Computer fundamentals for GIS. C) Spatial data models – raster and vector. D) Non spatial data. E) Metadata.	**10**
II	**Introduction to Quantum GIS (QGIS)**	A) Concept of Open-source software. B) Introduction to QGIS. C) Difference between ArcGIS and QGIS. D) Downloading and Installation of QGIS. E) Introduction to basic tools and panels in QGIS.	**10**

III	**Georeferencing**	A) Scanning a map or toposheet with required dpi (Raster). B) Downloading a toposheet from SoI webite. C) Uploading map / satellite image in QGIS. D) Selecting Georeferencing points (3 or 4). E) Georeferencing the map or image with the help of selected points.	**18**
IV	**Creating a map using readymade data (packages) Part - I**	A) Download the Natural Earth Quickstart Kit. B) Select an appropriate area for a map. C) Creating map layout. D) Grid and Coordinates. E) Legends.	**18**
V	**Creating a map using readymade data (packages). Part - II**	A) Adding Title and sub-title to the map. B) Formation of appropriate graphical scale. C) Adding Direction (North arrow). D) Exporting the map as image (set appropritate dpi) and as pdf file.	**20**
VI	**Attribute Data and Data Exploration Digitization and map making**	A) Creation of vector data model using line, polygone and point. B) Digitazation and creating an outline map. C) Adding attribute data to a map. D) Symbology based on attribute data. E) Creating map layout and addition coordinates, title, direction, scale and legend.	**20**

Weightage

Marks	
Internal Assessment	**40 marks**
External Assessment	**60 marks**

Suggested readings:

1) *"Geographic Information System Basics"* by Jonathan E. Campbell, UCLA, Michael Shin, UCLA.

   Available for free: http://2012books.lardbucket.org/books/geographic-information-system-basics/index.html

2) Kang-tsung Chang (2007), 'Introduction to Geographic Information Systems' Tata MCGraw Hill, New Delhi.

3) C.P.Lo and Albert K.W. Yeung (2006) "Concepts and Techniques of Geographic information Systems" Prentice Hall of India, New Delhi

4) Burrough, Peter A. and Rachael McDonnell, (1998), 'Principles of Geographical Information Systems' Oxford University press, New York.

5) Magwire, D.J. Goodchild, M.F. and Rhind, D.M., (2005), 'Geographical Information Systems: Principles and Applications', Longman Group, U.K.

6) Burrough, P.A., 1986, Geographical Information System for land Resources System, Oxford Univ. Press, UK.

7) Fotheringham, S.; Rogerson, P. (ed.), 1994. Spatial analysis and GIS. Taylor and Francis, London, UK.

8) Laurini, Robert and Dierk Thompson, 1992, Fundamentals of Spatial Information Systems, Academics Press, ISBN 0-12-438380-7.

9) Maguire,D.J.; Goodchild, M.F.; Rhind,D.W. 1991.Geographical information System, Longman, London,UK

10) Siddiqui, M.A.; 2006, Introduction to Geographical Information System, Sharda Pustak Bhavan, Allahabad.

11) Siddiqui, M.A.; 2011, Concepts and Techniques of Geoinformatics, Sharda Pustak Bhavan, Allahabad.

12) https://www.qgistutorials.com/en/index.html

13) https://docs.qgis.org/3.4/en/docs/training_manual/index.html

Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon

Syllabus M.A./M.Sc. Geography
Semester-II (CBCS Pattern)
Skill Based Course
Gg-205 : Practical in Geo-Statistical Methods.

(With Effect from June 2021)

(10 Students Per Batch)

Total Marks-100 **Credit Points- 04** **Teaching Hours/Week: 08**
Clock Hours : 96

Course Objectives:

1. To introduce some basic research methods to the students.
2. To introduce the importance of statistical techniques in Geography.
3. To introduce the skill and practical approach of Geo Statistical Methods.

Course Outcomes:

After completion of this course, the students will be able to,

1. Understand the importance and use of statistical methods in geography.
2. Use of sampling methods in Geo-statistical data.
3. Examine the relationship between two or more variables with the help of Correlation and regression analysis.
4. Measure probability using some probability distributions.
5. Apply large and small sample tests in Geo-statistical data.

Unit No	Topic	Sub Topic	Periods
I	**Introduction to Geo-Statistical Methods**	A) Introduction. B) Meaning and Definition of Geo-Statistical Methods. C) Importance and use of statistical methods in geography.	12
II	**Sampling and Sample Planning in Geo-Science**	A) Population and Sample. B) Sampling: Objectives, Advantages. C) Methods of Sampling. i). Simple Random Sampling. ii). Stratified Random Sampling. iii.) Systematic Sampling. iv). Cluster Sampling.	18
III	**Bivariate Analysis**	A) Bivariate Data. B) Covariance. C) Correlation: Karl Pearsons Correlation Coefficient. D) Regression: Meaning.	18

		E) Linear Regression. F) Non Linear Regression : Power, Exponential, Logarithmic	
IV	**Probability Distributions**	A) Probability functions and Computation of Probabilities using following distributions B) Binomial Distribution. C) Poisson Distribution. D) Normal Distribution. E) Standard Normal Distribution (Z ~ N (0,1)).	16
V	**Testing of Hypothesis - I**	A) Introduction. B) Types of Hypothesis. C) Type of Errors, Critical Value, Level of Significance, Concept of p-value. D) One tailed and two tailed test. E) Large Sample Tests (Based on Normal Distribution) – i) Test of Significance between sample mean and population mean. ii) Test of Significance between sample proportion and population proportion	16
VI	**Testing of Hypothesis - II**	A) Chi-square test. B) Student's t-test. C) Snedecor's variance ratio test (F test).	16

Weightage

Marks	
Internal Assessment	**40** marks
External Assessment	**60** marks

Suggested readings:

1) Cole, J.P., King, C.A.M. (1968): Quantitative Techniques in Geography. John Wiley & sons Inc.New York.
2) Gregory, S. (1968): Statistical methods and the geographer. Longman, London.
3) Elhance, D.N. (1972): Fundamentals of statistics, Kitab Mahal, Allahabad.
4) Mahmood, A. (1977): Statistical Methods in Geographical Studies, Rajesh Publications, New Delhi

5) Hammond,R., McCullagh P. (1978): Quantitative techniques in Geography An Introduction (2nd Ed.), Oxford University Press, USA.
6) Gupta, C.B. (1978); An introduction to statistical Methods, Vikas Pub.House,New Delhi.
7) 7.King, L.J. (1991): Statistical Analysis in geography. Prentice Hall, Englewood Cliff N.J.
8) Frank, H., & Althoen, S. C. (1994). *Statistics: Concepts and Applications*. Cambridge: Cambridge University Press.
9) Alvi, Z. (1995): Statistical Geography: Methods and Applications, Rawat Publications, Jaipur
10) Mann, P. S. (2007). *Introductory Statistics*. New Delhi: John Wiley and Sons
11) Burt, J.E., Barber, G.M., and Rigby, D.L. (2009): Elementary Statistics for Geographers (3rd Ed.), TheGuilford Press, 653pp.
12) Harris, R., Jarvis,C.(2011): Statistics for Geography and Environmental Science, Prentice Hall.
13) Acevedo, M.F.(2012): Data Analysis and Statistics for Geography, Environmental Science and Engineering, CRC Press.
14) Rogerson,P.A.(2015): Statistical Methods for Geography: A Student's Guide, 4th ed,Sage.

Model question paper format

For

Gg. 204: Practical in Cartographic Techniques with the Help of GIS

Note:

1. **Question 1 is compulsory.**
2. **Solve any two questions from 2 to 4.**

Question 1. Georeference the given part of toposheet / map. (10 Marks)

Question 2. Prepare the map of ..... (any country) by using the given dataset. The map must include Title, coordinates, north, scale and legend. (20 Marks)

Question 3. Prepare a choropleth map using the given outline and attribute data. (Jalgaon, Dhule, Nandurbar maps) (20. Marks)

Question 4. Prepare a outline map (vector) with help of given map (raster) using polygons or lines. The map must include Title, coordinates, north, scale etc. (20 Marks)

Question-5 Journal (05 Marks)

Oral (05 Marks)

Model Question Paper Format

For Gg-205 : Practical in Geo-Statistical Methods

Note: All questions are compulsory.

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Que. 1 Solve Example (Attempt any 01 out of 02) **(10 Marks)**

Que.2 Solve Examples (Attempt A and B) **(12 Marks)**

(A)

(B)

Que.3 Solve Example (Attempt any 01 out of 02) **(12 Marks)**

Que.4 (A) Solve Example (Attempt any 01 out of 02) **(10Marks)**

(B)Write short notes on (Attempt any two out of 04) **(06 Marks)**

Que. 5 Journal **(05 Marks)**

Oral **(05 Marks)**

M.A/ M.Sc. Part I

Semester II

Audit Courses

	AC-201(A): Soft Skills **(Personality and Cultural Development Related Audit course; Practical; 2 Credits)** **(Optional:)**	
	Course Objectives (CObs): •	
Unit 1	**Introduction to soft skills** Formal definition, Elements of soft skills, Soft vs. Hard skills, Emotional quotient, Goal setting, life skills, Need for soft skills, Communication skills, Etiquettes& Mannerism.	**2 h**
Unit 2	**Self-Assessment** Goal setting, SWOT analysis, attitude, moral values, self-confidence, etiquettes, non-verbal skills, achievements, positive attitude, positive thinking and self-esteem. Activity: The teacher should prepare a questionnaire which evaluate students in all the above areas and make them aware about these aspects.	**4 h**
Unit 3	**Communication Skills** Types of communication: Verbal, Non-verbal, body language, gestures, postures, gait, dressing sense, facial expressions, peculiarity of speaker (habits). Rhetoric speech: Prepared speech (topics are given in advance, students get 10 minutes to prepare the speech and 5 minutes to deliver, Extempore speech (students deliver speeches spontaneously for 5 minutes each on a given topic), Storytelling (Each student narrates a fictional or real-life story for 5 minutes each), Oral review (Each student orally presents a review on a story or a book read by them) Drafting skills: Letter, Report & Resume writing, business letters, reading & listening skills Activity: The teacher should teach the students how to write the letter, report and build resume. The teacher should give proper format and layouts. Each student will write one formal letter, one report and a resume.	**8 h**
Unit 4	**Formal Group Discussion, Personal Interview & Presentation skills** Topic comprehension, Content organization, Group speaking etiquettes, driving the discussion & skills. Preparation for personal interview: dress code, greeting the panel, crisp self-introduction, neatness, etiquettes, language tone, handling embarrassing & tricky questions, graceful closing. Activity: Each batch is divided into two groups of 12 to 14 students each. Two	**4 h**

	rounds of a GD for each group should be conducted and teacher should give them feedback. Mock interview are to be conducted.	
Unit 5	**Aptitude and analytical skills** Quantitative aptitude, Numerical reasoning, verbal reasoning, diagrammatic test, situational tests, logical thinking. Analytical skills: Definition, Types, problem solving	**8 h**
Unit 6	**Life skills** Time management, critical thinking, sound and practical decision making by dealing with conflicts, stress management, leadership qualities Activity: The teacher can conduct a case study activity to train students for decision making skills. The teacher should conduct a session on stress management and guide students on how to manage stress. The teacher may conduct a stress relieving activity in the class. He/she may counsel students individually to know their problems and guide them on dealing with them effectively.	**4 h**

Suggested readings:

1. Basics of Communication In English: Francis Sounderaj, MacMillan India Ltd.
2. English for Business Communication: Simon Sweeney, Cambridge University Press
3. An Introduction to Professional English and Soft Skills: Das, Cambridge University Press
4. Quantitative Aptitude: R.S. Agrawal

AC-201(B): Practicing Sports Activities

(Personality and Cultural Development Related Audit course; Practical; 2 Credits)

(Optional: Campus-level)

Course Objectives (CObs):

- To motivate students towards sports and provide them required training.

SR NO.	NAME OF THE SPORT/GAME (Select ONE of the Following)	SYLLABUS OF THE COURSE	TIMING (02 Hours in a Week)	SEMESTER
1	Volleyball	• General Fitness • Basic Fitness • Specific Fitness • History of the Game • Basic Skill of the Game • Major Skill of the Game • Technique & Tactics of the Game • Game Practice	Morning : 07 to 09 AM OR Evening : 05 to 07 PM	Total 30 Hours in Each Semester
2	Athletics			
3	Badminton			
4	Cricket			
5	Basketball			
6	Handball			
7	Kabaddi			
8	Kho-Kho			
9	Table-Tennis			
10	Swimming			

AC-201(C): Practicing Yoga (Personality and Cultural Development Related Audit course; Practical; 2 Credits) (Optional)	
	Course Objectives: • To motivate students towards yoga and provide them required training.
	• Yog: Meaning, Definition & Introduction, Objectives • Primary Introduction of Ashtanga Yoga • Preparation of Yogabhyas • Omkar Sadhana, Prayer, Guru Vandana • Sukshma Vyayamas • Suryanamaskar (12 Postures) • Asanas : ▪ Sitting (Baithaksthiti) - Vajrasana, Padmasan, Vakrasan, Ardha-Pashchimotanasanan ▪ Supine (Shayansthiti) - Uttan Padaasan(Ekpad/Dwipad), Pavanmuktasana, Viparitakarani Aasan, Khandarasan, Shavasana ▪ Prone (Viparitshayansthiti) - Vakrahasta, Bhujangasana, Saralhasta Bhujangasana, Shalabhasana(Ekpad/Dwipad), Makarasana ▪ Standing (Dhandsthiti) - Tadasana , TiryakTadasana, Virasana, Ardh Chakrasana • Primary Study of Swasana: Dirghaswasana, Santhaswasana, JaladSwasana - 6 Types • Pranayama : Anuloma-viloma, Bhramari

AC-201(D): Introduction to Indian Music (Personality and Cultural Development Related Audit course; Practical; 2 Credits) (Optional: Campus-level)	
	Course Objectives: • To motivate students towards Indian music and provide them minimum required training.
	• Definition and brief about generation of Swar, Saptak, Thaat, Raag, Aavartan, Meend, Khatka, Murkee, Taal, Aalaap etc. • Taal and its uses - Treetaal, Daadraa, Zaptaal, Kervaa. • Information of Badaakhyaal, Chhotaakhyaal (one), Sargam, Lakshangeet (information) • Detailed information of Tambora • Detailed information of Harmonium and Tablaa. • Five filmy songs based on Indian Classical Music (Theory and Presentation) • Sound Management - Basic information of Sound Recording (including Practicals) • Composition of Music as per the Story • Preparing news write-ups of the Seminars, Library Musical Programmes held at the nearest Akashwani, by personal visits.

Course Outcomes (COts):

On completion of this course, the student will be able to:

CO No.	CO	Cognitive level
AC201D.1	Identify different types of Indian music.	**3**
AC201D.2	Develop more interest to learn and practice Indian music.	**4**

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KAVAYITRI BAHINABAI CHAUDHARI NORTH MAHARASHTRA UNIVERSITY, JALGAON

Affiliated Colleges

MASTER OF SCIENCE in Computer Science
[M. Sc. (Computer Science)]

Syllabus

[*under CBCS*]

Faculty of Science and Technology

With effect from 2021-22

MASTER OF SCIENCE in Computer Science

[M.Sc. (Computer Science)]

PROGRAMME OBJECTIVES (POs):

1) **Broadly Educated and Versatile** - Able to draw upon foundational knowledge, learn, adapt and successfully bring to bear analytical and computational approaches on changing societal and technological challenges.
2) **Inspiring and Collaborative** - Able to induce and contribute to diverse teams, expertise, and experiences.
3) **Innovative** - Drives scientific and societal advancement through technological innovation and entrepreneurship.
4) **Engaged** - Is and remains engaged with the academics, technical and scientific professional communities.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

M.Sc. (Computer Science) Programme has been designed to prepare graduates for attaining the following program outcomes:

1) An ability to apply knowledge of computer science appropriate to the discipline.
2) An ability to apply computer science foundations, algorithmic principles, and computer science theory in the modeling and design of computational systems in a way that demonstrates comprehension of the tradeoffs involved in design choices.
3) Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.
4) Communicate effectively in a variety of professional and research contexts.
5) Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.
6) Apply computer science theory and software development fundamentals to produce computing-based solutions.
7) Acquire and apply new knowledge as needed, using appropriate learning strategies.

MASTER OF SCIENCE in Computer Science
[M.Sc. (Computer Science)]

Degree Name	**:**	Master of Science in Computer Science [M.Sc. (Computer Science)]
Faculty	**:**	Science and Technology
Duration	**:**	02 years, Full Time course
Medium of Instruction	**:**	English
Pattern	**:**	Semester Pattern (04 semesters)
Examination Pattern	**:**	60% (External Assessment) + 40% (Internal Assessment)
Passing Standard	**:**	Separate Passing for internal as well as external assessment.
Evaluation Mode	**:**	CGPA
Lecture	**:**	Clock hour (60 minutes)

Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon

Affiliated Colleges

Syllabus under CBCS for Master of Science in Computer Science [M.Sc. (Computer Science)]

Course Structure (w.e.f. 2021-22)

COURSE STRUCTURE WITH CREDIT

Semester-I

Course Code	Course Type	Title of the Course	Contact Hours/Week			Distribution of Marks for Examination						Credits
						Internal		External		Total		
			Th(L)	Pr	Total	Th	Pr	Th	Pr	Th	Pr	
CS-101	**Core**	Database Management System (DBMS)	04	-	04	40	-	60	-	100	-	04
CS-102	**Core**	Automata Theory and Computability	04	-	04	40	-	60	-	100	-	04
CS-103	**Core**	Operating Systems	04	-	04	40	-	60	-	100	-	04
CS-104	**Skill Based**	Object Oriented Programming using JAVA	**04**	**-**	**04**	**40**	**-**	**60**	**-**	100	**-**	**04**
CS LAB-I	**Core**	LAB on JAVA programming	-	04	04	-	40	-	60	-	100	04
CS LAB-II	**Core**	LAB on DBMS	-	04	04	-	40	-	60	-	100	04
AC-101	**Audit Course**	**Practicing Cleanliness**	**-**	**02**	**02**	**-**	**100**	**-**	**-**	**-**	**100**	**02**

Semester-II

Course Code	Course Type	Title of the Course	Contact Hours/Week			Distribution of Marks for Examination						Credits
						Internal		External		Total		
			Th(L)	Pr	Total	Th	Pr	Th	Pr	Th	Pr	
CS-201	**Core**	Compiler Construction	04	-	04	40	-	60	-	100	-	04
CS-202	**Core**	Artificial Intelligence	04	-	04	40	-	60	-	100	-	04
CS-203	**Core**	Design and Analysis of Algorithms	04	-	04	40	-	60	-	100	-	04
CS-204	**Skill Based**	Python Programming	**04**	**-**	**04**	**40**	**-**	**60**	**-**	100	**-**	**04**
CS LAB-III	**Core**	LAB on Design and Analysis of Algorithms (DAA)	-	04	04	-	40	-	60	-	100	04
CS LAB-IV	**Core**	LAB on Python Programming	-	04	04	-	40	-	60	-	100	04
AC- 201 (A)/(B)/(C)/(D)	**Elective Audit Course**	**Choose one out of four (AC-201(A)/(B)/(C)/(D))** (Personality and Cultural Development Related)	**-**	**02**	**02**	**-**	**100**	**-**	**-**	**-**	**100**	**02**

List of Elective Audit Courses to be offered in Semester-II:

AC-201 (A) : Soft Skills

AC-201 (B) : Practicing Sports Activities

AC-201 (C) : Practicing Yoga

AC-201 (D) : Introduction to Indian Music

Semester-III

Course Code	Course Type	Title of the Course	Contact Hours/Week			Distribution of Marks for Examination						Credits
						Internal		External		Total		
			Th(L)	Pr	Total	Th	Pr	Th	Pr	Th	Pr	
CS-301	**Core**	Web Application Development Technology	04	-	04	40	-	60	-	100	-	04
CS-302	**Core**	Digital Image Processing	04	-	04	40	-	60	-	100	-	04
CS-303	**Core**	Software Engineering	04	-	04	40	-	60	-	100	-	04
CS-304(A)/(B)/ (C)	**Elective**	Choose one from CS-304(A), CS-304(B) and CS-304(C)	**04**	**-**	**04**	**40**	**-**	**60**	**-**	100	**-**	**04**
CS LAB-V	**Core**	LAB on Web Application Development Technology	-	04	04	-	40	-	60	-	100	04
CS LAB-VI	**Core**	LAB on Digital Image Processing	-	04	04	-	40	-	60	-	100	04
AC-301 (A)/(B)/(C)/(D)	**Elective Audit Course**	**Choose one out of four (AC-301 (A)/(B)/(C)/(D))** (Technology + Value added course)	**-**	**02**	**02**	**-**	**100**	**-**	**-**	**-**	**100**	**02**

List of Elective Courses to be offered in Semester-III:

CS-304(A): Big Data Analytics CS-304(B): Windows WCF and WPF Programming CS-304(C): Web Analytics

List of Elective Audit Courses to be offered in Semester-III:

AC-301 (A) : Computer Skills AC-301 (B) : Cyber Security

AC-301 (C) : Linux (Spoken Tutorial Course) AC-301 (D) : Advance C++ (Spoken Tutorial Course)

Note: Syllabus for Spoken Tutorial Courses AC-301 (C)/(D) is available at https://spoken-tutorial.org developed at IIT Bombay for MHRD, Government of India.

Semester IV

Course Code	Course Type	Title of the Course	Contact Hours/Week			Distribution of Marks for Examination						Credits
						Internal		External		Total		
			Th(L)	Pr	Total	Th	Pr	Th	Pr	Th	Pr	
CS-401	**Core**	Natural Language Processing	04	-	04	40	-	60	-	100	-	04
CS-402	**Core**	Data Warehousing and Data Mining (DWDM)	04	-	04	40	-	60	-	100	-	04
CS-403(A)/(B)/ (C)	**Elective**	Choose one from CS-403(A), CS-403(B) and CS-403(C)	**04**	**-**	**04**	**40**	**-**	**60**	**-**	100	**-**	**04**
CS LAB-VII	**Core**	Data Warehousing and Data Mining (DWDM)	-	04	04	-	40	-	60	-	100	04
AC-401 (A)/(B)/(C)/(D)	**Elective Audit Course**	**Choose one out of four (AC-401 (A)/(B)/(C)/(D))** (Technology + Value added course)	**-**	**02**	**02**	**-**	**100**	**-**	**-**	**-**	**100**	**02**
Mini Project	**Core**	**Mini Project**									**200**	**06**

List of Elective Courses to be offered in Semester-IV:

CS-403(A) Optimization of Algorithm CS-403(B) Machine Learning CS-403(C) Advanced Network Programming

List of Elective Audit Courses to be offered in Semester-VI:

AC-401 (A) : Human Rights AC-401 (B) : Current Affairs or Research Methodology

AC-401 (C) : Seminar plus Review AC-401 (D) : Intellectual Property Rights(IPR)

Semester-I

*Course Code:***CS-102** **Database Management System (DBMS)** *Clock Hours:* **60** *Total Marks:* **100**

Course Objectives:

1) The course emphasizes the understanding of the fundamentals of relational systems including data models, database architectures, and database manipulations.
2) To develop conceptual understanding of database management system
3) To understand how a real-world problem can be mapped to schemas
4) To educate students with different Database Languages.
5) Understand the needs of database processing and learn techniques for controlling the consequences of concurrent data access.

Unit-I **[10]** Max Marks:**12**

Introduction: Database system application and purpose, Characteristics of DBMS, Database Users, 1-tier, 2-tier and 3-tier architecture of DBMS along with its advantages, Levels of Database Architecture, Data Models, Data-schemas and instances, Data Independence, Role and responsibilities of DBA, Concepts of ER Diagrams and Normalization.

Unit-II **[15]** Max Marks:**25**

Relational Databases: Structure of Relational Databases, Database Schemas, Keys, Schema diagrams, Relational Query Languages, Relational Operation. Overview of SQL, SQL Data Definition, Basic Structure of SQL Queries, Basic Operations, Set Operations, Null Values, Aggregate Functions, Nested Sub queries, Modification of Databases. Join Expressions, Views, Transactions, Integrity Constraints, SQL data types and Schemas, Authorization, Accessing SQL from Programming Languages, Overview of Dynamic SQL and SQL CLI. Functions and Procedures, Triggers. The relational Algebra fundamental and extended Operations. Tuple and Domain Relational Calculus.

Unit-III **[12]** Max Marks:**23**

Transaction Management and Query Processing: Transaction Concept, Model, Storage Structure, Atomicity and Durability, Isolation, Levels of Isolation, Overview of Query Processing, Measuring Query Cost, Selection Operation, Sorting, Join Operation, Other Operations and Evaluation of Expression. Overview of Query Optimization, Transformation of Relational Expression, Choice of Evaluation Plan.

Unit-IV **[10]** Max Marks:**15**

Concurrency Control and Recovery System: Lock based Protocol, Timestamp based Protocol, Validation based Protocol, Deadlock Handling, Failure Classification, Storage, Recovery and Atomicity, Recovery Algorithms, Buffer Management, Early lock release and logical undo operations, Remote Backup Systems. Case study: ARIES

Unit-V **[13]** Max Marks:**25**

Advanced Topics in Databases: Type your unit content here. (comma separated) Introduction to Object Databases: Shortcomings of Relational Data Model, The Conceptual Object Data Model, Objects in SQL:1999 and SQL:2003. Introduction to XML and Web Data: Semi-structured Data, Overview of XML, XML Data Definitions, XML Schema, XML Data Manipulation: XQuery, XPath Query Languages: XPath and SQL/XML. Distributed Databases: Overview, Homogeneous and Heterogeneous Databases, Distributed Data Storage, Distributed Transactions, Commit Protocols, Concurrency Control, Cloud based Databases.

References:

1. Michael Kifer, Arthur Bernstein, P.M, Lewis and P.K. Panigrahi, "Database Systems: An Application Oriented Approach", Second Edition, Pearson Education, ISBN:978-81-317-0374-8.
2. C.J.Date, A. Kannan and S. Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, ISBN:978-81-7758-556-8
3. A. Silberschatz, H.F.Korth, and S.Sudarshan, "Database System Concepts", TMH Publications, Sixth Edition, ISBN:978-007-132522-6.

Course Outcome:

Upon successful completion of this course, students will be able to

1. To analyze Database design methodology.
2. Acquire knowledge of fundamentals of Database Management System.
3. Analyze the difference between traditional file system and DBMS.
4. To deal with different Database languages.
5. Draw various data models for Database, writing and executing queries to get expected results.

Course Code: **CS-103** **Automata Theory and Computability** *Clock Hours:* **60**
Total Marks: **100**

Course Objectives:

Students will try to learn:

1. To learn fundamentals of Grammars and Languages.
2. To understand the relation between Regular Language and Finite Automata and machines.
3. To learn how to design Automata's and machines as Acceptors, Verifiers and Translators.
4. To understand the relation between Contexts free Languages, PDA and TM.
5. To learn how to design PDA as acceptor and TM as Calculators.
6. To understand the decidability and complexity measures.

Unit-I **[10]** Max Marks: **20**

Grammars: Production systems, Chomskian Hierarchy, Right linear grammar and Finite state automata, Context free grammars, Normal forms, uvwxy theorem, Parikh mapping, Self-embedding property, Subfamilies of CFL, Derivation trees and ambiguity

Unit-II **[10]** Max Marks: **20**

Finite State Automata: Nondeterministic and deterministic FSA, NFSA with ε- moves, Regular Expressions, Equivalence of regular expression and FSA, Pumping lemma, closure properties and decidability, Myhill - Nerode theorem and minimization, Finite automata with output

Unit-III **[08]** Max Marks: **15**

Pushdown Automata: Acceptance by empty store and final state, Equivalence between pushdown automata and context-free grammars, Closure properties of CFL, Deterministic pushdown automata

Unit-IV **[12]** Max Marks:**20**

Turing Machines: Techniques for Turing machine construction, Generalized and restricted versions equivalent to the basic model, Godel numbering, Universal Turing Machine, Recursively enumerable sets and recursive sets, Computable functions, time space complexity measures, context sensitive languages and linear bound automata

Unit-V **[08]** Max Marks: **10**

Decidability: Post's correspondence problem, Rice's theorem, decidability of membership, emptiness and equivalence problems of languages

Unit-VI **[10]** Max Marks: **15**

Complexity Measures: Time and tape complexity measures of Turing machines, Random access machines, the classes P and NP, NP-Completeness, satisfiability and Cook's theorem, Polynomial reduction and some NP-complete problems, Regulated rewriting L systems, Grammar systems

References:

1. K. Krithivasan and R. Rama (2009). Introduction to Formal Languages, Automata Theory and Computation: Pearson Education, ISBN 9788131723562.
2. J. E. Hopcroft, R.Motwani and J.D.Ullman (2001). Introduction to Automata Theory Languages and computation: Pearson Education Asia, ISBN 978-0321455369.
3. Peter Linz (2006). An Introduction to Formal Language and Automata 4th Edition: Narosa Publishing house, ISBN 978-1-4496-1552-9.
4. M.Sipser (1997). Introduction to the Theory of Computation; Singapore: Brooks/Cole, Thomson Learning ISBN, 978-1133187790.
5. John. C. Martin (2003). Introduction to the Languages and the Theory of Computation Third edition Tata McGraw-Hill ISBN 9780070660489.
6. 6. http://nptel.ac.in/

Course Outcome:

Students will able to:

1. Understand, design, construct, analyse and interpret Regular languages, Expression and Grammars.
2. Design different types of Finite Automata and Machines as Acceptor, Verifier and Translator.
3. Understand, design, analyse and interpret languages, Expression and Grammars.
4. Design different types of Push down Automata and Turing Machine.

Course Code: **CS-104** **Operating Systems** *Clock Hours:* **60**
Total Marks: **100**

Course Objectives:
The student should be able to

- understand different types of operating systems and the concepts that underlies operating systems.
- learn the fundamental concepts and algorithms that will be used in existing commercial operating systems.
- understand the issues related to protection and security.

Unit-I **[04]** Max Marks:**08**
Introduction: review of computer organization, introduction to popular operating systems like UNIX, Windows, etc., OS structure, system calls, functions of OS, evolution of OSs.

Unit-II **[03]** Max Marks:**06**
Computer organization interface: using interrupt handler to pass control between a running program and OS.

Unit-III **[08]** Max Marks:**12**
Concept of a process: states, operations with examples from UNIX (fork, exec), Process scheduling, inter-process communication (shared memory and message passing), UNIX signals.

Unit-IV **[04]** Max Marks:**06**
Threads: multithreaded model, scheduler activations, examples of threaded programs.

Unit-V **[06]** Max Marks:**10**
Scheduling: multi-programming and time sharing, scheduling algorithms, multiprocessor scheduling, thread scheduling (examples using POSIX threads).

Unit-VI **[08]** Max Marks:**12**
Process synchronization: critical sections, classical two process and n-process solutions, hardware primitives for synchronization, semaphores, monitors, classical problems in synchronization (producer-consumer, readers-writer, dining philosophers, etc.).

Unit-VII **[06]** Max Marks:**10**
Deadlocks: modelling, characterization, prevention and avoidance, detection and recovery.

Unit-VIII **[07]** Max Marks:**12**
Memory management: with and without swapping, paging and segmentation, demand paging, virtual memory, page replacement algorithms, working set model, implementations from operating systems such as UNIX. Current Hardware support for paging: e.g., Pentium/ MIPS processor etc.

Unit-IX **[07]** Max Marks:**12**

Secondary storage and Input/Output: device controllers and device drivers, disks, scheduling algorithms, file systems, directory structure, device controllers and device drivers, disks, disk space management, disk scheduling, NFS, RAID, other devices. operations on them, UNIX FS, UFS protection and security, NFS

Unit-X **[04]** Max Marks:**06**

Protection and security: Illustrations of security model of UNIX and other OSs. Examples of attacks.

Unit-XI **[03]** Max Marks:**06**

Epilogue: Pointers to advanced topics (distributed OS, multimedia OS, embedded OS, real-time OS, OS for multiprocessor machines).

All above topics shall be illustrated using UNIX as case-studies.

References:

1. Abraham Silberschatz, Peter B. Galvin, Greg Gagne (2009), Operating System Concepts, 8th Ed., John Wiley, *ISBN* 0-471-69466-5.
2. William Stallings (2014), Operating Systems: Internals and Design Principles. Pearson, 8th Ed., *ISBN*-13: 978-0-13-230998-1
3. AS Tanenbaum (2009), Modern Operating Systems, 3rd Ed., Pearson, *ISBN*: 0135013011
4. AS Tanenbaum, AS Woodhull (2006), Operating Systems Design and Implementation, 3rd Ed., Prentice Hall, *ISBN*-10: 0131429388
5. M. J. Bach (1986), Design of the Unix Operating System, Prentice Hall of India, *ISBN* 0 -13-201757-1 025

Course Outcome:

Upon completion of the subject, students will be able to:

- understand different types of operating systems.
- gain extensive knowledge on principles and modules of the operating systems.
- understand key mechanisms in the design of operating systems modules.
- understand process management, thread management, memory management, file management and deadlock handling.
- compare performance of different processor scheduling algorithms.
- produce algorithmic solutions to process synchronization problems
- understand the issues related to protection and security.

Course Code: **CS-105** **Object Oriented Programming using JAVA** *Clock Hours:* **60** *Total Marks:* **100**

Course Objectives:

Students will try:

1. To learn fundamentals of Java programming language and its constructs.
2. To understand concept of object-oriented programming concept using Java.
3. To study the concept of the Inheritance, Interfaces, Lambda Expressions, and Inner Classes.
4. To understand the concept of the Exceptions and Generic Programming

5. To learn about the Graphics Programming, Event Handling, Swing Components, and Database Programming

Unit- I **[08]** Max Marks:**12**

An Introduction to Java: Java as a Programming Platform, The Java "White Paper" Buzzwords, Java Applets and the Internet, Common Misconceptions about Java, The Java Programming Environment, Installation, A Simple Java Program, Comments, Data Types, Variables, Operators, Strings, Input and Output, Control Flow, Big Numbers, Arrays.

Unit-II **[08]** Max Marks:**12**

Objects and Classes: Introduction to Object-Oriented Programming, Using Predefined Classes, Defining Your Own Classes, Static Fields and Methods, Method Parameters, Object Construction, Packages, The Class Path, Documentation Comments

Unit-III **[10]** Max Marks:**16**

Inheritance, Interfaces, Lambda Expressions, and Inner Classes: Classes, Super classes, and Subclasses, Object: The Cosmic Superclass, Generic Array Lists, Object Wrappers and Autoboxing, Methods with a Variable Number of Parameters, Enumeration, Classes, Reflection, Interfaces, Examples of Interfaces, Lambda Expressions, Inner Classes, Proxies

Unit-IV **[10]** Max Marks:**16**

Exceptions and Generic Programming: Dealing with Errors, Catching Exceptions, Assertions and Logging, Why Generic Programming? Simple Generic Class, Generic Methods, Bounds for Type Variables, Inheritance Rules for Generic Types, Wildcard Types, Reflection and Generics

Unit-V **[12]** Max Marks:**24**

Graphics Programming, Event Handling and Swing Components: Introducing Swing, Creating a Frame, Positioning a Frame, Displaying Information in a Component, Working with 2D Shapes, Using Color, Using Special Fonts for Text, Displaying Images, Basics of Event Handling, Actions, Mouse Events, The AWT Event Hierarchy, Swing and the Model-View-Controller Design Pattern, Introduction to Layout Management, Text Input, Choice Components, Menus, Sophisticated Layout Management, Dialog Boxes.

Unit-VI **[12]** Max Marks:**20**

Deployment and Concurrency and Database Programming: JAR Files, Storage of Application Preferences, Service Loaders, Applets, Java Web Start, Threads, Interrupting Threads, Thread States, Thread Properties, Synchronization, Blocking Queues, Thread-Safe Collections, Callables and Futures, Executors, Synchronizers, Threads and Swing, The Design of JDBC, The Structured Query Language, JDBC Configuration, Working with JDBC Statements, Query Execution, Scrollable and Updatable Result Sets, Row Sets, Metadata.

References:

1. Cay S. Horstmann Core Java Volume I—Fundamentals (December 2015), Tenth Edition, Prentice Hall, ISBN: 9780134177335
2. Cay S. Horstmann Core Java, Volume II—Advanced Features (December 2016), Tenth Edition, Prentice Hall, ISBN: 9780134177878

3. Herbert Schildt, Java: The Complete Reference, Ninth Edition, McGraw Hill Education, ISBN 978-0-07-180855-2

Course Outcome:

Students will able to:

1. To understands the fundamentals of Java programming language and its constructs.
2. To understand concept of object-oriented programming concept using Java.
3. To implement the applications using the concept of the Inheritance, Interfaces, Lambda Expressions, and Inner Classes.
4. To design and implement the real-world application using the concept of the Exceptions and Generic Programming
5. To understand how to use concept of the Graphics Programming, Event Handling, Swing Components, and JDBC in their application.

Course Code: **CS LAB-I** **LAB on JAVA programming** *Total Marks:* **100**

Course Objectives:

The main objectives of this course are:

JAVA programming

- Gain knowledge about basic Java language syntax and semantics to write Java programs and use concepts such as variables, conditional and iterative execution methods etc.
- Understand the fundamentals of object-oriented programming in Java, including defining classes, objects, files, invoking methods etc and exception handling mechanisms.
- Understand the principles of inheritance, packages and interfaces
- Using Swing library and various GUI components, Applet programming, JDBC, generic programming and multithreaded programming

JAVA programming

1. Write a program that demonstrates program structure of java.
2. Write a program that demonstrates string operations.
3. Write a program that demonstrates package creation and use in program.
4. Write a program that demonstrate inner class.
5. Write a program that demonstrates inheritance.
6. Write a program that demonstrates 2D shapes on frames.
7. Write a program that demonstrates text and fonts.
8. Write a program that demonstrates event handling for various types of events.
9. Write a program to illustrate use of various swing components.
10. Write a program that demonstrates use of dialog box.
11. Write a program to create own dialog box.
12. Write a program to create toolbar, menu & popup menu.
13. Write a program to implement file handlings.
14. Write a program that demonstrates Applet programming.
15. Write a program to implement generic programming.
16. Write a program that demonstrates JDBC on applet/application.
17. Write a program that demonstrates multithreading.

Course Outcome:

The above exercise shall make the students competent in the following ways and will be able to learn following parameters at the end of the course.

JAVA programming

- Write Java application programs using OOP principles and proper program structuring
- Implementing user interface: 2D shapes, events, dialog box, menu and popup menu
- Developing Applets, multithreaded programs
- Implementing generic and JDBC programming
- Demonstrate the concepts of polymorphism and inheritance
- Write Java programs to implement error handling techniques using exception handling

Course Code: **CS LAB-II** **LAB on DBMS** *Total Marks:* **100**

Course Objectives:

1) The course mainly concentrates on understanding of the fundamentals of Data Definition Language and Data Manipulation Languages.
2) To develop conceptual understanding of database management system
3) To understand how a real-world schema can be implemented
4) To educate students with different Database Languages.
5) Understand the needs of database processing and learn techniques for controlling the consequences of concurrent data access.

1. Creating database tables and using data types.
   - Create table
   - Modify table
   - Drop table
2. Practical Based on Data Manipulation.
   - Adding data with Insert
   - Modify data with Update
   - Deleting records with Delete
3. Practical Based on Implementing the Constraints.
   - NULL and NOT NULL
   - Primary Key Constraint
   - Foreign Key Constraint
   - Unique Constraint
   - Check Constraint
   - Default Constraint
4. Practical for Retrieving Data Using following clauses.
   - Simple select clause
   - Accessing specific data with Where
   - Ordered By
   - Distinct
   - Group By
5. Practical Based on Aggregate Functions.

- AVG
- COUNT
- MAX
- MIN
- SUM
- CUBE

6. Practical Based on implementing all String functions.
7. Practical Based on implementing Date and Time Functions.
8. Practical Based on implementing use of UNION, INTERSECTION, SET DIFFERENCE.
9. Implement Nested Queries & all types of JOIN operation.
10. Practical Based on performing different operations on a view.
11. Practical Based on implementing use of Procedures.
12. Practical Based on implementing use of Triggers
13. Practical Based on implementing Cursor.
14. ++++VB.NET, C#.NET, JAVA, D2K, etc.
15. Practical based on creating Data Reports.
16. Design entity relationship models for a business problem and develop a normalized database structure

Course Outcome:

After successful completion of this course, students will be able to

1.To understand Database design methodology.
2.Acquire knowledge in fundamentals of Database Management System.
3.Work with popular Database languages.
4.Realise various data models for Database and Write queries in SQL.
5. Familiar with basic database storage structures and access techniques.

Semester-II

Course Code: **CS-201** **Compiler Construction** *Clock Hours:* **60**
Total Marks: **100**

Course Objectives:

To cover the major topics in compiler design with emphasis on solving the problems encountered in designing a compiler regardless of the source language or the target machine.

Unit-I **[05]** Max Marks:**10**

Compiler structure: analysis-synthesis model of compilation, various phases of a compiler, tool-based approach to compiler construction.

Unit-II **[06]** Max Marks:**15**

Lexical analysis: Interface with input, parser and symbol table, token, lexeme and patterns, Difficulties in lexical analysis, Error reporting, Implementation, Regular definition, Transition diagrams, LEX.

Unit-III **[15]** Max Marks:**30**

Syntax analysis: CFGs, ambiguity, associativity, precedence, top down parsing, recursive descent parsing, transformation on the grammars, predictive parsing, bottom up parsing, operator precedence grammars, LR parsers (SLR, LALR, LR), YACC.

Syntax directed definitions: inherited and synthesized attributes, dependency graph, evaluation order, bottom up and top down evaluation of attributes, L- and S-attributed definitions.

Type checking: type system, type expressions, structural and name equivalence of types, type conversion, overloaded functions and operators, polymorphic functions.

Unit-IV **[10]** Max Marks:**15**

Run time system: storage organization, activation tree, activation record, parameter passing, symbol table, dynamic storage allocation.

Unit-V **[10]** Max Marks:**15**

Intermediate code generation: Intermediate representations, translation of declarations, assignments, control flow, Boolean expressions and procedure calls. Implementation issues.

Unit-VI **[10]** Max Marks:**15**

Code generation and instruction selection: issues, basic blocks and flow graphs, register allocation, code generation, dag representation of programs, code generation from dags, peep hole optimization, code generator generators, specifications of machine.

References:

1. Aho A.V., R. Sethi and J.D. Ullman. Compiler Principle, Techniques and Tools: Addison Wesley, ISBN 0-321-48681-1.
2. Barret, Couch. Compiler Construction Theory and Practice: Computer Science series, Asian Student Ed, ISBN 978-0574213358
3. Dhamdhere D.M. Compiler Construction Principle and Practice: McMillan India, ISBN 9780333904060
4. Gres D. Compiler Construction for Digital Computer: Wiley, ISBN 047132776X.
5. David Galles (2009). Modern Compiler Design: Pearson Education, ISBN 9788131709412

Course Outcome:

Understanding of basic structure of compiler, concepts and terminology in programming languages, lexical analysis, finite state techniques, scanner generator, parsing, kinds of parsers, designing lexical analyzer, scanner and parsers, principal ideas with intermediate code generation, optimizations.

Understanding of all concepts essential to design compiler in general for programming languages.

Course Code: **CS-202** **Artificial Intelligence** *Clock Hours:* **60**
Total Marks: **100**

Course Objectives:
The primary objective of this course is to introduce the basic principles, techniques, and applications of Artificial Intelligence. Emphasis will be placed on the teaching of these fundamentals, not on providing a mastery of specific software or tools programming environments.

The student should be made to:

1) Gain a historical perspective of AI and its foundations.
2) Study the concepts of Artificial Intelligence.
3) Investigate applications of AI techniques in intelligent agents
4) Learn the methods of solving problems using Artificial Intelligence.
5) Learn various peculiar search strategies for AI

Unit-I **[08]** Max Marks:**10**
Introduction: Overview and Historical Perspective, Turing test, Physical Symbol Systems and the scope of Symbolic AI, Agents.

Unit-II **[06]** Max Marks:**10**
State Space Search: Depth First Search, Breadth First Search, DFID.

Unit-III **[08]** Max Marks:**12**
Heuristic Search: Best First Search, Hill Climbing, Beam Search, Tabu Search.

Unit-IV **[08]** Max Marks:**15**
Randomized Search: Simulated Annealing, Genetic Algorithms, Ant Colony Optimization.

Unit-V **[08]** Max Marks:**12**
Problem Decomposition: Goal Trees, AO*, Rule Based Systems, Rete Net.

Unit-VI **[06]** Max Marks:**12**
Game Playing: Minimax Algorithm, AlphaBeta Algorithm, SSS*.

Unit-VII **[08]** Max Marks:**14**
Planning and Constraint Satisfaction: Domains, Forward and Backward Search, Goal Stack Planning, Plan Space Planning, Graphplan, Constraint Propagation.

Unit-VIII **[08]** Max Marks:**15**
Logic and Inferences: Propositional Logic, First Order Logic, Soundness and Completeness, Forward and Backward chaining.

References:
1. Deepak Khemani (2013). A First Course in Artificial Intelligence, McGraw Hill Education (India), ISBN 9781259029981

2. Elaine Rich and Kevin Knight (1991). Artificial Intelligence, Tata McGraw Hill, ISBN 13: 9780070087705
3. Stuart Russell and Peter Norvig (2009). Artificial Intelligence: A Modern Approach, 3rd Edition, Prentice Hall, ISBN-13: 978-0-13-604259-4.

Course Outcome:

At the end of the course, the student should be able to:

1) Identify problems that are amenable to solution by AI methods.
2) Identify appropriate AI methods to solve a given problem.
3) Design smart system using different informed search / uninformed search or heuristic approaches.
4) Apply the suitable algorithms to solve AI problems.

Course Code: **CS-203** **Design and Analysis of Algorithms** *Clock Hours:* **60**
Total Marks: **100**

Course Objectives:

To Understand and learn

1. Basic concepts of algorithms and analyze the performance of algorithms.
2. Algorithm design techniques for developing algorithms.
3. Searching and traversal algorithms for graphs.
4. Nondeterministic algorithms and NP class of problem.

Unit-I **[10]** Max Marks:**15**

Introduction: What Is An Algorithm?, Algorithm Specification, Pseudocode Conventions, Recursive Algorithms, Complexity, Asymptotic Notation, Practical Complexities And Performance Measurement

Tree And Graph Representations, Binary Trees Basics, Heaps And Heap Sort, Sets And Disjoint Set Union And Find.

Unit-II **[12]** Max Marks:**15**

Divide and Conquer: General Method, Binary Search, Finding Maximum and Minimum, Merge Sort, Quick Sort, Strassen's Matrix Multiplication.

Unit-III **[08]** Max Marks:**15**

The Greedy Method: General Method, Knapsack Problem, Huffman Code, Minimum-Cost Spanning Trees (Prim's & Kruskal's Algorithm), Optimal Storage On Tapes, Single-Source Shortest Paths.

Unit-IV **[08]** Max Marks:**15**

Dynamic Programming: General Method, All-Pair Shortest Path, Matrix Chain Multiplication, Longest Common Sub Sequence, 0/1knapsack, Flow Shop Scheduling

Unit-V **[06]** Max Marks:**15**

Basic Search and Traversal Techniques: Breadth First Search and Traversal, Depth First Search And Traversal, Spanning Trees.

Unit-VI **[08]** Max Marks:**15**

Backtracking: General Method, Constrains, 8-Queens Problem Graph Coloring

References:

1. Horowitz E. and Sahni S. "Fundamentals of computer Algorithms" Galgotia publications. ISBN:0716783169
2. Horowitz E., Sahni S. and Rajshekaran S(),Computer Algorithms, Computer Science Press, ISBN-10: 8173716129
3. S. Dasgupta, C. H. Papadimitriou, and U. V. Vazirani(2006), Algorithms. McGraw-Hill publications, ISBN 9780073523408
4. Cormen, Leiserson and Rivest, Introduction to Algorithms, Prentice Hall of India, ISBN: 978-81-203-4007-7

Course Outcome:

1. Analyze the asymptotic performance of algorithms.
2. Write rigorous correctness proofs for algorithms.
3. Design and analyze divide-and-conquer based algorithms.
4. Devise and Synthesize greedy and dynamic-programming based algorithms.
5. Employ graphs to model problems solvable using traversal techniques.
6. Able to model problems using backtracking
7. Able to classify nondeterministic polynomial time algorithms.

Course Code: **CS-205** **Python Programming** *Clock Hours:* **60**
Total Marks: **100**

Course Objectives:

The student should be able to

- understand the fundamental concepts of Python programming.
- learn that how python programming supports some constructs of functional programming.
- work with strings, lists, tuples, dictionaries, and files.
- define their own classes, methods and module for solving real world problems.
- use regular expression for searching patterns in given strings.

Unit-I **[12]** Max Marks:**20**

The Python Programming Language, Python Data, Variables, Expressions and Statements, Values and Data Types, Type conversion Functions, Operators and Operands, Input, Order of

Operations, Functions, Calling Functions, Passing Functions, Formal Arguments, Variable-length Arguments, Functional Programming, Boolean Expressions, Logical operators, Precedence of Operators, Conditional Execution, Unary Selection, Nested conditionals, Chained conditionals, Boolean Functions, Iteration, The for loop, The while Statement

Unit-II **[08]** Max Marks:**15**

Strings, A Collection Data Type, Operations on Strings, Index Operator: Working with the Characters of a String, String Methods, Length, The Slice Operator, String Comparison, Lists, List Values, List Length, Accessing Elements, List Membership, Concatenation and Repetition, List Slices, Lists are Mutable, List Deletion, Objects and References, Aliasing, Cloning Lists, Repetition and References, List Methods, Append versus Concatenate Lists and for loops, Using Lists as Parameters, Nested Lists, Strings and Lists, List Type Conversion Function, Tuples, Tuple operators and built-in functions, Tuples and Mutability, Tuple Assignment, Tuples as Return Values

Unit-III **[15]** Max Marks:**20**

Dictionaries, Dictionary Operations, Dictionary Methods, Dictionary Keys, Aliasing and Copying, Sparse Matrices, Working with Data Files, Finding a File on your Disk, Reading a File, Iterating over lines in a file, Writing Text Files, Object Oriented Programming, Classes, Instances, Class method Calls, Coding Class Tree, Attributes, Building and Method Invocation, Composition, Inheritance, Operator Overloading, Encapsulation and Information Hiding, Search Algorithms, Sorting Algorithms, Hash Tables

Unit-IV **[10]** Max Marks:**20**

Regular Expressions, Exceptions, Standard Exceptions, Exceptions Syntax, The try/except/else Statement, The try/finally Statement, Unified try/except/finally, The raise Statement, The assert Statement, with/as Context Managers String-Based Exceptions, Class-Based Exceptions, General raise Statement Forms, Nesting Exception Handlers, Exception Idioms, Exception Design Tips. Catch All Exceptions, Catch A Specific Exception, Catch Multiple Specific Exceptions, Clean-up After Exceptions, GUI Programming using TKinter.

Unit-V **[15]** Max Marks:**25**

Advance Function Topics: Anonymous Function Lambda, Mapping Functions over Sequences: map, Functional Programming Tools: filter and reduce, List Comprehensions Revisited: Mappings. Modules: Python Program Architecture, Module Creation, Module usage, Module Namespaces, Reloading Modules, Module Packages. Data Hiding in Modules, Enabling Future Language Features, Mixed Usage Modes, Changing the Module Search Path, The import as Extension, Relative Import Syntax, Module Design Concepts

References:

1. John V Guttag (2013), Introduction to Computation and Programming Using Python, Prentice Hall of India, 2013, ISBN: 9780262525008
2. R. Nageswara Rao(2016), Core Python Programming, Dreamtech Press, 2016, ISBN-13: 9789351199427
3. Wesley J. Chun(2006), Core Python Programming - Second Edition, Prentice Hall, ISBN-13: 978-0132269933, ISBN-10: 0132269937

4. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser(2013), Data Structures and Algorithms in Pyhon", Wiley, 2013, ISBN : 978-1-118-54958-2, ISBN : 978-1-118-29027-9(HardCover)
5. Kenneth A. Lambert(2011), Fundamentals of Python – First Programs, CENGAGE Publication, 2011, ISBN 1111822700, ISBN 9781111822705
6. Luke Sneeringer(2015), Professional Python, Wiley Inc.,2015, ISBN: 1119070856
7. Mark Lutz (2007), Learning Python, 3rd Edition, O'Reilly Media, Inc., 2007, ISBN-13: 978-0-596-51398- 6, ISBN-10: 0-596-51398-4

Course Outcome:

Upon completion of the subject, students will be able to:

- understand the basic concepts of Python programming.
- write Python programs that supports some constructs of functional programming like map, reduce, filter.
- understand the use of strings, lists, tuples, dictionaries, and files and able to manipulates data available within them with help of various functions.
- understand how to write user defined classes, methods as well as module creation and handle exceptions while implementing python programs.
- use regular expression for validating email address or domain name.

Course Code: **CS- LAB-III** **LAB on Design and Analysis of Algorithms (DAA)** *Total Marks:* **100**

Course Objectives:

Understand and learn

1. To convert the algorithms to code.
2. To measure the complexities at run time.
3. To modify the algorithms for efficiency.
4. To debug and test the programs.
5. To conclude using profile of outcomes.

OS: Windows/Linux, **Programming Language:** C++/Java/C#

1. Write a program for creating max./min. heap using
   - INSERT
   - ADJUST/HEAPIFY
2. Write a program to implement union and find operation.
3. Write a program to find minimum and maximum form a given array.
4. Write a program for searching element form given array using binary search for n=1000,2000,3000 find exact time of execution.
5. Write a program for sorting given array in ascending/descending order with n=1000,2000,3000 find exact time of execution using
   - Heap sort
   - Merge sort
   - Quick sort
6. Write a program for matrix multiplication using Strassen's matrix multiplication.
7. Write a program to find solution of Knapsack instant.

8. Write a program to find shortest path using single source shortest path.
9. Write a program to find Minimum-Cost Spanning Trees (Prim's & Kruskal's Algorithm).
10. Write a program to find shortest path using all pair path.
11. Write a program to find longest common subsequence.
12. Write a program to implement breadth first and depth first search.
13. Write a program to implement breadth first and depth first traversal.
14. Write a program to find all solutions for 8-queen problem using backtracking.

Course Outcome:

1. Able to construct logic for the algorithms designed using designing techniques.
2. Able to do posterior analysis of the algorithms.
3. Able to debug the algorithms.
4. Modify to improve performance of the algorithms.
5. Able to test and profile the algorithms.

Course Code: **CS-LAB-IV** **LAB on Python Programming** *Total Marks:* **100**

Course Objectives:

The student should be able to

- develop the Python programs for searching, sorting, with help of fundamental concepts like lists, dictionary.
- understand the concepts of functions scoping, recursion, list mutability, regular expression in Python programming.
- learn to define their own classes, methods and modules according to the requirement of the problem and use of exception handling concepts.
- define regular expression and develop GUI programs using Tkinter.

1. Develop programs to understand the control structures of python
2. Develop programs to learn different types of structures (list, dictionary, tuples) in python
3. Develop programs to learn concept of functions scoping, recursion and list mutability.
4. Develop programs to understand object oriented programming using python.
5. Develop programs for data structure algorithms using python – searching, sorting and hash tables.
6. Develop programs to learn regular expressions using python.
7. Develop programs to learn GUI programming using Tkinter.
8. Demonstrate the concept of exception handling using try/except/else Statement, Unified try/except/finally, try/finally Statement, raise Statement, assert Statement, catch multiple specific exceptions
9. Demonstrate the concept of String-Based Exceptions, Class-Based Exceptions and Nesting Exception handlers.
10. Demonstrate implementation of the Anonymous Function Lambda.
11. Demonstrate implementation Mapping Functions over Sequences.
12. Demonstrate implementation functional programming tools such as filter and reduce
13. Demonstrate the Module Creation, Module usage, Module Namespaces, Reloading Modules, Module Packages, Data Hiding in Modules.

14. Demonstrate Mixed Usage Modes of modules, Changing the Module Search Path, The import as Extension, Relative Import Syntax, Module Design Concepts

Course Outcome:

Upon completion of the subject, students will be able to:

- implement Python programs that demonstrates all types of sorting and searching techniques.
- write programs that demonstrate the concepts of functions scoping, recursion, list mutability, regular expression and support of function programming constructs through Python programming.
- write Python programs that defines user defined classes, methods and module for solving real world problems as well as use of exception handling concepts whenever necessary.
- implement programs that uses regular expression for searching patterns and validating data.
- develop GUI programs using Tkinter.

Semester-III

Course Code: **CS-301** **Web Application Development Technology** *Clock Hours:* **60** *Total Marks:* **100**

Course Objectives:

- To learn .Net Framework
- Creating ASP.Net web applications using standard .net controls.
- Develop database applications using ADO.Net
- Use Web Services and develop simple and complex applications using .Net framework
- Develop a data driven web application.
- Connecting to data sources and managing them.
- Maintain session and controls related information for user used in multi-user web applications
- Understand the fundamentals of developing modular application by using object oriented methodologies

Unit-I **[10]** Max Marks:**15**

Desktop Computing vs. Internet Computing, Internet computing infrastructure, Client side scripting vs. Server Side Scripting technologies, Web Server basics and configuration: IIS, Apache etc., Web site hosting basics, Web Publishing, HTML, introduction to .NET framework, Features of .NET frameowork:CTS,CLS,CLR,.NET technologies, languages'C#.NET,VB.NET, basics of ASP.NET page framework, Visual studio .NET IDE, Page Life Cycle, PostBack, Viewstate, Page directives, ASP.Net page execution cycle, HTTP Pipeline, HTTP Application, HTTP Request, HTTP Response classes, HTTP Modules and HTTP Handlers, State Management, Role of Global.asax, Application configuration using web.config file

Unit-II **[15]** Max Marks:**25**

ASP.NET Control hierarchy, HTML Server Controls, Web Server Controls, User and Server controls, Validation Controls, List bound controls: dropdown lists, list boxes, Repeater, DataList, Data Grid, DataGridView, FormsView controls, Data binding to List Bound Controls, Templating and Styling of ASP.NET server controls

Unit-III **[20]** Max Marks:**25**

Web Page Designing principles, CSS anatomy, Anatomy of Master Pages, nesting master pages, Site map file, Web site Navigation controls, properties:TreeView, Sitemap Path, Menu, Other Navigation methods: Response.Redirect(), Server.Transfer(), Personalization through Profiles, Themes/Skins, Web Site security basics: authentication modes:Windows,Forms,passport, authorization, roles/Membership, access rules, login controls,Web services: working, anatomy, hosting

Unit-IV **[15]** Max Marks:**25**

Database technology: ADO.NET, Anatomy/architecture of ADO.NET, working with Connection, Command, Data Adaptor, DataReader, DataSet, DataTable objects, Editing data in Data Tables, concurrency control. Introduction to MVC, Data Reports

References:

1. Richard Anderson, Brian Francis, Alex Homer, Rob Howard, David Sussman, Karli Watson(2002), Professional ASP.NET 1.0, Special Edition, Wrox Press Ltd., 2002, ISBN 1-861007-0-3-5.
2. Chris Hart, John Kauffman, Dave Sussman, and Chris Ullman(2006), Beginning ASP.NET 2.0, Wiley Publishing, Inc., 2006, ISBN-13: 978-0-7645-8850-1, ISBN-10: 0-7645-8850-8.
3. Beginning ASP.NET 4: in C# and VB, Imar Spaanjaars, Wiley Publishing, Inc 2010., ISBN: 978-0-470-50221-1
4. Bill Evjen, Scott Hanselman, Devin Rader (2008), Professional ASP .NET 3.5 in C# and VB, Wiley Publishing Inc.,2008 ISBN:978-0-470-18757-9.
5. Dino Esposito (2008), Programming Microsoft ASP.NET 3.5, Second Edition, Microsoft Press, 2008, ISBN-10: 0735625271, ISBN-13: 978-0735625273

Auxiliary Resources:

Website URLs

- https://www.asp.net/
- http://asp.net-tutorials.com/

Video Links

- https://www.asp.net/web-forms/videos
- https://www.youtube.com/playlist?list=PL6n9fhu94yhXQS_p1i-HLIftB9Y7Vnxlo&feature=view_all

Course Outcome:

The student will be able apply technical knowledge and perform specific technical skills,

including:

- Successful students will able to design web applications using ASP.NET
- Successful students will be able to use ASP.NET controls in web applications.
- Successful students will be able to debug and deploy ASP.NET web applications
- Successful students will be able to create database driven ASP.NET web applications and web services.

Course Code: **CS-302** **Digital Image Processing** *Clock Hours:* **60**
Total Marks: **100**

Course Objectives:

1. To equip students with the fundamental knowledge and basic technical competence in the field of Computer Graphics and Digital Image Processing.
2. To provide an understanding of how to scan convert the basic geometrical primitives, basic principles of 2 and 3- dimensional computer graphics.
3. To be able to discuss the application of computer graphics concepts in the development of information visualization, and business applications.
4. Give an in-depth knowledge about the basic theory and algorithms related to Digital Image Processing.
5. Provide awareness about the current technologies and issues specific to Digital Image Enhancement, Restoration, Segmentation, Color Image Processing, and Morphological Image Processing.

Unit-I **[12]** Max Marks:**20**

Introduction to Digital Image Processing & Applications: Digital Image Processing. Applications of Digital Image Processing, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Image Sensing and Acquisition. Image Sampling and Quantization. Some Basic Relationships Between Pixels.

Unit-II **[14] Max Marks:25**

Image Enhancement: Background, Some Basic Gray Level Transformations, Histogram Processing, Enhancement Using Arithmetic/Logic Operations, Basics of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters, Combining Spatial Enhancement Methods,

Introduction to the Fourier Transform and the Frequency Domain, Smoothing Frequency-Domain Filters, Sharpening Frequency Domain Filters, Homomorphic Filtering

Unit-III **[14] Max Marks:20**

Image Restoration and Color Image Processing: A Model of the Image Degradation/Restoration Process, Noise Models, Restoration in the Presence of Noise Only-Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Linear, Position-Invariant Degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering,

Color Fundamentals, Color Models, Pseudocolor Image Processing, Basics of Full-Color Image Processing, Color Transformations, Smoothing and Sharpening.

Unit IV **[14] Max Marks: 20**

Morphological Image Processing & Segmentation: Detection of Discontinuities, Edge linking & Boundary Detection, Thresholding, Region based segmentation Laplacian of Gaussian, Derivative of Gaussian, Canny Edge Detection, Morphological operation: Dilation erosion, Opening & Closing, Basic Morphological Algorithm, Image representation schemes.

Unit V **[06] Max Marks: 15**

MATLAB Image processing toolbox: Introduction to MATLAB, Matrix Operations, Introduction to Image Processing Tool Box, Image Read & Write, Filters (spatial and frequency domain), Image Restoration and Reconstruction, Morphological Operations, Edge Detection and linking, Segmentation.

References:

1. Amarendra N Sinha, Arun D. Udai, (2008). Computer Graphics, TMH publication ISBN- 13 : 978-0-07-063437-4.
2. D. Hearn and M. Pauline Baker, Computer Graphics (C Version), Pearson Education, 2nd Edition ISBN-13: 978-0135309247
3. D. F. Rogers and J. A. Adams, Mathematical Elements for Computer Graphics, 2nd Edition, McGraw-Hill International Edition, ISBN-13:978-0-07-0486775
4. R.C.Gonzalez & R.E.Woods, Digital Image Processing, Pearson Education, 3rd edition, ISBN. 13:978-0131687288
5. S. Jayaraman Digital Image Processing TMH (McGraw Hill) publication, ISBN-13:978-0-07-0144798
6. Gonzalez, Woods & Steven, Digital Image Processing using MATLAB, Pearson Education, ISBN-13:978-0130085191

Course Outcome:

1. Developed scientific and strategic approach to solve complex problems Computer in the domain of Computer Graphics and Digital Image Processing.
2. Demonstrated various algorithms for scan conversion and filling of basic primitives objects and their comparative analysis and applied 2-D and 3-D geometric transformations, viewing and clipping on graphical objects.
3. Built the mathematical foundations for digital image representation, image acquisition, image transformation, image enhancement and restoration.
4. Developed a theoretical foundation of fundamental concepts of digital image processing.
5. Exposed students to MATLAB Image Processing Toolbox.

Course Code: **CS-303** **Software Engineering** *Clock Hours:* **60**
Total Marks: **100**

Course Objectives:

Students will try to learn:

- The nature of software development and software life cycle process models.
- Explain methods of capturing, specifying, visualizing and analyzing software requirements.

- Understand concepts and principles of software design and user-centric approach and principles of effective user interfaces.
- To know basics of testing and understanding concept of software quality assurance and software configuration management process.
- Understand need of project management and project management life cycle.
- Understand project scheduling concept and risk management associated to various type of projects.

Unit-I **[10]** Max Marks:**10**

Introduction and Process Models: Nature of Software, Software Engineering the process, Software Myths. Process Models: Generic process model, Prescriptive process models, Specialized process models, Unified process, Personal and Team process model, Process Technology, Product and Process. Agility, cost of change, Agile process, Extreme Programming, Agile Process models: Adaptive Software development, Scrum, Dynamic system development model, Crystal, Feature Driven development, Lean Software development, Agile modelling, Agile Unified process. Tool set for Agile process

Unit-II **[10]** Max Marks:**15**

Requirement Analysis and Modelling: Requirement Engineering, Establishing Groundwork, Eliciting Requirements Developing Use cases, Building Requirement model, Negotiating and Validating requirements. Requirement analysis, Scenario based modelling, UML models that supplements use case, Data modelling concepts, class based modelling. Requirement Modelling strategy, Flow oriented modelling, Creating Behaviour model, Pattern for Requirement modelling.

Unit-III **[08]** Max Marks:**15**

Quality Assurance and Change Management: Elements of SQA, SQA Tasks, Goal and Metrics, Formal approaches to SQA, Software Reliability, ISO 9000 Quality standards, SQA Plan. Software Configuration Management, SCM Repository, SCM process

Unit-IV **[11]** Max Marks:**20**

Design Concept: Design process, Design Concept: Abstraction, Architecture, Pattern, Separation of concept, Modularity, Information hiding, Functional independence, Refinement, Aspects, Refactoring. Design Model: Data design element, Architectural design element, Interface design element, Component level design element, Deployment level design element.

Unit-V **[11]** Max Marks:**20**

Architectural and Component Level Design: Software Architectures, Architectural Genres, Architectural styles, Architectural design, Accessing alternatives Architectural design, Architectural mapping using dataflow. Introduction to component, Designing class based component, Conducting component level design, Designing traditional component, component based development.

Unit-VI **[10]** Max Marks:**20**

Software Testing: Strategic approach to software testing, Test strategies for conventional software, Validation Testing, System testing, Software testing fundamentals, Internal and external view of testing, White box testing, Basic path testing, Control structure testing, Black

box testing, model based testing, Testing for specialized Environment, Architectures and applications.

References:

1. R. S. Pressman, "Software Engineering: A Practitioner's Approach", McGraw-Hill International Edition, Seventh Edition, ISBN:978-007-126782-3.
2. Pankaj Jalote, "Software Engineering: A Precise Approach", Wiley India Pvt. Limited ISBN: 978-81-265-2311-5.
3. K. K. Aggarwal and Yogesh Singh, "Software Engineering", Third Edition, New Age International Publishers, ISBN:978-81-224-2360-0.

Course Outcome:

Students will able to:

- Understand and demonstrate basic knowledge in software engineering
- Define various software application domains and remember different process model used in software development.
- Explain needs for software specifications also they can classify different types of software requirements and their gathering techniques.
- Convert the requirements model into the design model and demonstrate use of software and user interface design principles.
- Distinguish among SCM and SQA and can classify different testing strategies and tactics and compare them.
- Justify role of SDLC in Software Project Development
- Generate project schedule and can construct, design and develop network diagram for different type of Projects.

Course Code: **CS-304(A)** **Big Data Analytics** *Clock Hours:* **60**

Total Marks: **100**

Course Objectives:

1. To understand the Big Data challenges & opportunities, its applications
2. Understanding of concepts of map and reduce and functional programming
3. Gain conceptual understanding of Hadoop Distributed File System.
4. To solve the case studies related to real life situations
5. To bridge the gap between academics and industry needs.

Course Outcomes:

- Recognize the characteristics, applications of big data that make it useful to real-world problems.
- Process available data using big data tools hadoop file system and predict outcomes to solve given problem.
- Study & Design various case studies using big data tools/commands and analyse it.

Unit-I

Introduction to Big data : Big Data :Definition & taxonomy , Sources of Big Data , 3V's of Big Data (need for Hadoop), Varying data structures, Characteristics of Big Data 1,

Applications of Big Data 1.7 Challenges in Big Data 1.8 Big Data Implications for Industries Big Data Analytics for Telecom/Banking/Retail/HealthCare/IT/Operations

Unit-II

Emerging Database Landscape: Scale-Out Architecture, RDBMS Vs Non-Relational Database , Database Workload & its Characteristics , Implication of Big Data Scale on Data Processing

Unit- III

Application Architecture & Data Modeling For Big Data And Analytics , Big Data Warehouse & Analytics, Big data Warehouse System requirements & Hybrid Architectures , Enterprise Data Platform Ecosystem , Big Data and Master Data Management , Understanding data integration Pattern , Big Data Workload Design Approaches , Map-Reduce patterns ,Algorithms and Use Cases

Unit- IV

The Hadoop Ecosystem: Introduction to Hadoop, Hadoop Architecture, History of Hadoop-Facebook,Dynamo,Yahoo,Google, Hadoop Components :HDFS, Mapreduce , Introduction to Pig,Hive ,HBase ,Mahout, Installation of single node cluster-installation of java Hadoop configuration

Unit- V

Extracting Value From Big Data : Real Time Analytics , In-Memory Data Grid for real Time Analysis , Map reduce & Real Time Processing ,Use Cases

Unit- VI

Big Data Analytics Methodology : Big Data Analytics Methodology-Analyze & evaluate business cases, Develop Business Hypothesis –Analyze outcomes, Build & Prepare Data Sets ,Select & Build Analytical Model ,Design for Big Data scale .Build production ready system ,setting up the Big Data Analytics system ,Gathering data ,measure & monitor

References:

1) Madhu Jagdeesh,Soumendra Mohanty,Harsha Srivatsa,"Big Data Imperatives: Enterprise Big Data Warehouse,BI Implementations and Analytics",1st Edition, Apress(2013)
2) Frank J.Ohlhorst,"Big Data Analytics:Turning Big Data into Big Money",Wiley Publishers(2012)
3) Cristian Molaro,Surekha Parekh,Terry Purcell,"DB2 11:The Database for Big Data & Analytics",MC Press,(2013)
4) Tom White,"Hadoop-The Definitive Guide,Storage and analysis at internet scale",SPD, O'Really.
5) DT Editorial Services,"Big Data, Black Book-Covers Hadoop2, MapReduce,Hive,YARN, Pig, R and Data Visualization" Dreamtech Press,(2015).
6) Big Data Case Study by Bernard Marr –Willey Publications

Course Code: **CS-304(B)** **Windows, WCF and WPF Programming** *Clock Hours:* **60** *Total Marks:* **100**

Course Objectives:

Course Outcomes:

Unit 1:
Windows Programming : Windows environment – a simple windows program – windows and messages – creating the window – displaying the window – message loop – the window procedure – message processing – text output – painting and repainting – Mouse-Keyboard-introduction to GDI – device context – basic drawing – child window controls.

Unit 2: Windows Communication Foundation [WCF] : Windows Communication Foundation Overview, Windows Communication Foundation Concepts, Understanding Windows Communication Foundation, Addresses,Understanding and Programming WCF Binding, Understanding and Programming WCF Contracts, Clients, Services, Security.

Unit 3: Windows Presentation Foundation [WPF] : Overview of Windows Presentation Foundation, WPF and .Net Programming, Anatomy of EPF- Enabled Application, Building a Rich UI with Microsoft Expression Blend, Custom Controls, Security

References:

1) Charles Petzold, "Windows Programming",4th illustrated Edition, , 1996, ISBN: 9781556156762, Microsoft Press
2) Scott Klein, "Professional WCF Programming .Net Development with Windows Communication Foundation",2007, ISBN: 9780470089842,Wiley Publishing Inc.
3) Chris Andrade, Shawn Livermore, Mike Meyers, Scott Van Vilet, "Professional WPF Programming .Net Development with Windows Presentation Foundation", 2007, ISBN: 9780470041802 , Wiley Publishing Inc.

Course Code: **CS-304(C)** **Web Analytics** *Clock Hours:* **60** *Total Marks:* **100**

Course Objectives:
1) Understand social media, web and social media analytics, and their potential impact.
2) Determine how to Leverage social media for better services and Understand usability metrics, web and social media metrics.
3) Use various data sources and collect data relating to the metrics and key performance indicators.
4) Identify key performance indicators for a given goal, identify data relating to the metrics and key performance indicators.

Course Outcomes:

Unit-1 Introduction

1.1 What is web Analytics
1.2 Importance of web Analytics
1.3 Web Analytics process
1.4 Types of web analytics
1.5 Web analytics technical requirements
1.6 Web analytics 2.0 framework

Unit-2 Qualitative Analysis

2.1 Heuristic evaluations:
2.1.1Conducting a heuristic evaluation
2.1.2. Benefits of heuristic evaluations
2.2 Site Visits:
2.2.1. Conducting a site visit,
2.2.2. Benefits of site visits
2.3 Surveys:
2.3.1. Website surveys
2.3.2. Post-visit surveys
2.3.3. creating and running a survey
2.3.4. Benefits of surveys.

Unit-3 Web Metrics

3.1 Key metrics
3.2 Dashboard
3.2.1. Implementation
3.2.2. metrics
3.2.3. Types of metrics
3.3 Conversion
3.3.1. goals,
3.3.2. funnels
3.4 Data sources
3.4.1. server log
3.4.2. visitors data
3.4.3. search engine statistics and conversion funnels
3.5 Data segmentation
3.6 Analysis
3.7 Emerging analytics
3.7.1. e commerce
3.7.2. mobile analytics
3.7.3. A/B testing
3.8 Social Media Analytics
3.8.1. Sentimental Analysis

3.8.2. Text Analysis
3.9 Annotation and Reporting
3.9.1. Automated
3.9.2. Actionable

Unit-4 Web Analytics

4.1 Introduction to analytic 2.0
4.2 Competitive intelligence analysis
4.3 CI data sources:
4.3.1. Toolbar data
4.3.2. Panel data
4.3.3. ISP data
4.3.4. Search engine data
4.3.5. Hybrid data
4.4 Website traffic analysis:
4.4.1. Comparing long term traffic trends
4.4.2 Analyzing competitive site overlap and opportunities.

Unit-5 Google Analytics:

5.1 Audience analysis
5.2 Acquisition analysis
5.3 Behaviour analysis
5.4 Conversion analysis
5.5 Google website optimizer
5.6 Implementation technology
5.7 Privacy issues

References:

1) Clifton B., Advanced Web Metrics with Google Analytics, Wiley Publishing, Inc.2nd ed.
2) Kaushik A., Web Analytics 2.0, The Art of Online Accountability and Science of Customer Centricity, Wiley Publishing, Inc. 1st ed.
3) Kaushik A., Web Analytics: An Hour a Day, 1st ed.
4) Sterne J., Web Metrics: Proven methods for measuring web site success, John Wiley and Sons

Course Code: **CS LAB-V** **LAB on Web Application Development Technology** *Total Marks:* **100**

Course Objectives:

i. Students will understand the working of Internet, Types of Web Sites/applications, basics of Web hosting and working of IIS web server.
ii. Students will get practical hands-on experience on Microsoft ASP.NET Web Application Development Technology and required Programming Language (C#.Net/VB.NET)
iii. Basic hands on the C#.Net/VB.NET programming language.
iv. Students will practically understand actual working of the theoretical concepts.
v. Students

vi. Students will undertake Project Work and its Demonstration in Viva-voce.

1. Demonstrate followings in IIS:
   a. Creation of Virtual Directory, Home directory, Home page, hosting of website
2. Demonstrate Page Life Cycle of ASP.NET. Use important page events for your demonstration.
3. Write VB.Net/C# console applications to demonstrate: OO concepts: polymorphism, encapsulation, inheritance, interface inheritance, abstract classes/methods, overloading, overriding, collection classes, properties
4. Demonstrate concept of postback and viewstate using web form server controls of ASP.NET
5. Demonstrate various Web form server controls using sample data entry screen form for registering for a service on website. Also use validation controls to validate input data.
6. Demonstrate DropDown List box, CheckButtonList, RadioButtonList controls.
7. Demonstrate Databinding using Hashtable, ArraryList, DataTable data sources.
8. Demonstrate Repeater control with the help of various templates.
9. Demonstrate paging, sorting, filtering of data in asp:DataGrid/DataGridView.
10. Demonstrate editing process in DataGrid and DataList controls. Make use of necessary templates for proper visual appearance.
11. Demonstrate State Management features of ASP.NET using sample shopping cart application.
12. Create sample website for demonstrating use of Profiles/Themes using skin files.
13. Demonstrate Master Pages and website navigation controls(sitemap path, treeview, menu) using SiteMap file.
14. Demonstrate Properties of website navigation controls.
15. Demonstrate Authorization/Authentication using Login controls and Roles/Membership/AccessRules
16. Demonstrate creation of simple/complex DataReader/DataSet Objects.
17. Demosntrate editing in DataTable objects.
18. Demonstrate Web Service hosting, access in ASP.NET

Course Outcome:

i. Students will get hands-on experience on basic concepts in web applications development using ASP.NET technology.
ii. Students can develop or undertake professional looking real life web sites using ASP.Net technology.
iii. It will help students to grasp other Web Application Development technologies/platforms easily through learn-by-comparison approach so that the learning curve will be smooth and faster.

Course Code: **CS LAB-VI** **LAB on Digital Image Processing** *Total Marks:* **100**

Course Objectives:

1. The student will gain a deeper knowledge about a chosen field of computer graphics and image processing while working on one of the more complex projects solved in the Laboratory.
2. To implement line, circle and ellipse drawing algorithms and 2 and 3-dimensional geometric transformations using C++.
3. To be able to design and develop the programs for viewing and clipping on graphical objects.
4. To introduce MATLAB to implement the complex algorithms of Digital Image Processing.
5. Provide hands-on experience to process digital images and expose students to MATLAB Image Processing Toolbox for Digital Image Enhancement, Restoration, Segmentation, Color Image Processing, and Morphological Image Processing.

1. Introduction to Image Processing Toolbox
2. Read an 8 bit image and then apply different image enhancement techniques:
    - Brightness improvement
    - Brightness reduction
    - Thresholding
    - Negative of an image
    - Log transformation
    - Power Law transformation.
3. Implement different interpolation techniques using MATLAB/ SciLab
4. Read an image, plot its histogram then do histogram equalization. Comment about the result.
5. Read an image and apply
    - Implement Gray level slicing (intensity level slicing) in to read cameraman image.
    - Read an 8 bit image and to see the effect of each bit on the image.
    - Read an image and to extract 8 different planes i.e. 'bit plane slicing."
6. Implement various Smoothing spatial filter.
7. Read an image and apply
    - Gaussian 3x3 mask for burring
    - High pass filter mask with different masks
    - Laplacian operator with centre value positive and negative
    - High boost filtering.
8. Write a program to implement various low pass filters and high pass filter in frequency domain.
9. Write a program for erosion and dilation, opening & closing using inbuilt and without inbuilt function.
10. Implement and study the effect of Different Mask (Sobel, Prewitt and Roberts)
11. Implement various noise models and their Histogram
12. Implement inverse filter and wiener filter over image and comment on them

Course Outcome:

1. Developed scientific and strategic approach to solve complex problems Computer in the domain of Computer Graphics and Digital Image Processing using C++ and MATLAB respectively.
2. Implemented various algorithms for scan conversion and filling of basic primitives objects and their comparative analysis and applied 2-D and 3-D geometric transformations, viewing and clipping on graphical objects.
3. Exposed students to MATLAB and Image Processing Toolbox.
4. Used various tools in MATLAB to implemented image transformation, image enhancement in spatial and frequency domain.
5. Developed the programs on various digital image processing techniques.

Semester-IV

Course Code: **CS-401** **Natural Language Processing** *Clock Hours:* **60**
Total Marks: **100**

Course Objectives:

i. The prime objective of this course is to introduce the students to the field of Language Computing and its applications ranging from classical to modern context.
ii. Course also aims to provide understanding of various NLP tasks and NLP abstractions such as Morphological analysis, POS tagging, concept of syntactic parsing, semantic analysis etc.
iii. Course provide knowledge of different approaches/algorithms for carrying out NLP tasks.
iv. Course also discusses concepts of Language grammar and grammar representation in Computational Linguistics.

Unit-I **[08]** Max Marks:**12**

Introduction to NLP, brief history, NLP applications: Speech to Text(STT), Text to Speech(TTS), Story Understanding, NL Generation, QA system, Machine Translation, Text Summarization, Text classification, Sentiment Analysis, Grammar/Spell Checkers etc., challenges/Open Problems, NLP abstraction levels, Natural Language (NL) Characteristics and NL computing approaches/techniques and steps, NL tasks: Segmentation, Chunking, tagging, NER, Parsing, Word Sense Disambiguation, NL Generation, **Web 2.0 Applications** : Sentiment Analysis; Text Entailment; Cross Lingual Information Retrieval (CLIR).

Unit-II **[12]** Max Marks:**16**

Text Processing Challenges, Overview of Language Scripts and their representation on Machines using Character Sets, Language, Corpus and Application Dependence issues, Segmentation: word level (Tokenization), Sentence level. Regular Expression and Automata Morphology, Types, Survey of English and Indian Languages Morphology, Morphological parsing FSA and FST, Porter stemmer, Rule based, and Paradigm based Morphology, Human Morphological Processing, Machine Learning approaches

Unit-III **[12]** Max Marks:**18**

Word Classes ad Part-of-Speech tagging (POS), survey of POS tagsets, Rule based approaches (ENGTOWL), Stochastic approaches(Probabilistic, N-gram and HMM), TBL morphology, unknown word handling, evaluation metrics: Precision/Recall/F-measure, error analysis

Unit-IV **[15]** Max Marks:**22**

NL parsing basics, approaches: Top Down, Bottom Up, Overview of Grammar Formalisms: constituency and dependency school, Grammar notations CFG, LFG, PCFG, LTAG, Feature-Unification, overview of English CFG, Indian Language Parsing in Paninian Karaka Theory, CFG parsing using Earley's and CYK algorithms, Probabilistic parsing

Unit-V **[15]** Max Marks:**22**

Concepts and issues in NL, Theories and approaches for Semantic Analysis, Meaning Representation, word similarity, Lexical Semantics, word senses and relationships, WordNet (English and IndoWordnet), Word Sense Disambiguation: Lesk Algorithm Walker's algorithm, Coreferences Resolution: Anaphora, Cataphora

References:

1. Indurkhya, N., & Damerau, F. J. (Eds.). (2010). *Handbook of Natural Language Processing, 2nd Edition.* New York: CRC Press Taylor and Francis Group, Boca Raton London, New York. ISBN-10: 1420085921, ISBN-13: 978-1420085921
2. Martin, J. H., & Jurafsky, D.(2013), *Speech and Language Processing,* Pearson Education India; 2 edition, ISBN-10: 9332518416, ISBN-13: 978-9332518414
3. Manning, Christopher and Heinrich, Schutze(1999), Foundations of Statistical Natural Language Processing", MIT Press, ISBN-10: 0262133601, ISBN-13: 978-0262133609.
4. Akshar Bharati, Chaitanya, V., Kulkarni, A., & Sangal, R. (July 1997). *Machine translation in Stages* (Vol. 10 no. 3). Mumbai: NCST, Mumbai.
5. Bharati, A., Chaitanya, V., & Sangal, R. (1995). *Natural Language Processing: A Paninian Perspective,* New Delhi: Prentice Hall of India, ISBN 10: 8120309219, ISBN 13: 9788120309210.
6. Steven Bird, Edward Loper (2016),Natural Language Processing With Python, Ed. 2, O'Reilly Media,ISBN 1491913428, 9781491913420

Auxiliary Resources:

a. Web Links
   1. https://see.stanford.edu/Course/CS224N
   2. https://web.stanford.edu/~jurafsky/NLPCourseraSlides.html

b. Video Links
   1. http://www.nptelvideos.in/2012/11/natural-language-processing.html
   2. https://www.youtube.com/playlist?list=PL6397E4B26D00A269

Course Outcome:

i. Students will get idea about know-hows, issues and challenge in Natural Language Processing and NLP applications and their relevance in the classical and modern context.
ii. Student will get understanding of Computational techniques and approaches for solving NLP problems and develop modules for NLP tasks and tools such as Morph Analyzer, POS tagger, Chunker, Parser, WSD tool etc.
iii. Students will also be introduced to various grammar formalisms, which they can apply in different fields of study.
iv. Students can take up project work or work in R&D firms working in NLP and its allied areas

Course Code: **CS-402** **Data Warehousing and Data Mining (DWDM)** *Clock Hours:* **60** *Total Marks:* **100**

Course Objectives:

1. To comprehend evolution of decision making, operational vs decision support system and the concept of data warehouse.
2. To understand transactional and analytical processing
3. Significance of analytical processing and importance of data pre-processing.
4. Learn various data pre-processing techniques, methods.
5. Understand and apply various techniques/algorithms to obtain meaningful patterns from data (Association mining, classification and clustering)

Unit-I **[08]** Max Marks:**12**

Introduction to Data Warehousing: Evolution of decision system, Failure of past decision support system, Operational v/s decision support systems, Data warehousing lifecycle, Architecture, Building blocks, Components of DW, Data Marts and Metadata

Unit-II **[08]** Max Marks:**12**

Data Pre-processing: need for pre-processing of the data, Descriptive data summarization, Data cleaning, Data Integration and transformation, Data reduction, Data discretization and concept hierarchy generation.

Unit-III **[10]** Max Marks:**15**

OLAP Analytical Processing: OLAP in Data warehouse, Demand for online analytical processing, need for multidimensional analysis, limitations of other analysis methods, OLAP definitions and rules, OLAP characteristics, major features and functions, OLAP models-ROLAP, MOLAP, HOLAP, Differentiation, Data cubes and operations on cubes.

Unit-IV **[06]** Max Marks:**09**

Data Mining: Introduction-Data Mining functionalities, Classification of Data Mining Systems, basic Data Mining task, Data Mining Issues

Unit-V **[08]** Max Marks:**12**

Association Rule Mining: Efficient and Scalable Frequent Item set Mining Methods – Mining Various Kinds of Association Rules – Association Mining to Correlation Analysis – Constraint-Based Association Mining.

Unit-VI **[10]** Max Marks:**15**

Classification and Prediction : Issues Regarding Classification and Prediction – Classification by Decision Tree Introduction – Bayesian Classification – Rule Based Classification – Classification by Back propagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods – Prediction – Accuracy and Error Measures – Evaluating the Accuracy of a Classifier or Predictor – Ensemble Methods – Model Section.

Unit-VII **[10]** Max Marks:**15**

Cluster Analysis : Types of Data in Cluster Analysis – A Categorization of Major Clustering Methods – Partitioning Methods – Hierarchical methods – Density-Based Methods – Grid-Based Methods – Model-Based Clustering Methods – Clustering High-Dimensional Data – Constraint-Based Cluster Analysis – Outlier Analysis

References:

1. Jiawei Han and MichelineKamber "Data Mining Concepts and Techniques" Second Edition, Elsevier, Reprinted 2008.
2. M. H. Dunham. Data Mining: Introductory and Advanced Topics. Pearson Education. 2001.
3. H. Witten and E. Frank. Data Mining: Practical Machine Learning Tools and Techniques. Morgan Kaufmann. 2000.
4. D. Hand, H. Mannila and P. Smyth. Principles of Data Mining. Prentice-Hall. 2001
5. Tan Steinbach, Vipin Kumar, Introduction to Data mining, Pearson Eduction
6. Jarke Vassiliou, Fundamentals of Data Warehouses, IInd Edition, Springer
7. Anahory Murray, Data Warehousing in Real World, Pearson Education
8. Paulraj Ponniah , Data Warehousing.

Course Outcomes:

After this course students shall be able to –

1. Explain organization of data warehousing and data marts.
2. Differentiate between OLTAP and OLAP
3. Apply data pre-processing techniques
4. Write basic algorithms for extracting patterns from data (association mining, classification and clustering)
5. Solve problems related with various aspects of data mining.

*Course Code:***CS-403(A)** **Optimization Algorithms** *Clock Hours:***60**
Total Marks: **90**

Course Objectives:

1. To introduce with the branch of OR and its role in decision making.
2. To list out various types of applications of operations research (OR).
3. To explain Linear Programming Problem (LPP) and practice with techniques to solve various types of LPP (transportation problem, assignment problems, special cases of duality, Integer programming problems)
4. Describe the significance, concept of game theory and algorithms to solve game theory problems.
5. Introduce critical path analysis using network problems.

Unit-I **[05]** Max Marks:**08**

Overview of operations Research: Introduction, Applications, Role of OR in Decision Making, Feasible and optimal Solutions

Unit-II **[15]** Max Marks:**20**

Linear Programming: Special Types: Transportation Problem as LPP, Initial Basic Feasible Solution, North West corner Rule, Lowest Cost Method, Vogel's Approximation Method, MoDi method for optimization, Degeneracy.
Assignment problem, Hungarian Method, Special cases of assignment problem

Unit-III **[18]** Max Marks:**24**

Linear Programming Problems: Introduction, Formulation of Mathematical model of LPP, Standard form of linear programming problems, Solving LPP using Graphical method, Infeasible LPP, Unbounded LPP, Basic feasible solutions, Simplex method for solving LPP, augmentation using Slack and artificial variables, Big M and two phase method, Degeneracy, alternative optima, Interpretation of final Simplex table, Duality: concept, applications and example.

Unit-IV **[06]** Max Marks:**08**

Integer Programming: Introduction, How it differs from LPP, Pure and mixed integer programming problems, Binary IPP, Techniques to solve IPP.

Unit-V **[08]** Max Marks:**15**

Network Models: Definitions, Applications, Representation of a problem in network form, Critical Path Analysis, Resource planning, Giantt Chart.

Unit-VI **[08]** Max Marks:**15**

Game Theory : Concept, Two party zero sum game, Pay off matrix, Pure and mixed strategy games, Rule of Dominance, Subgame method, Brown's Algorithm

References:

1. Hamdy Taha (2010). Operations Research: An Introduction. Pearson Education. ISBN: 978-0132555937
2. L C Jhamb. Quantitative Techniques For Managerial Decisions Vol I, Vol II. Everest Publishing House, ISBN: 8186314628
3. PanneerSelvan R (2006). Operations Research. Prentice Hall of India. ISBN: 978-8120329287

Course Outcome:

After completion of this course students shall be able to-

1. write about OR and decision making.
2. Differentiate between feasible and optimal solution
3. Apply solving techniques to all types of LPP.
4. Apply solving techniques to network problems and game theory problems as well.

Course Code: **CS-403(B)** **Machine Learning** *Clock Hours:* **60**
Total Marks: **100**

Course Objectives:

- To introduce students to the basic concepts and techniques of Machine Learning.
- To have a thorough understanding of the Supervised and Unsupervised learning techniques
- To understand regression, classification and clustering
- To study the various probability based learning techniques
- To understand graphical models of machine learning algorithms

Unit-I **[08]** Max Marks:**10**
Introduction: Basic definitions, types of learning, hypothesis space and inductive bias, evaluation, cross-validation

Unit-II **[08]** Max Marks:**15**
Linear regression, Decision trees, overfitting

Unit-III **[09]** Max Marks:**15**
Instance based learning, Feature reduction, Collaborative filtering based recommendation

Unit-IV **[08]** Max Marks:**15**
Probability and Bayes learning

Unit-V **[09]** Max Marks:**15**
Logistic Regression, Support Vector Machine, Kernel function and Kernel SVM

Unit-VI **[09]** Max Marks:**15**
Neural network: Perceptron, multilayer network, backpropagation, introduction to deep neural network

Unit-VII **[09]** Max Marks**:15**
Clustering: k-means, adaptive hierarchical clustering, Gaussian mixture model

References:

1. Tom Mitchell (1997). Machine Learning. First Edition, McGraw- Hill, ISBN 10: 0070428077 ISBN 13: 9780070428072
2. Ethem Alpaydin (2009). Introduction to Machine Learning, Edition 2, The MIT Press. ISBN 978-0-262-01243-0

Course Code: **CS-403(C)** **Advance Network Programming** *Clock Hours:* **60**
Total Marks: **100**

Course Objectives:

- To introduce students to the basic concepts and techniques of Machine Learning.
- To have a thorough understanding of the Supervised and Unsupervised learning techniques
- To understand regression, classification and clustering
- To study the various probability based learning techniques
- To understand graphical models of machine learning algorithms

Unit-1. Network fundamentals

Project model IEEE 802, Network topologies Network infrastructure, Network Protocols UDP, TCP, Introduction to TCP/IP Architecture of the TCP/IP model.

Unit-2. Client server Programming and Application

The client server model and software design, the socket interface, concurrent processing in clientserver software, program interface to protocol algorithms & issues in client Software design, example client software, algorithms & issues in server software design Iterative connectionless server, iterative connection oriented server, single process Concurrent server concurrent connection oriented server, multiprotocol server , multi-service server concurrency in client external data representation remote procedure call concept,RPCgenconcept.

Unit-3. Network Interface Layer

Overview of network interface layer media access control standards, mapping the Physical address to the IP address. Internet Layer: Purpose of the internet layer, classes of lpv4 addresses, basics of routing, IP datagram ICMP, IGMP Transport Layer Types of data transfer connection-less data transfer, connection-oriented data transfer

Unit-4. Mobile Ad-Hoc Network

Overview of Wireless Ad-Hoc Network- MANET and WSN, Routing in Ad-Hoc Network, Routing Protocols for Ad-Hoc Wireless Network (Proactive, Reactive and Hybrid) Clustering Protocol

References:

1) Douglas E. Corner, David Stevens, "Intranetworking with TCP/IP volume III Client Server Programming and Applications", 2nd Edition, 1994, ISBN: 8178084880, Prentice Hallof India.
2) Douglas E. Corner,David Stevens, "Internetworking with TCP/IP volume I, Principles protocols & Architecture", 3rd Edition, 2015, ISBN: 8131706230, PHI.
3) Douglas E. Corner, David Stevens,"Internetworking with TCP/IP volume II Design Implementation and internals", 3rd Edition, 2003, ISBN: 8120309278, Prentice Hall India Learning Private Limited.
4) TCP/IP Bible, 1st Ed., Scringer LaSalle, Parihar Gupta, Hungry Minds IDG Looks India (P) Ltd.
5) SudipMisra, Isaac Woungang, "Guide to Ad-hoc Network", 2009, ISBN: 9781848003286, Springer.

Course Code: **CS LAB-VII** **LAB Data Warehousing and Data Mining(DWDM)** *Total Marks:* **100**

Course Objectives:

- To create awareness of how enterprise can organize and analyze large amounts of data by creating a Data Warehouse.

DWDM Assignments:

WEKA : Data processing in WEKA

Classification algorithms: decision tree classification, naive Bayesian classification, a brief introduction to other classifiers

Clustering algorithms: methods to cluster continuous data, methods to cluster categorical data

Association Mining: Apriori algorithm

Course Outcomes:

- Organize strategic data in an enterprise and build a data Warehouse.

Course Code: **CS-401** **Mini Project Guidelines** *Total Marks:* **200**

Course Objectives:

- To provide comprehensive learning platform to students where they can enhance their employ ability skills and become job ready along with real corporate exposure.
- To enhance students' knowledge in one technology.
- To increase self-confidence of students and helps in finding their own proficiency.
- To cultivate student's leadership ability and responsibility to perform or execute the given task.
- To provide learners hands on practice within a real job situation.

Six credits shall be awarded to the Mini Project course, which will commence in the IVth Semester and the final work and report will be completed at the end of IVth Semester of M. Sc. (Computer Science). The student is expected to work on software development project. The project work should have coding part. Student will have to submit the bound project report in university prescribed format at the end of the semester. Student will have to appear for Project Viva-voce and the marks and the credits will be allotted at the end of IVth semester of M. Sc. (Computer Science).

Course Outcomes:

- Capability to acquire and apply fundamental principles of Computers Science.
- Become master in one's specialized technology.
- Become updated with all the latest changes in technological world.
- Ability to communicate efficiently.
- Knack to be a multi-skilled Computer Science professional with good technical knowledge, management, leadership and entrepreneurship skills.

- Ability to identify, formulate and model problems and find engineering solution based on a systems approach.
- Capability and enthusiasm for self-improvement through continuous professional development and life-long learning

Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon

Bachelor of Computer Application

BCA

(At affiliated Institutes w.e.f A.Y. 2022-23)

w.e.f. Academic Year 2022-23

Summary of distribution of Credits under CBCS scheme for

BCA

Sr No	Type of Course	Sem I	Sem II	Sem III	Sem IV	Sem V	Sem VI
1	Core	16	16	12	12		04
2	Discipline Specific Course	08	08	16	16	16	16
3	Skill Enhancement Course	04	04	-		12	04
4	Project	-	-	-	-		04
		28	28	28	28	28	28

Course Credit Scheme

Semester	Core Courses			Discipline Specific Courses			Skill Enhancement			Projects			Total Credits
	No of Courses	Credits	Total Credits	No of Courses	Credits	Total Credits	No of Courses	Credits	Total Credits	No of Courses	Credits	Total Credits	
I	2	8+8	16	1	4+4	8	1	4	4	-	-	-	28
II	2	8+8	16	1	4+4	8	1	4	4	-	-	-	28
III	2	8+4	12	2	8+8	16	-	-	-	-	-	-	28
IV	2	8+4	12	2	8+8	16	-	-		-	-	-	28
V	-	-	-	2	8+8	16	2	8+4	12	-	-	-	28
VI	1	4	4	2	8+8	16	1	4	4	1	4	4	28
			60			80			24			4	168

Structure of Curriculum

		First Year				Second Year				Third Year				Total Credit Value
		Sem I		Sem II		Sem III		SemIV		Sem V		Sem VI		
		Cr	Co	Cr	Co	Cr	Co	Cr	Co	Cr	Co	Cr	Co	
		Core Courses												
A	Theory	8	2	8	2	8	2	8	2	-	-	4	1	36
	Practical	8	2	8	2	4	1	4	1	-	-	-	-	24
		Discipline Specific Courses												
B	Theory	4	1	4	1	8	2	8	2	8	2	8	2	40
	Practical	4	1	4	1	8	2	8	2	8	2	8	2	40
		Skill Enhanced Courses												
C	Theory	4	1	4	1	-	-	-	-	8	2	4	1	20
	Practical	-	-	-	-	-	-	-	-	4	1	-	-	4
		Project												
D	Project	-	-	-	-	-	-	-	-	-	-	4	1	4
Total Credit Value		28	7	28	7	28	7	28	7	28	7	28	7	168

Semester wise course structure of BCA

Sem I

Total Credits=28 [Theory =16, Practical =12]

Course Code	Course Type	Subject Name	Contact Hour/Week			Distribution of Marks for Examinations					Credits
			T	P	Total	Internal		External		Total	
						T	P	T	P		
BCA 101	SEC	Fundamentals of Accounting	04	-	04	40		60		100	4
BCA 102	Core	Fundamental of Computer	04	-	04	40		60		100	4
BCA 103	Core	Programming in C – I	04	-	04	40		60		100	4
BCA 104	DSC	Web Design – I	04	-	04	40		60		100	4
BCA 105	Core	Lab on Computer Fundamental	-	04	04		40		60	100	4
BCA 106	Core	Lab on C Programming – I	-	04	04		40		60	100	4
BCA 107	DSC	Lab on Web Design – I	-	04	04		40		60	100	4

Sem II

Total Credits=28 [Theory =16, Practical =12]

Course Code	Course Type	Subject Name	Contact Hour/Week			Distribution of Marks for Examinations					Credits
			T	P	Total	Internal		External		Total	
						T	P	T	P		
BCA 201	SEC	Professional Communication Skill	04	-	04	40	-	60	-	100	4
BCA 202	Core	Database Management System	04	-	04	40	-	60	-	100	4
BCA 203	Core	Programming in C – II	04	-	04	40	-	60	-	100	4
BCA 204	DSC	Web Design - II	04	-	04	40	-	60	-	100	4
BCA 205	Core	Lab on DBMS	-	04	04	-	40	-	60	100	4
BCA 206	Core	Lab on C Programming - II	-	04	04	-	40	-	60	100	4
BCA 207	DSC	Lab on Web Design – II	-	04	04	-	40	-	60	100	4

Sem III

Total Credits=28 [Theory =16, Practical =12]

Course Code	Course Type	Subject Name	Contact Hour/Week			Distribution of Marks for Examinations					Credits
			T	P	Total	Internal		External		Total	
						T	P	T	P		
BCA 301	Core	Fundamental Mathematics and Statistics	04	-	04	40	-	60	-	100	4
BCA 302	Core	Operating System	04	-	04	40	-	60	-	100	4
BCA 303	DSC	Programming in C++	04	-	04	40	-	60	-	100	4
BCA 304	DSC	Elective I A)Web Development Technology – I B)Data Analytics – I C)Python Programming	04	-	04	40	-	60	-	100	4
BCA 305	Core	Lab on Operating System	-	04	04	-	40	-	60	100	4
BCA 306	DSC	Lab on C ++ Programming	-	04	04	-	40	-	60	100	4
BCA 307	DSC	Lab on Elective	-	04	04	-	40	-	60	100	4

Sem IV

Total Credits=28 [Theory =16, Practical =12]

Course Code	Course Type	Subject Name	Contact Hour/Week			Distribution of Marks for Examinations					Credits
			T	P	Total	Internal		External		Total	
						T	P	T	P		
BCA 401	Core	Software Engineering	04	-	04	40	-	60	-	100	4
BCA 402	Core	Data Structures	04	-	04	40	-	60	-	100	4
BCA 403	DSC	Java Programming	04	-	04	40	-	60	-	100	4
BCA 404	DSC	Elective II A)Web Development Technology - II B)Data Analytics - II C)Artificial Intelligent	04	-	04	40	-	60	-	100	4
BCA 305	Core	Lab on Data Structure	-	04	04	-	40	-	60	100	4
BCA 306	DSC	Lab on Java Programming	-	04	04	-	40	-	60	100	4
BCA 307	DSC	Lab on Elective	-	04	04	-	40	-	60	100	4

Sem V

Total Credits=28 [Theory =16, Practical =12]

Course Code	Course Type	Subject Name	Contact Hour/Week			Distribution of Marks for Examinations					Credits
						Internal		External		Total	
			T	P	Total	T	P	T	P		
BCA 501	SEC	Employability Skill	04	-	04	40	-	60	-	100	4
BCA 502	SEC	E-Commerce and M-Commerce	04	-	04	40	-	60	-	100	4
BCA 503	DSC	Cloud Computing Application	04	-	04	40	-	60	-	100	4
BCA 504	DSC	Elective III A) Web Development Technology – III B) Data Analytics – III C) Machine Learning	04	-	04	40	-	60	-	100	4
BCA 505	SEC	Lab on E-Commerce		04	04	-	40	-	60	100	4
BCA 506	DSC	Lab on Cloud Computing		04	04	-	40	-	60	100	4
BCA 507	DSC	Lab based on Elective I		04	04	-	40	-	60	100	4

Sem VI

Total Credits=28 [Theory =16, Practical =12]

Course Code	Course Type	Subject Name	Contact Hour/Week			Distribution of Marks for Examinations					Credits
						Internal		External		Total	
			T	P	Total	T	P	T	P		
BCA 601	SEC	Entrepreneurship Development	04	-	04	40	-	60	-	100	4
BCA 602	Core	Cyber Security	04	-	04	40	-	60	-	100	4
BCA 603	DSC	Android Application Development	04	-	04	40	-	60	-	100	4
BCA 604	DSC	Elective IV A) Web Development Technology – IV B) Data Analytics - IV C) Data Mining	04	-	04	40	-	60	-	100	4
BCA 605	Project	Project Development		04	04	-	40	-	60	100	4
BCA 606	DSC	Lab on Android Application Development		04	04	-	40	-	60	100	4
BCA 607	DSC	Lab based on Elective		04	04	-	40	-	60	100	4

Program at a glance

Name of the Program	:	Bachelor of Computer Application
Apex body Approval	:	DTE, KBC NMU
Faculty	:	Science and Technology
Duration of the program	:	3 years (Comprising 6 Semesters)
Medium of the instruction and examination	:	English
Examination Pattern	:	60 % External Assessment + 40 % Internal Assessment
Passing Standards	:	Separate passing for Internal as well as External Assessment (min 40%)
Evaluation mode	:	CGPA
Total Credits of the program	:	168

Program Specific Objectives (PSO)

Objectives:

- BCA Program strives to create outstanding computer professionals with strong ethical and human values.
- This programme aims to prepare young minds for the challenging opportunities in the IT industry.
- The BCA Program aims at inculcating essential skills like Communication, Entrepreneurship Development & employability Skills as demanded by the global software industry through interactive learning process.
- The objective of the course is to develop skilled manpower in the various areas of software industry and Information Technology.

Program Outcome

PO1: At the end of the program students understand, analyze and develop computer programs in the areas like Web Design, Database manipulation, Windows & Mobile Application.

PO2: At the end of the program students understand, object-oriented programming features through various programming languages.

PO3: At the end of the program students are able to create dynamic, Interactive webpage's using various web technologies.

PO4: At the end of the program students understand the use of structured query language and its syntax, transactions, database recovery and techniques for query optimization.

PO5: At the end of the program students are able to work in the IT sector as system engineer, software tester, junior programmer, web developer, system administrator, software developer etc.

PO6: If chosen particular elective at the end of the program students are able to analyze very large data sets in the context of real world problems using various data analytical tools.

PO7: If chosen particular elective it will help students to develop in depth understanding of the key technologies in AI, data mining & machine learning.

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Bachelor of Computer Application (BCA)
(W.E.F. June 2022)

Course Code	Sem. – I	Course Code	Sem. – II
BCA 101	Fundamentals of Accounting	BCA 201	Professional Communication Skill
BCA 102	Fundamental of Computer	BCA 202	Database Management System
BCA 103	Programming in C – I	BCA 203	Programming in C – II
BCA 104	Web Design – I	BCA 204	Web Design - II
BCA 105	Lab on Computer Fundamental	BCA 205	Lab on DBMS
BCA 106	Lab on C Programming – I	BCA 206	Lab on C Programming - II
BCA 107	Lab on Web Design – I	BCA 207	Lab on Web Design – II
Course Code	**Sem. – III**	**Course Code**	**Sem. – IV**
BCA 301	Fundamental Mathematics and Statistics	BCA 401	Software Engineering
BCA 302	Operating System	BCA 402	Data Structures
BCA 303	Programming in C++	BCA 403	Java Programming
BCA 304	A) Web Development Technology – I	BCA 404	A) Web Development Technology - II
	B) Data Analytics – I		B) Data Analytics - I
	C) Python Programming		C) Artificial Intelligent
BCA 305	Lab on Operating System	BCA 405	Lab on Data Structure
BCA 306	Lab on C ++ Programming	BCA 406	Lab on Java Programming
BCA 307	A) Lab on Web Development Technology – I	BCA 407	A) Lab on Web Development Technology - II
	B) Lab on Data Analytics – I		B) Lab on Data Analytics - I
	C) Lab on Python Programming		C) Lab on Artificial Intelligent
Course Code	**Sem. – V**	**Course Code**	**Sem. – VI**
BCA 501	Employability Skill	BCA 601	Entrepreneurship Development
BCA 502	E-Commerce and M-Commerce	BCA 602	Cyber Security
BCA 503	Cloud Computing Application	BCA 603	Android Application Development
BCA 504	A) Web Development Technology – III	BCA 604	A) Web Development Technology – IV
	B) Data Analytics – III		B) Data Analytics - IV
	C) Machine Learning		C) Data Mining
BCA 505	Lab on E-Commerce	BCA 605	Project
BCA 506	Lab on Cloud Computing	BCA 606	Lab on Android Application Development
BCA 507	A) Lab on Web Development Technology – III	BCA 607	A) Lab on Web Development Technology – IV
	B) Lab on Data Analytics - III		B) Lab on Data Analytics - IV
	C) Lab on Machine Learning Using Python		C)Lab on Data Mining

Semester – I

Kavayitri Bahinabai Chaudhari
North Maharashtra University, Jalgaon
Faculty of Science and Technology
BACHELOR OF COMPUTER APPLICATIONS (BCA)
BCA 101 - Fundamentals of Accounting
W.E.F. 2022-23
[Total Marks: External60 + Internal40 =100 Marks]

Semester	**I**	CIE Marks :	**40**
Course Code	**BCA 101**	SEE Marks :	**60**
Contact Hours (L.T.P)	**4:0:0**	Exam Hours :	**02**

Course Outcomes – At the end of the course, student will be able to:

1. To understand fundamental concepts of financial accounting.
2. To understand the basics of cost accounting.
3. To maintain and record financial transactions in books of accounts.
4. To prepare final accounts of sole proprietary business.
5. To prepare Cost Sheet and record the transactions of materials.

Unit 1 – Introduction to Accounting :(theory only) 06L 15 M

1.1 Meaning and definition of Financial Accounting.
1.2 Objectives and scope of Financial Accounting,
1.3 Meaning and use of Book Keeping
1.4 Accounting v/s Book Keeping
1.5 Advantages and Limitations of Financial Accounting.

Unit 2 - Basics of Accounting (theory only) 08L 15M

2.1 Types of Accounting
2.2 Golden Rules of Accounting.
2.3 Double entry system in Accounting
2.4Terms used in accounting : Debtors, Creditors, Bill Receivable, Bills Payable, Credit Note ,Debit Note ,Petty Cash ,Contra Entry ,Trade Discount ,Cash Discount, Suspense A/c
2.5 Users of accounting information

Unit 3 –Fundamentals of Book Keeping & Recording of transactions (Practical Problems) 12L 15 M

3.1 Concept and Format of Journal
3.2 Recording of transactions in Journal
3.3 Meaning and Format of Ledger
3.4 Posting of transactions in Ledgers
3.5 Rectification of Errors

Unit 4 – Preparation of Final Accounts of Sole Proprietorship Business (Practical Problems) 16L 15M

4.1 Meaning, Importance & Objectives of Final Accounts
4.2 Preparation of Trial Balance
4.3 Preparation of Trading A/c., Manufacturing A/c.
4.4. Preparation of Profit & Loss A/c.
4.5 Preparation of Balance Sheet- Adjustments- Outstanding Expenses, Prepaid Expenses, Accrued Incomes, Depreciation

Unit 5 –Fundamentals of Cost Accounting (Theory and Problem) 08L 15 M
5.1 Cost, Expense, Loss : Meaning 5.2 Costing, Cost Accounting 5.3 Types of Costs on the basis of various criteria 5.4 Advantages and Limitations of Cost Accounting 5.5 Difference between Financial Accounting and Cost Accounting 5.6 Cost Sheet: Importance and objectives of Cost Sheet 5.7 Format of Cost Sheet & Preparation of Cost Sheet**(Problem)**
Unit 6 – Chapter 6 Material Control (Theory and Problem) 10L 15M
6.1 Meaning & Importance of Materials accounting and control 6.2 Different Level of Materials & their Calculations :Economic Order Quantity (EOQ), Maximum Level, Minimum Level, Average Level, Reorder Level, Danger Level **(Problems)** 6.3 Problems on Preparation of Store ledger under FIFO, LIFO, Simple Average Method **(Problems)**
Exam Pattern -
Reference Books -
1. Introduction to Accountancy by T.S. Gerwal, S.C. Gupta- S.Chand Publication- 8'th Edition, (ISBN-108121905699) 2. Financial Accounting by Bhushan Kumar Goyal, H.N.Tiwari- International Book House Pvt. Ltd.- First Edition (ISBN-9789381335420) 3. Fundamentals of Accounting by Dr. S.N. Maheshwari, Dr.S.K. Maheshwari- Vikas Publishing House (ISBN-139788180544491) 4. Accounting for Management by T. Vijaykumar, - (2010) – Tata McGraw Hill (ISBN-139780070090170)

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North Maharashtra University, Jalgaon
Faculty of Science and Technology
BACHELOR OF COMPUTER APPLICATIONS (BCA)
BCA 102–Fundamentals of Computer
W.E.F. 2022-23
[Total Marks: External60 + Internal40 =100 Marks]

Semester	**I**	CIE Marks :	**40**
Course Code	**BCA 102**	SEE Marks :	**60**
Contact Hours (L.T.P)	**4:0:0**	Exam Hours :	**02**

Course Outcomes – At the end of the course, student will be able to:

1. Acquire the knowledge of fundamentals of Computer and Operating System.
2. Develop problem solving skill through algorithms and flowcharts.
3. Understand the basics of computer networking and internet.

Unit 1 –Computer Fundamentals: 10L 15 M

History & generation of computer, Block diagram of computer system, Types of computers
Definition- Software, Hardware, Compiler, Interpreter, Characteristics & applications of Computer, Data Representation: Introduction to Number system: decimal, binary, octal and hexadecimal, Conversion in Number System, Character representation: ASCII

Unit 2 -Procedural Programming Paradigms and Platforms 10L 15M

Definition - Algorithm, Flowchart, Flowchart symbols, Examples for constructing algorithm and flowchart for simple programs (Minimum 5) , computer programming platforms (Hardware, software, server and cloud based)

Unit 3 –Operating System 10L 15 M

Definition, Need and Function of an operating system,
Types of operating system, Comparative study of various operating systems (DOS, Linux and Windows)

Unit 4 –Memory Management Concept 10L 15M

Types of Memory Primary– RAM, ROM, PROM, EPROM,
Secondary– Magnetic Disk, Hard Disk and CD
Definitions and Concept – Paging, Segmentation, Deadlock

Unit 5 – Networking and Internet 10L 15 M

What is Computer network? Types of Networks: LAN, MAN, WAN, Topologies: Star, Tree, Bus, Ring, Mesh, Fully Connected, Wireless Networks, Working of Internet, Use of Internet, Applications of Internet, Study of Web Browsers, Search Engines, Creating an E-mail Account, Sending & Receiving E-mail (with attachment).

Unit 6 –Office Automation 10L 15M

Basic Concepts, MS-Word- demonstration of text formatting, tables, shapes, smart-arts, charts, Spreadsheets- Functions- (Aggregate function) , Macros. Presentation Tool Design Slides (using Text, images, charts, clipart), Slide Animation, Template and theme creation

Exam Pattern -

Reference Books -

- V.RajaRaman, “Fundamentalsofcomputer”(PHIPublication)***ISBN***10:8120340116
- RogerHuntandJohnShelley, “Computerandcommonsense”(PHIPublication)***ISBN***10:0131646737
- AndrewS.Tanenbaum, “ComputerNetworks”–FourthEdition.***ISBNnumber***0130661023
- Hurwitz Judith S. and Daniel Kirsch, “Cloud Computing for Dummies”. ISBN
- GodboleAchyut and KahateAtul, “Web Technologies: TCP/IP, Web/ Java Programming, and Cloud Computing, ”, 3e Tata McGraw-Hill Education ISBN: 9332900914, 9789332900912.

Kavayitri Bahinabai Chaudhari
North Maharashtra University, Jalgaon
Faculty of Science and Technology
BACHELOR OF COMPUTER APPLICATIONS (BCA)
BCA 103 - Programming in C - I
W.E.F. 2022-23
[Total Marks: External60 + Internal40 =100 Marks]

Semester	**I**	CIE Marks :	**40**
Course Code	**BCA 103**	SEE Marks :	**60**
Contact Hours (L.T.P)	**4:0:0**	Exam Hours :	**02**

Course Outcomes – At the end of the course, student will be able to:

1. Understand the basic concepts of C Programming for problem-solving and Illustrate the C data types, syntax and constructs.
2. Illustrate C for decision making, branching and looping statements
3. Understand the concept of Array and Strings to solve different problems.

Unit 1 –PreliminaryConcepts **10L 15 M**

- Historyof 'C'Programminglanguage
- ApplicationsandFeatures
- Concept of Structured Programming
- StructureofC-program
- Compilation,ExecutionandDebuggingofC-program, Types of Errors
- Introduction to IDE, Types of IDEs: Turbo C++, Textpad, DevCPP, Code block etc

Unit 2 -Basicsof 'C'Program **10L 15M**

- C character set, Tokens :identifiers, keywords, Constants, Strings, Special Symbols and Operators
- Variables, Data types and Qualifiers, Assignment statement, Comments
- Input Output Statements (Standard and formatted)
- Introduction and features of 'C' preprocessor Directives: #define, File inclusion (#include)

Unit 3 – OperatorsandExpression10L 15 M

- Operators –Arithmetic, Relational, Logical, Assignment, Increment-Decrement, Conditional Operator, Bitwise, Special Operator(Comma, sizeof), Operator hierarchy & associativity
- Type Conversion – implicit and explicit

Unit 4 –Control Statements **10L 15M**

- If Statement, if-else Statement, nested if-else Statement, else-if ladder, Switch Statement
- Break, continue and goto statements
- Looping Concepts: While, do-while, for loop Nested loops Concept

Unit 5 – Arrays and Strings **10L 15 M**

- Definition: Array: declaration and Initialization
- Types of array(One Dimensional and Multidimensional)
- Advantages and disadvantages of array
- Applications of array
- Strings, Standard library string function: strlen(), strcpy(), strcat(), strcmp() etc.

Unit 6 - C Libraries **10L 15M**

- Introduction to C Programming Libraries: stdio.h, conio.h, stdlib.h, math.h, graphics.h, time.h,

ctype.h

- Math.h- abs (), sqrt( ), pow( ), ceil( ), floor( )
- Time.h – getdate(),clock(),time(),difftime()
- Ctype.h- islower(),isupper(), isalnum(), isdigit()
- Stdlib.h – exit(),random()

Exam Pattern -

Reference Books -

- Denis Ritchie. "C" Programming – Prentice Hall Software Series- ISBN. 10 9 8 7
- Yashwant P. Kanetkar - ANSI C ,BPB publication. ISBN: 9788183333245
- Byron Gottfried – Programming with C –Tata McGRAW-Hill ISBN-10: 0070145903
- Yashwant P. Kanetkar -Understanding pointers in "C" -BPB publication. ISBN-13: 978-8176563581
- E.Balguruswami -Programming in ANSI- C- Tata McGRAW-Hill- ISBN-10: 933921966X
- Mike McGrath - C programming in easy step – Wiley publication ISBN-10: 1840785446

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North Maharashtra University, Jalgaon
Faculty of Science and Technology
BACHELOR OF COMPUTER APPLICATIONS (BCA)
BCA 104 - Web Design - I
W.E.F. 2022-23
[Total Marks: External60 + Internal40 =100 Marks]

Semester	**I**	CIE Marks :	**40**
Course Code	**BCA 104**	SEE Marks :	**60**
Contact Hours (L.T.P)	**4:0:0**	Exam Hours :	**02**

Course Outcomes – At the end of the course, student will be able to:

4. Acquainted with elements, Tags and basic structure of HTML files.
5. Up skills the knowledge of basic and advanced web designing.
6. Students were implement effective use of List and Tables.
7. Students were implement effective web page navigation.
8. Students were capable to design web page layout
9. Students were understood and implement use of style sheet.

Unit 1 –Introduction to Web **10L 15 M**

Introduction to Internet, Advantages of Internet, Working of Internet, World Wide Web (WWW), Hypertext Transfer Protocol (HTTP), Universal Resource Locator (URL), Introduction to Web Browser and Web server, Introduction to Web page, Static and Dynamic Web page,

Unit 2 - Fundamentals of HTML **10L 15M**

Introduction to HTML, Basic structure of HTML document, Formatting Text, Font Tags and Attributes, Headings Tags, Image Tag and Attributes, Background Color and Background Images, Inserting Audio and Video Files, Marquee Tag and Attributes

Unit 3 – List, Hyper link and Table **10L 15 M**

List Tag - Ordered List, Unordered List, Definition List, Introduction to Hyperlink, Internal and External Hyperlink, Image Link, Table Tags & Attributes, Cell Spacing, Cell Padding, Row Span, Col Span

Unit 4 – Frame, Frameset and Form **10L 15M**

Frame, Frameset,Creating Framesets, Target Frameset, Form Tag and Attributes, Form Elements - Textbox, Text Area, List Box, Radio Button, Checkbox, Submit and Reset Button

Unit 5 – Introduction to CSS **10L 15 M**

Basic of CSS, Advantages of CSS, Role of CSS in Web Designing, CSS Structure and Syntax, Internal

CSS, Inline CSS, External CSS, Font Properties of CSS
Unit 6 – CSS Selectors **10L 15M**
Selectors and declarations, Element Selector, Class Selector, ID Selector, Child Selector, Universal Selector, Group Selector
Exam Pattern -
Reference Books -
▪ Textbook of Web Designing By Joel Sklar, Cengage Learning Publication 2009 ▪ Web designing in Nut Shell (Desktop Quick Reference) by Jennifer Niederst Publication – O'Reilly publication ▪ Designing web navigation by James Kalbach Publication – O'Reilly publication Textbook of ▪ Web Designing By Joel Sklar, Cengage Learning Publication 2009 ISBN, 1423901940

Kavayitri Bahinabai Chaudhari
North Maharashtra University, Jalgaon
Faculty of Science and Technology
BACHELOR OF COMPUTER APPLICATIONS (BCA)
BCA 105 - Lab on Computer Fundamental
W.E.F. 2022-23
[Total Marks: External60 + Internal40 =100 Marks]

Semester	**I**	CIE Marks :	**40**
Course Code	**BCA 105**	SEE Marks :	**60**
Contact Hours (L.T.P)	**4:0:0**	Exam Hours :	**03**

Course Outcomes – At the end of the course, student will be able to:

1. Students can able to understand the installation of operating system.
2. Students can understand basic DOS command, and different browser.
3. Student understand different platforms, Internet, mails, tables
4. Students can learn text formatting and table formatting.
5. Students capable to design power point presentation, tables, shapes, smart arts and charts

Assignments :

1. Installation of Operating System (Linux and Windows).
2. Run different commands of MS DOS – CD, DIR, COPY, REN, CLS, MD, RD, etc.
3. Study different web Browsers- Internet Explorer, Fire fox, downloading of files
4. Connect the Internet- open any website of your choice and download the WebPages.
5. Study different platforms – Hardware, Software, Server and Cloud.
6. Create your E-Mail ID on any free E-Mail Server.
7. Login through your E-Mail ID and do the following:
   a. Read your mail
   b. Compose a new Mail
   c. Send the Mail to one person
   d. Send the same Mail to various persons
   e. Forward the Mail
   f. Delete the Mail
   g. Send file as attachment
8. Create and demonstrate of text formatting, tables, shapes, smart-arts, charts.
9. Create a spreadsheet which will demonstrate use of aggregate function.
10. Create and demonstrate power point presentation with animation

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Faculty of Science and Technology
BACHELOR OF COMPUTER APPLICATIONS (BCA)
BCA 106 - Practical on Web Design - I
W.E.F. 2022-23
[Total Marks: External60 + Internal40 =100 Marks]

Semester	**I**	CIE Marks :	**40**
Course Code	**BCA 106**	SEE Marks :	**60**
Contact Hours (L.T.P)	**4:0:0**	Exam Hours :	**03**

Course Outcomes – At the end of the course, student will be able to:

1. Students were able to design consistent look and feel web pages.
2. Students were capable to use multimedia in web page.
3. Students were implement effective web page navigation.
4. Students were capable to design web page layout
5. Students were implement use of style sheet.

Assignments :

1. Create web page using basic HTML tags.
2. Create web page using Different Formatting tag.
3. Create Web page with different Images.
4. Create web page using Marquee Tag
5. Create a web page using different List tag.
6. Create web page using Anchor Tag (Internal Link and External Link)
7. Create web page to design time table of your college using Table tag.
8. Create web page inserting audio and video files.
9. Design a web page using Frames and Frameset Tag.
10. Design webpage of College Admission Form.
11. Design a web page using Inline and Internal CSS
12. Demonstrate the use of External CSS
13. Create web page to set background color using CSS.

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BACHELOR OF COMPUTER APPLICATIONS (BCA)
BCA 107–Lab on C Programming
W.E.F. 2022-23
[Total Marks: External60 + Internal40 =100 Marks]

Semester	**I**	CIE Marks :	**40**
Course Code	**BCA 107**	SEE Marks :	**60**
Contact Hours (L.T.P)	**4:0:0**	Exam Hours :	**03**

Course Outcomes – At the end of the course, student will be able to:

1. Students understand the input output functions.
2. Students can understand the use of various operator.
3. Students can understand the use of control statements.
4. Students can design the various expressions in C
5. Students can understand the array and its type.

Assignments :

1. Write a program using standard Input and Output Statements.
2. Write a program using formatted input output statements also study various format String and Escape sequence characters.
3. Write a program to illustrate various operators like arithmetic, relational, logical, Conditional etc.
4. Write a program to illustrate various control statements (if, if-else, nested if-else, switch)
5. Write a program to check whether the number is palindrome or not.
6. Write a program to check whether the number is Armstrong or not.
7. Write a program to generate Fibonacci series up to given term.
8. Write a program to find factorial of given number.
9. Write a program for print the table of 1 to 5 using nested loop.
10. Write a program to check whether the string is palindrome or not.
11. Write a program to demonstrate concept of array.
    i) One dimensional
    ii) Two dimensional
12. Write a program to demonstrate various standard library functions.

Semester – II

Kavayitri Bahinabai Chaudhari
North Maharashtra University, Jalgaon
Faculty of Science and Technology
BACHELOR OF COMPUTER APPLICATIONS (BCA)
BCA 201 –Professional Communication
W.E.F. 2022-23
[Total Marks: External60 + Internal40 =100 Marks]

Semester	**I**	CIE Marks :	**40**
Course Code	**BCA 201**	SEE Marks :	**60**
Contact Hours (L.T.P)	**4:0:0**	Exam Hours :	**02**

Course Outcomes – At the end of the course, student will be able to:

1. To develop his verbal and non verbal communication ability
2. To communicate with people effectively and confidently.
3. To draft effective business correspondence documents.
4. To make and present well designed and informative presentations

Unit 1 – Introduction to Communication **06L 15 M**

1.1. Introduction
1.2. Meaning
1.3. Definition
1.4. Process, importance.
1.5. Principles of effective communication
1.6. Scope of Business communication - Internal & External
1.7. Barriers to Communication, Overcoming the barriers

Unit 2 - Listening Skills **08L 15M**

2.1. Types of Listening (theory /definition)
2.2. Tips for Effective Listening
2.3. Academic Listening- (lecturing)
2.4. Listening to Talks and Presentations
2.5. Listening to Announcements- (railway/ bus stations/ airport / stadium announcement etc.)
2.6. Listening to Radio and Television

Unit 3 –Oral Communication & Presentation Skills **12L 15 M**

3.1 Need for Dialogue and Conversation Skills
3.2 Skills need for Dialogue
3.3 Clear & pleasant Speech
3.4 Speakers Appearance and Personality
3.5 Preparing text and visual material for presentation
3.6.Use of ICT tools for communication and presentation

Unit 4 –Soft Skills **16L 15M**

4.1. Empathy
(Understanding of someone else's point of view) 4.2. Intrapersonal skills
4.3. Interpersonal skills
4.4. Problem solving
4.5. Reflective thinking, Critical thinking
4.6. Negotiation skills

Unit 5 –Basics of English **08L 15 M**

5.1 Parts of Speech- Noun, Pronoun, Verb, Adjectives, Adverb, Conjunction, Preposition, Interjection
5.2 Tenses in a Nutshell -For proper sentence construction.
5.3 Punctuation: Commas, Semi-colons, colons, Hyphens & Dashes, Apostrophes
5.4 Vocabulary Building -; Antonyms and Synonyms; Prefixes and Suffixes

Unit 6 – Written Communication **10L 15M**

6.1 Letter writing, Essentials of Good Business letters
6.2 Types of letters: Types of Application Letters- Application for Job, Application for Leave.
6.3. Preparing Resume for Job
6.4 Email drafting and Etiquettes
6.5. Preparing agenda and writing minutes of meetings

Exam Pattern -

Reference Books -

1. Business Communication by Urmila Rai &S.M. Rai, Ninth Revised Edition (2010) (ISBN-83-8318-438-3) Himalaya Publishing House
2. Effective Business Communication by Asha Kaul, Second Edition (2015) (ISBN-789390464777)
3. THI Learning Pvt. Ltd., Business Communication by K.K. Sinha, Galgotia (2003)(ISBN-81-85989-36-2)
4. Business Communication by M. Balasubramanyam, (2003) (ISBN-13-9788-176-639118), Kalyani Publications

Kavayitri Bahinabai Chaudhari
North Maharashtra University, Jalgaon
Faculty of Science and Technology
BACHELOR OF COMPUTER APPLICATIONS (BCA)
BCA 202–Database Management System
W.E.F. 2022-23
[Total Marks: External60 + Internal40 =100 Marks]

Semester	**I**	CIE Marks :	**40**
Course Code	**BCA 202**	SEE Marks :	**60**
Contact Hours (L.T.P)	**4:0:0**	Exam Hours :	**02**

Course Outcomes – At the end of the course, student will be able to:

1. Introduction to the basic concepts of database management systems.
2. Learning to design databases using ER modeling.
3. Learning to apply integrity constraints.
4. To understand and demonstrate database schema.
5. Understand and demonstrate Relational databases, SQL.

Unit 1 – Basics: 10L 5 M

What is Data?, What is Information?, What is Data management?, What is Optimization?, Preprocessing of Data, Importance of Data Quality, Introduction to DBMS softwares

Unit 2 - Database Systems: 10L 10M

Introduction of File Processing System, Introduction of DBMS, Difference between File processing system & DBMS, Applications of DBMS, View of data, Database Languages, Database Users

Unit 3 –Data Models: 10L 10 M

Relational Model, Network Model, Hierarchical Model, Entity Relationship Model.

Unit 4 – Integrity Constraints: 10L 10M

Primary Key, Foreign Key, Candidate Key, Super Key, Null, Default, Not Null, Check constraint, Entity Integrity, Referential Integrity

Unit 5 – Relational Database Design : 08L 15 M

Normalization, Normal Form: 1 NF, 2 NF, 3 NF, BCNF

Unit 6 – Structured Query Language (SQL): 10L 15M

Introduction to SQL, Data types, Operators, Working with tables, Introduction to DML, TCL, DDL, DCL, Functions: Numeric Function, Character Function, Date Function, Conversion Function, Group Functions. Sub Queries, view, Sequence, Set Operators, Joins, Inner joins, Equi, Non Equi, Self-join & Outer Joins.

Exam Pattern -

Reference Books -

- Database System Concepts: - Abraham Silberschatz, Henry F. Korth& S. Sudarshan, McGrawHill ISBN 978-0-07-352332-3
- Introduction to Database Management Systems, by – AtulKahate (Pearson Education) ISBN 9788131700785
- Oracle PL/SQL by Example, Rosenweig, Pearson Education ISBN 10: 0133796787

Kavayitri Bahinabai Chaudhari
North Maharashtra University, Jalgaon
Faculty of Science and Technology
BACHELOR OF COMPUTER APPLICATIONS (BCA)
BCA 203–Programming in C – II
W.E.F. 2022-23
[Total Marks: External60 + Internal40 =100 Marks]

Semester	**I**	CIE Marks :	**40**
Course Code	**BCA 203**	SEE Marks :	**60**
Contact Hours (L.T.P)	**4:0:0**	Exam Hours :	**02**

Course Outcomes – At the end of the course, student will be able to:

1. Apply the concepts of Function modules, its usage
2. Apply the concepts of memory allocation using Pointers
3. Understand the concepts of structures and unions: declaration, initialization and implementation.
4. Learn to draw different graphics objects.
5. Learn to store and apply the data using files.

Unit 1 – Function: 10 L 12M

- Definition, Need of Function, prototype, passing parameters(Call by value and Call by reference)
- Scope of variable
- Functionwithreturnand Functionwithargument
- Recursion
- Storageclasses

Unit 2 –Pointers: 14L 10M

- Introduction: Defination and uses
- Declaration and Initialization
- Operations on Pointers: Pointer Arithmetic,Array of Pointer, Function and Pointer, Pointer to pointer
- Dynamic memory allocation(malloc(),calloc(),realloc() and releasing dynamically allocated memory(free(),flush()).

Unit 3 –Structure and Union: 12L 12 M

- Introduction. Declaration and accessing of structure and union
- Need of structure and union, Difference between structure and union
- Nested structure
- Array of structure

Unit 4 – Graphics : 12L 12M

- Introduction to Graphics in C
- Graphics functions: Initgraph(), putpixel(),closegraph(),outtextxy(), setcolor(),line(),circle(),rectangle(),ellipse(),arc(), bar()

Unit 5 – File Handling in C : 12L 12M

- Concept of files, records, field
- File Processing-fopen() , fclose(),fprintf(),fscanf(),getc(), putc(),getw(),putw() etc.
- Various mode of file opening and closing files.
- Command line arguments

Exam Pattern -

Reference Books -

- Denis Ritchie. “C” Programming – Prentice Hall Software Series- ISBN. 10 9 8 7
- Yashwant P. Kanetkar - ANSI C ,BPB publication. ISBN: 9788183333245
- Byron Gottfried – Programming with C –Tata McGRAW-Hill ISBN-10: 0070145903
- Yashwant P. Kanetkar -Understanding pointers in “C” -BPB publication. ISBN-13: 978-8176563581
- E.Balguruswami -Programming in ANSI- C- Tata McGRAW-Hill- ISBN-10: 933921966X
- Mike McGrath - C programming in easy step – Wiley publication ISBN-10: 1840785446

Kavayitri Bahinabai Chaudhari
North Maharashtra University, Jalgaon
Faculty of Science and Technology
BACHELOR OF COMPUTER APPLICATIONS (BCA)
BCA 204–Web Design - II
W.E.F. 2022-23
[Total Marks: External60 + Internal40 =100 Marks]

Semester	**II**	CIE Marks :	**40**
Course Code	**BCA 204**	SEE Marks :	**60**
Contact Hours (L.T.P)	**4:0:0**	Exam Hours :	**02**

Course Outcomes – At the end of the course, student will be able to:

1. Student were able to embed JavaScript in web page
2. Students successfully added interactivity in web page
3. Students were applied validation on web form
4. Students were implemented different events.
5. Students were familiar with bootstrap framework.

Unit 1 –Introduction to Web Site Development & Java Script 10L 15M

Web Site Development, Web Site Development Phases, Web Site Authoring tools, Web Site Development Model (RAD), Meaning of Scripting Language, Types of Scripting Language- JavaScript, VBScript, ASP, PHP, Differences between Client-Side &Server-Side Scripting, Introduction to Java Script, Advantages of JavaScript, Limitation of JavaScript

Unit 2 –Working with JavaScript 10L 15M

Embed JavaScript into HTML, Data Types, Creating Variable , Operators & Expressions, JavaScript Comments

Unit 3 – JavaScript Interactivity 10L 15M

Introduction to Function, Working with Function, Calling function, Built-in String function, Condition Checking-if-else statement, Switch Case Statement, Looping Statements - for LoopWhile Loop

Unit 4 – Dialog Box and Events 10L 15M

Dialog Boxes - Alert Dialog Box, Confirm Dialog Box, Prompt Dialog Box,
JavaScript Events - onclick, onmouseover, onmouseout, onkeypress, onkeydown, onkeyup,onfocus, onload,onunload,onblur, onsubmit

Unit 5 – JavaScript Objects 10L 15M

Array Object, Date Object, Math Object, Form Object

Unit 6 – Bootstrap and Responsive Design 10L 15M

Introduction to Bootstrap, Creating simple page, Layout of Bootstrap, Grid System, Bootstrap components – Buttons, Horizontal Naves, Dropdown,

Exam Pattern -

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Reference Books -

- The ABC's of Java Script by Lee Purcell Mary Jane Mara, BPB Publication .ISBN: 8170298261.
- The Complete Reference – Web Design, Thomas A. Powell, TMH, ISBN 0-07-041186.
- How to become webmaster in 14 days, James L Mohler, Techmedia ISBN 1575211696.
- HTML, DHTML, JavaScript, Perl & CGI by Ivan Bayross, BPB Publishing ... ISBN: 8176562742
- Web References: www.w3c.org, www.sybex.com ISBN 0-07-041186
- Web Enabled Commercial Application Development using HTML, DHTML, Java Script,PERL ISBN 13: 9788183330084.
- Bootstrap 4 Quick Start: Responsive Web Design and Development Basics for Beginners (Bootstrap 4 Tutorial Book 1)Jacob Lett

Kavayitri Bahinabai Chaudhari
North Maharashtra University, Jalgaon
Faculty of Science and Technology
BACHELOR OF COMPUTER APPLICATIONS (BCA)
BCA 205 - Lab on DBMS
W.E.F. 2022-23
[Total Marks: External60 + Internal40 =100 Marks]

Semester	**I**	CIE Marks :	**40**
Course Code	**BCA 205**	SEE Marks :	**60**
Contact Hours (L.T.P)	**4:0:0**	Exam Hours :	**03**

Course Outcomes – At the end of the course, student will be able to:

1. Students can able to create the database.
2. Students can understand basic database commands.
3. Students can understand constraint.
4. Students capable to design SQL using different clause.

Assignments :

1. Demonstration of creating database
2. Create table insert 10 records in it.
3. Demonstrate to INSERT, UPDATE, and DELETE Records in Table.
4. Demonstrate to SELECT with clauses
5. Demonstrate to Alter Table (Add Column, Delete Column, Rename, Modify Column
6. Demonstrate integrity constraints.
   PRIMARY KEY,
   FOREIGN KEY
   CHECK
   NOT NULL
   DEFAULT
7. Demonstrate use of operators.
8. Query based on operators and joins • Simple and nested query
9. Write down SQL by using i. WHERE Clause ii. GROUP BY ii. HAVING CLAUSE
10. Write down SQL by using i. Aggregate functions ii. Date functions iii. String functions

Kavayitri Bahinabai Chaudhari
North Maharashtra University, Jalgaon
Faculty of Science and Technology
BACHELOR OF COMPUTER APPLICATIONS (BCA)
BCA 206–Lab On C Programming - II
W.E.F. 2022-23
[Total Marks: External60 + Internal40 =100 Marks]

Semester	**II**	CIE Marks :	**40**
Course Code	**BCA 206**	SEE Marks :	**60**
Contact Hours (L.T.P)	**4:0:0**	Exam Hours :	**03**

Course Outcomes –

At the end of the course, student will be able to:

1. Student were able to understand the concept of Function techniques
2. Students were able to understand the storage classes
3. Students were able to understand pointer and its uses.
4. Students were able to design the basic graphics objects
5. Students were understand the operations on file and command line argument.

Assignments :

1. Write a program to illustrate concept of function using call by value.
2. Write a program to illustrate concept of function using call by reference.
3. Write a program to illustrate concept of recursion.
4. Write a program to demonstrate extern, static variables.
5. Write a program to demonstrate pointers to arrays.
6. Write a program to demonstrate pointers to function.
7. Write a program to pointers to pointer.
8. Write a program to demonstrate structure.
9. Write a program to demonstrate union.
10. Write a program to demonstrate various graphics function.
11. Write a program to implement read and write operations on file.
12. Write a program to demonstrate command line arguments

Kavayitri Bahinabai Chaudhari
North Maharashtra University, Jalgaon
Faculty of Science and Technology
BACHELOR OF COMPUTER APPLICATIONS (BCA)
BCA 207–Lab on OnWeb Design - II
W.E.F. 2022-23
[Total Marks: External60 + Internal40 =100 Marks]

Semester	**II**	CIE Marks :	**40**
Course Code	**BCA 207**	SEE Marks :	**60**
Contact Hours (L.T.P)	**4:0:0**	Exam Hours :	**03**

Course Outcomes –

At the end of the course, student will be able to:

1. Student were able to develop web page using JavaScript
2. Students successfully added interactivity features in web page
3. Students were implemented validation on web form
4. Students were implemented different events.
5. Students were familiar with bootstrap framework.

Assignments :

1: Write a program to embed JavaScript into HTML.

2: Write a JavaScript code to demonstrate Conditional Statements

3: Write a JavaScript code to demonstrate Looping Statements

4: Write JavaScript code to demonstrate different string functions.

5: Write JavaScript code to demonstrate onblur, onfocus, onload, onsubmit.

6: Write JavaScript code to demonstrate onkeypress, onmouseover, onmouseout.

7: Write a program to perform addition of two numbers using web form.

8: Create a HTML page to demonstrate Date object using JavaScript.

9: Write JavaScript code to demonstrate use of Dialog Boxes.

10: Write a JavaScript to apply form validation – not null, number, string etc.

11: Create simple registration form using Bootstrap.

12: Create Mini Website

KAVAYITRI BAHINABAI CHAUDHARI NORTH MAHARASHTRA UNIVERSITY, JALGAON

Faculty of Science and Technology

'A' Grade
NAAC Re-accredited
(3rd Cycle)

F. Y. B. Sc. BOTANY

Theory and Practical Syllabus

(CBCS Pattern)

As Per U. G. C. Guidelines

Semester – I

To Be Implemented From

Academic – Year 2022 - 2023

BOT. – 101: Diversity of Lower Cryptogams

BOT. – 102: Morphology of Angiosperms

BOT. – 103: Practical Based on BOT.-101 and BOT.-102

F.Y. B.Sc. Semester: I

Paper: I BOT. 101: Diversity of Lower Cryptogams		Lecture 30

Aims and Objectives:

1. To study the diversity among microbes.
2. To study systematic, morphology and structure of Bacteria, Viruses, Algae and Fungi.
3. To study the life cycle pattern of Bacteria, Viruses, Algae and Fungi.
4. To study the useful and harmful activities of Bacteria, Viruses, Algae and Fungi.

Course outcomes:

1. Provide identification technique of microbes, Viruses, Bacteria, Algae and Fungi.
2. Understand the systems of classification of Microbes, Viruses, Bacteria, Algae and Fungi, and its interdisciplinary approaches.
3. Provide lab-based training in writing short species descriptions and illustration.
4. Recognise members of the major microbes, Viruses, Bacteria, Algae, Fungi and their medicinal, economic importance for human welfare.

Unit 1	**Microbes:** 1.1: Introduction and main groups of microbes: Prions, Viroids, Viruses, Rickettsias, Mycoplasmas, Bacteria, Cyanobacteria. 1.2: Classification of microorganisms – R.H. Whittaker's (1969) five kingdom concept.	**02 L**
Unit 2	**Viruses:** 2.1: Introduction, discovery and characteristics of Viruses. 2.2: General morphology of viruses: Helical, Polyhedral, Enveloped and Complex viruses. 2.3: Nature of viruses (living and non-living) 2.4: Ultra structure of viruses 2.5: DNA Virus (T-Phase) and RNA, Virus (TMV) 2.6: Reproduction of Bacteriophage: Lytic and Lysogenic cycle. 2.7: Economic importance 2.8: Plant diseases caused by viruses w.r.t. causal organism, symptoms and control measures of. i. Yellow vein mosaic disease of Lady's finger. ii. Bunchy top of Banana.	**06 L**
Unit 3	**Bacteria:** 3.1: Introduction, discovery and general characters. 3.2: Classification of Bacteria on the basis of morphology. 3.3: Ultrastructure of Bacterial Cell 3.4: Gram positive and Gram negative Bacteria	**06 L**

	3.5: Reproduction - Asexual and Sexual (Conjugation) 3.6: Economic importance of Bacteria - useful and harmful activities 3.7: Study of Bacterial diseases w.r.t. causal organism, symptoms and control measures of i) Citrus canker ii) Black arm of Cotton.	
Unit 4	**Algae:** 4.1: Introduction, definition and general characters of algae 4.2: Habitats of algae: aquatic, terrestrial and algae unusual habitats 4.3: Thallus structure in algae. 4.4: Reproduction: vegetative, asexual and sexual 4.5: Classification of algae according to G. M. Smith (1955) up to classes with reasons giving at least two examples from each class. 4.6: Economic importance of algae in; i) Agriculture ii) Food iii) Industries iv) Medicine 4.7: A] Study of life cycle of ***Nostoc*** w.r.t. Systematic position Occurrence, structure of colony and filament, ultrastructure of ***Nostoc*** cell and reproduction B] Study of life cycle of ***Sargassum*** w.r.t. Systematic position, occurrence, external and internal structure of thallus, reproduction and alternation of generation.	**07 L**
Unit 5	**Fungi:** 5.1: Introduction, definition and general characters 5.2: Thallus structure, reproduction and mode of nutrition 5.3: Classification of Fungi, according to G.M. Smith up to classes with reasons giving at least two example of each class. 5.4: Economic importance of Fungi i) Agriculture ii) Food iii) Industries iv) Medicine 5.5: A] Study of life cycle ***Agaricus*** w. r. t. Systematic position, structure of mycelium, internal structure, (T.S. of gills) and reproduction. B] Study of life cycle ***Aspergillus.*** w. r. t. Systematic position, structure of mycelium and reproduction.	**07 L**
Unit 6	**Lichens and Mycorrhiza:** 6.1 Lichens: definition, characters, types - Crustose, Foliose, Fruticose and economics importance. 6.2 Definition, general account, significance of Mycorrhiza, 6.3 Types: Ectomycorrhiza and Endomycorrhiza.	**02 L**
Suggested readings:		

1. Agrawal, S. B. and Srivastav (1985)Modern Text Book of Botany Vol. I Algae, Fungi, Bacteria Viruses and Lichen, Universal Publication, Agra.
2. Biswas, S. B. and Amita Biswas (1986 Ed.)An Introduction to Viruses, Vikas Publishing House (P) Ltd. New Delhi.
3. Vashista, B.R. (2010) S. A Text Book of Algae S. Chand and Company (P.)Ltd New Delhi.
4. Vashista, B.R. (2010) S. A Text Book of Fungi S. Chand and Company (P.)Ltd New Delhi.
5. Sarabhai, B. P. &Arora C.K. (1995). A Text Book of Algae Anmol Publication, New Delhi.
6. Salle, A.J. (1974) Fundamental Principles of Bacteriology (TMH Ed.) New Delhi.
7. Gangulee, H.C. and Kar, A.K. (1998) College Botany Vol. II New Central Book Agency, Kolkota.
8. Pandey B. P. (2014) College Botany Volume 1S. Chand publications, New Delhi.
9. Pandey, S. N. and Trivedi (1997) A Text Book of Botany Vol. I Vikas Publishing House, New Delhi.
10. Sharma, P D. (1998) A Text Book of Fungi Rastogi Publication, Meerut.
11. Sharma, P D. (2009) A Text Book of Algae Tata McGraw Hill Publication, New Delhi

F.Y. B.Sc. Semester I

Paper II **BOT 102: Morphology of Angiosperms**		**Lecture 30**
Aims and objectives: **1.** To inculcate the students with angiosperm plant body. **2.** To study vegetative characteristics of angiosperm plants. **3.** To study reproductive characteristics of angiosperm plants. **4.** To study modifications and functions of plant organs. **Course outcomes:** **1.** Students will able to understand ground plan of angiospermic plant. **2.** Students will aware about vegetative and reproductive characteristics of angiospermic plant. **3.** Students will able to understand the modifications and functions of plant parts.		
Unit 1	**Introduction:** 1.1 Definition and scope of Morphology 1.2 Plant body – Root system, Shoot system	**02 L**
Unit 2	**Root:** 2.1 Definition 2.2 Characteristics of root 2.3 Functions of root 2.4 Types of root 2.5 Modifications of root for: a) Food storage:- Fusiform, Conical, Napiform, Tuberous root. b) Support:-roots, Stilt roots, Climbing roots c) Breathing:- Pneumatophores d) Special functions:- Epiphytic roots, Sucking roots	**04 L**
Unit 3	**Stem:** 3.1 Definition 3.2 Characteristics of stem 3.3 Functions of stem 3.4 Forms of stem: a) Strong form :- Herb, Shrub, Tree b) Weak form:- Creepers, Trailers and Climbers 3.5 Modifications of stem: a) Underground:- Rhizome, Stem tuber, Bulb and Corm b) Sub-aerial:- Runner, Stolon, Offset and Sucker c) Aerial:- Phylloclade, Cladode, Thorn, Stem tendril and Bulbil	**04 L**
Unit 4	**Leaf:** 4.1 Definition 4.2 Parts of leaf	**04L**

	4.3 Types of stipules 4.4 Types of leaf 4.5 Functions of leaf 4.6 Phyllotaxy:- definition and types: Alternate, Opposite (Decussate and Superposed) and Whorled. 4.7 Venation:- Definition and types: Reticulate and Parallel venation 4.8 Modifications of leaf:- leaf spines, leaf tendrils, fleshy leaves, phyllode, pitcher and bladder.	
Unit 5	**Inflorescence :** 5.1 Definition, Significance and parts of inflorescence 5.2 Types of inflorescence a) Racemose:- Raceme, Spike, Spikelet, Catkin, Spadix, Corymb, Umbel, Capitate and Head or Capitulum b) Cymose:- Solitary, Uniparous, Biparous and Multiparous c) Special type of inflorescence:-Cyathium, Verticillaster and Hypanthodium	**05L**
Unit 6	**Flower:** 6.1 Definition 6.2 Parts of typical flower 6.3 Types of flower:- Hypogynous, Epigynous and Perigynous 6.4 Symmetry of flower :- Actinomorphic and Zygomorphic 6.5 **Calyx:**- Polysepalous calyx, Gamosepalous calyx, Caducous calyx, Deciduous calyx, Persistent calyx and Petaloid calyx 6.6 **Corolla:** a) Forms of polypetalous corolla: Cruciform, Caryophyllaceous, Rosaceous and Paplionaceous b) Forms of gamopetalous corolla:- Campanulate, Infundibuliform, Tubular, Rotate, Hypocrateriform, Ligulate, Bilabiate and Personate 6.7 Perianth:-Polyphyllous and Gamophyllous 6.8 Aestivation:-i) Definition ii) Types of Aestivation. 6.9 **Androecium:** a) Attachment of anther to filament:- Basifixed, Dorsifixed and Versatile b) Cohesion and Adhesion of stamens. 6.10 **Gynoecium:** a) Apocarpous, Syncarpous, Monocarpellary, Bicarpellary and Polycarpellary b) Placentation: Definition and types of Placentation.	**06 L**
Unit 7	**Fruits:** **7**.1 Definition 7.2 Parts of typical fruit : nature of Pericarp 7.3 Types of fruits:- a) Simple fruits:- **i) Dry fruits:**	**05 L**

	a) Dehiscent:- Legume and Loculicidal Capsule b) Schizocarpic:-Lomentum and Regma c) Indehiscent:- Caryopsis, Cypsela **ii) Fleshy fruits:-** a) Drupe and Hesperidium b) Aggregate fruits:- Etaerio of berries and Etaerio of follicle c) Composite fruits:- Sorosis and Syconus.	

Suggested readings:

1. Gangulee H.C. Das K.S., Dutta C. (2014) College Botany Volume I, New Central Book Agency (P) Ltd. Kolkata.
2. Dutta A.C. (2013) Botany for Degree Students, Sixth edition, Oxford University Press, New Delhi.
3. Sachdeva S.K. (1990) Angiosperms – Morphology, Anatomy, Taxonomy, Evolution, Kalyani Publication, Ludhiana.
4. Pandey S.N. Mishra S.P. (2009) Taxonomy of Angiosperms, Ane Books Pvt. Ltd., New Delhi.
5. Singh M.P. Sharma A.K. (2002) Textbook of .Botany, Anmol Publication, Pvt. Ltd., New Delhi.
6. Sundararajan S. (2003) Practical Manual of Plant Morphology, Anmol Publication, Pvt. Ltd., New Delhi.
7. Bendre A. Kumar A. (1999) A Textbook of Practical Botany II, Rastogi Publication, Meerut

F.Y. B.Sc. Semester I

Paper III
Bot-103: Practical (Based on Bot.101 and Bot.102)

Practical – 1 : Study of Equipment, Chemicals and Stains used in Botany laboratory:

A) Equipment: Dissecting microscope, Compound Microscope

B) Chemicals:

i) Preservatives: FAA

ii) Stains: Safranin, Light green, Fast green, Cotton blue, Crystal violet,

iii) Mounting media; Glycerine, Lactophenol.

Practical - 2:.A) Study of viruses and bacteria using electron photomicrographs (TMV, Bacteriophage, Cocci, Bacillus, Spirillum Bacteria).

B) Technique of Gram staining of bacteria.

Practical – 3 & 4 : A) Study of Plant diseases w.r.t. causal organism, symptoms and control measures of the following:

a. Virus.

i. Yellow vein mosaic disease of Lady's finger

ii. Bunchy top of Banana

b. Bacteria

i. Citrus canker

ii. Black arm of cotton

c. Fungi

i. Green mould of citrus fruits

ii. White rust disease (Specimen/P.S.)/Tikka disease on groundnut [P.S.] (Any one)

B) Study of growth forms of lichens (Crustose, Foliose and Fruticose) specimens / P.S./ Photographs

C) Study of Mycorrhiza: (Ectomycorrhiza and Endomycorrhiza) by Photographs.

Practical -5& 6: Study of systematic position, vegetative and reproductive structures of the following:

A. ***Nostoc***

i) Vegetative structure -Filament and cell

ii) Reproductive structure (P.S.)

B. ***Sargassum***

i) Vegetative structure

ii) T. S. of main axis

iii) Reproductive structure male and female conceptacles (P.S.)

C. *Aspergillus*

i) Structure of thallus: mycelium,

ii) Reproductive structures asexual (Conidiophore and Conidia)

D. *Agaricus*

i) Structure of basidiocarp

ii) Reproductive structures: basidia and basidospores (V. S. of Gill)

Practical -7: Study of morphology of root and stem modifications as per theory.

Practical – 8 : Study of

a) Parts of leaf
b) Types of stipules
c) Types of leaf
d) Types of phyllotaxy
e) Types of venation
f) Modifications of leaf as per theory

Practical – 9 : Study of types of inflorescence as per theory.

Practical – 10 : Study of

a) Calyx – types of calyx as per theory
b) Corolla – forms of corolla as per theory
c) Types of aestivation

Practical -11: Study of

a) Androecium – Cohesion and Adhesion
b) Gynoecium– types of placentation.

Practical -12: Study of types of fruits as per theory.

Submission: 1. Excursion tour report

Note: Short or long excursion tour and visit to any botanical garden are compulsory.

KAVAYITRI BAHINABAI CHAUDHARI NORTH MAHARASHTRA UNIVERSITY, JALGAON

Faculty of Science and Technology

‘A’ Grade
NAAC Re-accredited
(3rd Cycle)

F. Y. B. Sc. BOTANY

Theory and Practical Syllabus

(CBCS Pattern)

As Per U. G. C. Guidelines

Semester – II

To Be Implemented From

Academic Year 2022 - 2023

BOT. – 201: Diversity of Higher Cryptogams

BOT. – 202: Taxonomy of Angiosperms

BOT. – 203: Practical Based on BOT.-201 and BOT.-202

F.Y. B.Sc. Semester II

Paper I Bot-201: Diversity of Higher Cryptogams		Lecture 30
Aims and objectives: 1. To study salient features of higher Cryptogams. 2. To know the morphology and systematics of higher cryptogams. 3. To study the life cycles of selected genera. 4. To study economic importance of higher cryptogams. To make the students aware about conservation and sustainable use of plants. **Course outcomes:** 1. Student will be able to understand the basic knowledge of the subject. 2. To understand the basic structure and study the comparative characteristic of Bryophytes and Pteridophytes. 3. Also, to understand the structural similarities and differences among both the groups. 4. Student will be able to aware developmental stages of life cycle of higher cryptogamic plants. To facilitate students for taking up and shaping a successful career in botany.		
Unit 1	**Introduction:** 1.1: Introduction, definition and diversity of higher cryptogams. 1.2: Bryophytes - a) Introduction. b) Habit and habitat. c) General characteristics of Bryophytes. d) Alternation of generations. 1.3: Classification of Bryophytes according to G. M. Smith (1955) up to classes with reasons, giving at least two examples from each class. 1.4: Economic and ecological importance of Bryophytes.	**05 L**
Unit 2	**Study of life cycle of *Riccia*:** 2.1: Systematic position with reasons. 2.2: Habit and habitat. 2.3: External and internal structure of gametophyte. 2.4: Vegetative reproduction. 2.5: Sexual reproduction (Development of sex organs not expected) 2.6: Fertilization. 2.7: Structure of mature sporophyte. 2.8: Structure and germination of spores. 2.9: Alternation of generation**.**	**05 L**
Unit 3	**Study of life cycle of *Funaria*:** 3:1. Systematic position with reasons. 3.2: Habit and habitat. 3.3: External and internal structure of gametophyte. 3.4: Vegetative reproduction.	**05 L**

	3.5: Sexual reproduction (Development of sex organs not expected) 3.6: Fertilization. 3.7: Structure of mature sporophyte. 3.8: Alternation of generation**.**	
Unit 4	**Pteridophytes:** 4.1: Introduction, definition and general characteristics of Pteridophytes. 4.2: Habit and Habitat. 4.3: Classification of Pteridophytes according to G. M. Smith (1955) up to classes with reasons, giving at least two examples from each class. 4.4: Economic importance of Pteridophytes.	**04 L**
Unit 5	**Study of life cycle of *Selaginella*:** 5.1: Systematic position with reasons. 5.2: Habit and habitat. 5.3: External and internal structure of sporophyte. 5.4: Asexual reproduction: position and structure of strobilus. 5.5: Sporangia (megasporangium and microsporangium). 5.6: Structure and germination of spores. 5.7: Structure of male and female gametophyte. 5.8: Position and structure of sex organs. (Development of sex organs not expected) 5.9: Fertilization. 5.10: Structure of mature embryo. 5.11: Alternation of generations. 5.12: Heterospory and its significance	**06L**
Unit 6	**Study of life cycle of *Adiantum* :** 6.1: Systematic position with reasons. 6.2: Habit and habitat. 6.3: External and internal structure of sporophyte. 6.4: Asexual reproduction: position and structure of sorus. 6.5: Structure of sporangium. 6.6: Structure and germination of spore. 6.7: Structure of mature gametophyte. 6.8: Position and structure of sex organs. (Development of sex organs not expected). 6.9: Fertilization. 6.10: Alternation of generation.	**05 L**

Suggested readings:

1. Gangulee, H.C. and Kar, A.K. (2001). College Botany Vol. II. Books and Allied Press Ltd. Kolkata.
2. Pandey, S.N. and Trivedi, P.S. (1997). A Text Book of Botany Vol. II, Vikas Publishing House (P.) Ltd. New Delhi.
3. Parihar, N.S. (1977). Biology and Morphology of Pteridophytes. Central Book Depot, Allahabad.

4. Parihar, N.S. (1984). An Introduction to Embryophyta Vol. I Bryophyta. Central Book Depot, Allahabad
5. Rashid, A. (1996). An Introduction to Bryophyta. Vikas Publishing House Ltd. New Delhi.
6. Rashid, A. (1996). An Introduction to Pteridophyta. Vikas Publishing House Ltd
7. Saxena, A.K. and Sarbhai, R.M. (1992). A Text Book of Botany Vol. II Embryophyta.
8. Ratan Prakashan Mandir, Agra.
9. Smith, G.M. (1995). Cryptogamic Botany. Vol. II (Bryophytes and Pteridophytes).
10. Mc Graw-Hill Book Company, New york and London.
11. Sporne, K.R. (1995). The Morphology of Pteridophyta. The Hutchinson University Library, London, U.K.
12. Vashistha, B.R. (1997). Botany For Degree Students-Bryophyta. S. Chand and company (P.) Ltd. New Delhi.
13. Vashistha, P.C. (1984). Pteridophytes. S. Chand and company (P.) Ltd. New Delhi

F.Y. B.Sc. Semester II

Paper II Bot-202: Taxonomy of Angiosperms		Lecture 30
Aims and objectives: **1.** To study the diversity of angiosperms. **2.** To study of comparative account among the families of angiosperm. **3**. To study the economic importance of the angiospermic plants. **4.** To study the distinguishing features, medicinal and economic importance of angiosperm families. **5.** To study botanical garden and herbarium techniques. **Course outcomes:** 5. Understanding of angiospermic plants Causes of phenomenal succession and alternation of generation. 6. Understand the systems of classification of angiosperms, nomenclature and interdisciplinary approaches. 7. Provide lab-based training in writing short species descriptions and illustration. 8. Recognise members of the major angiosperm families by identifying their diagnostic features, economic and medicinal importance. 9. Understand botanical gardens and herbarium technique		
Unit 1	**Introduction** 1:1 Definition, scope and importance of taxonomy. 1:2 General characters of Angiosperms. 1:3 Causes of phenomenon succession of Angiosperms. 1:4 Alternation of generations. 1:5 Taxonomy and systematics: synonyms.	**06 L**
Unit 2	**Taxonomic hierarchy** 2:1 Functions of Taxonomy: identification, classification and nomenclature. 2:2 Ranks of classification; major categories. 2:3 Binomial nomenclature. 2:4 Author citation and rejection of name. 2:5 Numerical Taxonomy; definition and applications.	**06 L**
Unit 3	**Classification** 3:1 Types of classification a) Artificial b) Natural c) Phylogenetic 3:2 Outline of Bentham and Hooker's system of classification up to series. 3:3 Merits and demerits.	**06L**

Unit 4	**Study of plants families w.r.t. systematic position, general characters, distinguishing characters and economic importance.** a) Malvaceae b) Papilionaceae (Fabaceae). c) Rubiaceae d) Solanaceae e) Euphorbiaceae f) Cannaceae	**06 L**
Unit 5	**Botanical Gardens and Herbarium.** 5:1) Botanical garden. a) Definition and Functions b) Special feature of following Botanical Garden. i) Indian Botanical Garden, Kolkata ii) Royal Botanical Garden, Kew England. 5:2) Herbarium. a) Definition, techniques and functions. b) Importance of herbaria.	**06L**

Suggested readings:

1. Gangully , H.C & K.S Das (1986) College Botany Vol. – 1 (6th Edition) , New Central book Agency, Calcutta , India.
2. Gangully H.C., K. S.Das and C.T Datta (1968) college Botany Vol.1 , New Central Book Agency , Calcutta , India.
3. Kumar, N.C (1992) An Introduction to Taxonomy of Angiosperm, Himalaya Publishing House, Bombay India.
4. Lawrence G.H.M (1951) Taxonomy of Vascular plants. Macmilan , New York , USA.
5. Naik , V. N (1984) Taxonomy of Angiosperms . Tata McGraw – Hil publishing Company Ltd , New Delhi , India
6. Pandey B.P. (1997) Taxonomy of Angiosperms . S. Chand & Company Ltd., New Delhi, India.
7. Sharma , O.P. (1997) Plants Taxonomy . Tata McGraw – Hill Publishing Co.Ltd . New Delhi, India
8. Shivarajan , V.V . (1984) Introduction to Principles of Principles of Plants Taxonomy . Oxford & IBHP publishing Co.New Delhi , India
9. Singh V. And Jain , D.K (1992) Taxonomy of Angiosperms. Rastogi publication , Meerut, India.
10. Subramanyam , N.S. (1997) Modern plants Taxonomy . Vikas Publishing house, New Delhi ,India.
11. MukerjeeSusilkumar (1984) College Botany Vol.3 Published by J.N.SenB.S.I.New central Book Agency Calcutta.
12. Vashistha , P.C. (1992) Taxonomy of Taxonomy of Angiosperms. R.Chand& Co. Publishers , New Delhi , India.

F.Y. B.Sc. Semester II

Paper III
Bot-203: Practical (Based on Bot.201 and Bot.202)

Practical - 1: Study of diversity of Bryophytes w.r.t systematic position and morphology of:
a) *Marchantia b*) *Anthoceros* c) *Sphagnum*

Practical - 2: Study of *Riccia:*
2.1: Systematic Position with reasons
2.2: External morphology
2.3: Mounting of scales and rhizoids
2.4: V. S. of Thallus
2.5: V. S. of thallus showing antheridia [P. S.]
2.6: V.S. of thallus showing archegonia [P.S.]
2.7: V.S. of sporophyte [P.S.]

Practical - 3: Study of *Funaria:*
3.1: Systematic Position with reasons
3.2: External morphology
3.3: T. S. of axis
3.4: V.S. of antheridial head [P.S.]
3.5: V.S. of archegonial head [P.S.]
3.6: V.S. of Capsule [P.S.]
3.7: Mounting of spores and peristomial teeth

Practical - 4: Study of diversity of Pteridophytes w.r.t systematic position and morphology of:
a) *Psilotum* b) *Lycopodium* *c*) *Equisetum*

Practical - 5: Study of *Selaginella*:
5.1: Systematic Position with reasons
5.2: External morphology
5.3: T. S. of Stem
5.4: Mounting of micro and megaspores
5.5: T. S. of Leaf [P.S.]
5.6: V. S of Strobilus [P.S.]

Practical - 6: Study of *Adiantum*:
6.1: Systematic Position with reasons
6.2: External morphology
6.3: T. S. of Rachis
6.4: T. S. of Sorus [P. S.]
6.5: Mounting of spores

Practical -7: How to describe Angiospermic plant.

Practical -8, 9&10: Study of plant families according to syllabus w.r.t Systematic position, morphological characters, floral formula and floral diagram.
i) Malvaceae iii) Rubiaceae v) Euphorbiaceae
ii) Papilionaceae/ Fabaceae iv) Solanaceae vi) Cannaceae

Practical -11: Preparation of artificial key based on vegetative & reproductive characters.

Practical -12: Herbarium and its techniques.

Submission: 1. Any five photographs of higher cryptogamic plants
2. Any five wild plant (Weeds) herbarium/photograph.
3. Excursion tour report

Note: Short or long excursion tour and visit to any botanical garden are compulsory.

Equivalence

	Old Syllabus w.e.f. June, 2018		New Syllabus, w.e.f. June 2022	
Sr. No.	Paper	Title	Paper	Title
SEMESTER-I				
1	BOT.101	Microbial Diversity of Algae and Fungi	BOT.101	Diversity of Lower Cryptogams
2	BOT.-102	Plant Taxonomy	BOT.-102	Morphology of Angiosperms
3	BOT.-103	Practical Course based on BOT-101 and BOT.-102	BOT.-103	Practical Course based on BOT-101 and BOT.-102
SEMESTER-II				
4	BOT.201	Diversity of Archegoniate	BOT.201	Diversity of Higher Cryptogams
5	BOT.-202	Plant Ecology	BOT.-202	Morphology of Angiosperms
6	BOT.-203	Practical Course based on BOT-201 and BOT.-202	BOT.-203	Practical Course based on BOT-201 and BOT.-202

Kavayitri Bahinabai Chaudhari
North Maharashtra University, Jalgaon

'A' Grade
NAAC Re-Accredited
(3rd Cycle)

SYLLABUS

For

M.A. / M. Sc.- IInd YEAR (Sem. IIIrdand IVth)

Subject: Geography

Under

Choice Based Credit System

(With Effect from June - 2022)

Summary of Distribution of Credits under CBCS Scheme for M. A /M.Sc. (Geography)

Sr. No	Type of course	Sem I	Sem II	Sem III	Sem IV
01	Core	**16**	**16**	**16**	**12**
02	Skill based	**04**	**04**	**-**	**-**
03	Elective	**-**	**-**	**04**	**04**
04	Project	**-**	**-**	**-**	**04**
05	Audit	**02**	**02**	**02**	**02**
06	Total Credits	**22**	**22**	**22**	**22**

Subject Type	Core	Skill based	School Elective	Project	Audit	Total
Credits	**60**	**08**	**08**	**04**	**08**	**88**

Total Credits = 88

Kavayitri Bahinabai Chaudhari North Maharashtra University Jalgaon

M.A / M. Sc. Geography

Choice Based Credit System (Outcome Based Curriculum) with effect from 2021 -2022

Course credit scheme

Semester	(A) Core Courses			(B) Skill Based / Elective Course			(C) Audit Course (No weightage in CGPA)			Total Credits (A+B+C)
	No. of Courses	Credits (T+P)	Total Credits	No. of Courses	Credits (T+P)	Total Credits	No. of Courses	Credits (Practical)	Total Credits	
I	4	8 + 8	**16**	1	4 + 0	4	1	2	2	**22**
II	4	12 + 4	**16**	1	0 + 4	4	1	2	2	**22**
III	4	8 + 8	**16**	1	4 + 0	4	1	2	2	**22**
IV	4	8 + 8	**16**	1	4 + 0	4	1	2	2	**22**
Total Credits	**64**			**16**			**8**			**88**

(T, Theory; P, Practical)

Structure of Curriculum

		First Year				Second Year				Total Credit Value
		Semester I		Semester II		Semester III		Semester IV		
		Credit	Course	Credit	Course	Credit	Course	Credit	Course	
(A)	**Prerequisite and Core Courses**									
	Theory	4	2	4	3	4	2	4	2	36
	Practical	4	2	4	1	4	2	4	2	28
(B)	**Skill Based / Subject Elective Courses**									
1	Theory /Practical	4	1	4	1	4	1	4	1	16
(C)	**Audit Course (No weightage in CGPA calculations)**									
1	Practicing Cleanliness	2	1							2
2	Personality and Cultural Development Related Course			2	1					2
3	Technology Related + Value Added Course					2	1			
4	Professional and Social + Value Added Course							2	1	2
	Total Credit Value	14	6	14	6	14	6	14	6	88

Semester III (Choose One)		**Semester IV** (Choose One)	
Technology + Value Added Course		**Professional and Social + Value Added Course**	
Course Code	**Course Title**	**Course Code**	**Course Title**
AC-301A	Computer Skills	AC-401A	Human Rights
AC-301B	Cyber Security	AC-401B	Current Affairs
AC-301C	Rainwater Harvesting	AC-401C	Green Audit
AC-301D	Geo-Tourism	AC-401D	Review of Research Paper

Semester-wise Course Structure of M.A M.Sc. Geography

Semester III

Course	Course Type	Course Title	Teaching Hours/ Week			Marks (Total 100)				Credits
						Internal		External		
			T	P	Total	T	P	T	P	
GG. -301	Core	Regional Geography of India	4	--	4	40	--	60	--	4
GG.-302	Core	Research Methodology	4	--	4	40	--	60	--	4
GG.303	Elective	**(Choose one out of Three.)** **GG.303 A** Watershed Management and Planning **GG.303 B** Geographical Information System **GG.303 C** Agricultural Geography	4	-	4	40	-	60	-	4
GG. -304	Core	Practical in Remote Sensing - Interpretation of Aerial Photographs and Satellite Imageries	--	4+4	8	--	40	--	60	4
GG. -305	Core	Practical of Computerize Data Analysis Techniques in Geography	-	4+4	8	-	40	-	60	4
AC-301 A/B/C/D	Audit Course	**(Choose one out of Four)** AC-301A - Computer Skills / AC-301B - Cyber Security / AC-301C – Rainwater Harvesting / AC-301D- Geo-tourism		2	2		100	--	--	2
Total Credit for Semester III: 22 (T = Theory: 8; P = Practical:8; Skill Based:4; Audit Course:2)										

Semester IV

Course	Course Type	Course Title	Teaching Hours/ Week			Marks (Total 100)				Credits
			T	P	Total	Internal		External		
						T	P	T	P	
GG. -401	Core	Geomorphology	4	--	4	40	--	60	--	4
GG.-402	Core	Climatology	4	--	4	40	--	60	--	4
GG.-403	Elective	**(Choose one out of Three.)** **GG.403 A** Geography of Rural Settlements **GG.403 B** Geography of Resources **GG.403 C** Industrial Geography	4	-	4	40	-	60	-	4
GG.-404	Core	Practical in Physical Geography	--	4+4	8	--	40	--	60	4
GG.405	Core	Project work	-	4+4	8	-	40	-	60	4
AC-401 A/B/C/D	Audit Course	**(Choose one out of Four)** AC-401A Human Rights / AC-401B Current Affairs / AC-401C Green Audit / AC-401D Review of Research Paper		2	2		100	--	--	2
Total Credit for Semester IV: 22 (T = Theory: 8; P = Practical:8; Skill Based:4; Audit Course:2)										

Equivalences for old courses of M.A / M.Sc Geography (Part I and II)

Semester – I st

Old Courses (June 2017)		New Courses (June 2021)	
Code of Courses	**Title of the courses**	**Code of Course**	**Title of the courses**
Gg.111	Principles of Economic Geography	GG. 101	Principles of Economic Geography
Gg.112	Principles of Population and Settlement Geography.	GG.102	Principles of Population Geography
Gg.113	Principles of Climatology.	GG.402	Climatology
Gg.114	Principles of Geomorphology.	GG. 401	Geomorphology
Gg.115	Practical in Geography	GG.103	Practical in Interpretation of SOI Topographical maps and Surveying by GPS

Semester – II nd

Old Courses (June 2017)		New Courses (June 2021)	
Code of Courses	**Title of the courses**	**Code of Courses**	**Title of the courses**
Gg.211	Geographical Thoughts	GG. 201	Geographical Thoughts
Gg.212	Social and Cultural Geography	GG.202	Social and Cultural Geography
Gg.213	Remote Sensing.	GG.203	Remote Sensing
Gg.214	Geo-Statistical Methods		#
Gg.215	Practical of Computerize Data Analysis Techniques in Geography	GG.204	Practical in Cartographic Techniques with the help of GIS

Semester – III rd

Old Courses (June 2017)		New Courses (June 2022)	
Code of Courses	**Title of the courses**	**Code of Course**	**Title of the courses**
Gg.311(A) Gg.311(B)	Regional Geography of U. S. A OR Regional Geography of Asia.	GG. 301	Regional Geography of India
Gg.312	Environmental Geography.		#
Gg.313	.Geographical Informational System.		#
Gg.314	Watershed Management and Planning		#
Gg.315	Practical of Physical Geography with the help of GIS.		#

Semester – IV th

Old Courses (June 2017)		New Courses (June 2022)	
Code of Courses	**Title of the courses**	**Code of Courses**	**Title of the courses**
Gg.411(A)	Fluvial Geomorphology. OR		#
Gg.411(B)	Industrial Geography. OR	GG. 403 (C)	Industrial Geography
Gg. 411(C)	Geography of Rural Settlement.	GG.403(A)	Geography of Rural Settlements.
Gg.412(A)	Tropical Geomorphology. OR		#
Gg.412(B)	Geography of Trade and Transport. OR		#
Gg. 412(C)	Urban Geography.		#
Gg. 413(A)	Research Methodology. OR	GG. 302	Research Methodology
Gg. 413 (B)	Dissertation.	GG.405	Project Work
Gg.414(A)	Geography of Tourism. OR GG.105		GG.105- Tourism Management
Gg.414(B)	Coastal Geomorphology. OR		#
Gg. 414 (C)	Agricultural Geography.		GG.303 (C) Agricultural Geography.
Gg.415	Interpretation of Topographical Maps, Aerial Photographs , Satellite Imageries , Surveying.		#

No equivalent course is available for this paper, so # No equivalent course is available for this paper, so students may be allowed to appear by old course.

Distribution of Course papers for M.A / M. Sc. Part II (Geography)

Subject Code	Title of the Paper		Duration (Hrs./Wk)	Max. Mark	Exam. Time (Hrs.)
M.A / M.Sc. Part II					
Semester III					
GG.-301	Regional Geography of India	Core course	04	100	03
GG -302	Research Methodology	Core course	04	100	03
GG -303	**Choose one out of Three** GG- 303A - Watershed Management and Planning. / GG- 303B - Geographical Information System ./ GG- 303C - Agricultural Geography /		04	100	03
GG -304	Practical in Remote Sensing – Interpretation of Aerial Photographs and Satellite Imageries	Core course	**04+04**	**100**	06
GG -305	Practical of Computerize Data Analysis Techniques in Geography	Core course	**04+04**	**100**	06
AC-301	**Choose one out of Four** AC-301A – Computer Skills / AC-301B – Cyber Security/ AC-301C -Rain water harvesting / AC-301D- Geo-tourism	Audit Course	**02**	**100**	
Semester IV					
GG -401	Geomorphology	Core course	**04**	**100**	03
GG -402	Climatology	Core course	**04**	**100**	03
GG -403	**Choose one out of Three** GG- 403A - Geography of Rural Settlements / GG- 403B - Geography of Resources / GG- 403C - Industrial Geography		**04**	**100**	03
GG -404	Practical in Physical Geography	Core course	**04+04**	**100**	06
GG -405	Project work		**04+04**	**100**	06
AC-401A/B/C/D	**Choose one out of Four** AC-401A - Human Rights / AC-401B - Current Affairs / AC-401C- Green Audit / AC-401D - Review of Research Paper -	Audit Course	**02**	**100**	

Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon
New Syllabus M.A./M.Sc. Geography
Semester-III (CBCS Pattern)
Theory - Core-Course

Gg. 301: Regional Geography of India

(With Effect from June 2022)

Total Marks-100 **Credit Points- 04** **Teaching Hours/Week: 04**
Clock Hours : 60

Course Objectives:

1. To acquaint the students with basic knowledge of our country.
2. To aware the students about physiography, drainage, climate, soils and natural vegetation of India.
3. To aware the students with natural resources available in the country and need of conservation and protection of them.
4. To make the students ready for NET, SET and competitive examinations.

Course Outcomes:

After completion of this course, the students will be able to

1. Know about their own country regarding physical and cultural aspects.
2. Examine the regional differentiation in the study of India.

Unit no.	Units	Sub-Units	Lectures
1	**Introduction of Physiography Drainage Systems**	i. Geographical and relative location of India Main physiographic divisions & their importance i. The northern mountains ii. The north Indian Plain iii. The peninsular plateau iv. The coastal lowlands v. The islands A) Himalayan drainage systems: i. Ganga ii. Brahmaputra iii. Indus B) Peninsular drainage system 1. East Flowing Rivers: i. Godavari ii. Krishna iii. Mahanadi 2. West Flowing Rivers: i. Narmada ii. Tapi	14

2	**Climate**	A) Main Seasons & Associated weather conditions: i. The winter ii. The summer iii. The rainy/monsoon iv. The retreat monsoon B) Origin and mechanism of monsoon: i. Traditional concept: Halley's view ii. Recent Concept: a. Role of Tibet plateau b. ITCZ c. Jet Stream d. El-Nino	08
3	**Soils and Agriculture**	) Major soil types and their distribution in India: i. Alluvial soil ii. Black soil iii. Red soil iv. Arid and Desert soils v. Saline and Alkaline soils vi. Peaty and Marshy soils iii. Soil degradation and soil conservation B) Distribution and Production of Major Crops: i. Rice ii. Wheat iii. Cotton iv. Sugarcane C) Factors affecting Indian Agriculture: i. Environmental Factors ii. Technological Factors iii. Institutional Factors	12
4	**Forest**	A) Main forest types and their distribution in India: i. Moist Tropical forests ii. Dry Tropical forests iii. Montane Sub-tropical forests iv. Montane Temperate forests v. Alpine forests	06
5	**Minerals, Energy Resources and Industries**	A) Distribution and Utilization of Minerals: i. Iron Ore ii. Manganese iii. Bauxite B) Distribution and Utilization of Energy Resources: i. Coal ii. Petroleum iii. Natural gas C) Major power projects in India: i. Hydro electric ii. Thermal Power	12

		iii. Atomic power A) Major Industries in India: i. Cotton Textile ii. Iron and Steel B) Major Industrial Regions in India	
6	**Population**	A) Growth and distribution of population in India B) Composition and structure of Population: i. Age-sex ii. Religious iii. Marital status iv. Occupational structure	08

N.B.: According need of topics, maps are expected.

Weightage

Marks	
Internal Assessment	**40** marks
External Assessment	**60** marks

Suggested readings:

1. Agrawal A. N. (2019): "Indian economy, Developmental Problems and policies" New Age International Pvt. Ltd.
2. Bhende, Asha A and Kanitkar Tara (2015): "Principles of Population Studies", Himalaya Pub. House, New Delhi.
3. Chandana R. C. (2016): "Geography of population", Kalyani Publishers, New Delhi.
4. Chopra S. N. - India, an Area Study.
5. Deshpande C. D. (1992): "India: A Regional Interpretation", Indian Council of Social Science Research and National Book Centre, New Delhi
6. Dubey and Negi - Economic Geography of India.
7. Gopal Singh (1976): Geography of India" Atma Ram Pub., Delhi
8. Khullar D. R. (2018) : "India: a Comprehensive Geography" Kalyani Publishers
9. Majid Husain (2008): "Geography of India", Tata McGraw Hill, New Delhi
10. Mathur, S. M. (1994): Physical Geology of India, National Book Trust, New Delhi, India.
11. Memoria, I. B. - Geography of India.
12. Singh R. L. (1971): "India-A Regional Geography". NGSI, Varanasi.

Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon
New Syllabus M.A./M.Sc. Geography
Semester-III (CBCS Pattern)
Theory - Core-Course

Gg. 302: Research Methodology

(With Effect from June 2022)

Total Marks-100 **Credit Points- 04** **Teaching Hours/Week: 04**
Clock Hours : 60

Course Objectives:

1. To create an awareness about research in the field.
2. To make a scientific view about the geographical phenomenon.
3. To develop the research ability and get solution on various problems.

Course Outcomes:

1. Student will acquire skills related to research methodology.
2. Students have been getting an advanced information and techniques in research.
3. Capability to acquire and apply fundamental principles of research methodology.

Unit No.	Units	Sub Units	Lectures
1	**Concept Research & Research Problem**	A) Concept of Research- I. Definition and Significance of Research. II. Motivation in Research. III. Types of Research. IV. Criteria of Good Research. V. Plagiarism -Concepts B) Research Problem- I. Meaning of Research Problem. II. Selecting the Problem. III. Techniques involved in defining a problem. IV. Literature Survey: Library and Documentation.	**14**
2	**Hypothesis**	A) Characteristic of usable hypothesis. B) Types of Hypothesis. C) Sources of Hypothesis. D) Formulation of Hypothesis. E) Testing of Hypothesis.	**8**
3	**Research Design**	A) Meaning of Research Design. B) Need of Research Design. C) Features of a Good Design. D) Important Concepts Relating to Research Design.	**8**

4	**Sampling Design**	A) Implications of Sample Design. B) Steps in Sampling Design. C) Criteria of selecting a Sampling Procedure. D) Characteristics of a Good Sample Design. E) Types of Sampling-Probability &Non Probability Sampling. F) Complex Random Sampling Design.	**10**
5	**Data Collection Methods**	A) Collection of Primary Data through- a. Observation b. Interview c. Questionnaires d. Schedules B) Collection of Secondary Data C) Guidelines for Constructing Questionnaire	**8**
6	**Interpretation And report writing**	A) Interpretation of Data – I. Techniques of Interpretation II. Precautions in Interpretation. B) Report Writing- I. Significance of Report writing. II. Types of Research Report. III. Different Steps in Writing Report. IV. Layout of the Research Report. V. Precautions for Writing Research Report.	**12**

Weightage

Marks	
Internal Assessment	**40** marks
External Assessment	**60** marks

Suggested readings:

1. Kothari, C, R, (2004II Edn): Research Methodology Methods and Techniques, New Age International Publishers, New Delhi.
2. Mishra, R, P. (1989): Research Methodology A Hand Book, Concept Publishing Co, New Delhi.
3. Nayak J, k. And Singh, Priyanka (2004II Edn): Fundamentals of Research Methodology Problems and Prospectus, SSDN Publishers and Distributors, New Delhi.
4. Nicholas Walliman (2011): Research Methods the Basics, Routledge Taylor and Francis Group, London & New York.
5. Pandey, Prabhat and Pandey, Meenu M, (2015): Research Methodology Tools and Techniques, Bridge Centre, Buzau, Romania.
6. Ranjit Kumar (2011 III Edn): Research Methodology A Step-by-Step Guide for Beginners, SAGE Publishers, Los Angeles, New Delhi.
7. Tiwari R, N. and Shukla, D, P. (2003): Research Methodology, College Book Depot, Tripolia, Jaipur.

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New Syllabus M.A./M.Sc. Geography
Semester-III (CBCS Pattern)
Theory – Elective - Course

Gg. 303 A : Watershed Management and Planning

(With Effect from June 2022)

Total Marks-100 **Credit Points- 04** **Teaching Hours/Week: 04**
Clock Hours : 60

Course Objectives:

1. To know the concept of watershed management
2. To learn the technique of watershed demarcation
3. To study the morphometric parameters
4. To learn the techniques of water conservation

Course Outcomes:

At the end of the course, the student will be able to -

1. Understand the concept of watershed management and planning
2. Demarcate the watershed boundary using toposheet
3. Analyze the morphometric parameters
4. Learn the hydrogeology term and application of GIS.

Unit no.	Units	Sub-Units	Lectures
1	**Introduction and Characteristics of Watershed**	a) Concept of Watershed b) Types of Watershed c) Need and Importance for watershed management d) Demarcation of Watershed e) Channel geometry i. Cross profile ii. Longitudinal Profile f) Types of Channel	**10**
2	**Basin Morphometry Linear Aspects**	Morphometric Parameters a) Stream order b) Stream Length c) Mean stream length d) Stream length ratio e) Bifurcation Ratio f) Sinuosity Index	**12**
3	**Basin Morphometry Aerial Aspects**	Morphometric Parameters a) Aerial Aspects i) Stream Frequency ii) Drainage Density b) Drainage analysis on the basis of	**10**

		i) Horton's Form Factor ii) Miller's Circularity Ratio iii) Strahler's Ruggedness Index iv) Elongation ratio by Schumn v) Texture ratio by Hortan	
4	**Relief Aspect**	Morphometric Parameters a) Basin relief b) Absolute relief ratio c) Relative relief ratio d) Relief ratio e) Ruggedness Number f) Dissection Index	**08**
5	**Hydrogeology**	a) Water Budgeting b) Hydrological Characteristics i) Infiltration ii) Porosity iii) Runoff c) Aquifer and types of Aquifer	**08**
6	**Watershed Management & Planning**	a) Applications of GIS in Watershed management b) Integrated Watershed Management Programs – IWMP (India) and Jalyukt Shivar (Maharashtra) c) Perspective on recycle and reuse d) Rainwater Harvesting	**12**

Weightage

Marks	
Internal Assessment	**40** marks
External Assessment	**60** marks

Suggested readings:

1. Murthy J. V. S. (1994): Watershed Management in India, Wiley Eastern Ltd. New Delhi.
2. Paranjape S. and Other (1980): Water based Development, Bharat Gyan Vigyan Samithi, New Delhi.
3. Mutreja K. N. (1990): Applied Hydrology, Tata Mc Graw Hill Pub. Co. Ltd. New Delhi.
4. Shing R. J. (2000): Watershed planning and Management, Yash Publishing House, Bikaner.
5. Chanda B., Dattaa D., Mujumdar (2001): Digital Image Processing and Analysis, Prentice- Hall of India.
6. Prithvish Nag and M. Kudrat (1998): Digital Remote Sensing, Concept Publishing Co. New Delhi.
7. Basudeb Bhatta (2011): Remote Sensing and GIS, 2nd ed., Oxford University Press.
8. M. Anji Reddy: Text book of Remote Sensing and GIS, 3rd Ed., BS Publications, Hydrabad-72.

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New Syllabus M.A./M.Sc. Geography
Semester-III (CBCS Pattern)
Theory – Elective - Course

Gg. 303 B : Geographical Information System .

(With Effect from June 2022)

Total Marks-100 **Credit Points- 04** **Teaching Hours/Week: 04**
Clock Hours : 60

Course Objectives:

1) To understand the principles and concepts of GIS and its applications.
2) To acquire theoretical knowledge of coordinate systems used in GIS.
3) To aware the students about the data models used in GIS.
4) To make the students familiar with the various processes involved in GIS.
5) To acquaint the students with the various Geo-spatial analysis.
6) To make the students aware of different Geo-spatial data analysis methods used in GIS.

Course Outcomes:

After completing this course, the students will be able to

1) Acquaint with different basic concepts and applications of GIS.
2) Explain theoretical knowledge of coordinate systems used in GIS.
3) Built various data models used in GIS.
4) Familiar with the various processes involved in GIS.
5) Acquaint with the various Geo-spatial analysis.
6) Understand the different Geo-spatial data analysis methods used in GIS

Unit no.	Units	Sub-Units	Lectures
1	**Introduction to GIS**	1.1 Introduction and Definition 1.2 History of GIS 1.3 Components of GIS 1.4 GIS Operations 1.5 Applications of GIS in various fields	**10**
2	**Coordinate Systems**	2.1 Geographical Coordinate System 2.2 Map Projections 2.3 Commonly used Map Projections 2.4 Projected Coordinate Systems	**10**
3	**Data Models**	3.1 Spatial Data Models: 3.1.1 Raster Data Model 3.1.2 Vector Data Model 3.1.3 Comparison of Raster and Vector Data Models 3.2 Non-Spatial Data Model: 3.2.1 Data Base Management Systems 3.2.2 Attribute Data	**08**
4	**Process of GIS**	4.1 Introduction	**10**

		4.2 Data Capture/Data sources 4.3 Data Encoding Methods 4.4 Linking of Spatial & Non-Spatial Data 4.5 Organizing Data for Analysis	
5	**Geospatial Analysis**	5.1 Introduction 5.2 Geospatial data analysis 5.3 Integration and Modeling of spatial data	**10**
6	**Geospatial Data Analysis Methods**	6.1 Database Query 6.2 Geospatial Measurements 6.3 Overlay operations 6.4 Network Analysis 6.5 Surface Analysis 6.6 Geo-statistics 6.7 Geo-visualization	**12**

Weightage

Marks	
Internal Assessment	**40** marks
External Assessment	**60** marks

Suggested readings:

1) Basudeb Bhatta. (2011): Remote Sensing and GIS, 2nd ed., Oxford University Press.
2) C. P. Lo & Albert K. W. Yeung (2002) Concepts and techniques of Geographic Information System, Prentice Hall, India.
3) Chanda B. Dattaa D., Mujumdar : Digital Image Processing and Analysis, Prentice Hall of India 2001.
4) Demers M. N. (2008): Fundamentals of Geographic Information Systems 2nd ed., John Wiley & Sons.
5) Michael F. Goodchild (2002): Introduction to Geographic Information System and Science, John Wiley & Sons.
6) Kang- Tsung Chang (2002): Introduction to Geographical Information System, McGraw Hill.
7) P. A. Burrough & R.A. McDonnell (2000): Principles of Geographical Information System, Oxford University Press.
8) Roy P. S. (2000): Geographical Information Science

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New Syllabus M.A./M.Sc. Geography
Semester-III (CBCS Pattern)
Theory – Elective - Course

Gg. 303 C: Agricultural Geography

(With Effect from June 2022)

Total Marks-100 **Credit Points- 04** **Teaching Hours/Week: 04**
Clock Hours : 60

Course Objectives:

1. To know the students the overall importance of agriculture in global perspective.
2. To discuss environmental technological and social issues in agricultural sector with special reference to India.
3. To familiarize the students with the fundamental concepts in agricultural geography.

Course Outcomes:

1. To acquaint the students with the application of various theories and models in agricultural geography.
2. To understand various Determinants of agricultural activities.
3. To aware the students towards recent Trends in Agriculture.

Unit no	Units	Sub - Units	Lectures
1	**Introduction to Agricultural Geography**	1. Meaning and Definition 2 Nature, scope and significance. 3 Interdisciplinary relevance to other Branches. 4 Importance of agriculture in Indian Economy	**06**
2	**Fundamental Concepts**	Fundamental concepts in agricultural geography 2.1 Land use 2.1.1 Agricultural land use 2.1.2 Net sown area 2.1.3 Gross cropped area 2.2 Crops 2.2.1 Crop concentration 2.2.2 Crop diversification 2.2.3 Crop combination.	**12**
3	**Determinants of agricultural activities**	A) Physical determinants 1. Topography , altitude and slope 2. Climate – temperature, sunshine, frost, moisture, drought , snow, winds, non-seasonal Precipitation. 3 Soils	**12**

		B) Socio- economic determinants 1.Land tenancy 2. Size of holding and fragmentation of fields 3. Labour 4.Capital 5.Mechanization and equipments 6. Marketing facilities 7. Government policies	
4	**Concept & Techniques of delimitation of Agricultural Regions**	1. Crop Combination, 2. Crop Diversification. 3. Measurement of Agricultural Productivity. 4. Agricultural Efficiency. 5. Levels of Agricultural development.	**12**
5	**Models in Agricultural Geography**	A) Model : i) Meaning & Concept ii) Significance of Agricultural models iii) Limitations of Agricultural Models B) Classification of agricultural models i) Normative or Economic models ii) Descriptive models C) Von Thunen's Models & its modifications	**10**
6	**Recent Trends in Agriculture**	1. White revolution and livestock resources 2. Tissue culture 3. Poly house 4. Organic Farming 5. Agro-tourism 6. Agro forestry	**08**

Weightage

Marks	
Internal Assessment	**40** marks
External Assessment	**60** marks

Suggested readings:

1. Symons, Leslie (1970) – Agricultural Geography, G. Belt and Sons Ltd, London.
2. Morgan. W.B. & S.C. Manton (1971) – Agricultural Geography Methuen, London.
3. Randhawa, M.S. (1980) – A History of Agriculture in India Vols. I,II,III,IV ICAR, New Delhi.
4. Singh. J. and Dhillon S.S (1994) – Agricultural Geography, Tata McGraw Hill, Publishing Co.Ltd.
5. Majid Husain (2010) – Systematic Agricultural Geography, Rawat Publications, Jaipur.
6. Grigg, D.B.: The Agricultural Systems of the World. Cambridge University Press, New York 1974.

7. Morgan, W.B.: Agriculture in the Third World - A Spatial Analysis. Westview Press, Boulder, 1978.
8. Tarrant, J.R.: Agricultural Geography. Wiley, New York, 1974.
9. Aher A. B., Salunkhe V. (2015): Agriculture Geography, Diamond Publication, Pune.
10. Bayliss Smith, T. P. (1987): The Ecology of Agricultural Systems, Cambridge University Press, London.
11. Brown, L. R. (1990): The Changing World Food Prospects - The Nineties and Beyond. World Watch Institute, Washington D.C.
12. Grigg, D. B. (1974): The Agricultural Systems of the World, Cambridge University Press, New York.
13. Hartshorne, T.N. and Alexander, J.W. (1988): Economic Geography, Prentice Hall, New Delhi.
14. Singh, J. and Dhillon, S. S. (2004): Agricultural Geography, Tata McGraw Hill Pub., New Delhi.
15. Wigley, G. (1981): Tropical Agriculture: The Development of Production, 4 th Edition, Arnold, London.
16. Saptarshi P. G., More J. C., Ugale V. R., Musmade A. H. (2009): India A Geographical Analysis, Diamond, Pune.
17. Symons, Leslie (1970): Agricultural Geography, G. Belt and Sons Ltd, London.
18. Randhawa, M. S. (1980): A History of Agriculture in India Vols. I, II, III, IV ICAR, New Delhi.
19. Majid Husain (2010): Systematic Agricultural Geography, Rawat Publications, Jaipur.
20. K. Siddartha (2000): Economic Geography, Kisalaya Publication Pvt. Ltd, New Delhi.

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New Syllabus M.A./M.Sc. Geography
Semester-III (CBCS Pattern)
Practical – Core - Course

Gg. 304 : Practical in Remote Sensing – Interpretation of Aerial Photographs and Satellite Imageries (With Effect from June 2022)

(10 Students Per Batch.)

Total Marks-100 **Credit Points- 04** **Teaching Hours/Week: 08**
Clock Hours : 96

Course Objectives:

1. To provide an exposure to students about fundamentals of Remote Sensing.
2. To familiarize with the different remote sensing platforms and sensors.
3. To provide with an insight in to the fundamentals of photogrammetry and satellite data.
4. To acquainted with the basic principles and procedure of visual image interpretation.
5. To identify various objects appeared on the aerial photographs and satellite image with the help of their physical characteristics.
6. To enable students to learn further in the fields and develop skills in their own way through geospatial technology.

Course Outcomes: On completion of the course, students are expected to:

1. Understand the fundamentals of Remote Sensing.
2. Get familiar with the different remote sensing platforms and sensors.
3. Get an insight to the fundamentals of photogrammetry and satellite data.
4. Understand the basic principles and procedure of visual image interpretation.
5. Read or Interpret remotely sensed data and identify the different cultural and natural features from an aerial photograph or satellite image and prepare thematic maps.
6. Work with geospatial data to address practical societal problems.

Unit No.	Units	Sub Units	Practical hours
1	**Basic Principles of Remote Sensing**	**A)** Introduction **B)** Electromagnetic Remote Sensing Process **C)** Energy Source and its characteristics Energy Interactions with Earth's Surface Materials. a. Spectral Reflectance Curves. **D)** Types of Remote Sensing. a. Based on Platform: Terrestrial, Airborne & Space borne b. Based on Energy Source: Active & Passive Remote Sensing **E)** Multiband Imaging	**14**

2	**Remote Sensing Platforms and Sensors**	**A)** Introduction **B)** Imaging Sensor System. a. Multispectral Imaging Sensor Systems b.Thermal Sensing Systems c. Microwave Image Systems **C)** Earth Resources Satellites. a. Landsat Satellite Programme b. SPOT Satellite Programme c. Indian Remote Sensing Satellite (IRS) **D)** OCEANSAT-1 (IRS) **E)** IKONOS Satellite Series **F)** Latest Trends a. Quick Bird b. Cartosat-1 c. Resourcesat-1	**14**
3	**Fundamentals of Photogrammetry**	**A)** Introduction **B)** Types of Aerial Photographs: Vertical, Horizontal and Oblique. **C)** Determination of photo Scale. **D)** Determination of height of an object. **E)** Area measurement of photographs. **F)** Image Parallax: Characteristics of Image Parallax, Parallax Measurement. **G)** Relief Displacements. **H)** Floating Marks.	**14**
4	**Introduction to Visual Image Interpretation**	**A)** Introduction **B)** Basic Visual Image Interpretation Equipment: Lens/pocket stereoscopes, Mirror Stereoscopes, Zoom Stereoscopes. **C)** Elements of Image Interpretation: Shape, Size, Pattern, Tone, Texture, Shadow, Site **D)** Factors governing the quality of an image and interpretability.	**14**
5	**Visual Image Interpretation: Aerial Photographs**	**A)** Visual Interpretation of Aerial Photograph. (BW or colour) using Mirror Stereoscope. (Interpretation of minimum two photographs) a. Physiography / Relief features b. Vegetation c. Water bodies d. Land use Land cover e. Settlements f. Transportation **B)** Extraction and drawing of following natural or cultural features from the given photograph. a. Natural features - Relief features, Water bodies, Vegetation b. Cultural features – Transportation, Settlement, Agriculture etc.	**20**

6	**Visual Image Interpretation: Satellite Images**	**A)** Visual Interpretation of satellite images based on following keys - a. Natural Features – Relief, Water bodies, Vegetation b. Cultural Features – Agriculture, Settlement, Transportation, LULC (Interpretation of minimum two images) **B)** Extraction and drawing of following natural or cultural features from the given photograph. a. Natural features - Relief features, Water bodies, Vegetation b. Cultural features – Transportation, Settlement, Agriculture etc. **C)** Drawing land use land classification (LULC) map by tracing	**20**

Weightage	
Internal Assessment	**40 marks**
External Assessment	**60 marks**

Suggested Readings:

1. Agarwal C.S. and Garg P.K. (2002): Text Book on Remote Sensing, Wheeler Publishing Delhi.
2. Basudeb Bhatta (2014): 'Remote Sensing and GIS, Oxford University Press, New Delhi.
3. Campbell, J. B. (2002): Introduction to Remote Sensing, Taylor and Francis, London
4. Joseph, G. (2003): Fundamentals of Remote Sensing, University Press, Hyderabad
5. Lillesand, Kiefer, Chipman (2008): Remote Sensing and Image Interpretation, Wiley India Pvt. Ltd.
6. M. Anji Reddy (2008): Textbook of Remote Sensing and Geographical Information Systems, B. S. Publication, Hyderabad.
7. Sabins, F. F. (1996): Remote Sensing: Principles and Interpretation, W. H. Freeman and Company, San Francisco.
8. S. Nayak · S. Zlatanova (Eds.) (2008): Remote Sensing and GIS Technologies for Monitoringand Prediction of Disasters, Springer-Verlag Berlin Heidelberg.
9. Tempfi, K., Kerle, N., Huurneman, G. and Janssen, L. F. (Eds) (2009): Principles of Remote Sensing – An Introductory Text Book, The International Institute for Geoinformation Science – Netherlands.

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New Syllabus M.A./M.Sc. Geography
Semester-III (CBCS Pattern)
Practical – Core - Course

Gg. 305 : Practical of Computerize Data Analysis Techniques in Geography

(With Effect from June 2022)

(10 Students Per Batch.)

Total Marks-100 **Credit Points- 04** **Teaching Hours/Week: 08**
Clock Hours : 96

Course Objectives:

1) To introduce some basic computerized data analysis techniques to the students.
2) To understand role of computer in geographical data entry (tabulation), analysis and presentation.
3) To recognize and select appropriate data analysis technique for different Geographical data of various branches.

Course Outcomes:

1) Understand the excel and its function.
2) Enhance analytical skill of students.
3) Adopt computerized techniques and turn geographical data in cartographic techniques.

Unit No.	Units	Sub-Units	Practical Hours
1	**Introduction to Microsoft Excel Work Sheet and Presentation Techniques**	**A) Microsoft Excel:** a) Workbooks and Worksheets b) Data Analysis tools and Techniques i) Advanced Filter Command, ii) IF Condition Command iii) Conditional Formatting iv) By default Insert Function c) Development of Syntax on Formula Bar i) Mathematical and Statistical Operators ii) Application of Operators in formula development d) Data Presentation Techniques **B) Presentation Techniques:** a) Introduction to M.S. Power Point b) Preparation of Slides c) Maps and Graphs import techniques for slide show	**18**

2	**Data Analysis Techniques in Population Geography**	**A) Density**: i) Arithmetic Density of Population ii) Economic Density of Population iii) Agricultural Density of Population iv) Critical Density of Population **B) Measures:** i) Fertility Rates ii) Mortality Rate iii) Population Growth Rate iv) Literacy Rate v) Child-Women Ratio vi) Sex Ratio: Sex Ratio	**16**
3	**Data Analysis Techniques in Rural Settlement Geography**	A) Classification of Rural settlements or Villages According to Size of Population B) Dispersion of Rural Settlements**:** i) Bernhard's method ii) Demangeon method iii) Debouvrie's method C) Density of Rural Settlements D) Density of Urban Settlement	**16**
4	**Data Analysis Techniques in Urban Geography**	A) Growth of Urban Population B) Degree of Urbanization C) Functional Classification of Towns by Thompson D) Centrality Index by Christaller	**14**
5	**Data Analysis Techniques in Agricultural Geography**	A. Cropping Intensity B. Intensity of Irrigation C. Crop Concentration by Bhatia D. Crop Diversification by Bhatia E. Crop Combination by Weaver's	**18**
6	**Data Analysis Techniques in Climatology**	A) Intensity of Rainfall B) Presentation of Rainfall and Temperature Data C) Wind rose	**14**

Weightage	
Internal Assessment	**40 marks**
External Assessment	**60 marks**

Suggested Readings

1. Edward Arnold: "The Study of Urban Geography".
2. George Omura: Mastering Auto CAD, BPB Publication, b14 Conneaut place, New Delhi.
3. Grini Courter and Annette Marquis (1999): "OFFICE 2000" BPB Publication.

4. Hudson, F. S. (1976): “Geography of Settlement”.
5. Mandal, R. B.: “Statistic for Geography and Social Science”.
6. Masjid Husain “: Agricultural Geography”.
7. Michaele, E. and E. Hurse: ‘Transportation Geography”.
8. Monkhouse: “Maps and Diagram”.
9. Sing, J. and Dhillon (1984): “Agricultural Geography”.
10. Sing, R. L. “Readings in Rural Settlement Geography”.
11. Yeats, M. H. (1974): “An Introduction to Quantitative Analysis in Human Geography”.

Audit Course
Semester - III
Choose One out of
AC 301 (A) , AC 301 (B), AC 301 (C), AC 301 (D)
(Practical)

Total Marks-100 (Internal) Credit Points- 02 Teaching Hours/Week: 02
Total Teaching Hours: 30

AC-301(A): Computer Skills	
	Course Objectives: To inculcate different daily useful computer skills among students. **Learning Outcomes:** Students will be able to • Identify their lacunas about some computer skills and try to overcome the same. • Practice the learned computer skills in real life and do their jobs more effectively.
Unit	**Content**
1.	**Elements of Information Technology** • Information Types: Text, Audio, Video, and Image, storage formats • Components: Operating System, Hardware and Software, firmware • Devices: Computer, Mobile Phones, Tablet, Touch Screen, Scanner, Printer, Projector, smart boards • Processor & Memory: Processor functions, speed, Memory types: RAM /ROM /HDD /DVD-ROM/Flash drives, memory measurement metrics.
2	**Office Automation-Text Processing:** • Views: Normal View, Web Layout View, Print Layout View, Outline View, Reading Layout View • Working with Files: Create New Documents, Open Existing Documents, Save Documents to different formats, Rename Documents, Close Documents • Working with Text: Type and Insert Text, Highlight Text, Formatting Text, Delete Text, Spelling and Grammar, paragraphs, indentation, margins • Lists: Bulleted and Numbered Lists, • Tables: Insert Tables, Draw Tables, Nested Tables, Insert Rows and Columns, Move and Resize Tables, Moving the order of the column and/or rows inside a table, Table Properties • Page Margins, Gutter Margins, Indentations, Columns, Graphics, Print Documents, • Paragraph Formatting, Paragraph Attributes, Non-printing characters

	• Types of document files: RTF, PDF, DOCX etc
3	**Office Automation-Worksheet Data Processing:** • Spreadsheet Basics: Adding and Renaming Worksheets, Modifying Worksheets • Moving Through Cells, Adding Rows, Columns, and Cells, Resizing Rows and Columns, Selecting Cells, Moving and Copying Cells • Formulas and Functions: Formulas, Linking Worksheets, Basic Functions, Auto Sum, Sorting and Filtering: Basic Sorts, Complex Sorts, Auto-fill, Deleting Rows, Columns, and Cells • Charting: Chart Types, drawing charts, Ranges, formatting charts
4	**Office Automation- Presentation Techniques and slide shows:** • Create a new presentation, AutoContent Wizard, Design Template, Blank Presentation, Open an Existing Presentation, PowerPoint screen, Screen Layout • Working with slides: Insert a new slide, Notes, Slide layout, Apply a design template, Reorder Slides, Hide Slides, Hide Slide text, Add content, resize a placeholder or textbox, Move a placeholder or text box, Delete a placeholder or text box, Placeholder or Text box properties, Bulleted and numbered lists, Adding notes • Work with text: Add text and edit options, Format text, Copy text formatting, Replace fonts, Line spacing, Change case, Spelling check, Spelling options • Working with tables: Adding a table, Entering text, Deleting a table, Changing row width, Adding a row/column, Deleting a row/column, Combining cells ,Splitting a cell, Adding color to cells, To align text vertically in cells, To change table borders, Graphics, Add clip art, Add an image from a file, Save & Print, slide shows, slide animation/transitions.
5	**Internet & Applications:** • Computer Network Types: LAN, PAN, MAN, CAN, WAN, Defining and describing the Internet, Brief history, Browsing the Web, Hypertext and hyperlinks, browsers, Uniform resource locator • Internet Resources: Email, Parts of email, • Protecting the computer: Password protection, Viruses, Virus protection software, Updating the software, Scanning files, Net banking precautions. • Social Networking: Features, Social impact, emerging trends, issues, Social Networking sites: Facebook, Twitter, linkedin, orkut, online booking services • Online Resources: Wikipedia, Blog, Job portals, C.V. writing • e-learning: e-Books, e-Magazines, e-News papers, OCW(open course wares): Sakshat (NPTEL) portal, MIT courseware.
6	• Cloud Computing Basics: • Introduction to cloud computing

	• Cloud computing models: SAS, AAS, PAS • Examples of SAS, AAS, PAS (Drop Box, Google Drive, Google Docs, Office 365 Prezi, etc.)

Suggested Readings :

1. TCI, "Introduction to Computers and Application Software", Publisher: Jones & Bartlett Learning, 2010, ISBN: 1449609821, 9781449609825
2. Laura Story, Dawna Walls, "Microsoft Office 2010 Fundamentals", Publisher: Cengage Learning, 2010, ISBN: 0538472464, 9780538472463
3. June Jamrich Parsons, Dan Oja, "Computer Concepts Illustrated series", Edition 5,Publisher Course Technology, 2005, ISBN 0619273550, 9780619273552
4. Cloud computing online resources

AC-301(B): Cyber Security	
	Course Objectives: To make students aware of different daily useful cyber security skills/rules. **Learning Outcomes:** Students will be able to • Practice learned cyber security skills/rules in real life. • Provide guidance about cyber security skills/rules to their friends, parents and relatives.
Unit	**Content**
1.	**Networking Concepts Overview:** Basics of Communication Systems, Transmission Media, ISO/OSI and TCP/IP models, Network types: Local Area Networks, Wide Area Networks, Internetworking, Packet Formats, Wireless Networks: Wireless concepts, Advantages of Wireless, Wireless network architecture, Reasons to use wireless and Internet.
2	**Security Concepts:** Information Security Overview, Information Security Services, Types of Attacks, Goals for Security, E-commerce Security, Computer Forensics, Steganography. Importance of Physical Security, Biometric security & its types, Risk associated with improper physical access, Physical Security equipments. Passwords: Define passwords, Types of passwords, Passwords Storage – Windows & Linux.
3	**Security Threats and vulnerabilities:** Overview of Security threats, Hacking Techniques, Password Cracking, Types of password attacks, Insecure Network connections, Wi-Fi attacks & countermeasures, Information Warfare and Surveillance. Cyber crime: e-mail related cyber crimes, Social network related cyber crimes, Desktop related cyber crimes, Social Engineering related cyber crimes, Network related cyber crimes, Cyber terrorism, Banking crimes etc.
4	**Cryptography:** Understanding cryptography, Goals of cryptography, Types of cryptography, Applications of Cryptography, Use of Hash function in cryptography, Digital signature in cryptography, Public Key infrastructure,
5	**System &Network Security:**

	System Security: Desktop Security, email security: PGP and SMIME, Web Security: web authentication, Security certificates, SSL and SET, Network Security: Overview of IDS, Intrusion Detection Systems and Intrusion Prevention Systems, Overview of Firewalls, Types of Firewalls, VPN Security, Security in Multimedia Networks, Fax Security.
6	**OS Security:** OS Security Vulnerabilities updates and patches, OS integrity checks, Anti-virus software, Design of secure OS and OS hardening, configuring the OS for security, Trusted OS.
	Security Laws and Standards: Security laws genesis, International Scenario, Security Audit, IT Act 2000 and its amendments.

Suggested Readings :

1. Skills Factory, Certificate in Cyber Security, Text Book Special edition, Specially published for KBC NMU, Jalgaon
2. BPB Publication, "Fundamentals of Cyber Security", Mayank Bhushan, Rajkumar Singh Rathore, Aatif Jamshed
3. Create Space Independent Publishing Platform, "Cyber Security Basics", Don Franke, ISBN-13: 978-1522952190ISBN-10: 1522952195
4. Online references

AC-301C: Rain Water Harvesting

Course Objectives:

1) To create an awareness about water resource.
2) To make a scientific view about the water cycle and availability of water resource.
3) To develop the ability and get solution on various problems related to the water resource and their conservation.

Course Outcomes:

1) Acquire knowledge with importance of water resource.
2) Capability enhances towards various techniques of rain water harvesting.
3) Student will be aware about crucial problems of water scarcity and able towards solving the problem.

Unit No.	Units	Sub - Units	Lectures
• First 3 unit comprises theory for get the knowledge about course objectives. • Reading reference material for acquire new knowledge. • Unit 4 is practical based study (Case Study Project) made on the above knowledge. • Complete case study and submit project report during the semester end.			
1	**Water Resource**	C) Water Resource - VI. Definition of water resource. VII. Significance of water resource. VIII. Availability and distribution of water resource on the earth. IX. Water cycle. X. Precipitation.	**30**
2	**Rain Water Harvesting**	F) Groundwater – i. Meaning ii. Significance of groundwater. G) Rainwater Harvesting – i. Concept ii. Rain water harvesting system iii. Purpose of rain water harvesting iv. Advantages of rain water harvesting	
3	**Rain Water Harvesting Technology**	E) Rain water harvesting structure. F) Rain water harvesting technology in – i. Built-up areas – roof top harvesting, temple tanks, wells and radiator wells, parking lot storage, recreational park ponds. ii. Open areas – percolation tanks, infiltration galleries, community wells, farm ponds, ducts, anicuts across the streams. iii. Rain water harvesting: calculation (Volume of water harvested)	

4	**Case study of Rain Water Harvesting and Report**	• Each student carries out one case study of Rain Water Harvesting Project in their local area. Visit them, collect information/data, structure, system with all essential details related to the study. • Write a brief report on concerned Rain Water Harvesting technology with photographs, maps, diagrams and submit to the department. • Report should be minimum 15 pages including title page, certificate, acknowledgements etc. • Project report should be hand written or typographical form.	

Assessment Types	Marks
CA Internal (Actual Field visit , Preparation of Case Study Project Report, and Oral)	100
Total Marks	**100**

Suggested Readings:

1) Singh, J. S., Singh, S. P. and Gupta, S. R. 2014. Ecology, Environmental Science and Conservation. S. Chand Publishing, New Delhi.
2) Eldho, T. I. () : Lecture Series 1-10 : Watershed Management- Rain Water Harvesting, IIT Mumbai.
3) Kalimuthu, A. (2016) : A Practical Guide on Roof Top Rain Water Harvesting, World Vision, India.
4) Government of India (2002) : Rain Water Harvesting and Conservation- Manual, Central Public Work Department, Government of India, New Delhi.
5) Rain Water Harvesting (2015), Indian Railways Institute of Civil Engineering, Pune.
6) Rain Water Harvesting Handbook, African Development Bank.
7) Singh, Anupam &Eldho, T.I. & Prinz, D. (2002). Integrated watershed approach for combating drought in a semi-arid region of India: the case of Jhabua watershed. Water science and technology : a journal of the International Association on Water Pollution Research. 46. 85-92. 10.2166/wst.2002.0666.
8) file:///C:/Users/docsc/Downloads/pdffox.com_rainwater-harvesting-rainwater-harvesting.pdf
9) https://www.mwe.go.ug/sites/default/files/library/Rain%20Water%20Harvesting%20Handbook.pdf
10) https://www.iricen.gov.in/iricen/books_jquery/rain_water_harvesting.pdf
11) https://www.pseau.org/outils/ouvrages/bafd_rainwater_harvesting_handbook.pdf

AC-301 D- Geo-tourism

Course objectives:

1. To understand the evolution of geographical sites and situations as concern to tourism.
2. To generalize the valuable contribution of geographical sites in global tourism activities
3. To study the major geo-tourist sites in India.
4. To help the students for preparation of competitive examinations as well as general knowledge about the region.
5. To elaborate the trends of tourism activities and geographical perspectives.

Course Outcomes:

Through the study of this course, the student will be able to:

1. Distinguish and identify the potential geological sites of tourist interest.
2. Have a good knowledge on the spectacular (e.g. geomorphic landforms, structures, processes) as well as intrinsic sites, major time boundaries, fossil sites, geological sites etc.
3. Understand the economic aspects and develop ability to link the geo-spots with other tourist destinations in a theme.
4. Discussing relationship of geography with tourism activities and its relationships.

Unit No.	Units	Sub - Units	Lectures
1	**Introduction to Geo-Tourism**	A) Geo-tourism : Meaning, Concept, B) Nature and Scope of Geotourism C) Characteristics and international , national perspectives, Eco-tourism and Geo-tourism	**06**
2	**Aspects of Geo-tourism : values and threats**	A) Geology and Tourism B) Geo-diversity and Geo-heritage C) Geo-conservation and their relationship to geo-tourism, D) Geo-tourism and cultural heritage, E) The application of geographical information systems in geo-tourism	**06**
3	**Preparation of Geotourism Field Study**	A) Geotourism Site Selection B) Proper Planning for visits C) Precautions during visits D) Data/information Collection during the visits E) Project/Report writing steps and Stages	**06**
4	**Case Study and Project Report**	A) Each student carries out one case study as a Geo-tourism project. Field visit is mandatory, based on collection of information, data, structure, system with all essential details related to the study.	**12**

		B) Write a brief report on concerned topic with photographs, map, and diagrams and submit to the department. C) Report should be minimum 15 pages including title page, certificate, acknowledgement etc. D) Project report should be hand written or computerized.	

Assessment Type	Marks
CA Internal (Actual Field visit , Preparation of Project Report, and Oral)	100
Total Marks	**100**

Suggested Readings:

1. The Principles of Geotourism, Anze Chen, Young C.Y. Ng, and Yunting Lu (Springer), (2015).
2. Global Geotourism perspectives, Dowling, R. K ., & Newsome, D. (Eds) USA: Good fellow Publishers Limited (2010).
3. Geotourism, Dowling, R. K ., & Newsome, D. (Eds) Elsevier Butterworth-Heinemann (2006).
4. Appreciating Physical Landscapes: Three Hundred Years of Geotourism, T.A .Hose (Ed.), Geological Society Special Publication No. 417, London (2016).
5. Geoheritage and Geotourism- a European Perspective, Thomas A . Hose (Ed) Boydell, Press Woodbridge, U K .
6. Handbook on Geotourism, Ross Dowling & David Newsome (Eds.) Edward Elgar Publishing (2018).
7. A monograph on National Geoheritage Monuments of India. Indian National Trust for Art and Cultural Heritage(IN T A C H) Natural Heritage Division, New Delhi (2016).
8. National Geological Monuments. Geological Survey of India, Kolkata, Special Publication, No.6 1 (2001).
9. Landscapes and Landforms of India, K ale, V. S. (ed) Springer, Dordrecht (2014).
10. History of Geo-conservation, C. V. Burek and C.D. Prosser (Eds.) Special Publication
11. Official Website of Geological Survey of India.
12. T.A. Hose (Ed.) (2016). Appreciating Physical Landscapes: Three Hundred Years of Geotourism, Geological Society Special Publication No. 417, London.
13. Thomas A. Hose (Ed.).Geoheritage and Geotourism- a European Perspective, Thomas A. Hose (Ed) Boydell Press Woodbridge, UK
14. Ross Dowling & David Newsome (Eds) (2018). Handbook on Geotourism, Edward Elgar Publishing

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New Syllabus M.A./M.Sc. Geography
Semester-IV (CBCS Pattern)
Theory - Core-Course

Gg. 401: Geomorphology

(With Effect from June 2022)

Total Marks-100 **Credit Points- 04** **Teaching Hours/Week: 04**
Clock Hours : 60

Course Objectives:

1. This course introduces the students with basic knowledge of Earth surface processes.
2. The course provides an overview of landforms, its formation processes, and landscape evolution.
3. This course shed light on various landform formation processes and how these depend on climate, tectonic regimes, and time.
4. This course conveys an understanding of landform formation processes on different temporal and spatial magnitudes.

Course Outcomes:

1. The student can explain different theories and models for landscape evolution.
2. The student can understand the development of micro to mega scale landforms and their lifespans.
3. The student can assess the mode of formation, age and history for landforms.
4. The student can search and find relevant information to elucidate geomorphological problems.

Unit No.	Units	Sub-Units	Lectures
1	**Introduction**	A. Definitions, Nature and Scope B. Fundamental Concepts I. Uniformitarianism II. Geological structure III. Geomorphological processes C. Theories of Landform Development I. Theory of W. M. Davis II. Theory of W. Penck D. Geological Time Scale	**10**
2	**Earth Movements**	A. Continental Drift Theory B. Plate Tectonic theory C. Endogenic Forces I. Epiorogenic and Orogenic Movements II. Compression, Tension III. Folds, Types and Landforms	**10**

		IV. Faults, Types and Landforms	
3	**Weathering, Mass Movement and slopes**	A. Meaning and concept of weathering B. Controlling factors of weathering C. Types of weathering processes I. Physical weathering II. Chemical weathering III. Biotic weathering D. Meaning and concept of mass movement E. Types of mass movement F. Meaning and concept of Slope G. Elements of Slopes I. Convex Slope II. Free Face Slope III. Constant or Talus Slope IV. Concave Slope	**12**
4	**Fluvial Processes and Landforms**	A. The Fluvial System B. Fluvial Erosion I. Process of Erosion II. Erosional Landforms C. Transportation by Rivers D. Deposition by Rivers I. Deposition Process II. Depositional Landforms	**10**
5	**Coastal Processes and Landforms**	A. Waves, tides, and currents B. Coastal processes C. Erosional coastal landforms I. Cliffs II. caves III. other erosional coastal landforms A. Depositional coastal landforms I. Beaches II. Bars III. Barriers IV. other depositional coastal landforms	**10**
6	**Aeolian Processes and Landforms**	A. Aeolian environments B. Erosional works of wind C. Erosional landforms D. Transportational works of wind E. Depositional work of wind F. Depositional landforms G. Fluvial desert landforms	**08**

Weightage of Marks: Equal Marks to all Topics

Weightage

Marks	
Internal Assessment	**40** marks
External Assessment	**60** marks

Suggested readings:

1. Savindra Singh (2005): "Geomorphology", Prayag Pustak Bhawan, Allahabad, India.
2. Thornbury, W.D. (1960) "Principles of Geomorphology", John Wiley and Sons, New York.
3. Chorley R. J., Schumm, S. A. and Sugen E.E. (1984): "Geomorphology", Methuen, London.
4. Kale V. S. and Gupta, A (2001); "Introduction to Geomorphology", Orient Longman, Calcutta.
5. Spark B.W. (1972): "Geomorphology", Longman, New York.
6. Ollier, C. D. (1981): "Tectonics and Landforms", Longman, London.
7. Strahler A. H. and Strahler, A.N. (1998): "Introducing Physical Geography", John Wiley and Sons, Inc. New York.
8. Wooldridge and Morgan (1959): "An outline of geomorphology: the physical basis of geography", Longman, New York.

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Semester-IV (CBCS Pattern)
Theory - Core-Course

Gg. 402: Climatology

(With Effect from June 2022)

Total Marks-100 **Credit Points- 04** **Teaching Hours/Week: 04**
Clock Hours : 60

Course Objectives:

1. To acquaint the students with basic knowledge of atmosphere, weather and climate.
2. To know the fundamental concepts of climatology and the significance of weather.
3. To understand various weather phenomena.
4. To identify climatic differentiation on the earth.
5. To acquire the knowledge of weather forecasting.
6. The explain the factors determining climate and its changes

Course Outcomes:

On completion of the course the student should have the following learning outcomes defined in terms of knowledge, skills and general competence:

1. The students should be able to differentiate between weather and climate.
2. The student is able to interpret Structure and composition of atmosphere.
3. The students should be able to understand the horizontal and vertical distribution of temperature.
4. The students should be able to describe the relationship between air pressure and wind direction in cyclonic and anticyclonic movement.
5. The students should be able to describe tropical air masses and how they move and to describe what happens when different air masses meet.
6. The students should be able to explain how storms form, the relationship between jet stream position and storm movement, and make the distinction between warm fronts and cold fronts.

Unit No.	Units	Sub-Units	Lectures
1	**Introduction**	A) Weather and Climate i) Meaning and concept ii) Elements iii) Role of Climate in human life B) Definition, Nature and Scope of Climatology C) Sub-divisions of Climatology (Physical, Regional, Applied) D) Atmosphere – Structure and composition	**08**

2	**Insolation and Temperature**	A) Insolation i) Meaning and definition of Insolation ,Solar constant and Albedo of the earth ii) Factors affecting the distribution of Insolation iii) Effects of atmosphere (Scattering, Diffusion, Reflecting and Absorption B)Temperature i) Heating and Cooling of Atmosphere – a)Conduction b) Radiation c) Convection ii) Distribution of Temperature- Horizontal and Vertical iii) Factors affecting the distribution v) Inversion of Temperature	16
3	**Atmospheric Pressure and Winds**	A) Atmospheric Pressure i) Formation of pressure belts ii) Shifting of pressure belts and their effects B) Winds i) Pressure gradient force, Carioles force, Geostrophic winds ii) Types of Winds a. Planetary winds b. Local winds (Land and Sea breezes) c. Seasonal winds - monsoon	08
4	**Humidity and Precipitation**	A) Humidity – Concept and types B) Process of evaporation, condensation & precipitation C) Forms of precipitation - mist, fog, rain, snow, hail, sleet, etc. D) Types of rainfall - convectional, orographic and cyclonic	8
5	**Air masses, Atmospheric Disturbances &Climatic Classification**	A) Air masses i) Definition, source regions ii) Classification iii) Modifications of Air masses (mechanical and thermodynamic) iv) Characteristics and types of fronts B) Atmospheric Disturbances-Cyclones and Anticyclones (Tropical & Temperate), Thunderstorms, Jet Streams	**12**

		C)Climatic classification- Koppen's classification (Basis, types, merits and demerits)	
6	**Origin of Monsoon** **And climate change**	A) Asian monsoon- East and Southasian monsoon i)classical theory of Indian monsoon B)Climat change-i) Impacts of climate change on Environment and agriculture -special reference to India ii)Government initiatives and public participation to mitigate climate change	08

Weightage

Marks	
Internal Assessment	**40** marks
External Assessment	**60** marks

Suggested readings:

1. Barura, A.K. (2005), "Climatology", Dominant Publishers & Distributors, New Delhi.
2. Barry, R.G. and Chorley R.J., "Atmosphere, Weather and Climate"
3. Byers, R.H. (1974), "General Meteorology", McGraw Hill, New York.
4. Critchfield, H.J. (1993), "General Climatology", Prentice Hall, New Delhi, India
5. Critchfield, H.J, (2004) : Principles of Climatology; Prentice Hall, London.
6. Das, P.K (1991), "The Monsoon" , National Book Trust, New Delhi.
7. K. Siddhartha (2011), "Atmosphere Weather & Climate – A text book of Climatology", Kisalaya Publications Pvt. Ltd., New Delhi.
8. Lal, D.S.(2011), "Climatology", ShardaPustakBhawan, Allahabad.
9. Sing Savindra, (2015),Climatology, PravlikaPublications ,Allahbad.

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New Syllabus M.A./M.Sc. Geography
Semester-IV (CBCS Pattern)
Theory Elective-Course

Gg. 403(A) : Geography of Rural Settlements

(With Effect from June 2022)

Total Marks-100 **Credit Points- 04** **Teaching Hours/Week: 04**
Clock Hours : 60

Course Objectives:

1. To study the essential concepts of geography of rural settlement.
2. To understand the relationship between house types with relief, climate and building materials.
3. To study the distributional patterns of rural settlement.
4. To study the rural morphology and rural functions with special reference to India

Course Outcomes:

1. The present paper shall enhance the knowledge of students about the historical development, patterns, types and functional systems of rural settlements.
2. Students will understand why people settle in certain areas.
3. Students will understand the needs of humans and how these needs impact the physical environment.

Unit No.	Units	Sub -Units	Lectures
1	**Geography of Rural Settlements**	A) Definition and Concept of Rural Settlements B) Nature and Scope C) Evolution of rural settlements D) Significance and Development of Rural Settlements E) Approaches to Settlement Geography	**8**
2	**Growth and Distribution**	A) Site, Situation & Location a. Factors affecting distribution of Rural Settlements b. Dispersion and nucleation, factors affecting dispersion and nucleation B) Growth of Settlements: a. Factors affecting growth of settlements - System of land division, - water rights system of agriculture, - land occupancy system	**10**
3	**Factors of Rural Land**	A. Factors Affecting Rural Land Use a. Social, economic, and political	**8**

	Use And Theory	b. Intensity of Land use c. Labour cost d. Marketing of product B. Theory: - Von Thunen- A Model of Agricultural Land Use	
4	**Types and Pattern of Rural Settlements**	A. Spatio-temporal Dimensions and Morphogenesis of Rural Settlement B. Site and Situation of Rural settlements C. Size and Spacing of Rural Settlement D. Types and Pattern of Rural Settlement E. Rural Settlements in Maharashtra: a. House types b. Settlement patterns	**10**
5	**Morphogenesis, Transformation and Migration of Rural Settlements**	A) Morphogenesis a. Social b. Cultural c. Economic organization within villages B) Transformation a. Socio-economic transformation in rural areas. C) Migration a. Definition, Causes & Consequence of migration in rural areas b. Seasonal Migration	**12**
6	**Rural Settlements in India & Planning**	A) Distribution and density of rural settlements in India B) Structure of house and building materials in India, special reference of Maharashtra C) Regional variations in rural settlement patterns in India D) Morphology of rural settlement in India E) Various Aspects of Rural Planning: Land use, Transport, Amenities, Population, Market, Environment & Agricultural policy	**12**

Weightage

Marks	
Internal Assessment	**40** marks
External Assessment	**60** marks

Suggested readings:

1. Desphpande, C. D. (2005): "Cities: A Geographical Study", Translated by V. G. Amrite, Manan Prakashan, Mumbai
2. Gharpure, V. (2013): "Nagari Bhugol", (Marathi) Pimpalapure and Company Publishers, Nagpur
3. Gharpure, V. (2013): "Vasti Bhugol", (Marathi) Pimpalapure and Company Publishers, Nagpur
4. Gharpure, V. (2017): "Manavi Bhugol", (Marathi) Pimpalapure and Company Publishers, Nagpur
5. Ghosh. S. (2015): "Introduction to Settlement Geography", Orient Blackswan Private Limited, Hyderabad
6. Jyptirmoy Sen (2007): A Text Book of Social and Cultural Geography," Kalyan Publsiher, New Delhi.
7. Knowles, R and Wareing, J. (1996): "Economic and Social Geography", the Made Simple Series, Rupa & Co., Calcutta
8. Leong, Goh-Cheng and Morgan, G. (1994): "Human and Economic Geography", Oxford University Press, Oxford
9. Alam S. M. et. al. (1982): Settlement system of India, Oxford and IBH Publication New Delhi.
10. Doniel P. and Hopkinson M. (1982): The geography of settlement, Oliver & Byod, Edinburgh.
11. Hudson F. S. (1976): A Geography of Settlement, Macdonald and Evans, New York.
12. Rao R. N. (1986): Strategy for Integrated Rural Development, B.R. Publication, Delhi.
13. Rapoport A. (1969): House form and Culture, Prentice Hall, New Jersey.
14. Srinivas M.N. (1968): Village India, Asia Publication House, Bombay.
15. Wanmati S. (1983): Service Centres in Rural India, B.R. Publication, Delhi.
16. Singh R. L. Edt. (1975): Reading in Rural Settlement Geography.

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Semester-IV (CBCS Pattern)
Theory – Elective - Course

Gg. 403(B) : Geography of Resources

(With Effect from June 2022)

Total Marks-100 **Credit Points- 04** **Teaching Hours/Week: 04**
Clock Hours : 60

Course Objectives:

1) To introduce the students of the basic concepts in Geography of Resources.
2) To acquaint the students with fundamental concept of resources.
3) To aware the students about the problems and utilization of Resources.
4) To understand about conservation of resources for sustainable development.
5) To aware the students about use of resources with prudence.

Course Outcomes:

After Completion of this course the student will be able to,
1) To understand the concepts in Geography of Resources.
2) Student able to evaluate different models of resources utilization.
3) Student compare the how to use of different resources.
4) Student know the various problems of resources.

Unit No.	Units	Sub – Units	Lectures
1	**Introduction to Resource Geography**	1.1 Meaning and Concept of Resource Geography 1.2 Nature and Scope of Resource Geography 1.3 Concepts of Resources : Adequacy and Scarcity 1.4 Components of resources : Natural and Human 1.5 Importance of the Study of Resource Geography	**10**
2	**Classification of Resources**	2.1 Basis of classification of Resources a) Renewable Resources b) Non – Renewable Resources c) Biotic Resources d) Abiotic Resources	**8**
		3.1 Distribution and Production of	

3	**Renewable and Non Renewable Resources**	Renewable and Non- Renewable Resources in India. a) Solar b) Wind c) Hydel power d) Mineral Oil e) Coal 3.2 Problems and management of Renewable and non- renewable Resources	**12**
4	**Biotic and Abiotic Resources**	4.1 Distribution and Production of Biotic & Abiotic Resources in India a) Forest b) Marine c) Water d) Minerals -Iron ore, Bauxite 4.2 Problems and Management of Biotic and Abiotic Resources	**10**
5	**Problems of Resource Appraisal**	5.1 Population Pressure on Resources 5.2 Models of Resource Utilization- Von-Thunen, M. Smith 5.3 Resource Depletion and emerging issues: a) Desertification b) Loss of Biodiversity d) Water Scarcity and Conflicts e) Energy Crises	**10**
6	**Conservation and Management of Resources**	6.1 Concepts and Methods of conservation 6.2 Conservation of Management of Resources in India i.e. Forest, Land and Water. 6.3 Integrated Resource Development 6.4 Sustainable Development and Conservation of Resources.	**10**

Weightage

Marks	
Internal Assessment	**40** marks
External Assessment	**60** marks

Suggested readings:

1) Burton I. and Kates, R.W. (ed) Readings in Resource Management and Conservation, 1965.
2) Central Ground Water Board – http://www.cgwb.gov.in/
3) Dr. Vitthal Gharpure : " Sadhansampatti Bhugol", Pimpalapure and Company Publishers, Nagpur.
4) Ground Surveys and Development Agency – https://gsda.maharashtra.gov.in/
5) Holechek J.L. et al : Natural Resources : Ecology Economics and policy, prentice Hall, New Jersey, 2000.
6) Kates R.W. and Burton, I. (ed) : Geography Resources and Environment, Vol. II, University of Chicago press, Chicago, 1986.
7) Khullar D.R. (2017) India - A comprehensive Geography, kalyani publishers, New Delhi.
8) Mc. Laren D.J. and Skinnet, B.J. (ed) : Resources and World Development, John Wiley & Sons, New York, 1986.
9) Maharashtra Development Annual Report.
10) Mather A.S. and Chapman, K. : Environmental Resources, Longman Scientific and Technical, London, 1995.
11) Negi B.S. (1997): " Geography of Resources", Kedarnath Ramnath, Meerut.
12) Newson M.D. : Land, Water and Development, River basin Systems and Management, Rutledge London, 1991.
13) Prof. D.V. Patil and Sau Jayshri Patil : " Sadhansampatti Bhugol.
14) Qwen S. and Qwens, P.L. : Environment, Resources and Conservation, Cambridge University Press, New York 1991.
15) Ramesh A: Resources Geography.
16) Ray S. (2008) : " National Resources, Organization and Technology Linkages".
17) Rees J. : Natural Resources : Allocation, Economics and Policy Methuen, London, 1988.
18) Redclift M. : Sustainable Development : Exploring the Contraction, Methuen London, 1987.
19) Simmons I.G. : Earth, Air and Water Resources and Environment In Late 20th Century, Edward Arnold, 1991.
20) Skinner, B.J. (1969) : " Earth Resources", Prentice Hall, Englewood Cliffs, N.J.
21) Thomas Alan et al : Environmental Policies & NGO Influence, Rutledge London, 1995.

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Semester-IV (CBCS Pattern)
Theory - Elective-Course

Gg. 403(C) : Industrial Geography

(With Effect from June 2022)

Total Marks-100 **Credit Points- 04** **Teaching Hours/Week: 04**
Clock Hours : 60

Course Objectives:

1) To acquaint the students with stages of economic process.
2) To introduce the nature, development and significance of manufacturing industries and its links with the world economy.
3) To understand the role of industries in the economic development of India.
4) To understand the location of major manufacturing activities with the support of various industrial location theories.
5) To produce skilled expert in the field of industry.
6) To impart knowledge on advances and challenges in Geographical challenges.

Course Outcomes:

After completion of this course, students will be able to-

1) Suggest locations of industries with the help of factors of industrial location.
2) Find out the advantages and related problems of industrialization.
3) Identify the industrial regions of selected countries.
4) Acquire knowledge about world selected industries.
5) Acquire knowledge about social media network and industries.

Unit No.	Units	Sub - Units	Lectures
1	**Introduction to Industrial Geography**	1.1 Definition and concept of Industrial Geography 1.2 Nature and Scope of Industrial Geography 1.3 Approaches to the study of Industrial Geography 1.4 Social media network and Industries	**10**
2	**Location of Industries**	Factors of Industrial location 2.1 Primary: Raw material, Labour, Transport, Market, Power. 2.2 Secondary: Government policy (Role), Capital, Infrastructure facilities & external economics, Proper industrial	**08**

		climate, Required site condition	
3	**Theories of Industrial location and classification of Industries**	3.1 Theories of Industrial location 3.1.1 Alfred Weber 3.1.2 August Losch 3.2 Classification of Industries: 3.2.1 Small Industries 3.2.2 Medium Industries 3.2.3 Large Industries	**10**
4	**World distribution of selected Industries**	4.1 Iron & steel Industry 4.2 Cotton Textile Industry 4.3 Information Technology Industry 4.4 Engineering Industry 4.4.1 Automobile Industry 4.4.2 Aircraft Industry 4.4.3 Defence Industry	**12**
5	**Industrial regions and Concepts**	5.1 Major Industrial regions in world 5.1.1 India 5.1.2 Japan 5.1.3 U.S.A. 5.2 Concepts 5.2.1 Location quotient 5.2.2 Index of concentration 5.2.3 Scatter diagram	**12**
6	**Advantages of Industrialization and related problems**	6.1 Advantages of industrialization 6.2 World industrial problems 6.2.1 Industrial problems in developed countries 6.2.2. Industrial problems in developing countries	**08**

Weightage

Marks	
Internal Assessment	**40** marks
External Assessment	**60** marks

Suggested readings:

1. Mather J. R.: Climatology (1974): Fundamentals and Application. McGraw Hill New York 2) Hobbs, John E (1980): Applied Climatology, Dawson West View Press.
2. Oliver, John E. (1973): Climate and Mavis Environment, John Wiley and Sons, New York. 4) Geiger, Rudolf, (1966): The climate near the Ground, Hardward University Press.
3. Lal M. (ed.) (1981): Climatology, Selected Application, V .H. Winston and Sons, London. 6) Alexander, J. W. (1998): Economic Geography, Prentice Hall, Englewood Cliffs.
4. Alexanderson, C. (1967): Geography of Manufacturing, Prentice Hall, Bombay.
5. Hoover, E.M. (1948): The Location and Space Economy, McGraw Hill, New York.
6. Isard, W. (1956): Methods of Regional Analysis, The Technology Press of M.I.T. & John Wiley & Sons, New York.
7. Miller, E. (1962): Geography of Manufacturing, Prentice Hall, Englewood Cliffs, New Jersey.
8. Weber, Alfred (1957) Theory of Location of Industries, Chicago University Press, Chicago.
9. Goh Cheng Leong (1997): Human and Economic Geography, Oxford University Press, New York.
10. Truman, A. Harishorn, John W. Alexander (2000) "Economic Geography", Prentice Hall of India Ltd., New Delhi.
11. Thoman, R. S., Conkling E. C. and Yeates, M. H. (1968): Geography of Economic Activity, McGraw Hill Book Company.
12. Siddharth K (2017): Economic Geography Kitab Mahal, Allahabad.
13. Husain M. (1994): Industrial Geography, Anmol Publications Pvt ltd. Daryaganj, New Delhi
14. Sadhukhan S.K (1994): Economic Geography S. Chand and company ltd. Ram nagar, New Delhi
15. A. P. Chaudhari., Archana Chaudhari (2011): Industrial Geography, Prashant publication, Jalgaon.
16. M. A. Khandave (1979): Industrial Geography. Continental Publication, Pune-30.

Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon
New Syllabus M.A./M.Sc. Geography
Semester-IV (CBCS Pattern)
Practical – Core - Course

Gg. 404 : Practical in Physical Geography

(With Effect from June 2022)

(10 Students Per Batch.)

Total Marks-100 **Credit Points- 04** **Teaching Hours/Week: 08**
Clock Hours : 96

Course Objectives:

5. To introduce the students with basic knowledge of techniques in physical geography.
6. To know the importance role of physical geography in applied research.
7. To prepare the students for better planning of watershed.
8. To understand and evaluate the spatial patterns and processes in physical geography.

Course Outcomes:

1. Enhance interpretative skills of the students about techniques in physical geography.
2. Identifying the natural phenomena with the help of techniques in physical geography.
3. This course will place a strong emphasis on practical experience about physical geography
4. This course will give you an integrated scientific understanding of the earth surface & climate.

Unit No.	Units	Sub-Units	Lectures
1	**Drainage Basin & Catchment Area**	A) Delineation of Drainage Basin B) Delineation of Drainage network C) Measurement of drainage basin catchment area D) Drainage network hierarchy I. Strahler's stream ordering E) Longitudinal profile F) Cross Profile	**16**
2	**Morphometric Analysis: Linear Aspects**	A) Laws of drainage composition a) Law of stream order I. Measurement of order wise stream number II. Stream number v/s Stream order. (Preparation of graph) III. Bifurcation ratio b) Law of stream length I. Measurement of stream length and average stream length. II. Stream order v/s average stream length.	**16**

		(Preparation of graph) III. Length Ratio B) Sinuosity Indices I. S. A. Schumm's model II. J. E. Muller's model	
3	**Morphometric Analysis: Areal Aspects**	A) Geometry of Basin Shape I. Horton's form factor II. Stoddart's Ellipticity Index III. V. C. Miller's Circularity Index IV. S. A. Schumm's Elongation Ratio B) Calculation of Stream Frequency C) Calculation of Drainage Density	**16**
4	**Morphometric Analysis: Relief Aspects**	A) Relative Relief B) Dissection Index C) Slope Analysis D) Hypsometric curve	**14**
5	**Climatic Maps & Diagrams**	A) Construction and interpretation of wind rose B) Construction and interpretation of climograph C) Construction and interpretation of Hythergraph D) Construction of Isohyets Map E) Construction of Isotherms Map	**16**
6	**Climatic Classification & Calculations**	A) Calculation of Relative Humidity B) Calculation of Rainfall Intensity C) Estimation of Potential Evapotranaspiration. (Thornwaite's Method.) D) To find out the mean rainfall for a given drainage basin by isohyetal method. E) Determination of climatic type by using Koppen's scheme of classification.	**18**

Weightage

Marks	
Internal Assessment	**40** marks
External Assessment	**60** marks

Suggested Readings :

1. Monkhouse F. J. & Wilkinson H. R. (1976): "Maps & Diagrams" Methune & Co. London.
2. King C. A. M. (1966): "Techniques in Geomorphology", Edward Arnold, London.

3. Savindra Singh (2005): “Geomorphology”, Prayag Pustak Bhawan, Allahabad, India.
4. Savindra Singh (2005): “Climatology”, Prayag Pustak Bhawan, Allahabad, India.
5. Singh Gopal (Rep. 2010): “Map Work and Practical Geography”, Vikas Publishing House Pvt Ltd.
6. Singh L. R. (2011): “Fundamentals of Practical Geography”, Sharda Pustak Bhawan.
7. Rana P. B. Singh, R.L. Singh (Rep. 2009): “Elements of Practical Geography”, Kalyani Publisher.
8. P. Saha and P. Basu (2006): “Advanced Practical Geography”, Books and Allied Publication, Kolkata, India

Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon
New Syllabus M.A./M.Sc. Geography
Semester-IV (CBCS Pattern)
Core - Course

Gg. 405 : Project Work

(With Effect from June 2022)

(10 Students Per Batch.)

Total Marks-100 **Credit Points- 04** **Teaching Hours/Week: 08**
Clock Hours : 60

Course Objectives:

1. To motivate the students towards Research.
2. To understand the various problems in the field of Geography.
3. To develop the skill in statistical as well as cartographic techniques.
4. To enhance analytical thinking and report writing ability of the students.

Course Outcomes:

1. Students will acquire proficiency and skills in research techniques.
2. Students will aware about various problems related to geography through their critical thinking.
3. Students able to collect, analyse and interpret the primary as well as secondary data
4. Enhance capability and enthusiasm for self-improvement through continuous professional development and life-long learning.

Project Work & Report.			
Unit	**Sub - Units**	**Marks**	**Lectures**
Project Work & Report (Each student selects separate topic)	-The project report on various geographical topics (especially related to the problems in concerned local region i.e. village/Tahsil/district/khandesh level) will be a comprehensive work based on conceptual aspects, field work, analysis of primary and secondary data in the laboratory. -Students are required to select an exploratory topic of geographical importance based on empirical evidences of literature. They are expected to carry out fieldwork & generate primary data or collect secondary data, analyze it & prepare a Project Report to submit at the time of examination. • Project Work do with following steps-	100	60

	➢ Selection of the topic ➢ Design study plan ➢ Field work (if applicable) ➢ Collection of data ➢ Analysis and interpretation of data ➢ Report writing ➢ Submission etc.		

Internal Marks

Attendance & Behaviour	10
Participation in Field Work/Data Collection	30
Total Internal Marks	**40**

External Marks

Project Report	**50**
Presentation with PPT (Viva-Voce)	**10**
Total External Marks	**60**

- **General Guide Lines for the Project Work, Writing Report& Submission of Project Work Report :-**
  1. A student should individually carry out project work and prepare report on one topic.
  2. Guide teacher guided to the students about research methodology for conduct the project work.
  3. The final project report should cover the following aspects.
     A. Title Pages-
        i. Title Page
        ii. Certificate
        iii. Acknowledgement
        iv. List of tables/maps/photographs etc.
        v. Index
     B. Main Text-
        i. Introduction to the problem.
        ii. Aims and objectives of the study.
        iii. Methodology
        iv. Analysis, description and interpretation.
        v. Results

vi. Conclusions

C. End Matter

i. Bibliography

ii. Appendices

4. Every table, figure, maps, photograph should have a caption and with references.
5. The list of references should be given at the end and all the references should be complete in all respects (author(s)) name, year, title of the article or book, name of the journal, name of the publisher of the book and place of publication, volume of journal and page numbers).

Example-

Wagh, S. A. (2015) : Physical Geography, Atharva Publications, Jalgaon

Wagh, S. A. And Patil, M. B. (2019) : Gender Disparity in Maharashtra : A Geographical Analysis, Ajanta Research Journal, Vol. III, Issue I, January-March 2019, Pp. 55-63.

6. The total number of pages should be **minimum 30 and maximum 40**, including text, figures, tables, photographs, references and appendices.

7. The medium of writing will be **English** only. Project report should be submitting in **Computer typing with Spiral/Hard bounding.**

8. At the time of viva-voce presentation may be given with the help of equipments which are available in the respective department.

- **Important Notes :**
  1. Assessment of the project by external examiner/guide teacher. One Copy of the Project and Sealed Mark list submit to the College Principal by external examiner/guide teacher after conducting viva-voce.
  2. Allocate of Guide Teacher to the studentsat the start of Sem-IV by Head of the concerned department through discussion with all other teachers as per their area of specialization/ interest.
  3. Allotted guide teacher should assist the students for selecting research problem, construct objectives and hypothesis and guiding on related topics from beginning of the Sem-IV.
  4. Guide teacher is expected to guide the students for data collection, data interpretation and writing project report.
  5. Introduce theory part related to research methodology within allotted regular periods.
- **Suggested Topic for Project Work :-**

  Each student should have select one topic of their interest through discussion with his/her guide teacher. The following inventory is for the convenient only. A guide

teacher or student is free to choose any other topic related to Geography apart from the list given below.

- **Population Geography-**
    1. Sex Ratio
    2. Population Growth
    3. Population Distribution
    4. Population Characteristics
    5. Literacy
    6. Occupational Structure
    7. Social study
    8. Migration
    9. Tribal/Rural/Urban Population Problems
- **Agricultural Geography-**
    1. Land Use
    2. Crop Combination/Diversification
    3. Cropping Pattern
    4. Agricultural Production
    5. Irrigation System
    6. Agricultural Market
    7. Farming
    8. Soil
    9. Live stock Farming
- **Economic Geography-**
    1. Human Occupations
    2. Trade and Transport
    3. Globalization
    4. Agricultural Economy
    5. Regional Development
- **Settlement Geography-**
    1. Settlement Pattern
    2. Rural Settlement study
    3. Urban Settlement study
    4. Tribal Settlement study
    5. Rural Service Centre
    6. Urban Sprawl
    7. Problems of villages/cities
- **Human Geography-**
    1. Human Race
    2. Food Security
    3. Poverty
- **Geomorphology/Physical Geography-**
    1. Geomorphic study
    2. Watershed Management

3. Groundwater
4. Morphometric Analysis
5. Indogenic Forces
6. Exogenic Forces

- **Biogeography/Phytogeography-**
  1. Natural Vegetation
  2. Wildlife
  3. Forest
  4. Biodiversity
- **Medical Geography-**
  1. Health status
  2. Malnutrition
  3. Fertility/Mortality
- **Social and Cultural Geography-**
  1. Religion Composition
  2. Social Aspects
  3. Language
  4. Cultural Aspects
- **Environmental Geography-**
  1. Environmental Issues
  2. Global Warming
  3. Climate Change
  4. Ozone Depletion
  5. Hazards
  6. Pollution
  7. Natural Resources
  8. Water Scarcity
- **Remote Sensing and GIS-**
  1. Application of Remote Sensing in....
  2. .... Analysis with the help of GIS

Suggested Readings :-

1. Archer J.E. &dalton T.H. (1968): The fields work in Geography, E.t.BatsfordLtd.,London.
2. Dikshit, R. D. (2003) : The Art and Science of Geography: Integrated Readings. Prentice-Hall of India, New Delhi.
3. Johnes, P.A. (2008): Field Work in Geography, Longman.
4. Karlekar, S. N. (2006) : Research Techniques in Geography, Diamond Publications, Pune
5. Kothari C.R.(1996): Research Methodology, Vishwas Prakashan, New Delhi.
6. Misra R.P. (1991): Research Methodology in Geography, concept pub. New Delhi.

7. Ranjeet Kumar : Research Methodologya Step-By-Step Guide For Beginners, Sage Publication
8. Pandey,Prabhat &Pandey, Meenu Mishra : Research Methodology: Tools And Techniques, Bridge Center, 2015
9. Sudhir Bodhankar and Vivek Aloni (2007) : SamajikSanshodhanPaddhati, Sainath Prakashan, Nagpur
10. Pradip Aaglave- SamajikSanshodhanPaddhati

Audit Course

Semester - IV

Choose One out of

AC 401 (A) , AC 401 (B), AC 401 (C), AC 401 (D)

(Practical)

Total Marks-100 (Internal) Credit Points- 02 Teaching Hours/Week: 02
Total Teaching Hours: 30

AC-401(A): Human Rights	
	Course Objectives: To make students aware about human rights and human values. **Learning Outcomes:** Students will be able to • Practice the learned issues under human rights and human values in real life. • Provide social justices to people around them and provide guidance about human rights to their friends, parents and relatives.
Unit	**Content**
1.	**Introduction to Human Rights** • Concept of Human Rights • Nature and Scope of Human Rights • Fundamental Rights and Fundamental Duties • Interrelation of Rights and Duties
2	**Human Rights in India** • Meaning and Significance of : 1) Right to Equality 2) Right to Freedom, 3) Right against Exploitation, 4) Right to Freedom of Religion, 5) Cultural and Educational Rights, and 6) Right to Constitutional Remedies. • Constitutional Provisions for Human Rights • Declaration of Human Rights • National Human Rights Commission
3	**Human Values** • Meaning and Definitions of Values • Importance of values in the life of Individual

	• Types of Values • Programmes for conservation of Values
4	**Unit 4: Status of Social and Economically Disadvantaged people and their rights** • Rights of women and children in the context of Social status • The Minorities and Human Rights • Status of SC/ST and other Indigenous People in the Indian Scenario • Human rights of economically disadvantaged Society

Suggested Readings :

1. Human rights education – YCMOU, Nasik
2. Value education – SCERT, Pune
3. Human rights reference handbook – Lucille whare

AC-401(B): Current Affairs			
	Course Objectives: To make students updated about current affairs of India and world. **Learning Outcomes:** Students will be able to • Identify important issues currently/recently happening in India or world. • Summarize current affairs regularly.		
Unit. No.	**Title**	**Content**	**Hours**
1.	**Politics & Economy**	• National & International Political Activity, Organization. • Economy & Business, Corporate world	**08**
2	**Awards and recognitions**	• National & International Awards and recognitions • Books and authors	**07**
3	**Science & Technology**	• Software, Automobile, Space Research • New inventions and discoveries	**07**
4	**Environment & Sports**	• Summit & conference, Ecology & Climate, Organization. • National & International Games, Olympics, commonwealth etc.	**08**

Suggested Course Reading (Use recent years 'data and current literature) :

1. India 2019, by Publications Division Government of India
2. Manorama Year Book by Philip Mathew,
3. India 2019, Rajiv Maharshi
4. Quick General Knowledge 2018 with Current Affairs Update, Disha Experts
5. General Knowledge 2018: Latest Who's Who & Current Affairs by RPH Editorial Board.

AC-401 C: Green Audit

Course Objectives: -

1) Understand the scope of audit.
2) Enable students to pursue knowledge with an insatiable thirst, discipline them to harness their energy for creative purposes.

Course Outcomes: -

To become a green auditor employment opportunities are available for an auditor in various sectors.

Unit No.	Units	Sub-Units
1	**Introduction**	1.1 Green Audit – Definition, Concept and features 1.2 Objectives of Green Audit 1.3 Benefits of Green Audit
2	**Process of Green Audit**	Stage I – Pre-audit or planning stage Stage II – On-site or field audit Stage III – Past audit Stage IV – Follow up or Review stage
3	**Tools and Techniques used in Green auditing**	Checklist, Questionnaires, observation, Photographs, Research base.
4	**Assignment (Practical)**	Assignment to conduct the Green Audit to your institute / any institute/ any garden/ any place, prepare report & submit it at the time of Examination

Assessment Type	Marks
CA Internal Conduction of the Green Audit to your institute / any institute/ any garden/ any place, prepare report & submition of report at the time of Examination and oral.	100
Total Marks	**100**

Suggested Readings : - Green Audit reports of various institutes are available on Google

AC-401 D: Review of Research Paper Total Lectures : 30

Course Objectives:

1. To introduce some basic of review of research paper to the students.
2. To develop interest of students in research.
3. To Promote students for reading of research articles and writing its review.
4. Students will acquire analytical thinking on the topic of interest.

Course Outcomes:

After completion of this course, the students will be able to,

1. Search and Describe scientific research articles.
2. Recognize and Write the contents of research paper in summarized form.
3. Develop comparative and analytical thinking in students.
4. Compile the scientific information on a topic, verify for similarity index or plagiarism.

Unit No.	Units	Sub-Units	Lectures
1	**Introduction of Literature review**	1.1 Types of literature reviews: A) Evaluative B) Exploratory C) Instrumental D) Systematic review. 1.2 Types of research article: A) scientific research articles B) Review articles C) Theoretical D) Case studies E) Application oriented etc. 1.3 Purpose of literature review	**30**
2	**Key steps of literature review**	2.1 Search for relevant literature 2.2 Evaluate and select sources 2.3 Identify themes, debates and gaps 2.4 Outline your literature review's structure	
3	**Other Aspects of literature review**	3.1 Reference styles 3.2 Use of bibliography/ reference/ citation managers and generators A) Reference Manager B) End Note C) Ref Works D) Mendeley E) Zotero etc. 3.3 Ethics of publication A) Approval and consent B) Data ethics C) Plagiarism and self-plagiarism	

		D Collaborative authorship E) Conflict of interest F) Legal consequences 3.4 Content similarity detection A) Use of anti-plagiarism services (Urkund, iThenticate, Turnitin, Copyscape, Grammarly, etc.)	
4	**Internal Assessment**	4.1 At least 02 review research papers writing by the students and submit to the college (handwritten or typographical form) 4.2 Write your literature review with following points to be covered: A) Abstract B) Introduction C) Body D) Discussion E) Conclusion F) References.	

Weightage	
Internal Assessment (At least 02 review research papers writing by the students and submit at the time of examination and oral	**100**

Suggested Readings:

1) R. M. Desai (1988) : Strategy of food and agriculture – Bombay
2) Robinson H.A.A. -Geography of Tourism, MacDonald and Evans, London.
3) Seth: Tourism Management : Sustainable Tourism Development, Guide for Local Planners by WTO, Sterling Publishers Pvt. Ltd., New Delhi-110016
4) Smith, W. R. (1956). Product differentiation and market segmentation as alternative marketing strategies. *Journal of Marketing*. (Vol. 21, Issue 1, July). p3-8.

Model Question Paper Format

For

GG. 304 Practical in Remote Sensing-Interpretation of Aerial Photographs and Satellite Imageries.

Note: All questions are compulsory.

Que. 1 – Interpret the Aerial Photograph visually with the help of mirror stereoscope considering the following points. (12 Marks)

(a)

(b)

(c)

Que. 2 Interpret the Satellite Image visually with the help of mirror stereoscope considering the following points. (12 Marks)

(a)

(b)

(c)

Que. 3 Extraction and drawing of following natural or cultural features from the given photograph. (12 Marks)

(a)

(b)

(c)

(d)

Que. 4 A) Calculate the area measurement from aerial photograph as per oral instruction. (05 Marks)

B) Write short notes on chapter no 1, 2 & 3. (Any three out of five) (09 Marks)

Que. 5 a) Inspection of journal. (05 Marks)

b) Oral (05 Marks)

Model Question Paper Format

For

GG-305 : Practical of Computerize Data Analysis Techniques in Geography

Note: All questions are compulsory.

Que. 1 Solve Example: Chapter no-2 (10 Marks)

Que.2 Solve Examples: Chapter no-3 (Attempt A and B)

(12 Marks)

(A)

(B)

Que.3 Solve Example: Chapter no-5 (12 Marks)

Que.4 (A) Solve Example: Chapter no-6 (08 Marks)

(B) Solve Example: Chapter no-1 &4 (08 Marks)

Que. 5 Journal (05 Marks)

Oral (05 Marks)

Model Question Paper Format

For

Gg. 404: Practical in Physical Geography

Note: All questions are compulsory.

Que. 1 Solve Example: Chapter no-2 (10 Marks)

Que.2 Solve Examples: Chapter no-3 (08 Marks)

Que.3 Solve Example: Chapter no-4 (10 Marks)

Que.4 (A) Solve Example: Chapter no-5 (08 Marks)

(B) Solve Example: Chapter no-6 (08 Marks)

(C) Write short notes on. (Chapter no- 1) (06 Marks)

1.

2.

Que. 5 Journal (05 Marks)

Oral (05 Marks)

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Kavayitri Bahinabai Chaudhari

North Maharashtra University, Jalgaon

SYLLABUS

For

Master of Science (M. Sc.)
[Botany]

M.Sc. Part-IInd (Sem-III and IV)

Choice Based Credit System

(Outcome Based Curriculum)

2022 – 2023

PROGRAMME AT A GLANCE

Name of the program (Degree)	:	M. Sc. Botany
Faculty	:	Science and Technology
Duration of the Program	:	Two years (four semesters)
Medium of Instruction and Examination	:	English
Exam Pattern	:	60: 40 (60 marks University exam and 40 marks continuous internal assessment)
Passing standards	:	40% in each exam separately(separate head of passing)
Evaluation mode	:	CGPA
Total Credits of the program	:	88 (68 core credits including 4 credits of project/ dissertation, 04 skill enhancement credits, 08 subject elective credits and 08 audit credits

Summary of Distribution of Credits under CBCS Scheme for

M.Sc. BOTANY

Sr. No	Type of course	Sem I	Sem II	Sem III	Sem IV
01	Core	**16**	**20**	**16**	**12**
02	Skill based	**04**	--	-	-
03	Elective	-	-	**04**	**04**
04	Project	-	-	-	**04**
05	Audit	**02**	**02**	**02**	**02**
06	Total Credits	**22**	**22**	**22**	**22**

Subject Type	Core	Skill based	School Elective	Project	Audit	Total
Credits	**64**	**04**	**08**	**04**	**08**	**88**
						Total Credits = 88

Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon

M.Sc. Botany

Choice Based Credit System (Outcome Based Curriculum) with effect from

2021 -2022

Course credit scheme

Semester	(A) Core Courses			(B) Skill Based / Elective Course			(C) Audit Course (No weightage in CGPA)			Total Credits (A+B+C)
	No. of Courses	Credits (T+P)	Total Credits	No. of Courses	Credits (T+P)	Total Credits	No. of Courses	Credits (Practical)	Total Credits	
I	4	8 + 8	**16**	1	4 + 0	4	1	2	2	**22**
II	4	12 + 8	**20**	1	0 + 0	--	1	2	2	**22**
III	4	8 + 8	**16**	1	4 + 0	4	1	2	2	**22**
IV	4	8 + 8	**16**	1	4 + 0	4	1	2	2	**22**
Total Credits	**68**			**12**			**8**			**88**

(T-Theory, P-Practical)

Structure of curriculum

		First Year				Second Year				Total Credit Value
		Semester I		Semester II		Semester III		Semester IV		
		Credit	Course	Credit	Course	Credit	Course	Credit	Course	
(A)	**Prerequisite and Core Courses**									
	Theory	4	2	4	3	4	2	4	2	36
	Practical	4	2	4	2	4	2	4	2	28
(B)	**Skill Based / Subject Elective Courses**									
1	Theory /Practical	4	1	--	--	4	1	4	1	16
(C)	**Audit Course (No weightage in CGPA calculations)**									
1	Practicing Cleanliness	2	1							2
2	Personality and Cultural Development Related Course	--	--	2	1	--	--	--	--	2
3	Technology Related + Value Added Course	—	—	—	—	2	1	—	—	—
4	Professional and Social + Value Added Course							2	1	2
	Total Credit Value	14	6	14	6	14	6	14	6	88

List of Audit Courses (Select any ONE course of Choice from Semester II; Semester III and Semester IV)							
Semester I (Compulsory)		**Semester II** (Choose One)		**Semester III** (Choose One)		**Semester IV** (Choose One)	
		Personality and Cultural Development		**Technology + Value Added Course**		**Professional and Social + Value Added Course**	
Course Code	**Course Title**	**Course Code**	**Course Title**	**Course Code**	**Course Title**	**Course Code**	**Course Title**
AC-101	Practicing Cleanliness	AC-201A	Soft Skills	AC-301A	Computer Skills	AC-401A	Human Rights
		AC-201B	Sport Activities	AC-301B	Cyber Security	AC-401B	Current Affairs
		AC-201C	Yoga	AC-301C	Seminar + Review Writing	AC-401C	Banana Fruit Processing
		AC-201D	Music	AC-301D	Biodiversity & Conservation	AC-401D	Intellectual Property Rights (IPR)

Semester-wise Course Structure of M.Sc. Botany

Semester I

Course	Course Type	Course Title	Teaching Hours/ Week			Marks (Total 100)				Credits
			T	P	Total	Internal		External		
						T	P	T	P	
BOT-101	Core	Plant Systematics-I (Algae, Fungi & Bryophytes)	4	--	4	40	--	60	--	4
BOT-102	Core	Taxonomy of Angiosperms	4	--	4	40	--	60	--	4
BOT-103	Core	Practical Based on Bot. 101	--	4+4	8	--	40	--	60	4
BOT-104	Core	Practical Based on Bot. 102	--	4+4	8	--	40	--	60	4
BOT-105	Skill Based	Applied Plant Biotechnology	4	--	4	40	--	60	--	4
AC-101	Audit Course	Practicing Cleanliness	------	2	2	--	100	--	--	2
Total Credit for Semester I: 22 (T = Theory: 8; P = Practical:8; Skill Based:4; Audit Course:2)										

Semester II

Course	Course Type	Course Title	Teaching Hours/ Week			Marks (Total 100)				Credits
			T	P	Total	Internal		External		
						T	P	T	P	
BOT-201	Core	Plant Systematics-II (Pteridophytes, Gymnosperm & Palaeobotany)	4	--	4	40	--	60	--	4
BOT-202	Core	Plant Physiology and Biochemistry	4	--	4	40	--	60	--	4
BOT-203	Core	Cytogenetics and Molecular Biology	4	--	4	40	--	60	--	4
BOT-204	Core	Practical based on BOT 201 & BOT 202	--	4+4	8	--	40	--	60	4
BOT-205	Core	Practical based on BOT 203	--	4+4	8	--	40	--	60	4
AC-201 A/B/C/D	Audit Course **(Select any one)**	AC-201 A: Soft Skills AC-201 B: Sport Activities AC-201 C: Yoga AC-201 D: Music	--	2	2	--	100	--	--	2
Total Credit for Semester II: 22 (T = Theory: 12; P = Practical:8; Skill Based:00; Audit course:2)										

Semester III

Course	Course Type	Course Title	Teaching Hours/ Week			Marks (Total 100)				Credits
			T	P	Total	Internal		External		
						T	P	T	P	
BOT-301	Core	Plant Development & Reproduction	4	--	4	40	--	60	--	4
BOT-302	Core: Special Paper	BOT-302 A: Phycology Special Paper-I BOT-302 B: Mycology Special Paper-I BOT-302 C: Angiosperm Special Paper-I	4	--	4	40	--	60	--	4
BOT-303	Core	Practical Based on BOT 301	4	--	4	40	--	60	--	4
BOT-304	Core	Practical Based on BOT 302 (Special Paper)	--	4+4	8	--	40	--	60	4
BOT-305	Elective **(Select anyone)**	BOT 305 A: Biostatistics and Bioinformatics BOT 305 B: Techniques in plant Sciences	4	--	4	40	--	60	--	4
AC-301 A/B/C/D	Audit Course **(Select anyone)**	AC-301 A: Computer Skills AC-301 B: Cyber Security AC-301 C: Seminar and Review Writing AC-301 D: Biodiversity and Conservation	--	2	2	--	100	--	--	2
Total Credit for Semester III: 22 (T = Theory: 8; P = Practical:8; Skill Based:4; Audit Course:2)										

Semester IV

Course	Course Type	Course Title	Teaching Hours/ Week			Marks (Total 100)				Credits
			T	P	Total	Internal		External		
						T	P	T	P	
BOT-401	Core: Special Paper	BOT-401 A: Phycology Special Paper-II BOT-401 B: Mycology Special Paper-II BOT-401 C: Angiosperm Special Paper-II	4	--	4	40	--	60	--	4
BOT-402	Core: Special Paper	BOT-402 A: Phycology Special Paper-III BOT-402 B: Mycology Special Paper-III BOT-402 C: Angiosperm Special Paper-III	4	--	4	40	--	60	--	4
BOT-403	Core	Practical based on BOT 401 & BOT 402	—	4+4	8	--	40	--	60	4
BOT-404	Core	Practical: Project Dissertation	--	4+4	8	--	40	--	60	4
BOT-405	Elective **(Select any one)**	BOT-405 A: Plant Ecology & Phytogeography BOT-405 B: Industrial Botany	4	--	4	40	--	60	--	4
AC-401 A/B/C/D	Audit Course **(Select any one)**	AC-401 A: Human Right AC-401 B: Currant Affairs AC-401 C: Banana Fruit Processing AC-401 D: Intellectual Property right (IPR)	—	2	2	—E	100	--	--	2
Total Credit for Semester IV: 22 (T = Theory: 8; P = Practical:8; Skill Based:4; Audit Course:2)										

Distribution of Course papers for M. Sc. Part II (Botany)

Subject Code	Title of the Paper		Duration (Hrs./Wk)	Max. Mark	Exam. Time (Hrs.)
M.Sc. Part II					
Semester III : Theory Courses					
BOT-301	Plant Development & Reproduction	Core course	04	100	03
BOT -302	BOT-302 A: Phycology Special Paper-I BOT-302 B: Mycology Special Paper-I BOT-302 C: Angiosperm Special Paper-I	Core course	04	100	03
BOT-305	BOT 305 A: Biostatistics and Bioinformatics BOT 305 B: Techniques in plant Sciences	Skill based	04	100	03
Semester III : Practical Courses					
BOT-303	Practical Based on Bot. 101	Core course	**04+04**	**100**	**06**
BOT-304	Practical Based on Bot. 102	Core course	**04+04**	**100**	**06**
AC-301 A/B/C/D (Select any one)	AC-301 A: Computer SkillsAC-301 B: Cyber Security AC-301 C: Seminar and Review Writing AC-301 D: Biodiversity and Conservation	Audit Course	**02**	**100**	
Semester IV : Theory Courses					
BOT-401	BOT-401 A: Phycology Special Paper-II BOT-401 B: Mycology Special Paper-II BOT-401 C: Angiosperm Special Paper-II	Core course	**04**	**100**	**03**
BOT-402	BOT-402 A: Phycology Special Paper-III BOT-402 B: Mycology Special Paper-III BOT-402 C: Angiosperm Special Paper-III	Core course	**04**	**100**	**03**
BOT-403	Practical based on BOT 401 & BOT 402	Core course	**04**	**100**	**03**
Semester II : Practical Courses					
BOT-404	Practical: Project Dissertation	Core course	**04+04**	**100**	**06**
BOT-405 (Elective)	BOT-405 A: Plant Ecology & Phytogeography BOT-405 B: Industrial Botany	Core course	**04**	**100**	**06**
AC- 401 A/B/C/D (Select any one)	AC-401 A: Human Right AC-401 B: Currant Affairs AC-401 C: Banana Fruit Processing AC-401 D: Intellectual Property right (IPR)	Audit Course	**02**	**100**	

M.Sc. Part-II Semester-III Botany: Core Courses

Core Course	BOT-301 PLANT DEVELOPMENT AND REPRODUCTION	Lectures 60

Course Objectives

1.To study vascular tissues, structure of woods and anomalous secondary growth
2.To study historical development of embryology
3.To study structure and development of microsporangium, megasporangium and endosperm.
4.To study methods of pollination and fertilization
5.To study applications of embryology in plant tissue culture

Course Outcomes

1.Able to differentiate vascular tissue
2.Able to identify embryological stages
3.Expertise in tissue culture technique

Unit-1	**Growth of Plants** **1.1** Meristems**:** Classification based on a) Origin and development b) Plane of division c) Function and position **1.2** Theories of zonation and differentiation i. Apical cell theory ii. Histogen theory iii. Tunica-corpus theory iv. Korper- Koppe theory v. Cytohistological zonation vi. Concept of quiescent center **1.3** Study of stomata and Trichomes a) Introduction b) Classification of stomata by: i) Metcalfe and Chalk ii) Stebbins and Khush c) classification of Trichomes by i) Uphof's ii) Ramayya's	**11**
Unit-2	**Vascular Tissues** 2.1 Cambium: Origin, Structure, Types 2.2 Differentiation of xylem and Phloem elements and their phylogeny 2.3 Study of Woods: i) Dicotyledonous woods ii) Gymnospermous woods iii) Reaction woods iv) Sap and Heart wood 2.4 Axial parenchyma and their Distribution: i) Apotracheal ii) Paratracheal iii) Boundary parenchyma 2.5 Anomalous Secondary Growth in Plants : a) Dicot stem: i. Normal cambium with abnormal activity	**14**

	ii. Abnormal cambium with abnormal activity b) Monocot stem : Dracaena, Palms	
Unit-3	3.1Introduction 3.2 Contribution of Strasburger and P. Maheshwari 3.3 Microsporangium: i) Development and structure of microsporangium ii) Wall layers of microsporangium iii) Types of Tapetum iv) Pollenkitt and sporopollenin v) Microsporogenesis vi) Pollen units 3.4 Male gametophyte: structure, development and spermatogenesis 3.5 Study of certain abnormal developments (i) Pollen formation in Cyperaceae (Pseudomonad) (ii) Pollen embryo sac 3.6 Megasporangium: A) i) Development ii) Structure iii) Megasporogenesis B) Types of female gametophytes (embryo sac) 3.7 Pollination and Fertilization: A) Self-pollination: i) methods of pollination ii) structure of stigma and style B) Pollen germination: i) pollen-tube formation ii) sperm- cell C) pollen-pistil interaction: i) pollen recognition ii) acceptance-rejection iii)pollen incompatibility D) Entry of pollen tube: i)through stigma, style and embryo sac ii) transfer of pollen tube contents into embryo sac iii) fusion of gametes and fusion of nuclei	**12**
Unit-4	4.1 Endosperms: i) Introduction ii) development and structure of endosperms iii) Physiology and cytology of endosperms with suitable examples. iv) Function of endosperms 4.2 Polyembryony : i) Introduction ii) Classification of polyembryony iii) Causes of polyembryony iv) Types of polyembryony: a) simple polyembryony b) multiple embryony c) nucellar and integumentary polyembryony d) endothelial polyembryony e) zygotic, suspensor and synangial polyembryony 3 Experimental Embryology:	**13**

	i) Anther and pollen culture ii) ovary culture iii)ovule culture iv) nucellar culture v) endosperm culture vi) embryo culture	
Unit-5	5.1 Introduction 5.2 Scope and Importance 5.3 Pollen grains: A) Development of pollen grains: i) Meiotic and post-meiotic processes ii) Differentiation of wall layers iii) Exine stratification iv)Polarity v)Symmetry B) Structure of mature pollen grain C) Pollen polymorphism D) NPC system 5.4 Spore/Pollen development in plants w.r.t. wall composition, exine ornamentation and apertural variations. i) Algae ii) Bryophytes iii) Pteridophytes ii) Angiosperms 5.5 Applied Palynology: Geopalynology, Melittopalynology, Pollen allergy, Aerobiology Palynotaxonomy and Forensic palynology.	**10**

Suggested Readings

1.Carlquist, S. (1961) Comparative Plant Anatomy, Hold, Rinehart and Winston, New York, U.S.A.

2.Carlquist, S. (1988) Comparative Wood Anatomy: Systematic, Ecological and Evolutionary Aspects of Dicotyledonous Wood. Springer-Verlag, Berlin, Germany

3.Cutter, D.F. (1978) Applied Plant Anatomy, Longman, London and New York, USA

4.Cutter, E.G.(1969) Plant Anatomy: Experiment and Interpretation. Part-I : Cell and Tissues, Edward Arnold, London, UK.

5.Eames, A.J. (1961) Morphology of Angiosperms, McGraw Hill, New York, U.S.A.

6.Eames, A.J. and McDaniels, L.H. (1974) An Introduction to Plant Anatomy, IInd Ed. McGraw Hill, New York and London, UK.

7.Easu, K. (1960) Anatomy of the Seed Plants, Wiley, New York, U.S.A.

8.Easu, K. (1965) Vascular Differentiation in Plants. Hold, Rinehart and Winston, New York, U.S.A.

9.Easu, K. (1977) Anatomy of Seed Plants, (IInd Ed.) John, Wiley and Sons, New York, U.S.A Fahn, A. (1982) Plant Anatomy, III Ed. Pergamon Press, Oxford U.K.

10.Fahn, A. (1995) Secretory Tissues in Plants. Academic Press. London, U.K.

11.Foster, A.S. (1949) Practical Plant Anatomy, IInd, Ed. Van Nosrand, New York, U.S.A. Lyndon, R.F. (1990) Plant Development. The Cellular Basis. Unnin Hyman, London, U.K.

12.M.N.B. (1998) Wood Anatomy and Major Uses of Wood. Faculty of Forestry, University Putra Malaysia, Malaysia.

13.Mauseth, J.D. (1988) Plant Anatomy. The Benjamin / Cummings Publ. Co. In. Menio Park, californis, U.S.A.

14.Metcalfe, C.R. (1960) Anatomy of the Monocotyledons. I Graminae. Clarendon Press, Oxford, U.K.

15.Metcalfe, C.R. and Chalk, L. (1950) Anatomy of Dicotyledonos Vol.I-II. Clarendon Press, Oxford, U.K. Steeves, T. A. and I. M. Sussere (1989) Patterns in Plant Development (IInd Ed.) Cambridge University Press. Cambridge, U.S.A.

16.Tomlinson, P.B. (1961) Anatomy of the Monocotyledons-II. Palmae (Ed. C.R.Metcalfe), Clarendon Press, Oxford, U.K.

17.Bhojwani S.S. and S.P. Bhatnagar S.P. (1974) Embryology of Angiosperms Vikas Publishing House (P.) Ltd., New Delhi, India.

18.Davis, G.L. (1966) Systematic Embryology of Angiosperms, John, Wiley and Sons, NewYork, U.S.A

19.Johri, B.M. (1984 Ed.) Embryology of Angiosperms. Springer-Verlag, Berlin, Heidelberg, New York, U.S.A.

20.Maheshwari, P. (1950) An Introduction To The Embryology of Angiosperms, McGraw Hill Book Co. New York, U.S.A.

21.Maheshwari, P. (1963 Ed.) Recent Advances In The Embryology of Angiosperms International Society of Plant Morphologists, University of Delhi. Delhi, India.

22.Percival, M.S. (1965) Floral Biology, Pergamon Press, Oxford, U.S.A.

23.Proctor, M. and Yeo, P. (1973) The Pollination of Flowers, William Collins Sons, London. Raghavan, V. (1986) Embryogenesis in Angiosperms: A Developmental and Experimental Study, Cambridge University Press. Cambridge, U.S.A.

24.Raghavan, V. (1997) Molecular Embryology of Flowering Plants, Cambridge University Press. Cambridge, U.S.A.

25.Raghavan, V. (1999) Developmental Biology of Flowering Plants, Springer- Verlag, New York, U.S.A.

26. Raven, P.H., Evert, R.F. and S. E. Eicbhom (1992) Biology of Plants (Vth Ed,) Worth, New York, U.S.A.

27.Erdtman, G. (1966) Pollen Morphology and Plant Taxonomy: Angiosperms, Hafner, New York, U.S.A

28.Erdtman, G. (1969) Handbook of Palynology. , Hafner, New York, U.S.A

29.Faegri, K. and J. Iversen (1964) Text Book of Pollen Analysis, Hafner, New York, U.S.A Faegri, K. and Van Der Pijl. L. (1979) The Principles of Pollination Ecology. Pergamon Press,Oxford. U.K

30. Nair, P.K.K. (1970) Pollen Morphology of Angiosperms: A Historical and Phylogenetic tudy.The Scholar Publishing House, Lucknow, India.

31.Nair, P.K.K. (1970) Pollen Morphology of Angiosperms. Vikas Publ. House (P.) Ltd. New Delhi, India.

32.Shivanna, K.R. and B.M.Johri (1985) The Angiosperm Pollen : Structure and Function, Wiley Eastern Ltd., New York, U.S.A.

33.Shivanna,K. R. and Rangaswamy N.S.(1992) Pollen Biology : A Laboratory Manual, Springer-Verlag, Berlin, Germany.

34.Stanley, R.G. and H.F.Linskens (1974) Pollen Biology, Biochemistry and Management, Springer, New York, U.S.A.

35.Shivanna, K.R. and Sawhney V.K. (Eds.) (1997) Pollen Biotechnology For Crop Production and Improvement, Cambridge University Press, Cambridge, U.K.

Core Course	BOT-302 A PHYCOLOGY SPECIAL PAPER-I	Lectures 60

Course Objectives

1. The main objective is to fulfil the knowledge of rapidly expanding branch Phycology of Botanical Science.
2. To know diversity of various algal groups.
3. To provide a clear and sound background knowledge in respect to morphology; reproduction and interrelationships of Algae.
4. To study different systems of classification of algae.
5. To study and understand the local Algal diversity from various habit and habitat.

Course Outcomes

1.Able to differentiate and identify algal forms.
2.Able to classify algae.
3.Expertise in algal diversity and Habitat.

Unit-1	1. Introduction, a brief History of Phycology, contribution of Indian algologist. 2. Comparative account of general characters of different groups of algae. (According to F. E.Fritsch's classification). 3. Systems of classification of algae up to orders according to F. E. Fritsch, G. M. Smith, H. C. Bold,and W. J. Wynne. 4. Modern trends in algal systematics.	**12**
Unit-2	Discussion of algae with reference to Reproduction, Life Cycle, Evolution, Phylogeny and interrelationships of belonging to the following algal classes (sensu F. E. Fritsch). 1. Cyanophyceae. 2. Chlorophyceae. 3. Euglenophyceae. 4. Xanthophyceae. 5. Bascillariophyceae. 6. Phaeophyceae. 7. Rhodophyceae.	**36**
Unit-3	Brief discussion in relation to the morphology and systematic position of the following groups. 1. Chrysophyceae. 2. Dinophyceae. 3. Desmophyceae. 4. Prasionophyceae 5. Cryptophyceae. 6. Chloromonadophyceae	**12**

Suggested Readings

1. Anand, N. (1998). Indian Freshwater Microalgae, Bishen Singh Mahendra Pal Singh, Dehradun, India.
2. Bold, H and Wynne. M. J (1978) Algal structure and reproduction. Prentice Hall of India pvt. Ltd. New Delhi, India.
3. Bony, A.D. (1978). Phytoplankton. Edward Arnold pub. Ltd. London, U.K.
4. Chapman, V.J. and Chapman D.J. (1979). The Algae. English Language Book Society and Mc. Millan, Co, London, U.K.
5. Daws, C. J. (1981). Marine Botany. Wiley Publication Com. New York, USA.
6. Desikachary, T.V. (1959). Cyanophyta. ICAR, New Delhi, India.

7. Fritsch, F.E. (1959-1961). The Structure and Reproduction of the Algae. Vol. 1 & 2 Cambridge University Press, U.K.
8. Ghandi, H.P. Fresh Water Diatoms of Central Gujrat, Bishen Singh Mahendra Pal Singh Dehradun , India.
9. Gonzalves,E. (1981). Oedogoniales. ICAR, New Delhi, India.
10. Gordon, F. Leedale (1969). Euglenoid Flagellates Biological techniques series Prentice-Hall, Inc, Englewood, London, U.K.
11. Irvine D. E. G. & D. M. John (1984). Systematics of Green Algae (The systematic association special vol. 27), Academic Press, London
12. Iyengar, M.O.P. and Desikachary, T.V. (1981). Volvocales. ICAR, New Delhi, India.
13. Lee, R.E. (1989). Phycoogy. Cambridge University Press, Cambridge, U.K.
14. Misra, J.N. (1966). Pheohyceae in India.ICAR, New Delhi, India.
15. Morris, I (1967). An Introduction To The Algae Hutchinson University Press
16. Pal, B.P. and Sunderlingam et al. (1962). Characeae.ICAR, New Delhi, India.
17. Philipose, M.T. (1960). Chrococcales. ICAR, New Delhi, India.
18. Prescott, G.W. (1968). The Algae : A Review. Houghton-Mifflin Co. Boston.
19. Ramanathan, M.S. (1964). Ulotrichales. ICAR, New Delhi, India.
20. Randhawa,M.S. (1959). Zygnemataceae. ICAR, New Delhi, India.
21. Round, F.E. (1973). The Biology of the Algae. Edward Arnold, London, U.K.
22. Sahoo, Dinabandhu and DebasishNivedita (2001). The Checklist of Seaweeds of Indian Coast APH Publishing Corporation, Delhi, India.
23. Sarode, P.T. and Kamat N.D. (1984). Freshwater Diatoms of Maharshtra.Saikrupa Pub. Aurangbad (M.S.), India.(12)
24. Smith, G.M. (1950). Freshwater Algae of the United States.Mc.Graw Hill, New York, U.S.A.
25. Srinivasan, K.S. (1969). PhycologiaIndica. Icones of Indian Marine Algae.Vol. 1 and 2. Botanical Survey of India, India.
26. Venkatraman, G.S. (1969). Vaucheriaceae ICAR, New Delhi, India.

Core Course	BOT-302 B MYCOLOGY SPECIAL PAPER-I	Lectures 60

Course Objectives

1. To reveal historical development in mycology.
2. To make aware principles, rules and regulations of ICBN.
3. To know ultra-structure of fungal cells.
4. To study different classifications for fungal organisms.
5. To study vegetative structure of various groups of fungi.
6. To study reproductive structure phylogeny, interrelationship and life cycle pattern of various groups of fungi.

Course Outcomes

1. Able to know history of Mycology and Nomenclature of fungi.
2. Able to describe life cycle patterns of various groups of fungi.
3. Higher cognitive skills about taxonomy of fungi will develop.

Unit-1	**A)** History of Mycology **B)** International code and Botanical nomenclature. Principles, major rules, Revisions and recommendations,effective and valid publications, typification, rejection of names of taxa, starting date point, priority and authority. **C)** Outline classification proposed by Ainsworth (1973), Hawksworth *et. al*., (1995) and Alexopoulous *et al.*, (1996). **D)** Ultra structure of fungal cell, cell-wall composition, septa, rhizomorph	**05**
Unit-2	Discussion of fungi with reference to vegetative structure, reproductive structure, phylogeny, interrelationship (if any) and life cycle pattern of following: **A) Myxomycota:**Acrasiales,Dictyosteliales, Labyrinthullales,Ceratiomyxales,Physarales,Trichiales,Stemonitales, Plasmodiophorales. **B) Mastigomycotina**Chytridiales,Blastocladiales,Saprolegnials, Lagenidiales, Perenosporales. **C) Zygomycotina:** Entomophthorales, Mucorales, Endogonales	**18**
Unit- 3	Discussion of fungi with reference to vegetative structure, reproductive structure, phylogeny, interrelationship (if any) and life cycle pattern of following: **Ascomycotina:**Taphrinales,Endomycetales,Protomycetales, Eurotiales,Erysiphales,Meliolales,Clavicepitales,Sphaeriales, Xylariales,Pezizales,Laboulbeniales,Myringiales,Hysteriales, Dothidiales, Pleosporales.	**16**
Unit-4	Discussion of fungi with reference to vegetative structure, reproductive structure, phylogeny, interrelationship (if any) and life cycle pattern of following: **Basidiomycotina:**Uredinales,Ustillaginales,Auriculariales, Dacrymycetales,Tulasnellales,Aphyllophorales,Agaricales, Lycoperdales, Nidulariales, Phallales, Podaxales.	**15**
Unit-5	Discussion of fungi with reference to vegetative structure, reproductive structure, phylogeny, interrelationship (if any) and life cycle pattern of following: **Deuteromycotina:**Blastomycetes,Hyphomycetes,Coelomycetes.	**06**

Suggested Readings

1. Ainsworth *et.al.*, (1965-73). The fungi, An advanced treatise Vol. I-IV B, Academic press, London, UK.
2. Alexopous & Mims (1979). Introductory Mycology, Willey Eastern Ltd. New Dehli, India. Alexopolus, Mims and Blckwell (1996) Introductory Mycology (4th Ed.). John. Willey and Sons. Inc New York., USA.

3. Aneja K. R, (1996) Experiments in microbiology, Plant pathology, Tissue culture and mushroom cultivation. Vishwa Prakashan New Dehli, India.
4. Burnett and Hunter (1972) Illustrated Genera of Imperfect Fungi, Minnesota.
5. Barron G. L. (1968). The Genera of Phycomycetes from Soil. Williams and Wilkins, Baltimore.
6. Bassey E. A. (1950). Morphology and Taxonomy of Fungi, The Blakriston Ed. Philadelphia
7. Bhide et. al (1987). Fungi of Maharashtra, M. A. C. S. Inst. Pub Pune (M. S.), India.
8. Biligrami et. al (1979-81). Fungi of India (Part I-II). Today and tomorrow's Pub. New Dehli, India.
9. Biligrami K. S. (1991). Fungi of India, International Book House New Dehli, India.
10. Bonner J. T. (1996). The culture of Slime moulds Princaton, Univ press
11. Borse, B. D., Borse, K. N. , Pawar, N. S. And Tuwar, A. R. (2012) Marine Fungi of India (Monograph), Broadway Book Center Publishers and Distributors, Panjim, Goa Pp. 1- 471.
12. Borse, B.D., Borse, K. N., Patil, S. Y., Pawara, C. M., Nemade, L. C. And Patil, V. R. (2016) Freshwater Higher Fungi of India, Lulu Publication, USA and Laxmi Book Publisher, Solapur, Maharashtra, India. Pp. 1-636.
13. Borse, B. D., Borse, K. N., Chaudhari, S. A., Patil, V. R., Patil, S. Y., Gisavi, S. A. and Borade D. S. (2017) Freshwater and Marine Fungi of India. Lambart Academic Publishing Group, Meldrum Street, Beau Bassin 71504, Mauritius.
14. Burnett J. H. (1986). Fundamentals of Mycology, Edward Arnold. London, UK.
15. Clemet and Shear (1993). The Genera of Fungi, H. W. Wilson New York, USA.
16. Cummins G. B. (1979). Illustrated Genera of Rust Fungi, Burgens Pub. Co. Minnacapolin
17. Cummins G. B. (1971). The Rust Fungi of Cereals Grasses and Bamboos, Spinrigles, Verlag New York, USA
18. Dayal R. & Kiran U. (1989). Zoosporic Fungi of India Inter India Pub. New York, USA.
19. Dennis R. W. G. (1977). British Ascomycetes (3rd Ed.) J. Ceamer, Vaduz, Germany.
20. Ellis M. B. (1971). Demaeticeous Hypomycetes, CMI publication Kew Survey, London.
21. Gauman E. A. (1928). Comparative Morphology of Fungi McGraw-Hill Pub. New York, USA
22. Hawksworth D. L. (1971). Mycologist. CBI, Kew Kamat M. N. (1959). Hand Book of Mycology Vol. I-II Prakash Publication. Pune, India.
23. Kamat M. N. (1959). Introductory Plant Pathology Prakash Publication. Pune, India.
24. Khulbe, R. D. (2001) A manual of Aquatic Fungi (Chytridiomycetes and Oomycetes), Daya Publishing House, New Delhi, Pp. 1-255.
25. Lakhanpal and Mukherji (1981). Indian Myxomycetes L. Cramer Vaduz.
26. Mehrotra and Aneja (1991, 2015). An Introduction of Mycology. Wiely Eastern ltd. New Dehli, India.
27. Mundkur and Thirumatcher (1952). Ustilagenales of India. CMI Pub. Kew survey, England. Mahadevan and Shridhar (1982). Methods in Physiological Plant Pathology II Ed. Sivakarni Pub. Madras, India.
28. Pathak V. R. (1972). Essentials of Plant Pathology. Prakash Pub Jodhpur, India.
29. Patahk, Khatri, Pathak. (1996). Fundamentals of Plant Pathology, Agro Botanical Pub. Bikaner, India.

30. Sarbhoy A. K. (1983). Advance Mycology, Today's and Tomorrow's pub. New Dehli, India Subramanian C. V. (1981). Hypomycetes, Academic Press London, UK
31. Tondon R. N. (1968). Mucorales of India ICAR Pub. New Dehli, India.
32. Thind K. S. (1977). Myxomycetes of India ICAR New Dehli, India.
33. Vasudeva R. S. (1961). India Cercosporae ICAR New Dehli, India.
34. Webster J. (1980). Introduction to Fungi 2nd ed. Cambridge Uni, press Cambridge.
35. Wolf and Wolf (1964-69). The Fungi Vol. I-II, John Wiley and Hafner New York, USA

Core Course	BOT-302 C ANGIOSPERM SPECIAL PAPER -I	Lectures 60

Course Objectives

1. To study importance of classification in Angiosperms.
2. To study primitive and advanced groups of Angiosperm.
3. To study taxonomic structure of Angiosperms.
4. To study orders of Engler and Prantl's system of classification.
5. To study botanical nomenclature of Angiosperms.

Course Outcomes

1. Able to differentiate and identify various Angiospermic plants
2. Able to classify flowering plants.
3. Expertise taxonomic structure and nomenclature of Angiosperm.

Unit-1	**Classification** 1. Need for classification, (ii) Process of classification, (iii) Classification and Aesthetics, (iv) Hierarchial classification, (v) General and special purpose classification, (vi) Horizontal and Vertical classification, (vii) Polythetic and Monothetic classification, (viii) Folk classification, (ix) Phase of Classification.	**08**
Unit -2	**Discussion of the following with respect to** **1. Ranales:** A group of most primitive dicotyledons, evolutionary trends. **2. Amentiferae:** A heterogenous assemblage of moderately advanced dicotyledons, evolutionary trends **3. Sympetalae:** Heptaphyletic in origin, evolutionary trends.	**08**
Unit-3	**Taxonomic structure** 1. Taxonomic categories 2. Major categories 3. Minor categories 4. Historical development of concept of species 5. Concept of species 6. Intraspecific categories.	**08**
Unit-4	**Discussion of orders as defined in Engler and Prantl's system with reference to:** 1. Range of floral variation 2. Taxonomy, phylogeny and evolutionary trends in the **Orders**: Helobiae, Liliflorae, Glumiflorae, Scitaminae, Microspermae,Rosales, Contortae, Tubiflorae and Centrospermae	**25**
Unit-5	**Study of Botanical Nomenclature with respect to:** 1. Scientific names and Common names 2. International Code of Botanical Nomenclature (ICBN) 3. Review of Various codes: i) Paris Code (1867), ii) Rochester Code (1892), iii) Vienna Code (1905), iv) American Code (1907),v) Cambridge Code (1935),vi) Edinburgh Code (1966) vii) Leningrad Code (1978), viii) St. Louis Code (1999). 4.Principles of the code I-V 5.Type method (Typification) and working of Type method 6. Author citation 7. Rejection of names 8. Retention of names 9. Conservation of names 10. New Names 11. Names of cultivated and hybrid plants	**11**

Suggested Readings

1. Cronquist A. 1981. An Integrated System of Classification of Flowering Plants. Columbia University Press, New York, USA.

2. Cronquist A. 1988. The Evolution and Classification of Flowering Plants (2nd ed.) Allen Press, U.S.A.

3. Davis P. H. and V. H. Heywood 1991. Principles of Angiosperm Taxonomy. Today and Tomorrow Publications, New Delhi, India.

4. Heywood V.H.1968. Modern Methods in Plant Taxonomy. Oliver Boyd. Edinbburg. Judd Walter S., Campbell C. S., Kollogg, E. A., Stevens P.F. and M. J. Donoghue 2008. Plant Systematics. Sinauer Associates, INC, Publishers. Sunderland, Massachusetts, USA.

5. Lawrence George H. M. 1951. Taxonomy of Vascular Plants. Oxford and IBH Publ. Co. Pvt. Ltd. New Delhi, India.

6. Manilal K. S. and M. S. Muktesh Kumar [ed.] 1998. A Handbook of Taxonomic Training. DST, New Delhi, India.

7. Mondal A. K. 2016. Advanced Plant Taxonomy. New Central Book Agency (P) Ltd. Kolkata, India.

8. Mukhopadhyay N. C. 2006. Plant Taxonomy. Avishkar Publishers, Distributors, Jaipur, India.

9. Naik V. N. 1984. Taxonomy of Angiosperms Tata McGraw-Hill Publication Com. Ltd. New Delhi, India.

10. Nair R. 2010.Taxonomy of Angiosperm. A. P. H. Publishing Corporation, New Delhi, India.

11. Quicke Donald, L. J. 1993. Principles and Techniques of Contemporary Taxonomy. Blakie Academic & Professional, London.

12. Sharma O. P. 2003. Plant Taxonomy. Tata McGraw-hill Publishing Company Limited, New Delhi, India.

13. Sivrajan V.V.1984. Introduction to Principle of Plant Taxonomy. Oxford and IBH Publ. New Delhi, India.

14. Stace C. A. 1989 Plant Taxonomy and Biosystematics. Edward Arnold, London, U.K.

15. Stuessy T. F. 2002. Plant Taxonomy. The Systematics Evaluation of Comparative data.
16. Biseu Sing Mahendra Pal Singh, Dehera Dun, India.

17. Subrahmanyam N.S. 2003. Modern Plant Taxonomy. Vikas Publishing House PVT. LTD. New Delhi, India.

18. Taylor, D. V. and L. J. Hickey 1997. Flowering Plants: Origin, Evolution and Phylogeny. CBS Publishers & Distributers, New Delhi, India.

19. Vardhana Rashtra 2009. Taxonomy of Angiosperm. Vol. 1-2, Campus Books International, New Delhi, India.

20. Walter S. Judd. Et al. 2002. Plant Systematics- A Phylogeny Approach. Sinauer Associates-Inc. USA

Bot.303
Practical- (Core Course)
Practical Based on Bot-301

Practicals 1-2: Study of stomatal types by peeling method

a. Types in Dicotyledones

b. Types in Monocotyledones

Practical 3 : Study of Trichomes locally available plants

Practicals 4 & 5: Isolation and study of wood elements by acid maceration method.

(Preparation of permanent slides by students)

Practical 6, 7 & 8: Study of different types of woods by double stained preparation of:

a. Dicot woods (Covering different types)

b. Gymnospermous wood (Any two coniferous woods)

Practicals 9 & 10 : Study of anomalous structures in stem from permanent or prepared slides

i) Bignonia

ii) *Aristolochia, Tinospora* (Any one)

iii) *Boerhavia, Mirabilis, Chenopodium* and *Amaranthus*(Any two)

iv) Achyranthes

v) *Salvadora* and *Combretum* (Any one)

vi) Dracaena

Practicals 11 & 12: Double stained preparation of permanent slides using microtomy. (Using any suitable plant parts like leaf, stem, root, flower, etc.)

Practical 13 : Types of flowers (P.S.).

Practicals 14 and15: Study of development of microsporangium, microsporogenesis, microspores, male gametophyte of angiosperms with the help of permanent slides

Practical's 16 & 17: Study of megasporogenesis and types of female gametophytes (embryosacs) of angiosperms from permanent slides

Practical 18 : Study of endosperm types (P.S.)

Practical 19 : Study of stages of embryo development (P.S.)

Practical's 20 & 21: Dissection and mounting of different stages of embryo development using suitable materials (e.g. *Cyamopsis tetragonaloba* and *Cucumis* and multiple embryos in *Citrus* seeds.)

Practical 22: Study of pollen units: monads, dyads, tetrads, polyads, pollinia

Practicals 23 & 24: Pollen/ Spore preparation of the following using acetolysis or any other suitable method:

i. Angiosperm pollens

ii. Gymnosperm pollens

iii. Bryophytes types

iv. Pteridophytes types

Note:

i) Submission of permanent slide preparation at least two dicot woods and Two Gymnosperm woods and two whole mounts of wood maceration is necessary.

ii) Submission of permanent slides at least one vegetative/ floral part.

iii) Submission of five palynological slides is compulsory.

BOT.304
PRACTICAL-II (Core course)
(Based on BOT. 302 A Phycology Special Paper I)

Practical 1-8: Chlorophyceae

- **A)** Volvocales:
  *Chlamydomonas,Dunaliella,Pandorina,Eudorina,Volvox,*and*Gonium*(Any locally available forms)
- **B)** Cholorococcales:
  Chlorococcum,Chlorella,Trebauxia,Tetraedron,Characium,Charasiophon,Ankistrodesmus,Selenestrum,Oocystis,Botryococcus,CoelastrumScenedesmus,Pediastrum,Hydrodictyon, Protosiphon and *Crucigenia*. (Any locally available forms)
- **C)** Ulotrichales: *Ulothrix,Uronema,Microspora,Sphaeroplea,Cylindrocapsum,Ulva,Enteromorpha Schizomeris* and *Monostroma*, (Any locally available forms)
- **D)** Chaetophorales:
  Stigeoclonium, Chaetophora, Draparnaldia, Draparnaldiopsis, Fritschiella, Coleochaete, Trentepohlia, and *Cephaleuros* (Any locally available forms)
- **E)** Cladophorales:
  Cladophora, Rhizoclonium, Pithophora, Chaetomorpha, and *Sponogomarpha* (Any locally available forms)
- **F)** Oedogoniales:
  Oedogonium, Bulbochaete and *Oedocladium* (Any locally available forms)
- **G)** Conjugales:
  Spirogyra,Zygnema,Mougeotia,Sirogonium,Sirocladium,Cosmarium,Euastrum,Pleurotaenium Closterium and Cylindrocystis (Any locally available forms)
- **H)** Siphonales:
  Caulerpa,Bryopsis,Dichotomositin,Codium,Halimeda,Udotea Chaemodoris, Boergesenia,Valonia,Valoniopsis,Neomeris, Acetabularia and *Tydemania* (Any ocally available forms)
- **I)** Charales: *Chara* and *Nitella (*Any locally available forms)

Practical 9-10:

- **A)** Xanthophyceae: *Vaucheria* and *Botrydium* (Any locally available forms)
- **B)** Chrysophyceae: *Dinobryon* and *Synura* (Any locally available forms)
- **C)** Bacillariophyceae: *Coscinodiscus, Melosira, Cyclotella, Chaetoceros, Cymbella, Cocconeis, Biddulphia, Navicula, Nitzschia, Synedra, Pinnularia, Fragilaria,Gyrosigma, Pleurosigma, Gomphonema* and *Surirella.* (Any locally available forms)
- **D)** Euglenophyceae: *Euglena, Phacus, Lepocinclis* and *Trachelomonas* (Any locally available forms)

Practical 11-13: Phaeophyceae:
Ectocarpus, Giffordia, Sphacelaria, Dictyota, Padina, Stoechospermum, Spatoglossum, Dictyopteris, Iyengaria,Colpomenia, Hydroclathrus, Sargassum, Turbinaria, Zonaria,Rosenvingea, Laminaria, Fucus, Cystoseria, Chnoospora,Macrocystis, Nereocystis and *Postelsia* (Any locally available forms)

Practical 14-16: Rhodophyceae:
Porphyra, Compsopogon, Batrachospermum, Liagora,Scinia, Gelidium, Gelidiella, Grateloupia, Gracilaria, Hypnea, Rhodymenia, Champia, Ceramium, Caloglossa, Acanthophora,Chondrus, Laurencia, Polysiphonia, Asparqgopsis, Helminthocladia,Sebdenia, Halymenia, Botryocladia, Gastroclonium, Nemalion and *Amphiroa* (Any locally available forms)

Practical 17-21: Cyanophyceae :
Chroococcus, Gloeocapsa, Gloeothece, Merismopedia,Aphanothece, Coelosphaerium, Microcystis, Oscillatoria,Phormidium, Lyngbya, Arthrospira, Spirulina, Gloeothrichia,,Cylindrospermum, Nostoc, Anabaena, Nostochopsis, Hapalosiphon, Stigonema, Tolypothrix, Rivularia, Calothrix and *Dichothrix* (Any locally available forms)
Practical 22 – 23: Artificial key of the genera based on Morphology and Reproductive Characters.

Practical 24: Field work Surveys and collection of algae from local water reservoir as ponds, rivers, lakes and polluted habitats.

Notes:
(i) Classification of algae should be followed according to F. E. Fritsch

(ii) Students will submit their scientific survey reports and algal collection at the time of examination.

BOT.304
PRACTICAL-II (Core course)
(Based on BOT. 302 B Mycology Special Paper I)

Study of the representative genera belonging to following groups with respect to observations made based on accessory organs, asexual and sexual structures, fruiting body ascocarp/ basidiocarp/ Pycnidia. (Study should be based on genera collected from the regular field trips and outside tours.)

Practical: 01-03	Myxomycota (Any 10 Genera)
Practical: 04-05	Mastigomycotina (Any 08 Genera)
Practical: 06	Zygomycotina (Any 04 Genera)
Practical :07-12	Ascomycotina (Any 20 Genera)
Practical: 13-18	Basidiomycotina (Any 20 Genera)
Practical: 19-20	Deteuromycotina (Any 08 Genera)
Practical: 21-22	Preparation of artificial key based on appropriate characters
Practical: 23	Isolation of aquatic fungi by baiting in the laboratory
Practical: 24	Botanical Excursion

Note: Botanical excursion, collection of fungal specimens, tour report and submission of fungal specimens/Photographs is compulsory.

BOT.304
PRACTICAL-II (Core course)
(Based on BOT. 302 C Angiosperm Special Paper I)

Practical 1-17: Study of Angiospermic families locally available in the region covering all orders/series (*Sensu* Bentham and Hooker, at least 30 families).

Practical 18-19: Preparation of artificial dichotomous keys of (i) indented (ii) bracketed type based on vegetative and floral characters.

Practical 20-23: Identification of plant specimens up to species level with help of flora`s

Practical 24: To study the herbarium techniques

Note:

Botanical excursion is compulsory and students should submit botanical excursion report and digital herbarium/photograph of the plants.

Core Course	BOT-305 A BIOSTATISTICS AND BIOINFORMATICS	Lectures 60

Course Objectives

1. To understand the ways to report the results in a scientific way.
2. Explain the concept of a random, representative sample from population.
3. To recognize importance of Biostatistics in interpreting the biological data and design suitable experiments.
4. Compare two (or more) groups based on continuous, categorical data using comparative measures and hypothesis tests.
5. To use Bioinformatic tools to analyze different protein or nucleotide sequences to reach meaningful conclusions.

Course Outcomes

1. Able to understand the ways to report the results in a scientific way.
2. Able to recognize importance of Biostatistics in interpreting the biological data
3. Expertise in Bioinformatic stools to analyze different protein or nucleotide sequences

Unit-1	**Fundamental of biostatistics**: Introduction to Biostatistics, Definition, Population, Sample and Samplings, Variables in biology, Types of variables, Collection of data, Types of data, Classification of data, Tabulation of data, Graphic representation of data (Histogram, Frequency Polygon, Frequency curve, Cumulative frequency curve), Significance and limitation of graphic representation.	**10**
Unit-2	**Statistical Methods I:** A- Measure of Central tendency: Mean, Median, Mode; Merits and Demerits of central tendency B- Measure of Dispersion: Range, Mean Deviation/ Average Deviation, Standard Deviation, Coefficient of Variation; Merits and Demerits of Measure of Dispersion. C- Probability: Addition rule, Multiplication rule; Probability Distribution: Normal, Binomial and Poisson.	**10**
Unit-3	**Statistical Methods II:** Chi-Square test (X^2- test), Test of Significance (t-test/Student test), Analysis of Variance (ANOVA) Correlation and Regression: Correlation analysis, Types of correlation, Methods of studying of correlation, Degree of correlation, significance test of correlation coefficient. Regression Analysis: Linear regression analysis.	**10**
Unit-4	**Introduction to Bioinformatics:** Definition of Bioinformatics- History of Bioinformatics, scope and application of Bioinformatics. Fundamentals of Internet, www, HTML, URLs, Role of internet and www in bioinformatics. Biological Data Acquisition- The form of biological information; DNA sequencing methods – basic DNA sequencing, Types of DNA sequences – genomic DNA, cDNA, Expressed sequence tags (ESTs), Genomic survey sequences (GSSs); Databases: Format and Annotation Common sequencing file formats – NBRF/ PIR, FASTA, Files for multiple sequence alignment – multiple sequence format (MSF), ALN format; Files for structural data – PDB format. Bioinformatics Databases: -	**10**

	Primary sequence databases (GenBank-NCBI, the nucleotide sequence database-EMBL, DNA sequence databank of Japan-DDBJ; Protein sequence and structure databases (PDB, SWISS-PROT and TrEMBL); Derived (Secondary) Databases of Sequences and Structure: Posited, PRODOM, PRINTS, Pfam, BLOCK, SSOP, and CATH. Enzyme Database, Biodiversity Database.	
Unit-5	**Technique's in Bioinformatics:** Sequence alignment, database searching and structure prediction Pairwise sequence alignment, database similarity searching, FASTA, and BLAST. Multiple sequence alignment and analysis with CLUSTAL X and CLUSTAL W. Measurement of sequence similarity; Similarity and homology. Phylogenetic tree. Phylogenetic data analysis, tree building methods, tree evaluation & interpretation methods. Phylogenetic analysis with PHYLIP software. Prediction of secondary and tertiary structures with different software's and tools. Structure visualization software's. Introduction to Genomics and Proteomics: - Introduction to genomics- scope and application, Computational genomics, Organization of the prokaryotic and eukaryotic genomes, Human Genome Project. Genome maps and types, current sequencing technologies, partial sequencing, gene identification, gene prediction rules and software, Genome databases; Annotation of genome, Genome diversity: taxonomy and significance of genomes –bacteria, yeast, Homo sapiens, Arabidopsis, etc. Functional Genomics - Microarray - Gene Expression, methods for gene expression analysis; Applications of DNA microarray.	**20**

Suggested Readings

1. Arora, P. N. and P. K. Malhan (2006) Biostatistics: Himalaya Publishing House, Girgaon Mumbai-400004. Pp. 578.
2. Baxevanis, A.D. and Francis Ouellellette, B.F. (1998) "Bioinformatics– a practical guide to the analysis of genes and proteins" John Wiley and Sons
3. Cantor C.R., Smith C.L., (1993) "Genomics: the science and technology behind the Human Genome Project" John Wiley and Sons
4. Choudhuri S., Carlson D. B. (2008), "Genomics: fundamentals and applications" Informa Healthcare
5. Griffiths A. J. F., Miller J.H., Suzuki D.T., (2000) "An Introduction to Genetic Analysis" W.H. Freeman and Co., Publishers.
6. Khan Irfan Ali and Atiya Khanum (2004): Fundamental of Biostatistics. Ukaaz Publication, Hydrabad- 500036 (Andhra Pradesh). Pp. 498.
7. Mount, D. (2004) "Bioinformatics: Sequence and Genome Analysis"; Cold Spring Harbor Laboratory Press, New York. (ISBN 0-87969-712-1)
8. N. Gurumani (2005) An Introduction to Biostatistics. MJP Publishers, Channai- 600005.Pp. 407.
9. Pevsner J (2009), "Bioinformatics and functional genomics", Edition 2, John Wiley and Sons
10. Primrose S. B., Twyman R. M. (2004), "Genomics: applications in human biology" Wiley-Blackwell
11. Primrose S. B., Twyman R. M. (2006), "Principles of gene manipulation and genomics" WileyBlackwell 12) Saccone C., Pesole G., (2003), "Handbook of comparative genomics: principle and methodology" John Wiley and Sons
12. Sharma, V. Munjal, A. and Shankar, A. (2008) "A text book of Bioinformatics" first edition, Rastogi Publication, Meerut – India.
13. Suhai S (2000), "Genomics and proteomics: functional and computational aspects" Springer
14. Bergman N. H. (2007)," Comparative genomics" Volume 2, Humana Press

Core Course	BOT-305 B TECHNIQUES IN PLANT SCIENCES	Lectures 60

Course Objectives

1. To study principles and applications of technique used in life science
2. To know the principles and application of Microscopy
3. To know the principles and application of Microtomy, Histochemical and Cytochemical techniques
4. To know the principles and application of Chromatography and Centrifugation techniques
5. To know the principles and application of Electrophoretic and Molecular biology techniques
6. To know the principles and application of Spectroscopic techniques.

Course Outcome

1. Able to operate all the instruments.
2. Expertize in instrumentation calibration and Practical application.

Unit-1	**Microscopy** 1.1 Image formation (properties of light), Lens- refraction, dispersion of light, objects, images, image quality, magnification concept, resolution 1.2 Light microscopy, Confocal microscopy, Phase Contrast microscopy, Fluorescence microscopy, Electron microscopy (SEM and TEM), Flow cytometry.	**12**
Unit-2	**Microtomy, Histochemical and Cytochemical technique** 2.1 Dissection, maceration, squash, peeling and whole mount pre-treatment and procedures 2.2 Serial sectioning, double or multiple staining, lesser assisted Microtomy 2.3 Localization of specific Compounds/reactions/ activities in tissues and cells	**12**
Unit-3	**Chromatography techniques and Centrifugation techniques** 3.1 Introduction, concept of partition coefficient, Paper, TLC, Column, Gel filtration 3.2 Affinity, Ion exchange, HPLC 3.3 Gas Chromatography techniques 3.4 Principles, Rotors, Factors affecting centrifugation, Ultracentrifugation, 3.5 Density Gradient Centrifugation, High speed centrifuges	**12**
Unit-4	**Electrophoretic and Molecular biology techniques** 4.1 History, Principles, Agarose gel electrophoresis, Pulsed Field Gel Electrophoresis, Polyacrylamide Gel Electrophoresis (PAGE/ Native) 4.2 Sodium Dodecyl Sulphate polyacrylamide gel electrophoresis (SDS-PAGE/ Denaturing), 4.3 Isoelectric focusing, 2 Dimensional Gel Electrophoresis (2-D method), Blotting techniques 4.4 DNA sequencing techniques- Sanger's method, Maxam- Gilbert's method, Automated DNA sequences, Pyrosequencing 4.5 Sequencing of proteins and PCR 4.6 DNA microarray	**12**
Unit-5	**Spectroscopic techniques** 5.1 General principles, Beer and Lambert's Law, Molar extinction coefficient, Spectrophotometer (working and application) 5.2 UV-Visible spectroscopy, Nuclear Magnetic 5.3 Resonance (NMR) spectroscopy, 5.4 X-ray crystallography, Spectro-flurometry 5.5 AAS, MS, IR Spectroscopy	**12**

Suggested Readings

1. Annie and Arumugam (2000). Biochemistry and Biophysics, Saras Publishing, Tamilnadu.
2. Bisen P.S. Mathur S. (2006). Life Science in Tools and Techniques. CBS Publishers, Delhi.
3. Egerton R.F. Physical Principle of Electron Microscopy: an Introduction to TEM, SEM and AEM.
4. Gamborg O.L., Philips G.C. (Eds.) (1995). Plant Cell, Tissue and Organ Culture fundamental Methods. Narosa Publishing House (P) Ltd.
5. Gunadegaram P. (1995). Laboratory Manual in Microbiology. New Age International (P) Ltd.
6. Harborne J.B. (1998). Phytochemical Methods. Springer (I) Pvt. Ltd.
7. Khasim S.M. (2002). Botanical Micro techniques: Principles and Practice. Capital Publishing Company.
8. Krishnamurthy K.V. (1999). Methods in Cell Wall Cytochemistry. CRC Press. LLC.
9. Marimuthu R. (2008). Microscopy and Microtechnique. MJP Publishers, Chennai.
10. Pal and Ghaskadabi (2009). Fundamentals of Molecular Biology. Oxford Publishing Co.
11. Plummer David (1987). An Introduction to Practical Biochemistry. 3rd Eds. Tata Mc Graw-Hill Publishing Company Ltd.
12. Prasad and Prasad (1984). Outline of Microtechnique. Emkay Publications, Delhi.
13. Sadasivam S.,Manickam A. (1996). Biochemical Methods. 2nd Edn. New Age International (P) Ltd.
14. Sass John E. (1984). Botanical Microtechniques. Tata McGraw-Hill Publishing Company Ltd.
15. Sharma V.K. (1991). Techniques in Microscopy and Cell Biology. Tata McGraw-Hill Publishing Company Ltd.
16. Srivastava S. and Singhal V. (1995). Laboratory Methods in Microbiology. Anmol Publication Pvt. Ltd. Delhi.
17. Srivistava M.L. (2008). Bioanylatical Techniques. Narosa Publishing House (P) Ltd.
18. Wilson K., Walker J. (2000). Practical Biochemistry Principles and Techniques. Cambridge University Press.
19. Wilson K., Walker J. (2005). Principles and Techniques in Biochemistry and Molecular Biology. Cambridge University Press.

M.Sc. Part-II Semester-III Botany: Audit Courses

	AC-301 A: Computer Skills (2 Credits)
Unit 1	**Elements of Information Technology** 1.1 Information Types: Text, Audio, Video, and Image, storage formats 1.2 Components: Operating System, Hardware and Software, firmware 1.3Devices: Computer, Mobile Phones, Tablet, Touch Screen,Scanner, Printer, Projector,smart boards. 1.4Processor & Memory: Processor functions, speed, Memorytypes: RAM/ROM/HDD/DVDROM/Flash drives, memory measurement metrics
Unit 2	**Office Automation- Text Processing** 2.1 Views: Normal View, Web Layout View, Print Layout View, Outline View, ReadingLayout View 2.2 Working with Files: Create New Documents, Open Existing Documents, SaveDocuments to different formats, Rename Documents, Close Documents 2.3 Working with Text: Type and Insert Text, Highlight Text, Formatting Text, Delete Text,Spelling and Grammar, paragraphs, indentation, margins 2.4 Lists: Bulleted and Numbered Lists, 2.5 Tables: Insert Tables, Draw Tables, Nested Tables, Insert Rows and Columns, Moveand Resize Tables, Moving the order of the column and/or rows inside a table, TableProperties 2.6 Page Margins, Gutter Margins, Indentations, Columns, Graphics, Print Documents, 2.7 Paragraph Formatting, Paragraph Attributes, Non-printing characters 2.8 Types of document files: RTF, PDF, DOCX etc
Unit 3	**Office Automation-Worksheet Data Processing** 3.1 Spreadsheet Basics: Adding and Renaming Worksheets, Modifying Worksheets, 3.2 Moving Through Cells, Adding Rows, Columns, and Cells, Resizing Rows and Columns,Selecting Cells, Moving and Copying Cells 3.3 Formulas and Functions: Formulas, Linking Worksheets, Basic Functions, AutoSum,Sorting and Filtering: Basic Sorts, Complex Sorts, Auto-fill, Deleting Rows, Columns,and Cells 3.4 Charting: Chart Types, drawing charts, Ranges, formatting charts
Unit 4	**Office Automation-Presentation Techniques and slide shows** 4.1 Create a new presentation, AutoContent Wizard, Design Template, Blank Presentation,Open an Existing Presentation, PowerPoint screen, Screen Layout 4.2 Working with slides: Insert a new slide, Notes, Slide layout, Apply a design template,Reorder Slides, Hide Slides, Hide Slide text, Add content, resize a placeholder or textbox, Move a placeholder or text box, Delete a placeholder or text box, Placeholder orText box properties, Bulleted and numbered lists, Adding notes 4.3 Work with text: Add text and edit options, Format text, copy text formatting, Replacefonts, Line spacing, Change case, spelling check, Spelling options 4.4 Working with tables: Adding a table, Entering text, Deleting a table, Changing rowwidth, Adding a row/column, Deleting a row/column, Combining cells ,Splitting a cell,Adding color to cells, To align text vertically in cells, To change table borders,Graphics, Add clip art, Add an image from a file, Save & Print, slide shows, slideanimation/transitions.
Unit 5	**Internet& Applications:** 5.1 Computer Network Types: LAN, PAN, MAN, CAN, WAN, Defining and describing theInternet, Brief history, Browsing the Web, Hypertext and hyperlinks, browsers,Uniform resource locator 5.2 Internet Resources: Email, Parts of email, 5.3 Protecting the computer: Password protection, Viruses, Virus protection software,Updating the software, Scanning files, Net banking precautions.

	5.4 Social Networking: Features, Social impact, emerging trends, issues, Social Networking sites: Facebook, Twitter, linkedin, orkut, online booking services 5.5 Online Resources: Wikipedia, Blog, Job portals, C.V. writing 5.6 e-learning: e-Books, e-Magazines, e-Newspapers, OCW(open course wares): Sakshat(NPTEL) portal, MIT courseware
Unit 6	**Cloud Computing Basics** 6.1 Introduction to cloud computing 6.2 Cloud computing models: SAS, AAS, PAS 6.3 Examples of SAS, AAS, PAS (DropBox, Google Drive, Google Docs, Office 365 Prezi, etc.)

	AC-301 B: Cyber Security(2 Credits)
Unit 1	**Networking Concepts Overview** Basics of Communication Systems, Transmission Media, ISO/OSI and TCP/IP models, Network types: Local Area Networks, Wide Area Networks, Internetworking, Packet Formats, Wireless Networks: Wireless concepts, Advantages of Wireless, Wireless network architecture, Reasons to use wireless, Internet.
Unit 2	**Security Concepts** Information Security Overview, Information Security Services, Types of Attacks, Goals for Security, E-commerce Security, Computer Forensics, Steganography. Importance of Physical Security, Biometric security & its types, Risk associated with improper physical access, Physical Security equipments. Passwords: Define passwords, Types of passwords, Passwords Storage – Windows & Linux.
Unit 3	**Security Threats and vulnerabilities** Overview of Security threats, Hacking Techniques, Password Cracking, Types of password attacks, Insecure Network connections, Wi-Fi attacks & countermeasures, Information Warfare and Surveillance. Cyber crime: e-mail related cyber crimes, Social network related cyber crimes, Desktop related cyber crimes, Social Engineering related cyber crimes, Network related cyber crimes, Cyber terrorism, Banking crimes,
Unit 4	**Cryptography** Understanding cryptography, Goals of cryptography, Types of cryptography, Applications of Cryptography, Use of Hash function in cryptography, Digital signature in cryptography, Public Key infrastructure,
Unit 5	**System &Network Security** System Security: Desktop Security, email security: PGP and SMIME, Web Security: web authentication, Security certificates, SSL and SET, Network Security: Overview of IDS, Intrusion Detection Systems and Intrusion Prevention Systems, Overview of Firewalls, Types of Firewalls, VPN Security, Security in Multimedia Networks, Fax Security.
Unit 6	**OS Security** OS Security Vulnerabilities updates and patches, OS integrity checks, Anti-virus software, Design of secure OS and OS hardening, configuring the OS for security, Trusted OS.
Unit 7	**Security Laws and Standards** Security laws genesis, International Scenario, Security Audit, IT Act 2000 and its amendments.

M.Sc. Part II Semester IV Botany: Core Special Paper

Core Course	**BOT-401 A** **PHYCOLOGY SPECIAL PAPER-II**	**Lectures 60**

Course Objectives:

1. To know cellular details of prokaryotic and eukaryotic algae.
2. To understand algal physiology, biochemistry and genetics.
3. To know about cultivation of algae and its application.
4. To aware about commercial utilization of algae.
5. Role of algae in industries.

Course Outcomes:

1. Able to understand algal physiology,biochemistry
2. Able to cultivate algae for its utilization

Unit I	**Algal Cell Biology and Genetics:** 1. Prokaryotic, Mesokaryotic, Eukaryotic Cell structure and cellular organelles 2. Cell wall, Flagella, Cell division in algae 3. Type of Chloroplast / Plastids, Structure and arrangement of Thylakoid, Stroma. 4. Endoplasmic Reticulum, Gas vacuoles, Golgi bodies, Mitochondria 5.The nucleus and nuclear divisions, Cell Division and Chromosomes in algae 6. Extra chromosomal Inheritance 7. Plastid DNA 8. Cyanophages 9. Sexuality (All three types)	**15 L**
Unit II	**Algal Physiology and Biochemistry:** 1. Biochemical characteristics of Algal pigments and Extracellular products 2. Biochemicals from algae: a) Carbohydrates and Proteins in Algae b) Essential fatty Acids c) Plant growth regulators 3. Algal toxins: Effect of toxins, mode of action, problems and prospects. 4. Nutrition in algae: a) Mineral nutrition: Macronutrients and Micronutrients b) Types of Nutrition: Phototropic, Chemotropic. 5. Biological nitrogen fixation: a) Role of enzyme nitrogenase, hydrogenase b) Mechanism of nitrogen fixation c) Nitrogen fixing blue green algae d) Heterocyst development and site of nitrogen fixation e) Factors affecting on nitrogen fixation f) Calcification and Silicification.	**15 L**
Unit III	**Algal Cultivation** 1. Definition, General requirements for culturing of algae, types of culture media 2. Preparatory culture, isolation of algae, streak culture, nutritive solution, dilution culture 3. Types of cultures: Enrichment culture synchronous culture, continuous culture, mass culture. 4. Cultivation of algae in waste water 5. Current status of the large-scale culture of algae in India	**12 L**

Unit IV	**Marine Algal Cultivation** 1. Introduction, Necessity of marine algal cultivation. 2. Principle methods of cultivation : a) Vegetative propagation / *Eucheuma* type mariculture b) Nonmotile spore type / *Porphyra* type mariculture c) Motile spore (Zoospore) type / The *Laminaria* type Mariculture. 3. Marine algal cultural status and utilization in India	**08 L**
Unit V	**Algal Utilization** 1. Nutritional Value of Microscopic and Macroscopic algae 2. Micro algae industrial raw material. 3. Industrial uses: Agar Agar, Alginates, Carrageen and other by products of marine algae. 4. Algal fuel: Biogas from algae, algal energy products, Hydrocarbons from algae 5. Cyanobacteria in human welfare: Production of fine chemicals, polysaccharides, bioactive molecules, pigments, antioxidants, and biofertilizer, Reclamations of Usar soils 6. Algae in Pharmacy Iodine, Vitamins, Proteins, Antibiotics. 7. Human food: Role of algae as nutrients supplement.	**10 L**

Suggested Readings:

1. C. Van den Hoke, D. G. Mann & H.M. Jahns (1995) Algae An Introduction to Phycology, Cambridge University Press

2.Carr N.G. & B. A. Whitton (1982) The Biology of Cyanobacteria Botanical Monograph Vol-II Blackwell Scientific Publication, London, UK.

3. Janet R. Stein (1975) Phycologycal methods, Cambridge University Press.

4.John D. Dodge (1973) The Fine Structure of algal cells, Academic Press, New York, USA.

5.John S. Burlew (1976)AlgalCullture from Laboratory to Pilot Plant, Crnegie Institution of Washington Publication 600, Washington, D. C., USA.

6.Peter S. Dixon (1973) Biology of the Rhodophyta, Oliver & Boyd Croythorn House, 23 Ravelston Terrace, Edinburgh

7.Ralph A. Lewin. (1976) The Genetics of Algae (Botanical Monographs Vol. 12), Blackwell Scientific Publications, Oxford.

8.Tilden J. E. (1968) The Algae and Their life relations (Fundamentals of Phycology) Hafner Publishing Co, London, UK.

9.Alan J. Brook (1981) The Biology of Desmids. University of California Press , Berkeley.

M.Sc. Part II Semester IV Botany: Core Special Paper

Core Course	**BOT-401 B** **MYCOLOGY SPECIAL PAPER-II**	Lecture 60

Course Objectives:

1) Identify, characterize, maintain industrially important moulds
2) To learn possibilities for fungal growth, fermentation technology, production of alcohol, antibiotics, enzymes, organic acid.
3) To study mushroom technology, fungal toxins.
4) To provide students with knowledge of harmful and beneficial soil microflora.
5) To learn role of soil microorganism, environmental aspects, symbiosis, nitrogen fixation.
6) To study the fungal ecology, make students aware about fungal biotechnology.
7) To learn the fungal genetics, improvement of fungal strains.

Course Outcomes:

1) This paper acquaints students with maintenance and preservation industrial important fungi.
2) Able to know fermentation technology, mushroom technology, fungal toxins, soil microflora, importance of soil microflora, nitrogen fixation, fungal ecology, fungal genetics and fungal biotechnology.

Unit I	Industrial Mycology:A i) Maintenance and Preservation of Cultures ii) Methods of Sterilization: Physical, Chemical, Radiations iii) Principals of Microbial Growth: Batch Cultures, Continuous Culture, Synchronous Culture iv) Assay Methods for Fermentation Products: Physical, Chemical and Biological Methods v) Mushroom Cultivation: Important steps involved in cultivation of *Agaricus* (Button) and *Pleurotus* (Dhingri) mushrooms on large Scale.	**12 L**
Unit II	Industrial Mycology: B i) Fermentation Methods for- Alcohol Production, Citric acid Production, Antibiotic (Penicillin) Production, Vitamins (Vitamin B12, Vitamin A B-Carotene, Riboflavin and Gibberellin) Production, Enzymes Production ii) Non Alcoholic Beverages: Tea, Coffee, Cocoa iii) Retting/Rotting of Fibres iv) Fungal Toxins: Fungal toxins affecting animals and man- Mycotoxins of Food and Feed, Ergot toxins, Mushroom toxins.	**12 L**
Unit III	Soil Microbiology: i) Structure of soil, Types of soil, Microbial distribution in soil ii) Role of microbes in soil and their effect on plant growth. iii) Humus and its role in agriculture iv) Rhizosphere and Rhizoplane v) Microbial association in soil, Nitrogen fixation	**14 L**
Unit IV	Fungal Ecology: i) Fungi in extreme environment- Thermophilic and Psychrophilic fungi ii) Heterotrophy and consequences, practical exploitation of saprotrophy iii) Fungi as control agents-Entomogenous, Nematophagus and Mycoparasites Fungi and Biotechnology: i) Fungi in Industry- Mycoprotein, Growth Hormone, Miscellaneous products as Zearalenone, Mycoinsecticides, Mycoweedicides. ii) Mycorrhiza- Mass cultivation and its uses in agriculture and forest.	**12 L**

	iii) Protoplast isolation and fission iv) Engineering plants for resistance to disease and pest	
Unit V	Fungal Genetics: i) Incompatibility System, Tetrad analysis ii) Sexual reproductive structures in Ascomycetes and Basidiomycetes iii) Parasexual Cycle iv) Industrial strain improvement in Penicillium, Yeast and Mushroom	**10 L**

Suggested Readings:

Barron J. H. (1975) The nematodes destroying Fungi. Can. Biol. Pub. Ltd. Gulph Ontario

Burnett J. H. (1975) Myogenetics: Introduction to General Genetics of Fungi Wiley- Blackwell, London.

Casida L. F.JR. (1968) Industrial Microbiology New International Publishers, New Delhi.

Dayal R. (2000) Predaceous Fungi Common wealth Publishers.

Dubey R. C. (1995) A text Book of Biotechnology. S. Chand and Company Ltd. New Delhi

Essar K E and R Kuenen (1967) Genetics of Fungi Sringer-Verzlag, Berline

Funcham (1990) Fungal Genetics Oxfort and Edinburgh, Blackwell Scientific Publication

Griffin (1973) Ecology of Fungi, Chapman and Hall, London

Hudson H J (1961) Fungal Sporophytism. Edward Arnold Ltd. London

Martin A (1961) An introduction to soil microbiology Vol. I, II, III Rastogi Publication, Meerut.

Nair M C and Balakrishinan (1986) (Eds.)Benificial Fungi and Their Utilization, Scientific Pub. Jodhpur.

Pathak Y B (1998) Mushroom Production and Processing Technology Vol III Himalaya Publishing Bombay

Purkyastha and Chanda (1976) Indian Edible Mushroom, Firma Klam Pvt. Ltd. Calcutta

Singh B D (1998) Biotechnology Kalyani Pub. New Delhi

Smith G (1969) An Introduction to Industrial Mycology, Edward Arnold London

M.Sc. Part II Semester IV Botany: Core Special Paper

Core Course	**BOT-401 C** **ANGIOSPERM SPECIAL PAPER II**	**Lecture 60**

Objectives:

1. To study Cronquist`s system of classification of angiosperms.
2. To study phylogeny and interrelationship of different orders.
3. To study biosystematics and ultra structural systematic.
4. To study the numerical taxonomy of angiosperms.
5. To study chemotaxonomy of Angiospermic plants.

Course outcomes:

1. Able to know Cronquist`s system of classification.
2. Able to know phylogeny and interrelationship of different orders and taxa.
3. Able to understand biosystematics and ultra structural systematic.
4. Able to understand the numerical taxonomy of angiosperms.
5. Able to understand chemotaxonomy of Angiospermic plants.

Unit 1	**Cronquist's system of classification (1968, 1988) w.r.t.** 1.1 Outline of the system. 1.2 Refinements over his earlier system of 1968. 1.3 Salient features of the system. 1.4 Merits and demerits of system. 1.5 Description, characterization and critical tendencies of the subclasses.	**12 L**
Unit 2	**Discussion on the orders (Sensu Cronquist):w.r.t. Morphological characters, floral variation, phylogeny and interrelationship.** 2.1 Piperales 2.2 Hamamelidales 2.3 Caryophyllales 2.4 Dilleniales 2.5 Euphorbiales 2.6 Asterales 2.7 Najadales 2.8 Arales 2.9 Cyperales 2.10 Zingiberales 2.11 Liliales	**12 L**
Unit 3	**Systematics** **3.1 Biosystematics** i. Concept, aims and objectives, categories. ii. Methods in biosystematics, ecotypic variations, scope and limitations. iii. Comparison of classical taxonomy and biosystematics. **3.2 Ultra structural Systematics** i. SEM and TEM studies and plant systematic ii. SEM and plant surface structure. iii. TEM and dilated cisterneae of endoplasmic reticulum and sieve element plastids. iv. Applications of data in the classification of higher taxa	**12L**
Unit 4	**Numerical Taxonomy** 4.1 Phenetic methods in taxonomy (taxometris) 4.2 Principles, construction of taxonomic groups 4.3 OTUs, unit character, measurement of resemblances, cluster analysis 4.4 Phenons and ranks, discrimination, nomenclature and numerical taxonomy. 4.5 Applications, merits and demerits, cladastics and cladogram, parsimony analysis, cladastics and classification.	**12 L**
Unit 5	**Chemotaxonomy** 5.1 Origin of chemotaxonomy, classes of compounds and their biological significance. 5.2 Stages in chemotaxonomic investigations, techniques. 5.3 Uses of chemical criteria in plant taxonomy, protein and taxonomy, seed proteins, techniques of protein electrophoresis, 5.4 Chemical protein analysis procedures, analysis of amino acid	**12L**

	sequence and its significance in systematics, 5.5 Serology and taxonomy, history, precipitation reaction, techniques, antigen, antisera antibody, application of serological data in systematics	

Suggested readings:

1. Cronquist, A. 1981. An Integrated System of Classification of Flowering Plants. Columbia University Press, New York, USA.
2. Cronquist, A. 1988. The Evolution and Classification of Flowering Plants (2nd ed.), Allen Press, U.S.A.
3. Davis, P. H. and V. H. Heywood 1991. Principles of Angiosperm Taxonomy. Today and Tommorow Publications, New Delhi, India.
4. Endress Peter, K. 1994. Diversity and Evolutionary Biology of Tropical Flowers. Cambridge.
5. Judd Walter S., Campbell C. S., Kollogg, E. A., Stevens P. F. and M. J. Donoghue 2008. Plant Systematics. Sinauer Associates, INC, Publisher. Sunderland, Massachusetts, USA.
6. Judd Walter S., Cmpbell C. S., Kollogg, E. A., Stevens P.F. and M. J. Donoghue 2008. Plant Systematics. Sinauer Associates, INC,Publishers.Sunderland, Massachusetts, USA.
7. Lawrence George H. M. 1951. Taxonomy of Vascular Plants. Oxford and IBH Publ. Co. Pvt. Ltd. New Delhi, India.
8. Naik, V. N. 1984. Taxonomy of Angiosperms Tata McGraw-Hill Publication Com. Ltd. New Delhi, India.
9. Quicke, Donald, L. J. 1993. Principles and Techniques of Contemporary Taxonomy. Blakie Academic & rofessional, London, UK.
10. Rao, R. R. 1994. Biodiversity of India (Floristic Aspects). Bishen Singh Mahendra Pal Singh, Dehradun, India.
11. Richard, A. J. 1997. Plant Breeding Systems. (2ed.) Chapman and Hall.
12. Shivanna, k. R. and B. M. Johri 1985. The Angiosperm Pollen: structure and Function. Wiley Eastern limited, New Delhi, India.
13. Stace, C. A. 1989 Plant Taxonomy and Biosystematics. Edward Arnold, London, U.K.
14. Stuessy,T. F. 2002. Plant Taxonomy. The Systematics Evaluation of Comparative data. Bishen Sing Mahendra Pal Singh, Deheradun, India.
15. Taylor, D. V. and L. J. Hickey 1997. Flowering Plants: Origin, Evolution and Phylogeny. CBS Publishers & Distributers, New Delhi, India.

M.Sc. Part II Semester IV Botany: Core Special Paper

Core Course	**BOT 402: A** **PHYCOLOGY SPECIAL PAPER - III**	**Lecture 60**
	Course Objectives: 1. To study ecological classification of algae. 2. To understand those environmental factors which control their survival growth, distribution and causal mechanisms 3. To helps in bio-monitoring the water bodies and pollution control. 4. To know phycological techniques, for water supplies. 5. To study the role of algae in sewage disposal. ***Course Outcomes:*** 1. Able to understand ecological classification of algae , Habitats of algae. 2. Able to know algae and sewage disposal and eutrophication.	
Unit I	**Ecological Classification of Algae** 1. Phytoplankton 2. Benthic algae 3. Cryophilic algae 4. Thermophillic algae 5. Soil Algae 6. Epiphytic algae 7. Lithophytes 8. Endophytic algae 9. Symbiotic algae 10. Parasitic algae 11.Epizooic Algae	08 **L**
Unit II	**A) Fresh Water Bodies** 1. Lentic and Lotic environment: - General considerations physical and chemical factor and their influence, Types of Lakes, Zonation types of Lentic and Lotic water bodies, phytoplankton nature, adaptation, periodicity and succession. 2. Flora of Lentic and Lotic series and its feature **B) Marine Environment** 1. General considerations, physical and chemical factors, marine phytoplankton nature, seasonal growth cycles, productivity. 2. Marine benthic algae, shore type Zonation patterns and factors governing them, Zonation pattern of East and west Coast of India.	**15 L**
Unit III	**Algae and Sewage Disposal** 1. Necessity of sewage disposal 2. Composition of sewage (Physical, chemical biological) 3. Treatment of waste water: Pretreatment, secondary biological treatment. 4. Types of algal stabilization ponds 5. Algal flora their periodicity and succession in sewage stabilization ponds.	**10 L**
Unit IV	**Eutrophication and Biomonitoring of Water Quality** (17 L) 1. Definition of Water pollution 2. Types of water pollutants 3. Eutrophication Definition, Process of eutrophication, Effects of eutrophication and algal bloom, Controls of water blooms, pollution tolerant genera. 4. Saprobic zones (Kolvewitz and marson 1909); Saprobic zones (Partick 1977)	

	5. Algae in organically polluted waters and home sewage 6. Common algae in water supplies 7. Diatoms as indicators of water pollutions 8. Nygaard's tropic state indices. 9. Palmer's pollution index 10. Filter clogging algae; Algae causing odour, taste, colour, and slime in water. 11. Uses of algae in water supplies; Control of algae in water supplies. 12. Water pollution monitoring and management bodies	**17 L**
Unit V	**: Phycological Techniques** 1. Field Collection procedure for marine and freshwater algae, phytoplankton Phytoplankton counts methods. 2. Ecological Field Methods: Macro algae 3. Preservation, preparation of herbarium and permanent slides 4. Histochemical and general methods, stains and fixatives 5.Important organizations involved in water pollution control and monitoring in India and role of NGO's in water pollution management 6. Some international phycological societies and journals	**10 L**

Suggested Readings:

1. Abbasi, S.A. (1998) Water Quality Sampling and Analysis. Discovery Publishing House New Delhi, India.
2. Agrawal, S.C. (1999) Limnology. APH Publishing Corporation, New Delhi, India.
3. Anand, N. (1989) Handbook of Blue Green Algae. Bishen Singh Mahendra Pal Singh, Dehradun, India.
4. Anonymous, (1971) Algal Assay Procedure Bottle Test. Nat. Eut. Res. Prog. EPA.
5. APHA, (2017) Standard Method for the Examination of Water and Waste Water. 23rd.Edition American Public Health Association, New York, U.S.A.
6.Fatma, T.(1999) Cyanobacterial And Algal Metabolism and Environmental Biotechnology.Narosa Pub. House, New Delhi, India.
7. Kachroo, P . Aquatic Biology in India. Bishen Singh Mahendra Pal Singh Dehradun, India.
8. Mark M. Littler & Diane S. Litter (1985) Hand book of Phycological Methods, Cambridge University Press.
9. Palmer, C. Wervin (1980) Algae and Water Pollution.Castle House Publications Ltd. , London, U.K.
10. R. Ramesh, M. Anbu (1996) Chemical Methods for Environmental Analysis. McMillan India Ltd., Mumbai, India.
11. Sambamurty, A.V.S.S. (2005) A Text Book of Algae. I.K. International, Mumbai, India.
12. Sharma, O.P. (2003) A Text Book of Algae. Tata Mc. Grew Hill Pub. Mumbai, India.
13. Trivedi, P.C.(2001) Algal Biotechnology. Pionter Pub., Jaipur, India.

M.Sc. Part II Semester IV Botany: Core Special Paper

Core Course	**BOT. 402 B** **MYCOLOGY SPECIAL PAPER-III**	**Lectures 60**

Course objectives:

1. To know scope and significance and history of plant pathology.
2. To study pathogenesis, defense mechanism and physiology of diseased plants.
3. To make aware about Specific Plant diseases and disease management.
4. To know seed pathology, Market pathology, Forest pathology and medical mycology.

Course outcomes:

1. Able to know concept, scope and importance of the plant pathology.
2. Able to describe development of disease, pathogenesis, defense mechanism.
3. Higher cognitive skills about abiotic and biotic diseases of plants will develop.

Unit 1	Plant pathology: A) Definition, Objectives, Scope and significance of plant pathology. History of Plant Pathology in India. B) Concept of disease, Disease pyramid. C) Classification of Plant diseases D) Stages in development of disease (Disease cycle).	**12 L**
Unit 2	A) Pathogenesis (Mechanism of infection): penetration, invasion and growth. B) Plant-parasite relationship. C) Chemical Weapons of pathogen: i) Enzymes in plant diseases ii) Microbial toxins in plant diseases, Non-Host specific toxins and Host-specific toxins.	**12 L**
Unit 3	A) Effect of environment on disease development B) Defense mechanism: i) Structural defense mechanism ii) Biochemical defense mechanism C) Physiology of diseased plants	**12 L**
Unit 4	Specific Plant diseases and disease management: a) Abiotic: environmental factors that cause disease- temperature, moisture, oxygen, light and mineral deficiency. b) Biotic : Plant diseases caused by i) Viruses: Leaf curl of Tomato, Yellow vein mosaic of Bhendi. ii) Mycoplasmas: Little leaf of Brinjal, Grassy shoot of Sugarcane ii) Bacterial: Citrus canker, Angular leaf spot of Cotton. iv)Nematode: Root knot of vegetable, Soybean cyst nematode. v) Fungal: Downy mildew of crucifers, Downy mildew of Grapes, Powdery mildew of Grapes, Rust of Wheat, Smut of Jowar, Red rot of Sugarcane. c) Physical, Chemical and Biological Control measures	**12L**
Unit 5	A) Seed Pathology: Methods of study, external and internal seed born diseases, Quarantine laws and seed certification, storage mycoflora and toxins. B) Forest Pathology: Forest diseases, management and wood decay. C) Market pathology: Post harvest fungal diseases of fruits and vegetables. D) Medical Mycology: Mycotic infections, Dermatophytes and Deep mycoces.	**12L**

Suggested readings:

1. Agrios G. N. (1969). Plant Pathology. Academic Press, New York, USA
2. Ainsworth G. C. 1952. Medical Mycology. Pitma Press, London, UK
3. Bakshi B. K. 1976 Forest pathology. Controller of Pub. New Dehli, India.
4. Billgrami and Dubey 1976 Modern plant Pathology. Vikas Publ House Pvt. Ltd., New Delhi, India.
5. Butler E. J. 1973 Fungi and plant diseases in plants Thecker Spinck and Co., Culcutta
6. Cochrane V. W. 1958 Physiology of Fungi Wiley Chapman and Hall, New York, USA
7. Daniel and Roberts, Carlw. Boothroyd (II nd Ed.) 1987. Fundamentals of plant pathology. CBS Publ and distributors. New Delhi, India.
8. Dugger B. M.1998 Fungus diseases of plants, Agro Bot. Pub., New Delhi, India.
9. Ellis M. B. 1976 Medical Mycology. Led and Febiger, Philadelphia
10. Harsfall and Diamond 1971 Plant pathology Vol I – V Academic press New Delhi, India.
11. Joshi K. R. 1966 Opportunetic mycosis. Scientific Publisher, New Dehli, India.
12. Kamat M. N. 1959 Introductory Plant Pathology. Prakash Publ., Pune, India.
13. Mehrotra 1994 Plant Pathology. International Pub House, New Delhi, India.
14. Merotra R. S. Ashok Agrawal 2003 Plant Pathology. Tata Mac Graw Hill Publ Co Ltd, New Delhi, India.
15. Mukherji and Bhasin 1986 Plant diseases of India Tata Mac Graw Hill Publ Co Ltd New Delhi, India.
16. Nene Y. L. 1976 Fungicides in plant diseases controls. Oxford and IBH Publ. Co. New Delhi, India.
17. Pathak V. R. 1972 Essentials of plant pathology.Prakash publishing, Jodhpur.
18. Pathak, Khatri and Pathak 1996 Fundamentals of Plant Pathology. Agro Bot. Publ Bikaner India
19. Robertis and Boothroyd 1972 Fundamentals Plant Pathology Toppan Co. Ltd. Tokya.
20. Sharma Rajni 2000 Plant Pathology Campus Books International New Delhi, India.
21. Singh R. S. 1982 Plant Pathology Oxford and IBH Publ. Co. New Delhi, India.
22. Singh R. S. 1990 Plant diseases 6 th edition Oxford and IBH Publ. Co. New Delhi, India.
23. Stakman and Harrar 1957 Principles of Plant pathology, Ronold Press Co., New Delhi,India.
24. Suryanarayana D. 1978 Seed Pathology. Vikas Pub. House Pvt . New Delhi, India.
25. S. A. J. 1972 Principles of Plant Pathology. The McMellian Press, India
26. Walker J. C. 1974 Plant Pathology. McGraw-Hill Book Co. Inc., New York, USA.

M.Sc. Part II Semester IV Botany: Core Special Paper

Core course	**BOT. 402 C** **ANGIOSPERM SPECIAL PAPER-III**	**Lectures 60**

Course objectives:

1.To trace the origin of Angiosperms.

2.To study embryology of Angiosperm plant.

3.To study palynology of Angiosperm plant.

4.To study wood anatomy of Angiosperm plant.

5.To study ecological anatomy of Angiosperms.

Unit: 1	**Origin of Angiosperms :** 1. Time of origin of angiosperms 2. Cradle of angiosperms 3. Theories of origin of Angiosperms with respect to time, place, and possible ancestors: a. The *Isoetes*– monocotyledons theory, b. The Coniferales- Amentiferae theory, c. The Gnetales- Angiosperm theory, d. The Anthostrobilus- (Bennettitalean) theory, e. The CaytonialeanTheory, f. The Stachyospory- Phyllospermae theory, g. The Pteridosperm theory, h. The Pentoxylales theory and The Durian theory	**(20 L)**
Unit: 2	**Embryology :** 1. Different schools of embryology and their contributions, 2. Artificial pollination, fertilization, 3. Sexual incompatibility, 4. Endosperm, endosperm – ultra structure andhisto-chemistry. 5. Embryo as a reaction system, homologies, experimental embryogenesis, 6. Embryo-endospermrelationship, 7. Embryology in relation totaxonomy, 8. Fertilization in *Tambourissa*and *Butomopsis* and their significance.	**(10 L)**

Unit: 3	**Palynology:** 1. Pollen units, pollen biochemistry, and pollen physiology. 2. Pollenkitt, sporopollenin, pollen wall proteins, pollen germination *in vivo* and *in vitro.* 3. Pollen storage and viability, pollen sterility. 4. Pollen polymorphism. 5. Palynology in relation to angiosperm phylogeny.	**(15 L)**
Unit: 4	**Wood Anatomy:** 1. Introduction 2. Hard and softwood. 3. Elements of wood, their structure anddistribution. 4. Properties and uses of wood in relation to structure and composition 5. Anatomy and identification of important timbers.	**(07L)**
Unit: 5	**Ecological Anatomy:** 1. Hydrophytes: (i)Submerged, (ii)Free floating, (iii) Anchored floating, (iv)Amphibious. 2.Xerophytes: (i) Microphyllous, (ii) Sclerophyllous, (iii)Trichophyllous, (iv)Malacophyllous 3. Halophytes 4. Parasites 5.Epiphytes	**(08 L)**

Suggested readings:

vani, S. S. and Bhatnagar, S. P. 1984. Embryology of Angiosperms. Vikas Publ. House, New Delhi, India.

Bhojwani, S. S., Bhatnagar, S. P. and P. K. Dantu 2015. The Embryology of Angiosperms. Vikas Publ. House, New Delhi, India.

Carlquist, S.1961 Comparative Plant anatomy, Hold, Rinehart and Winson, New York, USA.

Cronquist, A. 1981. An Integrated System of Classification of Flowering Plants. Columbia University Press, New York, USA.

quistA.1988.TheEvolutionandClassificationofFloweringPlants(2nded.)AllenPress, U.S.A.

P. H. and V. H. Heywood 1991. Principles of Angiosperm Taxonomy. Today and Tomorrow Publications, New Delhi, India.

an G. 1952. Pollen Morphology and Plant Taxonomy. Angiosperms. Alquist and Wiksell. Stockholm.

Erdman G. 1952. Pollen Morphology and Plant Taxonomy. Angiosperms. Hafner Publ. Co. New York, USA.

Esau K.1960.Anatomy of Seed Plants, Wiley. New York, USA.

M.Sc. Part II Semester IV Botany: Core Course

BOT-403 Practical (Core Course) (Based on BOT. 401 A and 402 A)	
Practical 1	Preparation of culture media (De's modified Beneck's medium for Blue Green Algae)
Practical 2	Isolation and cultivation of algae by dilution and streak culture technique
Practical 3	Mass culture of blue green algae as bio-fertilizer
Practical 4	Biomass estimation, total chlorophyll / fresh and dry weight
Practical 5-6	Extraction and separation of amino acids and carbohydrates of algae by chromatography methods
Practical 7-8	Algae of unusual habitats (a) Epiphytic algae, (b) Epizoic and Endozoic algae, (c) Symbiotic algae, (d) Endophytic algae, (e) Benthic algae, (f) Aerial algae (g) phytoplankton
Practical 9-10	Algae of east & west coast of India
Practical 11-12	Qualitative and quantitative studies of phytoplankton using standard Methods Lacky's simple drop method and haemo-cytometer method.
Practical 13	Study of Palmer's pollution index for assessing the water quality of any polluted habitat
Practical 14 -17	Water analysis pH, Turbidity, Total dissolved solids dissolved oxygen, Free CO2, BOD, COD, Carbonate, Bicarbonate, Total Alkalinity, Chlorides, Hardness, Calcium, Magnesium, Nitrate, Sulphate, Phosphate (any 6)
Practical18	Cytological studies of *Chara, Hydrodictyon, Cladophora, Spirogyra, Oedogoniun* (any 1)
Practical 19	Extraction of Mucilage from algal material.
Practical 20-21 Practical - 22	Extraction of Agar-Agar, Extraction of Algenic acid from Marine algae Extraction and Estimation of algal proteins from unpolluted waters and polluted water bodies.
Practical 23	Extraction and Estimation of Phitosynthetic pigments of algae from polluted and unpolluted waters using the method of Arnon (1949).
Practical 24	Culture and Test for oils of diatoms biomass.
Note:	1.Compulsory Botanical excursion of marine and fresh water habitats 2 Compulsory Botanical excursion Visit to nearby ponds rivers lakes and polluted habitats; Submission of algal photomicrograph and tour report is essential 3. Duly certified journals are compulsory at the time of practical examination.

M.Sc. Part II Semester IV Botany: Core Course

BOT-403 **Practical I (Core Course)** **(Based on BOT. 401 B and 402 B)**	
Practical 1	Basic Techniques in Plant Pathology
Practical 2	Isolation of Mycorrhiza from soil
Practical 3	Isolation of Fungal Pathogens
Practical 4 & 5	Isolation and enumeration of microorganism from soil by serial dilution plate method
Practical 6	Isolation of *Rhizobia* from root nodules
Practical 7	Study of seed pathology
Practical 8	Study of fruit pathology
Practical 9	Study of Forest plant pathogens
Practical 10	Study of diseases caused by bacteria and viruses (any two)
Practical 11	Study of diseases caused by Mastigomycotina and Plasmodiophorales (any three)
Practical 12	Study of diseases caused by Ascomycotina (any three)
Practical 13	Study of diseases caused by Basidiomycotina (any three)
Practical 14	Study of diseases caused by Deuteromycotina (any three)
Practical 15 &16	Biochemical studies of diseased plants by paper chromatography (sugar/amino acid)
Practical 17	Biochemical studies of diseased plants (enzymes/proteins)
Practical 18 & 19	Citric acid fermentation and assay
Practical 20 & 21	Alcohol fermentation and Distillation
Practical 22 &23	Spawn preparation and mushroom cultivation
Practical 24	Field Visit
	Note: Visit to fermentation industry, research institute, Agriculture University, tour for collection of Phytopathological organism is compulsory.

M.Sc. Part II Semester IV Botany: Core Course

BOT-403 Practical (Core Course) (Based on BOT. 401 C and 402 C)	
Practical 1-6	Study of the families with respect to morphological characters using botanical terms, floral formula, floral diagram and classification. (Sensu. Bentham and Hooker`s system at least 12 families)
Practical 7-13	Study of anatomical features of ecological interest of the following: **Hydrophytic leaves (Any two**) : *Potamogeton, Ceratophyllum, Hydrilla, Ottelia, Vallisneria, Typha, Limnophila,Phylla nodiflora, Bacopa monieri, Nymphaea, Nelumbo.* **Hydrophytic stem or petiole (Any two):** *Limnophila, Hydrilla, Potamogeton, Bacopa monieri, Nymphea, Nelumbo.* **Xerophytic leaves (Any two):** *Euphorbia nerifolia, Calotropis sp., Pentatropis sp., Nerium sp., Ficus bengalensis.* **Xerophytic stem (Any two):** *Casuarina equisitifolia, Tamarix sp., Capparis deciduas, Caralluma sp., Euporbia tirucaulli, Sarcostemasp.* **Specialized structure**: (a) Cladode of *Asparagus sp.*(b) Phyllode of *Acacia auriculiformis* **Parasites:** *Striga gesneroides, Cuscuta chinensis.* **Epiphytes:** Study of velamen tissue (either from root material orpermanent slide
Practical 14-15	Identification of six important timbers with the help of anatomical character and prepare an artificial key of timber wood on the basis of anatomical characters.
Practical 16-18	Embryology: 1. To study types of tetrads, pollen unit (Polyad and Pollinia) from locally available plant material. 2. Dissection and mounting of stages of embryo development, multiple embryos. 3. To study different types of endosperm from locally available materials
Practical 19-22	Palynology: 1. To observe pollen fertility and sterility. 2. To study pollen polymorphism. 3. Palynotaxonomy of some selected taxa (either family or a genus). 4. To study of pollen from honey by acetolysis or any other suitable method.
Practical 23-24	Field tour.
Note:	1. Excursion report is compulsory. 2. Any five timber block submission is compulsory 2 Submission of five permanent slide from embryology and palynology is compulsory. 3. Duly certified journals are compulsory at the time of practical examination.

M.Sc. Part II Semester IV Botany: Core Course

BOT-404 **Practical (Core Course)** **Project Dissertation**
Submission of project work certified by Guide. Presentation of project work using LCD. Viva- voce.

M.Sc. Part II Semester IV Botany: Elective Course

Core course	**BOT. 405 A** **PLANT ECOLOGY AND PHYTOGEOGRAPHY**	**Lectures 60**

Course objectives:

1. To know concept, scope and importance of the discipline.
2. To study ecosystem ecology and community ecology.
3. To make aware about conservation of biodiversity, energy and Pollution.
4. To study botanical regions of India and vegetation types of Maharashtra.
5. To study Bioremediation, Global warming and climate change.

Course outcomes:

1. Able to know concept, scope and importance of the discipline.
2. Able to describe ecosystem ecology and community ecology.
3. Higher cognitive skills about conservation of biodiversity, energy and pollution will develop.

Unit 1	A) Plant Ecology: Definition, Concept and Scope of Ecology, Branches of Ecology. B) Ecosystem Ecology: i) Introduction, kinds of ecosystems, structure and functions of ecosystem. ii) Productivity of ecosystem iii) Food chain and food web iv) Major ecosystems- Pond ecosystem, Ocean (Marine) ecosystem, Grassland ecosystem, Forest ecosystem, Desert ecosystem, Cropland ecosystem. v) Biogeochemical (Nutrient) cycles in ecosystem: Water cycle, Carbon cycle, Nitrogen cycle and impact of human activities on them.	**12 L**
Unit 2	**C)** Community Ecology: i) Definition and concept of community ii) Structure- Zonation and Stratification iii) Characters used to describe community structure: Quantitative and Qualitative characters iv) Methods of community studies **D)** Community Dynamics: i) Ecological succession- Definition causes and types. ii) Process of succession- Hydrosere and Xerosere iii) Climax concept- Monoclimax and Polyclimax	**12 L**
Unit 3	Conservation Ecology: A) Biodiversity and its Conservation: i) Definition and importance ii) Types of Biodiversity: Genetic, Species, Ecosystem. iii) Indian Hot spots of biodiversity: Eastern Himalayas and Western Himalayas. iv) Conservation of Biodiversity: In-situ and Ex-situ In-situ Conservation: Biosphere reserves, National parks, Wildlife Sanctuaries. Ex-situ Conservation: Botanical gardens/Herbal gardens, Seed (Germplasm) bank, Pollen bank. B) Energy Conservation: i) Sources of Energy: Conventional and non conventional ii) Non conventional sources: Solar energy, Tidal energy, Biomass energy. iii) Perspective alternatives for energy:Petroplants, Biogas energy.	**12 L**

Unit 4	A) Pollution: i) Air pollution: Sources, types, effect of air pollution on plants, effect of air pollutants on human. ii) Water pollution: causes, effects, control measures. iii) Global warming and climate change: Greenhouse effect, Ozone depletion, El NINO and LA NINA. B) Bioremediation: i) Definition, concept, need and scope. ii) Phytoremediation: a) Recovery of heavy metals from soil b) Reclamation of industrial waste and municipal waste water c) Revegetation of industrial deserts.	**12 L**
Unit 5	A) Phytogeography: i) Main Botanical Regions of India. ii) Detailed study of vegetation types in Maharashtra B) Ecological Indicators: i) Introduction ii) Plants as indicators: Soil, pH, Ground water, Minerals. Metals and Pollution C) Endemism: Causes and types. D) Biogeography: Dispersal- Barriers and means of dispersal.	**12L**

Suggested readings:

1. Agrawal, K.C. (1996). Environmental Biology,Agro-Botanical Publisher, Bikaner India
2. Ambasta, R.S.(1988).A Text of Plant Ecology, Student Friends &Co. Varanasi, India.
3. Ambasta,R.S.(1990).Environmental and Pollution, Student Friends & co. Varanasi,India.
4. Chapman, and Reiss, M.J.(1998). Ecology: Principles and Applications. Cambridge University Press, Cambridge
5. Dash, M.C. (1993). Fundamentals of Ecology, Tata McGraw Hill Publishing Co. Ltd. New Delhi, India.
6. Heywood, V.H. and Watson, R.T.(1995). Global Biodiversity Assessment, Cambridge University Press, Cambridge.
7. Hill, M. K. (1997). Understanding Environmental Pollution, Cambridge University Press, Cambridge.
8. Kapur, P. And Govil, S.R.(2000).Experimental Plant Ecology S.K.Jain for CBS Publishers and Distributors, New Delhi, India.
9. Kothari, A. (1997). Understanding Biodiversity: Life Sustainability and Equity Orient Longman.
10. Krebs, CJ.(1989). Ecological Methodology. Harper and Row, New York, USA.
11. Kumar, H.D. (1996). Modern Concept of Ecology (4th Ed.) Vikas Publishing House (P.)Ltd. New Delhi.
12. Kumar, H.D. (1997). General Ecology, Vikas Publishing House (P.) Ltd. New Delhi,
13. Kochhar, P. L. Plant Ecology. Genetics and Evolution, S. Nagin& Co. Ltd. New Delhi.
14. Moore,P.W. and Chapman,S.B. (1986).Method in Plant Ecology. Blackwell Scientific Publications.
15. Mukherjee B. Environmental Biology. Tata McGraw Hill Publishing Ltd.
16. Purohit S.S. and Ranjan R.(2007).Ecology, Environment and Pollution. Agrobios (India)
17.Sharma P.D.(2018)Ecology and Environment. Rastogi Publications, Meerut-New Delhi.

M.Sc. Part II Semester IV Botany: Elective Course

Core course	**BOT. 405 B** **INDUSTRIAL BOTANY**	**Lectures 60**

Course objectives:

1) To study importance and production of SCP.
2) To study the preservation canning and processing of fruits and vegetables.
3) To learn mushroom technology.
4) To acquire the knowledge of sugar production and fermentation technology.
5) To study the paper production technology, production of essential oils.

Course outcomes:

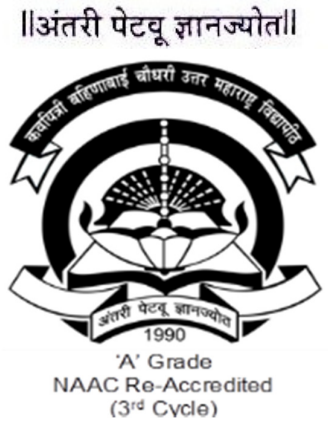
This paper acquaints students with various plant materials and microbes viz. Algae, Fungi, Bacteria used on large scale for industrial purpose like food industry, Sugar industry, Paper industry, Oil industry, Medicine (Space food).

Unit 1	i) Introduction, scope and importance of Industrial Botany ii) Production of Single Cell Protein (SCP): Introduction, Bacterial proteins, Yeast proteins, Fungal proteins, Algal proteins.	**10L**
Unit 2	**Food processing Industry** i) Principles of preservation: Canning and bottlings fruits and vegetables. Principle of food processing. ii) Commercial Canning: Factory site, factory building, water supply, and drainage. Machinery and equipment's, canning process, sorting and grading, washing, peelings, corning and pitting, can filling processing. Heat penetration in cans, processing methods, processing pressure and temperature. Testing for defects, labelling, sorting and packing. iii) Containers for packing: Tin and glass container, manufacture of cans, testing of cans, mechanical defects, size of cans. iv) Canning fruits: Apple, Mango, Banana, Grape, Orange, Papaya, Pineapple. v) Canning of vegetables: Cabbage, Beans, Potato, Tomato, Spinach vi) Preparation of Jams, Jellies and Squashes	**14 L**
Unit 3	**Mushroom Industry** i) Importance of mushrooms ii) Selections of mushrooms for cultivation, mushroom house design, spawn and spawning, preparation of mother spawn and planting spawn. iii) Cultivation method of white button mushroom (*Agaricus bisporus*): Compost preparation, methods of composting, spawning, crop management, maintenance, casing, harvesting, preservation. iv) Oyster mushroom (*Pleurotus* sp.): Materials and substrates, sterilization, spawning, incubation, crop maintenance, harvesting, preservation. v) Mushroom marketing, mushroom recipe.	**12 L**
Unit 4	**Sugar and Fermentation Industry** i) Sugar manufacture, machinery and equipment's	

	ii) Crushing of sugarcane, composition of juice, juice heating, liming and sulphuration. iii) Sedimentation, filtration of mud, evaporation, syrup sulphuration, crystallization, drying. iv) Grading, bagging, storage. v) Yeast and its uses: Production of Brewers Yeast, Production of Bakers Yeast, Production of food and fodder Yeast. Vi) Production of Alcohol.	**12 L**
Unit 5	**Paper and Oil Industry** i) Sources of raw material for paper: Wood, chemistry of wood, Cellulose, hemicellulose, lignin. ii) Pulping: General principle of pulping. Types of pulping processes: mechanical, chemical, semi-chemical, sulphate process, Kraft process. Process calculations. Raw material utility requirements. Process flow sheet and description. Washing and bleaching. Common unit operation. Wood treatment, digestion, evaporation, drying with equipment used. iii) Treatment of Pulp: Screening, washing, refining, thickening of pulp. Bleaching- conventional and non-conventional bleaching techniques. Paper Making: Preliminary operations on pulp. Beating and refining of pulp. Non-fibrous materials. Fillers and loading material. Internal sizing. Wet and additive surface treatment. Paper coloring. Surface sizing. iv) Essential oil and their characteristics v) Production of essential oils. **Suggested readings:** 1) A. H. Patel (1985) Industrial Microbiology. Published by MACMILLAN INDIA LTD. Ansari Road, Dariyaganj, New Delhi. 110002. 2) Christopher Biermann (1996) Handbook of Pulping and Papermaking. Elsevier. 3) D. P. Kulkarni (2015) Cane Sugar Manufacture in India. Published by The Sugar Technologists Association of India, 21 Community Center, East Kailash, New Delhi-110005 4) G. S. Siddappa ((1998) Preservation of Fruits and Vegetables. Indian Council of Agricultural Research, New Delhi 5) Henry Kraemer (1997) Applied and Economic Botany (Vo. I and II) Ambey Publications, Tank Road, Karol Bagh, New Delhi- 110005 6) L. E. Casida Jr. (2009) Industrial Microbiology. New Age International(P) Limited, Publishers, Ansari Road, Dariyaganj, New Delhi 110002. 7) O. P. Sharma (1996) Hill's Economic Botany. Tata McGraw-Hill Publishing Company Limited, New Delhi. 8) Pathak, Yadav, Gaur (1998) Mushroom Production and Processing Technology. Agrobios (India) Behind Nasrani Cinema, Chopasani Road, Jodhpur- 342002. P. Srinivasa (2013) Production Functions in Sugar Industry. Serials Publication.	**12L**

M.Sc.-II (Botany) Equivalence of Papers			
Semester-III			
Code	Title (Old)	Code	Title (New)
BOT. - 301	Gymnosperm and Palaeobotany	BOT-301	Plant Development & Reproduction
BOT. - 302	Plant Biotechnology and Bioinformatics	BOT-305A	Biostatistics and Bioinformatics
BOT. - 331	Algae special paper – I	BOT-302 A	Phycology Special Paper-I
BOT. - 332	Mycology and Plant Pathology Special paper - I	BOT-302 B	Mycology Special Paper-I
BOT. - 333	Genetics and Plant breeding Special paper - I	----	----
BOT. - 334	Angiosperm Taxonomy Special paper – I	BOT-302 C	Angiosperm Special Paper-I
BOT. - 304	Practical - I (Based on Bot. - 301 & 302)	BOT-303	Practical Based on BOT 301
BOT. - 305	Practical - II (Based on Bot. - 331 / 332 / 333/ 334)	BOT-304	Practical Based on BOT 302 (Special Paper)
Semester-IV			
BOT-401	Developmental Botany	BOT-405 A	Plant Ecology & Phytogeography
BOT-421	Algae special paper – II	BOT-401 A	Phycology Special Paper-II
BOT-422	Mycology and Plant Pathology Special paper - II	BOT-401 B	Mycology Special Paper-II
BOT-423	Genetics and Plant breeding Special paper - II	---------	--------
BOT-424	Angiosperm Taxonomy Special paper – II	BOT-401C	Angiosperm Special Paper-II
BOT-431	Algae special paper – III	BOT-402 A	Phycology Special Paper-III
BOT-432	Mycology and Plant Pathology Special paper – III	BOT-402 B	Mycology Special Paper-III
BOT-433	Genetics and Plant breeding Special paper - III	--------	-------
BOT-434	Angiosperm Taxonomy Special paper – III	BOT-402 C	Angiosperm Special Paper-III
BOT-404	Practical – I (Based on Bot. – 401)	------	---------
BOT-405	Practical – II (Based on Bot. – 421 & 431 /Bot. – 422 & 432 / Bot. 423 &433/ Bot. – 424 &434)	BOT-403	Practical based on BOT 401 & BOT 402
BOT-406	Project work	BOT-404	Practical: Project Dissertation

Kavayitri Bahinabai Chaudhari
North Maharashtra University, Jalgaon



SYLLABUS

for

Master of Science (M. Sc.) II
Zoology

Choice Based Credit System
(Outcome Based Curriculum)

2022 - 2023

Program at a Glance

Name of the program (Degree)	: M. Sc. (Zoology)
Faculty	: Science and Technology
Duration of the Program	: Two years (four semesters)
Medium of Instruction and Examination	: English
Exam Pattern	: 60 : 40 (60 marks University exam and 40 marks continuous internal assessment)
Passing standards	: 40% in each exam separately (Separate head of passing)
Evaluation mode	: CGPA
Total Credits of the program	: 88 (64 core credits including 4 credits of project/dissertation, 08 skill enhancement credits, 08 subject elective credits and 08 audit credits)

Summary of Distribution of Credits under CBCS Scheme
for
M.Sc. (Zoology)

Sr. No	Type of course	Sem I	Sem II	Sem III	Sem IV
01	Core	**16**	**16**	**16**	**12**
02	Skill based	**04**	**04**	**-**	**-**
03	Elective	**-**	**-**	**04**	**04**
04	Project	**-**	**-**	**-**	**04**
05	Audit	**02**	**02**	**02**	**02**
06	Total Credits	**22**	**22**	**22**	**22**

Subject Type	Core	Skill based	School Elective	Project	Audit	Total
Credits	**60**	**08**	**08**	**04**	**08**	**88**

Total Credits = 88

KBC North Maharashtra University Jalgaon

M. Sc. Zoology

Choice Based Credit System (Outcome Based Curriculum) with effect from 2021 -2022

Course credit scheme

Semester	(A) Core Courses			(B) Skill Based / Elective Course			(C) Audit Course (No weightage in CGPA)			Total Credits (A+B+C)
	No. of Courses	Credits (T+P)	Total Credits	No. of Courses	Credits (T+P)	Total Credits	No. of Courses	Credits (Practical)	Total Credits	
I	4	8 + 8	**16**	1	4 + 0	4	1	2	2	**22**
II	4	12 + 4	**16**	1	4 + 0	4	1	2	2	**22**
III	4	8 + 8	**16**	1	4 + 0	4	1	2	2	**22**
IV	4	8 + 8	**16**	1	4 + 0	4	1	2	2	**22**
Total Credits	**64**			**16**			**8**			**88**

(T= Theory; P=Practical)

Structure of Curriculum

		First Year				Second Year				Total Credit Value
		Semester I		Semester II		Semester III		Semester IV		
		Credit	Course	Credit	Course	Credit	Course	Credit	Course	
	Prerequisite and Core Courses									
(A)	Theory	4	2	4	3	4	2	4	2	36
	Practical	4	2	4	1	4	2	4	2	28
(B)	**Skill Based / Subject Elective Courses**									
1	Theory /Practical	4	1	4	1	4	1	4	1	16
(C)	**Audit Course (No weightage in CGPA calculations)**									
1	Practicing Cleanliness	2	1	--	--	--	--	--	--	2
2	Personality and Cultural Development Related Course	--	--	2	1	--	--	--	--	2
3	Technology Related + Value Added Course	--	--	--	--	2	1	--	--	--
4	Professional and Social + Value Added Course	--	--	--	--	--	--	2	1	2
	Total Credit Value	14	6	14	6	14	6	14	6	88

List of Audit Courses (Select any ONE course of Choice from Semester II; Semester III and Semester IV)							
Semester I (Compulsory)		**Semester II** (Choose One)		**Semester III** (Choose One)		**Semester IV**(Choose One)	
		Personality and Cultural Development		**Technology + Value Added Course**		**Professional and Social + Value Added Course**	
Course Code	**Course Title**	**Course Code**	**Course Title**	**Course Code**	**Course Title**	**Course Code**	**Course Title**
AC-101	Practicing Cleanliness	AC-201A	Soft Skills	AC-301A	Computer Skills	AC-401A	Human Rights
		AC-201B	Sport Activities	AC-301B	Cyber Security	AC-401B	Current Affairs
		AC-201C	Yoga	AC-301C	Seminar + Review Writing	AC-401C	Seminar + Review Writing
		AC-201D	Music	AC-301D	Biostatistics	AC-401D	Intellectual Property Rights (IPR)

Semester-wise Course Structure of M.Sc. II Zoology

Semester III

Course	Course Type	Course Title	Teaching Hours/ Week			Marks (Total 100)				Credits
			T	P	Total	Internal		External		
						T	P	T	P	
Zoo-301	Core (Any one from A,B,C&D	A)Animal Physiology I B)Reproductive Physiology I C)Entomology I D)Heminthology I	4	--	4	40	--	60	--	4
Zoo-302	Core	Enzymology and Immunology	4	--	4	40	--	60	--	4
Zoo-303	Core	Practical I	--	4+4	8	--	40	--	60	4
Zoo-304	Core	Practical II	--	4+4	8	--	40	--	60	4
Zoo-305	Elective (Select any one)	(A)Animal behaviour (B) Forensic Zoology (C) Endocrinology	4	--	4	40	--	60	--	4
Zoo AC-301 A/B/C/D	Audit Course	Choose one out of Four (AC-301A/ AC-301B/AC-301C/AC-301D) from Technology + Value Added Courses	--	2	2		100	--	--	2
Total Credit for Semester III: 22 (T = Theory: 8; P = Practical: 8; Skill Based: 4; Audit Course: 2)										

Semester IV

Course	Course Type	Course Title	Teaching Hours/ Week			Marks (Total 100)				Credits
			T	P	Total	Internal		External		
						T	P	T	P	
Zoo-401	Core (Any one from A,B,C& D	A) Animal Physiology II B) Reproductive Physiology II C) Entomology II D) Heminthology II	4	--	4	40	--	60	--	4
Zoo-402	Core	Molecular Biology	4	--	4	40	--	60	--	4
Zoo-403	Core	Practical I (corresponds to 401 and 402)	--	4+4	8	--	40	--	60	4
Zoo-404	Core	Project	--	4+4	8	--	40	--	60	4
Zoo-405	Elective (Select any one)	(A)Zoogeography (B)Writing & presenting scientific research paper (C)Computational Biology	4	--	4	40	--	60	--	4
Zoo AC-401 A/B/C/D	Audit Course	Choose one out of Four (AC-401A/ AC-401B/ AC-401C/ AC-401D) from Professional and Social + Value Added Courses	--	2	2		100	--	--	2
Total Credit for Semester IV: 22 (T = Theory: 8; P = Practical: 8; Skill Based: 4; Audit Course: 2)										

MSc II Sem III Core Courses		
Zoo- 301: (A) Animal Physiology – II		
Total Hours: 60	**Program specific objective** • To learn about the various aspects of Animal physiology. • To acquire a broad understanding of physiological processes.	**Credits: 4**
	Program specific outcomes • To understand the structure and functioning of Animal physiology • To gain the detail knowledge on Animal physiology	**Lectures** 60
Unit	**Topics**	
Unit I	**A)Defination, significance and scopes of physiology** **B)Water Relation and Ionic Regulation** i) Role of membranes in osmotic and ionic regulation; Role of body fluid; ii) Adaptation to marine habitat; Adaptation to brackish water habitat; Adaptation to Fresh water habitat; Adaptation to terrestrial habitat C) **Thermoregulation:** i)Homeostasis; ii)Classification of Animals Based on Thermoregulation; iii)Vants Hoff law; Lethal temperature; iv)Effect of cold Acclimation; v)Thermoregulatory Mechanisms; Vi)Thermoregulation in Camel.	**15**
Unit II	**Metabolism** a) **Carbohydrate Metabolism**: Intermediary Metabolism; Glycogenesis; Glycogenolysis; Glycolysis, Krebs cycle, Electron transport system; Respiratory chain; Oxidative phosphorylation; Energetics of Glucose; Metabolism; Pasteur effect; Gluconeogenesis; Cori cycle or lactic acid cycle; Uronic acid pathway; Crabtree effect, b) **Lipid metabolism**: Metabolism of lipids; Oxidation of Glycerols; Fatty Acid, Oxidation; β-Oxidation; Ketogenesis; Ketosis; Ketolysis; Biosynthesis of Fatty Acids; Biosynthesis of Triglycerides, c) **Protein Metabolism**: Deamination; Transamination; Decarboxylation; Ornithine cycle; Krebs Cycle, Citric Acid Cycle; Catabolism of the Carbon; Skeleton of amino acids; Pyruvic acid; Amino acids entering by α-Ketoglutaric Acid; Amino Acids entering by Succinyl Co-enzyme A; Catabolism of Amino Acids that are both Ketogenic and Glucogenic; Anabolism of Proteins; Energetics of amino Acids Oxidation.	**15**
Unit III	**Nutrition and Digestive system** a) Types of nutrition; Ingestion; Feeding mechanism; Digestion; Enzymes; b) Physiology of digestion; Absorption; Assimilation; Egestion or defecation, c) The evolution of digestive mechanism: Phagocytosis; A digestive cavity (Intracellular digestion), d) Organization of Vertebrate Digestive System, e) Functional Adaptations of the Alimentary Canal,	**10**

	f) Types of Digestion.	
Unit IV	**Respiration** a) Introduction; b) Mechanism of respiration in man; c) Tidal volume and Vital capacity; d) Control of respiration; e) Respiratory pigments: a) Hemoglobin, b)Haemocyanin, c) Haemoerythrin, d) Chlorocruorin, e) Molpadin, f) Pinnaglobin, g) Vanadium, h) Echinochrome f) Haemoglobin as an Oxygen Carrier; Transport of Gases-Oxygen transport: Oxygen, Dissociation Curve; Bohr's effect; Chloride shift; Respiratory Quotient; g)Anaerobiosis	**10**
Unit V	**Circulatory system** a) Introduction; Functions of Circulatory system in Vertebrates; Closed and open Circulatory system; b) Types of Circulation: a)Systemic circulation b)Pulmonary circulation, c)Advantages of Double Circulation; c) Types of Heart: Pulsating Heart, Tubular Heart, Chambered Heart, Accessory heart d) Physiological types of Hearts: Neurogenic heart and Myogenic heart, e) ECG; Heart Sound; Cardiac cycle; Cardiac output; f) General plans of Circulation: Annelid plan, Amphioxus plan, Gill plan of fishes, Lung plan of Mammals; g) Blood vessels: i) Arteries and arterioles ii)Veins and Venules, iii)Microcirculation	**15**
	Total	**60**
Suggested Readings	G. J. Tortora: Principle of Anatomy and Physiology • Hoar: General and Comparative physiology • Dr. P.V. Jabade: General Physiology • B. K. Berry: Animal Physiology • C. C. Chatterjee: Human Physiology • Goel and Shastri: Textbook of Animal Physiology • K.S. Nelson: Animal Physiology • Holurn: Principles of Physiology and Biochemistry • Bell and Davidson: Textbook of Physiology and Biochemistry • Withers: Comparative Animal Physiology • Mohan P. Arora: Animal Physiology R. C. Sobti; Animal Physiology	

MSc II Sem III Core Courses		
Zoo -303: Practical I Corresponding to Zoo 301 (A) Animal Physiology I		
Total Hours: 60	**Program specific objective** • To know process of preparation of buffers and saline • To estimate SGOT and SGPT and analyse vital functions • To understand process of estimating biochemicals	**Credits: 4**
	Program specific outcomes After successful completion of this course, students are expected to: • acquire the knowledge related to process of preparation of buffers and saline • gain the knowledge related to estimation of SGOT and SGTP • learn the process of estimations of various biochemicals	
Practical	1. Preparation of Phosphate and Bicarbonate Buffers, given Normality solutions, Physiological Mammalian Saline Solution. 2. To demonstrate the principle of Osmosis. 3. Estimation of SGOT/SGPT from given biological sample. 4. Study of adaption in brackish, Fresh, marine water and terrestrial habitat. 5. Determination of oxygen consumption of any suitable animal. 6. Determination of Salivary Enzyme digestion and Effect of Temperature on Enzyme Activity. 7. Recording of lung volumes and capacities by spirometry. 8. Determination of Fatty acids and Amino Acid from Lipid and Protein Digestion respectively. 9. Antioxidant activity of any suitable material. 10.Estimation of plasma proteins by copper sulphate specific gravity method. 11.Estimation of Blood Glucose level.	

MSc II Sem III Core Courses		
Zoo – 301 (B): Reproductive Physiology-I		
Total Hours: 60	**Program specific objective** • To learn about the various aspects of reproductive physiology. • To acquire a broad understanding of the hormonal regulation of physiological processes. • To build reproductively healthy society by providing proper knowledge related to reproductive aspects.	**Credits: 4**
	Program specific outcomes After successful completion of this course, students are expected to: • Understand the structure of male and female reproductive systems particularly in humans. • Understand the functioning of male and female reproductive systems particularly in humans. • Comprehension of the interplay of various hormones in the functioning and regulation of the male and female reproductive systems.	**Lectures** 60
Unit	**Topics**	
Unit I	**Male Reproductive System :** • Internal and External Genitalia • Histological structure and functions of testis • Male accessory ducts and accessory reproductive organs:- Epididymis, Seminal vesicle, Prostate gland, Bulbourethral gland • Cryptorchidism • Semen	**14**
Unit II	**Female reproductive System:** • Internal and External Genitalia • Histological structure and functions of:- ovary ,Graafian follicle corpus luteum and corpus albicans • Structure and functions of:- Fallopian tube ,Uterus • Structure and functions of:- Bartholin's gland, Mammary glands	**14**
Unit III	**Gametogenesis-** • Structure of sperm • Spermatogenesis , Spermiogenesis,, Maturation and storage of sperm, Motility, capacitation and fate of spermatozoa. • Structure of ovum • Oogenesis , Ovulation, Gametogenesis at the chromosomal level: mitosis and meiosis	**14**
Unit IV	**Reproductive cycles-** • Estrous and menstrual cycles • Hormonal control of normal menstrual cycle • Puberty and delayed puberty , menarche and menopause	**10**
Unit V	**Chemistry, biosynthesis, mode of action and functions of Sex hormones and Gonadotropins** • Male Sex hormones :- androgen • Female sex hormones:- oestrogens and progesterone • Hormones of pituitary gland:- FSH, LH	**08**

Suggested Readings	• Prakash S Lohar, 2012 – Endocrinology Hormones and Human Health, MJP Publishers, Chennai • P. J. Hogarth, 1978- Biology of Reproduction Wiley, New York. • J. S. Perry, 1971- The Ovarian cycle of animals, Oliver and Boyed. • C.R. Austin and R. V. Short, 1972 Reproduction in Mammals, Vol. 1-8, Cam. Uni. Press. • P. Gibian and E.J. Platz, eds, 1970- Mammalian Reproduction, Springer Verlag. • Robert H. Williams, 1981 – Text book of Endocrinology, W. B. Saunders Company • Chandi Charan Chatterjee, 1985 – Human Physiology Vol.II Tenth Edition, Medical Allied Agency, Calcutta, India. • Arthur J. Vander, James H. Sherman and Dorothy S. Luciano – Human Physiology, • Mcgraw-Hill International Editions, Biological Sciences Series. • Nalbandov, A. V.- Reproduction Physiology.	

MSc II Sem III Core Courses		
Zoo - 303: Practical corresponding to ZOO 301 (B) Reproductive Physiology - I		
Total Hours: 60	**Program specific objective** • To demonstrate endocrine glands and their physiological role • To study different stages of reproductive cycle • To understand histology of organs of reproduction	**Credits: 4**
	Program specific outcomes After successful completion of this course, students are expected to: • acquire the knowledge related to endocrine glands • gain the knowledge related to reproductive cycle • understand the histology of organs related to reproductive system	
Practical	• Demonstration of rat/mice endocrine glands with the help of figure/chart/model. • Histological structure of male and female reproductive organs in rat/mice/human. • Study of different stages of estrous cycle. • Microscopic observations of spermatozoa / ova from suitable mammal • Histological structure of male accessory reproductive organs. • Histological structure of female accessory reproductive organs. • Cellular structure of anterior pituitary gland.	

MSc II Sem III Core Courses		
Zoo - 301: (C) Entomology I		
Total Hours: 60	**Program specific objective** • To understand habit, habitat and taxonomic status of vertebrate animals. • To know the basic aspects of structural and functional anatomy of vertebrate animals.	**Credits: 4**
	Program specific outcomes After successful completion of this course, students are expected to: • Acquire the knowledge of entomology and insects and understand origin and evolution of insects and their relation to other arthropods. • Understand the classification of insects up to family with distinguishing characters and examples of each order and family. • Understand the structure, chemical composition and functions of Integument and its derivatives, modifications of insect body regions and their appendages. • Acquire the knowledge of comparative anatomical and histological structure of various body systems. • Understand the location, structure and functions of various Endocrine and Exocrine glands, Light and Sound producing organs in various insects.	**Lectures** 60
Unit	**Topics**	
Unit I	General outline of Classification and Phylogeny of insects. Classification of following insect orders up to families A) Apterygota: Thysanura, Collembolla	**12**
Unit II	B) Pterygota: a) Odonata b) Orthoptera – Tettigonidae, Gryllotalpidae, Acrididae c) Dyctioptera- Blattidae, Mantidae d) Isoptera e) Mallophaga f) Siphanuculata g) Hemiptera: • Suborder- Homoptera - Flugoridae, Cicadidae, Aphididae • Suborder- Heteroptera – Cimiadae, Pyrrochoridae, Pentatomidae, Belostomidae	**12**
Unit III	h) Coleoptera: • Suborder- Adephaga- Carabidae, Dysticidae • Suborder- Polyphaga- Hydrophilidae, Scarabidae, Bupristidae, Tenebrionidae, Curcurlionidae i) Diptera: • Suborder- Nematocera- Culicidae, Chironomidae • Suborder- Brachaeocera- Tabanidae	**12**

	• Suborder- Cyclorrhapha- Syrphidae, Muscidae, Hippoboscidae, Glossinidae j) Lepidoptera: Nymphalidae, Papillionidae, Sphingidae, Noctuidae k) Hymenoptera: • Symphyta- Tenthreadinidae • Apocrita- Apidae, Ichnnemonidae	
Unit IV	A) Integument and its derivatives B) Comparative study of – • Head and its appendages • Thorax and its appendages and • Abdomen and its appendages	**12**
Unit V	A) Comparative anatomical and histological study of the following: • Alimentary canal and associated glands • Circulatory system • Ventilatory system • Excretory system and fat bodies • Nervous system and sense organs • Reproductive system B) Light and sound producing organs	**12**
Suggested Readings	• Chapman R. F.: The Insect: Structure and Function, E.L.B.S., and E.U.P. London. • Comstock J. H.: An Introduction to Entomology, Ithaca, New York. • Fox R. M and J. W. Fox: Introduction to comparative Entomology, Reinhold, New York. • Mani M. S.: General Entomology, 2nd edition, Oxford and IBH Publishing Company, New Delhi. • Nayar K. K., T. N. Anathakrishnan and B.V. David: General and Applied Entomology, Tata McGraw-Hill, New Delhi. • Richards O. W. and R. G. Davies: Imm's text book of entomology, Methuen and com, London, Vol. I and II • Ross H. H.: A Text book of Entomology, John Wiley and Sons, Ins. New York. • Snodgrass R. E.: Principles of insect morphology, Tata Mc-Graw Hill Bombay. • Tembhare D. B.: Modern Entomology, 2nd edition, Himalaya Publication House, Bombay.	

MSc II Sem III Core Courses		
Zoo - 304: Practical I (corresponding to Zoo 301(C) Entomology I)		
Total Hours: 60	**Program specific objective** • To know the knowledge of entomology and insects and understand origin and evolution of insects and their relation to other arthropods. • Understand the outline of classification of insects up to family with distinguishing characters and examples of each order and family. • To know the location, structure and functions of various endocrine and exocrine glands, light and sound producing organs in various insects.	**Credits: 4**
	Program specific outcomes After successful completion of this course, students are expected to: • Acquire the knowledge of entomology and insects and understand origin and evolution of insects and their relation to other arthropods. • Give outline of classification of insects up to family with distinguishing characters and examples of each order and family. • Understand the structure, chemical composition and functions of Integument and its derivatives, modifications of insect body regions and their appendages. • Understand the location, structure and functions of various endocrine and exocrine glands, light and sound producing organs in various insects.	
Unit	**Zoo 301(C) Entomology I**	
	• Collection and preservation techniques of insects	
	• Classification of insects upto orders and families as per syllabus	
	• Pictorial Collection and Identification of 25 insect species related to different orders and families	
	• Culturing/rearing of any suitable insect/s (Housefly/ Drosophila)	
	• Histology of Integument and its derivatives with the help of Slides (D)	
	• Comparative study of Head capsule – any four (adults or larvae) from local area	

	• Temporary preparation of Insects,
	  • Mouthparts, Antennae, Legs, Wings and Genitalia.
	  • Halter of Housefly	

	• Study of Bugs, Beetles, House Fly with reference to following systems (Any 2 insects) • Digestive system	

	• Reproductive system • Nervous system	

	• Histology of different organs of –
	  • Alimentary canal,
	  • Trachea,
	  • Heart,
	  • Muscle,
	  • Blood of suitable insects	

	• Compulsory visit to Agriculture College or University or Research institute.	
Suggested Readings	• Chapman R. F.: The Insect: Structure and Function, E.L.B.S., and E.U.P. London. • Comstock J. H.: An Introduction to Entomology, Ithaca, New York. • Fox R. M and J. W. Fox: Introduction to comparative Entomology, Reinhold, New York. • Mani M. S.: General Entomology, 2nd edition, Oxford and IBH Publishing Company, New Delhi. • Nayar K. K., T.N. Anathakrishnan and B.V. David: General and Applied Entomology, Tata McGraw-Hill, New Delhi. • Richards O. W. and R. G. Davies: Imm's text book of entomology, Methuen and com, London, Vol. I and II • Ross H. H.: A Text book of Entomology, John Wiley and Sons, Ins. New York. • Snodgrass R. E.: Principles of insect morphology, Tata Mc-Graw Hill Bombay. • Tembhare D. B.: Modern Entomology, 2nd edition, Himalaya Publication House, Bombay.	

M. Sc. II Sem III Core Courses		
Zoo 301 (D) Helminthology-1		
Total Hours: 60	**Program specific objective** • The programme has been designed in such a way so that the students get the flavour of both classical and modern aspects of Zoology/Animal Sciences. • It aims to enable the students to study Heminthology-1 as a core course. • The lab courses have been designed in such a way that students will be trained to join public or private labs.	Credits: 4
	Program specific outcomes The student at the completion of the course will be able to: • Understand the Parasitology and Heminthology. • Know about the classification of Helminthes. • To be familiar with the life cycle of various parasites • Students learn about the Nature, pathogenicity and prevention of endoparasites. • Their identification, nature of damage control of these endoparasites.	Lectures 60
Unit	**Topics**	
Unit 1	1. Introduction to Parasitology and scope of Helminthology 2. Origin and evolution of parasites. 3. Inter-specific biological relationships , symbiosis, Commensalisms and parasitism. 4. Adaptation in parasites. 5. Types of Parasites. 6. Types of hosts- Definitive and intermediate, primary, secondary specific host, Paratenic, Carrier, Susceptible, Resistant, Accidental, Vectors etc.	12
Unit 2	1. General organization and Classification of Platyhelminthes up to order level. Cestodes (Cestodarians and Eucestodes), Trematodes (Monogenea, Aspidobothria and Digenea) 2. Functional anatomy of Reproductive system a. Trematodes (Digeneans) b. Cestodes (Pseudophyllideans & Cyclophyllideans). 3. Types of Cercaria. 4. Different types of larvae in cestodes and their pathogenicity. 5. Holdfast organs with its adaptations in cestodes	14
Unit 3	1. Life cycle patterns of Digenetic Trematodes a) Single intermediate host life cycle. b) Two intermediate host life cycles 2. Life cycle patterns in Cestodes a) No intermediate host life cycle b) Single intermediate host life cycle c) Two intermediate host life cycles.	12
Unit 4	Geographical distribution, habitat, morphology (Structure), life cycle, pathogenicity, diagnosis, treatment & prevention of the following Trematodes 1. *Pragonimus westermani* 2. *Fasciolopsis buski* 3. *Gastrodiccoides hominis.*	10
Unit 5	Geographical distribution, habitat, morphology (Structure), life cycle, pathogenicity, diagnosis, treatment and prevention	12

	of the following Cestodes*:* *1) Diphyhidium canium 2) Diphyllobothrium latum* *3) Echinococcous granulosus 4) Taenia saginata* *5) Hymenolepis nana*	
Suggested Readings	1. Medical Parasitology by Markell, Voge and John, 8thed. W.B. Saunders Co. 2. The Biology of animal parasites, Cheng T.C. (1964)- Saunders International Student Edition. 3. The advances in the Zoology of tapeworm from 1970- Wardle and Mcleod 4. Text book Medical Parasitology Jaypee Brothers, - Medical Publishers, New York. - Panikar C.K.J (1988) 5. The Parasitology of Trematodes Oliver and Boyd Ltd. Edinburgh - Smyth J.D (1977) 6. Parasitology (Protozoology and Helminthology) –Sood Pamnik (1993) CBS Publication and Distrubution, Delhi. 7. Human helmintology Manual for Clinical, Sanitarians Medical Zoologists – Faust, Emerest Caroll. 8. Systema Helminthum Vol. II Cestoda - Yamaguti S. (1963) Inter-Science Publishers, London. 9. Synopsis of Digenetic Trematodes of Vertebrates – Yamaguti S. (1971) Vol. I & II Keigaku Publishing Co., Tokyo, Japan. 10. Keys to the Cestode Parasites of Vertebrates, CBA International - Khalil, Jones and Bray (1994) 11. Cestodes Parasites of Indian Mammals - Nama (1990)	

MSc II Sem III Core Courses		
Zoo - 303: Practical I Practical corresponding to ZOO 301 (D) Helminthology I		
Total Hours: 60	**Program specific objective** • To know process of Collection, fixation and staining methods of worms • To understand use of identification keys for cestodes and trematodes. • To learn Histopathology of host and worms	**Credits: 4**
	Program specific outcomes After successful completion of this course, students are expected to: • Study the Collection, fixation and staining methods of worms • Understand key of Identification for cestodes and trematodes. • Practice the study of Histopathology of host and worms • Study the various types of parasites	
Practical	• Study of different types of animal associations with suitable examples. • Collection, fixation and preservation of Cestodes from locally available hosts • Collection, fixation and preservation of trematodes from locally available hosts. • Staining and identification of cestodes and preparation of permanent slides • Staining and identification of trematodes and preparation of permanent slides • Histopathology of host tissue, to study host parasites relation • Study of different cestodes (10) and trematodes (10) from permanent slides. • Examination of ova in fecal samples of any suitable animal. • Submission of five permanent slides at the time of practical examination.	

M. Sc. II Sem III Core Courses		
Zoo 302 Enzymology and Immunology		
Total Hours: 60	**Program specific objective** • To acquire the flavour of modern aspects of Zoology/Animal Sciences. • To enable the students to study Enzymology and Immunology as a core course. • To learn practicing skill so that to join public or private labs.	Credits: 4
	Program specific outcomes The student at the completion of the course will be able to: • Know about the Enzymology and Immunology. • To be familiar with the Enzyme structure, properties and its activity • Understand the basic principles of Enzymology and Immunology • To understand the principle and mechanism of immunoglobulins	Lectures 60
Unit	**Topics**	
Unit I	**Enzyme structure and properties** : a) Enzyme Classification and nomenclature (International Union of Biochemistry (I.U.B.); Enzyme Commission number (EC) b) Primary and secondary structure, tertiary structure, the active site, quaternary structure, examples of enzyme- ribonuclease and chymotrypsin and their mechanism of action.	12
Unit II	**Enzyme activity:** a) Methods of investigating the mechanisms of enzyme catalyzed reactions- Isotopes labeling, b) Kinetics methods (enzyme velocity, units) steady-state methods, continuous methods. c) Steady-state enzyme kinetics- Effect of substrate concentration on initial velocity, d) Michaelis-Menten Hypothesis, Briggs- Haldane Hypothesis, Determination of Km and Vmax.	12
Unit III	**Enzyme immobilization and inhibition:** a) Enzyme purification techniques, b) Immobilization techniques, experimental procedures, enzyme stabilization, properties of immobilized enzyme c) Enzyme inhibition Competitive, non-competitive and uncompetitive inhibition, d) Allosteric activation and inhibition- sequential and concerned symmetry models.	12
Unit IV	**Central cell types of the immune system**: T and B lymphocytes, the NK cells, the neutrophilic, basophilic and eosinophilic granulocytes and the macrophages Types, structure, and function of molecules: immunoglobulins, T-cell receptors, MHC molecules, complement proteins, a few key cytokines and chemokines and their receptors.	12

Unit V	• Defense against as bacteria, fungi, virus and parasites • Mechanisms behind several immunological diseases, as hypersensitivity reactions, allergies, autoimmunity and immuno deficiencies. • Mechanisms of action of certain immunosuppressive drugs as glucocorticoids and cyklosporin. • Immunological methods: ELISA, Western blot, production of monoclonal and polyclonal antibodies	12
Suggested readings	1. Immunology (6 th Edition) by Roit IM, Brostoff J and Male D. Mosby, An imprint of Elsevier Sci Ltd., 2002. 2. Kuby Immunology (4 th Edition) by Golds RA, Kindt TJ, Osborne A. W.H. Freeman and Co. Ltd., New York, USA, 1994. 3. Textbook on Principles of Bacteriology, Virology and Immunology, 5 Volumes (9 th Edition) by Topley and Wilson. Edward Arnold, London, 1995. 4. Basic and Clinical Immunology, by Stites DP. Appleton & Lang Press. 5. Immunology, by Weissman and Wood. Benjamin Cummings. 6. Fundamentals of Immunology, by Coleman RM, Lombard MF, Sicard RE and Rencricca NJ. Wm. C. Brown Publishers, 1989.	

<table>
<tr><th colspan="3">MSc II Sem III Core Courses</th></tr>
<tr><th colspan="3">Zoo -304: Practical I Corresponding to Zoo 302 Enzymology and Immunology</th></tr>
<tr><td>Total Hours: 60</td><td>Program specific objective
• To know process of cell fractionation technique
• To analyse the enzyme activity and Km value
• To understand immunological techniques</td><td>Credits: 4</td></tr>
<tr><td></td><td>Program specific outcomes
After successful completion of this course, students are expected to:
• acquire the knowledge related to process of cell fractionation
• gain practical skill related enzyme analysis and Km
• learn various immunological techniques.</td><td></td></tr>
<tr><td rowspan="2">Practical</td><td>Practical corresponding to Enzymology
• Preparation of tissue homogenate and fractionation of liver cell components
• Effect of activators and inhibitors on enzyme activity
• Determination of α-amylase by starch digestion
• Determination of tryptic activity by casein digestion method
• Determination of pancreatic lipase activity
• Determination of Km Value of enzyme</td><td rowspan="2"></td></tr>
<tr><td>Practical corresponding to Immunology
• Chemistry of immunoglobulin molecules, classes and physiological importance.
• Use of ELISA technique (HIV) or any suitable method
• Isolation and purification Bovine serum immunoglobulin G (IgG) fraction by suitable method
• Study of agglutination reaction and its significance performing WIDAL test.
• Determination of Antigen and Antibody reaction by using any suitable method</td></tr>
</table>

M. Sc. II: Semester III Elective Courses		
ZOO 305 (A) Animal behavior		
Total Hours: 60	**Program specific objective** 1. The programme has been designed in such a way so that the students get the flavour of both classical and modern aspects of Zoology/Animal Sciences. 2. It aims to enable the students to study Heminthology-1 as a core course. 3. The lab courses have been designed in such a way that students will be trained to join public or private labs.	Credits: 4
	Program specific outcomes The student at the completion of the course will be able to: ➢ Understand the Feeding and Antipredator behavior of animals. ➢ Know about the Aggression, Territoriality and Conflict behavior. ➢ To be familiar with the Biological Communication ➢ Students learn about the Orientation and Navigation	Lectures 60
Unit 1	**Introduction:** 1.1 What is Behavior? Behavioral Ecology.	04
Unit 2	**Feeding and Antipredator Behavior:** **2.1** Food preferences, Feeding Techniques, Using Tools, Feeding in Group-living Herbivores, Social Carnivores, 2.2 Anti Predator Behavior, Concealment, Camouflage, Warning Coloration and Mimicry, Freezing, Escape, Social Antipredator Behavior, Confusion Effect, Detection, The Development of Anti Predator Behavior.	14
Unit 3	**Aggression, Territoriality and Conflict behavior:** **3.1** Forms of Aggressive Behavior, Aggression and Competition, Types of Aggressive Behavior. 3.2 Social Use of Space (Territoriality), Size and Boundaries of Territory, Territorial Model, Dominance Hierarchiess, Dominance in Females, Dominance in males, Advantage of Dominance, Factors Affecting aggression, Limbic System, Hormones, Genetic Control, 3.3 External factors in Aggression, Learning and Experience, Pain and Frustration, Xenophobia,Crowding, Breeding, Feeding, Restrain of Aggression, Displays,, Territorial Conflicts	14
Unit 4	**Biological Communication:** **4.1** How signal convey information, Discrete and Graded Signals, Distance and Duration, Composite Signals, Syntax and Context, Metacommunication, Information and Manipulation, Messages and their Meaning, Signals, 4.2 Measurement of Communication, Observation, Quantification, Channels of Communication, Odor, Sound, Touch, Surface Vibration, Electric Field, Vision.	14
Unit 5	**Orientation and Navigation:** 5.1 Navigation, Invertebrates, Topographic Features, Sun, Stellar Cues, Meteorlogical Cues, Olfactory Cues, Geomagnetic Cues, Mammals, 5.2 Other Navigation Mechanisms.	14
Suggested Readings	1. Reena Mathur: Animal Behaviour, Rastogi Publication, Meerut 2. M.P.Arora: Animal Behaviour Himalaya Publishing House, Mumbai 3. Harjindra singh: A text book of Animal Behaviour, Anmol Publiccations Pvt. Ltd, New Delhi)	

M. Sc. II Sem III Elective Courses		
ZOO 305 (B) Forensic Zoology		
Total Hours: 60	**Program specific objective** • The programme has been designed in such a way so that the students get the flavour of modern aspects of Zoology/Animal Sciences. • It aims to enable the students to study Forensic Science as a elective course.	Credits: 4
	Program specific outcomes The student at the completion of the course will be able to: • Understand the History and development of forensic science. • Know about the forensic science laboratories. • To be familiar with the Biological evidences, collection and packaging. • Students learn about the analysis of biological fluids	Lectures 60
Unit	**Topics**	
Unit 1	Forensic Science : Definitions, History and Development Scope and importance of forensic science	06
Unit 2	**Forensic Science Laboratories And Facilitie**s: Growth of Forensic Science Laboratories in India – Central and State level laboratories; Educational setup in Forensic Science in India; Services and functionalities provided by various FSLs	12
Unit 3	**Biological Evidences Collection and Packaging**: Protection of Biological Evidences; Documentation; Recognition of Biological evidences encountered in various cases; Search & Collection of Biological Evidences; Packaging & transportation of Biological Evidences	15
Unit 4	**Analysis of Biological Fluid**- Saliva; Semen; Vaginal Fluid; Urine; Sweat; Serological Concepts; Antigen / Antibodies; Polyclonal antibodies; Monoclonal antibodies; Antiglobulins; Human & Animal Hair morphology; Blood Grouping – Human & Non-human; Analysis of Skeletal Remains	15
Unit 5	**Forensic Entomology** Basic Principle of Insect Biology; Life Cycle; Estimation of Time of Death; Preservation of Sample.	12
Suggested Readings	• Nanda, B.B. and Tewari, R.K. (2001) : Forensic Science in India : A vision for the twenty first century Select Publisher, New Delhi. • James, S.H and Nordby, J.J. (2003) Forensic Science: An introduction to scientific and investigative techniques CRC Press, USA. • Barnett (2001): Ethics in Forensic Science. • Saferstien : Forensic Science, Handbook, Vol. I, II & III, Prentice Hall Inc. USA. • Saferstein : Criminalistics, 1976, Prentice Hall Inc., USA. • Nickolas : Scientific Criminal Investigation • Deforest, Gansellen & Lee : Introduction to Criminalistics. • Sharma, B.R. : Forensic Science in Criminal Investigaion and Trials, Central Law Agency, Allahabad, 1974. • Kirk : Criminal Investigation, 1953, Interscience Publisher Inc. New York	

M. Sc. II Sem III Elective Courses		
ZOO 305 (C) Endocrinology		
Total Hours: 60	**Program specific objective** • The programme has been designed in such a way so that the students get the flavour of modern aspects of Zoology/Animal Sciences. • It aims to enable the students to study Endocrinology as a elective course.	Credits: 4
	Program specific outcomes The student at the completion of the course will be able to: • Understand the Histology of endocrine glands. • Know about the synthesis, transport and metabolism of hormones. • To be familiar with the hormone replacement theory • Students learn about the classification of hormones	Lectures 60
Unit	**Topics**	
Unit I	1.1 Histology of vertebrate endocrine glands: Pituitary gland, Thyroid gland, Parathyroid gland, Adrenal gland, Pineal and Thymus gland 1.2 Melatonin function: Jet-lag and sleep disturbances. Melatonin as an anti-oxidant. Melatonin and cancer. Melatonin and depressive disorders. Melatonin and endocrine disorders. Adverse effects of Melatonin. 1.3 Histophysiologies of endocrine placenta, testis and ovary in vertebrates 1.4 Structure and functions of Islets of Langerhans 1.5 Histophysiologies of Urohypophysis and Corpuscles of Stanius in fishes	12
Unit II	2.1 Classification of Hormones (Peptides, Steroids and amino acid derived) a. Hormone action at cellular level 2.3 Hormone action at genetic level 2.4 Hormones in biological clock 2.5 Role of hormones in digestion 2.6 Hormonal regulation of carbohydrate, Lipid and Protein metabolism 2.7 Hormonal regulation of Growth and Reproduction	12
Unit III	3.1 Synthesis, transport (release) and metabolism of steroid hormones 3.2 Synthesis, transport and metabolism of T3, T4 and epinephrine 3.3 Synthesis transport and metabolism of insulin 3.4 Prostaglandins 3.5 Ectohormones in insects and mammals	12
Unit IV	4.1 Thyroid hormones and disorders 4.2 Parathyroid hormones and disorders 4.3 Pituitary hormones and major Disorders 4.4 Adrenal Gland hormones and Disorders 4.5 Diabetes: Diabetes Type I, Diabetes Type II, Diabetic Kidney Problems, Diabetes And Pregnancy, Diabetic Nerve Problems, Autoimmune diabetes	12

	4.6. Comparative study of steroid and non-steroid hormones in reproduction	
Unit V	5.1 Hormone replacement therapy 5.2 Risks and benefits of Hormone replacement therapy 5.3 Other hormones: Rennin, angiotensin, cytokines, ANF, Erytropoietin 5.4 Evolution of hormones 5.5 Neuroendocrine mechanism in insects and crustacean metamorphosis 5.6 Neuroendocrine mechanism in Amphibian metamorphosis	12
Suggested Readings	• .Lohar Prakash S.2014 Endocrinology:Hormone and Human Health.MJP Publishers, Chennai • Human Physiology- C. C. ChatterjiVol. I and II • Comparative Vertebrate Endocrinology, Bentley: Cambridge • University Press, 1998 • Fundamentals of Comparative Endocrinology, Chester-Jones et al.: Plenum Press, New York, London, 1987. • Comparative Endocrinology, Gorbman et al.: John Wiley & Sons,New York, 1983 • Vertebrate Endocrinology, Norris: (2nd ed.), Lea & Febiger, 1997. • Vertebrate Endocrinology Schreibman & Pang: Vol. I-IV, • Fundamentals & Biomedical Implications, Academic Press, 1985 & onwards • Endocrinology, Hadley: Prentice hall. International Edition. 2000 • Text Book of Endocrinology, 10th edition Larson: Williams. W. B. Saunders Company, Philadelphia. 2002. • William's text book of Endocrinology. (XI edition) H. M. Kronenberg, S. Melmed, K.S. Polonsky and P. R. Larsen. Publisher - Saunders, Elsevier Inc. (2009).	

MSc II Sem IV Core Courses		
Zoo- 401: (A) Animal Physiology – I		
Total Hours: 60	**Program specific objective** • To learn about the anatomy and physiology. • To understanding the various systems of animal body.	**Credits: 4**
	Program specific outcomes • To understand the functioning of Animal physiology • To obtain the detail knowledge on structure of animal systems.	**Lectures** 60
Unit	**Topics**	
Unit I	**A)Excretion and Osmoregulation** i)Definition of Excretion; Types of excretory Products, ii)Comparative aspect of Excretory organs in Invertebrates and Vertebrates, iii)Osmoregulation in Invertebrates and Vertebrates B) **Nervous System** i)Nervous cordination: Brain; Spinal cord, Neurons ii)Nerve Fibres; Neuroglea; Nerve impulse; Neuromuscular junction; iii) Neurotransmitters; Reflex arc; Types of Reflexes; iv) Evolution of nervous system; v)EEG	**12**
Unit II	**Physiology of Muscles** a) Types: Phasic muscles, Tonic Muscles, Striated Muscles,Smooth muscles, Cardiac muscles b) Chemical Composition of Muscle: Water; Proteins; Actin; Myosin; Tropomyosin; Troponin; Actinin; c) Neuromuscular junction; Motor unit; Membrane excitation; d) Mechanism of muscle contraction; Sliding filament theory; e) General properties of Muscles; Properties of Voluntary muscles; Physical and Chemical aspects of muscle contraction; Molecular basis of Muscle contraction; Control of Muscle contraction; f) Role of Regulator proteins and calcium in muscle contraction;Changes during muscle contraction; Single muscle twitch; Latent phase or period; Contraction phase; Relaxation phase; g) Invertebrate muscle, h) Tetanus	**14**
Unit IV	**Endocrine System** a) Properties and types of Hormones, Mechanism of Hormone action b) The Pituitary Gland: Pituitary Gland in Different Chordates, It Hormones, c) Gigantism, Acromegaly, Dwarfism; d) Thyroid Gland: Cretinism, myxoedema, exophthalmic Goitre; e) Parathyroid Gland: Functions of PTH, Disorders of parathyroid; f) Pancreas: Islets of Langerhans: Diabetes g) Adrenal Gland: Addison's disease, Cushing's syndrome;	**14**

	h) Thymus Gland: Thymosin; i) The pineal Gland: Melatonin, j) Reproductive glands; Testes; Prostate gland, Ovary; Placenta; k) Gastrointestinal hormones; Renal Hormones; Prostaglandins; l) Endocrine Glands in Invertebrates: Neurosecretory cells and Neurosecretion; Neurosecretion in Insects; Pheromones	
Unit V	**Reproductive System** a) Patterns of Animal Reproduction: Asexual and Sexual i)Sexual Reproduction; Male Reproductive System- Spermatogenesis, Transportation of sperm, Composition of Semen; Female Reproductive System- Puberty; Oogenesis; Graafian Follicles; Menstrual cycle; Ovulation; Fertilization; Implantation; Oestrus Cycle: b) Hormonal Control of Reproductive Cycle; Menopause; c) Hormonal Control of Pregnancy; Parturition; d) Hormonal Control of Lactation	**12**
Unit VI	**Sensory Physiology** a) Sensory coding - Transduction, Relationship between Stimulus Intensity and Response, Central control of Sensory Reception; b) Chemoreception - Gustation and Olfaction; c) Thermoreceptors and Infrared reception; d) Mechanoreception, Mechanotransduction - Invertebrate and vertebrate Mechanoreceptors - Muscles spindle, e) Acoustico lateralis System, f) Echolocation; g) Electroreception; h) Magnatoreception	**08**
	Total	**60**
Suggested Readings	Prakash S Lohar: Endocrinology-Hormones and Human Health, MJP Pulishers, Chennai • G. J. Tortora: Principle of Anatomy and Physiology • Hoar: General and Comparative physiology • Dr. P.V. Jabade: General Physiology • B.K. Berry: Animal Physiology • C.C. Chatterjee: Human Physiology • Goel and Shastri: Textbook of Animal Physiology • K.S. Nelson: Animal Physiology • Holurn: Principles of Physiology and Biochemistry • Bell and Davidson: Textbook of Physiology and Biochemistry • Harper, Physiological chemistry • Mariakuttikan N. Arumugam: Animal Physiology • Itta Sambasiviah, A. P. Kamalakara Rao, S. Augustiane Chellappa: A Textbook of Animal Physiology and Ecology	

MSc II Sem IV Core Courses		
Zoo 403 Practical correspond to Zoo - 401 (A) Animal Physiology II		
	Program specific objective • To understand the process of determining GFR • To analyse reflexes in man an sensivity • To understand process of ovulation, semen analysis	**Credits: 2**
	Program specific outcomes After successful completion of this course, students are expected to: • acquire the knowledge related to determination of GFR • gain the knowledge related to reflexes in man • understand the process of ovulation and semen analysis.	
Practical	1) To demonstrate the principle of dialysis. 2) Determination of GFR. 3) Determination of Nitrogenous Excretory Product – Uric acid 4) Reflexes in man. 5) Study of different types of muscles. 6) Super-ovulation in Rat. 7) To study the estrous cycle by vaginal smear method. 8) Assessing skin sensitivity - locating different receptors. 9) Study of Endocrine glands with the help of Slides/ Photographs 10) Qualitative estimation of hCG. 11) Perform Semen analysis (Motility, Sperm count, Morphology of sperm) 12) Isolation of Haemoglobin.	

MSc II Sem IV Core Courses		
Zoo – 401 B: Reproductive Physiology-II		
Total Hours: 60	**Program specific objective** • To learn about the various aspects of reproductive physiology and events. • To acquire a broad understanding of the hormonal regulation of physiological processes. • To create awareness of new technologies in assisted reproduction as well as contraceptive methods. • To build healthy society by providing proper knowledge related to reproductive aspects.	**Credits: 4**
	Program specific outcomes After successful completion of this course, students are expected to: • Understand the functioning of male and female reproductive systems particularly in humans. • Comprehension of the interplay of various hormones in the functioning and regulation of the male and female reproductive systems. • Know about infertility • Know about modern contraceptive devices	**Lectures** 60
Unit	**Topics**	
Unit I	**Fertilization-** • Ejaculation, Insemination, • Gamate transport (ovum and sperm) • Sperm capacitation and activation • Entry of sperm into ovum, Acrosomal reaction, Activation of ovum • Significance of fertilization • Early development:- Early cleavages, blastomeres	**12**
Unit II	**Implantation and Pregnancy** • Morphological and physiological relationship between blastocyst and uterus during implantation. • Abnormal implantation • Hormonal changes during pregnancy. • Ectopic pregnancy and pseudo pregnancy • Role of Hormones during Pregnancy:- Progesterone hCG, HPL, relaxin	**12**
Unit III	**Placenta, Parturition and Lactation** • Formation and development of placenta • Histological structure of placenta • Endocrine functions of placenta **Parturition** • Initiation of labour • Properties of uterine muscles • Process and factors involved in parturition **Lactation** • Development of mammary gland • Hormonal control on the Functions of mammary gland	**12**

	• Lactogenesis	
Unit IV	**Reproductive Health** • Definition, Reproductive Health Care programme • Goals of RCH programme • **Birth Control Methods** • **A)** Natural Temporary methods :- Safe period, Coitus inerruptus, Lactational amenorrhea • **B)** Male and female contraceptives with their Advantages and disadvantages :- Chemical means, Mechanical means (Barrier), Physiological devices(Oral pills), Birth control Implants • **C)** Permanent method: - Tubectomy, Vasectomy	**12**
Unit V	**Problems and Remedies related to Reproduction** • MTP (Medical Termination of Pregnancy) • Amniocentesis , PNDT Definition and Legal acts • Sexually Transmitted Diseases:- Syphilis, Gonorrhoea • Male and female infertility(sterility) • Artificial/assisted reproductive techniques :- IVF, GIFT, ZIFT, ICSI, AI, IUI, Surrogacy, Sperm bank.	**12**
Suggested Readings	• Prakash S Lohar, 2012 – Endocrinology Hormones and Human Health, MJP Publishers, Chennai • P. J. Hogarth, 1978- Biology of Reproduction Wiley, New York. • J. S. Perry, 1971- The Ovarian cycle of animals, Oliver and Boyed. • C.R. Austin and R. V. Short, 1972 Reproduction in Mammals, Vol. 1-8, Cam. Uni. Press. • P. Gibian and E.J. Platz, eds, 1970- Mammalian Reproduction, Springer Verlag. • Robert H. Williams, 1981 – Text book of Endocrinology, W. B. Saunders Company • Chandi Charan Chatterjee, 1985 – Human Physiology Vol.II Tenth Edition, Medical Allied Agency, Calcutta, India. • Arthur J. Vander, James H. Sherman and Dorothy S. Luciano – Human Physiology, • Mcgraw-Hill International Editions, Biological Sciences Series. • Nalbandov, A. V.- Reproduction Physiology.	

MSc II Sem IV Core Courses		
Zoo 403 Practical correspond to Zoo - 401 (B) Reproductive Physiology II		
	Program specific objective • To know different stages of embryonic development • To study placenta and types of contraceptives • To estimate biochemicals associated with reproduction	**Credits: 2**
	Program specific outcomes After successful completion of this course, students are expected to: • acquire the knowledge related to embryonic development • gain the knowledge related to histology of placenta and types of contraceptives • Estimate biochemicals associated with reproduction.	
Practical	1. Study of various stages of development of mammalian egg, cleavage, blastula, gastrula. 2. Study of histological slides of placenta. 3. Study of types of contraceptives. 4. Demonstration of surgical operation in rat/mice- tubectomy. 5. Demonstration of surgical operation in rat/mice- vasectomy. 6. Collection of Mammalian sperms. 7. Pregnancy test (immunological) 8. Estimation of total gonadal (testis) cholesterol from rat/mice. 9. Estimation of total adrenal cholesterol from rat/mice. 10. Estimation of Ascorbic acid from Ovary / Testis. 11. Estimation of Protein from Ovary / Testis by Lowry's method **12.** Estimation of Glycogen from Ovary / Testis by Anthrone Method	

MSc II Sem IV Core Courses		
Zoo - 401: (C) Entomology II **Insect Physiology and Applied Entomology**		
Total Hours: 60	**Program specific objective** • To develop a strong foundation in entomology, including understanding of the importance of insects to human society. • To know the process of digestion and metabolism, circulation, excretion, respiration, role of hormone in insect reproduction. • To familiarize the students with identification of insect pests, vectors and their control methods. • To develop a sufficient background for those students who wish to study more advanced entomological topics.	**Credits: 4**
	Program specific outcomes After successful completion of this course, students are expected to: • Acquire the knowledge of process the process of digestion and metabolism, circulation, excretion, respiration, role of hormone in insect reproduction. • Understand the systematic position, habit and habitat of Insects pests. • Acquire the knowledge about morphology, physiology, ecology, behavior and physiology of insect pests. • Acquire the knowledge of identification of insect pests, vectors and their control methods.	**Lectures** 60
Unit	**Topics**	
	Insect Physiology	
Unit I	A) Penetration of substances through cuticle B) Nutritional requirement and Mechanism of Digestion C) Circulation : a) Circulatory Mechanisms in Terrestrial and Aquatic insects b) Control of Heart beat D) Excretion in Terrestrial and Aquatic insects E) Respiration : a) Diffusion theory of respiration b) Respiratory Mechanisms in Terrestrial and Aquatic insects	**12**
Unit II	A) Physiological Properties of Insect Muscle B) Locomotion - Terrestrial, Aerial and Aquatic C) Neural Integration and Sense Organs D) Role of Hormones in Reproduction, E) Metamorphosis and Regeneration	**12**
	Applied Entomology	

Unit III	General biology of important pests of crops cultivated in Maharashtra in particular and India in general : A) Agricultural Crop pests: Sugarcane, Paddy, Maize, Jawar. B) Fiber crop pests: Cotton, Jute C) Vegetable pests: Bhendi, Brinjal, Cabbage, Pea, Chillies, Onion. D) Fruit pests: Lemon, Mango, Guava, Ber-cucurbita E) Oil seed plant: Ground nut, Castor, Soyabean, Mustard, Sesamum	**12**
Unit IV	A) Important pests of forest trees and steps taken to check their infestation : a) Termites, c) Forest defoliators, b) Borers d) Sap suckers B) Household and stored grain pests their control : a) Rice weevil, c) Pulse beetle, b) Tribolium d) Rice moth	**12**
Unit V	A) Medical and Veterinary entomology with reference to important Vectors and their control measure : a) Mosquito, b) Housefly, c) Flea and d) Sand fly B) Integrated pests Management (I.P.M.), C) Role of insects in forensic science	**12**
Suggested Readings	• Bursell E.: An Introduction to Insect Physiology, Academic Press Inc. New York, 1978 • Crop pests and how to fight them: Govt. of Maharashtra Pub. Bombay. • Pfadt R.E.: Fundamental of Applied Entomology, Mac Millan, New York, 2nd Ed.1971. • Pradhan S.: Insect pests of crop, NBY, New Delhi 1969. • Rock Stein M.: The Physiology of Insects by Vol. I- VI, Academic press London 1973-76. • Roy D. N. and A WA Brawn: Entomology, The Banglore Printing and Publ. Co. Ltd. 1970. • Short JRI: Introduction to Applied Entomology, Longmans Green London 1963. • Simi KGV Trustees of Britmus London: Insects and other Arthropods of Medical importance, 1973. • Wigglesworth V. B.: The principles of Insect Physiology, Chapman and Hall Ltd. London. 7th Ed. 1972.	

MSc II Sem IV Core Courses		
Zoo - 403: Practical I (corresponding to Zoo 401 (C) Entomology II) Insect Physiology and Applied Entomology		
Total Hours: 60	**Program specific objective** • To develop a strong foundation in entomology, including understanding of the importance of insects to human society. • To know the process of digestion and metabolism, circulation, excretion, respiration, role of hormone in insect reproduction. • To familiarize the students with identification of insect pests, vectors and their control methods. • To develop a sufficient background for those students who wish to study more advanced entomological topics.	**Credits: 2**
	Program specific outcomes After successful completion of this course, students are expected to: • Acquire the knowledge of process the process of digestion and metabolism, circulation, excretion, respiration, role of hormone in insect reproduction. • Understand the systematic position, habit and habitat of Insects pests. • Acquire the knowledge about morphology, physiology, ecology, behavior and physiology of insect pests. • Acquire the knowledge of identification of insect pests, vectors and their control methods.	
	Insect Physiology	
	• Detection of chitin in insects • Detection of $CaCO_3$ in Malphigian tubules of cockroach • Study of haemocytes in insect haemolymph • Detection of Uric acid in Malphigian tubules of cockroach • Estimation of Amylase activity in alimentary canal of Cockroach • Counting of Heart beats of cockroach by using normal insect saline and effect of drugs, temperature on Heart beats	
	Applied Entomology	

	• Study of insect pests of agricultural importance
	  • Agricultural crop pests: Maize, Sugarcane
	  • Pests of Vegetables: Bhendi, Brinjal, Cabbage
	  • Pests of Fiber Crops: Cotton and Jute
	  • Pests of Fruit Plants: Lemons, Mango, guava.
	  • Pests Oil Seeds: Ground nut, Soyabean	

	• Study of Insect Vectors of Man: Mosquitoes, House fly, Bedbug, Head louse • Study of Insect Pest of Cattle and Domestic Animals: Mite, Horn fly, Horse fly	
	• Study of Stored Grain and Household Pests: Flour beetle, Rice weevil, Pulse beetle • Study of Forest Pests: Termites, Borers, Defoliators etc. • Study of Forensic Insects: Flesh fly, Blow fly • Compulsory Field Trip: To visit Agriculture University, Institute etc.	
Suggested Readings	• Bursell E.: An Introduction to Insect Physiology, Academic Press Inc. New York, 1978 • Crop pests and how to fight them: Govt. of Maharashtra Pub. Bombay. • Pfadt R.E.: Fundamental of Applied Entomology, Mac Millan, New York, 2nd Ed.1971. • Pradhan S.: Insect pests of crop, NBY, New Delhi 1969. • Rock Stein M.: The Physiology of Insects by Vol. I- VI, Academic press London 1973-76. • Roy D. N. and A WA Brawn: Entomology, The Banglore Printing and Publ. Co. Ltd. 1970. • Short JRI: Introduction to Applied Entomology, Longmans Green London 1963. • Simi KGV Trustees of Britmus London: Insects and other Arthropods of Medical importance, 1973. • Wigglesworth V. B.: The principles of Insect Physiology, Chapman and Hall Ltd. London. 7th Ed. 1972.	

M. Sc. II: Semester IV Core Courses		
Zoo 401 (D) Helminthology-1I		
Total Hours: 60	**Program specific objective** 4. The programme has been designed in such a way so that the students get the flavour of classical and modern aspects of Zoology/Animal Sciences. 5. It aims to enable the students to study Heminthology-I1 as a core course. 6. The lab courses have been designed in such a way that students will be trained to join public or private labs.	Credits: 4
	Program specific outcomes The student at the completion of the course will be able to: ➢ Understand the Heminthology-II. ➢ Know about the classification of Nematodes. ➢ To be familiar with the life cycle of various nematodes ➢ Students learn about the Nature, pathogenicity and prevention of ecto and endoparasites. ➢ Their identification, nature of damage control of these nematodes.	Lectures 60
Unit	**Topics**	
Unit 1	1. General control measure of endo-parasites. Chemical, Biological, Physical/ Mechanical, Culture and Legislative. 2. Economic importance of parasites, direct or indirect effect on human, animal, farm animals and agriculture, poultry and fisheries pathogenicity. 3. General pattern of parasitic transmission. 4. Parasitic zoonosis.	14
Unit 2	Study of medically and veterinary important Parasitic Nematodes. a. Intestinal nematodes infective in egg stage. b. Intestinal nematodes infective in larval stage. c. Blood & tissue dwelling nematodes	08
Unit 3	1. Feeding and nutrition's in Nematodes. 2. Reproductive system in male, female, fertilization, development and hatching of eggs. 3. Molting and Development in nematodes. 4. Different life cycle patterns in Nematodes. 5. Morphology, life cycle, pathogenicity, control and Prevention of following types. *a. Strongyloides stercoralis* *b. Wuchereria bancrofti* *c. Trichenella spiralis* *d. Trichuris trichura* *e) Dracunculuc medinensis*	16
Unit 4	1. General organization and Outline classification of plant Nematodes. 2. Feeding habits and modifications in anterior region. 3. Symptoms of Nematode injuries to plants (above ground. below ground)	10

Unit 5	1. Controlling nematode diseases of plants (Cultural, biological, chemical, physical, legislative) 2. Life cycle studies of followings *a.* Root knot Nematodes (*Meloidogyne)* b. Citrus Nematodes (*Tylenchulus)* c. Bud and leaf Nematodes (*Aphelenchoides)* *d.* Seed gall Nematodes (*Anguina)*	12
Suggested Readings	1. Text book of medical Parasitology - Dey 2. Structure of Nematode - Allen bird 3. An introduction to Nematodology - Chitwood 4. Organization and Biology of nematodes -Crool 5. Physiology of nematodes - Lee 6. Principal of Nematodology - Throne 7. Applied Parasitology - Hiware, Jadhav and Mohekar 8. Physiology of nematode parasite - Smith 9. Animal Nematodes from Indian Mammals - Nama, Shinde and Jadhav 10 Vertebrate Nematodes - York and Mapelston 11. Physiology of nematode parasites - Bee 12. Nematodes Parasites of domestic animal - Levine 13. Structure of Nematodes -Allen Bird 14. Biology of nematode - Crool	

MSc II Sem IV Core Courses		
Zoo 403 Practical correspond to Zoo - 401 (D) Helminthology II		
Total Hours: 60	**Program specific objective** • To understand the process of Study the Collection, fixation and staining methods of nematodes • To understand key of Identification for nematodes. • To practice camera lucida for sketching of nematodes • To study the various types of nematodes in vertebrates	**Credits: 2**
	Program specific outcomes After successful completion of this course, students are expected to: • Study the Collection, fixation and staining methods of nematodes • Understand key of Identification for nematodes. • Practice camera lucida for sketching of nematodes • Study the various types of nematodes in vertebrates	
Practical	• Techniques for collection and Fixation of nematodes from various hosts. • Basic techniques of preservation and mounting of Nematodes. • Identification of collected nematodes. • Sketching of the nematodes with the help of Camera Lucida • Examination of fecal sample of sheep, goat and chicken for different helminthes ova and their identification. • Study of permanent whole mount slides: (At least 8). • Submission of permanent slides at the time of examination. • Visit to veterinary and medical parasitology laboratory	

MSc II Sem IV Core Courses		
Zoo – 402: Molecular Biology		
Total Hours: 60	**Program specific objective** • To understand the basic structure of cells, tissues and their working system. • Know the handling skill in laboratory methods of estimation, determination, working of cells and their molecules. • Use of binocular research microscope and bioinstrumentation in laboratory.	**Credits: 4**
	Program specific outcomes After successful completion of this course, students are expected to: • Acquire skills related to molecular analysis of biological species, cells and tissues. • Predict the outcome of various cellular reactions carried out in cell and cellular system under various conditions. • Predict the role of genes and its relevance to human genetics and diseases.	**Lectures** 60
Unit	**Topics**	
Unit I	DNA replication, repair and recombination: Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons, DNA damage and repair mechanisms	**12**
Unit II	RNA synthesis and processing: Transcription factors and machinery, formation of initiation complex, transcription activators and repressors, RNA polymerases, capping, elongation and termination, RNA processing, RNA editing, splicing, polyadenylation, structure and function of different types of RNA, RNA transport	**12**
Unit III	Protein synthesis and processing: Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, translational proofreading, translational inhibitors, post- translational modification of proteins.	**12**
Unit IV	Control of gene expression at transcription and translation level: Regulation of phages, viruses, prokaryotic and eukaryotic gene expression, role of chromatin in regulating gene expression and gene silencing	**12**
Unit V	Tools and Techniques in Molecular Biology. i. Polymerase chain reaction (PCR); ii. Electrophoresis- PAGE, SDS - PAGE and Agarose gel electrophoresis. iii. Blotting techniques: Southern, Northern and Western blotting iv. ELISA technique and v. DNA finger printing	**12**
Suggested Readings	• Prakash S. Lohar : Cell and Molecular Biology, MJP Publishers, Chennai	

	• Gerald Karp: Cell and Molecular Biology, John Wiley and Sons International, London • H.S. Bhamrah: Molecular Cell Biology • J.D. Watson: Molecular Biology of the gene • P.K. Gupta: Cell and Molecular Biology	

MSc II Sem IV Core Courses		
Zoo 403 Practical correspond to Zoo - 402 Molecular Biology		
Total Hours: 60	**Program specific objective** • To know process of making paper model of DNA • To estimate DNA and demonstrate vital staining • To understand the process of AGE and PAGE	**Credits: 2**
	Program specific outcomes After successful completion of this course, students are expected to: • acquire the knowledge related to preparation of DNA model • learn the process of estimation of DNA and vital staining • understand the process of AGE and PAGE.	
Practical	1. Study of cell fractionation (D) 2. Preparation of Paper Model of DNA (D) 3. Extraction of DNA from rat liver/ Spleen (E) 4. Estimation of DNA from suitable material by Diphenylamine reagent. (E) 5. Estimation of RNA from suitable material by Orcinol reagent. (E) 6. Vital staining of mitochondria by using Janus Green B stain. (E) 7. Preparation of salivary gland chromosome from Chironomus / Drosophila larva. (E) 8. Isolation of Genomic DNA from suitable material. 9. Determination of Thermal melting point (Tm) of nucleic acid. 10. Isolation of plasmid DNA and detection by Agarose gel electrophoresis. 11. Detection of protein by PAGE and molecular determination. **12.** Gene mapping in Prokarytes problem.	

MSc II Sem IV Zoo 404: Project (Credit 4)

Project on suitable topic should be given to each student in the beginning of 3rd Semester and through the year work should supervised and finally Project Report with following points should be typed, bind (at least 30 pages) and submitted to department before final examination (4th Semester).

Title of the Project: Define a short, significant title which reflects clearly the contents of the report.

Abstract: Succint abstract of less than one page.

Table of content: The table of content lists all chapters (headings/subheadings) including page number.

Introduction: Explain why this work is important giving a general introduction to the subject, list the basic knowledge needed and outline the purpose of the report.

Background and results to date: List relevant work by others, or preliminary results you have achieved with a detailed and accurate explanation and interpretation. Include relevant photographs, figures or tables to illustrate the text. This section should frame the research questions that your subsequent research will address.

Aims and Objectives : List the main research question(s) you want to answer. Explain whether your research will provide a definitive answer or simply contribute towards an answer.

Methodology: Explain the methods and techniques which will be used for your project depending on the subject: field work, laboratory work, modeling technique, interdisciplinary collaboration, data type, data acquisition, infrastructure, software, etc.

Discussion / Conclusion: Explain what is striking/noteworthy about the results. Summarize the state of knowledge and understanding after the completion of your work. Discuss the results and interpretation in light of the validity and accuracy of the data, methods and theories as well as any connections to other people's work. Explain where your research methodology could fail and what a negative result implies for your research question.

Acknowledgement: Thank the people who have helped to successfully complete your project, like project partners, tutors, etc.

Reference & Literature (Bibliography): List papers and publication you have already cited in your proposal or which you have collected for further reading. The style of each reference follows that of international scientific journals.

Appendix: Add pictures, tables or other elements which are relevant, but that might distract from the main flow of the proposal

MSc II Sem IV Elective Course (Any one from A,B and C)		
Zoo – 405 (A): Zoogeography		
Total Hours: 60	**Program specific objective** • The course is designed to provide students with an understanding of zoogeography, the study of the spatial patterns, or geography, of animals. • Examine environmental and zoogeographic patterns • Develop an understanding of the influence of earth history and basic zoogeographic processes on animals • Explore the application of zoogeography to conservation of animals • The course will finish by applying this knowledge to an understanding of current issues in biodiversity.	**Credits: 4**
	Program specific outcomes After successful completion of this course, students are expected to: • show mastery in the broad areas of environmental factors and their variation on various spatial and temporal scales • learn ecological and evolutionary biogeography, and application of such knowledge to conservation biology.	**Lectures** 60
Unit	**Topics**	
Unit I	**Introduction to Zoogeography** • History. Concepts- Zoogeography. • Definitions, Nature, Scope, Principles, Disciplines – Geography, Plant ecology and evolution, Geology, Ethnology • Environmental and geographical settings Physical Setting: the Geographic Template • The Changing Earth, continental drift.	**12**
Unit II	**The Geography of Communities** • Distributions of communities • Glaciation and its biotic effects • Glaciation and Biogeographic Dynamics of the Pleistocene • Speciation and its geographical context Endemism, cosmopolitanism, and disjunction • Classification and Mapping of Animals Classification of animals according phylum Protozoa, Coelenterta, Platyhelminthes, Annelida, Arthropoda, Mollusca, Echinodermata, Chordate. • Factors of animal mapping: Shape of area, Structure of area, Ecology of area, History of area, Relict area, Geography of area, Dynamic of area, Community area, areas of Aquatic animals.	**12**

Unit III	**Dispersal and Immigration** • Animal Dispersai :- Factors of Animals dispersal: – Climate, Vegetation, Physical barriers, other animals. • Types of Animals dispersal- Active, Passive, Gradual, Rapid, Seasonal, Forced, Anthropogenic. • Barriers of Animals dispersal – Physical, climatic, biological Water, Ecological, Living environment, Time and distance. • Modes of dispersal • Dispersal routes of faunas.	**12**
Unit IV	**The Geography of Diversification** • Types of distribution of animals- Areography, Ecogeographic Rules, and Diversity Gradients • The Distribution of Species: Ecological Foundations • Distributions of single species, • Types of Distribution continuous discontinuous Bipolar. • Bathymetric distribution- Geobiotic Limnobiotic Holobiotic. • Theories of distribution of animals climatic and evolution theory of Matthew, age and area theory of Willis • Zoogeographical regions of the world with characteristic fauna (Distributional Regions and sub regions of animals)- Ethiopian, Australian, New world, Neartic, oriental, Palaearctic, Neotropical. Wallece's line	**12**
Unit V	• Eco- Geographic System Concept, Allen's Eco-geographic system, evolution of new species and their causes, faunal main and sub-regions-land, aquatic. • Factors affecting on ecology of animals - light , weather , food , temperature, space, mobility, shelter, soil , plant formation and size of population. • Marine realm and characteristics . Biogeography and the Geography of Extinction Conservation Biogeography	**12**
Suggested Readings	• Frank Evers Beddard (2008): A Text-Book of Zoogeography, Published by BiblioBazaar, • John R. Merrick (2006): Evolution and Biogeography of Australasian Vertebrates. Publisher • Savindra Singh (1997): Environmental science, Prayang Pustak Bhawan, Allahabad • Tiwari S.K. (1985): Zoo-Geography of India and South East Asia. International Book Dist. Dehra Dun. • Tiwari, S. K Wallace.(2006): Fundamentals of World Zoogeography. Vedams eBooks (P) Ltd (India) • Wallace A.R., (1962): The geographical distribution of animals. Hafner Publ. Co. • Illies, J .1974 .Introduction to zoogeography .Macmillan . • International commission for zoological Nomenclature(ICZN). 1999 . International code of zoological Nomenclature. Nature History Museum Cromwell Road, London S W 7 5BDUK • .Kapoor, v.c Theory and practice of Animal Taxonomy Oxford –IBH publishing co., N Delhi ,Mumbai & Kolkata . • Mayer , E. Principles of systematic zoology . Mc-Graw Hill publication, New Delhi Simpson , G.C. Principles of Animal Taxonomy. Oxford –IBH publishing co, New Delhi	

MSc II Sem IV Elective Course		
Zoo – 405 (B):Writing and Presenting Scientific Research Paper		
Total Hours: 60	**Program specific objective** • To understand the process of writing, presentation and publication of research paper • To learn the skills related to presentation of paper • To avoid the mistakes in writing research paper	**Credits: 4**
	Program specific outcomes After successful completion of this course, students are expected to: • acquire the knowledge of writing, presentation and publication of research paper • gain the skills related to presentation of paper • learn to avoid the mistakes in writing research paper	**Lectures** 60
Unit	**Topics**	
Unit I	**Introduction to writing research project** purpose of writing research report of dissertation and thesis, style and structure of research report, preliminary section. **Review of Literature** Purpose, method and Types**:** Argumentative, Integrative, Historical, Methodological, systematic and theoretical.	**12**
Unit II	**Writing a research report**: Main body of the report, - introduction, review of literature, methods of study, results and analysis of data, summary, suggestion, conclusion of data and reference section. **General precautions**, editing and correction, final evaluation of research report, **IMMRAD** pattern of research report.	**12**
Unit III	**Use of visual aid for effective presentation**: Power point presentation: Synopsis, summary, abstract, tables, graphs,Summary, References, Acknowledgement	**12**

	Poster presentation: Appropriate size of the poster with Title, author, affiliation, introduction material and methods, results, summary selection of appropriate font size, table, figure, etc	
Unit IV	**Common mistakes in writing scientific paper** • Unclear aim • Structure of the manuscript is confusing • Methods without enough details • Wrong statistic used • Sections are mixed up • Conclusions do not match with present results • Writing inaccurate • Citations/references are incomplete	**12**
Unit V	**Guidelines for paper publication:** • Formatting of the paper as per rules of **journal** • Guidelines for Author. • Submission of Article. • Assigned Reviewers. • Decision by Reviewers. • Reviews to the Author. • Updated Paper Received. • Feedback.	**12**
Suggested Readings	• Dr. Nageshwar Rao and Dr. Rajendra P. Das: Communication Skills, Himalaya Publishing House 2005 • Margerson, J.E.: The Art of effective communication, Excel Books New Delhi • Richard, W. Clark and Barbara, L. Clinton: Effective Speech Communication, MacMillan, Mac Graw Hill, New York, 1999 • N. Gurumani, Research Methodology for biological sciences, MJP publishers,Chennai • Gopen, G.D. and Swan J.A. The Science of Writing, American Scientist, 1990 • • Hall, G.M. How to write a paper, By Word publication, 1996	

MSc II Sem IV Elective Course		
Zoo – 405 (C):Computational Biology		
Total Hours: 60	**Program specific objective** • To get introduced to the basic concepts of Computational biology • To overview about types of Biological data and database search tools. • To acquire knowledge about computational tools for Proteomics and Genomics	**Credits: 4**
	Program specific outcomes After successful completion of this course, students are expected to: • learn the basic concepts of Computational biology • gain knowledge about types of Biological data and database search tools. • acquire skill to use computational tools for Proteomics and Genomics	**Lectures** 60
Unit	**Topics**	
Unit I	• Definition, Objectives and scope of Computational Biology • Application of Bioinformatics in various Fields. • Concept of Biological database • Types and significance of biological database	**12**
Unit II	• Concept of Sequence alignment • Types of sequence alignment • BLAST, types and applications • FASTA, format and applications	**12**
Unit III	• Proteomics : Definition and significance • Protein structure visualization tools • Protein sequence databases- • Protein folding and disorders • PDB and Protein microarray	**12**
Unit IV	• Genomics: Definition and significance • Comparative, structural and functional genomics • DNA microarray • Human Genome Project	**12**
Unit V	A)Computational analysis of the genomics of • *Escherchia coli* • *Drosophila melanogaster* • *Rattus rattus* B) GenBank, DDBJ, EMBL	**12**
Suggested Readings	• Attwood, T.K., Michie, A.D. and Jones, M.L. (1996): DbBrowser: integrated access to database worldwide. *TiBS*. Vol. 21(5), 191. • Barnes, M.R. and Gray, I.C.(2003) eds., *Bioinformatics for Geneticists*, first edition. Wiley,ISBN 0-470-84394-2 • Prakash S.Lohar (2011) Bioinformatics ISBN 978-81-8094-066-8 MJP Publishers, Triplicane, Chennai. • Lesk, A.M. (2001): *Introduction to Protein Architecture: The Structural Biology of Proteins* (Oxford: Oxford University Press). • Pocock,M.R. et al. (2000) BioJava: open source components for bioinformatics. ACM SIGBIO	

Kavayitri Bahinabai Chaudahri North Maharashtra University, Jalgaon

M. Sc. (Part II) Zoology

Equivalence 2018-19 (Old courses) with 2022-23 (New Courses)

Paper Code	Old Courses 2018-19	Paper Code	New Courses 2022-23
Semester III			
ZOO 301 (Any one from A,B,C,and D) Specialized paper	(A) Entomology I or (B) Animal Physiology I (C) Reproductive Physiology I (D) Helminthology I	ZOO 301 (Any one from A,B,C,and D) Specialized paper	(A) Animal Physiology I (B) Reproductive Physiology I (C) Entomology I (D) Helminthology I
ZOO 302	Immunology and Molecular Biology	ZOO 302	Enzymology and Immunology
ZOO 303	Genetics	Elective course ZOO 303 (Any one)	Animal Behaviour Forensic Zoology Endocrinology
		Audit Course	Any one
		AC-301A	Computer Skills
		AC-301B	Cyber Security
		AC-301C	Seminar + Review Writing
		AC-301D	Biostatistics
ZOO 304	ZOO 304: Practical 301 + 302	ZOO 304	Practical I: Zoo 301
ZOO 305	ZOO 305: Practical 302 + 303	ZOO 305	Practical II: Zoo 302
		AC-301 Audit Course	Any one
		AC-301A	Computer Skills
		AC-301B	Cyber Security
		AC-301C	Seminar + Review Writing
		AC-301D	Biostatistics
Semester IV			
ZOO 401 (Any one from A,B,C,and D) Specialized paper	(A) Entomology II or (B) Animal Physiology II or (C) Reproductive Physiology II or (D) Helminthology II	ZOO 401 (Any one from A,B,C,and D) Specialized paper	(A) Animal Physiology II (B) Reproductive Physiology II (C) Entomology II (D) Helminthology II
ZOO 402	Systematic and Evolutionary Biology	ZOO 402	Molecular Biology
ZOO 403	Skill in Communication and Writing Research Paper	ZOO 403 Elective (Select any one)	A) Zoogeography B) Writing scientific research paper C) Computational Biology
ZOO 404	ZOO 404: Practical 401 + 402	ZOO 404	Practical I: Zoo 401 + Zoo 402
ZOO 405	ZOO 405: Practical 402 + 403	ZOO 405	Project
		Audit Course	Any one
		AC-401A	Human Rights
		AC-401B	Current Affairs
		AC-401C	Seminar + Review Writing
		AC-401D	Intellectual Property Rights (IPR)

KAVAYITRI BAHINABAI CHAUDHARI NORTH MAHARASHTRA UNIVERSITY, JALGAON

॥अंतरी पेटवू ज्ञानज्योत॥

'A' Grade
NAAC Re-Accredited
(4th Cycle)

National Education Policy 2020

SUBJECT BASKET

For

M. Sc. (BOTANY)
Part-I Semester- I & II

For

Affiliated Colleges

(With effect from - June 2023)

Semester-wise Code, Structure and Titles of the Courses For

Master of Science (M. Sc.) Botany

Semester I, II, III & IV

(As per NEP-2020 Pattern)

For

Affiliated College w.e.f. June, 2023-2024

Semester-wise Course Structure, Course Code and Credit distribution of Two Years/ One Year M. Sc. Programme.

Abbreviations:

- **T:** Theory Course
- **P:** Practical course
- **DSC:** Discipline Specific Core Course
- **MIN:** Minor subject
- **DSE:** Discipline Specific Elective Course
- **ES:** Environment studies
- **VSC:** Vocational Skill Courses
- **CI:** Constitution of India
- **SEC:** Skill Enhancement Courses
- **ENG:** English
- **GE/OE:** Generic/open elective
- **RP:** Research Project
- **IKS:** Indian Knowledge System
- **RM:** Research methodology
- **CEP:** Community engagement and service
- **MIL:** Modern Indian language
- **VSEC:** Vocational skill and Skill enhancement courses
- **OJT**: On Job Training: Internship/ Apprenticeship
- **Co-curricular Course (CC)**
  - **a) CC-1: CC-120: Sports and Yoga**
  - **b) CC-2: CC-130: Cyber Security**
  - **c) CC-3: CC-220: Human Rights and Environment Law**
  - **d) CC-4: CC-229: Communication Skills and Personality Development**
  - **Value Education Courses (VEC)**
    - **a) VEC1: ES-118: Environmental Science**
    - **b) VEC2: CI-129: Constitution of India**
  - **Indian Knowledge System (IKS):**
    - **a) IK: 119: Ayurvedic Medicine in Ancient India**

- **Ability Enhancement Courses (AEC)**
  - **a) AEC-1: EG: 101 – English -1**
  - **b) AEC-2: EG: 102 – English -2**
  - **c) AEC-3: MR: 201 – Marathi -1**
  - **d) AEC-3: HN: 201 – Hindi -1**
  - **e) AEC-3: MR: 202 – Marathi -2**
  - **f) AEC-3: HN: 202 – Hindi -2**

Semester-wise Course Structure, Course Code and Credit distribution of Two Years/ One Year M. Sc BOTANY Programme as per NEP2020, for Affiliated Colleges w.e.f – June 2023.

SEMESTER – I, Level – 6.0

Course	Course Type	Course Code	Course Title	Credits	Teaching Hours/Week			Marks (Total 100)			
					T	P	Total	Internal (CA)		External (UA)	
								T	P	T	P
DSC-25	DSC	BO-411	Plant Systematics- I (Algae, Fungi and Bryophytes)	4	4	--	4	40	--	60	--
DSC-26	DSC	BO-412	Molecular biology	2	2	--	2	20	--	30	--
DSC-27	DSC	BO-413	Taxonomy of Angiosperms	4	4	--	4	40	--	60	-
DSC-28	DSC	BO-414	Practical based on BO-411	2	--	4	4	--	20	--	30
DSC-29	DSC	BO-415	Practical based on BO-412 & BO-413	2	--	4	4	--	20	--	30
DSE-5	DSE	BO-416(A)	Plant Biotechnology	4	4	--	4	40	--	60	-
		BO-416(B)	Seed Processing Techniques	4	4	--	4	40	--	60	-
		BO-416(C)	Fermentation Technology	4	4	--	4	40	--	60	-
RM	RM	RM-417	Research Methodology	4	4	--	4	40	--	60	-
SEMESTER – II, Level – 6.0											
DSC-30	DSC	BO-421	Plant Systematics II (Pteridophytes, Gymnosperm and Paleobotany)	4	4	--	4	40	--	60	--
DSC-31	DSC	BO-422	Genetics	2	2	--	2	20	--	30	-
DSC-32	DSC	BO-423	Plant Physiology	4	4	--	4	40	--	60	-

DSC-33	DSC	BO-424	Practical based on BO-421	2	--	4	4	--	20	--	30
DSC-34	DSC	BO-425	Practical based on BO-422 & BO-423	2	--	4	4	--	20	--	30
DSE-6	DSE	BO-426(A)	Techniques in Plant Science	4	4	--	4	40	--	60	--
		BO-426(B)	Plant Ecology and Phytogeography	4	4	--	4	40	--	60	-
		BO-426(C)	Agricultural Botany	4	4	--	4	40	--	60	-
OJT	*OJT/ Int.	BO-427	On Job Training	4	--	8	8	--	40	--	60

Semester-wise Course Structure, Course Code and Credit distribution of Two Years/ One Year M. Sc BOTANY Programme as per NEP2020, for Affiliated Colleges w.e.f – June 2023.

SEMESTER – III, Level – 6.5

Course	Course Type	Course Code	Course Title	Credits	Teaching Hours/Week			Marks (Total 100)			
					T	P	Total	Interal (CA)		External (UA)	
								T	P	T	P
DSC-35	DSC	BO-511	Plant Development and Reproduction	4	4	--	4	40	--	60	--
DSC-36	DSC	BO-512	Plant Breeding and Evolution	2	2	--	2	20	--	30	--
DSC-37	DSC	BO-513	A. Phycology Special Paper- I B. Mycology Special Paper- I C. Angiosperm Taxonomy Paper- I D. Physiology Special Paper- I	4	4	--	4	40	--	60	--
DSC-38	DSC	BO-514	Practical based on BO-511 & BO-512	2	--	4	4	--	20	--	30
DSC-39	DSC	BO-515	Practical based on Sp. Paper BO-513 (A/B/C/D)	2	--	4	4	--	20	--	30
DSE-7	DSE	BO-516(A)	Biostatistics and Bioinformatics	4	4	--	4	40	--	60	--
		BO-516(B)	Banana Technology	4	4	--	4	40	--	60	--
		BO-516(C)	Forensic Botany	4	4	--	4	40	--	60	--
RP	RP	BO-517	Research Project	4	-	8	8	--	40	--	60

SEMESTER – IV, Level – 6.5											
DSC-40	DSC	BO-521	A. Phycology Special Paper- II B. Mycology Special Paper- II C. Angiosperm Taxonomy Paper- II D. Physiology Special Paper- II	4	4	--	4	40	--	60	--
DSC-41	DSC	BO-522	A. Phycology Special Paper- III B. Mycology Special Paper- III C. Angiosperm Taxonomy Paper- III D. Physiology Special Paper- III	4	4	--	4	40	--	60	--
DSC-42	DSC	BO-523	Practical based on Sp. Paper BO-521 (A/B/C/D)	2	--	4	4	--	20	--	30
DSC-43	DSC	BO-524	Practical based on Sp. Paper BO-522 (A/B/C/D)	2	--	4	4	--	20	--	30
DSE-8	DSE	BO-525(A)	Post Harvest Technology	4	4	--	4	40	--	60	--
		BO-525(B)	Green House Technology	4	4	--	4	40	--	60	--
		BO-525(C)	Green Belt and Green Credit	4	4	--	4	40	--	60	--
RP	RP	BO-526	Research Project	6	--	12	12	--	60	--	90
Cumulative Credits For Second Year – 44											
2 Years-4 Sem. PG Degree (88 credits) after Three Year UG Degree or 1 Year-2 Sem PG Degree (44 credits) after Four Year UG Degree											
Cumulative Credits For First Year – 44* Students need to complete one month on job training **(OJT)** or internship in any industry related to major subject.											

Programme: M.Sc. Botany
Programme Outcomes (POs)

Programme: M.Sc. Botany
Programme Outcomes (POs)

After the completion of the M.Sc Botany Programme, the students will be in a position to

PO1: Domain knowledge: Demonstrate knowledge of basic concepts, principles and applications of the specific science discipline.

PO2: Resource Utilisation. Cultivate the skills to acquire and use appropriate learning resources including library, e-learning resources, ICT tools to enhance knowledge-base and stay abreast of recent developments.

PO3: Analytical and Technical Skills: Ability to handle/use appropriate tools/techniques/equipment with an understanding of the standard operating procedures, safety aspects/limitations.

PO4: Critical thinking and Problem solving: Identify and critically analyse pertinent problems in the relevant discipline using appropriate tools and techniques as well as approaches to arrive at viable conclusions/solutions.

PO5: Project Management: Demonstrate knowledge and scientific understanding to identify research problems, design experiments, use appropriate methodologies, analyse and interpret data and provide solutions. Exhibit organisational skills and the ability to manage time and resources.

PO6: Individual and team work: Exhibit the potential to effectively accomplish tasks independently and as a member or leader in diverse teams, and in multidisciplinary settings.

PO7: Effective Communication: Communicate effectively in spoken and written form as well as through electronic media with the scientific community as well as with society at large. Demonstrate the ability to write dissertations, reports, make effective presentations and documentation.

PO8: Environment and Society: Analyse the impact of scientific and technological advances on the environment and society and the need for sustainable development

PO9: Ethics: Commitment to professional ethics and responsibilities **PO10: Life-long learning:** Ability to engage in life-long learning in the context of the rapid developments in the discipline.

Programme Specific Outcomes (PSOs)

By the end of the Programme, the students will be able to

PSO1: Academic competence:

1. Recall fundamental concepts, state principles and outline processes underlying in the field of Botany, its different sub fields and its linkage with related disciplinary areas/subjects.
2. Demonstrate an understanding of a wide range of physiological, biochemical, cellular, molecular, developmental processes in plant cell.
3. Execute botanical excursion tour for correct taxonomic identification, collection, preservation of plant specimens.

PSO2: Personal and Professional Competence:

1. Carry out activities effectively as an individual or a member of a team or leader of a group to fulfil the responsibilities related to group activities.
2. Analyse data and samples procured during experiments, projects, and field work.
3. Formulate the ideas, draft scientific reports, authenticate conclusions, present effectively with effective communication skills.
4. Implement self-learning, discipline, and take logical correct approach for solving problems.

PSO3: Research Competence:

1. Apply appropriate techniques to solve and analyse problems with specific reference to biological techniques and instrumentations.
2. Integrate knowledge of fundamental aspects of Botany with applied aspects to design the experiment, interpret the data, and provide valid conclusions.
3. Assess problems, identify, formulate research literature, and test probable solutions for challenges in various fields of Botany.

PSO4: Entrepreneurial and Social competence:

1. Employ the applied knowledge of Botany for self-employment with demonstration of true values of leadership, co-operation, and teamwork.
2. Associate the impact of anthropogenic factors, importance of conservation, diversity, and our social role in sustainable development.
3. Execute social competence including listening, speaking, observational, effective interactive skills and presenting skills to meet global competencies.

Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon
MSc. Botany Part - I: Semester - I & II

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Programme at a Glance Syllabus for M. Sc. Botany

Board of Studies in Botany

Name of the program (Degree)	: M.Sc. Botany
Faculty	: Science and Technology
Duration of the Program	: Two years (four Semesters)
Medium of Instruction and Examination	: English
Exam Pattern	: 60: 40 (60 marks University exam and 40 marks continuous internal assessment)
Passing standards	: 40% in each exam separately (Separate head of passing)
Evaluation mode	: NEP 2020
Credits of the program	:88

Semester – Ist

DSC-25 [4T]	BO-411	Plant Systematics- I (Algae, Fungi and Bryophytes)	60 L
DSC-26 [2T]	BO-412	Molecular biology	30 L
DSC-27 [4T]	BO-413	Taxonomy of Angiosperms	60 L
DSC-28 [2P]	BO-414	Practical based on DSC-25	30 L
DSC-29 [2P]	BO-415	Practical based on DSC-26 & 27	30 L
DSE-5 [4T]	BO-416 (A) BO-416 (B) BO-416 (C)	Plant Biotechnology Seed Processing Technology Fermentation Technology	60 L
RM [4T]	RM-417	Research Methodology	60 L

Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon
M. Sc. Botany Part - I: Semester - I

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DSC- 25 Major (Core) Course [Lectures: 60][4T] BO-411 Plant Systematics - I (Algae, Fungi and Bryophytes)		
Course Objectives: 1. To study salient features of Algae, Fungi and Bryophytes. 2. To know the diversity of Cryptogamic plants in nature. 3. To study the life cycle patterns in cryptogams.		
Course outcomes: 1. Able to differentiate cryptogamic plants. 2. Able to describe life cycle patterns in cryptogams. 3. Higher cognitive skills will develop.		
Unit 1	**Introduction to Algae** 1. Introduction: Definition, Occurrence and Habitat General characters, and similarities and differences with Fungi and Bryophyte. 2. Reproduction; Life cycle and Alternation of generation. 3. Algae in human welfare.	**03**
Unit 2	**Classification of algae** 1. Basis of algal classification and nomenclature; Classification of algae According to F. E. Fritsch (1945) and Parker (1982) up to class and subclass: 2. Comparative account of the algal classes, with respect to pigments, reserve food, cell wall, chloroplast and eyespot, flagella	03
Unit 3	**Study of importance classes of algae** **A. Cyanophyceae** i) Introduction, Ecology of Blue Green Alga, ii) Thallus organization, Ultra cell structure & Heterocyst, Heterocyst function iii) Reproduction and Economic role **B. Chlorophyceae** i) General characters, Range of thallus structure, Structure of Cell ii) Method of reproduction. **C. Phaeophyceae** i) General characters, Range of thallus structure ii) Method of reproduction **D. Rhodophyceae** i) General characters, Range of thallus structure ii) Method of reproduction **E. Introduction and General Characters of following Class** *i) Bacillariophyceae* *ii) Euglenophyceae*	14

Unit 4	**Fungi – Introduction:** 1. Distinguishing characters, Thallus structure, Hyphal modifications 2. Nutrition 3. Classification of fungi up to classes as per- Ainsworth et al., system (1973). 4. Economic importance- Fungi in biotechnology, fungi as food.	03
Unit 5	**A) Myxomycota:** i) Distinguishing characters. ii) Structure of thallus and reproductive bodies. *iii)* Life cycle pattern with reference to *Pysarum.* **B) Mastigomycotina:** i) Distinguishing characters. ii) Thallus structure and reproduction (Asexual and sexual). *iii)* Life cycle pattern with reference to *Plasmopara.* **C) Zygomycotina:** i) Distinguishing characters ii) Thallus structure, Heterothallism and reproduction. *iii)* **Life cycle** pattern with reference to *Mucor.*	09
Unit 6	**A) Ascomycotina:** i) Distinguishing characters. ii) Thallus structure, structure of asci, Types of ascocarps. ii) Life cycle pattern with reference to *Eurotium.* **B) Basidiomycotina:** i) Distinguishing characters. ii) Thallus structure, Types and Structure of basidia and basidiocarps. iii) Life cycle pattern with reference to Teliomycete.s **D) Deuteromycotina:** i) Distinguishing characters. ii) Thallus structure, fructifications, Types of conidia.	08
Unit 7	**Introduction to Bryophytes** **A) Introduction: -** General characteristics, habitat, reproduction, structure of gametophyte & sporophyte. **B) Classification: -** Classification of Bryophytes up to orders by G.M. Smith 1955). **C) Economic importance of Bryophytes** **D) Evolution of gametophytes & sporophytes in Bryophytes.**	05
Unit 8	Distinguishing features, phylogeny & evolutionary tendencies of the following orders with their affinities. **Hepaticae :(** Marchantiales, Jungermannias, Metzeriales and *Calobryales* **Anthocerotae:** Anthocerotales. **Musci:** Polytrichales.	15

Suggested readings:

1. Bold, H and Wynne M.J. (1978) Algal structure and reproduction. Prentice Hall of India Pri.Ltd.New Delhi, India.
2. Bony, A.D. (1978) Phytoplankton.Edward Arnold Pub.Ltd. London, U.K.
3. Chapman, V.J. and Chapman D.J. (1979) The Algae. English Language Book Society and Mc.millan,Co, London, U.K.

4. C. van den Hoek; D.G.Mann; H.M. Jahns (1988) Algae An introduction to Phycology. Cambridge University Press, UK.
5. Daws, C. J. (1981) Marine Botany. Wiley Publication Com. New York, USA.
6. E.Fritsh (1965) The Structure and reproduction of Algae Vol. I and II. The syndics of the Cambridge University press, London.
7. Gupta J.S (1981) A Text Book of Algae, Oxford & IBH Publishing Co. Mumbai, India.
8. Khan M. (1970) Fundamentals of Phycology Bishan Singh Mahendra Pal Singh, Dehra Dun, India.
9. Lee, R.E. (1989) Phycology. Cambridge University Press, Cambridge, U.K.
10. Mahendra Perumal G and N. Anand(2009) Mannual of Freshwater Algae of Tamil Nadu, Bishen Singh Mahendr Pal Singh, Dehra Dun, India.
11. Morris, I (1967) An Introduction To The Algae, Hutchinson University Press, U.K.
12. Prescot, G.W. (1969). The Algae.Thomas Nelson and Sons Ltd, Nashville, USA
13. Robin G.South and Alan Whittick (1996).Phycology .Blackwell science. Oxford London Edinburg, U.K.
14. Round, F.E. (1973)The Biology of the Algae. Edward Arnold, London, U.K.
15. Sharma, O.P.(1950)A text book of Algae.TataMcGraw Hill, New Delhi, India.
16. Smith, G.M. (1950). Fresh water Algae of United States.McGrawHill Book Company, New York, USA.
17. Sambamurty A.V.S.S. (2005) A Text Book of Algae. I.K.International Mumbai, India.
18. Vashishta B.R. (2010) Botany Part- I Algae S.Chand& Company Ltd.New Delhi, India.
19. Vijayaraghavan M.R. and Sunita kumara (1995) Chlorophyta Structure Ultrastructure & Reproduction, Bishen Singh Mahendr Pal Singh, Dehra Dun, India
20. O. P.Sharma (2011) Algae. Tata Mc Graw Hill Education Private Limited, New Delhi.
21. Vashishta B.R. (2010) Botany Pa rt- I Algae S.Chand& Company Ltd.New Delhi, India.
22. Ainsworth, Sussman and Sparrow (1973) The fungi. Vol IV A & IV B. Academic Press. London, U.K.
23. Alexopolous C.J., Minms C.W. and Blackwell M. (1999) (4th edn) Introductory Mycology. Willey, New York, USA.
24. Deacon J.W. (2006) Fungal Biology (4th Ed.) Blackwell Publishing, Oxford, U.K.
25. Dube H.C. (2004) An Introduction To Fungi. Vikas Publishers.New Delhi, India.
26. Kendrick B. (1994) The Fifth Kingdom (paperback), North America, New York Publisher:
27. Kirk et al. (2001) Dictionary of fungi, 9th edn, Wallingford: CABI.
28. Mehrotra R.S. and Aneja K.R. (1990) An Introduction To Mycology. New Age Publishers, New Delhi, India.
29. Miguel U., Richard H., and Samuel A. (2000) Illustrated Dictionary of the Mycology. Elvira Aguirre Acosta, Publisher: St. Paul, Minn: APS press.
30. Sharma O.P. (2010) A Text Book of Fungi. S.Chand'sPublication,New Delhi, India.
31. Sharma, P.D. (1998) The Fungi. Rastogi Publications, Merrut, India.
32. Vashista, B.R. and Sinha A.K. (2008) Botany for Degree Students –Fungi. S.Chand and company Ltd., New Delhi, India.
33. Webster J. and Rpland W. (2007) Introduction To Fungi (3rd Edn) Cambridge University, Press, U.K.
34. Cavers F. (1976) Interrelationships of Bryophytes S.R. Technic, Ashok Rajpath, Patana.
35. Chopra R.N. & Kumar P.K. (1988) Biology of Bryophytes John Wiley & Sons, New York.

36. Kashyap S.R. (1929) Liverworts of the Western Himalayas and the Punjab Plains Part 1, Chronica Botanica, New Delhi.
37. Kashyap S.R. (1932) Liverworts of the Western Himalayas and the Punjab Plains (Illustrated) Part 2, Chronica Botanica, New Delhi.
38. Pandey B.P. (2014) College Botany: 1 S. Chand Publications 20th Edition.
39. Parihar N.S. (1980).Bryophytes : An Introduction to Embryophyta Vol-I, Central Book Depot, Allahabad.
40. Prem Puri (1981) Bryophytes: Morphology, Growth and Differentiation. Atma Ram and Sons , New Delhi.
41. Rashid A. (1996) An Introduction to Bryophytes Vikas Publication House Pvt. Ltd. New Delhi.
42. Sambamurty A.V.S.S. (2020) A textbook of Bryophytes, pteridophyes gymnosperms & paleobotany, Dreamtech Press.
43. Smith G.M. (2019) Cryptogamic Botany, Bryphytes& Pteridophytes Vol-II 2nd Edition, Surjeet Publications.
44. Udar R. (1975) Bryology in India. Chronica Botanica, New Delhi.
45. Udar R. (1970) Introduction to Bryophytes, Shashidhar MalaviyaPrakashan, Lucknow.
46. Watson E.V. (1971) Structure and life of Bryophytes 3rd Edn. Hutchinson University Library London.
47. Vashishta B.R., Sinha A.K., Kumar A. (2008) Botany for degree students Bryophyta, S.Chands Publication

Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon
M. Sc. Botany Part - I: Semester -I

DSC- 26 Major (Core) Course [Lectures: 30] [2T]
BO-412 Molecular Biology

Course Objectives:

1. To study molecular biology about genetic material, its replication.
2. To study transcription, translation post-translation modification of a protein.
3. To study gene regulation in prokaryotes and eukaryotes.
4. The course will mainly focus on the study of principal molecular events of cell incorporating DNA Replication, Transcription and Translation in prokaryotic as well as eukaryotic organisms.

Course outcomes:

1. Understanding concept of molecular biology in detail.
2. Understand the molecular details of DNA replication in prokaryotes and eukaryotes.
3. Explain the mechanisms of protein synthesis.
4. Explain nucleic acid structure.

Unit 1	**Introduction to Molecular biology** Definition, milestones of molecular biology, scope and importance molecular biology Structure of different types of nucleic acids, hydrolysis of nucleic acids. DNA: Watson-Crick model of DNA, Chemical composition of DNA, Forms of DNA (A, B, Z), Properties of DNA & Function of DNA RNA: Definition, Structure and function of different types of RNA, Different between DNA and RNA	**6**
Unit 2	**DNA Replication:** Definition of DNA replication. Types of DNA replication Mechanism of DNA replication in Prokaryotes and Eukaryotes Models of DNA replication (Rolling circle model of replication, D-loop replication & Liner replication model) Brief note: - Okazaki Fragments, Lagging strand, Leading strand and DNA Polymerase.	**6**
Unit 3	**Unit-3 Gene & Genetic Code** 3.1 Definition, characteristics, Structure and Functions of Gene. One Gene One Enzyme hypothesis Promoter in Prokaryotes and Promoter in Eukaryotes. Definition Characteristics & properties of genetic code. Brief note: - Pribnow Box, TATA Box, Coding Sequence.	**6**
Unit 4	**Protein synthesis and processing**	**6**

	Required components for Transcription. Central dogma of molecular biology Steps of transcription (Initiation, Elongation and Termination) Inhibitors of transcription (Lac repressor, Rifampicin, Alpha amanitin, Actinomycin D & Platinum anti- tumor drugs) Mechanism of Translation (Activation of amino acid, Attachment of activation of amino acid, Imitation of polypeptide chain, Elongation of polypeptide chain & Termination of polypeptide chain)	
Unit 5	**Unit-5 Regulation of Gene Expression** Definition of gene expression Reasons for regulation of gene expression Regulation of gene expression in Prokaryotes. (Operon concept, LACOperon TRP Operon), Regulation of gene expression in Eukaryotes.	**6**

Suggested readings:

1. De Robertis and De Robertis (2005) Cell and Molecular Biology, 8thEd, Lippincott Williamand Wilkins U.S.A.4. Eldon john Gardner, Michel J. Simmons and D. Peter Snustad (1991) Princiles of genetics 8thEd . Wiley India edition, New Delhi, India.
2. Gupta, P. K. (2007) Genetics: Classical to Modern. Rastogi Publications, Meerut, India.
3. Gerald Karp (2008). Cell and Molecular biology: Concepts and experiments (V Edn). John Wiley & Sons
4. H.S. Bhamaah, 1990, Molecular cell Biology, Anmol Publication New Delhi.
5. James Jorwell, Honey Ladish, 1986. Molecular cell biology scientific American
6. Prescott, D.M.1988 Cells: Principles of Molecular structure and function. Johes and Bortlet pub. Boston.
7. S.C. Rastogi, 1995, Concepts, in Molecular Biology. Reeta Area, 1998, Cell biology, Anmol Publications, New Delhi.
8. Waston, I.D. Et. Al. 1965. Molecular, Biology of the gene. 4th Ed.
9. Karp, G. Cell and Molecular biology: Concepts and experiments (V Edn). John Wiley & Sons, 2008. Print.
10. Pal Jayanta and Saroj S. Ghaskadabi Fundamentals of Molecular Biology, Oxford Higher Education.
11. Rastogi V.B Concepts in Molecular Biology.
12. Twyman R.M (2003) (Third Reprint). Advanced Molecular Biology. Viva Books Pvt. Ltd., New Delhi.
13. https://microbenotes.com.
14. https://www.uou.ac.in/sites/default/files/slm/BSCBO-301.pdf
15. https://www.easybiologyclass.com/molecular-biology-online-tutorials-lecture-notes-study-materials/
16. https://thebiologynotes.com

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M. Sc. Botany Part - I: Semester - I

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DSC- 27 Major (Core) Course [Lectures: 60] [4T] BO-413 Taxonomy of Angiosperms		
Course Objectives: 1. To study aims, principles and methods in taxonomy. 2. To study taxonomic structure of Angiosperms. 3. To study Cronquist system of classification. 4. To study recent APG system of classification and evolutionary trends. 5. To study morphological peculiarities and biological importance of plants.		
Course outcomes: 1. Student provide with importance of classification in Angiosperms. 2. They will get the knowledge of recent system of classification in Angiosperms. 3. This course helps to make them aware of wild plants their habit and habitat from field tour. 4. Student will know biological adaption and evolutionary trends of angiosperm.		
Unit 1	**Taxonomy** 1. Aim, principles and methods in taxonomy. 2. Basic Concepts of Biosystematics and Taxonomy, Trends in biosystematics, Chemotaxonomy, Cytotaxonomy. 3. Taxonomic Tools – Floras, monographs, Herbaria, Botanical survey of India (Regional & zonal center, activity)	12
Unit 2	**System of classification** 1. Review of Pre- Darwinian and Post Darwinian classification 2. Cronquist system of classification: Introduction, principles, Outline, Merits and demerits.	12
Unit 3	**Angiosperm phylogeny group (APG)** 1. Introduction 2. Principles of APG 3. APG-III (2003) system of classification: Introduction, Comparative study with Bentham and Hooker System 4.	12
Unit 4	**Nomenclature:** 1. Introduction 2. Principles of Plant Nomenclature (I-VI) 3. Recent code of Plant Nomenclature (Schenzhen Code) a) Typification b) Author citations c) Rejection of Names d) Retention of names	12

Unit 5	**A] Biological importance and morphological peculiarities of the families.** Nepenthaceae, Orobanchaceae, Balanophoraceae, Refflesiaceae, Podostemnaceae, Orchidaceae **B]Study of evolutionary trends in taxonomy** i) Evolution of Inflorescence ii) Evolution of floral nectaries iii) Evolution of Androecium iv) Evolution of Gynoecium	12

Suggested readings:

1. Agashe SN (1995). Paleobotany, Oxford and IBH Publ. Co. Pvt. Ltd, New Delhi.
2. Briggs David (2009). Plant microevolution and Conservation in Human-influenced Ecosystems.Cambridge University Press.
3. Cook T. (1903). The Flora of Presidency of Bombay, Vol. I (Indian Reprint) Bishen Singh, Mahendra Pal Singh, Dehradun
4. Cronquist, A. (1981).An Integrated System of Classification of Flowering Plants Columbia University Press, New York
5. Cronquist, A. (1988).The Evolution and Classification of Flowering Plants (2nded.) Allen Press, U.S.A.
6. Davis, P. H. and V. H. Heywood (1991).Principles of Angiosperm Taxonomy.Today and Tomorrow Publications, New Delhi.
7. Eames A J (1961). Morphology of Angiosperms, McGraw Hill Book Co.
8. Erdtman G (1966). Pollen Morphology and Plant Taxonomy of Angiosperms (An introduction to Palynology - I), Hafner Pub. Co. London.
9. Hickey M and King C (2000). The Cambridge Illustrated Glossary of Botanical Terms. Cambridge University Press, UK.
10. Jain S. K. and Rao R. R. Handbook of Field and Herbarium Methods, Today and Tomorrow Publishers, New Delhi.
11. Jones S B and LuchingerA E (1986). Plant Systematics 2nd edn, McGraw Hill Book Co.
12. Judd et al. (2007). Plant Systematics – A phylogenetic approach. Sinauer Pub. 3rd edition
13. Judd W. S., Campbell, C. S., Kellogg, E. A., Stevens P. F. and M. J. Donoghue 2008.Plant Systematics: A phylogenetic Approach.Sunderland, Massachusetts, USA.
14. Kubitzki K (1977). Flowering Plants Evolution and Classification of Higher Categories. Plant Systematics – Evolution Supplement I.
15. Kuijt J. (1969). The biology of parasitic flowering plants. California University Press.
16. Lawrence George H. M. 195.1 Taxonomy of Vascular Plants.Oxford and IBH Publ. Co. Pvt. Ltd. New Delhi.
17. Leadlay E. and S. Jury (ed.) (2006).Taxonomy and Plant conservation.Cambridge University Press.
18. Manilal, K. S. and M. S. Muktesh Kumar [ed.] (1998).A Handbook of Taxonomic Training. DST, New Delhi.
19. Naik, V. N. (1984).Taxonomy of Angiosperms. Tata McGraw-Hill Publication Com. Ltd. New Delhi.
20. Quicke, Donald, L. J. (1993).Principles and Techniques of Contemporary Taxonomy. Blakie Academic & Professional, London
21. Radford A E (1986). Fundamentals of Plant Systematics, Harper and Row N Y.

22. Simpson M. Plant Systematics, Academic Press, 2nd edition.
23. Singh G (2004). Plant Systematics, 2nd edn, Oxford and IBH, New Delhi.
24. Sivrajan V V (1984). Introduction to Principles of Plant Taxonomy, Oxford and IBH, New Delhi.
25. Smith P M (1976). The Chemotaxonomy of Plants, Edward Arnold Pub. Ltd.
26. Sporne K R (1974). Morphology of Angiosperms, Hutchinson University Library, London.
27. Stace C A (1989). Plant Taxonomy and Biosystematics.
28. Stewart W N and Rothwell G W (2005). Paleobotany and the Evolution of Plants, 2nd edn, Cambridge University Press.
29. Subrahmanyam K. Aquatic angiosperms. BSI. India.
30. Takhtajan, A. (1962).Flowering plants- Origin and Dispersal.
31. Taylor, D. V. and L. J. Hickey (1997). Flowering Plants: Origin, Evolution and Phylogeny.CBS Publishers & Distributers, New Delhi.

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M. Sc. Botany Part - I: Semester - I

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DSC- 28 Major (Core) Course [Lectures:60] [2P] Practical – I Based on DSC-25 BO-414 Plant Systematics- I (Algae, Fungi and Bryophytes)	
Course Objective: To Study the occurrence, diversity, structural organization and reproduction of algae, fungi and bryophytes.	
Course Outcome: Students acquaint the occurrence, diversity, structural organization and reproduction of algae, fungi and bryophytes.	
Algae: (05 Practicals)	
Representative genera belonging to following Classes and orders of Algae with respect to Morphological, reproductive structures and classification with reasons according to F.E. Fritsch 1956)).	
Practical -1	**Cyanophyceae:** Any six forms.
Practical -2	**Chlorophyceae:** Any Ten forms.
Practical - 3	**Phaeophyceae:** Any Three forms.
Practical - 4	**Rhodophyceae:** Any Three forms.
Practical - 5	i. Xanthophyceae : Any Two forms. ii. Bacillariophycece- Any Four forms. iii. Euglenophyceae- Any Two forms.
Fungi: (05 Practicals)	
Representative genera belonging to following divisions and subdivisions of fungi with respect to vegetative, reproductive structures and classification with reasons according to Ainsworth et al. (1973).	
Practical - 6	**i) Myxomycota** -Any two forms **ii) Mastigomycotina**- Any two Forms
Practical -7	**Zygomycotina** - Any four forms
Practical - 8	**Ascomycotina**- Any four t forms
Practical -9	**Basidiomycotina** - Any four forms
Practical -10	**Deuteromycotina** - Any four form
Bryophytes: (05 Practicals)	
Practical: 11	Morphological, Anatomical and Reproductive studies of the following: **Hepaticeae- Marchantiales:** i) *Targionia,* ii)*, Plagiochasma*
Practical: 12	Morphological, Anatomical and Reproductive studies of the following: **Hepaticeae- Marchantiales:** i) *Asterella,* ii) *Dumortiera*
Practical:13	Morphological, Anatomical and Reproductive studies of the following: **Hepaticeae- Jungermanniales:** i)*Pellia,* ii) *Fossombronia,* iii) *Pallavicinia,*

	iv)*Porella,* v) *Frullania* **(Any Two)**
Practical: 14	Morphological, Anatomical and Reproductive studies of the following: **Anthocerotae- Anthocerotales:** i) *Anthoceros,* ii) *Notothylus*
Practical: 15	Morphological, Anatomical and Reproductive studies of the following: **Musci-Polytrichales:** i) *Polytrichum,* ii)*Pogonatum*

Note:

1. Excursion tour is compulsory to observe algae, fungi and bryophytes in nature.
2. Tour report along with photographs must be submitted at the time of practical examination.
3. Duly certified journals are compulsory at the time of practical examination.

Suggested readings:

Algae:

1. Bold, H and Wynne M.J. (1978) Algal structure and reproduction. Prentice Hall of IndiaPri.Ltd.New Delhi, India.
2. Bony, A.D. (1978) Phytoplankton.Edward Arnold Pub.Ltd. London, U.K.
3. Desikachary, T. V. (1959) *"Cyanophyta"* Indian Council of Agricultural Research, New Delhi.
4. Gandhi, H. P. (1960) The Diatom flora of the Bombay and Salsette islands. *J. Bombay Nat. Hist. Soc*
5. Gonzalves, E. A. and H. P. Gandhi (1952-54) A Systematic account of the diatoms of Bombay and Salsette-I -III. *J. Indian Bot. Soc.*
6. M.O.P. Iyengar and T. V. Desikachary (1981) Volvocales, *Indian Council of Agricultural Research, New Delhi.*
7. Philipose, M. T. (1967) Chlorococcales, *Indian Council of Agricultural Research, New Delhi*.
8. Prescott, G. W. (1966) Algae of the Western Ghat lakes area exclusive desmids and diatoms, *Bull. Cranbrook Inst. Sci.*
9. Sarode, P. T. and N. D. Kamat (1984) *Freshwater Diatoms of Maharashtra.* Saikrupa Prakashan, Aurangabad,
10. Sarma, Y. S. R. and M. Khan (1980) Algal taxonomy in India, *Today and Tomorrow, Book Agency, New Delhi*.

Fungi:

11. Ainsworth, Sussman and Sparrow (1973) The fungi. Vol IV A & IV B. Academic Press.London, U.K.
12. Alexopolous C.J., Minms C.W. and Blackwell M. (1999) (4th edn) Introductory Mycology.Willey, New York, USA.
13. Barron, G L (1968) The genera of Hyphomycetes from soil, The Williams and Wilkins Co., Baltimore.
14. Bhat, D. J.(2010)Fascinating microfungi (Hyphomycetes) of Western Ghats - India,by Broadway Book Centre Publishers & Distributors, Pungim, Goa, India.
15. Ellis, M B (1971) Dematiaceous Hyphomycetes, Comm onwealth Mycological Institute, Kew, England.UK.
16. Ellis, M B (1976)More Dematiaceous Hyphomycetesby Commonwealth Mycological Institute, Kew, England, UK.
17. Kiffer ,E & Morelet M (2000)The Deuteromycetes, Mitosporic fungi Classification and Generic Keys , New Hampshire,
18. Kirk, P M, Cannon P F, Minter D W & Stalper J A.(2008)Ainworth & Bisby's Dictionary of fungi, 10th editionby CAB International, Wallinford.
19. PandeAlaka (2008)Ascomycetes of Peninsular India, Scientific Publishers (India), Jodhpur , India
20. Rao, G. P., Manoharachary, C., Bhat, D. J., Rajak, R. C., & Lakhanpal, T. N.

(eds.)(2003) Frontiers of Fungal Diversity in India - Prof. Kamal Festschrift Volume,) International Book Distributing Co. Lucknow, India.

21. Subramanian, CV (1971)Hyphomycetes, ICAR, New Delhi,India .

Bryophytes:

22. A.Rashid (1998) An Introduction to Bryophytes Vikas Publishing house Pvt. Ltd. New Delhi, India

23. Kashyap, S.R. (1929) Liverworts of the Western Himalayas and the Punjab Plain (illustrated): Part 2. Chronica Botanica, New Delhi.

24. Parihar, N.S. (1980) Bryophytes: An introduction to Embryophyta. Vol.I Central Book Depot, Allahabad, India.

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DSC- 29 Major (Core) Course [Lectures: 60] [2P] Practical - II BO-415 Based on DSC-26 BO-412 Molecular Biology and DSC-27 BO-413 Taxonomy of Angiosperms	
Course Objective: To learns various instruments, solutions require in molecular biology laboratory, estimate nucleic acids. To study the morphological characters, floral formula, floral diagrams, classification, peculiar characters of angiosperms and to prepare artificial keys and to identify the genera and species.	
Course Outcomes: Students acquaint in various instruments, solutions require in molecular biology laboratory, estimation nucleic acids. Students understood the morphological characters, floral formula, floral diagrams, classification, peculiar characters of angiosperms and to prepare artificial keys and to identify the genera and species.	
Practical 1-5	**Study of families (Sensu: Bentham & Hooker System) w.r.t. morphological characters, floral formula, floral diagram and classification with reasons-** Ranunculaceae, Menispermaceae, Papaveraceae, Capparidaceae, Portulaceae, Sterculiaceae, Tiliaceae, Malpighiaceae, Zygophllaceae, Meliaceae, Rhamneae, Moringeae, Papilionaceae, Myrtaceae, Cucurbitaceae,Umbelliferae, Rubiaceae, Plumbagineae, Apocynaceae, Boraginaceae, Convulvulaceae, Scrophulariaceae, Bignoniaceae, Acanthaceae, Verbenaceae, Labiatae, Nyctagineae, Chenopodiaceae, Polygonaceae, Scitaminae, Amaryllideae, Liliaceae, Commelinaceae, Typhaceae, Cyperaceae, Graminae (Any 10 families from different series)
Practical 6-7	Identification of genus and species from locally available wild plants using regional and state floras (At least 20 plant species from locally available families).
Practical 8	Preparation of artificial bracketed/indented dichotomous keys based on vegetative &reproductive characters from different families, genera and species. (Specimens from different family, same family, different genera of same family, Species from same genera.)
Practical 9-10	Study of morphological and biological peculiarities of the specimens from following families. Nepenthaceae, Balanophoraceae, Podostemnaceae, Orobanchaceae, Refflesiaceae, Orchidaceae.
Practical based on BO-412 Molecular Biology	

Practical 11	Study of following instruments for principle, working and uses in molecular biology. (Laminar airflow hood, Gel electrophoresis unit, Centrifuge machine, Spectrophotometer, pH meter and Autoclave)
Practical 12-13	Preparation of solutions, buffers and reagents (Molar solution NaOH, Normal solution, Tris-HCl buffer, TE buffer, TBE buffer, Gel loading dye, 0.7% to 2.0 % Agarose). -
Practical 14	Determine DNA concentration and purity using UV- visible spectrophotometer.
Practical 15	Estimation of RNA, following the orcinol method.

Suggested Readings:

1. Kar and Halder, (2009)Cell Biology Genetics Molecular Biology; New Central Book Agency (P) Ltd. Kolkata, India.
2. Karp, G. (1999) Cells and Molecular Biology concepts and Experiments; Hohn Wiley & Sons Inc. USA.
3. S. Sadasivam amd A. Manickam (1991) New Age International Publisher.
4. Verma, Agarwal, (2005) Cell Biology, Genetics, Molecular Biology, Evolution and Ecology: S.Chand and Company , New Delhi, India.
5. Cooke, T. (1958) Flora of Presidency of Bombay Vol.I-II, Botanical Survey of India, Calcutta, India.
6. Hooker, J.D.(1872-1897) Flora of British India, Vol. I-VII, Reeves & Co., London.
7. Kamble, S.Y. and S.G. Pradhan (1988) Flora of Akola District, Maharashtra, Botanical Survey of India, Calcutta, India.
8. Kshirsagar, S.R. and D.A.Patil (2008) Flora of Jalgaon District, Maharashtra, Bishen Singh Mahendra Pal Singh, Dehra Dun, India.
9. Kulkarni, B.G. (1988) Flora of Sindhudurg, Botanical Survey of India, Calcutta, India.
10. Lakshminarasimhan, P.& B.D. Sharma (1991)Flora of NashikDistrict, Botanical Survey of India, Calcutta, India.
11. Naik, V.N. (1999) Flora of Marathwada, Vol. I-II, Amrut Prakashan, Station Road, Aurangabad, India.
12. Patil, D.A. (2003) Flora of Dhule and Nandurbar District (Maharashtra). Bishen SinghMahendra Pal Singh, Dehra Dun, India.
13. Shah, G.L. (1978) Flora of Gujarat State, Vol. 1-2, Vallabh Vidyanagar, Gujarat, India.

Note:

1. Excursion tour is compulsory to observe algae, fungi and bryophytes in nature.
2. Tour report along with photographs must be submitted at the time of practical examination.
3. Duly certified journals are compulsory at the time of practical examination.

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DSE-5 Major (Core) Course [Lectures: 60][4T] **BO-416 (A) Plant Biotechnology /** **BO-416 (B) Seed Processing Technology /** **BO-416 (C) Fermentation Technology /**		
BO-416 (A) Plant Biotechnology		
Course Objectives: 1. Imbibe the basic knowledge of different aspects of Biotechnology and tissue culture. 2. Understand the knowledge of methods in biotechnology. 3. Understand the knowledge of advanced techniques in Biotechnology biology used in study of plants.		
Course outcomes: 1. The students will be able to understand the use of biotechnology in botany. 2. The students will be able to understand the various branches of biotechnology in plant science. 3. The students will be able to know the recent biotechnology in study of plants. 4. The students will be able to know of application of genes, proteins and secondary metabolites in plant science.		
Unit 1	**Biotechnology** Basic concept and brief introduction of biotechnology, History, Scope and Importance, Commercial application of biotechnology. **Introduction to tissue culture** Principle of plant tissue culture, Tissue culture laboratory, Equipment's in Tissue culture laboratory, Preparation of Media, Media composition, Cellular totipotency Plant Growth Regulators and their Role, Different type of media, Different types of explants of, Sterilization, Different methods of sterilization -Heat, Radiation and chemical.	**10**
Unit 2	**Cell and organ culture** Plant organ culture; shoot tip, shoot apical meristem, root, leaf, embryo culture, factors influencing embryogenesis, suspension culture in stationary and stirred tank reactors, isolation of single cells and their culture, measurement of growth.	**10**
Unit 3	**Fermentation biotechnology and biomass production** History of fermentation, Methods of sterilizations, Principles of microbial growth, Alcohol fermentation, Citric acid fermentation, Antibiotic (Penicillin) fermentation, Introduction to biomass**,** Concept of SCP, its need and application, Mass culture of algae for protein.	**10**

Unit 4	**RECOMBINANT DNA TECHNOLOGY** Gene cloning, Vectors, Role of Agrobacterium, Gene cloning techniques – Gene gun, Electroporation, Microinjection, Liposome mediated gene transfer, Ultra sonication and Pollen Mediated gene transfer	**10**
Unit 5	**TRANSGENIC PLANTS** Transgenic crops in India, Resistance against Abiotic and biotic stress, improved crops productivity, Nutraceutical improved crops, transgenic plants for edible vaccine and antibodies.	**10**
Unit 6	**APPLICATIONS OF PLANT TISSUE CULTURE** Applications in agriculture and horticulture, Applications in forestry. Applications of tissue culture in pharmaceuticals industry, In situ and ex-situ conservation. In vitro mutagenesis and its application. Production of transgenic plants.	**10**

Suggested readings:

1. Henry, R.J. Practical application of plant molecular Biology, Champman and Hall
2. Kalyan kumar De. Introduction to Plant Tissue culture,
3. Bhojwani, Plant Tissue Culture.
4. Montell S.H. Mathews, J.A., Meker, R.A. Principles of Plant Biotechnology.
5. Glover, D.M. and Hanes, B.D. (eds.) 1995. DNA cloning 1: A practical approach, core techniques, 2nd edition, PAS, IRL press at Oxford University Press.
6. Plant cell culture protocols. Humana Press, Inc. New Jersey, USA.
7. Shaw, C.H. (ed.) 1998, Plant Molecular Biology. A practical approach IRI Press, Oxford.
8. Smith, R.H. 2000. Plant Tissue culture: Techniques and Experiments. Academic Press, New York.
9. Susan R. Barnum (1998). Biotechnology: an introduction. Thomson Brooks/cole.
10. George Acquaah (2005). Understanding biotechnology. Pearson.
11. Biotechnology; P.K. Gupta
12. B. D. Singh (2006) Plant Biotechnology, Kalyani Publishers

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M. Sc. Botany Part - I: Semester - I

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DSE-5 Major (Core) Course [Lectures: 60][4T]
BO-416 (B) Seed Processing Technology

Course Objectives:

1. Student will gain expertise in the field of seed science & technology.
2. To impart knowledge on the principles and techniques of seed processing for quality up gradation and of storage for maintenance of seed quality.

Course outcomes:

1. Students will be able to believe the role of good quality seed in agriculture.
2. Students will be able to grasp the significance of basic principles of seed production in crop plants.
3. Students will be able to build private seed farms.
4. Students will be able to impart knowledge about various tools involved in hybrid seed production of crop plants.

Unit 1	**Introduction:** Principles of seed processing; methods of seed drying including dehumidification and its impact on seed quality. Relative humidity and equilibrium moisture content of seed; Thumb rules of seed storage; loss of viability in important agricultural and horticultural crops, viability equations and application of monograph.	**12**
Unit 2	**Seed cleaning equipment and their functions:** Preparing seed for processing; functions of scalper debearder, scarifier, huller, seed cleaner and grader. Screen cleaners, specific gravity separator, indented cylinder, velvet-spiral-disc separators, colour sorter, delinting machines; seed blending.	**12**
Unit 3	Assembly line of processing and storage, receiving, elevating and conveying equipments, plant design and layout, requirements and economic feasibility of seed processing plant.	**12**
Unit 4	Seed treatments-methods of seed treatment, seed treating formulations and equipment, seed dis-infestations, identification of treated seeds; Packaging: principles, practices and materials; bagging and labeling. Seed storage: Seed drying and storage; drying methods-importance and factors affecting it, changes during storage, concepts and significance of moisture equilibrium, methods of maintaining safe seed moisture content. Methods to minimize the loss of seed vigour and viability; factors influencing storage losses. Storage methods and godown sanitation. Storage structures. Storage problems of recalcitrant seeds and their conservation.	**12**

Unit 5	Concept of seed ageing and deterioration, its causes, symptoms, mechanisms and related theories; different changes associated with the loss of vigour and viability during storage; application of physiological and biochemical techniques for evaluation of seed ageing; genetics of seed viability; effect of seed ageing on crop performance; maintenance of viability and vigour during storage; seed amelioration techniques, mid storage corrections etc.	**12**

Suggested readings:

1. Arora, S.K. Hariyana Men Subjion ki Utpadan Prodhyokiki. Scientific Pub. India. B.P.
2. Ghildyal and R.P. Gupta, 2002. Soil Structure: problems and Management, ICAR, New Delhi.
3. Bassett, M.J. (1986) Breeding vegetable crops. AVI Publishing Comp.
4. Dennis R. Decoteau (2000) Vegetable Crops. Prentice Hall.
5. Desai BB, Katecha, PM & Salunke DK.1997. Seed Hand Book: Biology, Production, Processing and Storage.
6. Marcel Dekker. Desai BB. 2004. Seeds Handbook. Marcel Dekker.
7. George RAT. 1980. Vegetable Seed Technology. A Technical Guide to Vegetable Seed Production, Processing, Storage and Quality Control. FAO, Rome.
8. Harihar Ram. (1997). Vegetable Breeding; Principles and Practices.
9. Jagminder Hartman HT & Kester DE. 2000. Plant Propagation: Principles and Practices.
10. Prentice Hall. Inns, N.L. (1983). Breeding field vegetables, Asian vegetable Research and Development Centre.
11. Tainan...Taiwan ISTA (1983). Seed Technology in the tropic. The International Seed Testing Association, reprinted by Scientific Publishers, India
12. Kelly AF & George RAT. (Eds.).1998. Encyclopedia of Seed Production of World Crops. John Wiley & Sons.
13. Jeswani, L.M. and Baldev, B. (1997). Advances in pulse production technology, ICAR, New Delhi.
14. McDonald MB Jr & Copeland LO. 1997. Seed Production of Crops: Principles and Practices. Chapman & Hall.
15. Miller, B. McDonald and Lawrence O. Copeland, (1998). Seed Production: Principles and Practices. CBS publishers and distributors, 11 Darya Ganj, New Delhi.
16. Mini, C. and Krishnakumary, K. (2004). Leaf Vegetables: Agrotech Publishing Academy, Sector-5, Hiran magri, Udaipur.
17. Prem Singh Arya, (2000) Off-Season Vegetable Growing In Hills. A.P.H. Publishing Corporation, 5-Ansari Road, Daryaganj, New Delhi.
18. Salunkhe DK, Desai BB & Bhat RN. 1987. Vegetable and Flower Seed Production. Agricole Publ. Academy.
19. Singh SP. 2001. Seed Production of Commercial Vegetables. Agrotech.
20. Suman Bhati and Uma Verma (1997). Fruits and vegetable processing. CBS. Publ. Book Agency. New Delhi Work.
21. Paul (1997). Vegetable production and marketing. Daya Publ. House, Devram.

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M. Sc. Botany Part - I: Semester - I

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DSE-5 Major (Core) Course [Lectures: 60][4T]
BO-416 (C) Fermentation Technology

Course Objectives:

After completion of this course, student will be able to understand

1. The aim of fermentation technology course is to know current bio-resources and their exploitations on the production of microbial products.
2. The main objective of this course is to train students practically in basic principles of food and industrial microbiology.
3. Design of various reactors used in Industries.
4. Criteria for selection of media for microbial growth and Methods for strain improvement and preservation of cultures.
5. Upstream as well as downstream processing involved in fermentation industries
6. The content of the precise course include nature of the bio-resources, industrially important microorganisms, up and down stream process, functions of the fomenters, primary and secondary metabolites and production of recombinant products.

Course outcomes:

After completion of this course the student can able to

1. Understand the basics of microbial metabolites in industry and its economic importance.
2. Apply the knowledge of molecular biology and microbial genetics to develop industrially important microorganism.
3. The course will also provide meticulous ideas on different types of fermentors and their functions.
4. Use the most common equipment, materials and methods related to fermentation processes, microbial growth and cultivation and sterilization.

Unit 1	**Introduction to Fermentation Technology:** History, Scope and Development of Fermentation technology, Introduction to fermentation processes, industrially important microorganisms-Isolation, screening, and preservation of industrially important microorganisms.	**15**
Unit 2	**Fermentation raw materials:** Media for industrial fermentation, Criteria used in media formulation, sterilization, raw materials and process control. Downstream processing- Separation processes and recovery methods for fermentation products.	**15**
Unit 3	**Strain Improvement:** Natural selection, mutation and screening of improved cultures, random and strategic screening methods, Use of recombinant DNA technology, protoplast fusion etc. Principles of overproduction of primary and secondary metabolites with relevant examples.	**15**
Unit 4	**Fermentor design:**Basic designs of Fermentor; Type of fermentors: Waldhof, Tower, Deepjet, Cyclone column, Packed tower and airlift fermenter; Scale up study and Product development; Down-stream processing and Product recovery; Regulation and safety.	**15**

Suggested readings:

1. Stanbury, P.F., Hall, S., Whitaker, A. (1998), Principles of Fermentation Technology, 2ndedn. Butterworth-Heinemann Ltd.
2. Ward O.P., (1999), Fermentation Biotechnology – Principles, Process and Products. Prentice Hall Publishing, New Jersey.
3. Rehm, H.J., Reed, G.B., Puehler, A. and Stadler (1993), Biotechnology, Vol. 1-8, VCH Publication.
4. Prescott, S.C.and Dunn,G.C (1992), Industrial Microbiology, 4 th Edition CBS Publication, New Delhi.
5. Demain, A. I. and Davies, J. E. (1999) Manual of Industrial Microbiology and Biotechnology, 2 nd Edition, ASM Press, Washington D.C.
6. Glazer and Nikaido (1998) Microbial Biotechnology By WH Freeman & Company, New York.
7. Cruger,W. and Kruger. (2002), Biotechnology –A Textbook of Industrial Microbiology, 2 nd Edition, Panima Publishing Corporation, New Delhi.
8. Mansi, E.I., Bryce, T and Francis, (1999). Fermentation Microbiology and Biotechnology. London, Philadelphia.
9. Crueger, W., and Crueger, A., (2000). Biotechnology: A Text Book of Industrial Microbiology, Panima Publishing Corporation, New Delhi/Bangalore.
10. Okafer, N., (2007). Modern Industrial Microbiology & Biotechnology. Scientific Publishers, Enfield, USA.

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M. Sc. Botany Part - I: Semester - I

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RM-417 Research Methodology [Lectures: 60] [4T]

Course Objectives:

To make the students familiar with the,

1. To learn the basics of science, scientific research its importance.
2. To learn the Ethics and plagiarism precautions to be taken while doing research.
3. To understand the detailed referencing and literature review procedure before beginning the research.
4. To understand the process of writing research papers, research project report and research proposal.
5. To learn various advanced tools useful for the science and aware about the laboratory safety

Course outcomes:

On completion of this course, the students will be able to:

1. Students will understand the basic concept of science and scientific research.
2. Learn and follow the ethical guidelines while doing research avoid plagiarism in research publications.
3. Able to write a comprehensive literature review on a given research topic.
4. To able to write a crisp research proposal or research project independently.
5. To learn most advanced chemistry tools for the efficient research work.
6. Acquire knowledge about various hazardous chemical handling procedures and implement it while working in the laboratory.

Unit	Course Contents (Topics and subtopics)	Letures
Unit 1	**Science and Scientific Research** What is Science? Characteristics of Science, Technology and techno-science, Meaning of Research, Characteristics and types of research, Importance of research activities, Principles of quality research work, Problems in research, Scientific attitude and temper, Qualities of good researcher, Scientific community, Non-science and Pseudoscience, Scientific realism.	**12**
	Ref. 1: 1-24 and 49-54; Ref. 2: 1-71; Ref. 3: 1-21.	
Unit 2	**Design and Criteria of Scientific Research** Introduction, Research planning and design, Selection of research topic, Criteria for good research problem, Source of research Idea, Principles of good research, Criteria of good research, Guidelines for research skill and awareness, Research validity and reliability, Artefact and bias in research. **Scientific methodology:** Rules and principles of scientific methods, Research methods versus methodology, Hypothesis and testing of hypothesis. **Research ethics:** Principles and values. **Plagiarism:** its types and how to avoid it.	**12**

	Ref. 1: Pages: 1-24, 55-92 and 233-262; Ref. 3: 24-52.	
Unit 3	**Literature Survey:** Literature review, Approaching the literature, Scholarly literature, Data provenance and evaluation, Intellectual property. **Sources of information:** Primary, Secondary, Tertiary sources, Patents, Journals (Print and e-journal),Type of Journals, Conference Proceedings. Journal Impact Factor, Citation index, h-index. **Understanding of literature**: Reading A Scientific Paper, Abstracts, Current titles, Reviews, Monographs, Books, Current contents, Cross referencing, Indian patent database. **Tools for Digital Literature Survey:** Scientific databases, e-journals, INFLIBNET, Shodsindhu, Shodhganga, Google/Google Scholar, ResearchGate, PubMed, finding and citing Information.	**10**
	Ref. 1: 148-180; Ref. 4: 299-317; Ref. 5: 1569-1603	
Unit 4	**Scientific Writing:** Introduction to scientific writing, writing science laboratory Notebook. **Writing Research Paper:** Title, Abstracts, Keywords, Introduction, Material and Methods, Results and discussion, Conclusion, Acknowledgement, References and Supplementary data. Difference between research communication and Review article, Reply to Referee comments for science research paper. Preparation of Poster and Oral Presentation. **Writing Proposals:** Research grant and its various components	**12**
	Ref. 1: 180-229; Ref. 6: 29-43; Ref. 7: Relevant Pages	
Unit 5	**Advanced Scientific Tools and Laboratory Safety** A) **Advanced Tools:** Tools for citing and referencing: Mendeley, Zotero, Endnote etc. Styles of referencing: Referencing from reputed publishing houses National and International. Online searching Databases: Sci Finder, Scopus, Web of Science, ACM Digital Library, Pro Quest Biological Sciences (All the databases only introduction). B) **Laboratory Safety:** Laboratory safety, Laboratory manual, Lab as a safe place: habits, Cause of accidents and What to do in case of an accident, Personal protective equipment, Emergency equipment for general purpose.Laboratory ventilation. C) **Introduction to Intellectual Property:** Introduction, Role of IP in the economic and cultural development of the Society, IP Governance, IP as a Global Indicator of Innovation, Origin of IP, History of IP in India (Introduction: Patents, Copyrights and Related Rights,Trademarks, Geographical Indications, Trade Secrets, Semiconductor Integrated Circuits and Designation, Plant Varieties, Traditional Knowledge, Industrial Designs, Biodiversity Conservation). Categories of Intellectual Property, Conditions for Obtaining a Patent Protection	**12**
	Ref. 8, and9: Relevant Pages, Ref. 10: 1-44 and Relevant Pages Ref. 11 onwards: Relevant Pages and Links	

Suggested readings:

1. New Delhi – 110002, (2019).
2. Research Methodology: The Aims, Practices and Ethics of Science, Peter Pruzan,Springer International Publishing (2016).
3. Research Methodology: Methods and Techniques, 3rdedition, Kothari, C.R. Published by New Age International (P) Ltd., Publishers (2004).
4. Teaching to Avoid PlagiarismHow To Promote Good Source, Diane Pecorari, Use-Open University Press (2013).
5. APPENDIX A: The Literature of Organic Chemistry March'sAdvanced Organic Chemistry: Reactions, Mechanisms, and Structure, Seventh Edition, by Michael B. Smith and Jerry March Copyright John Wiley & Sons, Inc. (2013).
6. Joaquín Isac-García, José A. Dobado, Francisco G. Calvo-Flores, Henar Martínez-García - Experimental Organic Chemistry laboratory manual, Academic Press (2016)
7. A Practical Guide to Scientific Writing in Chemistry Scientific Papers, Research Grants and Book Proposals Tyowua, A. T., CRC Press is an imprint of Taylor & Francis Group, LLC (2023).
8. Chemical Information for Chemists: A Primer, edited by Currano, J. N., Roth, D. L. Publisher The Royal Society of Chemistry (2014).
9. Handbook of Safety in Science Laboratories Education Bureau Kowloon Tong Education Services Centre, Hong Kong (2013).
10. Intellectual Property A Primer for Academia,Tewari, R., Bhardwaj, M.Publication Bureau, Panjab University, Chandigarh, © Panjab University, Chandigarh, ISBN: 81-85322-92-9, (2021).
11. A Manual for Referencing Styles in Research, M. H. Alvi (2016)
12. https://academic.oup.com/pages/authoring/books/preparing-yourmanuscript/referencing-styles
13. https://revvitysignals.com/products/research/chemdraw
14. LaTeX Beginner's Guide, Stefan Kottwitz, Packt Publishing, http://static.latexstudio.net/wpcontent/uploads/2015/03/LaTeX_Beginners_Guide.pdf
15. Falagas, M.E., Pitsouni, E.I., Malietzis, G.A. and Pappas, G. (2008), Comparison of PubMed, Scopus, Web of Science, and Google Scholar: strengths and weaknesses. The FASEB Journal, 22: 338-342. https://doi.org/10.1096/fj.07- 9492LSF
16. Plagiarism, Citation and Referencing: Issues and Styles, A Manual for Referencing Styles in Research, Mohsin Hassan Alvi, DOI: 10.13140/RG.2.1.5149.6408 http://bit.ly/46nFwYi
17. Citation tools: Easing up the researchers' efforts, Dhiraj Kumar, Gyankosh: The Journal of Lib. & Info. Management Vol 4 No. 2 Jul-Dec, 2013
18. Citation Management:How to use citation managers such as End Noteand Zotero. URL:https://guides.lib.uchicago.edu/citationmanagement/
19. https://pubs.acs.org/doi/full/10.1021/acsguide.40303
20. https://edu.rsc.org/resources/how-to-reference-using-the-rsc-style/1664.article
21. https://www.springer.com/gp/authors-editors/journal-author/journal-authorhelpdesk/preparation/1276
22. https://service.elsevier.com/app/answers/detail/a_id/28224/supporthub/publishing/
23. End Note: A comprehensive guide to the reference management software EndNote. URL: https://aut.ac.nz.libguides.com/endnote
24. Zotero: Learn how to use the reference management software Zotero. URL: https://aut.ac.nz.libguides.com/zotero
25. Mendeley: Learn how to use the reference management programme Mendeley. URL: https://aut.ac.nz.libguides.com/mendeley
26. Grammarly User Guide, https://bpbapse2.wpmucdn.com/blogs.auckland.ac.nz/dist/3/316/files/2020/02/Gr ammarly-Manual-Feb-2020-1.pdf

27. Online Resources: Publishers, Chemical Societies, Electronic Journals etc.: https://www-jmg.ch.cam.ac.uk/data/c2k/cj /
28. https://scholar.google.com/
29. https://shodhganga.inflibnet.ac.in/
30. https://patents.google.com/
31. https://ipindia.gov.in/history-of-indian-patent-system.htm
32. https://www.cas.org/about-us
https://clarivate.com/products/scientific-and-academic-research/researchdiscovery-and-workflow-solutions/webofscience-platform/
https://www.mendeley.com/guides

Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon
MSc. Botany Part - I: Semester -I & II

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Programme at a Glance

Syllabus for M. Sc. Botany

Board of Studies in Botany

Program at a Glance

Name of the program (Degree)	: M. Sc. Botany
Faculty	: Science and Technology
Duration of the Program	: Two years (four semesters)
Medium of Instruction and Examination	: English
Exam Pattern	: 60: 40 (60 marks University exam and 40 marks continuous internal assessment)
Passing standards	: 40% in each exam separately (Separate head of passing)
Evaluation mode	: NEP 2020
Credits of the program	88

Semester – IInd

DSC-30 [4T]	BO-421	Plant Systematics- II (Pteridophytes, Gymnosperms and Paleobotany)	60 L
DSC-31 [2T]	BO-422	Genetics	30 L
DSC-32 [4T]	BO-423	Plant Physiology	60 L
DSC-33 [2P]	BO-424	Practical based on DSC-30	30 L
DSC-34 [2P]	BO-425	Practical based on DSC-31 & 32	30 L
DSE-6 [4T]	BO-426 (A) BO-426 (B) BO-426 (C)	Techniques in Plant Science Plant Ecology and Phytogeography Agricultural Botany	60 L
OJT [4T]	BO-427	On Job Training	60 L

Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon

M. Sc. Botany Part - I: Semester - II

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DSC- 30 Major (Core) Course [Lectures: 60] [4T] **BO-421 Plant Systematics- I** **(Pteridophytes, Gymnosperms and Paleobotany)**		
Course Objectives: 1. Describe habit and habitat of pteridophytes, their characteristics and classification. 2. Relate telome theory with the origin of higher pteridophytes from the lower Pteridophytes and Gymnosperms. 3. Describe stelar variation and evolution of stele in pteridophytes. 4. Understand the phenomenon of heterospory in Pteridophytes and its significance. 5. Explain life-cycle in Pteridophytes ang Gymnosperms.		
Course outcomes: 1. The students develop the basic understanding of important characteristics, anatomy, reproduction and evolution along with economic importance of these groups.		
Unit 1	**Introduction of Pteridophytes** A) General characteristics, Habitat, Reproduction(Vegetative & Asexual), Sporophyte, Gametophyte (Sexual reproductive phase),Fertilization & Zygote formation, Embryo development, Life cycles (Homosporous &Heterosporous), Apogamy & Apospory B) Classification of Pteridophytes Classification of Pteridophytes up to orders proposed by Reimers (1954) C) Economic Importance D) Soral Evolution **Gymnosperms** E) Introduction, General Characters, Distinguishing features of Gymnosperms. F) Outline system of classification of Gymnosperms by Sporne (1965) G) Economic importance	**09**
Unit 2	**Distinguishing features, morphology, anatomy, reproduction, phylogeny, evolutionary tendencies and affinities of following orders:** i) Lycopodiales ii) Isoeatales iii) Ophioglossales iv) Osmundales v) Filicales (at least 2 families)	**15**
Unit 3	**General characters, morphology, anatomy, sporogenesis, gametogenesis, embryology, affinities, evolutionary trends and phylogeny of following orders.**	**12**

	i) Ginkgoles ii) Coniferales iii) Gnetales (Except *Gnetum*)	
Unit 4	**Paleobotany** A) Introduction, Scope and importance B) Applied aspect of Paleobotany C) Techniques for fossil study, Ground thin section, Peel method, Maceration, Indian fossil flora from Upper and Lower Gondwana	**12**
Unit 5	**Study of distinctive fossil genera along with their external, internal features of following orders** *i)* **Psilophytales:** *Rhynia,* ii) **Lepidodendrales:** *Lepidodendron* (complete reconstruction), *iii)* **Calamitales:** *Calamites, Annularia, Calamostachys, Paleostachya* *iv)* **Sphenophyllales:** *Sphenophyllum,* *v)* **Hydropteridineae:** *Rodeitesdakshinii* *vi)* **Pteridospermales:** *Lyginopteris oldhamia* (Stem), I *Glossopteris, Vertebraria, Scutum* *vii)* **Bennettitales:** *Williamsonia sewardiana, W. spectabilis* viii) **Pentoxylales:** *Pentoxylon sahnii*(reconstruction) ix) **Cordaitales:** *Cordaites* (Stem) *x)* **Fossil Angiosperms: Monocot**: *Palmoxylon, Cyclanthodendron, Tricoccites* *xi)* **Fossils of Dicot:** *Sahnipushpam, Sahnianthus, Enigmocarpon*	**12**

Suggested readings:

1. Andrews, H.N. (1961) Studies in Paleobotany, New York,London.
2. Arnold, C.A. (1947) An Introduction to Paleobotany McGraw Hill Co., NewYork, USA.
3. Banks, H.P. (1970) Evolution and plants of the PasT. McMillan Press Ltd.London,U.K.
4. Bierhorst, D.W. (1971) Morphology of vascular plants Mcmillan Co. New York
5. Bhatnagar, S. P. and Alok Moitra (1996) Gymnosperms, New Age International (P)Limited, Publishers, New Delhi.
6. Chamberlain, C.J. (1935) Gymnosperms: Structure And Evolution. Dover publ.INC.,New York,
7. Eames, A.J. (1974) Morphology of vascular plants Mc. Grow Hill PublicationCo. New Delhi.
8. Foster, A.S. & Gifford E.M. (1959) Comparative morphology of vascularplants San Francisco.
9. Ganguli, H.C. and Kar A. K. (2001) College Botany Vol. II Book and allied Press.Ltd. Calcutta, India.
10. Ganguly & Kar (2011) College Botany Vol-II New Central Book AgencyPvt. Ltd. 4 th edition.
11. John Waltan (1953) Introduction to Study of fossil Plants. Adam andCharles Block, London, UK.
12. Maheshwari, P and R.R. Konar (1971) Pinus CSIR New Delhi, India.

13. Pande B. P. (1994) GymnospermsS. Hand and Co. New Delhi, India.
14. Pandey B.P. (2010) College Botany Vol-2: v. IIS. Chand & Company, 2 nd edition
15. Parihar N.S. (1977) Biology & Morphology of Pteridophytes Centralbook Depot. Allahabad.
16. Parihar N.S. (2019) An Introduction to Embryophyta, Pteridophytes, Surjeetpublication 5 th edition.
17. Pant D. D. (1973) Cycas and the Cycadales Central Book Depot, Allahabad, India.
18. Rashid A. (1999) An Introduction to Pteridophyta, South Asia Books, II edition.
19. Saxena and Sarabhai, R. M. (1972) Text Book of Botany, Vol. II,
20. Sharma O.P. (2017) Pteridophyta Mc. Grow Hill Education.
21. Seward,A.C.(1969) Fossil Plants Vol.I to IV, Hafner Publ. Co. New York, USA.
22. Shukla, A. C. and S.P. Misra (1982) Essentials of Palaeobotany Vikas Publishing House Pvt. Ltd. Delhi, India.
23. Siddiqui, K.A.(2002) Elements of Paleobotany Kitab Mahal,Allahabad
24. Sporne K.R. (1966) Morphology of Pteridophyta Hutchinson Univ. Library London.
25. Sporne K.R. (1967) Morphology of Gymnosperms Hutchinson Univ. Library, London, UK.
26. Surange K.R. (1966) Indian Fossil Pteridophytes CSIR, New Delhi, India.
27. Vasishtha, P. C. (1983) Botany for Degree Students Vol V Gymnosperms S. Chand & Co. New Delhi, India.
28. Vashishta P.C., Sinha A.K., Anil Kumar (2010) Pteridophyta, S Chand and Company Wilson N. Stewart and Gar W. Rothwell (1993) Paleobotany and Evolution of Plants-II. Cambridge Univ. Press. Cambridge.

Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon

M. Sc. Botany Part - I: Semester - II

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DSC- 31 Major (Core) Course [Lectures: 30] [2T]
BO-422 Genetics

Course Objectives:

1. To build knowledge on the fundamentals of genetics, heredity, or inheritance.
2. To present selected challenges and issues currently facing genetics research and communities.
3. To use the principles of chromosome transmission to predict patterns of inheritance.
4. To understand how the structure of DNA enables it to function as genetic material and explain the relationship between genotype and phenotype.
5. To understand extrachromosomal involvement in heredity
6. To understand chromosomes and their role in microbes and higher organisms.

Course outcomes:

1. Learn about the development of genetics historically and how a fully formed idea of genetics was introduced.
2. Study the inheritance laws that apply to higher and microbial organisms.
3. Learn about the different gene interactions and their effects.
4. Become familiar with the basics of extrachromosomal inheritance.
5. Inform experts about the concepts, theories, issues, and research findings related to the genetics framework's questions.

Unit 1	**Introduction:**Principles of Genetic sand History of Genetics **Mendelian principles:** Dominance, independent assortment,segregation. **Extensions of Mendelian principles:** Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex-limited, and sex-influenced characters. **Concept of a gene:** Pseudo allele, Allele, multiple alleles, complementation tests.	**6**
Unit 2	**Cytogenetics:** Physical Basis of Inheritance, Special types of Chromosomes, Sex Linkage, Extra Chromosomal Inheritance, Chromosomal aberrations **Mutation:** Types, causes, and detection, mutant types – lethal, conditional, biochemical, loss of function, the gain of function, germinal vs somatic mutants, insertional mutagenesis.	**6**
Unit 3	**Structural and numerical alterations of chromosomes:** Deletion, duplication, ploidy, inversion, translocation, and their genetic implications. **Gene mapping methods** Linkage maps, tetrad analysis, mapping with	**6**

	molecular markers.	
Unit 4	**4.1 Microbial genetics:** Methods of genetic transfer transformation, mapping genes by interrupted mating, conjugation, transduction and sex-duction, fine structure analysis of genes.	**6**
Unit 5	**Extrachromosomal inheritance:** Inheritance of Mitochondrial and chloroplast genes, maternal inheritance. **Quantitative genetics:** Polygenic inheritance, heritability, and its measurements, QTL mapping. **Recombination:** Homologous and non-homologous recombination, including transposition.	**6**

Suggested readings:

1 Benjamin A. Pierce (2010) Genetics: A conceptual approach, Fourth edition, Publisher W H Freeman & Co.

2 Benjamin Lewin (2009) Genes– VI, VII, VIII and IX; Oxford, Univ. Press, USA.

3 D. Peter Snustad, Michael J. Simmons (2015). Principles of Genetics, 7th Edition. Publisher John Wiley & Sons.

4 De Robertis and De Robertis (2005) Cell and Molecular Biology, 8thEd, Lippincott William and Wilkins U.S.A.

5 Eldon John Gardner, Michel J. Simmons and D. Peter Snustad (1991) Principles of genetics 8th Ed. Wiley India edition, New Delhi, India.

6 Gerald Karp (2008). *Cell and Molecular biology: Concepts and experiments* (V Edn). John Wiley & Sons

7 Gupta, P. K. (2007) Genetics: Classical to Modern. Rastogi Publications, Meerut, India.

8 Hartl D L and Jones E W (1998) Genetics Principles and Analysis; (4thed.). Jones and Barflett Publishers, USA.

9 Harvey Lodish, Arnold Berk, Lawrence Zipursky, Paul Matsudaira, David Baltimore, James Darnell (2000). *Molecular cell biology* (IV Edn). W H Freeman & Company.

10 Hexter W and Yost Jr. H T., (1977) The Science of Genetics; Prentice Hall of IndiaPvt. Ltd., New Delhi, India.

11 Kar and Halder, (2009) Cell Biology Genetics Molecular Biology; New Central Book Agency (P) Ltd. Kolkata, India.

12 Karp, G. (1999) Cells and Molecular Biology concepts and Experiments; HohnWiley& Sons Inc. USA.

13 Phundan Singh, (1996) Essentials of Plant Breeding; Kalyani publication, New Delhi India.

14 Powar, C. B (2003) Genetics I & II Himalaya Publishing House, Nagpur, India.

15 Powar, C. B. (1992) Cell Biology, Himalaya Publishing House Nagpur, India.

16 Russel, P.J. (1998) Genetics (5th edition); The Benjamin/ Cummings Publishing Company Inc., USA.

17 Swanson, C. P. T. Merz, and W.J. Young (1982) Cytogenetics; Prentice Hall of India Pvt. Ltd., New Delhi, India.

18 Verma, Agarwal, (2005) Cell Biology, Genetics, Molecular Biology, Evolution and ecology: S. Chand and Company, New Delhi, India.

Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon

M. Sc. Botany Part - I : Semester - II

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DSC- 32 Major (Core) Course [Lectures: 60] [4T] **BO- 423 Plant Physiology**		
Course Objectives: The learner will 1. Understand the basics of plant physiology. 2. Understand the metabolic processes essential in plants. 3. Understand the implementation of knowledge in plant physiology in the field of research. 4. Know the applications of plant physiology in sustaining agriculture and natural plant diversity.		
Course outcomes: The learner should be able to 1. Understand and apply the knowledge of the basics of plant physiology. 2. Understand the various branches of plant physiology. 3. Know the recent trends in plant physiology. 4. Know of application of plant metabolism regulators in agriculture and allied fields.		
Unit 1	**Introduction** Introduction, Scope and Importance of Plant Physiology Introduction to Biological Oxidation and Reduction a) Oxidation and Reduction b) Redox reactions in Biological system c) Oxidation- reduction potential and its measurement d) Biologically important Redox Systems	**12**
Unit 2	**Photosynthesis** Introduction and Definition Photosynthetic Pigments and their role, photosynthesis apparatus Mechanism of photosynthesis a) Light Reaction- Two pigment system, Red-Drop and Emerson Effect b) Dark Reaction- Calvin Cycle, CAM Pathway c) HSK Pathway d) Chemosynthesis	**12**
Unit 3	**UNIT. 3 Respiration** Introduction and Definition Mechanism of Respiration a) Glycolysis b) Kreb's Cycle c) Cyanide resistant pathway	**12**

Unit 4	**Fat Metabolism** Introduction a) Synthesis of fatty acids and glycerol b) Condensation of fatty acids and glycerol c) α- and β oxidation d) Glyoxylate cycle (C 2 Cycle)	**12**
Unit 5	**Dormancy and Seed Germination and Stress Physiology** Dormancy- Introduction a) Causes of seed dormancy b) Mechanism of seed dormancy c) Methods of breaking of seed dormancy Stress- Introduction a) Water stress- Water, Cold and Salt stress b) Temperature stress- High and Low	**12**

Suggested readings:

1. Amarsingh (1977) Practical Plant Physiology. Kalyani Publishers, New Dehli,India.
2. Anand, B. K. & S. K. Manchanda (1976) Text Book of Physiology. Tata McGraw Hill Publications Co. Ltd, Dehli, India.
3. Arditt, J. (1969) Experimental Plant Physiology, Holt Rinehrt& Winston Inc, NewYork.
4. Bidwell, R. G. (1979) Plant Physiology. McMillan Publishing Co. Inc. NewYork.
5. Bonner, J. and J. E. Varner (Eds.) (1976) Plant Biochemistry 3 rdEds.AcademicPressLondon, UK.
6. Buchanan B. B., Gruissem W. and Jones R. L. (2000), Biochemistry and Molecular Biology ofPlants, American Society of Plant Physiologists, Maryland, USA.
7. Con, E. F. and P. F. Stumpf (1976) Outlines of Biochemistry Wiley EasternLtd., New Dehli, India.
8. De. Robertis, E. D. P. and De Robertis, E. M. T. (1987) Cell andMolecular Biology. VIII Eds. Lea & Febiger International Edition Info -Med.Hongkong.
9. Deb, A. C. (2004) Viva & Practical Biochemistry. New Central BookAgency, Kolkata, India.
10. Delvin, R. M. and F. H Whittam (1986) Plant Physiology IV eds. CBS Publishers & Distributors, New Delhi, India.
11. Grewal, R. C. (2000) Plant Physiology. Campus Books International, DaryaGanj, New Delhi, India.
12. Hess, D. (1975) Plant Physiology. Narosa Publishing House, New Delhi, India.
13. Hill, R. & C. P. Whittingham (1957) Photosynthesis. London, UK.
14. Hopkins, W. G. (1995) Introduction to Plant Physiology. John Wiley & Sons,New Jersey, USA.
15. Jain J. L., Sunjay Jain and Nitin Jain (2008), Fundamentals of Biochemistry, S. Chand &Co Ltd.
16. Keith Wilson, John M Walker and Andreas Hofmann; Samuel Clokie(2018) Wilson and Walkers principles and techniques of biochemistry andmolecular biology Cambridge, United Kingdom ; New York, NY :Cambridge University Press.

17. Mehta, S. L. Lodha, M. L. and P.V. Sane (Eds.) (1989) Recentadvances in PlantBiochemistry. Pub. ICAR, New Delhi, India.
18. Mukherji, S. and A. K. Ghosh (2005) Plant Physiology. New CentralBook Agency Kolkata, India.
19. Nobel, P. S. (1999) Physio-chemical and Environmental Plant Physiology (II Eds.)Academic Press, Sandiago, USA.
20. Noggle, G. R. & G. J. Frtiz (1982) Introductory Plant Physiology.Prentice Hall of India New Delhi, India.
21. Taiz, L., Zeiger, P. E. E., Mller, P. E. I. M., & Murphy, P. A. C.A. (2018).Fundamentals of plant physiology. Sinauer Associates.

Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon

M. Sc. Botany Part-I: Semester-II

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DSC-33 Practical – I: [Lectures: 60] [2P] **BO- 424 Based on DSC -30 BO-421: Plant Systematics - II** **(Pteridophytes, Gymnosperms and Paleobotany)**	
Course Objective: To Study the occurrence, diversity, structural organization and reproduction of pteridophytes and gymnosperms To learns the types of plant fossils with their age, type of fossilization, classification, structural organization.	
Course Outcome: Students acquaint the occurrence, diversity, structural organization and reproduction of pteridophytes and gymnosperms. Students understood types of plant fossils with their age, type of fossilization, classification, structural organization.	
Practical 1	Study of External Morphology and Anatomical features (double stained preparation) of the following (with the help of material/specimen/P.S.) **Class: Lycopsida:** *Lycopodium* (Eligulate)
Practical 2	Study of External Morphology and Anatomical features (double stained preparation) of the following (with the help of material/specimen/P.S.) **Class: Lycopsida:** *Isoetes* (Ligulate)
Practical 3	Study of External Morphology of reproductive structures of the following (with the help of material/specimen/P.S.) **Class: Pteropsida:** *Ophioglossum*
Practical 4	Study of External Morphology of reproductive structures of the following (with the help of material/specimen/P.S.) **Class: Pteropsida:** *Osmunda*
Practical 5	Study of External Morphology of reproductive structures of the following (with the help of material/specimen/P.S.) **Class: Pteropsida:** i) *Gleichenia,* ii) *Lygodium,* iii) *Pteris,* iv) *Adiantum* **(Any Two)**
Practical 6-7	Study of External Morphology, wood anatomical features (double stained preparation) by taking T.S., T.L.S. and R.L.S. of **any four** of the following: i)*Pinus,* ii)*Thuja,* iii)*Cedrus,* iv)*Cupressus,* v)*Araucaria,* vi)*Agathis,* vii)*Podocarpus,* viii)*Cryptomeria,* ix) *Juniperus*
Practical 8	Study of External Morphology of male and female cone of **any four** ofthe following with the help of material/specimen/P.S. i)*Pinus,* ii)*Thuja,* iii)*Cedrus,* iv)*Cupressus,* v)*Araucaria,* vi)*Agathis,* vii)*Podocarpus,* viii)*Cryptomeria,* ix) *Juniperus*

Practical 9	Study of External Morphology, Anatomy (T.S.) and morphology of reproductive organs (male and female cone) of *Ephedra* (P.S. / specimen)
Practical 10	Study of External Morphology, Anatomy and morphology of reproductive organs of *Ginkgo* (P.S. or specimen)
Practical 11	Study of following fossils (P.S. or specimen) *Rhynia, Lepidodendron* Stem, *Lepidocarpon* *Calamites* Stem, *Annularia, Sphenophyllum* Stem
Practical 12	Study of following fossils (P.S. or specimen) *Lyginopteris oldhamia* stem *,Neuropteris, Glossopteris,Vertebraria*
Practical 13	Study of following fossils (P.S. or specimen) *Rodeites, Pentoxylon* stem *, Cordaites* stem
Practical 14	Study of following fossils (P.S. or specimen)*Palmoxylon, Cyclanthodendron, Tricoccites*
Practical 15	Study of following fossils (P.S. or specimen) *Sahnipushpam, Sahnianthus, Enigmocarpon*

Suggested Readings:

1. A. Rashid (1999) An introduction to Pteriophyta. Vikas publishing house Pvt. Ltd. New Delhi, India.
2. Parihar, N.S. (1976) Biology and Morphologyof Pteridophytes. Central Book Depot, Delhi, India.
3. Sharma, O.P. (1990) Textbook of Pteridophyta. MacMillan India Ltd. Delhi, India.
4. Smith, G.M. (1995) Cryptogamic Botany Vol-II McGraw Hill. New York. USA.
5. Sporne, K.R. (1986) The morphologyof Pteridophytes. Huschinson University Library, London, UK.
6. Sundar Rajan S. (1999) Introduction to Preridophyta. New Age International Publishers. New Delhi, India.
7. Chamberlain, C.J. (1935) Gymnosperms: Structure And Evolution. Dover publ.INC.,New York,
8. Eames, A.J. (1974) Morphology of vascular plants Mc. Grow Hill PublicationCo. New Delhi.
9. Foster, A.S. & Gifford E.M. (1959) Comparative morphology of vascularplants San Francisco.
10. Pande B. P. (1994) GymnospermsS. Hand and Co. New Delhi, India.
11. Seward,A.C.(1969) Fossil Plants Vol.I to IV, Hafner Publ. Co. New York, USA.
12. Shukla, A. C. and S.P. Misra (1982) Essentials of Palaeobotany Vikas Publishing HousePvt. Ltd. Delhi, India.
13. Siddiqui, K.A.(2002) Elements of Paleobotany Kitab Mahal,Allahabad
14. Sporne K.R. (1966) Morphology of Pteridophyta Hutchinson Univ. Library London.
15. Sporne K.R. (1967) Morphology of Gymnosperms Hutchinson Univ. Library, London,UK.
16. Surange K.R. (1966) Indian Fossil Pteridophytes CSIR, New Delhi, India.

Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon

M. Sc. Botany Part - I: Semester - II

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DSC-34 Practical - II [Lectures: 60] [2P] **BO- 425 Based on DSC-31 BO-422: Genetics and DSC -32 BO-423: Plant Physiology**	
Course Objective: To learn role of fixative and stains in cytology. To study the cell division in plants, mitosis and meiosis. To learn various metabolic activities of plants.	
Course Outcomes: Students understood the role of fixative and stains in cytology. To study the cell division in plants, mitosis and meiosis. Students acquaint the metabolic activities of plants.	
Practical:1	Preparation of Cytological fixative and Stains (Carnoy's fluid I, II, and Navashin'sfluid and Acetocarmine)
Practical:2	Squash preparations of onion root tips to study Mitosis using Acetocarmine stain.
Practical:3	Smear preparation of Maize, Onion or Rhoeo flower buds to study meiosis usingAcetocarmine stain.
Practical:4	Determination of Mitotic index and Metaphase frequency in *Allium cepa* or other plant material.
Practical:5	Staining of salivary gland chromosome in (Chironomus larvae/Drosophila).
Practical:6	To study the lipase enzyme activity.
Practical:7	Separation of chloroplast pigments by paper chromatography.
Practical:8	To determine diurnal fluctuations in titrable acid number (TAN) values of CAMsucculents (e.g., Aloe, Bryophyllum, Kalanchoe- anyone).
Practical:9-10	Determine the absorption spectrum of chlorophyll pigments and estimate the amount of Chl-A, Chl-B and total Chlorophylls by spectrophotometer method.
Practical:11	Extraction and separation of free amino acid of germinating seed by circular paperchromatography.

Practical: 12	To extract and estimate the amount of Ascorbic acid present in green paper (raw) /lemon (Fresh).
Practical:13-14	Extraction and Detection of secondary plant metabolites from suitable plantmaterial i) Alkaloids ii) Phenols iii) Terpenoids iv) Proteins.
Practical: 15	Estimation of ether soluble fat oil of Ricinus/ Arachis seeds by Soxhlet apparatus.

1. Amarsingh (1977) Practical Plant Physiology. Kalyani Publishers, New Dehli, India.
2. Arditt, J. (1969) Experimental Plant Physiology, Holt Rinehrt& Winston Inc, NewYork.
3. Bajpai P. K. (2006) Biological Instrumentation and Methodology, S. Chand Publication, New Delhi.
4. Karp, G. (1999) Cells and Molecular Biology concepts and Experiments; Hohn Wiley & Sons Inc. USA.
5. Nagavi B. G. (1989) Laboratory Hand Book of Industrial Drug Analysis, Vallabh Prakashan, Delhi.
6. S. Sadasivam and A. Manickam (1976) New Age International Publisher, S. Chand Publisher, New Delhi.
7. Srivastava and Srivastava (1976) Introduction to Chromatography
8. Verma, Agarwal, (2005) Cell Biology, Genetics, Molecular Biology, Evolution and Ecology: S.Chand and Company , New Delhi, India.

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M. Sc. Botany Part - I: Semester - II

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DSE-6 Major (Core) Course [Lectures: 60] **BO-426 (A) Techniques in Plant Science /** **BO-426 (B) Plant Ecology and Plant Geography /** **BO-426 (C) Agricultural Botany**		
BO-426 (A) Techniques in Plant Science		
Course Objectives: 1. To familiarize modern plant extraction techniques, sample preparation for various detection and quantitation of metabolites. 2.To provide training on the handling of various computational data analyses and molecular docking tools. 3. To make detailed sample preparation methods and advanced microscopy such as 4. STEM, con-focal microscopy, etc.		
Course outcomes: 1. Concepts, tools and techniques related to in plants. 2. Different methods used for genetic transformation of plants. 3. Various case studies techniques related to basic and applied research in plant science.		
Unit 1	**Basic Techniques in Botany** Lab maintenance and sterilization techniques Preservation of materials- types of fixatives, macerations, peeling. Whole mount preparations: Bacteria, Algae, Fungi, Bryophytes, Pteridophytes, Gymnosperms and Angiosperms Staining: Types of stains, procedure of double and multiple staining.	**12**
Unit 2	**Microscopy and Micrometry** Historical microscopy, principle of microscopy Types and working of light microscope Types and Working of Electron microscope (SEM and TEM), dark field microscope, Fluorescence microscopy, phase contrast microscope, Micrometry: Metric units' principles and techniques, properties of light wavelengths and resolving power of microscope.	**12**
Unit 3	**Separation Techniques** Basic principles of chromatography RF value calculation Adsorption, absorption, solutes and solvents Paper chromatography, column chromatography, gel filtration, ion exchange chromatography HPLC, gas chromatography Gel electrophoresis (one and two dimensional) SDS-PAGE, AGAROSE. Principle and working of centrifuge, RPM, rotors and its type	**12**

	3.8 Types of centrifuges: High speed centrifuge, Ultra centrifuge, Gradient Centrifuge	
Unit 4	**Spectroscopic Techniques and Microtomy** Beer's Law, Lambert's Law, Beer-Lambert Law Visible and Ultraviolet (UV) spectroscopy I. R. spectrophotometer, flow cytometry NMR and ESR spectroscopy Atomic absorption and mass spectrometry, flame photometer Microtome- Types, Serial sectioning	**12**
Unit 5	**Radioactive and Immunological Techniques** Properties of different types of radioisotopes in biological systems Radio degradation, half life period, radio dating, radio labeling Auto radiography safety guidance Immunological Techniques: Antibody and Antigen Classes of antibodies ELISA, Immune precipitation	**12**

Suggested readings:

22. Annie and Arumugam (2000). Biochemistry and Biophysics, Saras Publishing, Tamilnadu.
23. Bisen P.S. Mathur S. (2006). Life Science in Tools and Techniques. CBS Publishers, Delhi.
24. Egerton R.F. Physical Principle of Electron Microscopy: an Introduction to TEM, SEM and AEM.
25. Gamborg O.L., Philips G.C. (Eds.) (1995). Plant Cell, Tissue and Organ Culture fundamental Methods. Narosa Publishing House (P) Ltd.
26. Gunadegaram P. (1995). Laboratory Manual in Microbiology. New Age International (P) Ltd.
27. Harborne J.B. (1998). Phytochemical Methods. Springer (I) Pvt. Ltd.
28. Khasim S.M. (2002). Botanical Micro techniques: Principles and Practice. Capital Publishing Company.
29. Krishnamurthy K.V. (1999). Methods in Cell Wall Cytochemistry. CRC Press. LLC.
30. Marimuthu R. (2008). Microscopy and Microtechnique. MJP Publishers, Chennai.
31. Pal and Ghaskadabi (2009). Fundamentals of Molecular Biology. Oxford Publishing Co.
32. Plummer David (1987). An Introduction to Practical Biochemistry. 3rd Eds. Tata Mc Graw-Hill Publishing Company Ltd.
33. Prasad and Prasad (1984). Outline of Microtechnique. Emkay Publications, Delhi.
34. Sadasivam S.,Manickam A. (1996). Biochemical Methods. 2nd Edn. New Age International (P) Ltd.
35. Sass John E. (1984). Botanical Microtechniques. Tata McGraw-Hill Publishing Company Ltd.
36. Sharma V.K. (1991). Techniques in Microscopy and Cell Biology. Tata McGraw-Hill Publishing Company Ltd.

Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon

M. Sc. Botany Part - I: Semester - II

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DSE-6 Major (Core) Course [Lectures: 60] **BO-426 (B) Plant Ecology and Plant Geography**		
Course Objectives: 1.To inspire the students about ecological importance of the environment, natural resources, various problems related to environment and its protection. 2.To make aware about conservation of biodiversity, energy. 3. To study Bioremediation, global warming and climate change, Pollution.		
Course outcomes: 1.The students will understand the various conservation strategies, man made environmental issues at local, national and global level and the measures to control their adverse effects at individual and collective level. 2.Understanding the Management and Conservation strategies at national and international. 3.Understanding the key environmental issues and ecosystem Management.		
Unit 1	**Plant Ecology and Environment Management** **i. Definition, Concept and scope of Ecology, Branches of Ecology.** ii. **Management and Conservation of Natural Resources:** Aims, objectives and principles of conservation; Conservation policies; Conservation strategies at national and international level; Sustainable development and ecological economics. iii. **Environment Pollution:** Definition, Different types of pollutants; Sources of pollutants of air, water and soil; Effects of pollutants of air, water and soil; Control of pollution; Detailed account of Indoor pollution.	**15**
Unit 2	**Global Environmental Changes:** i. **Global warming;** Climate change, reasons, Factors contributing to climate change; consequences of climate change and measures to combat the problem. ii. **Ozone hole:** General account of ozone layer and hole; Factors contributing to ozone hole; Effects and Remedies. iii. **Environment Protection:** International concern and efforts for environmental protection, global plan, Stockholm Summit, priority issues; Earth Summits. iv. **Resource Economics:** Introduction and significance. v. **Environment Impact assessment:** Introduction and significance.	**15**
Unit 3	**Phytogeography:** **I. Definition,** principles governing plant distribution, factors affecting plant distribution, theories of distribution, different types of distribution of vegetations on the earth, continuous and discontinuous distribution. II. Main Botanical regions of India, Detailed study of vegetation types in Maharashtra. III. **Endemism:** causes and types. IV. **Remote sensing**: Definition and data acquisition techniques. Application of remote sensing in vegetation classification, understanding the key	**15**

	environmental issues and ecosystem management.	
Unit 4	**Environmental Biotechnology and solid waste management:** i. **Concept of waste:** types and sources of solid wastes including e-waste. Bioindicator and biomarkers of environmental health. Bioremediation, Phytoremediation, bioaugmentation, biofilms, biofilters, bio scrubbers and trickling filters. Use of bioreactors in waste management. ii. **Allelopathy:** Concept, mechanisms and exploitation in weed management. iii. **Plant Invasion:** Definition, factors (both Intrinsic and extrinsic) affecting invasion, Status and impact of plant invasion on native flora.	**15**

Suggested readings:

1. Altieri, M.A., and Liebman, M. Weed Management in Agroecosystems: Ecological Approaches. Florida, USA: CRC Press, 1988. Print.
2. Agrawal,K.C (1996) Environmental Biology, Agro-Botanical Publisher, Bikaner, India
3. Ambasta, R.S. (1990) Environment and pollution, student friends and co. Varanasi, India Botkin, D. and Keller, E. Environmental Science. New York, USA: John Wiley Publishers, 1995. Print.
4. Enger, E.D., and Smith, B.F. Environmental Science. Iowa, U.S.A.: WCB, Publi., 1992. Print.
5. Hunter, M.L. Maintaining Biodiversity in Forest Ecosystems. Cambridge: Cambridge University Press, 1999. Print.
6. Kothari, A. (1997). Understanding Biodiversity: Life Sustainability and Equity Orient Longman
7. Kumar, H.D. (1997) General Ecology, Vikas Publishing House Private Ltd. New Delhi
8. Newman, E.I. Applied Ecology.UK: Blackwell Scientific Publishers, 1994. Print.
9. Odum, E.P. Fundamentals of Ecology. USA: Saunders Toppan, 1971. Print.
10. Purohit S.S. and Ranjan R. (2007). Ecology, Environment and Pollution. Agrobios (India)
11. Ramakrishnan, P.S. Ecology of Biological Invasion in the Tropics. New Delhi: International Scientific Publications, 1991. Print.
12. Raven, P.H., Berg, L.R., and Hassenzahl, D.M. Environment. 7thed. USA: Wiley, Hoboken, 2010. Print.
13. Shibu, J., Singh, H.P., Batish, D.R. and Kohli, R.K. Invasive Plant Ecology. New York, USA:CRC Press, Taylor and Francis Group, Boca Raton, 2013. Print.
14. Sharma P.D(2018) Ecology and Environment Rastogi Publications, Meerut-New Delhi.
15. Singh, H.P., Batish, D.R., and Kohli, R.K. Handbook of Sustainable Weed management. New York, USA: Food Products Press, 2006. Print.
16. Singh, J.S., Singh, S.P., and Gupta, S.R. Ecology, Environment and Resource Conservation. New Delhi: Anamaya Publishers, 2006. Print.

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M. Sc. Botany Part - I: Semester - II

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DSE-6 Major (Core) Course [Lectures: 60] BO-426 (C) Agricultural Botany		
Course Objectives: This course has the following objectives in order to achieve the above aims: 1. Understand the basic concept in agricultural botany 2. Identify and classify some plant 3. Appreciate the morphological, and their physiological functions 4. To distinguish between pure and applied botany 5. Know the relevance of botany to agriculture		
Course outcomes: 1. Students Students will demonstrate the ability to analyze data and draw appropriate statistical conclusions. 2. Students will demonstrate knowledge of the legal and ethical environment impacting agriculture organizations and exhibit an understanding and appreciation of the ethical implications of decisions. 3. Students will demonstrate an understanding of and appreciation for the importance of the impact of globalization and diversity in modern agriculture organizations. 4. Students will demonstrate an ability to work effectively with others.		
Unit 1	**BASIC CONCEPTS IN AGRICULTURAL BOTANY** i. Introduction of agricultural botany ii. Objectives of agricultural botany iii. Definition of agricultural botany iv. Scope of agricultural botany v. Importance of green Plants vi. Components of agricultural botany vii. Approaches to studying botany viii. The concept of agricultural botany.	**12**
Unit 2	**Plant morphology** a) Definition of root, types of roots, structure root, functions root and root systems b) Definition of Stem, types of Stems, Stem functions and modifications of Stem c) Leaf functions, leaf morphology and leaf phyllotaxy.	**12**
Unit 3	**Plant reproduction** a. Reproduction in gymnosperms and angiosperms b. Flower morphology c. Types of inflorescences d. Flower symmetry e. Pollen, structure and pollination f. Fruits and fruit classification	**12**

Unit 4	**Introduction to plant physiology** **A.** Definition and importance B. The plant cell structure and basic cell types; C. Seed structure; D. The physiology of seed germination E. Requirements for germination F. Steps in seed germination G. Plant Water Relation H. Mechanism of Water Absorption I. Mechanism of Salt Absorption J. Definition of transpiration K. Types of transpiration L. Factors affecting transpiration M. Photosynthesis N. Factors affecting Photosynthesis	
Unit 5	Introduction to field crops- Agricultural classification of field crops. Family description, economic parts, economic uses, value additions, in the following crops a) **Cereals:** Rice ,Wheat and maize b) **Millets**: Sorghum and Pearl millets c) **Pulses:** Soy bean, Cow pea, Black gram, and Green Gram d) **Oilseeds:** Groundnut, Caster, Sunflower and Mustard. e) **Fibers**: cotton, Jute and Sun hemp, f) **Sugars:** Sugar cane and Sugar beet **g) Forage crops** **h) Tree fodder.**	**12**

Suggested readings:

5 Mauseth J.D. 2003. Botany: An introduction to Plant Biology. Jones and Bartlett Publishers. ISBN 0-7637-2134-4

6 Berrie, G.K., A Berrie, and J.M.O. Eze 1987. Tropical Plant Science. Longman and Scientific Technical. ISBN 0-582-64705-3

7 Kochhar, S.L. 1981. Tropical Crops: a textbook of economic botany. MacMillan Publishers. ISBN 0-333-39241-8

8 Laetsch, W.M. 1979. Plants: Basic concepts in Botany. Little, Brown and Company, Toronto, USA. Library Catalog Card No. 78-64497

9 Baranov, V.D. Ustimenko, G.V. (1994). Mir Kulturnih Rasteniyi. Misl, P.381.

10 Cobley, L.S. and Steele, W.M. (1976). An Introduction to the Botany in the Tropics, Second Edition. Longman Group Limited.

11 Dutta, A. C. (2000). Botany for Degree Students Oxford University Press 10th Edition.

12 Ebukanson and Bassey: (1992). About Seed Plants. Baraka Press and Publishers LTD.

13 Green, D.J., Stout, G.W. (2004). Biological Science, 3rd Edition. Cambridge University Press

14 James, W.O. (1975). An Introduction to Plant Physiology Seventh Edition, Oxford University Press. P.181

15 Kochhar, S. L. (2001). Economic Botany in the Tropics Second Edition, Macmillan India LTD

16 Murkin, B.M. Naumova, L.G. and Muldashev, A.A. (2000). Vissheye Rasteniye. M.

Logos P.264.
17 Pandey, S. N. Sinha, B.K. (2003). Plant Physiology Third Edition, Vikas Publishing House PVT LTD. P.581.
18 "Introduction to Crop Physiology" by H. H. Hadley
19 Reddy, M. S. (2005). Principles of Agronomy. Kalyani Publishers.

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M. Sc. Botany Part - I: Semester - II

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Major (Core) Course [Lectures: 60]
BO-427 On Job Training

Course Objectives:

1. To provide work experience enabling students to apply what they learnt in the college and acquire new skills.
2. To give students an opportunity to establish interest in industrial/ commercial activities.
3. To provide foundation to prepare students to work efficiently in their jobs after the training.
4. An MSc Botany student can build a career in many paths. Starting from school teachers to microbiological and virological research, many different fields and job profiles are open for these candidates.
5. With each passing day, the demand for MSc Botany candidates in the research field is increasing. The need to tackle problems like global warming, deforestation and increasing thirst for knowing about new plants and their importance has led to an ever-increasing demand for Botany based candidates in the field of research.
6. After completing your postgraduate studies in Botany, you will be serving under the finest and reputed organizations.
7. Offers the aspirant with an option to go for further studies or doctoral-level studies.
8. It provides you with the opportunity to work in various departments of government institutions like forestry, Social forestry, Recreation gardens, Landscape gardening, Plant nursery, food processing industry, oil industry, Mushroom cultivation, Hydroponics farms etc.
9. The problems related to forests, climate change, desertification, etc, can be easily solved with a better understanding of Botany.

Course outcomes:

1. On-the-job training helps employees learn and perform their jobs in real-life situations while minimizing potential issues.
2. As a result, job-related knowledge is learned, retained and applied more reliably.
3. Training of an organization's workers enables them to perform their job to the best of their ability.
4. It provides the knowledge as well as the skills they require to carry out their duties effectively.

On Job training: Botany Career Opportunities and Job Prospects:

A career in Botany might just be one of the most preferred careers in India. Botany as a subject is related to the study of plants and a career in it would mean studying in depth about *fungi, algae, plants, diseases, growth, metabolism and the structure* between different groups. When planning a career in Botany, the job profile can include study of plants, research, working with industries, teaching, self-employment, and being a part of many more fields.

A person who works in this field is called a botanist. It will be the job of the botanist to study plant life along with finding solutions to problems related to that of forest and agriculture. There are also botanists who deal with space travel agriculture, artificial environments, hydroponics and various other interesting areas of research.

MSc Botany course is best suited for the students who have completed their graduation in botany or integrated biology (biological sciences), and are looking to pursue a course that will have an adequate mix of mainstream biology along with genetics and biotechnology. During this course, a candidate is given a complete idea about the entire plant kingdom and plant physiology, along with some additional topics related to genetics and biotechnology, cell biology, microbiology, and ecology.

1. The course covers every aspect of plant biology in great detail. It covers topics like plant physiology, plant kingdom, Taxonomy, microbiology, genetics and ecology.
2. It is a 2 year long course which is generally divided into four semesters.
3. It is generally a theoretical course along with some opportunities for academic research which is accompanied with laboratory work.
4. The students completing this course generally go on to build a career in academics. Some students also go for research and higher studies.
5. They can seek employment as Ecologist, Morphologist, Cytologist, Taxonomist, Ethno Botanist, Mycologist, Plant Biochemist, Foresters and Researchers etc.

Plant explorer: Botanist with a passion for plants who could be a photographer, writer, expeditioner, etc

Conservationist: Is an individual who works for the conservation of the environment and is often linked to organizations working for the cause.

Ecologist: A person who works for the eco-system and a balanced environment.

Environment consultant: Some botanists qualify to work as environmental consultants, providing inputs and advice for the conservation of the environment.

Horticulturist: A horticulturist knows the science behind different plants, flowers, and greenery. They conduct research in gardening and landscaping, plant propagation, crop production, plant breeding, genetic engineering, plant biochemistry, and plant physiology.

Plant biochemist: Biochemists study the chemical and physical principles of living things and of biological processes, such as cell development, growth, heredity, and disease.

Molecular biologist: Molecular biologists conduct research and academic activities. The research component involves the study of biological structures in well-equipped laboratories with advanced technology to help them explore complex molecular structures and their particular functions. The equipment may include microscopes, lab centrifuges, computers with specific software that allows them to analyze obtained data, and many more.

The number of professions botanists can go into nowadays is endless. Moreover the application of plant sciences improves the yield and supply of medicines, foods, fibers, building materials and other plant products. The knowledge of plant sciences is essential for development and management of forests, parks, waste lands, sea wealth etc.

Few of the industries which one can work with are:

- Phyto chemical Industry
- Food Companies

- Arboretum
- Forest Services
- Biotechnology Firms
- Oil Industry
- Land Management Agencies
- Seed And Nursery Companies
- Plant Health Inspection Services
- National Parks
- Biological Supply Houses
- Plant Resources Laboratory
- Educational Institutions

Suggested readings:

1. Mastering Professional Scrum: A Practitioner s Guide to Overcoming Challenges and Maximizing the Benefits of Agility by Stephanie Ockerman and Simon Reindl
2. Adapt by Tim Harford
3. Team of Teams by Stanley McChrystal
4. Servant Leadership by Robert K. Greenleaf
5. Scrum Mastery by Geoff Watts
6. Coaching Agile Teams by Lyssa Adkins
7. The Surprising Power of Liberating Structures by Henri Lipmanowizc and Keith McCandless
8. The DevOps Handbook by Kim, Debois, Williz and Humble
9. The Professional Product Owner by Don McGreal and Ralph Jocham
10. The Product Samurai by Chris Lukassen
11. Product Mastery by Geoff Watts
12. Lean Change Management by Jason Little
13. Reinventing Organizations by Frederic Laloux
14. Creating Great Teams by Sandy Mamoli and David Mole
15. The Serving Leader: Five Powerful Actions to Transform Your Team, Business, and Community by Ken Jennings and John Stahl-Wert
16. Turn the Ship Around!: A True Story of Turning Followers into Leaders by L. David Marquet

Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon

॥ अंतरी पेटवू ज्ञानज्योत ॥

SYLLABUS

for

First Year

Master of Science (M. Sc.)

Zoology

NEP 2020 based curriculum

for

Affiliated Colleges of
Kavayitri Bahinabai Chaudhari North Maharashtra University
Jalgaon 425 001 (MS)

2023 – 2024

Submitted by Zoology Subject Committee NEP 2020

INDEX

Program at a Glance

Name of the program (Degree)	**:**	M. Sc.
Subject	**:**	Zoology
Faculty	**:**	Science and Technology
Duration of the Program	**:**	Two years (four semesters)
Medium of Instruction and Examination	**:**	English
Credits of the program	**:**	Total 88 credits
Examination Pattern	**:**	The 60**:**40 (60 marks University assessment (exam) and 40 marks continuous internal college assessment (exam)
Evaluation mode	**:**	CGPA
Passing standards	**:**	The 40% in each exam separately (separate head of passing)
Result	**:**	As per the University's rules of CGPA system

1. Introduction to Program in M. Sc. (Hons.) Zoology

The Master of Science (Hons.) and Research in Zoology program is designed to provide students with a comprehensive understanding of the diverse aspects of zoology and develop their research skills in this field. This postgraduate program offers an opportunity for students to pursue advanced studies and engage in original research in various areas of zoology, including animal physiology, ecology, behavior, evolution, taxonomy, and conservation.

The program is structured to equip students with a strong foundation in zoological principles, theories, and methodologies. Through a combination of coursework, laboratory work, fieldwork, and research projects, students will develop a deep understanding of the intricate biological systems, ecological interactions, and evolutionary processes that shape the animal kingdom.

One of the key highlights of this program is the emphasis on research. Students will have the opportunity to work closely with experienced faculty members and engage in cutting-edge research projects that contribute to the advancement of zoological knowledge. They will learn to formulate research questions, design experiments, collect and analyze data, and communicate their findings effectively through scientific reports and presentations.

The program also places importance on critical thinking, problem-solving, and interdisciplinary approaches. Students will be encouraged to think critically, analyze complex scientific problems, and develop innovative solutions. They will explore the interconnectedness of zoology with other scientific disciplines, fostering collaborations and a broader perspective in addressing scientific challenges.

Ethical considerations in zoological research and conservation will be integrated into the program. Students will be encouraged to conduct their research in an ethical manner, ensuring the welfare and responsible treatment of animals. They will develop an understanding of conservation strategies and the importance of sustainability in preserving biodiversity and managing ecosystems.

Upon completion of the program, graduates will be well-prepared for a range of career opportunities in academia, research institutions, conservation organizations, zoos, museums,

and government agencies. They will possess the necessary knowledge, research skills, and professional competence to pursue doctoral studies or embark on fulfilling careers in zoology.

The Master of Science (Hons.) and Research in Zoology program aims to nurture passionate and skilled zoologists who will contribute to scientific advancements, conservation efforts, and the sustainable management of our natural world. Graduates of this program will be at the forefront of research and innovation, making significant contributions to our understanding of animal life and its conservation.

2. Learning Outcome-Based Curriculum Framework In Program

The M.Sc. program in Zoology follows a learning outcome-based curriculum framework, ensuring that students acquire the necessary knowledge, skills, and competencies in the field of zoology. The curriculum is designed to align with the program objectives and equip students with a strong foundation in zoological sciences while promoting active learning, critical thinking, and research skills. The following are the key components of the curriculum framework:

1. **Foundation Courses:**

Provide students with a comprehensive understanding of the core concepts, principles, and theories in zoology.
Develop a solid foundation in areas such as animal physiology, ecology, behavior, evolution, taxonomy, and conservation.
Introduce students to research methodologies, data analysis, and scientific writing.

2. **Specialization Courses:**

Offer advanced courses in specific areas of zoology, allowing students to deepen their knowledge and expertise in their chosen field of interest.
Explore specialized topics such as animal behavior, population dynamics, molecular genetics, evolutionary biology, and ecological conservation.
Foster critical thinking and problem-solving skills by analyzing and evaluating complex scientific problems within the chosen specialization.

3. **Laboratory and Fieldwork:**

Provide hands-on practical experiences through laboratory sessions, fieldwork, and data collection in natural habitats.
Develop practical skills in techniques such as specimen collection, taxonomic identification, data recording, and experimental methodologies.
Enhance observational and analytical skills by conducting field surveys, ecological studies, and animal behavior observations.

4. **Research Projects:**

Engage students in independent research projects, allowing them to apply their knowledge and skills to investigate scientific questions in zoology.
Develop research proposals, design experiments, collect and analyze data, and interpret and present research findings.
Enhance critical thinking, problem-solving, and scientific communication skills through research work.

5. **Interdisciplinary Approach:**

Encourage interdisciplinary perspectives by integrating concepts and methodologies from other related disciplines, such as ecology, genetics, conservation biology, and environmental sciences.

Foster collaborations and interdisciplinary research to address complex issues and challenges in zoology.

6. Ethical Considerations:

Promote ethical awareness and responsible conduct in zoological research and conservation.
Address ethical considerations related to animal welfare, research ethics, and conservation practices.
Instill a sense of ethical responsibility in students towards the well-being and conservation of animal species.

7. Seminars and Presentations:

Enhance students' oral and written communication skills through seminars, presentations, and scientific writing assignments.
Develop the ability to effectively communicate scientific ideas, research findings, and complex concepts to both scientific and non-scientific audiences.
Encourage critical evaluation and constructive feedback through participation in seminars and scientific discussions.

8. Professional Development:

Equip students with professional skills necessary for their future careers in zoology.
Foster teamwork, leadership, time management, and organizational skills.
Promote lifelong learning, continuous professional development, and staying updated with advancements in the field.

The learning outcome-based curriculum framework ensures that students in the M.Sc. program in Zoology develop a broad knowledge base, research skills, critical thinking abilities, and ethical considerations necessary to contribute to scientific knowledge, conservation efforts, and the sustainable management of animal populations.

3. Purpose of The Program

The M.Sc. program in Zoology serves the following purposes:

- Advanced Knowledge: The program aims to provide students with advanced knowledge and understanding of the diverse aspects of zoology, including animal physiology, ecology, behavior, evolution, taxonomy, and conservation. It builds upon the foundational concepts introduced at the undergraduate level and delves deeper into specialized areas of study.
- Research Skills Development: The program seeks to develop students' research skills and abilities. Students will acquire the necessary skills to design and conduct independent research projects, apply scientific methodologies, collect and analyze data, and interpret research findings. This emphasis on research fosters critical thinking, problem-solving, and scientific inquiry.
- Specialization and Expertise: The program offers students the opportunity to specialize in specific areas of zoology based on their interests and career goals. By focusing on a particular field, students can develop specialized knowledge, expertise, and skills that will enhance their professional competitiveness and open doors to various career opportunities.
- Professional Growth: The program aims to facilitate the professional growth of students in the field of zoology. Through a combination of coursework, research projects, seminars, and presentations, students will enhance their oral and written communication skills, critical evaluation abilities, and scientific reasoning. They will

develop professionalism, teamwork, leadership, and time management skills essential for successful careers in zoology.

- ❖ Interdisciplinary Perspective: The program encourages students to adopt an interdisciplinary approach to zoological research and study. It emphasizes the interconnectedness of zoology with other scientific disciplines, such as ecology, genetics, conservation biology, and environmental sciences. This interdisciplinary perspective enables students to address complex scientific problems and contribute to interdisciplinary research projects.
- ❖ Ethical Considerations: The program recognizes the importance of ethical considerations in zoological research and conservation. Students will develop an understanding of ethical guidelines and principles related to animal welfare, research ethics, and conservation practices. They will learn to conduct their research and conservation efforts in a responsible and ethical manner, considering the welfare and conservation of animal species.
- ❖ Contribution to Science and Conservation: The program aims to produce graduates who will contribute to the advancement of scientific knowledge and the conservation of animal species. Through their research projects and academic pursuits, students will make valuable contributions to the field of zoology by expanding our understanding of animal life, ecosystems, and conservation strategies.
- ❖ Academic and Career Opportunities: The program prepares students for further academic pursuits, including Ph.D. studies and research careers in academia and research institutions. It also equips students with the skills and knowledge required for diverse career opportunities in areas such as conservation organizations, environmental agencies, zoos, museums, and government bodies engaged in animal-related research and management.

Overall, the purpose of the M.Sc. program in Zoology is to provide students with advanced knowledge, research skills, and a strong foundation in zoological sciences. It aims to develop well-rounded professionals who can contribute to scientific knowledge, conservation efforts, and the sustainable management of animal populations.

4. Nature and Scopes of The Program

Nature:

The M.Sc. program in Zoology is a postgraduate academic program that focuses on the in-depth study of the animal kingdom and its various aspects. It combines theoretical knowledge, practical skills, and research opportunities to provide students with a comprehensive understanding of zoological sciences. The program emphasizes scientific inquiry, critical thinking, and research skills development, preparing students for careers in academia, research institutions, conservation organizations, and related fields.

Scope:

- ➢ Broad Field of Study: The program covers a wide range of topics within zoology, including animal physiology, ecology, behavior, evolution, taxonomy, conservation, and more. Students explore the diversity of animal life, understand the ecological interactions, and study the evolutionary processes that have shaped the animal kingdom.
- ➢ Research-Oriented: The program offers ample opportunities for students to engage in research. They undertake independent research projects, work closely with faculty mentors, and contribute to scientific knowledge by conducting original research in

their chosen specialization. Students learn research methodologies, data analysis techniques, and scientific writing skills.

- Interdisciplinary Connections: The scope of the program extends beyond zoology as it encourages interdisciplinary connections. Students explore the interrelationships between zoology and other scientific disciplines, such as ecology, genetics, conservation biology, and environmental sciences. This interdisciplinary approach enhances their understanding of complex scientific problems and promotes collaborative research.
- Practical Application: The program provides hands-on experiences through laboratory work, fieldwork, and practical training. Students gain practical skills in techniques such as specimen collection, taxonomic identification, ecological surveys, behavioral observations, and experimental design. This practical application strengthens their ability to apply theoretical knowledge in real-world scenarios.
- Ethical Considerations: The program instills a sense of ethical responsibility in students by addressing ethical considerations in zoological research and conservation. Students learn about ethical guidelines, animal welfare, and responsible conduct in scientific research. They develop a deep understanding of the importance of conservation and sustainable practices in the management of animal populations.
- Career Opportunities: The program prepares students for diverse career opportunities in the field of zoology. Graduates can pursue academic positions as professors or researchers in universities and colleges. They can also work in research institutions, conservation organizations, zoos, museums, environmental agencies, and government bodies involved in animal-related research and management.
- Contribution to Science and Conservation: The scope of the program includes the contribution to scientific knowledge and conservation efforts. Through research projects, students make valuable contributions to the understanding of animal biology, behavior, ecology, and conservation strategies. They contribute to the preservation of biodiversity, sustainable management of ecosystems, and the protection of endangered species.

In summary, the M.Sc. program in Zoology provides a comprehensive and research-oriented study of the animal kingdom. It offers a broad scope of study, practical application, interdisciplinary connections, and ethical considerations. Graduates of this program are equipped with the knowledge, research skills, and practical experiences necessary to make significant contributions to scientific knowledge, conservation efforts, and the sustainable management of animal populations.

5. Graduate Attributes of M. Sc. Honors in Zoology:

- Advanced Knowledge: Graduates of the M.Sc. (Honors)/Research in Zoology program possess advanced knowledge and expertise in various aspects of zoology. They have a deep understanding of animal physiology, ecology, behavior, evolution, taxonomy, and conservation. They are equipped with the latest scientific knowledge and are familiar with current research trends in their chosen specialization.
- Research Skills: Graduates have developed strong research skills throughout the program. They can design and conduct independent research projects, formulate research questions, select appropriate methodologies, collect and analyze data, and interpret research findings. They are skilled in literature review, experimental design, statistical analysis, and scientific writing.
- Critical Thinking: Graduates have honed their critical thinking abilities through rigorous analysis of complex scientific problems in zoology. They can evaluate

evidence, identify research gaps, and propose innovative solutions. They are adept at logical reasoning, problem-solving, and making evidence-based decisions in their field of expertise.

- Scientific Communication: Graduates possess excellent scientific communication skills, both orally and in writing. They can effectively present their research findings to scientific and non-scientific audiences through presentations, seminars, and publications. They can communicate complex scientific concepts in a clear and concise manner, demonstrating their ability to disseminate knowledge effectively.
- Interdisciplinary Collaboration: Graduates understand the interdisciplinary nature of zoology and can collaborate effectively with experts from diverse fields. They can contribute to interdisciplinary research projects, bridging the gap between zoology and related disciplines such as ecology, genetics, conservation biology, and environmental sciences. They have the ability to work in multidisciplinary teams to address complex scientific challenges.
- Ethical Considerations: Graduates are well-versed in ethical considerations related to zoological research and conservation. They have a strong understanding of ethical guidelines, animal welfare, and responsible conduct in scientific research. They prioritize the ethical treatment of animals and are committed to conservation and sustainability practices.
- Professionalism and Leadership: Graduates exhibit professionalism, integrity, and ethical behavior in their work. They have developed strong leadership qualities and are capable of leading research projects, managing teams, and effectively communicating with colleagues and stakeholders. They understand the importance of professional ethics and adhere to high standards of scientific integrity.
- Lifelong Learning: Graduates recognize the importance of lifelong learning and professional development. They have cultivated a commitment to staying updated with the latest advancements in zoology through continuous learning, attending conferences, workshops, and engaging in ongoing research. They are motivated to contribute to the field through teaching, mentoring, and further academic pursuits, such as pursuing Ph.D. studies.
- Career Readiness: Graduates are well-prepared for diverse career opportunities in academia, research institutions, conservation organizations, zoos, museums, and government agencies. They have acquired the necessary skills, knowledge, and practical experience to excel in their chosen careers in zoology. They are adaptable, resilient, and equipped with a strong foundation to thrive in a dynamic and evolving professional environment.

The M.Sc. (Honors)/Research in Zoology program develops graduates with advanced knowledge, research skills, critical thinking abilities, and ethical considerations necessary for successful careers in zoology. They possess the attributes required to contribute to scientific advancements, conservation efforts, and the sustainable management of animal populations.

On-the-job training in zoology provides practical skills, exposure to real-world scenarios, and networking opportunities within the field. It enhances participants' employability, allows them to explore specific areas of interest, and complements their academic knowledge with practical experience. It is important to note that the availability of on-the-job training programs may vary based on geographical location and the specific institutions and organizations within the field of zoology.

6. Qualification Descriptors for Zoology Post-Graduation:

- Upon completion of a post-graduation degree in Zoology, graduates are expected to demonstrate the following qualification descriptors:
- Advanced Knowledge: Graduates possess a comprehensive and advanced understanding of the principles, theories, and concepts in the field of zoology. They have in-depth knowledge of animal physiology, ecology, behavior, evolution, taxonomy, and conservation. They are familiar with current research trends and advancements in their specialized area of study.

- Research Skills: Graduates have acquired advanced research skills and are capable of conducting independent research. They are proficient in research methodologies, experimental design, data collection, statistical analysis, and data interpretation. They can critically evaluate scientific literature, identify research gaps, and contribute to the development of new knowledge in zoology.
- Critical Thinking and Problem-solving: Graduates demonstrate strong critical thinking abilities and are skilled at analyzing complex scientific problems in zoology. They can apply logical reasoning, evaluate evidence, and propose innovative solutions. They have the ability to think critically and creatively, demonstrating adaptability and resourcefulness in addressing research and practical challenges.
- Scientific Communication: Graduates possess excellent scientific communication skills, both orally and in writing. They can effectively communicate their research findings, ideas, and scientific concepts to both scientific and non-scientific audiences. They are proficient in scientific writing, report preparation, and presenting research results through presentations, seminars, and publications.
- Interdisciplinary Integration: Graduates can integrate knowledge and collaborate effectively across interdisciplinary boundaries. They understand the interconnectedness of zoology with other scientific disciplines such as ecology, genetics, conservation biology, and environmental sciences. They can contribute to interdisciplinary research projects, bridging the gap between different fields and applying diverse perspectives to address complex scientific challenges.
- Ethical Considerations: Graduates possess a strong understanding of ethical considerations related to zoological research and conservation. They adhere to ethical guidelines and prioritize the welfare of animals. They conduct research and conservation efforts in a responsible and ethical manner, considering the ethical implications of their work and the broader impact on animal populations and ecosystems.
- Professionalism and Leadership: Graduates exhibit professionalism, integrity, and ethical behavior in their work. They demonstrate leadership qualities and can effectively manage research projects, lead teams, and collaborate with colleagues and stakeholders. They have developed strong teamwork, communication, and interpersonal skills necessary for successful careers in zoology.
- Lifelong Learning: Graduates have cultivated a commitment to lifelong learning and professional development. They recognize the importance of staying updated with the latest advancements in zoology through continuous learning, attending conferences, workshops, and engaging in ongoing research. They are motivated to contribute to the field through teaching, mentoring, and pursuing further academic pursuits, such as Ph.D. studies.
- Career Readiness: Graduates are well-prepared for diverse career opportunities in academia, research institutions, conservation organizations, zoos, museums, and government agencies. They have acquired the necessary skills, knowledge, and

practical experience to excel in their chosen careers in zoology. They possess a strong foundation to contribute to scientific advancements, conservation efforts, and the sustainable management of animal populations.

These qualification descriptors reflect the skills, knowledge, and competencies that graduates of a post-graduation program in Zoology should possess. They provide a framework for assessing and evaluating the capabilities and readiness of graduates in the field of zoology.

- **Curriculum in subjects has to follow these Model Program Structures. The Terminology used in these Program Structures is as under;**
  - ✓ Discipline Core (DSC) refers to Core Courses/Papers in a Core Discipline/ Subject
  - ✓ Discipline Elective (DSE) refers to Elective Courses/Papers in the Core Subject or Discipline.
  - ✓ Open Elective (OE) refers to Elective Courses/Papers in a non-core Subject across all disciplines.
  - ✓ Program Structures also contain Ability Enhancement Compulsory Courses (AECC), Languages,
  - ✓ Skill Enhancement Courses (SEC) (Both skills and value-based).

Pedagogy involves L+T+P model. Generally, subjects with practicals involve L+P, while the subjects without practicals involve L+T model. The numbers in parentheses indicate credits allotted to various courses/papers as per definitions of Choice Based Credit System (CBCS). Generally, 1 hour of Lecture or 2 hours of practicals per week in a semester is assigned one credit. Generally, core subject theory courses/papers will have 3 or 4 credits, while practical are assigned 2 or 3 credits

Subject prerequisite: To study ZOOLOGY at the Master's level, a student must pass out a three-year degree in Zoology (Hon.) / Research and earn the required credit points.

Duration

The duration of the M.Sc. degree program shall consist of two academic years divided into four semesters. Each Semester consists of 90 working days. Each theory and practical course should be completed in about 60 lectures (a 2-credit theory course should be completed in 30 lectures).

Medium of instruction

The medium of instruction and examination for each course shall be English.

Credit to contact hour

One credit is equivalent to 15 periods of 60 minutes each for a theory course lecture. While credit weightage for self-learning based on e-content shall be 50% or less than that for lectures.

Attendance

The student enrolled for M.Sc. Zoology must have 75% attendance in each course in order to appear for term-end examinations, otherwise, the candidate may not be allowed to appear for term end examination as per ordinance.

Semester-wise Course Structure, Course Code and Credit distribution of Two Years/ One Year M. Sc ZOOLOGY Programme as per NEP2020, for Affiliated Colleges w.e.f – June 2023.

Course	Course Type	Course Code	Course Title	Credits	Teaching Hours/ Week			Marks (Total 100)			
					T	P	Total	Internal (CA)		External (UA)	
								T	P	T	P
SEMESTER – I, Level – 6.0											
DSC-25	DSC	ZO-411	Comparative Anatomy of Invertebrates	4	4	--	4	40	--	60	--
DSC-26	DSC	ZO-412	Biochemistry	2	2	--	2	20	--	30	--
DSC-27	DSC	ZO-413	Biostatistics	4	4	--	4	40	--	60	--
DSC-28	DSC	ZO-414	Practicals based on Comparative Anatomy of Invertebrates	2	--	4	4	--	20	--	30
DSC-29	DSC	ZO-415	Practicals based on Comparative Biochemistry, and Biostatistics	2	--	4	4	--	20	--	30
DSE-5	DSE	ZO-416	Wildlife Conservation and Management	4	4	--	4	40	--	60	--
RM	RM	RM-417	Research Methodology	4	4	--	4	40	--	60	--
SEMESTER – II, Level – 6.0											
DSC-30	DSC	ZO-421	Comparative Anatomy of Vertebrates	4	4	--	4	40	--	60	--
DSC-31	DSC	ZO-422	Immunology	2	2	--	2	20	--	30	--
DSC-32	DSC	ZO-423	Tools and Techniques in Life Sciences	4	4	--	4	40	--	60	--
DSC-33	DSC	ZO-424	Practicals based on Comparative Anatomy of Vertebrates	2	--	4	4	--	20	--	30
DSC-34	DSC	ZO-425	Practicals based on Comparative Immunology, and Tools and Techniques in Life Sciences	2	--	4	4	--	20	--	30
DSE-6	DSE	ZO-426	Environmental Biology	4	4	--	4	40	--	60	--
OJT	*OJT/Int	ZO-427	Zoology-related industries, gardens, museums, zoos, etc., and prepare the report	4	--	8	8	--	40	--	60
Cumulative Credits For First Year – 44											

*** Specialization, either anyone will be selected by the respective center / college**

* Students need to complete one month on job training (OJT) or internship in any industry related to major subject.

Semester-wise Course Structure, Course Code and Credit distribution of Two Years/ One Year M. Sc ZOOLOGY Programme as per NEP2020, for Affiliated Colleges w.e.f – June 2023.

Course	Course Type	Course Code	Course Title	Credits	Teaching Hours/ Week			Marks (Total 100)			
					T	P	Total	Internal (CA)		External (UA)	
								T	P	T	P
SEMESTER – III, Level – 6.5											
DSC-35	DSC	ZO-511	Specialization* – 1. Animal Physiology - I 2. Entomology -I 3. Reproductive Physiology - I Helminthology -I	4	4	--	4	40	--	60	--
DSC-36	DSC	ZO-512	Enzymology	2	2	--	2	20	--	30	--
DSC-37	DSC	ZO-513	Practicals based on Specialization	4	4	--	4	40	--	60	--
DSC-38	DSC	ZO-514	Practicals based on Enzymology	2	-	4	4	--	20	--	30
DSC-39	DSC	ZO-515	Bioeconomics	2	-	4	4	--	20	--	30
DSE-7	DSE	ZO-516	Animal Husbandry	4	4	--	4	40	--	60	--
RP	RP	ZO-517	Research project on any topic related to Zoology	4	--	8	8	--	40	--	60
SEMESTER – IV, Level – 6.5											
DSC-40	DSC	ZO-521	Specialization* – 1. Animal Physiology - II 2. Entomology -II 3. Reproductive Physiology - II Helminthology -II	4	4	--	4	40	--	60	--
DSC-41	DSC	ZO-522	History of Indian Science	4	4	--	4	40	--	60	--
DSC-42	DSC	ZO-523	Practicals based on Specialization	2	- -	4	4	--	20	--	30
DSC-43	DSC	ZO-524	Practicals based on the History of Indian Science	2	- -	4	4	--	20	--	30
DSE-8	DSE	ZO-525	Aquaculture	4	4	--	4	40	--	60	--
RP	RP	ZO-526	Research project on any topic related to Zoology	6	- -	12	12	--	60	--	90
Cumulative Credits For Second Year – 44											
2 Years-4 Sem. PG Degree (88 credits) after Three Year UG Degree or 1 Year-2 Sem PG Degree (44 credits) after Four Year UG Degree											

*** Specialization, either anyone will be selected by the respective center/college**

Curriculum Structure for Post Graduate Degree Program M. Sc., Hons in Zoology

- Name of the Degree Program: **M. Sc., Hons**
- Discipline Core: **Zoology**
- Total Credits for the Program: **44/88**
- Starting year of implementation: **2023-24**

Program Objectives (POs) for Postgraduate Programme in Zoology:

- **PO1: Advanced Knowledge:** To provide students with an in-depth understanding of the fundamental concepts, theories, and principles of zoology, encompassing areas such as animal physiology, ecology, behavior, evolution, and taxonomy.
- **PO2: Research Skills:** To develop students' research skills, enabling them to design and conduct independent research projects in zoology, including formulating research questions, selecting appropriate methodologies, collecting and analyzing data, and interpreting research findings.
- **PO3: Critical Thinking:** To cultivate critical thinking abilities in students, enabling them to evaluate and analyze complex scientific problems and challenges in zoology. Students will learn to apply logical reasoning, critical analysis, and problem-solving strategies to advance scientific knowledge in the field.
- **PO4: Communication Skills:** To enhance students' oral and written communication skills, enabling them to effectively present scientific ideas, research findings, and complex concepts to both scientific and non-scientific audiences. Students will learn to prepare scientific reports, research papers, and deliver engaging presentations.
- **PO5: Ethical Considerations:** To instill an understanding of ethical considerations in zoological research and its applications. Students will be aware of the ethical guidelines and principles in animal research and conservation, ensuring the welfare and responsible treatment of animals.
- **PO6: Interdisciplinary Approach:** To encourage students to adopt an interdisciplinary perspective, recognizing the interconnectedness between zoology and other scientific disciplines. Students will develop the ability to collaborate with experts from diverse fields to address complex research questions and contribute to interdisciplinary projects.
- **PO7: Professional Development:** To equip students with professional skills necessary for a successful career in zoology. This includes developing leadership qualities, teamwork abilities, time management skills, and an understanding of professional ethics in the field.
- **PO8: Conservation and Sustainability:** To foster an understanding of the importance of conservation and sustainability in zoology. Students will gain knowledge of conservation strategies, habitat management, and the implications of human activities on animal populations. They will develop skills to contribute to the preservation of biodiversity and the sustainable management of natural resources.
- **PO9: Career Readiness:** To prepare students for diverse career opportunities in academia, research institutions, conservation organizations, zoos, museums, and related fields. Students will acquire the necessary skills, knowledge, and practical experience to excel in their chosen careers in zoology.

- **PO10: Lifelong Learning:** To cultivate a commitment to lifelong learning and professional development in students. They will be encouraged to stay updated with the latest advancements in zoology, engage in continuous learning, and contribute to the field through ongoing research, teaching, and participation in scientific conferences and workshops.

These program objectives aim to guide the curriculum and learning outcomes of the postgraduate programme in Zoology, providing students with a comprehensive education and preparing them for successful careers in the field.

Programme Outcomes for Postgraduate Programme in Zoology:

- **Knowledge and Understanding:** Graduates of the postgraduate programme in Zoology will demonstrate advanced knowledge and understanding of the core concepts, theories, and principles of zoology. They will possess a comprehensive understanding of the diversity, structure, function, behavior, and evolution of animals across various taxonomic groups.
- **Research Skills:** Graduates will be equipped with the necessary skills to conduct independent and original research in the field of zoology. They will be able to design and execute research projects, collect and analyze data using appropriate methodologies, and interpret and present their findings effectively.
- **Critical Thinking and Problem-Solving:** Graduates will develop advanced critical thinking skills, enabling them to evaluate and analyze complex scientific problems related to zoology. They will be able to apply logical reasoning and scientific methodologies to identify and propose innovative solutions to zoological challenges.
- **Communication Skills:** Graduates will possess excellent oral and written communication skills, allowing them to effectively communicate scientific ideas and research findings to both scientific and non-scientific audiences. They will be able to prepare and deliver scientific presentations, write research papers, and effectively communicate their knowledge to a broader community.
- **Ethical Considerations:** Graduates will demonstrate a strong understanding of ethical considerations in zoological research and its applications. They will adhere to ethical principles and guidelines while conducting research involving animals, ensuring the welfare and conservation of animal species.
- **Interdisciplinary Perspective:** Graduates will develop an interdisciplinary perspective, recognizing the connections between zoology and other scientific disciplines. They will be able to collaborate with experts from various fields to address complex research questions and contribute to interdisciplinary research projects.
- **Professional Development:** Graduates will exhibit professional skills necessary for a successful career in zoology. They will have the ability to work both independently and as part of a team, demonstrating leadership qualities, time management, and organizational skills. They will also have a commitment to lifelong learning and staying updated with advancements in the field of zoology.
- **Conservation and Sustainability:** Graduates will understand the importance of conservation and sustainability in the context of zoology. They will possess knowledge of conservation strategies, habitat management, and the impacts of human activities on animal populations. They will contribute to the preservation of biodiversity and the sustainable management of natural resources.

- **Career Readiness:** Graduates will be prepared for a wide range of career opportunities in academia, research institutions, conservation organizations, environmental agencies, zoos, museums, and other related fields. They will have the necessary skills and knowledge to pursue further academic research or professional careers in zoology.
- **Continuous Improvement:** Graduates will engage in continuous professional development, seeking opportunities to enhance their knowledge and skills in zoology. They will actively contribute to the advancement of the field through their research, teaching, and collaborations.

These programme outcomes reflect the expected knowledge, skills, and attributes that students will acquire upon completing a postgraduate programme in Zoology. They aim to prepare graduates for successful careers in the field of zoology, contributing to scientific knowledge and the conservation of animal species.

Assessment framework:

Type of Course	College Assessment Marks	University Assessment Marks
Theory	**40**	**60**
Practical	**40**	**60**
Projects	**100**	**150**

Examination

Each theory and practical course will be 100 marks comprising 40 marks for internal (20 marks for 2 internal examinations) and 60 marks for external examinations. Separate head of passing in Internal and External examinations is mandatory. In case of failure in an internal examination of a particular course, the student will have to appear for the same in the next semester as per the schedule of the examination. In case a student fails in a particular course in a semester and the same course(s) are revised/removed from the curriculum in due course, the student will have to appear as the per new curriculum and or pattern in the subsequent semester at his own responsibility observing the course equivalence.

Term-end examination (60 marks) will be of three hours duration for each theory course. There shall be 5 questions each carrying equal marks (12 marks each) as follows:

1.	**A)**	Answer **any four** of the following.	**12**
	i)		
	ii)		
	iii)		
	iv)		
	v)		
	vi)		
2.		Attempt **any three** of the following.	**12**

	i)		
	ii)		
	iii)		
	iv)		
	v)		
3.		Attempt **any three** of the following.	**12**
	i)		
	ii)		
	iii)		
	iv)		
4.		Attempt **any two** of the following.	**12**
	i)		
	ii)		
	iii)		
5.		Attempt **any two** of the following.	**12**
	i)		
	ii)		
	iii)		

Internal examination (40 marks each semester)

Internal assessment of the student by the respective teacher will be comprehensive and continuous, based on written tests. The written test shall comprise both objective and subjective type questions. Two internal tests (20 marks each) will be conducted during the semester as a part of continuous assessment.

Practical Examination

A practical examination shall be conducted at the end of the semester. Practical examination will be of a minimum 6 hours duration and shall be conducted as per schedule (10 am to 5 pm on scheduled date or can be scheduled 10 am - 1pm/ 2 – 5 pm for 2 consecutive days) in case of Biochemistry practicals where incubation condition, allied aspects are essential. There shall be 5 marks for the laboratory record book and well-written certified journal, 10 marks for viva-voce, and a minimum of three experiments (major and minor). A certified journal is compulsory to appear for practical examination. There shall be one expert and two examiners (external and internal) per batch for the practical examination.

Semester I **Course Title**: Comparative Anatomy of Invertebrates

Course Title/Code: **DSC-25** **ZO 411 Comparative Anatomy of Invertebrates**	Course Credits: **4**
Course Code: **DSC-25**	L-T-P per week: **4-0-0**
Total Contact Hours**: 60**	Duration of Lecture: **1 Hour**
College Assessment (CA) Marks: **40**	University Assessment (UA) Marks:**60**

Course specific objective

- To understand the structural and functional anatomy of Invertebrates.
- To acquire knowledge about locomotory, nutritional and organs of digestion and its mechanism
- To understand the respiratory, excretory and nervous coordinating organization
- To learn about the larval forms, colonial and social life of invertebrates.

Course specific outcomes

After successful completion of this course, students are expected to:

- Enlighten themself with knowledge related to structural & functional anatomy of invertebrate animals.
- Enrich themselves with understanding of organs and systems of locomotory, nutrition, digestion and other vital process.
- Know the larval forms found in invertebrates and their significance.
- Understand the social life in honey bees.

Semester I- Zoology DSC-25 Course Content:

F. Y. M. Sc (Zoology) Sem-I

ZO 411 Comparative Anatomy of Invertebrates

Unit	Topics	Lectures	Marks
1.	A. Taxonomy, their types, Species concept, systematic gradation of animals, nomenclature. B. Organization of Coelom: a. Acoelomates b. Pseudocoelomates c. Coelomates - Protostomia and Deuterostomia C. Locomotion: a. Structure/Ultrastructure of locomotory organelles – Pseudopodia, Cilia, flagella and Myonemes b. Modes of Locomotion: Amoeboid (sol-gel), Flagellar and Ciliary movement.	15	25
2.	A. Nutrition and Digestion: a. Pattern of feeding and digestion in lower metazoan, b. Filter feeding and digestion in polychaeta, c. Filter feeding and digestion in mollusca and Echinodermata B. Respiration: a. Organs of respiration- Gills and lophophores,	15	25

	b. Gills and lungs in Mollusca, c. Tracheal system and mechanism in Insecta, d. Gills respiration and mechanism in Crustacea, e. Respiratory pigments in invertebrates		
3.	A. Excretion and osmoregulation: a. Organs and Mechanism of excretion - Flame cells, Nephridia and Malpighian tubules b. Osmoregulation in terrestrial and aquatic invertebrates. B. Nervous system: a. Primitive nervous system- Coelenterates and Echinodermata, b. Advanced nervous system- Annelida, Arthropoda (Crustacea and Insecta), and c. Mollusca (Cephalopoda)	15	25
4.	A. Invertebrate larvae: a. Larval forms of parasitic invertebrates: Platyhelminthes, b. Larval forms of free living invertebrates: Crustacea, Mollusca and Echinodermata c. Significance of larval forms. B. Social life in invertebrates: a. Polymorphism in Coelenterate (types of polyp and medusa) b. Social life in the honey bee, Ants and Termites C. General account and affinities of Hemichordata	15	25
	Total	**60**	**100**

Suggested Readings:

- Barnes R. O.: The Invertebrates, W. B. Saunders and Co.
- Barrington E.J.W.: Invertebrates, Structure and function,
- homes Nelson and Sons, Ltd., London
- Hyman L.H.: The Invertebrate Volume 1 to 8, McGraw Hill Co. New York
- Jordan, E. L.: The Invertebrates, S. C. Chand, New Delhi.
- Kotpal R. L.: Modern Text book of Zoology: Invertebrates, Rastogi publications, Meerut
- Kotpal R.L.: Protozoa to Echinodermata Series,
- Marshall and William: A text book of Zoology: Invertebrate Vol. I, CBS publishers, New Delhi.
- Prasad S. N.: Life of Invertebrates, Vikas publishing house, New Delhi.
- Russel Hunter : A Biology of higher invertebrates, McMillon Co. Ltd. London

Semester I **Course Title**: Biochemistry

Course Title/Code: **DSC-26** **ZO 412 Biochemistry**	Course Credits: **2**
Course Code: **DSC-26**	L-T-P per week: **2-0-0**
Total Contact Hours**: 30**	Duration of Lecture: **1 Hour**
College Assessment (CA) Marks: **20**	University Assessment (UA) Marks:**30**

Course Objective:

- To acquire knowledge regarding biochemical aspects of life.
- To understand different type of metabolic process and energetics thereof.
- To make students familiar with details of enzymes, classes and factors influencing rate of enzymatic reactions.
- To learn about hormones, neurotransmitters and its mode of action.
- To gain the insight about Proteomics and Genomics with its applications.

Learning outcome:

After successful completion of this course, students are expected to:

- Enlighten themselves with knowledge related to biochemical aspects of life.
- Enrich them with understanding of different type of metabolic process and energetics thereof.
- Know the details of enzymes, classes and factors influencing rate of enzymatic reactions.
- Understand different hormones, neurotransmitters and its mode of action.
- Gain insight about Proteomics and Genomics with its applications

Semester I- Zoology DSC-26 Course Content:

F. Y. M. Sc (Zoology) Sem-I
ZO 412 Biochemistry

Unit	Topics	Lectures	Marks
1.	Water, Acid, Base, Buffer, Buffers in Biological system Derivation of Henderson-Hasselbalch equation, Types of metabolism and energetics	07	10
2.	Enzymes: Definition, Different classes and Examples of enzymes, Factors affecting rate of enzyme reaction Isoenzyme: Lactate dehydrogenase Hormones, types and examples, mode of action of peptide and steroid hormones.	08	15
3.	Neurotransmitters: Types, Synthesis, storage, uptake, degradation and mechanism of action of acetyl choline, GABA, serotonin, dopamine, glutamate, aspartate, nitrous oxide and neuropeptides (Endorphins, enkephalins and substance P)	07	10
4.	Proteomics and genomics: definition, scope and	08	15

	applications. Protein data bank and GenBank.		
	Total	**30**	**50**

Suggested Readings:

- Lehninger, A.L.: Principles in Biochemistry, CBS publication, New Delhi
- Principles and techniques of practical Biochemistry, K. Wilson and J. Walkar, ISBN edition
- Biochemistry: Stryer
- Harper's Biochemistry: Robert Murray, D.K. Granner, Peter A. Mayer and Victor w.
- Rodwell. International 25th edition.
- Biochemistry: Zubay
- Biochemistry: Satyanarayan

Semester I **Course Title**: Biostatistics

Course Title/Code: **DSC-27** **ZO 413 Biostatistics**	Course Credits: **4**
Course Code: **DSC-27**	L-T-P per week: **4-0-0**
Total Contact Hours**: 60**	Duration of Lecture: **1 Hour**
College Assessment (CA) Marks: **40**	University Assessment (UA) Marks:**60**

Course Objective:

- Understand the Fundamentals of Biostatistics: The first objective of the Biostatistics course in Zoology is to provide students with a solid understanding of the fundamental concepts and principles of biostatistics.
- Apply Statistical Methods to Biological Data: The second objective is to enable students to apply statistical methods to analyze and interpret biological data effectively.
- Interpret and Critically Evaluate Research Findings: The Biostatistics course aims to develop students' ability to interpret and critically evaluate research findings in zoology.
- Apply Biostatistics to Experimental Design: The fourth objective is to equip students with the knowledge and skills to apply biostatistics in designing scientific experiments in zoology.

Learning outcome:

- Knowledge and Understanding: Upon completion of the Biostatistics course in zoology, students will demonstrate a solid knowledge and understanding of the fundamental concepts, principles, and techniques of biostatistics.
- Data Analysis Skills: Students will develop the skills to analyze and interpret biological data using appropriate statistical methods.
- Critical Thinking and Interpretation: Students will develop critical thinking skills and the ability to interpret research findings in the context of biostatistics.
- Experimental Design and Statistical Decision-making: Students will learn how to apply biostatistics in experimental design.

Semester I- Zoology DSC-27 Course Content:

F. Y. M. Sc (Zoology) Sem-I
ZO 413 Biostatistics

Unit No.	Content	Lectures	Marks
1.	**Introduction, Sampling and Data Classification** • Applications and uses of statistics. • Meaning of Population, Sample, random sampling. • Methods of collection of Data:- SRSWR, SRAWOR, Systematic random sampling, Stratified random Sampling.	15	25

	• Meaning of variable, discrete variable, continuous variable. • Some important terms: frequency, relative frequency, class limits, class width, inclusive and exclusive method of classification. • Frequency distribution, relative frequency distribution, and cumulative frequency distribution.		
2.	**Graphical representation of grouped data** • Histogram, frequency polygon, Ogive curves. • Exercise and problems. **Measures of central tendency and dispersion:** • Computation of mean, mode and median (for raw data and grouped data) • Computation of variance, SD, coefficient of variation (for raw data and grouped data) • Exercise and problems.	15	25
3.	**Correlation and Regression** • Concept of Correlation, types of correlation, scatter diagram. • Karl-Pearsons's coefficient of correlation (ungrouped data) and its properties. • Concept of Regression, linear regression, regression coefficients and its properties. • Exercise and problems. **Analysis of variance:** • Meaning of ANOVA, one-way and two-way classification. • Linear model of one-way and two-way classification. • Exercise and problems	15	25
4.	**Testing of hypothesis:** • Statistical Hypothesis, Null hypothesis, Alternative hypothesis, critical region, acceptance region, Type I error, Type II error, Level of significance, one tailed and two tailed tests. • Tests Based on large samples: - test of significances of mean, test of significance of difference of means. • Tests based on small samples: - • t- test: Testing single population mean, two population means, paired t-test. • $\chi 2$ – test for testing independence of attributes, single population variance. • F- Test for testing two population variances. • Exercise and problems.	15	25
	Total	**60**	**100**

Suggested Readings:

- N. Gurumani :- An introduction to biostatistics, 2nd revised edition, MJP publishers, Chennai 600 005

- Irfan Ali Khan and Atiya Khanum:- Fundamentals of biostatistics, 3rd edition, Ukaaz publication, Hyderabad
- Dr. Satguru Prasad:- Fundamentals of biostatistics [Biometry], Emkay publications, Delhi 110051
- B.K.Mahajan:- Methods in Biostatistics, Jaypee Brothers, Medical publishers (p) ltd. New Delhi, 110 002
- Principles and practice of Biostatistics :- J.V.Dixit

Zoology Core Lab Course Content

Semester I

Course Title: **DCS-28 : Practical** **ZO 414 Practicals based on Comparative Anatomy of Invertebrates**	Course Credits:**2**
Course Code: **DSC-28**	L-T-P per week: **0-0-4**
Total Contact Hours**: 60**	Duration of Practical: **4 Hours**
College Assessment (CA) Marks: **40**	University Assessment (UA) Marks: **60**

Course Objectives

- To acquire the practical skill about dissection of Grasshopper or Cockroach related to their digestive, nervous and reproductive system.
- To perform mountings of various significant parts of Grasshopper/Cockroach
- Understand the concept of systematics or taxonomic features of invertebrate animals.

Course Outcomes (COs):

After successful completion of this course, students are expected to:

- perform dissection of Grasshopper or Cockroach related to their digestive, nervous and reproductive system.
- acquire practical skills for mountings of various significant parts of Grasshopper/Cockroach
- Classify the invertebrate animals belonging to phylum Porifera to Hemichordata

Lab Course Content
Comparative Anatomy of Invertebrates

List of experiments/practicals to be conducted	
1. Classification and general characters of Invertebrates - Porifera to Annelida up to order (one example from each order) **2.** Classification and general characters of Invertebrates -Arthropoda to Hemichordata up to order (one example from each order) **3. Dissection (Any available animal by showing picture/chart/model) (E)** a. Digestive system (Leech and Cockroach) b. Nervous System (Earthworm and cockroach) c. Reproductive system (Leech and cockroach (Male and Female) **4. Mounting of following – (E)** a. Porifera: Spicules and gemmules b. Earthworm: Ovary and Spermatheca, c. Leech: jaws and Nephridia d. Cockroach: Mouthparts, salivary gland and Trachea e. Larval forms of Parasitic invertebrates: f. Larval forms of free living invertebrates: Zoea, Nauplius, Glochidium,	**60 hours and 50 marks**

Zoology Core Lab Course Content

Semester I

Course Title: **DCS-29 : Practical** **ZO 415 Practicals based on Biochemistry and Biostatistics**	Course Credits:**2**
Course Code: **DSC-29**	L-T-P per week: **0-0-4**
Total Contact Hours**: 60**	Duration of Practical: **4 Hours**
College Assessment (CA) Marks: **40**	University Assessment (UA) Marks: **60**

Course Objectives

- Application of Statistical Software: The first objective of the Biostatistics Practicals is to provide students with hands-on experience in applying statistical software for data analysis.
- Practical Application of Biostatistical Techniques: The second objective is to allow students to apply biostatistical techniques learned in theory to real-world biological datasets through practical exercises, students will have the opportunity to analyze and interpret actual data sets from zoological studies.

Course Outcomes (COs):

- Data Analysis Proficiency: Upon completion of the Biostatistics Practicals, students will demonstrate proficiency in analyzing biological data using appropriate statistical techniques.
- Statistical Software Skills: Students will develop skills in using statistical software for data analysis.
- By the end of the course, students will have the ability to use statistical software effectively to analyze biological data and present their findings visually.

Lab Course Content

Biochemistry

List of experiments/practicals to be conducted	
1. Preparation of buffer of known molarity and pH 2. Estimation of Glycogen from liver of rat/goat/suitable animal 3. Estimation of protein by Lowry method 4. Estimation of crud fat content in food by soxhlet method 5. Study of enzyme inhibition using suitable inhibitor, substrate and enzyme 6. Estimation of sex hormones in blood samples using suitable method 7. Study of Protein structure using PDB file and Ramachandran plot 8. Study of genomic database of human being using GenBank	**30 Hours and 25 marks**

Biostatistics

List of experiments/practicals to be conducted	
1. Construction of frequency distribution and its graphical representation. frequency curve, frequency polygon, ogives) **2.** Computation of mean, mode, and median. (ungrouped and grouped data) **3.** Computation of variance, Sd, and coefficient of variation (ungrouped	**30 Hours and 25 marks**

and grouped data) **4.** Correlation and regression (ungrouped data) **5.** Large sample tests **6.** Small sample tests (Chi-square test, t-test, and F-test) **7.** ANOVA (Based on one-way and two-way classification)	

Suggested Readings:

Biochemistry

- Lehninger, A.L.: Principles in Biochemistry, CBS publication, New Delhi
- Principles and techniques of practical Biochemistry, K. Wilson and J. Walkar, ISBN edition
- Biochemistry: Stryer
- Harper's Biochemistry: Robert Murray, D.K. Granner, Peter A. Mayer and Victor w.
- Rodwell. International 25th edition.
- Biochemistry: Zubay
- Biochemistry: Satyanarayan

Biostatistics

- N. Gurumani :- An introduction to biostatistics, 2nd revised edition, MJP publishers, Chennai 600 005
- Irfan Ali Khan and Atiya Khanum:- Fundamentals of biostatistics, 3rd edition, Ukaaz publication, Hyderabad
- Dr. Satguru Prasad:- Fundamentals of biostatistics [Biometry], Emkay publications, Delhi 110051
- B.K.Mahajan:- Methods in Biostatistics, Jaypee Brothers, Medical publishers (p) ltd. New Delhi, 110 002
- Principles and practice of Biostatistics :- J.V.Dixit

Semester I **Course Title**: Wildlife Conservation and Management

Course Title/Code: **DSE-5** **ZO 416 Wildlife Conservation and Management**	Course Credits: **4**
Course Code: **DSE-5**	L-T-P per week: **4-0-0**
Total Contact Hours**: 60**	Duration of Lecture: **1 Hour**
College Assessment (CA) Marks: **40**	University Assessment (UA) Marks:**60**

Course objectives:

- To provide graduates in Biology a specialization in the field of Biodiversity, Conservation and Wildlife Management
- To generate qualified students who can directly get jobs in the allied fields of Biodiversity, Conservation and Wildlife Management;
- To generate qualified postgraduates who can be part professional organizations working in the field of conservation and environment protection.
- To generate a team of post graduates who can take up jobs related to the environment in educational institutions.

Course Outcomes (COs):

- Skilled post graduates who can undertake research in the field of Biodiversity, Wildlife biology and Nature conservation.
- An alternate avenue to Biology graduates to specialize as "environmental entrepreneurs" in areas such as Environmental audits, Environmental education, Ecotourism etc.
- Awareness about Biodiversity and Nature Conservation.

Semester I- Zoology DSE-5 Course Content:

F. Y. M. Sc (Zoology) Sem-I
ZO 415 Wildlife Conservation and Management

Unit	Topics	Lectures	Marks
1.	**A. Concept of Biodiversity.** a. What is biodiversity b. Types of Biodiversity c. Climatic Zones and Biodiversity d. Biodiversity as a natural resource **B. Wildlife Management** a. Principles of wildlife management b. Wildlife management techniques c. Prey-predator ratio d. Improving carrying capacity Water holes, salt licks, stall feeding, e. Controlled grazing, controlled fire Culling & translocation	15	25
2.	**A. Species Conservation Techniques** a. In situ conservation (Biosphere Reserves, National Parks, Wildlife Sanctuaries, Conservation Reserves,	15	25

	Community reserves). b. Ex-situ conservation (Botanical & Zoological Gardens, Gene Banks, Seed and Seedling Banks, Pollen Culture, Tissue Culture and DNA banks, Butterfly Gardening) c. Concept of Biodiversity Hotspots and Mega-diversity Country; Role of captivity In wildlife management. B. **Habitat Conservation Techniques** a. Concept of Habitat b. Habitat Management c. Habitat Edge improvement d. Role of Corridor in Wildlife Management e. Ecological Restoration Programme; Social Forestry; Agro Forestry; Joint Forest.		
3.	**A. Wildlife conflicts** a. Dealing with Human–Wildlife conflicts Compensating losses b. Regulating forest usage (e.g. grazing at Keoladeo / Gir, Fishing in Sunderbans, Mahua collection in Kanha) **B. People's participation in managing protected areas** a. Integrating Local Community in conservation (e.g. Kaziranga, Eagle's Nest) b. Training & skill development of local human resource c. Interpretation Centers & Interpretation to visitors d. Case studies of success stories: (e.g. Ranthambor, Periyar, Lakswadweep, Van samitis).	15	25
4.	**A. Threats to Biodiversity.** a. Biodiversity of Indian subcontinent b. India as a mega diversity nation c. Factors causing biodiversity degradation d. Concept of species extinction. **B. Wildlife Trade and Laws** a. Wildlife protection Act of India b. CITES c. TRAFFIC d. RED Data Book e. Measures to control poaching & wildlife trad	15	25
	Total	**60**	**100**

Suggested Readings

- Fundamentals of Wildlife Management, Gopal, Rajesh Justice Home, Allahabad, India.
- Wildlife Ecology, Conservation and Management, Anthony R.E. Sinclair, John M. Fryxell and Graeme Caughly, Blackwell Publishing, U.S.A.
- Wild Animals in Central India, Brander, A.A, Natraj Publisher, Dehradun.
- Wild Animals, Their Minds and Manners, Hornaday, W.T. IBD, Dehradun.
- Concepts in Wildlife Management, Hosetti, B.B. Daya Publishing House, Delhi.

- Handbook of Environment, Forest and Wildlife Protection Laws in India, Justice Kuldip Singh, Natraj Publishers, Dehradun.
- Biodiversity conservation in managed and protected areas, Katwal/Banerjee, Agrobios, India.
- Wildlife Issues in a Changing World, Moulton, M. P. & J. Sanderson, St. Lucie Press
- Biodiversity and its conservation in India, Negi, S.S. International Book Distributor, Dehradun.
- Manual for Wildlife Management in India, Negi, S.S. International Book Distributor, Dehradun.
- Fundamentals of Ecology, Odum, Eugene P, Natraj Publishers, Dehradun.
- Essentials of Conservation Biology, Primack, R.B.,
- Sinauer Associates, Inc. Nederland, MA
- Wildlife management, Robert, G.H, W.H. Freeman and Co., San Francisco, U.S.A.

Semester I **Course Title**: Research Methodology

Course Title/Code: **RM** **ZO 417 Research Methodology**	Course Credits: **4**
Course Code: **RM**	L-T-P per week: **4-0-0**
Total Contact Hours**: 60**	Duration of Lecture: **1 Hour**
College Assessment (CA) Marks: **40**	University Assessment (UA) Marks:**60**

Course Objective:
To make the students familiar with the,

- To learn the basics of science, scientific research its importance.
- To learn the Ethics and plagiarism precautions to be taken while doing research.
- To understand the detailed referencing and literature review procedure before beginning the research.
- To understand the process of writing research papers, research project report and research proposal.
- To learn various advanced tools useful for the science and aware about the laboratory safety.

Learning outcome:
On completion of this course, the students will be able to:

- Students will understand the basic concept of science and scientific research.
- Learn and follow the ethical guidelines while doing research avoid plagiarism in research publications.
- Able to write a comprehensive literature review on a given research topic.
- To be able to write a crisp research proposal or research project independently.
- To be learn most advanced chemistry tools for the efficient research work.
- Acquire knowledge about various hazardous chemical handling procedures and implement it while working in the laboratory.

Semester I- Zoology RM - Course Content:

F. Y. M. Sc (Zoology) Sem-I
ZO 417 Research Methodology

Unit	Topics	Lectures	Marks
1.	**Science and Scientific Research** What is Science? Characteristics of Science, Technology and techno-science, Meaning of Research, Characteristics and types of research, Importance of research activities, Principles of quality research work, Problems in research, Scientific attitude and temper, Qualities of good researcher, Scientific community, Non-science and Pseudoscience, Scientific realism.	12	20
	Ref. 1: 1-24 and 49-54; Ref. 2: 1-71; Ref. 3: 1-21.		

2.	**Design and Criteria of Scientific Research** Introduction, Research planning and design, Selection of research topic, Criteria for good research problem, Source of research Idea, Principles of good research, Criteria of good research, Guidelines for research skill and awareness, Research validity and reliability, Artefact and bias in research. • Scientific methodology: Rules and principles of scientific methods, Research methods versus methodology, Hypothesis and testing of hypothesis. Research ethics: Principles and values. • Plagiarism: its types and how to avoid it.	14	25
	Ref. 1: Pages: 1-24, 55-92 and 233-262; Ref. 3: 24-52.		
3.	**Literature Survey** Literature review, Approaching the literature, Scholarly literature, Data provenance and evaluation, Intellectual property. Sources of information: Primary, Secondary, Tertiary sources, Patents, Journals (Print and e-journal), Type of Journals, Conference Proceedings. Journal Impact Factor, Citation index, h-index. Understanding of literature: Reading A Scientific Paper, Abstracts, Current titles, Reviews, Monographs, Books, Current contents, Cross referencing, Indian patent database. • Tools for Digital Literature Survey: Scientific databases, e-journals, INFLIBNET, Shodsindhu, Shodhganga, Google/Google Scholar, ResearchGate, PubMed, finding and citing Information.	14	25
	Ref. 1: 148-180; Ref. 4: 299-317; Ref. 5: 1569-1603		
4.	**Scientific Writing** Introduction to scientific writing, writing science laboratory Notebook. Writing Research Paper: Title, Abstracts, Keywords, Introduction, Material and Methods, Results and discussion, Conclusion, Acknowledgement, References and Supplementary data. Difference between research communication and Review article, Reply to Referee comments for science research paper. Preparation of Poster and Oral Presentation • Writing Proposals: Research grant and its various components	12	20
	Ref. 1: 180-229; Ref. 6: 29-43; Ref. 7: Relevant Pages		
5.	**Advanced Scientific Tools and Laboratory Safety** A) **Advanced Tools:** Tools for citing and referencing: Mendeley, Zotero, Endnote etc. Styles of referencing: Referencing from reputed publishing houses National and International. Online searching Databases: SciFinder, Scopus, Web of Science, ACM Digital Library, ProQuest	08	10

	Biological Sciences (All the databases only introduction). **B) Laboratory Safety** Laboratory safety, Laboratory manual, Lab as a safe place: habits, Cause of accidents and What to do in case of an accident, Personal protective equipment, Emergency equipment for general purpose. Laboratory ventilation.		
	Ref. 8 and 9: Relevant Pages Ref. 10 onwards: Relevant Pages and Links		
	Total	**60**	**100**

Suggested Readings:

1. Research Methodology for Scientific Research, K. Prathapan, I.K. International Pvt. Ltd., New Delhi – 110002, (2019).
2. Research Methodology: The Aims, Practices and Ethics of Science, Peter Pruzan, Springer International Publishing (2016).
3. Research Methodology: Methods and Techniques, 3rd edition, Kothari, C.R. Published by New Age International (P) Ltd., Publishers (2004).
4. Teaching to Avoid Plagiarism How To Promote Good Source, Diane Pecorari, Use-Open University Press (2013).
5. APPENDIX A: The Literature of Organic Chemistry March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure, Seventh Edition, by Michael B. Smith and Jerry March Copyright John Wiley & Sons, Inc. (2013).
6. Joaquín Isac-García, José A. Dobado, Francisco G. Calvo-Flores, Henar Martínez-García - Experimental Organic Chemistry laboratory manual, Academic Press (2016)
7. A Practical Guide to Scientific Writing in Chemistry Scientific Papers, Research Grants and Book Proposals Tyowua, A. T., CRC Press is an imprint of Taylor & Francis Group, LLC (2023).
8. Chemical Information for Chemists: A Primer, edited by Currano, J. N., Roth, D. L. Publisher The Royal Society of Chemistry (2014).
9. Handbook of Safety in Science Laboratories Education Bureau Kowloon Tong Education Services Centre, Hong Kong (2013).
10. A Manual for Referencing Styles in Research, M. H. Alvi (2016)
11. https://academic.oup.com/pages/authoring/books/preparing-your-manuscript/referencing-styles
12. https://revvitysignals.com/products/research/chemdraw
13. LaTeX Beginner's Guide, Stefan Kottwitz, Packt Publishing, http://static.latexstudio.net/wp-content/uploads/2015/03/LaTeX_Beginners_Guide.pdf
14. Falagas, M.E., Pitsouni, E.I., Malietzis, G.A. and Pappas, G. (2008), Comparison of PubMed, Scopus, Web of Science, and Google Scholar: strengths and weaknesses. The FASEB Journal, 22: 338-342. https://doi.org/10.1096/fj.07-9492LSF
15. Plagiarism, Citation and Referencing: Issues and Styles, A Manual for Referencing Styles in Research, Mohsin Hassan Alvi, DOI: 10.13140/RG.2.1.5149.6408 http://bit.ly/46nFwYi
16. Citation tools: Easing up the researchers' efforts, Dhiraj Kumar, Gyankosh: The Journal of Lib. & Info. Management Vol 4 No. 2 Jul-Dec, 2013
17. Citation Management: How to use citation managers such as EndNote and Zotero.
18. URL: https://guides.lib.uchicago.edu/citationmanagement

19. https://pubs.acs.org/doi/full/10.1021/acsguide.40303
20. https://edu.rsc.org/resources/how-to-reference-using-the-rsc-style/1664.article
21. https://www.springer.com/gp/authors-editors/journal-author/journal-author-helpdesk/preparation/1276
22. https://service.elsevier.com/app/answers/detail/a_id/28224/supporthub/publishing/
23. EndNote: A comprehensive guide to the reference management software EndNote. URL: https://aut.ac.nz.libguides.com/endnote
24. Zotero: Learn how to use the reference management software Zotero. URL: https://aut.ac.nz.libguides.com/zotero
25. Mendeley: Learn how to use the reference management programme Mendeley. URL: https://aut.ac.nz.libguides.com/mendeley
26. Grammarly User Guide, https://bpb-ap se2.wpmucdn.com/blogs.auckland.ac.nz/dist/3/316/files/2020/02/Grammarly-Manual-Feb-2020-1.pdf
27. Online Resources: Publishers, Chemical Societies, Electronic Journals etc.: https://www-jmg.ch.cam.ac.uk/data/c2k/cj/
28. https://scholar.google.com/
29. https://shodhganga.inflibnet.ac.in/
30. https://patents.google.com/
31. https://ipindia.gov.in/history-of-indian-patent-system.htm
32. https://www.cas.org/about-us
33. https://clarivate.com/products/scientific-and-academic-research/research-discovery-and-workflow-solutions/webofscience-platform/
34. https://www.mendeley.com/guides

SEMESTER II

Semester II **Course Title**: Comparative Anatomy of Vertebrates

Course Title/Code: **DSC-30** **ZO 421 Comparative Anatomy of Vertebrates**	Course Credits: **4**
Course Code: **DSC-30**	L-T-P per week: **4-0-0**
Total Contact Hours**: 60**	Duration of Lecture: **1 Hour**
College Assessment (CA) Marks: **40**	University Assessment (UA) Marks:**60**

Course Objective:

- Understand the basic principles of comparative anatomy: The primary objective of this course is to provide students with a comprehensive understanding of the fundamental principles of comparative anatomy.
- Develop skills in anatomical observation and comparison: Another key objective of the course is to develop students' skills in anatomical observation and comparison.
- Explore the evolutionary relationships among vertebrate groups: Comparative anatomy provides valuable insights into the evolutionary relationships among different vertebrate groups.
- Apply comparative anatomy to broader scientific contexts: The final objective of the course is to enable students to apply their knowledge of comparative anatomy to broader scientific contexts.

Learning outcome:

- Demonstrate a thorough understanding of vertebrate anatomy: Upon completing the course, students will be able to demonstrate a comprehensive understanding of the anatomical structures and systems found in different vertebrate groups.
- Apply comparative approaches to analyze anatomical variations: Students will develop the ability to apply comparative approaches to analyze and interpret anatomical variations among vertebrate organisms.
- Evaluate and interpret phylogenetic relationships: Students will gain the skills to evaluate and interpret the phylogenetic relationships among vertebrate groups based on anatomical evidence.
- Apply knowledge of comparative anatomy to scientific research and applications: The course will equip students with the ability to apply their knowledge of comparative anatomy to broader scientific contexts and practical applications.

Semester II- Zoology DSC-30 Course Content:

F. Y. M. Sc (Zoology) Sem-II

ZO 421 Comparative Anatomy of Vertebrates

Unit	Topics	Lectures	Marks
1.	A. Origin and ancestry of Chordates B. General organization and affinities of Cyclostomata C. General organization and affinities of	15	25

	Cephalochordata D. General characters and affinities of Dipnoi E. Vertebrate integument, functions and its derivatives (epidermal glands, scales, hoof, horns and claws, nails, hooves and baleen).		
2.	**A.** Adaptive radiation 1. Origin and evolution in Amphibians 2. Adaptive radiation in extinct Reptiles. 3. Origin and ancestry of Birds 4. Evolution of Man. **B. Study of Endoskeleton of Rabbit** 1. Axial Skeleton: Skull, Vertebral Column, Rib Cage a. 2. Appendicular Skeleton: Girdles and appendages.	15	25
3.	A. Organs and mechanism of respiration in Pisces and Amphibia. B. Evolution of Aortic arches. C. Comparative anatomy of brain in Scoliodon, Frog, Calotes, Pigeon and Rat D. Comparative study of heart in Scoliodon, Frog, Calotes, Pigeon and Rat E. Comparative study of urinogenital organs in Scoliodon, Frog, Calotes, Pigeon and Rat	15	25
4.	**A.** Receptor organs in Scoliodon, Frog, Lizard, Pigeon, Rabbit: 1. Olfactory 2. Gustatory 3. Photoreceptors (Eye) 4. Statoacoustic (internal Ear) **B. General topics** 1. Interesting features of Sphenodon. 2. Interesting features of Archaeopteryx 3. Parental care in Amphibians. 4. Migration in fishes and Birds. 5. Accessory respiratory organs in fishes.	15	25
	Total	**60**	**100**

Suggested Readings

- Young, J.Z.: Life of Vertebrates. The Oxford University Press, London.
- Parker and Haswell: Text book of Zoology vol. II
- Goodrich. Structure and Development of Vertebrates Vol.I and II.
- Watermann, A.J.: Chordate Structure and Function, Mac Millan Co. New York.
- Weichert C.K.: Anatomy of Chordates 4th edn. MC Graw Hill Books Co. New York.
- Comparative Anatomy of Vertebrates- R.K. Saxena and Sumitra Saxena, Viva Books.
- Comparative Anatomy and Developmental Biology R.L. Kotpal, Sastry& Shukla-Rastogi publication
- Kardong K, Vertebrates: Comparative Anatomy, Function and Evolution, McGraw-Hill Companies, USA.

- Kent CG and Carr R, Comparative Anatomy of Vertebrates, McGraw-Hill Companies, USA.
- Liem KF and Franklin W, Functional Anatomy of the Vertebrates: an Evolutionary Perspective, Harcourt College Publishers, California.
- Wolff RG, Functional Chordate Anatomy, Amazon Publication, UK.
- Hildebrand, M. (1995). Analysis of Vertebrate Structure. John Wiley & Sons.

Semester II **Course Title**: Immunology

Course Title /Code: **DSC- 31** **ZO 422 Immunology**	CourseCredits:**2**
Course Code: **DSC- 31**	L-T-P per week: **2-0-0**
Total Contact Hours**: 30**	Duration of Lecture: **1 Hour**
College Assessment (CA) Marks:**20**	University Assessment (UA) Marks:**30**

Course objectives:

Upon successful completion students will –

- Understand all basics components of the immune system.
- get knowledge of how the immune system works building on their previous knowledge from biochemistry, genetics, cell biology and microbiology;
- understand the role of cytokines in immunity and immune cell activation; and be able to identify and characterize cytokines of particular immune importance;
- understand the significance the Major Histocompatibility Complex in terms of immune response and transplantation;

Course Outcomes (COs):

- Healthy immunity accomplishes four essential principles:
  - ability to detect and fight off infection;
  - ability to recognize a host's own cells as "self," thereby protecting them from attack;
  - a memory from previous foreign infections; and
  - ability to limit the response after the pathogen has been removed.
- This subject will describe the development, function and regulation of cells of the immune system; immunoglobulins; cytokines; immunological mechanisms operating in immunity to infectious disease; autoimmunity; hypersensitivity; and transplantation and tumour immunology.
- Immunology study helps to explain how the body's defense system (the immune system) functions and treat patients with immune system disorders.
- One can provide support for the diagnosis and management of conditions such as HIV, multiple sclerosis and tuberculosis.

Semester II- Zoology DSC-31 Course Content:

F. Y. M. Sc (Zoology) Sem-II
ZO 422 Immunology

Unit	Content	Lectures	Marks
1	**A. INTRODUCTION** a. Introduction- immunity- types-innate, acquired. b. Primary and Secondary lymphoid organs, lymphoid tissues. c. Immunoreactive cells- structure and functions-macrophages, granulocytes, NK cells, d. T and B lymphocytes – origin, development, differentiation, lymphocyte e. Sub-population in humans.	7	10
2	**A. ANTIGENS & IMMUNOGLOBUINS**	8	15

	a. Antigens and immunogenicity- terminologies and definition- antigen, immunogen, haptens, super antigen, tolerates, epitope, paratope. b. Features associated with antigenicity and immunogenicity. c. Basis of antigen specificity. MHC – types and importance- distribution and function. d. Antigen processing and presentation to T- lymphocytes. e. Immunoglobulin- structure, types, distribution, biological and chemical properties . f. Theories of antibody production- its regulation and diversity. g. Monoclonal and polyclonal antibodies. h. Complement system – mode of activation- Classical, Alternate and Lectin **i.** Pathways, biological functions.		
3	**A. IMMUNE RESPONSE** a. Antigen recognition – TCR, BCR, MHC restriction, b. Lymphocyte activation, c. Clonal proliferation and differentiation. d. Physiology of acquired immune response – various phases of HI, e. CMI – cell mediated cytotoxicity, f. DTH response.	7	10
4	**A. HYPERSENSITIVITY** a. Hypersensitivity – types and mechanisms, • Type I: reaction mediated by IgE antibodies. • Type II: cytotoxic reaction mediated by IgG or IgM antibodies. • Type III: reaction mediated by immune complexes. • Type IV: delayed reaction mediated by cellular response. **b.** Autoimmunity, immune response during bacterial (tuberculosis), parasitic (malaria) and viral (HIV) infections, c. Detection of molecules using ELISA, RIA, western blot, detection of molecules in living cells, immunoprecipitation, flow cytometry, immunofluorescence microscopy, in situ localization by techniques such as FISH and GISH d. Immune regulation mechanisms – brief account on immuno-induction, immunosuppression, immuno-tolerance, immuno-potentiation. e. Role of cytokines, lymphokines and chemokines	8	15
	Total	**30**	**50**

Suggested readings-

- Kuby J. (1996) Immunology. 3rd Ed. W. H. Freeman and Co, New York
- Pancer Z. and Cooper M. D. (2006). The Evolution of Adaptive Immunity, Ann. Rev. Immunol., 24: 497–518
- Pathak S. S. and Palan V. (1997) Immunology - Essential and Fundamental. Pareen Publications Bombay.
- Roitt E., Brostoff J. and Male D. (1993) Immunology. 6th Ed. Mosby and Co. London.
- Roitt I. M. (1988). Essentials of Immunology. ELBS, London.
- Roitt M. (1984). Essentials of Immunology. P. G. Publishers Pvt. Ltd., New Delhi.
- Stites D. P., Stobo J. D., Fudenberg H. H. and Wells J. V. (1982). Basic and Clinical Immunology. l 4th Ed. Lange Medical Publications. Maruzen Asia Pvt. Ltd., Singapore
- Talwar G. P. (1983) Handbook of Immunology, Vikas Publishing Pvt. Ltd. New Delhi.

Semester II **Course Title**: Tools and Techniques in Life Sciences

Course Title/Code: **DSC-32** **ZO 423 Tools and Techniques in Life Sciences**	Course Credits: **4**
Course Code: **DSC-32**	L-T-P per week: **4-0-0**
Total Contact Hours**: 60**	Duration of Lecture: **1 Hour**
College Assessment (CA) Marks: **40**	University Assessment (UA) Marks:**60**

Course Objective:

- Introduction to Essential Tools and Techniques: The first objective of the course is to introduce students to a range of essential tools and techniques used in life sciences research in the field of zoology.
- Hands-on Experience with Laboratory Techniques: The second objective is to provide students with hands-on experience in using various laboratory techniques relevant to zoology.
- Field Sampling and Data Collection Methods: Students will learn about field sampling techniques and data collection methods specific to zoology.
- Data Analysis and Interpretation: Students will learn how to analyze and interpret data collected using tools and techniques in life sciences.

Learning outcome:

- Proficiency in Laboratory Techniques: Upon completion of the course on Tools and Techniques in Life Sciences in Zoology, students will demonstrate proficiency in performing various laboratory techniques.
- Familiarity with Advanced Research Tools and Instruments: Students will develop a strong familiarity with advanced research tools and instruments used in zoological research.
- Competence in Field Sampling and Data Collection: Students will acquire competence in field sampling techniques and data collection methods specific to zoology.
- Data Analysis and Interpretation Skills: Students will develop data analysis and interpretation skills related to tools and techniques in life sciences.

Semester II- Zoology DSC-32 Course Content:

F. Y. M. Sc (Zoology) Sem-II

ZO423 Tools and Techniques in Life Sciences

Unit No.	Name of Topic	Lectures	Marks
1.	Principle, parts and its applications of microscopic techniques: a) Mircoscope: Light, phase contrast, interference, fluorescence, polarization. b) Inverted and electron microscopy. Principles and Uses of analytical instruments-	15	25

	a) Balances, pH meter, colorimeter, spectrophotometer. b) Densitometric scanner, spectrofluorometer, chemiluminometer. c) Radioactivity counter, Differential scanning calorimeter. d) ESR and NMR spectrometers.		
2.	Principle, instrumentation and application of - a) UV-Vis spectrophotometer, b) Colorimeter c) Fluorimeter a) Electrophoresis: Principle, types and applications of agrose gel electrophoresis, starch, SDS and PAGE electrophoresis. b) Radioactivity: Radioisotopes, half life units, Geiger Muller counter, gamma counter and scintillation, safety guidelines.	15	25
3.	Principle, instrumentation and application of - a) Centrifuge: Basic principle, type analytical and preparative centrifuges, different density gradient centrifuge and analytical with its application b) Incubator, hot air oven and autoclave: Principle, instrument and its application. c) pH meter: Principle types, types of electrodes and application. d) Freezers, coolers, platelet agitators, cryo thawing baths. Cell culture techniques a) Design and functioning of tissue culture laboratory b) Cell proliferation measurement c) Cell viability testing d) Culture media preparation and cell harvesting methods	15	25
4.	Separation techniques in biology a) Molecular separation by chromatography, Precipitation. b) Organelles separation by centrifugation etc. c) Cell separation by flowcytometry, density gradient centrifugation, unit gravity centrifugation, affinity adsorption, anchorage base techniques. a) Immunological techniques based on antigen-antibody interaction – Principle and applications. b) Biosensors.	15	25
	Total	**60**	**100**

Suggested Readings:

- Plummer, L: Practical Biochemistry Tata McGraw-Hill.
- Bullock, J. D., Kristiansen, B.- Basic Biotechnology, 1987, academic press,New York.
- Prave, P. Faust, V., Sitting, W &Sukatsch, D.A.- Fundamental ofBiotechnology, VCLPublishers, New York. 1987.
- Spier, R. E. and Griffins, J.B.- Animal Cell Biotechnology, Vol. I&II,Academic Press,Orlande, 1985.
- KeshavTrehan- Biotechnology. Wiley Estern Limited, Bangalore, 1990.
- D. B. Tembhare- Techniques in Life Sciences, Himalaya Publishing House.
- T. Poddar, S. Mukhopadhyay, S. K. Das- An Advanced Laboratory Manual Of Zoology, MACMILLAN.
- Keith Wilson, John Walker Principles and Techniques of Practical Biochemistry (Wilson, Principles and Techniques of Practical Biochemistry)

Zoology Core Lab Course Content

Semester II

Course Title: **DSC-33 : Practical** **ZO 424 Practicals based on Comparative Anatomy of Vertebrates**	Course Credits:**2**
Course Code: **DSC-33**	L-T-P per week: **0-0-4**
Total Contact Hours**: 60**	Duration of Practical: **4 Hours**
College Assessment (CA) Marks: **40**	University Assessment (UA) Marks: **60**

Course Outcomes (COs):

- Develop proficiency in anatomical specimen preparation: The primary objective of the practical component of this course is to develop students' practical skills in anatomical dissections and specimen preparation.
- Identify and describe anatomical structures through hands-on observation: The practical sessions will enable students to identify and describe anatomical structures of vertebrates through hands-on observation.
- Apply comparative approaches to analyze anatomical variations: Students will learn to apply comparative approaches during practical sessions to analyze and interpret anatomical variations among vertebrate organisms.
- Acquire data collection and analysis skills for anatomical research: The practical component will provide students with valuable skills in data collection and analysis for anatomical research.

Learning outcomes

- Demonstrate proficiency in anatomical dissections and specimen preparation: Upon completion of the practical component, students will be able to demonstrate proficiency in anatomical dissections and specimen preparation.
- Apply comparative approaches to analyze and interpret anatomical variations: Students will develop the ability to apply comparative approaches during practical sessions to analyze and interpret anatomical variations among vertebrate organisms.
- Acquire data collection and analysis skills for anatomical research: Through practical sessions, students will acquire data collection and analysis skills for anatomical research.
- Demonstrate effective communication of anatomical findings: Students will develop effective communication skills for presenting and communicating their anatomical findings.

Lab Course Content

Comparative Anatomy of Vertebrates

Title of Practical	60 Hours and 50 marks
1. Classification and general characters of vertebrates - Urochordata to Amphibia up to order (one example from each order) 2. Classification and general characters of vertebrates - Reptilia to Mammalia up to	

order (one example from each order) 3. Study of Axial and Appendicular skeleton of Rabbit. 4. Study of Heart of Scoliodon, Frog, Calotes, Pigeon, Rat. 5. Study of Brain of Scoliodon, Frog, Calotes, Pigeon, Rat. 6. Study of eye ball muscles of Scoliodon. 7. Study of Internal ear in Scoliodon, Frog, Calotes, Pigeon, Rat. 8. Accessory respiratory organs in fish.	

Suggested Readings:

- Alexander, R. M.: The chordate. Cambridge University press Lodon.
- Ballairs- Reptiles (Hutchinson)
- Bourne, G. M.: The structure and function of nervous tissue. Academic Press, Newyork.
- Carter, G. S.: Structure and Habit in vertebrate evolutions. Sedgwich and Jackson London.
- Eecles, J. C.: The understanding of the brain. McGraw hill Co., Newyork.
- Hyman : Comparative vertebrate Anatomy, University of Chicago Perss.
- Green : Anatomy of Rat (Hafner)
- Kingsley J.S. : outlines of comparative Anatomy of Vertebrates (Central book Depot, Allahabad)

Zoology Core Lab Course Content

Semester II

Course Title: **DSC-34 : Practical** **ZO 425 Practicals based on Immunology and Tools and Techniques in Life Sciences**	Course Credits:**2**
Course Code: **DSC-33**	L-T-P per week: **0-0-4**
Total Contact Hours**: 60**	Duration of Practical: **4 Hours**
College Assessment (CA) Marks: **40**	University Assessment (UA) Marks: **60**

Course Objectives:

- Develop proficiency in essential immunological laboratory techniques: The primary objective of the practical component in immunology is to develop students' proficiency in essential immunological laboratory techniques.
- Apply immunological techniques to investigate immune responses and diseases: The practical sessions will provide students with the opportunity to apply immunological techniques to investigate immune responses and diseases.
- Develop proficiency in essential laboratory tools and techniques: The primary objective of the practical component in Tools and Techniques in Life Sciences is to develop students' proficiency in essential laboratory tools and techniques.
- Apply laboratory tools and techniques to solve research questions: The practical sessions will provide students with opportunities to apply laboratory tools and techniques to solve research questions in the life sciences.

Course Outcomes (COs):

The student will …..

- Demonstrate proficiency in immunological laboratory techniques: Upon completion of the practical component, students will demonstrate proficiency in a variety of immunological laboratory techniques.
- Apply immunological techniques to investigate immune responses and diseases: The practical sessions will enable students to apply immunological techniques to investigate immune responses and diseases.
- Demonstrate proficiency in a range of laboratory tools and techniques: Upon completion of the practical component, students will demonstrate proficiency in a range of laboratory tools and techniques commonly used in life sciences.
- Apply laboratory tools and techniques to investigate biological phenomena: The practical sessions will enable students to apply laboratory tools and techniques to investigate and analyze biological phenomena.

Lab Course Content

Immunology

List of experiments / practicals to be conducted	
1) Blood Grouping 2) Chemistry of immunoglobulin molecules, classes and physiological importance. 3) Use of ELISA technique (HIV) or any suitable method 4) Isolation and purification Bovine serum immunoglobulin G (IgG) fraction by suitable method 5) Study of agglutination reaction and its significance performing WIDAL test. 6) Determination of Antigen and Antibody reaction by using any suitable method 7) **Demonstrations of:**	**30 Hours and 50 marks**

a. Serum protein separation by electrophoresis b. ELISA (Antigen/ Antibody detection) c. Egg inoculation technique	

Tools and Techniques in Life Sciences

List of experiments / practicals to be conducted	
1. Calibration of pH meter. 2. Study of Compound and Phase Contrast microscopy. 3. To verify Beer-Lamberts Law. 4. Cell fractionation by using density gradient centrifuge (any suitable gradient) 5. Test Cell viability and counting. 6. Determination of Molecular Weight of DNA by electrophoresis 7. Study of agglutination reaction and its significance performing WIDAL test.	**30 Hours and 50 marks**

Suggested Readings:

- Pravash Sen. Gupta, Clinical Immunology; Oxford University Press. 2003.
- Noel R. Rose, Herman Friedman, John L. Fahey, Manual of Clinical Laboratory Immunology. ASM. III edition; 1986.
- Frank C. Hay, Olwyn M. R. Westwood, Practical Immunology, 4th Edition ISBN: 978-1-405-14673-9 April 2008 Wiley-Blackwell
- Leslie Hudson and Frank C. Hay, Practical Immunology, Blackwell Scientific Publication. Ed.3; 1989.
- Goding J.W., Monoclonal Antibodies: Principle and Practice; Academic Press. 2001.
- Carl A. K. Borrebacck, Antibody Engineering, Oxford University Press. Ed.2; 1995.
- Leonore A. Herzenberg, Donald M. Weir, Leonard A. Herzenberg, Caroline Blackwell, Weir's Handbook of Experimental Immunology, Vol. I – IV; Blackwell Science. 1996.
- Stefan H.E. Kaufmann and Dieter Kabelitz, Immunology of Infection. Methods in Microbiology. Vol. 25; Academic Press. 1998.
- Sringer, T.A, Hybridoma Technology in the Biosciences and Medicine; Plenum Press. New York. 2004.
- Garrison Fathman. C., Fitch, F.W., Isolation, Characterization and Utilization of T lymphocyte clones; Academic Press. 2003.
- G.P.Talwar and S.K.Gupta., A Handbook of Practical and Clinical Immunology, Vol.I-II; CBS Publishers and Distributors. Delhi. 1993

Semester II **Course Title**: Environmental Biology

Course Title/Code: **DSE-6** **ZO 426 Environmental Biology**	Course Credits: **4**
Course Code: **DSC-6**	L-T-P per week: **4-0-0**
Total Contact Hours**: 60**	Duration of Lecture: **1 Hour**
College Assessment (CA) Marks: **40**	University Assessment (UA) Marks:**60**

Course Objective:

- To understand the Population and age structure of Population
- To understand Growth of organism and models of population growth
- To acquire knowledge of prey-predator system
- To know Competition in Nature and concept of niche
- To understand Community, Diversity and Ecological Succession
- To Understanding the need of conservation

Learning outcome:

After successful completion of this course, students are expected to:

- Enrich with the knowledge of Population and its structure
- Know the Growth of organism and models of population growth
- Understand the prey-predator system
- Understand Meaning of Competition in Nature and how the concept of niche evolved
- Know the community structure, significance of species diversity and Concept of Ecological Succession
- Elucidate the how conservation is important for species diversity and ultimately humans

Semester II- Zoology DSE-6 Course Content:

F. Y. M. Sc (Zoology) Sem-II

ZO 426 Environmental Biology

Unit	Topics	Lectures	Marks
1.	**A. Ecology Of Population** • Population Ecology, Characteristic of population (Population density, Methods of measuring population Density), Population growth curve (Exponential growth, Logistic growth), Population regulation, Life history strategies (R & K selection), Age structure Population	15	25
2.	**A. Population Growth** • Population Growth, Growth of organism with non-overlapping generation, Effect of Overlapping Generations, Stochastic and time lag model of population growth, Exponential growth, Verhulst–Pearl logistic growth model, Semelparous and Iteroparous Reproductive strategies, Stable age distribution **B. Predation** • Predation, Patterns of abundance Models of	15	25

	• Prey-Predation dynamics (discrete generation and continuous generation Systems), Optimal foraging theory, Patch choice, Diet Prey Selectivity Foraging time, Role of predation in nature		
3.	**A. Competition And Niche Theory** • Species competition, Intra-specific competition, Inter-specific competition, History of niche concepts (Grinnellian and Eltonian Niche; Hutchinsonian niche and Modern Niche Theory), Symbiosis and its classification	15	25
4.	**A. Community Ecology And Ecological Succession** • Nature of Community, Community Structure (Factors to shape community, Shannon Wiener Diversity Index and Simpson index), Keystone species, Level of species diversity, Measurement of Biological Diversity, Factors affecting species diversity, Edges & Ecotones, Succession & Type of Ecological Succession, Concept of Climax **B. Conservation Biology** • Principle of Conservation, Goal of Conservation biology, Need of conservation Biology, Major drivers of diversity changes-Direct and indirect Drivers.	15	25
	Total	**60**	**100**

Suggested Readings

- M Ausloos and M Dirickx (eds.), The logistic map and the route to chaos: From the beginnings to modern applications, Understanding Complex Systems (Springer, Berlin, 2006).
- J R Miner, Pierre-François Verhulst, the discoverer of the logistic curve, Human Biology 5 (1933), 673-689.
- Fundamental Of Ecology by Dash Madhab Chandra, Dash Satya Prakash The Mc Graw Hill Edition 3rd Edition 2009.
- Environmental biology (principle of ecology) by Verma P.S, Agarwal V.K S.Chand publication second edition reprint 2013.
- Sharma, P.D. (2003) Ecology and Environment. 7th Edition, Rastogi Publication, Meerut.
- General book of Ecology by P.D. Sharma

Course Title/Code: **OJT ZO 427 On Job Training**	Course Credits: **4**
Course Code: **OJT ZO 427**	L-T-P per week: **8-0-0**
Total Contact Hours**: 60**	Duration of Lecture: **1 Hour**
College Assessment (CA) Marks: **40**	University Assessment (UA) Marks:**60**

Students need to complete one month on job training (OJT) or internship (Int.) in any industry related to major subject.

Guidelines for Individual/ Team Projects and Field Reports

The aim of the individual/ team project/s is to develop an aptitude for research in Zoology and to inculcate proficiency to identify appropriate research topic and presentation.

The topics of biological interest and significance can be selected for the project. Project is to be done by a group not exceeding 5 students. The project report should be submitted on typed A4 paper, 12 Font, 1.5 Space in spirally bound form and duly attested by the supervising teacher and the Head of the Department on the day of practical examination before a board of two Examiners for End Semester. The viva-voce based on the project is conducted individually. Project topic once chosen shall not be repeated by any later batches of students.

The project report may have the following sections:

1. Preliminary (Title page, declaration, certificate of the supervising teacher, content etc.)
2. Introduction with relevant literature review and objective
3. Materials and Methods
4. Result
5. Discussion
6. Conclusion / Summary
7. References.

Field Study/ Study tour

Students have to visit one research institute and one wild life sanctuary / museum / zoo. Scientifically prepared hand-written study tour report along with photographs of candidate at the places of visit must be submitted by each student for End Semester on the day of the examination of project.

On-the-job training in zoology provides practical skills, exposure to real-world scenarios, and networking opportunities within the field. It enhances participants' employability, allows them to explore specific areas of interest, and complements their academic knowledge with practical experience. It is important to note that the availability of on-the-job training programs may vary based on geographical location and the specific institutions and organizations within the field of zoology.

Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon

FACULTY OF SCIENCE AND TECHNOLOG, M.Sc. (Computer Science) PROGRAMME WEF 2023-24

Credit distribution structure for Two Years/One Year PG Degree

Year (2 Yr PG)	Level	Sem (2Yr)	Major (Core) Subjects		RM	OJT/FP	RP	Cumulative Credits	Degree
			Mandatory (DSC)	Elective(DSE)					
I	6.0	Sem-I	CS-411: Artificial Intelligence (4)(T) CS-412: Optimization of Algorithms (2)(T) CS-413: Current Computing Trends in Java (4)(T) CS-414: Lab on Artificial Intelligence (2)(P) CS-415: Lab on Current Computing Trends in Java (2)(P)	CSE-416 (A): Big Data Analytics (4)(T) **OR** CSE-416 (B): Cloud Computing (4)(T)	RM-417: Research Methodology (4)	---	---	22	PG Diploma (After 1 Yr PG Degree)
		Sem-II	CS-421: Data Warehousing and Data Mining (4)(T) CS-422: Angular JS (2)(T) CS-423: Compiler Construction (4)(T) CS-424: Lab on Data Warehousing and Data Mining (2)(P) CS-425: Lab on Angular JS (2)(P)	CSE-426 (A1): Web Analytics (2)(T) CSE-426 (A2): Lab on Web Analytics (2)(P) **OR** CSE-426 (B1): Soft Computing (2)(T) CSE-426 (B2): Lab on Soft Computing (2)(P)	---	--	CS-427: Field Project /On Job Training (4)	22	
Cum. Cr. For PG Diploma			**28**	**8**	**4**	**-**	**4**	**44**	
Exit option: PG Diploma(44Credits)after Three Year UG Degree									
II	6.5	Sem-III	CS-511: Network Programming (4)(T) CS-512: Design and Analysis of Algorithm (4)(T) CS-513: Digital Image Processing (2)(T) CS-514: Lab on Network Programming (2)(P) CS-515: Lab on Digital Image Processing (2)(P)	CSE-516 (A): Ethical Hacking (4)(T) **OR** CSE-516 (B): Internet of Things (4)(T) **OR** CSE-516 (C): Swayam/NPTEL Course (T)	---	---	CS-517: Research Project (4)	22	PG Degree (After 2-Yr PG)
		Sem-IV	CS-521: Advanced Operating System (4)(T) CS-522: Machine Learning with Python (4)(T) CS-523: Lab on Advanced Operating System (2)(P) CS-524: Lab on Machine Learning with Python (2)(P)	CSE-525 (A): Network Security & Firewall (4)(T) **OR** CSE-525 (B): Natural Language Processing (4)(T) **OR** CSE-525 (C): Swayam/NPTEL Course (T)	---	CS-526: Research Project (6)	--	22	
Cum. Cr. for 1 Yr PG Degree			**26**	**8**	**---**	**6**	**4**	**44**	
Cum. Cr. For 2 Yr PG Degree			**54**	**16**	**4**	**6**	**8**	**88**	

2 Years-4 Sem.PG Degree (88credits) after Three Year UG Degree or1Year-2Sem PG Degree (44credits) after Four Year UG

Abbreviations: Yr.: Year; Sem.: Semester; OJT: On Job Training: Internship/ Apprenticeship; FP: Field projects; RM: Research Methodology; ResearchProject:RP;CumulativeCredits:Cum.Cr.,CW:Coursework,T-TheoryCourse,P–Practicalcourse,DSC-DisciplineSpecificCoreCourse,DSE-DisciplineSpecificElective Course.

Note: The courses which do not have practical,'P'will be treated as'T'.

FACULTY OF SCIENCE AND TECHNOLOGY, PGDEGREE M.Sc. (Computer Science) PROGRAMME

Credit distribution structure For Two Years/One Year PG M.Sc.(Computer Science) Degree Programme

BoS: Computer Science

Teaching and Examination Scheme, Master of Science M.Sc. (Computer Science) WEF 2023-24

M.Sc. (Level 6.0) Sem-I (Name of Courses for -Major, RM, OJT, RP courses)

Sr. No.	Course Category	Name of the course(Title of the Paper)	Total Credit	Hours/ Semester	Teaching Scheme (hrs/week)		Evaluation Scheme		
					Theory	Practical	Continuous Internal Evaluation(CIE) (CA)	End Semester Evaluation (ESE)(UA)	Duration of Examination (Hrs)
					T	P			
1	DSC	CS-411: Artificial Intelligence [T]	4	60	4	--	40	60	3.00
		CS-412: Optimization of Algorithms [T]	2	30	2	--	20	30	2.00
		CS-413: Current Computing Trends in Java [T]	4	60	4	--	40	60	3.00
		CS-414: Lab on Artificial Intelligence [P]	2	60	--	4	20	30	2.00
		CS-415: Lab on Current Computing Trends in Java [P]	2	60	-	4	20	30	2.00
2	DSE (Any One)	CSE-416 (A): Big Data Analytics [T] **OR** CSE-416 (B): Cloud Computing [T]	4	60	4	--	40	60	3.00
3	Research	RM-417: Research Methodology	4	60	4	-	40	60	3.00
Total			22	390	18	8	220	330	---

Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon

FACULTY OF SCIENCE AND TECHNOLOGY, PGDEGREE (M.Sc.) PROGRAMME

Credit distribution structure for Two Years/One Year PG M.Sc. (Computer Science) Degree Programme

BoS: Computer Science

Teaching and Examination scheme, Master of Science M.Sc. (Computer Science)

M.Sc. (Level 6.0) Sem-II (Name of Courses for-Major, RM, OJT, RP courses) **WEF 2023-24**

Sr. No.	Course Category	Name of the course(Title of the Paper)	Total Credit	Hours/ Semester	Teaching Scheme (hrs/week)		Evaluation Scheme		
					Theory	Practical	Continuous Internal Evaluation (CIE)(CA)	End Semester Evaluation (ESE)(UA)	Duration of Examination (Hrs)
					T	P			
1	DSC	CS-421: Data Warehousing and Data Mining [T]	4	60	4	--	40	60	3.00
		CS-422: Angular JS [T]	2	30	2	--	20	30	2.00
		CS-423: Compiler Construction [T]	4	60	4	--	40	60	3.00
		CS-424: Lab on Data Warehousing and Data Mining [P]	2	60	--	4	20	30	2.00
		CS-425: Lab on Angular JS [P]	2	60	--	4	20	30	2.00
2	DSE (**Any One Group**)	CSE-426 (A1): Web Analytics [T] CSE-426 (A2): Lab on Web Analytics [P] **OR** CSE-426 (B1): Soft Computing [T] CSE-426 (B2): Lab on Soft Computing [P]	2 2	30 60	2 --	-- 4	20 20	30 30	2.00 2.00
3	FP/OJT,RP	CS-427: Field Project /On Job Training	4	120	--	8	40	60	3.00
Total			22	480	12	20	220	330	

Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon
FACULTY OF SCIENCE AND TECHNOLOGY, PGDEGREE (M.Sc.) PROGRAMME
Credit distribution structure for Two Years/ One Year PG M.Sc. (Computer Science) Degree Programme

BoS: Computer Science

Teaching and Examination scheme, Master of Science M.Sc. (Computer Science)

M.Sc. (Level 6.5) Sem-III (Name of Courses for-Major, RM, OJT, RP courses)

Sr. No.	Course Category	Name of the course(Title of the Paper)	Total Credit	Hours/ Semester	Teaching Scheme (hrs/week)		Evaluation Scheme		
					Theory	Practical	Continuous Internal Evaluation (CIE)(CA)	End Semester Evaluation (ESE)(UA)	Duration of Examination (Hrs)
					T	P			
1	DSC	CS-511: Network Programming [T]	4	60	4	-	40	60	3.00
		CS-512: Design and Analysis of Algorithm [T]	4	60	4	-	40	60	3.00
		CS-513: Digital Image Processing [T]	2	30	2	-	20	30	2.00
		CS-514: Lab on Network Programming [P]	2	60	-	4	20	30	2.00
		CS-515: Lab on Digital Image Processing [P]	2	60	-	4	20	30	2.00
2	DSE **(Select Any One)**	CSE-516 (A): Ethical Hacking [T] **OR** CSE-516 (B): Internet of Things [T] **OR** CSE-516 (C): Swayam/NPTEL Course	4	60	4	-	40	60	3.00
3	FP/OJT,RP	CS-517: Research Project	4	120	-	8	40	60	3.00
Total			22	450	14	16	220	330	--

Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon
FACULTY OF SCIENCE AND TECHNOLOGY, PGDEGREE M.Sc. (Computer Science) PROGRAMME
Credit distribution structure for Two Years/One Year PG M.Sc. (Computer Science) Degree Programme

BoS: Computer Science

Teaching and Examination scheme, Master of Science M.Sc. (Computer Science)

M.Sc. (Level 6.5) Sem-IV (Name of Courses for -Major, RM, OJT, RP courses)

SrNo	Course Category	Name of the course(Title of the Paper)	Total Credit	Hours/ Semester	Teaching Scheme(hrs/week)		Evaluation Scheme		
					Theory	Practical	Continuous Internal Evaluation (CIE)(CA)	End Semester Evaluation (ESE)(UA)	Duration of Examination (Hrs)
					T	P			
1	DSC	CS-521: Advanced Operating System [T]	4	60	4	-	40	60	3.00
		CS-522: Machine Learning with Python [T]	4	60	4	-	40	60	3.00
		CS-523: Lab on Advanced Operating System [P]	2	60	-	4	20	30	2.00
		CS-524: Lab on Machine Learning with Python [P]	2	60	-	4	20	30	2.00
2	DSE (**Select Any One**)	CSE-525 (A): Network Security & Firewall [T] **OR** CSE-525 (B): Natural Language Processing [T] **OR** CSE-525 (C): Swayam/NPTEL Course	4	60	4	-	40	60	3.00
3	FP/OJT, RP	CS-526: Research Project	6	180	-	12	60	90	3.00
Total			22	480	12	20	220	330	--

Semester-I

Course Code: **CS-411** **Artificial Intelligence** *Clock Hours:* **60**
Total Marks: **100**

Course Objectives:

1. The primary objective of this course is to introduce the basic principles, techniques and applications of Artificial Intelligence.
2. Emphasis will be placed on the teaching of these fundamentals, not on providing a mastery of specific software or tools programming environments.

The student should be made to:

1. Gain a historical perspective of AI and its foundations.
2. Study the concepts of artificial intelligence.
3. Investigate applications of AI techniques in intelligent agents.
4. Learn the methods of solving problems using artificial intelligence.
5. Learn various peculiar search strategies for AI.

Unit I: Introduction **[10L] Max Marks: 18**

Overview and defining AI techniques, Turing test, Branches of Artificial Intelligence, Applications of Artificial Intelligence - Intelligent Agents - Structure, Types of Agents and Autonomous Agents.

Unit-II: State Space Search and Heuristic Search Techniques **[12L] Max Marks: 18**

Defining Problems as State Space Search, Production Systems And Characteristics, Hill Climbing, Breadth First And Depth First Search, Best First Search, AO*.

Unit-III: Knowledge Representation **[10L] Max Marks: 18**

Knowledge Management, Types Of Knowledge, Knowledge Representation-Bases And Structures - First Order Logic, Unification Algorithm, Frames, Conceptual Dependency, Scripts, Semantic Network.

Unit-IV: Reasoning **[8L] Max Marks: 10**

Types of Reasoning, Non-Monotonic Reasoning, Fuzzy Logic, Bayes Rule, Bayesian Networks.

Unit-V: Game Playing and Planning **[8L] Max Marks: 10**

Mini-max Algorithm, Alpha-beta Algorithm, Goal Stack Planning.

Unit – VI: Machine Learning **[12L] Max Marks: 16**

Why Machine Learning, Types of Machine Learning: Supervised Learning- Classification & Regression, K-NN Algorithm, Unsupervised Learning-Clustering & Association, Reinforcement Learning.

References:

1. Deepak Khemani (2013), A First Course in Artificial Intelligence, McGraw Hill Education (India), ISBN 9781259029981
2. Elaine Rich and Kevin Knight (1991), Artificial Intelligence, Tata McGraw Hill, ISBN 13:9780070087705
3. Stuart Russell and Peter Norvig (2009), Artificial Intelligence: A Modern Approach, 3rdEdition, Prentice Hall, ISBN-13: 978-0-13- 604259-4

Course Outcome:

At the end of the course, the student should be able to:

1. Identify problems that are amenable to solution by AI methods.
2. Identify appropriate AI methods to solve a given problem.
3. Design smart system using different informed search / uninformed search or heuristic approaches.
4. Apply the suitable algorithms to solve AI problems.

Course Code: **CS-412** **Optimization Algorithms** *Clock Hours:* ***30***
Total Marks: ***50***

Course Objectives:

1. To introduce with the branch of Optimization and its role in decision making.
2. To list out various types of applications of Optimization Algorithms.
3. To explain Linear Programming Problem (LPP) and practice with techniques to solve various types of LPP (transportation problem, assignment problems, special cases of duality).
4. Describe the significance, concept of game theory and algorithms to solve game theory problems.

Unit-I Introduction to Optimization and Linear Programming [10L] Max Marks: 15

Optimization: Introduction, Applications, Feasible and optimal Solutions, Linear Programming: Special Types: Transportation Problem as LPP, Initial Basic Feasible Solution, North West corner Rule, Lowest Cost Method, Vogel's Approximation Method, MODI method for optimization, Degeneracy. Assignment problem, Hungarian Method, Special cases of assignment problem.

Unit-II Linear Programming Problems [12L] Max Marks: 18

Linear Programming Problems: Introduction, Formulation of Mathematical model of LPP, Standard form of linear programming problems, Solving LPP using Graphical method, Infeasible LPP, Unbounded LPP, Basic feasible solutions, Simplex method for solving LPP, augmentation using Slack and artificial variables, Degeneracy, Duality: concept, applications and example.

Unit-III Game Theory [8L] Max Marks: 12

Game Theory: Concept, Two persons zero sum game, Pay off matrix, Pure and mixed strategy games, Rule of Dominance, Subgame method.

References:

1. Hamdy Taha (2010), Operations Research: An Introduction. Pearson Education, ISBN: 978-0132555937
2. L C Jhamb, Quantitative Techniques for Managerial Decisions Vol. I, Vol. II. Everest Publishing House, ISBN: 8186314628
3. Jasbir Arora (2016), Introduction to Optimum Design. 4th Edition. Elsevier. Hardback ISBN: 9780128008065 eBook ISBN: 9780128009185.
4. Panneer Selvan R (2006), Operations Research. Prentice Hall of India. ISBN: 978-8120329287

Course Outcome:

After completion of this course students shall be able to

1. Write about Optimization and decision making.
2. Differentiate between feasible and optimal solution
3. Apply solving techniques to all types of LPP.
4. Apply solving techniques to game theory problems.

Course Code: **CS-413** **Current Computing Trends in Java** *Clock Hours:* ***60***
Total Marks: ***100***

Course Objectives:

1. Understand the fundamentals of the Spring framework and its core concepts.
2. Develop and deploy web applications using Spring Boot and Hibernate.
3. Build RESTful APIs and secure them using Spring Security.
4. Perform data access operations using Hibernate ORM.
5. Gain knowledge of advanced topics such as caching, asynchronous programming, and microservices architecture.
6. Apply best practices for designing and implementing scalable and maintainable Java applications.

Unit-I Introduction to Spring Boot **[10L] Max Marks: 15**

Introduction to Spring framework, Features and advantages of Spring Boot, Setting up a Spring Boot project, Building and running a basic Spring Boot application, Configuring Spring Boot with application properties.

Unit-II: Spring Boot Data Access with Hibernate **[10L] Max Marks: 15**

Introduction to Hibernate ORM, Setting up Hibernate with Spring Boot, Configuring database connection properties, Mapping entities and relationships with Hibernate annotations, Performing CRUD operations with Hibernate.

Unit-III: **Spring Boot RESTful Web Services** **[10L] Max Marks: 15**

Introduction to RESTful architecture, Creating RESTful APIs with Spring Boot, HandlingHTTP methods (GET, POST, PUT, DELETE), Request and response serialization with Jackson, Handling exceptions and error responses.

Unit-IV: Spring Boot Security **[10L] Max Marks: 15**

Introduction to Spring Security, Configuring Spring Security with Spring Boot, User authentication and authorization, Securing RESTful APIs with role-based access control, Implementing JWT (JSON Web Tokens) for authentication.

Unit-V: Advanced Spring Boot Topics **[10L] Max Marks: 15**

Caching data with Spring Boot, Asynchronous programming with Spring Boot, Handling file uploads and downloads, Integration with external services (e.g., email, payment gateways), Deploying Spring Boot applications to a server.

Unit-VI: Introduction to Microservices with Spring Boot [10L] Max Marks: 15

Microservices architecture principles and benefits, Building microservices with Spring Boot, Service discovery and load balancing, Inter-service communication with REST and messaging, Monitoring and logging microservices, Application of Spring JPA.

References:

1. Craig Walls, Spring Boot in Action, ISBN-9781617292545.
2. John Carnell, Spring Micro services in Action, ISBN-13 978-1617293986
3. Felipe Gutierrez, Pro Spring Boot 2: An Authoritative Guide to Building Micro services, Web and Enterprise Applications, ISBN-13 978-1484236758
4. Christian Bauer & Gavin King, Java Persistence with Hibernate, ISBN-9781617290459
5. Laurentiu Spilca, Spring Security in Action, ISBN-9781617297731
6. Thorben Janssen, Hibernate Tips: More than 70 solutions to common Hibernate Problems ISBN-13 978-1544869179
7. Alex Soto Bueno & Jason Porter, Testing Java Micro services, ISBN-9781617292897
8. Petri Kainulainen, Spring Data JPA: Modern Data Access for Enterprise Java, ISBN-13 978-1449323950

Course Outcome:

After completion of this course students shall be able to

1. Develop high performance applications.
2. Acquire knowledge of secure and flexible framework.
3. Learn ease of use of databases in projects.
4. Define HTTP GET and POST operations.
5. Use a REST Client to make POST and GET requests to an API
6. Build self-contained and ready to run applications.

Course Code: **CS-414** **Lab on Artificial Intelligence (AI)** *Clock Hours*: **60**
Total Marks: **50**

Course Objectives:

1. Understand and learn.
2. To convert the algorithms to code.
3. To measure the complexities at run time.
4. To modify the algorithms for efficiency.
5. To debug and test the programs.
6. To conclude using profile of outcome OS: windows, programming language: python.

Laboratory Assignments:

1) Implement simple program for Chabot.
2) Implement programs in problem solving and state space search in AI missionary and cannibals.
3) Implement programs in problem solving and state space search in AI tic-tac-toe.
4) Implement programs in problem solving and state space search in AI tower of Hanoi.
5) Implement programs in problem solving and state space search in AI water-jug.
6) Implement algorithms in depth first search.
7) Implement algorithms in breadth first search.
8) Implement A* algorithm.
9) Implement program for travelling salesman problem.

Course Outcome:

1. Able to construct logic for the algorithms designed using designing techniques.
2. Able to do posterior analysis of the algorithms.
3. Able to debug the algorithms.
4. Modify to improve performance of the algorithms.
5. Able to test and profile the algorithms.

Course Code: **CS-415** **Lab on Current Computing Trends in Java** *Clock Hours*: **60**
Total Marks: **50**

Course Objectives:

1. To learn Object Serialization.
2. To learn mapping of JAVA classes to database tables.
3. To learn sending and retrieving data across the network.
4. To learn to interact with databases without any SQL.
5. To learn to handle different HTTP requests.

Laboratory Assignments:

1. Build a blog management system where users can create, read, update, and delete blog posts. Use Hibernate to map the "Blog" entity and its relationships with other entities suchas "User" and "Comment." Implement CRUD operations to manage blog posts.

2. Develop an e-commerce product catalog where users can browse and search for products. Use Hibernate to map the "Product" entity and its relationships with entities like "Category" and "Supplier." Implement CRUD operations to manage products and perform searches based on various criteria.

3. Build an employee management system where administrators can add, update, and delete employee records. Use Hibernate to map the "Employee" entity and its relationships with entities like "Department" and "Role." Implement CRUD operations to manage employee records and perform searches based on different criteria.

4. Develop a library management system where users can borrow and return books. Use Hibernate to map the "Book" and "User" entities and their relationship as a many-to-many association. Implement CRUD operations to manage books and user records, as well as handling book borrowing and returning operations.

5. Create a RESTful API for managing user data. Implement endpoints for retrieving a list of users, getting a specific user by ID, creating a new user, updating an existing user, and deleting a user. Handle different HTTP methods (GET, POST, PUT, DELETE) for user-related operations.

6. Develop a RESTful API for managing a product catalog. Implement endpoints for retrieving a list of products, getting a specific product by ID, adding a new product,updating an existing product, and deleting a product. Handle appropriate HTTP methods and serialization of request/response objects.

7. Create a RESTful API that provides weather forecast data for different locations. Implement endpoints for retrieving weather information by location, handling different HTTP methods, and serializing response objects with appropriate weather data.

8. Build a RESTful API for uploading and downloading files. Implement endpoints for uploading a file, retrieving a list of uploaded files, downloading a specific file by ID, and deleting a file. Handle appropriate HTTP methods and handle file serialization and deserialization.

9. Build a microservice responsible for user registration. Implement endpoints for user registration, validation, and retrieval. Use Spring Boot and Spring JPA to persist user data in a database.

10. Develop a microservice for order management. Implement endpoints for placing new orders, retrieving order details, and updating order status. Utilize Spring Boot and Spring JPA to store and retrieve order data.

Course Outcome:

After successful completion of the course students are able to

1. Implement object serialization.
2. Implement mapping of JAVA classes to database tables.
3. Implement sending and retrieving the data across the network.
4. Implement interaction with databases without SQL.
5. Implement handling of different HTTP requests.

Select any one Elective form CSE-416 (A) and CSE-416 (B)

Course Code*: CSE-416 (A)** **Big Data Analytics** *Clock Hours:* ***60
Total Marks: ***100***

Course Objectives:

1. To understand the Big Data challenges & opportunities, its applications
2. Understanding of concepts of map and reduce and functional programming
3. Gain conceptual understanding of Hadoop Distributed File System.
4. To solve the case studies related to real life situations
5. To bridge the gap between academics and industry needs.

Unit-I: Introduction to Big Data **[10L] Max Marks: 14**

Data Storage and Analysis, Characteristics of Big Data, Big Data Analytics, Typical Analytical Architecture, Requirement for new analytical architecture, Challenges in Big Data Analytics, Need of big data frameworks.

Unit-II: Hadoop Framework **[14L] Max Marks: 20**

Hadoop – Requirement of Hadoop Framework, Design principle of Hadoop – Comparison with other system - Hadoop Components – Hadoop 1 vs. Hadoop 2 – Hadoop Daemon's – HDFS Commands – Map Reduce Programming: I/O formats, Map side join, Reduce Side Join, Secondary sorting, Pipelining Map Reduce jobs.

Unit-III: HDFS (Hadoop Distributed File System) **[6L] Max Marks: 12**

The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces.

Unit-IV: Map Reduce **[10L] Max Marks: 12**

Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features.

Unit-V: Hadoop Eco System **[14L] Max Marks: 20**

Pig: Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators.

Hive: Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions. Hbase : HBasics, Concepts, Clients, Example, Hbase Versus RDBMS. Big SQL : Introduction.

Unit-VI: Data Analytics with R Machine Learning **[6L] Max Marks: 12**

Introduction, Supervised Learning, Unsupervised Learning, Collaborative Filtering. Big Data Analytics with Big R.

References:

1. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.
2. Jay Liebowitz, "Big Data and Business Analytics" Auerbach Publications, CRC press (2013)
3. Tom Plunkett, Mark Hornick, "Using R to Unlock the Value of Big Data: Big Data Analytics with Oracle R Enterprise and Oracle R Connector for Hadoop", McGraw-Hill/Osborne Media (2013), Oracle press.
4. Anand Rajaraman and Jef rey David Ulman, "Mining of Massive Datasets", Cambridge University Press, 2012.
5. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley & sons, 2012.
6. ArvindSathi, "Big Data Analytics: Disruptive Technologies for Changing the Game", MC Press, 2012
7. Paul Zikopoulos, Dirk DeRoos, Krishnan Parasuraman, Thomas Deutsch, JamesGiles, David Corigan , "Harness the Power of Big Data The IBM Big Data Platform",Tata McGraw Hill Publications, 2012.

Course Outcomes:

After completion of this course students shall be able to

1. Recognize the characteristics, applications of big data that make it useful to real-world problems.
2. Process available data using big data tools hadoop file system and predict outcomes to solve given problem.
3. Study & Design various case studies using big data tools/commands and analyze it.
4. Discuss the challenges and their solutions in Big Data
5. Understand and work on Hadoop Framework and eco systems.
6. Explain and analyze the Big Data using Map-reduce programming in Hadoop.

Course Code*: CSE-416 (B)** **Cloud Computing** *Clock Hours: **60

*Total Marks: **100***

Course Objectives:

2. Understand the fundamental concepts, principles, and components of Cloud Computing.
3. Learn the general comparative study on different types of cloud architecture.
4. Analyse and understand the basics of cloud architecture.
5. Evaluate cloud architecture in terms of comparative study on various cloud architecture available.
6. Critique cloud architecture and various components in cloud architecture.

Unit-I: Introduction to Cloud Architecture [10L] Max Marks: 14

Introduction to Cloud Computing Architecture, Private, public and hybrid cloud, Types of cloud architecture, Cloud types; IaaS, PaaS, SaaS, Benefits and challenges of cloud computing, public vs private clouds, role of virtualization in enabling the cloud, Business Agility: Benefits and challenges to Cloud architecture.

Unit-II: Server Architectures [08L] Max Marks: 12

Introduction to server, Stand-alone, blades, Stateless server, Clustering and scaling, Optimization and virtualization, Limitation of traditional server deployments, Modern solutions, Applications: database, finance etc., Redundant Layer 2 and Layer 3 designs, Case studies.

Unit-III: Data Centre Architectures [10L] Max Marks: 15

Network connectivity optimization evolution, Top of rack (TOR), end of rack (EOR), Scale up vs scale up, solutions that reduce power and cabling, Data Centre standards; TIA/EIA-942, Structured cabling standards, fibre and copper cabling characteristics, Cable management, bandwidth requirements, I/O connectivity.

Unit-IV: Virtualized Data Center Architecture [10L] Max Marks: 15

Cloud infrastructures; public, private, hybrid, Service provider interfaces; Saas, Paas, Iaas, VDC environments; concept, planning and design, business continuity and disaster recovery principles, Managing VDC and cloud environments and infrastructures.

Unit-V: Storage Network Design [08L] Max Marks: 12

Architecture of storage, Analysis and planning, Storage network design considerations; NAS and FC SANs, Hybrid storage networking technologies (iSCSI, FCIP, FCoE), Design for storage virtualization in cloud computing, Host system design considerations.

Unit-VI: Security Concepts **[14L] Max Marks: 22**

Introduction to cloud Security, Confidentiality, privacy, integrity, authentication, non-repudiation, availability, access control, defense in depth, least privilege, How these concepts apply in the cloud, What these concepts mean and their importance in PaaS, IaaS and SaaS. e.g. User authentication in the cloud;

Cryptographic Systems- Symmetric cryptography, stream ciphers, block ciphers, modes of operation, public-key Cryptography, hashing, digital signatures, public-key infrastructures, key management, X.509 certificates, OpenSSL.

References:

1. Gautam Shroff, "Enterprise Cloud Computing Technology Architecture Applications", Cambridge University Press; 1 edition, [ISBN: 978-0521137355], 2010
2. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach" McGraw-Hill Osborne Media; 1 edition [ISBN: 0071626948], 2009.
3. Greg Schulz, "Cloud and Virtual Data Storage Networking", Auerbach Publications [ISBN: 978-1439851739], 2011
4. Cloud Computing Protected: Security Assessment Handbook (John Rhoton, Jan De Clercq, David Graves) ISBN: 9780956355621, 0956355625
5. Kevin Corbin, Ron Fuller, David Jansen, "NX-OS and Cisco Nexus Switching:Next-Generation Data Center Architectures" Cisco Press; 1 edition [ISBN: 9781587058929], 2010

Course Outcomes:

After successful completion of this course, student will be able to

1. Explain the core concepts of the cloud computing paradigm: how and why this paradigm shift came about, the characteristics, advantages and challenges brought about by the various models and services in cloud computing.
2. Apply the fundamental concepts in datacentres to understand the trade-offs in power, efficiency and cost.
3. Identify resource management fundamentals, i.e. resource abstraction, sharing and sandboxing and outline their role in managing infrastructure in cloud computing.
4. Analyze various cloud programming models and apply them to solve problems on the cloud.

Semester-II

Course Code: **CS-421** **Data Warehousing and Data Mining** *Clock Hours:* ***60***
Total Marks: ***100***

Course Objectives:

1. To comprehend evolution of decision making, operational vs. decision support system and the concept of data warehouse.
2. To understand transactional and analytical processing.
3. Significance of analytical processing and importance of data pre-processing.
4. Learn various data pre-processing techniques, methods.
5. Understand and apply various techniques/algorithms to obtain meaningful patterns from data (Association mining, classification and clustering).

UNIT-I: Fundamentals of Data Warehousing **[10L] Max Marks: 12**

Failure Of Past Decision Support System, Operational V/S Decision Support Systems, Data Warehousing Lifecycle, Architecture, Building Blocks, Components Of DW, Data Marts And Metadata.

UNIT-II: Data Pre-processing **[10L] Max Marks: 12**

Need for Pre-Processing of the Data, Descriptive Data Summarization, Data Cleaning, Data Integration and Transformation, Data Reduction, Data Discretization And Concept Hierarchy Generation.

UNIT-II: OLAP **[10L] Max Marks: 14**

OLAP In Data Warehouse, Demand For Online Analytical Processing, Need For Multidimensional Analysis, Limitations Of Other Analysis Methods, OLAP Definitions And Rules, OLAP Characteristics, Major Features And Functions, OLAP Models-ROLAP, MOLAP, HOLAP, Differentiation, Data Cubes And Operations On Cubes.

UNIT-IV: Data Mining **[06L] Max Marks: 10**

Introduction-Data Mining functionalities, Classification of Data Mining Systems, Basic Data Mining task, Data Mining Issues.

Unit-V: Association Rule Mining **[08L] Max Marks: 12**

Efficient and Scalable Frequent Item set Mining Methods, Mining Various Kinds of Association Rules-Mining multilevel association rules- Mining multidimensional association rule(Association Mining to Correlation Analysis, Constraint-Based Association Mining).

Unit-VI: Classification and Prediction **[08L] Max Marks: 18**

Issues Regarding Classification and Prediction, Classification by Decision Tree Introduction, Bayesian Classification, Rule Based Classification, Support Vector Machines, Associative Classification, Lazy Learners, Other Classification Methods – Prediction – Accuracy and Error Measures.

Unit-VII: Cluster Analysis **[08L] Max Marks: 12**

Types of Data in Cluster Analysis, A Categorization of Major Clustering Methods –Partitioning Methods – Hierarchical methods – Density-Based Methods – Grid-Based Methods – Model-Based Clustering Methods, Clustering High-Dimensional Data, Outlier Analysis.

References:

1. Jiawei Hanand Micheline Kamber, Data Mining Concepts and Techniques, Second Edition, Elsevier, Reprinted 2008.
2. M. H. Dunham, Data Mining: Introductory and Advanced Topics, Pearson Education, 2001.
3. H. Witten and E. Frank, Data Mining: Practical Machine Learning Tools and Techniques, Morgan Kaufmann, 2000.
4. D.Hand, H.Mannila and P.Smyth, Principles of Data Mining, Prentice-Hall, 2001
5. Tan Steinbach,Vipin Kumar,IntroductiontoDatamining, Pearson Eduction
6. JarkeVassiliou, Fundamentals of DataWarehouses, IInd Edition,Springer
7. Anahory Murray, Data Warehousing in Real World, Pearson Education

Course Outcomes:-

After this course students shall be able to –

1. Explain organization of data warehousing and data marts.
2. Differentiate between OLTAP and OLAP.
3. Apply data pre-processing techniques.
4. Write basic algorithms for extracting patterns from data (association mining, classification and clustering).
5. Solve problems related with various aspects of data mining.

Course Code: **CS-422** **Angular JS** *Clock Hours:* ***30***
Total Marks: ***50***

Course Objectives:

1. Reduce the amount of code you write to build rich user interface applications.
2. Increase the reliability and maintainability of UI by using data binding.
3. Retrieve data from back-end server, manipulate it and display it with ease.
4. Modularize your code with the custom services and directives.
5. Providing two ways binding of data.
6. Create Single Page Applications (SPA).

UNIT- I: Introduction to Angular JS [06L] Max Marks: 08

What is Angular JS? Advantages and Disadvantages of Angular JS, Features of Angular JS, Angular JS Directives, Angular CLI and Troubleshooting, Node JavaScript Introduction, Setup Node JS with angular, Typescript Introduction, What is bootstrap, How AngularJS Integrates with HTML, Creating AngularJS Application.

UNIT –II: Modules and Components, Data Binding in Angular JS [10L] Max Marks: 12

What is Component in Angular JS, what is Module in Angular JS, Create and Start Component, Why Components are important. How we create a component, Create Component using CLI, What is nesting Component, What is Component Template, Component Styles and Selectors. What is Data Binding? Splitting Application into Component, String Interpolation, What is Property Binding, Difference between Property Binding and String Interpolation, What are Binding Properties and Events, Two Way binding, Combine Forms with Data binding.

UNIT –III: Dependency Injection in Angular JS [06L] Max Marks: 10

What is Dependency Injection, What is Services, Logging Service and Injection, Create Data Service, Instance of Services, Insert Service into Services, How to use service in Cross Component, What is Hierarchical Injector.

UNIT-IV: Forms in Angular JS [08L] Max Marks: 15

What is Forms and how do we handle it? Reactive Approach, Template Driven, Create Template Driven Forms, What is Registering Control, Use and Submit of Forms, Access of Forms, How to add validation in use input, Build-In Validation, HTML5 Validation, Output Validation and Error Messages, Two Way Binding, Grouping, Radio Button Handling,

Patch Forms Values, Resetting Templates form Forms, Reactive Forms, What is Reactive Forms, Create Reactive form through code.

References:

1. Istvan Novak, Unraveling AngularJS 1.5: With Over 140 Complete Samples (Unraveling series), ISBN-978-1532916144
2. Brad Green and Shyam Seshadri, Angular JS: Up and Running - Enhanced Productivity with Structured Web Apps, ISBN- 978-9351108016
3. Pawel Kozlowski, Mastering Web Application Development with Angular JS, ISBN-978-1-78216-182-0
4. Andrew Grant, Beginning Angular JS, ISBN- 978-1484201619

Course Outcomes:

After this course students shall be able to –

1. Understand the fundamentals of Angular Forms and its architecture.
2. Present data in beautiful, interactive lists.
3. Build forms and setting pages.

Course Code: **CS-423** **Compiler Construction** *Clock Hours:* ***60***
Total Marks: ***100***

Course Objectives:

1. To learn the various phases of compiler.
2. To learn the various parsing techniques.
3. To understand intermediate code generation and run-time environment.
4. To learn to implement code generator.

Unit-I: Compiler Structure **[07L] Max Marks: 08**

Analysis-synthesis model of compilation, various phases of a compiler, tool-based approach to compiler construction.

Unit-II: Lexical Analysis **[08L] Max Marks: 12**

Interface with input, parser and symbol table, token, lexeme and patterns, Difficulties in lexical analysis, Error reporting, Implementation, Regular definition, Transition diagrams, LEX.

Unit-III: Syntax Analysis **[15L] Max Marks: 25**

CFGs, ambiguity, associativity, precedence, top down parsing, recursive descent parsing, transformation on the grammars, predictive parsing, bottom up parsing, operator precedence grammars, LR parsers (SLR, LALR, LR), YACC. Syntax directed definitions: inherited and synthesized attributes, dependency graph, evaluation order, bottom up and top down evaluation of attributes, L- and S-attributed definitions. Type checking: type system, type expressions, structural and name equivalence of types, type conversion, overloaded functions and operators.

Unit-IV: Run Time System **[10L] Max Marks: 15**

Storage organization, activation tree, activation record, parameter passing, symbol table, dynamic storage allocation.

Unit-V: Intermediate Code Generation **[10L] Max Marks: 15**

Intermediate representations, Translation of declarations, Assignments, Control flow, Boolean expressions and procedure calls. Implementation issues.

Unit-VI: Code Generation and Instruction Selection [10L] Max Marks: 15

Issues, basic blocks and flow graphs, register allocation, code generation, DAG representation of programs, code generation from DAGs, peep-hole optimization, code generator generators, specifications of machine.

References:

1. Aho A.V., R. Sethi and J.D. Ullman, Compiler Principle, Techniques and Tools: Addison Wesley, ISBN 0-321-48681-1
2. Barret, Couch. Compiler Construction Theory and Practice: Computer Science series, Asian Student Ed, ISBN 978-0574213358
3. Dhamdhere D.M. Compiler Construction Principle and Practice: McMillan India, ISBN 9780333904060
4. Gres D. Compiler Construction for Digital Computer: Wiley, ISBN 047132776X. 5. David Galles (2009). Modern Compiler Design: Pearson Education, ISBN 9788131709412

Course Outcome:

After this course students shall be able to –

1. Understanding of basic structure of compiler, concepts and terminology in programming languages, lexical analysis, finite state techniques, scanner generator, parsing, kinds of parsers, designing lexical analyzer, scanner and parsers, principal ideas with intermediate code generation, optimizations.
2. Understanding of all concepts essential to design compiler in general for programming languages.

Course Code: **CS-424** **Lab on Data Warehousing and Data Mining** *Clock Hours*: **60**
Total Marks: **50**

Course Objectives:

- To create awareness of how enterprise can organize and analyze large amounts of data by creating a Data Warehouse.

Laboratory Assignments:

1. Demonstrate the data preprocessing dataset using: Student .arff.
2. Demonstration of association rule process on dataset test.arff using apriori algorithm.
3. Demonstration of association rule process on dataset employee .arff using j 48 algorithm.
4. Demonstration of Clustering rule process on dataset Student. arff Using Simple K-means.
5. Demonstration of classification rule process on dataset employee. arff Using naïve bayes algorithm.
6. Demonstration of Clustering rule process on our own dataset Using Simple K-means.
7. Demonstration of Clustering algorithms.

Course Outcomes:

- Organize strategic data in an enterprise and build a data Warehouse.

Course Code: **CS-425** **Lab on Angular JS** *Clock Hours:* **60**

Total Marks: **50**

Course Objectives:

1. Reduce the amount of code you write to build rich user interface applications.
2. Increase the reliability and maintainability of UI by using data binding.
3. Retrieve data from back-end server, manipulate it and display it with ease.
4. Modularize your code with the custom services and directives.
5. Create Single Page Applications (SPA).

Laboratory Assignments:

1. Write a program to print "Hello world!" using angular js script.
2. Write an Angular JS script to demonstrate arithmetic expressions.
3. Write an Angular JS script to add Modules and Controller.
4. Write an Angular JS script to print first name and last name using angular js controller.
5. Write an Angular JS script to demonstrate the use of services.
6. Write an Angular JS script to demonstrate the use of Tables.
7. Write an Angular JS script to create select box using options.
8. Design a simple form using Angular JS Script.
9. Design a simple form and apply validation to it.

Course Outcomes:

After completing this course, you will be able to:

- Get familiar with client-side Javascript frameworks and the Angular framework.
- Use various Angular features including directives, components, and services.
- Implement a functional front-end web application using Angular.

Select Elective any one group form CSE-426(A) and CSE-426 (B)

Course Code: **CSE-426 (A1)** **Web Analytics** *Clock Hours:* **30**
Total Marks: **50**

Course Objectives:

- Understand social media, web and social media analytics, and their potential impact.
- Determine how to Leverage social media for better services and Understand usability metrics, web and social media metrics.
- Use various data sources and collect data relating to the metrics and key performance indicators.
- Identify key performance indicators for a given goal, identify data relating to the metrics and key performance indicators.

UNIT-I: Introduction **[05L] Max Marks: 08**

What is web Analytics, Importance of web Analytics, Web Analytics process, Types of web analytics, Web analytics technical requirements, Web analytics 2.0 framework.

UNIT-II: Qualitative Analysis **[06L] Max Marks: 08**

Heuristic evaluations: Conducting a heuristic evaluation, Benefits of heuristic evaluations, Site Visits: Conducting a site visit, Benefits of site visits, Surveys: Website surveys, Post-visit surveys, creating and running a survey, Benefits of surveys.

UNIT-III: Web Metrics **[08L] Max Marks: 14**

Key metrics, Dashboard: Implementation, metrics, Types of metrics, Conversion: goals, funnels, Data sources: server log, visitors data, search engine statistics and conversion funnels, Data segmentation, Analysis, Emerging analytics: e –commerce, mobile analytics, A/B testing, Social Media Analytics: Sentimental Analysis, Text Analysis, Annotation and Reporting: Automated, Actionable.

UNIT-IV: Web Analytics **[07L] Max Marks: 10**

Introduction to analytic 2.0, Competitive intelligence analysis, CI data sources: Toolbar data, Panel data, ISP data, Search engine data, Hybrid data Website traffic analysis, Comparing long term traffic trends, Analyzing competitive site overlap and opportunities.

UNIT-V: Google Analytics **[04L] Max Marks: 05**

Audience analysis, Acquisition analysis, Behavior analysis, Conversion analysis, Google website optimizer, Implementation technology, Privacy issues.

References:

1) Clifton B., Advanced Web Metrics with Google Analytics, Wiley Publishing, Inc.2nd Edition
2) Kaushik A., Web Analytics 2.0, The Art of Online Accountability and Science of Customer Centricity, Wiley Publishing, Inc. 1st Edition
3) Kaushik A., Web Analytics: An Hour a Day, 1st Edition
4) Sterne J., Web Metrics: Proven methods for measuring web site success, John Wiley and Sons

Course outcomes:

After this course students shall be able to –

1. Determine the likelihood that a given customer will repurchase a product after purchasing it in the past.
2. Personalize the site to customers who visit it repeatedly.
3. Monitor the amount of money individual customers or specific groups of customers spend.
4. Observe the geographic regions from which the most and the least customers visit the site and purchase specific products.

Course Code: **CSE-426 (B1)** **Soft Computing** *Clock Hours:* **30**

Total Marks: **50**

***Course Objectives**:*

1. Understand the fundamental concepts, principles, and components of Soft Computing.
2. Gain knowledge of Fuzzy Logic, Neural Networks, and Genetic Algorithms, and their applications.
3. Develop skills in designing and implementing Fuzzy Logic systems, Neural Networks, and Genetic Algorithms.
4. Learn to integrate different Soft Computing techniques to solve complex real-world problems.
5. Enhance problem-solving abilities using practical exercises and hands-on implementation.
6. Foster critical thinking and analytical skills in the field of Soft Computing.

UNIT- I: Introduction to Soft Computing **[6L] Max Marks: 08**

Introduction to Soft Computing: Definition, characteristics, and significance, Comparison of Soft Computing with traditional computing techniques, Components of Soft Computing: Fuzzy Logic, Neural Networks, Genetic Algorithms, Applications and benefits of Soft Computing in various domains, Challenges and limitations of Soft Computing techniques.

UNIT- II: Fuzzy Logic **[6L] Max Marks: 10**

Introduction to Fuzzy Logic: Principles and concepts, Fuzzy Sets and Membership Functions: Definition and properties, Fuzzy Logic Operations: Union, Intersection, Complement, Fuzzy Rules and Rule-based Systems: Construction and inference mechanisms, Fuzzy Inference Systems: Mamdani and Sugeno models, Fuzzy Control Systems: Design and implementation.

UNIT-III: Neural Networks **[12L] Max Marks: 15**

Fundamentals of Artificial Neural Networks (ANN): Architecture and working principles, Single-layer and Multi-layer Perceptrons: Structure and training algorithms, Activation functions: Types and their impact on network performance, Training algorithms: Backpropagation, Gradient Descent, and variants, Supervised and Unsupervised learning in neural networks, Deep Learning and Convolutional Neural Networks (CNN): Concepts and applications, Neuro-Fuzzy Systems: Architecture and learning algorithms.

UNIT-IV: Genetic Algorithms **[6L] Max Marks: 12**

Introduction to Genetic Algorithms (GA): Basic concepts and principles, Chromosomes, Genes, and Fitness Function: Representation and evaluation, Genetic Operators: Selection, Crossover, and Mutation, Encoding and decoding strategies for problem-solving, Fitness evaluation and selection mechanisms, Fuzzy Genetic Algorithms, Applications of Genetic Algorithms in optimization and search problems.

References:

1. S.N.Sivanandam , S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt.Ltd., 2nd Edition, 2011
2. N.P.Padhy, S.P.Simon, "Soft Computing with MATLAB Programming", Oxford University Press, 2015
3. S.Rajasekaran, G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications ", PHI Learning Pvt.Ltd., 2017

Course outcomes:

After this course students shall be able to –

1. Understanding the basic soft computing with its applications and benefits.
2. Understanding basic principles of fuzzy logic with its control system designing and implementing.
3. Understanding architecture of neural network with its activation functions and deep learning.

Course Code: **CSE-426 (A2)** **LAB on Web Analytics** *Clock Hours:* **60**
Total Marks: **50**

Course Objectives:

1. Understand social media, web and social media analytics, and their potential impact.
2. Determine how to Leverage social media for better services and Understand usability metrics, web and social media metrics.
3. Use various data sources and collect data relating to the metrics and key performance indicators.
4. Identify key performance indicators for a given goal, identify data relating to the metrics and key performance indicators.

Laboratory Assignments:

1. **Mining Twitter: Exploring Trending Topics, Discovering What People Are Talking About, and More**: Why Is Twitter All the Rage?, Exploring Twitter's API, Fundamental Twitter Terminology, Creating a Twitter API Connection, Exploring Trending Topics, Searching for Tweets, Analysing Tweets and Tweet Entities with Frequency Analysis.
2. **Mining Facebook: Analyzing Fan Pages, Examining Friendships:** and More Overview, Exploring Facebook's Social Graph API, Understanding the Social Graph API, Understanding the Open Graph Protocol, Analyzing Social Graph Connections, Analysing Facebook Pages, Examining Friendships
3. **Mobile Analytic: Analyze the your site on mobile device**: In last 30 days, how many new users come from mobile, What was the bounce rate of visitors on mobile device, What was the average session duration?
4. **Segment traffic:** Which social channel is sending the most engaged new users, Which pageof your Website have been shared most, Which URL has the best engagement matrix.
5. **Use Google Analytics to measure the various metrics for E-commerce site amazon.**

- **On-site** − It measures the users' behavior once it is on the website. For example, measurement of your website performance.
- **Off-site** − It is the measurement and analysis irrespective of whether you own or maintain a website. For example, measurement of visibility, comments, potential audience, etc.

Course Outcomes:

1. Gain a deep understanding of Web analytics as well as data about customer interactions with your organization online.
2. Identify and interpret conventional and emerging Web analytics measurements.
3. Understand the Web data collection and integration techniques and their potential applications and limitations.

Course Code: **CSE-426 (B2)** **Lab on Soft Computing** *Clock Hours:* **60**

Total Marks: **50**

Course Objectives:

The main objective of the course is to expose the students to soft computing, various types of soft computing techniques, and applications of soft computing.

Upon completion of this course, the student should be able to get an idea on:

1. Artificial Intelligence, Various types of production systems, characteristics of production systems.
2. Neural Networks, architecture, functions and various algorithms involved.
3. Fuzzy Logic, Various fuzzy systems and their functions.
4. Genetic algorithms, its applications and advances.

Laboratory Assignments:

1. Design a command-line calculator that performs arithmetic operations (addition, subtraction, multiplication, division) on fuzzy numbers. Implement fuzzy arithmetic operations using appropriate fuzzy logic rules and membership functions. Test the calculator with different fuzzy numbers and evaluate the accuracy of the results.

2. Develop a simulation of a fuzzy traffic light controller for a busy intersection. Define fuzzy sets and membership functions for traffic flow (e.g. low, medium, high) and waiting time. Design fuzzy rules to determine the duration of green, yellow, and red lights based on traffic flow and waiting time. Simulate the traffic light controller and analyze its performance in terms of traffic congestion and waiting times.

3. Design a fuzzy logic controller for a washing machine that adjusts the wash cycle based on the level of dirtiness and fabric type. Define fuzzy sets and membership functions for dirtiness level (e.g. low, medium, high) and fabric type (e.g., delicate, cotton, heavy-duty). Create fuzzy rules to determine the wash cycle duration, water temperature, and detergent amount based on dirtiness level and fabric type. Implement the fuzzy logic controller and evaluate its effectiveness in achieving clean and undamaged clothes.

4. Design and implement a single-layer perceptron from scratch using Python. Train the perceptron on a binary classification problem.

5. Develop a Multi-Layer Perceptron (MLP) for any real world problem.

6. Application of genetics algorithm to real world problems.

Course Outcomes:

At the end of the course the student should be able to:

1. Learn about soft computing techniques and their applications.
2. Analyze various neural network architectures.
3. Understand perceptron's and counter propagation networks.
4. Define the fuzzy systems.
5. Analyze genetic algorithms and their applications.

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