



Principal

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ARTS,COMMERCE & SCIENCE WOMEN'S COLLEGE

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No.MAKM/...../.....

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**PROGRAM OUTCOME, COURSE OUTCOME,TARGET SETTING
AND ATTAINMENT IS WELL DEFINED, DISSEMINATED AND
EXECUTED.**

Course outcomes of one course and policy of attainment and dissemination:

The institution aims at the holistic development of the student community and also fulfills the vision and mission of the institution. Faculty gets a wide knowledge about framing the POs, PSOs and COS.

Measuring Attainment FormalMechanism

The Institution evaluates the programme outcomes, programme specific outcomes and course outcomes through CIA and End Semester examination. Assignments, quizzes, tests, viva voce, laboratory records assess the learning attainment of the students. The end semester examination evaluates the summative course attainment. Result analysis and feedback,placement records ensure the evaluation of the attainment of learning outcomes. Direct Mechanism 93% of students attains eligibility to opt for their career in academia, research institutions, and industries.

The copy of POs, PSOs and Cos attached herewith,please find the attachment.




PRINCIPAL
M.A.K. Women's College
Hinganghat



Program Outcomes, Program Specific Outcomes and Course Outcomes

For B. Sc. NEP 2020

(Major: Physics, Chemistry, Computer Science, Mathematics, Zoology, Botany)

(NEP Effective from 2024-25)

&

M.Sc. (Botany, Chemistry, Mathematics, Physics, Zoology)

(NEP Effective from 2023-24)

As per New Education Policy 2020 (Effective from session 2024-25)

B.Sc.(Botany, Chemistry, Computer Science, Mathematics, Physics and Zoology)

Program Outcomes (POs) for B.Sc. Programme

PO1.Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO2.Problem Solving: Solve problems from the disciplines of concern using the knowledge, skills and attitudes acquired from sciences/ mathematics/ social sciences/ humanities.

PO3.Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO4.Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in wide variety of settings.

PO5.Ethics: Understand multiple value systems including your own, the moral dimensions of your decisions, and accept responsibility for them.

PO6.Environment and sustainability: Understand the impact of technology and business practices in societal and environmental contexts, and sustainable development.

PO7.Self-directed and life-long learning: Demonstrate the ability to engage in independent and life-long learning in the broadest context socio-technological changes.

PO8.Design/Development of Solutions: Design solutions for complex science problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO9.Computational Thinking: Understand data-based reasoning through translation of data into abstract concepts using computing technology-based tools.

PO10.Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO11.Global Perspective: Understand the economic, social and ecological connections that link the world's nations and people.

PO12.Aesthetic Engagement: Demonstrate and master the ability to engage with the arts and draw meaning and value from artistic expression that integrates the intuitive dimensions of participation in the arts with broader social, cultural and theoretical frameworks.

**Program Outcomes (POs), Program Specific Outcomes (PSOs) and
Course Outcomes (Cos) for B.Sc. (Physics) Programme
As per National Education Policy 2020**

B.Sc. Part I to Part VI (Semester I to Semester VI)

PROGRAM: B.Sc. PHYSICS

Program Outcome:

PO1. Knowledge and Understanding:

Develop a deep understanding of fundamental concepts in physics such as mechanics, electricity and magnetism, thermodynamics, optics, and quantum mechanics. Gain insight into advanced physics topics and their applications in the real world.

PO2. Problem-Solving Skills:

Cultivate analytical skills to approach and solve physical problems using mathematical models. Apply problem-solving techniques to understand both classical and modern physics phenomena.

PO3. Practical Skills:

Conduct laboratory experiments to verify physical laws, and use various equipment and technologies. Develop skills to analyze experimental data and present findings effectively.

PO4. Critical Thinking:

Engage in scientific reasoning and critical evaluation of results. Analyze scientific problems and propose innovative solutions.

PO5. Research and Development:

Understand the research methodology and develop the ability to conduct scientific research in physics. Stay updated with current trends in physics and related interdisciplinary areas.

PO6. Communication Skills:

Improve oral and written communication skills for presenting scientific ideas clearly. Ability to write research papers, reports, and scientific papers.

PO7. Interdisciplinary Applications:

Integrate knowledge from various disciplines such as mathematics, chemistry, and computer science to solve complex physics problems. Understand the applications of physics in areas like engineering, environmental science, and medical technologies.

PO8. Ethical and Social Responsibility:

Appreciate the social, ethical, and environmental responsibilities related to the use of scientific knowledge. Foster a sense of responsibility when applying scientific advancements for societal benefit.

Program Specific Outcome

The B.Sc. (Honours / Honours. with Research) programme in Physics is designed to develop a comprehensive understanding of physical laws and phenomena through theoretical study, laboratory experiments, computational techniques, and research activities. The programme equips students with scientific knowledge, practical skills, and transferable competencies required for higher education, research, industry, and other professional pursuits.

PO1. Knowledge Width and Depth: Students acquire a thorough understanding of the fundamental concepts, principles, theories, and applications of Physics. The programme covers major branches of Physics including Mechanics, Waves and Oscillations, Electricity and Magnetism, Optics, Thermal Physics, Electronics, Quantum Physics, Nuclear Physics, Solid State Physics, Electromagnetic Theory, and Computational Physics. Depth of knowledge is achieved through advanced courses and research-oriented learning, while breadth is enhanced through elective and multidisciplinary courses.

PO2. Laboratory Skills: A significant outcome of the programme is the development of experimental and analytical skills through extensive laboratory training. Students learn scientific measurement techniques, data analysis, error estimation, interpretation of results, and operation of laboratory instruments. Practical exposure prepares students for careers in scientific laboratories, research institutions, industries, instrumentation centres, and technology-based sectors.

PO3. Communication: Effective communication is an essential component of scientific education. The programme provides opportunities to develop scientific writing, technical reporting, oral presentation, poster presentation, and documentation skills through laboratory reports, seminars, projects, and research assignments. Students learn to communicate scientific ideas clearly and logically to both scientific and non-scientific audiences.

PO4. Capacity Enhancement: The programme nurtures critical thinking, creativity, independent learning, and collaborative working abilities. Through projects, laboratory work, group activities, and research assignments, students develop leadership qualities, problem-solving abilities, decision-making skills, and adaptability to changing scientific and technological environments.

PO5. Portable Skills: The programme develops a range of transferable skills that are valuable across various professions and disciplines. These include quantitative reasoning, mathematical modelling, computational skills,

data analysis, information retrieval, digital literacy, organizational ability, teamwork, and scientific problem-solving. Such skills enhance employability and support lifelong learning.

PO6. Structure of the Programme in B.Sc. (Hons./Res.) Physics

The programme consists of Major (Discipline Specific) Courses, Minor Courses, Multidisciplinary Courses, Skill Enhancement Courses, Ability Enhancement Courses, Value Added Courses, Internship/Field Projects, and Research Projects as envisaged under NEP-2020.

The Major Courses provide a strong foundation in core areas of Physics and are compulsory for all students. Students are also offered opportunities to choose courses from Minor and Multidisciplinary baskets to broaden their academic exposure. Skill Enhancement Courses focus on practical, technical, computational, and employability skills, while Ability Enhancement and Value-Added Courses contribute to personality development, communication skills, environmental awareness, ethics, and social responsibility.

Internships, field-based projects, laboratory-based projects, and research projects form an integral component of the curriculum. Students opting for the Honors. with Research pathway in the fourth year undertake a research project/dissertation under faculty supervision, enabling them to acquire research methodology, scientific investigation skills, data analysis techniques, and scientific writing abilities.

Course Outcomes

B.Sc. SEM-I

Paper-I (BPH1DSC01T) - Measurements, Mechanics, and Properties of Matter

CO1:

- Understand the physical quantities and their units and use precision instruments correctly while identifying their least counts and measurement limits.
- Analyse the laws of motion and conservation of linear and angular momentum for different situations.
- Evaluate the elastic properties of materials and the inter-relationships between elastic constants.
- Explain the mechanics of fluids and surface phenomena.

SEC - 1 Practical (BPH1SEPC01P) - Electric Wiring for Domestic Applications

CO2:

- Identify the line, neutral and earth wire by using test lamp.
- Describe basic safety rules in his/her words.
- Describe KVL and KCL in his/her words.
- Calculate electric energy consumption by domestic appliances.
- Perform to control lamp, fan by switches.
- Differentiate between PVC Conduits and Casing-Capping wirings.
- Apply the practical knowledge in conducting various practical during graduation.
- Compare the rating of switches as per appliances.
- Evaluate estimate cost for electric wiring.
- Design a test lamp and extension board.

GE/OE (BPH1GOE01T) - Physics of Sports

CO3:

- Understand the application of mechanics and motion in sports activities and athletic performance.
- Explain the role of friction, collisions, and projectile motion in various games and sports.
- Describe the effects of aerodynamics, drag, buoyancy, and spin in sports performance.

B.Sc. SEM- II

Paper-II (BPH2DSC02T) - Semiconductor Physics and devices

CO1:

- Explain the fundamental physics of semiconductors, including carrier transport and energy band structures.
- Describe the formation and working of p-n junction diode and its applications.
- Understand the basic operation of transistors and their use as amplifier and switch.
- Identify and differentiate between various modern devices like FETs, LEDs, and Solar Cells based on their functional requirements.
- Perform simple experiments related to semiconductor devices and interpret their characteristics qualitatively.

SEC - 2 Practical (BPH2SEC02P) Fundamentals of Data Analysis and Data Interpretation

CO2:

- Collect a big data as per requirements and automatically get it in spreadsheet for further processing.
- Navigate on the spread sheet to edit text and values by inserting and deleting the ranges.
- Use various charts and formatting tables with row and column formatting.
- Use various mathematical functions to explore the necessary interpretations.
- Use various statistical functions to explore the necessary interpretations.
- Perform line / curve fitting for analysis.

GE/OE (BPH2GOE02T) - Physics in Daily Life

CO3:

- Understand the physical processes related to the Earth's atmosphere.
- Explain the basic principles of physics involved in the human body.
- Apply concepts of heat transfer and sound in analysing the working of common household devices.
- Describe the principles and safe usage of common house hold electrical appliances.
- s-Mossotti equation and calculate dielectric constants.
- Understand and Analyze magnetic properties.
- Discuss superconductivity concepts like critical temperature and the Meissner effect.
- Use the Drude-Lorentz model to calculate electrical and thermal conductivity.
- Understand band theory to classify metals, semiconductors, and insulators.
- Explain the Hall effect and analyse Fermi energy in relation to material properties.

Paper-6 (BPH3T06) – Optics

CO2:

- Describe fundamental principles of geometric optics, including Snell's Law and total internal reflection.
- Explain image formation by spherical boundaries and thin lenses.
- Derive focal length equations for thin lenses using paraxial approximations.
- Analyse interference patterns in thin films for wavelength and refractive index measurements.
- Utilize interferometers to determine wavelength differences with precision.
- Explore diffraction phenomena, including Fresnel and Fraunhofer diffraction, and their impact on optical resolution.
- Apply polarization principles such as Brewster's law and Nicol prism.
- Discuss the principles of lasers, focusing on population inversion and coherence.
- Identify various laser types (e.g., Ruby, He-Ne, semiconductor) and their applications.
- Examine coherence in laser systems and its practical applications in optics.

Minor-1 (BPH1T01) - Measurements, Mechanics, and Properties of Matter

CO3:

- Develop interest in measurement with conceptual knowledge of physics.
- Develop practical skills in accurate measurements with minimal errors.
- Understand and practice these skills while performing physics practical.
- Understand the use of apparatus and their use without fear.
- Correlate their physics theory concepts with practical outcomes.
- Understand the concepts of errors and their estimation.

Minor-2 (BPH1T02) - Kinetic theory of gases and Thermodynamics

CO4:

- Understand the assumptions of kinetic theory of gases, ideal and real gases.
- Understand the nature of calorimetry by specific heat of solids and gases.
- Analyses different transport phenomena in gases.
- Describe basic concepts of Thermodynamics.
- Analyses the laws of thermodynamics in different cases and entropy.
- Restate definition of system, surrounding, closed and open system, extensive and intensive variables and properties.
- Design various types of basic heat engines.
- Apply Maxwell's thermodynamic relations. Understanding the low temperature physics.

GE/OE-5 (BGO3T05)- Digital Systems

CO5:

- Differentiate between analog and digital systems and understand the significance of digital systems in modern technology.
- Perform binary arithmetic operations and convert between different number systems.
- Apply Boolean algebra and logic gates to simplify and design basic digital circuits.
- Design and analyse simple combinational and sequential circuits, including adders, subtractors, multiplexers, flip-flops, and counters.

VSC (BVS3P05) - Regulated Power Supply

CO6:

- Understand the working principles of different types of power supplies and the significance of regulated power supplies in electronic circuits.
- Demonstrate the ability to construct and test rectifier circuits, including halfwave, full-wave, and bridge rectifiers, and evaluate their performance.
- Analyse and implement various filtering techniques to reduce ripple in rectified DC output, including capacitor and LC filters.

- Design and construct voltage regulator circuits using Zener diodes, fixed voltage regulators (e.g., LM7805), and adjustable regulators (e.g., LM317).
- Identify and implement short-circuit and overload protection mechanisms in power supplies to ensure safe and reliable operation.
- Troubleshoot common faults in regulated power supply circuits, including rectifier failure, excessive ripple, and thermal issues.
- Design a complete regulated power supply system based on specified voltage and current requirements.

B.Sc. SEM –IV

Paper-7 (BPH4T07) - Lasers and Optical Fibres

CO1:

- Understand LASER and MASER Fundamentals: Describe the basic principles and properties of LASER and MASER technologies.
- Explain Coherence and Spectral Purity: Discuss spatial and temporal coherence and its importance in laser technology.
- Differentiate Laser Types: Identify and compare different types of lasers, including solid-state, gas, and semiconductor lasers.
- Evaluate Laser Applications: Discuss various applications of lasers in industries such as medicine, defence, and communications.
- Comprehend Fiber Optics Principles: Explain the fundamental principles of fibre optics, including total internal reflection and numerical aperture.
- Classify Optical Fibers: Differentiate between single-mode and multimode fibres, as well as step-index and graded-index fibres.
- Assess Optical Fiber Losses: Analyse the types of losses in optical fibres, including attenuation and dispersion.
- Explore Fiber Optic Applications: Describe the applications of optical fibres in communication and medical fields, including endoscopy and sensing technologies.

Paper-8 (BPH4T08) - Mathematical Physics

CO2:

- Classify and solve first-order and second-order differential equations, applying them to physical problems.
- Understand and apply partial differential equations and exact differentials.
- Utilize polynomial, exponential, logarithmic, and hyperbolic functions in data fitting and real-world applications.
- Differentiate between scalar and vector fields, including polar and axial vectors, with physical examples.
- Compute and interpret gradient, divergence, and curl of vector fields with geometric significance. Derive and apply the Del operator and Laplacian in various coordinate systems.
- Perform vector integration, including line, surface, and volume integrals, with physical interpretations.
- Apply Gauss' Divergence Theorem, Green's Theorem, and Stokes' Theorem in practical situations.

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Minor -3 (BPH2T03) - Acoustic and Ultrasonics

CO3:

- Understand the different aspects and attributes of a musical sounds.
- Also response of ear to sound and audible limits of human ear Learn about various musical scales and musical instruments .
- Learn about acoustics of a hall and requirement of a good acoustic of a hall Learn about different microphones their design and action and also about loudspeaker.
- Learn about the characteristics and production method as well as detection of USW.
- Learn about different applications of USW like SONAR, soldering, cleaning and medical applications like sonography etc.

Minor -4 (BPH2T04)- Oscillations and Black body radiation

CO4:

- Understand the simple harmonic motion, and properties of different oscillatory motion of an object 2.
- Understand the damped and forced oscillation.
- Understand mechanical waves in a medium and wave equation of the transverse waves on string and longitudinal waves in a fluid.
- Understand black body radiation and development of quantised nature of blackbody radiation.
- Understand the temperature of heavenly bodies.

GE/OE- (BGO4T06) - Communication Systems

CO5:

- Demonstrate a clear understanding of key communication concepts, including information, signals, noise, and bandwidth.
- Differentiate between Analog and digital communication systems, including their components like transmitters and receivers.
- Describe various modulation and demodulation techniques used in analogy communication, including AM, FM, and PM.
- To understand Signal Quality and impact of noise on Analog communication systems and compute signal-to-noise ratios and noise figures.
- Explain and implement pulse amplitude modulation (PAM), pulse code modulation (PCM), and digital modulation techniques like ASK, FSK, and PSK.
- Understand Multiple Access Techniques: Explain different multiple access techniques (FDMA, TDMA, CDMA) and their applications in communication systems.
- Describe the principles of multiplexing and its significance in efficient communication system design.
- Familiarise Emerging Technologies: Analyse the applications and trends in wireless communication, including cellular networks, Wi-Fi, and 5G technologies.

SEC (BVS4P06) - Advanced Experimentation

CO6:

- Study regular experiments with great details with precision and perform error analysis of result obtained against standard value of a physical quantity in an experiment.
- Understand Radioactive Decay: Demonstrate the ability to measure and analyze radioactive decay using a Geiger-Müller (GM) counter and a radioactive source.
- Calculate Rydberg's Constant: Accurately determine Rydberg's constant through experimental measurements of spectral lines.
- Setup the Michelson-Morley apparatus to conduct precision measurements of light interference and

demonstrate wave properties.

- Find the magnetic susceptibility of materials using a Guoy balance and interpret the results.
- Employ flame thermometry to find flame temperatures through the analysis of reversal spectral lines.
- Study the variation of dielectric constant with temperature and analyse its implications for material properties.
- Find the frequency of a VHF oscillator using a Lichtenberg wire and interpret the results.
- Write and execute a program on a Microprocessor 8085 or 8086, demonstrating an understanding of assembly language.

B.Sc. SEM –V

Paper 9 (Electrostatics and Electric Currents):

CO1:

- Compute electric fields using Coulomb's law and Gauss's law.
- Analyse electric field, electric potential, and energy in electrostatic systems.
- Understand the effect of electrostatic fields on conductors and dielectrics.
- Calculate capacitance of parallel plate capacitor.
- Understand the basic concept of electric current.

Paper 10 (Magnetostatics and Magnetism):

CO2:

- Understand the origin and nature of magnetic fields produced by steady currents.
- Apply Biot-Savart and Ampere's laws to simple geometries.
- Understand magnetic dipoles and energy in magnetic fields.
- Analyze Earth's magnetic field parameters and apply experimental methods.
- Explain magnetic behavior of materials using microscopic ideas.
- Appreciate the role of magnetism in Earth sciences and modern technology.

Paper 11 (Electronic Devices and Circuits):

CO3:

- Explain the basic concept of semiconductors and the operational characteristics of PN junction and Zener diodes.
- Understand the operation of rectifiers and simple filters.
- Understand the working of BJT and its applications.
- Understand the working of oscillators.
- Understand the working of power electronic devices.

Elective Course Paper 12 (A) (Digital Electronics and Microprocessor):

CO4:

- Understand the basic requirement of digital electronics.
- Describe the use of Boolean algebra for circuit operations.
- Elaborate the use of Flip flops as memory in data processor.
- Simplify logical expressions using Boolean algebra.
- Understand the basics and working of 8085 microprocessors.

Elective Course Paper 12 (B) (Opto electronics and devices):

CO5:

- Analyze the fundamental physics of semiconductors, including energy band structures and carrier recombination mechanisms.
- Understand the operation and performance parameters of various light-detecting devices, such as LDRs, PIN photodiodes, and phototransistors.
- Explain the operating principles and characteristics of optoelectronic devices such as solar cells, LEDs, OLEDs and laser diodes.
- Describes the structure, working, and applications of display and isolation devices, including LCDs and optocouplers.
- Understand the working principles of modern optoelectronic sensors such as CCD, CMOS, UV sensors, gas sensors, and LiDAR.

Minor-5 - Solid State Physics

CO6:

- Classify materials as amorphous or crystalline and explain crystal structures.
- Calculate unit cell properties like atomic packing fraction and density.
- Apply Bragg's Law to determine crystal structures and use Miller indices.
- Differentiate between polar and non-polar dielectrics and analyse polarization.
- Analyse magnetic properties and understand diamagnetism, paramagnetism and ferromagnetism.
- Understand band theory to classify metals, semiconductors and insulators.

Minor -6 – Optics

CO7:

- Describe fundamental principles of geometric optics, including Snell's Law and total internal reflection.
- Explain image formation by spherical boundaries and thin lenses.
- Analyse interference patterns in thin films for wavelength and refractive index measurements.
- Utilize interferometers to determine wavelength differences with precision.
- Apply polarization principles such as Brewster's law and Nicol prism.

VSC 5 (BVS3PO5) Optical Instruments

CO8:

- Apply optical knowledge into real world applications such as optical inspection, basic lens analysis or functioning of optical tools.
- Apply the principles of optical systems to use and interpret measurements from instruments such as spectrometer, telescope, optical bench, sextant and Lux meter etc.
- Perform practical tasks and hands on skill with optical equipment.
- Assess focal length, magnification of optical instruments and compare experimental observations with theoretical predictions.

B.Sc. SEM –VI

Paper 13(Quantum Mechanics –I):

CO1:

- Explain the experimental evidence that led to the failure of classical physics and the emergence of quantum mechanics, including blackbody radiation, photoelectric effect, Compton effect, and matter waves.
- Interpret the physical significance of wave-particle duality and apply Heisenberg's uncertainty principle to simple quantum systems.
- Formulate and solve the time-dependent and time-independent schrodinger equations for one-dimensional quantum systems under appropriate boundary conditions.
- Analyze standard quantum mechanical problems such as particle in a box, potential step, potential barrier, and harmonic oscillator using the schrodinger equation.
- Evaluate expectation values of physical observable and relate eigen values and eigen functions to measureable quantities.
- Apply operator formalism in quantum mechanics, including commutation relations and Hermitian operators, to understand measurement and observables.

Paper 14 (Classical Mechanics):

CO2:

- Analyse motion in inertial and non-inertial frames using Newton's laws, Galilean transformations, and fictitious forces.
- Formulate and solve equations of motion for constrained systems using Lagrange's equations and apply them to simple mechanical systems.
- Evaluate rotational motion of rigid bodies using concepts of torque, angular momentum and conservation principles.
- Solve problems related to central force motion, including planetary motion, satellite motion, and escape velocity using effective potential and inverse square law.
- Demonstrate understanding of conservation laws and apply them to real physical systems and qualitative astrophysical applications.

Paper 15 (Atomic and molecular Physics):

CO3:

- Analyse the historical failures of classical physics and the necessity of quantum mechanical models.
- Calculate spectral terms and predict the splitting of atomic lines in magnetic and electric fields.
- Distinguish between rotational, vibrational and electronic transition in molecules.
- Interpret Raman and IR spectra to determine the structural properties of diatomic and polyatomic molecules.
- Apply the principles of resonance spectroscopy to understand modern diagnostic tools.

Paper 16 (A) (Analogue and Communication Electronics):

CO4:

- Explain the working and applications of differential amplifiers, operational amplifiers, and IC 555 timer.
- Describe the principles of analog communication including modulation techniques, bandwidth, guard and wireless frequency ranges.

- Explain pulse and digital modulation techniques used in communication systems.
- Describe the basic principles of modern communication systems, receivers, and antennas.

Paper 16 (B) (Astrophysics and Special theory of Relativity):

CO5:

- Explain astronomical coordinate systems, stellar properties and the H-R diagram.
- Describe stellar evolution processes and basic cosmological models.
- Understand and derive Lorentz transformation and relativistic effects.
- Apply relativistic mechanics concepts such as mass-energy equivalence and momentum.
- Analyze experimental evidence supporting special theory of relativity.

Minor-7 (BPH4T07) - Lasers and Optical Fibres

CO6:

- Understand LASER and MASER Fundamentals: Describe the basic principles and properties of LASER and MASER technologies.
- Explain Coherence and Spectral Purity: Discuss spatial and temporal coherence and its importance in laser technology.
- Differentiate Laser Types: Identify and compare different types of lasers, including solid-state, gas, and semiconductor lasers.
- Evaluate Laser Applications: Discuss various applications of lasers in industries such as medicine, defence, and communications.
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- Explore Fiber Optic Applications: Describe the applications of optical fibres in communication and medical fields, including endoscopy and sensing technologies.

VSC 5 (BVS6PO8) Installation of roof top of Solar systems

CO7:

- Understand complete rooftop solar PV system design including mechanical and electrical aspects.
- Select suitable solar panels based on application, efficiency and cost.
- Design proper mounting structures by considering angle, direction, height and safety.
- Perform accurate power, energy and efficiency calculations for real installations.
- Estimate required solar capacity for homes, institutions and industries.
- Acquaint with basic installation procedure and wiring of rooftop solar systems.
- Evaluate energy generation, savings, and payback period for consumers.
- Understand government policies, subsidies and documentation procedures for solar projects.
- Monitor performance and carry out routine maintenance of solar PV systems.
- Work confidently as technician in rooftop solar installation and maintenance industries or start business related to solar panel system.



As per National Education Policy 2020

B.Sc.Part I to Part III (Semester I to Semester VI)

PROGRAM: B.Sc. CHEMISTRY

Program Outcome:

PO1.Knowledge: Width and depth:

Students acquire theoretical knowledge and understanding of the fundamental concepts, principles and processes in main branches of chemistry, namely, organic chemistry, inorganic chemistry, physical chemistry, analytical chemistry and biochemistry. In depth understanding is the outcome of transactional effectiveness and treatment of specialized course contents. Width results from the choice of electives that students are offered..

PO2.Laboratory Skills: Quantitative, analytical and instrument based:

A much valued learning outcome of this programme is the laboratory skills that students develop during the course. Quantitative techniques gained through hands on methods opens choice of joining the industrial laboratory work force early on. The programme also provides ample training in handling basic chemical laboratory instruments and their use in analytical and biochemical determinations. Undergraduates on completion of this programme can cross branches to join analytical, pharmaceutical, material testing and biochemical labs besides standard chemical laboratories.

PO3. Communication:

Communication is a highly desirable attribute to possess. Opportunities to enhance students' ability to write methodical, logical and precise reports are inherent to the structure of the programme. Techniques that effectively communicate scientific chemical content to large audiences are acquired through oral and poster presentations and regular laboratory report writing.

PO4. Capacity Enhancement:

Modern day scientific environment requires students to possess ability to think independently as well as be able to work productively in groups. This requires some degree of balancing. The chemistry honours programme course is designed to take care of this important aspect of student development through effective teaching learning process

PO5.Portable Skills:

Besides communication skills, the programme develops a range of portable or transferable skills in students that they can carry with them to their new work environment after completion of chemistry honours programme. These are problem solving, numeracy and mathematical skills- error analysis, units and conversions, information retrieval skills, IT skills and organizational skills. These are valued across

Program Specific Outcome

PSO1. Deep understanding of chemistry branches:

Students should have a strong grasp of organic, inorganic, physical, and analytical chemistry principles.

PSO2. Problem-solving skills:

Students should be able to apply chemical principles to solve problems, analyze data, and draw logical conclusions.

PSO3. Understanding of reaction mechanisms:

Students should be able to understand and explain the mechanisms of various chemical reactions.

PSO4. Laboratory techniques and instrumentation:

Students should be proficient in using modern chemical tools, models, and instruments for synthesis, analysis, and characterization of compounds.

PSO5. Research skills:

Students should be able to design and conduct experiments, analyze results, and contribute to research projects.

Course Outcomes

B.Sc. Semester – I

BCH1T01-Inorganic Chemistry-1 (Atomic structure, bonding and main group elements)

CO1.

- Solve the conceptual questions using the knowledge gained by studying the quantum mechanical model of the atom, quantum numbers, electronic configuration, radial and angular distribution curves, shapes of s, p, and d orbitals, and periodicity in atomic properties.
- Draw the plausible structures and geometries of molecules using VSEPR theory. Explain geometries and properties of molecules based on VBT.
- Understand the concept of lattice energy using Born-Haber Cycle.
- Rationalize the metallic properties based on various theories.
- Elaborate structures and properties of common compounds formed by main group elements.
- Identify acidic and basic radicals in simple inorganic salts

SEC (BVS1P02) - FOOD ADULTERATION ANALYSIS

CO2.

- The objective of this course is to impart practical skill enhancement in field of food adulteration testing. Completion of this course will enable the students to understand, learn and perform skills needed in Food Science/Quality Analysis laboratories.

Generic Elective-1 (BCH1GOE01T) - Food Adulteration

CO3.

- Understand the adulteration of common foods and their adverse impact on health.
- Comprehend certain basic skills of detecting adulteration in common foods.
- The students are able to understand role and importance of food additives.
- Apply their knowledge of food safety and regulations.
- Prevent food adulteration in the day to day life.

B.Sc. Semester – II

BCH2DSC02T -Organic Chemistry-2 (Fundamentals, stereochemistry and hydrocarbon)

CO1.

- Understand and explain the different nature and behaviour of organic compounds based on fundamental concepts learnt.
- Formulate the mechanism of organic reactions by recalling and correlating the fundamental properties of the reactants involved.
- Learn and identify many organic reaction mechanisms including Free Radical Substitution, Electrophilic Addition and Electrophilic Aromatic Substitution.
- Understand the fundamental concepts of stereochemistry.
- Elaborate various properties of aliphatic and aromatic hydrocarbons.
- Identify extra element and functional group in the given organic compound.

Generic Elective-2 -BCH2GOE02T :Kitchen and Nutrition Chemistry

CO2.

- Understand the chemical composition of food, including macromolecules, nutrients, and additives, and their significance in cooking, nutrition, and medical applications
- Apply knowledge of macromolecules, cooking chemistry, and food additives to analyse and optimize cooking processes, ensuring the preservation of nutritional value and sensory quality in prepared foods.
- Evaluate the classification and sources of nutrients in food, considering macronutrients, micronutrients, and additives, to make informed dietary choices that support overall health and well-being.
- Critically analyse the role of food additives in food preservation and flavour enhancement, considering their chemical composition and potential impacts on human health and food quality.

SEC (BVS2P04) - Water and wastewater analysis

CO3.

- Identify sampling locations for different types of water samples.
- Carry out sampling of water and wastewater from various sources.
- Analyze spot parameters at sampling location.
- Carry out complete physico-chemical analysis of different types of water samples.
- Suggest remedial measures for water detoxification.

B.Sc. Semester – III

BCH3T05- : Physical Chemisty-2- (Thermodynamics, phase equilibria, electrochemistry and kinetics)

CO1.

- Recollect the meanings of various thermodynamic terminology.
- Evaluate the thermodynamic quantities.
- Deduce and interpret the phase diagrams of binary and ternary systems.
- Analyze and elaborate the conductance properties of electrolytes.
- Evaluate the emf values and interpret the results in redox equilibria .
- Understand the mechanisms and kinetics of chemical reactions.

BCH3T06- Inorganic Chemisty-2 (Bonding, transition elements and solutions)

CO2.

- Explain properties of diatomic molecules using MO theory. Deduce the structures of various inorganic molecules formed by noble gases.
- Explain the properties of f-block elements using electronic configuration concept.
- Explain various reactions in non-aqueous media.
- Discuss properties of compounds using HSAB principle. Elaborate the geometries of compounds formed by noble gases.

BGO3T05-Chemistry in Everyday Life-(Generic Elective)

CO3.

- Explain chemicals involved in food products
- Elaborate the structural basis of colour and constitution
- Evaluate the properties of various organic molecules in biosystems

- Understand the impact of toxicants on environment.

VSC (BVS3P05) - Soil sampling and analysis

CO4.

- 1. Identify sampling locations for different types of soil samples.
- Carry out sampling of soils from various locations.
- Analyse spot parameters at sampling location.
- Carry out complete analysis of soil using classical and instrumental methods.
- Suggest remedial measures for soil quality improvement.

Minor 1: BCH1T01 Inorganic Chemistry-1 (Atomic structure, bonding and main group elements)

CO5.

- Solve the conceptual questions using the knowledge gained by studying the quantum mechanical model of the atom, quantum numbers, electronic configuration, radial and angular distribution curves, shapes of s, p, and d orbitals, and periodicity in atomic properties.
- Draw the plausible structures and geometries of molecules using VSEPR theory.
- Explain geometries and properties of molecules based on VBT.
- Understand the concept of lattice energy using Born-Haber Cycle.
- Rationalize the metallic properties based on various theories.
- Elaborate structures and properties of common compounds formed by main group elements.
- Identify acidic and basic radicals in simple inorganic salts.

Minor 2: BCH1T02 Organic Chemistry-1 (Fundamentals, stereochemistry and hydrocarbons)

CO6.

- Understand and explain the different nature and behaviour of organic compounds based on fundamental concepts learnt.
- Formulate the mechanism of organic reactions by recalling and correlating the fundamental properties of the reactants involved.
- Learn and identify many organic reaction mechanisms including Free Radical Substitution, Electrophilic Addition and Electrophilic Aromatic Substitution.
- Understand the fundamental concepts of stereochemistry.
- Elaborate various properties of aliphatic and aromatic hydrocarbons.
- Experimentally identify extra element and functional group in the given organic compound.
- Synthesize various organic compounds making use of selective reagents.

B.Sc. Semester – IV

BCH4T07: Inorganic Chemistry-3 Coordination chemistry, Redox reactions and Inorganic polymers

CO1.

- Understand various theories of coordination compounds.
- Discuss the structural aspects and isomerism in complexes.
- Explain the behaviour of various acids and bases using different theories.
- Draw various stability diagrams of redox systems under environmental conditions.
- Expertise in inorganic polymers structures and applications.

BCH3T08: Organic Chemistry-3 (Nitrogen compounds, Heterocyclics and organometallics)

CO2.

- Name various organic compounds containing nitrogen with their structures.
- Explain structural features of heterocyclic compounds of N, S, and O.
- Evaluate the percentage composition of organic compounds with their empirical formulae.
- Explain the electromagnetic spectrum with their interaction with matter.
- Calculate the bond parameters using IR frequencies.

Generic Elective (BGO4T06) Molecules of Life

CO3.

- Draw the structures of essential biomolecules.
- Understand the role of biomolecules in various life processes.
- Understand the structure and importance of proteins and nucleic acid.
- Understand the general idea about the polymer and way of synthesis of synthetic drugs and dyes.

(SEC) BVS4P06: Phytochemistry

CO4.

- To understand the medicinal properties in different medicinal plants.
- To confirm medicinal values of plant by pharmacological activity.
- To analyse various chemical molecules present in plant extract responsible for reduction and other activities.
- To prepare plant extract by applying various techniques.
- To isolate and identify the structures of the active ingredients.
- To ascertain possible medicinal actions.

Minor 3: BCH2T03 Organic Chemistry-2 (Functional group chemistry)

CO5.

- Understand preparation, properties and reactions of haloalkanes, haloarenes and oxygen containing functional groups.
- Use the synthetic chemistry learnt in this course to do functional group transformations.
- To propose plausible mechanisms for various reactions.
- Suggest synthesis routes for desired product from initial reactant.
- Identify given organic compound by systematic chemical analysis.
- Synthesize derivatives of given organic compound.

Minor 4: BCH2T04 Physical Chemistry-1 (Thermodynamics, gaseous and liquid states)

CO6.

- Solve fundamental mathematical function based problems in chemistry.
- Understand the three laws of thermodynamics, concept of State and Path functions, extensive and intensive properties.
- Derive the expressions of ΔU , ΔH , ΔS , ΔG , ΔA for ideal gases under different conditions.
- Evaluate thermodynamics of various physical and chemical processes.
- Analyse and explain properties of ideal gas, real gas and liquids.
- Evaluate thermodynamic constants through calorimetric studies.
- Use various properties of liquids for determination of their concentration and composition.

B. Sc. Sem-V

BCH5T09: Organic Chemistry-4(NMR, Enolates and Natural Product)

CO1.

- Understand the basics of principles and applications of NMR spectroscopy.
- Apply spectroscopic techniques for structure elucidation of organic compounds.
- Conceptualize the structural properties of enolates for synthesis applications.
- Provide various methods of synthesis of valuable organic compounds starting with enolates.
- Evaluate the quality of lipids and oils based on their properties.
- Predict the synthesis routes, reactions and applications of polymers.

BCH5T10: Physical Chemistry–3

(Solid State, Surface Chemistry, Spectroscopy and Quantum Mechanics)

CO2.

- Explain the classification of solids, laws of crystallography, crystal systems, Bravais lattices, and analyse crystal structures using X-ray diffraction and Bragg's equation.
- Determine crystal parameters such as Miller indices, interplanar spacing (cubic systems), and interpret the structures of NaCl, KCl, and CsCl using Laue and powder methods.
- Differentiate physical and chemical adsorption, apply Freundlich, Langmuir, and B.E.T. isotherms to adsorption phenomena, and explain the principles and industrial applications of catalysis including enzyme kinetics (Michaelis–Menten equation).
- Interpret rotational and vibrational spectra of molecules, derive relevant expressions for energy levels and spectral lines, and calculate molecular parameters such as moment of inertia and bond length.
- Explain limitations of classical mechanics and discuss the development of quantum theory including Planck's hypothesis, Bohr's model, de Broglie concept, and Heisenberg's principle.
- Apply Schrödinger wave equation and postulates of quantum mechanics to simple systems (particle in a box), interpret wave functions, eigenvalues, operators, and solve related numerical problems.
- Perform and analyse experiments related to crystallography, adsorption, and autocatalytic reactions to interpret structural characteristics of solids, verify adsorption isotherms, compare adsorption efficiencies, and understand reaction kinetics through experimental data.

BCH5T11: Inorganic Chemistry-4 (Complexes and Organometallics):

CO3.

- Understand the theoretical background of metal-complexes formation and structures
- Elaborate the structural basis of optical and magnetic properties of complexes
- Evaluate the thermodynamics involved in stability of coordination compounds
- Understand the structure and bonding in organometallic compounds
- Explain importance and role of essential metals in biosystems.

BCH5T12: (A) Basic Analytical Chemistry

CO4.

- Analytical techniques and their selection or criteria
- Carry out statistical analysis of the data
- Analyse sampling methods and cryogenic sampling for chemical analysis.
- Develop theoretical concepts used in various types of titrations and redox reactions
- Suggest theoretical practical concepts of gravimetric analysis.

Minor 5: BCH3T05: Physical Chemistry-2 (Thermodynamics, phase equilibria, electrochemistry and kinetics)

CO5.

- Recollect the meanings of various thermodynamic terminology

- Evaluate the thermodynamic quantities
- Deduce and interpret the phase diagrams of binary Qld ternary systems
- Analyze and elaborate the conductance properties of electrolytes
- Evaluate the emf values and interpret the results in redox equilibria
- Understand the mechanisms and kinetics of chemical reactions

Minor 6: BCH3T06: Inorganic Chemistry-2 (Bonding, transition elements and solutions)
CO6.

- explain properties of diatomic molecules using MO theory I.
- Deduce the structures of various inorganic molecules formed by noble gases
- Explain the properties of f-block elements using electronic configuration concept
- Explain various reactions in non-aqueous media
- Discuss properties of compounds using HSAB principle
- Elaborate the geometries of compounds formed by noble gases.

VSC 5: BVS5P07: Vocational IT skill

CO7.

- Become familiar with the use of computers for tabulating data, plotting graphs and charts, carry out statistical analysis of the data.
- Solve chemistry problems and simulate graphs.
- Prepare documents that will incorporate chemical structure, chemical equations, mathematical expressions from chemistry.
- Introduce fundamental concepts of artificial intelligence in chemical data analysis and prediction

B. Sc. Sem-VI

BCH6T13: Physical Chemistry-4 (Electrochemistry, Quantum Chemistry and Characterization)

CO1.

- Understand the basics of principles and applications of emf measurements
- Apply electrochemical cells for various qualitative and quantitative analysis
- Conceptualize the applications of quantum mechanics in chemistry.
- Interpret the physical significance of bonding theories in explaining bond formation and molecular stability.
- Provide principles involved in various photochemical processes
- Elaborate theory and applications of Raman spectroscopy
- Predict the techniques based on colligative properties for characterization
- Describe classification, kinetics, and characterization of macromolecules, including determination of number-average and weight-average molar masses and evaluation of Polydispersity Index (PDI).
- Perform physicochemical experiments using potentiometry, spectrophotometry, viscometry, polarimetry, and kinetic methods to determine physicochemical parameters such as strength and dissociation constant of acids, redox potential, molecular mass, specific rotation, concentration, and reaction rate, and interpret the experimental data accurately

BCH6T14: Inorganic Chemistry-5 (Bioinorganic Chemistry)

CO2.

- Know the idea behind inorganic materials in biosystems
- Understand the role of metal ions in biosystems.
- Conceptualize the metalloproteins and metalloenzymes in biosystems
- Provide principles involved in metal ion toxicity
- Elaborate theory and mode of action of inorganic materials in biosystems
- Predict the metal ion toxicity and probable remedies for it

BCH6T15: Organic Chemistry-5 (Molecules of Life)

CO3.

- Understand the basics of principles of carbohydrate structures elucidation
- Apply properties of Amino acids in their separation and analysis

- Conceptualize the structural aspects of peptides and proteins
- Describe structures of DNA and RNA
- Elaborate various aspects of genetic coding and role of chemists in bio-research
- Understand structure and function of Enzyme and Vitamin

DSE-2 (ELECTIVE PAPER-2) BCH6T16: (A) Instrumental Methods of Analysis
CO4.

- Understand the basic principles and instrumentation of spectrophotometry
- Apply optical methods for qualitative and quantitative analysis
- Conceptualize conductance measurement and applications thereof
- Construct electrochemical cell for analytical applications
- Separate various components in mixture to overcome mutual interferences
- Apply combination of separation and analytical methods in combination

DSE-2 (ELECTIVE PAPER-2) BCH6T16: (B) Chemistry of Dyes and Drug
CO5.

- Understand the basics dyes and drugs
- Elaborate the correlation between colour and constitution
- Conceptualize the classification of dyes based on applications
- Describe classification of dyes using chemical constitution
- Explain classification of drugs based on their action
- Develop methods of drug analysis

Minor 7 BCH4T07: Inorganic Chemistry-3 (Coordination chemistry, Redox reactions and Inorganic polymers
CO6.

- Understand various theories of coordination compounds
- Discuss the structural aspects and isomerism in complexes
- Explain the behaviour of various acids and bases using different theories
- Draw various stability diagrams of redox systems under environmental conditions
- Expertise in inorganic polymers structures and applications

BVS6P08: 011 and Fats Technology
CO7.

- Become familiar with the properties of oils
- Evaluate the physical properties of oils and fats
- Evaluate and interpret the data obtained through experimental observations
- Interpret the results and comment on the quality of oil or fat
- Suggest appropriate applications of the oils and fats




PRINCIPAL
 M.A.K. Women's College
 Hinganghat

As per National Education Policy 2020

B.Sc. Part I to Part III (Semester I to Semester VI)

PROGRAM: **B.Sc. Computer Science**

Program Outcome:

After successful completion of the B.Sc. (Honors/Research) in Computer Science programme, students will be able to:

1. Demonstrate comprehensive knowledge of fundamental and advanced concepts in computer science.
2. Apply techniques to solve theoretical and real-world problems.
3. Analyze, interpret, and evaluate computational arguments and proofs logically.
4. Use computational tools and mathematical software for modeling, simulation, and data analysis.
5. Formulate and solve problems using appropriate method and techniques.
6. Conduct independent research and findings effectively.
7. Integrate computational knowledge with interdisciplinary applications.
8. Demonstrate critical thinking, creativity and innovation in addressing complex challenges.
9. Exhibit professional ethics, social responsibility and lifelong learning skills.
10. Pursue higher education, research, entrepreneurship and diverse career opportunities in mathematics and allied disciplines

Course Outcomes

B.Sc. Semester-I (Computer Science)

PROGRAMMING IN c (Paper 1)

Course Outcomes: After completing this course satisfactorily, a student will be able to:

1. Apply simple algorithms for arithmetic and logical problems.
2. Implement conditional branching and iteration.
3. Divide complex tasks into reusable user define function and handle recursion
4. Analyze the use of pointers Structures, union and implement dynamic allocation.

GE/OE-I COMPUTER FUNDAMENTALS

Course Outcomes: After completing this course satisfactorily, a student will be able to:

1. Understand the architecture of digital computer, memory hierarchy and language translator.
2. Identify and explain the working principles and applications Of input, output, storage devices.

3. Apply number system conversions, perform binary arithmetic and analyze the operation of basic and universal logic gates.
4. Explain computer networking concepts, network topologies, communication devices and internet Protocols.

B.sc. Semester II (Computer Science)

OBJECT ORIENTED PROGRAMMING USING C++(Paper2)

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

1. Realize the need, features of OOP, and idealize how C++ differs from C.
2. Infer knowledge on various types of overloading.
3. Choose suitable inheritance while solution for the given problem.
4. Illustrate application Of pointers in virtual functions.

GE/OE-2 OFFICE AUTOMATION

Course Outcomes: After completing this course satisfactorily, a student will be able to:

1. Understand functionality of Operating Systems and its applications.
2. Prepare documents, letters and do necessary formatting of the document.
3. Worksheet creation, and editing data in cells
4. Opening/savinga presentation and printing of slides and handouts.

B.Sc. SEM-III

SC- DSC (Paper I) BCS3T05- DATA STRUCTURES

CO1:

1. Describe how arrays, records, linked structures, stacks, queues, trees, and graphs are represented in memory and used by algorithms
2. Describe common applications for arrays, records, linked structures, stacks, queues, trees, and graphs
3. Write programs that use arrays, records, linked structures, stacks, queues, trees, and graphs 4. Demonstrate different methods for traversing trees
5. Compare alternative implementations of data structures with respect to performance
6. Describe the concept of recursion; give examples of its use
7. Discuss the computational efficiency of the principal algorithms for sorting and searching

SC- DSC (Paper II) BCS3T06- LINUX OPERATING SYSTEM

CO2:

1. To understand the basic commands of linux operating system and can write shell scripts
2. To understand in detail the vi editor.
3. To create file systems and directories and operate them
4. To manage the disk space.
5. To study the graphical user interface KDE and GNOME Desktop environment.

(Computer Science - Minor) BCS1T01- PROGRAMMING IN 'C'

CO3:

1. Write simple algorithms for arithmetic and logical problems.
2. Write the C code for a given problem
3. Perform input and output operations using programs in C
4. Write programs that perform operations on arrays, strings, structures, unions, functions and file handling.

(Computer Science - Minor) BCS1T02- COMPUTER FUNDAMENTALS

CO4:

1. Confidently operate computers to carry out computational tasks
2. Understand working of Hardware and Software and the importance of operating systems
3. Understand number systems, peripheral devices, networking, multimedia and internet con

(Computer Science –GE/OE) BGO3T05 DATABASE MANAGEMENT SYSTEM

CO5:

1. Understand the concepts and principles of database management systems.
2. Design and create ER diagrams and understand the concept of strong and weak entity sets.
3. Study about the relational data model.
4. Apply normalization techniques to ensure data integrity.

(Computer Science - VSC) BVS3P05 WEB DESIGN USING HTML AND DHTML

CO6:

1. Apply various elements of HTML
2. To study and understand the basic tags of HTML.
3. Create web page using DHTML.
4. Create web page using Cascading Style Sheets

B.Sc. Sem –IV

(Computer Science - Major) SC- DSC (Paper I)BCS4T07 JAVA PROGRAMMING

CO1:

1. To solve real world problems using OOP techniques.
2. To understand the use of abstract classes.
3. To solve problems using java collection framework and I/O classes.
4. To develop multithreaded applications with synchronization.
5. To develop applets for web applications.
6. To design GUI based applications

SC- DSC (Paper II) BCS4T08 SOFTWARE ENGINEERING

CO2:

1. To decompose the given project in various phases of a lifecycle.
2. To choose appropriate process model depending on the user requirements.

3. To perform various life cycle activities like Analysis, Design, Implementation, Testing and Maintenance.
4. To know various processes used in all the phases of the product.
5. To apply the knowledge, techniques, and skills in the development of a software product.

(Computer Science - Minor)

BCS2T03 OBJECT ORIENTED PROGRAMMING USING 'C++'

CO3:

1. Realize the need and features of OOP and idealize how C++ differs from C.
2. Infer knowledge on various types of overloading.
3. Choose suitable inheritance while proposing solution for the given problem.
4. Handle pointers and effective memory management.
5. Illustrate application of pointers in virtual functions

(Computer Science - Minor) BCS2T04 - OPERATING SYSTEMS

CO4:

1. Describe the various OS functionalities, structures and layers.
2. Usage of system calls related to OS management and interpreting different stages of various process states.
3. Design CPU scheduling algorithms to meet and validate the scheduling criteria.
4. Apply and explore the communication between inter process and synchronization techniques.
5. Implement memory placement strategies, replacement algorithms related to main memory and virtual memory techniques.
6. Differentiate the file systems; file allocation, access techniques along with virtualization concepts and designing of OS with protection and security enabled capabilities.

(Computer Science – GE/OE) BGO4T06 - CYBER SECURITY

CO5:

1. Measure the security protections and limitations provided by today's technology.
2. Compare and contrast symmetric and asymmetric encryption systems and their vulnerability to attack.
3. Understand the concept of personal integrity and Cryptography.
4. Identify information security and cyber security threats.
5. Analyze threats in order to protect or defend it in cyberspace from cyber-attacks.
6. Build appropriate security solutions against cyber-attacks

(Computer Science – SEC)BVS4P06 VISUAL BASIC PROGRAMMING

CO6:

1. Discuss and improve skills in object-oriented analysis, design, programming, and testing.
2. Understand VB application environment and event driven programming
3. Learn about basic programming concepts like variables, operators and various control for I/O in VB
4. Implement various control constructs, arrays and collections used in VB
5. Learn and implement about procedure, subroutine and menu driven programming

B.Sc. Sem -V (Computer Science - Major)

SC-DSC (Paper I)

ADVANCED JAVA PROGRAMMING

Course Outcomes: After completing this course satisfactorily, a student will be able to:

1. Identify and compare different types of JDBC drivers.
2. Handle HTTP requests and responses using GET and POST methods.
3. To develop web applications using JSP and Servlets for dynamic web content generation.
4. Create remote interfaces and implement RMI server and client programs.
5. Implement accessor and mutator methods to define JavaBean properties.
6. Develop JavaBeans using BDK and package them using Manifest and JAR files.

B.Sc. Sem -V (Computer Science - Major)

SC-DSC (Paper II)

DATABASE MANAGEMENT SYSTEM

Course Outcomes: After completing this course satisfactorily, a student will be able to:

1. Understand the concepts and principles of database management systems.
2. Design and create ER diagrams and understand the concept of strong and weak entitysets.
3. Study about the relational data model.
4. Apply normalization techniques to ensure data integrity.

B.Sc. Sem -V (Computer Science - Major)

SC-DSC (Paper III)

DATA COMMUNICATION AND NETWORKS

Course Outcomes: After completing this course satisfactorily, a student will be able to:

1. To understand the fundamentals of network and transmission media.
2. To understand the error detection, correction codes and datalink layer protocols.
3. To understand the various routing algorithms and Internetworking.
4. To enhance the knowledge of sockets and congestion control techniques.
5. To enhance the knowledge in IDS and cryptographic techniques.

B.Sc. Sem -V (Computer Science)

DSE (Elective1)

WEB TECHNOLOGY

Course Outcomes: After completing this course satisfactorily, a student will be able to:

1. Understand web application architecture and can develop basic websites using HTML and Cascading Style Sheets.
2. Gain skills in different programming control structures and functions for development of dynamic client-side web applications.
3. To build dynamic web pages with validation using Java Script objects and by applying different event handling mechanisms

B. Sc. Sem-V (Computer Science-Minor)

DATA STRUCTURES

Course Outcomes: After completing this course satisfactorily, a student will be able to:

1. Describe how arrays, records, linked structures, stacks, queues, trees, and graphs are represented in memory and used by algorithms
2. Describe common applications for arrays, records, linked structures, stacks, queues, trees, and graphs
3. Write programs that use arrays, records, linked structures, stacks, queues, trees, and graphs
4. Demonstrate different methods for traversing trees
5. Compare alternative implementations of data structures with respect to performance
6. Describe the concept of recursion; give examples of its use
7. Discuss the computational efficiency of the principal algorithms for sorting and searching

B. Sc. Sem-V (Computer Science-Minor)

LINUX OPERATING SYSTEM

Course Outcomes: After completing this course satisfactorily, a student will be able to:

1. To understand the basic commands of linux operating system and can write shell scripts
2. To understand in detail the vi editor.
3. To create file systems and directories and operate them
4. To manage the disk space.
5. To study the graphical user interface KDE and GNOME Desktop environment.

B.Sc. Sem -V (Computer Science - VSC)

WEB DEVELOPMENT USING JAVA

Course Outcomes: After completing this course satisfactorily, a student will be able to:

1. To develop foundational skills in JavaScript
2. To understand the concept of classes, objects and inheritance concepts in JavaScript and their significance in organizing and managing code.
3. To learn how to create and utilize functions and loops.
4. To be familiar with JavaScript web APIs and their applications.
5. To develop proficiency in using JavaScript to enhance web forms, including form object manipulation and handling form elements.
6. Apply acquired knowledge to create interactive and responsive web forms.

B.Sc. Sem -VI (Computer Science - Major)

SC-DSC (Paper I)

CYBER SECURITY

Course Outcomes: After completing this course satisfactorily, a student will be able to:

1. Recognize and respond to cyberbullying and online harassment
2. Apply strategies to prevent and address online abuse
3. Implement parental controls and promote children's online safety
4. Secure mobile devices and wearable technology
5. Protect devices from malware and physical threats.

B.Sc. Sem -VI (Computer Science - Major)

SC - DSC (Paper II)

SQL AND PL/SQL

Course Outcomes: After completing this course satisfactorily, a student will be able to:

1. Create, modify, and manage Oracle database objects.
2. Develop solutions for business problems
3. Develop stored procedures and Implement robust database programs.
4. Create and manage PL/SQL functions
5. Develop automated and efficient database applications using functions and triggers.

B.Sc. Sem -VI (Computer Science - Major)

SC - DSC (Paper III)

PYTHON PROGRAMMING

Course Outcomes: After completing this course satisfactorily, a student will be able to: 1.

1. Understand Python syntax, data types, and basic programming constructs.
2. Write programs using functions, control structures, and loops.
3. Handle files and exceptions effectively in Python.
4. Develop real-time applications using libraries and modules.
5. Apply object-oriented principles using classes and objects.

B.Sc. Sem -VI (Computer Science)

DSE (Elective 2)

A. ASP .NET

Course Outcomes: After completing this course satisfactorily, a student will be able to:

1. Apply delegates and variable operations in programming tasks.
2. Import and manage namespaces effectively in .NET applications.
3. Develop web pages using ASP.NET web controls and events.
4. Implement validation and rich controls in web applications.
5. Develop component-based ASP.NET applications including database components.

B.Sc. Sem -VI (Computer Science)

DSE (Elective 2)

B. EMBEDDED SYSTEM

Course Outcomes: After completing this course satisfactorily, a student will be able to:

1. Analyze key characteristics of embedded systems including throughput, response time, reliability, power consumption, and cost.
2. Create and integrate Board Support Packages (BSPs) using the Catalog Editor.
3. Develop embedded applications using Microsoft Visual C++.
4. Apply thread synchronization techniques.

5. Analyze real-time features such as interrupt latency and nested interrupts.
6. Develop basic device drivers for Windows CE.NET.

B.Sc.Sem-VI(Computer Science- Minor)
JAVA PROGRAMMING

Course Outcomes: After completing this course satisfactorily, a student will be able to:

1. To solve real world problems using OOP techniques.
2. To understand the use of abstract classes.
3. To solve problems using java collection framework and I/O classes.
4. To develop multithreaded applications with synchronization.
5. To develop applets for web applications. 6. To design GUI based applications

B.Sc. Sem -VI (Computer Science - VSC)
SHELL PROGRAMMING

Course Outcomes: After completing the course, students will be able to:

1. Understand the UNIX working environment and its architecture.
2. Use UNIX commands to perform various system operations.
3. Differentiate between DOS/Windows and UNIX environments.
4. Write and execute shell scripts for solving computing problems. 5. Implement concepts like processes and system utilities in UNIX. 6. Manage users, permissions, and basic system administration tasks.




PRINCIPAL
M.A.K. Women's College
Hinganghat

As per National Education Policy 2020
B.Sc.Part I to Part III (Semester I to Semester VI)
PROGRAM: B.Sc. Mathematics

Program Outcome:

1. **PO1: Critical Thinking:** Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.
2. **PO2: Problem Solving:** Solve problems from the disciplines of concern using the knowledge, skills and attitudes acquired from mathematics/ sciences/social sciences/humanities.
3. **PO3: Effective Communication:** Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.
4. **PO4: Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in wide variety of settings. **PO10: Effective Citizenship:** Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
5. **PO5: Ethics:** Understand multiple value systems including your own, the moral dimensions of your decisions, and accept responsibility for them.
6. **PO6: Environment and sustainability:** Understand the impact of technology and business practices in societal and environmental contexts, and sustainable development.
7. **PO7: Self-directed and life-long learning:** Demonstrate the ability to engage in independent and life-long learning in the broadest context socio-technological changes.
8. **PO8: Design/Development of Solutions:** Design solutions for complex science problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
9. **PO 9: Computational Thinking:** Understand data-based reasoning through translation of data into abstract concepts using computing technology-based tools.
10. **PO 10: Global Perspective:** Understand the economic, social and ecological connections that link the world's nations and people.
11. **PO 11: Aesthetic Engagement:** Demonstrate and master the ability to engage with the arts and draw meaning and value from artistic expression that integrates the intuitive dimensions of participation in the arts with broader social, cultural and theoretical frameworks.
12. **PO 12:** Demonstrate comprehensive knowledge of fundamental and advanced concepts in mathematics.
13. **PO 13 :** Apply mathematical principles and techniques to solve theoretical and real-world problems.
14. **PO 14:** Analyze, interpret, and evaluate mathematical arguments and proofs logically.
15. **PO 15:** Use computational tools and mathematical software for modeling, simulation, and data analysis.
16. **PO 16 :** Formulate and solve problems using appropriate mathematical methods and techniques.
17. **PO 17 :** Conduct independent research and communicate mathematical findings effectively.
18. **PO 18 :** Integrate mathematical knowledge with interdisciplinary applications..
19. **PO19 :** Demonstrate critical thinking, creativity, and innovation in addressing complex challenges.
20. **PO20 :** Exhibit professional ethics, social responsibility, and lifelong learning skills.
21. **PO21 :** Pursue higher education, research, entrepreneurship, and diverse career opportunities in mathematics and allied disciplines.

Course Outcomes

B.Sc. SEM-I

DSC (Paper I) BMT1DSC01T- Elementary Mathematics

1. CO1: Understand the concepts of number theory including divisibility, Euclidean algorithm, GCD, LCM, equivalence relations, and equivalence classes.
2. CO2: Analyse different types of matrices and apply matrix operations, rank, canonical forms, and Cayley–Hamilton theorem to solve systems of equations.
3. CO3: Solve polynomial equations using transformation techniques, Horner’s method, Descartes’ rule of signs, Cardano’s method, and Ferrari’s method.
4. CO4: Apply the concepts of complex numbers including De Moivre’s theorem, roots of unity, logarithm of complex variables, and separation into real and imaginary parts.
5. CO5: Develop analytical thinking and problem-solving skills in algebra, matrices, equations, and complex variable theory.

GE/OE :BMT1GOE01T - Quantitative Aptitude

6. CO1: Understand and apply the concepts of number system, H.C.F., L.C.M., decimal fractions, and simplification techniques.
7. CO2: Solve problems related to average, percentage, ratio, and proportion in daily life and competitive examinations.
8. CO3: Apply the concepts of profit and loss, simple interest, and compound interest in commercial and financial calculations.
9. CO4: Analyze and solve problems based on numbers, ages, surds, indices, and logarithms using mathematical reasoning.

SEC 1 : BMT1SEC01P- Equation Editor in MS Office

10. CO1: Technical Proficiency: Navigate the Microsoft Equation Editor to accurately insert and format a wide range of mathematical symbols and complex structures.
11. CO2 : Advanced Notation Mastery: Construct professional-grade expressions for advanced topics including Calculus, Linear Algebra, Vector Calculus, and Piecewise functions.
12. CO3: Data Visualization: Integrate clear graphs, charts, and SmartArt to effectively represent mathematical data and relationships within a presentation.
13. CO4: Dynamic Content Creation: Design engaging educational materials using animations and interactive elements like hyperlinks and custom navigation.
14. CO5: Professional Delivery: Configure and manage advanced slide show settings to deliver polished, non-linear mathematical presentations.

B.Sc. SEM-II

DSC (Paper II) BMT2DSC02T- Differential and Integral Calculas

1. CO1: Apply successive differentiation, Leibnitz's theorem, Taylor's theorem, Maclaurin's theorem, and L'Hospital's rule to solve problems in single variable calculus.
2. CO2: Analyse functions of two variables using limits, continuity, partial derivatives, total differentials, homogeneous functions, and Jacobians.
3. CO3: Evaluate integrals using reduction formulae, Beta and Gamma functions, and understand their properties and interrelations.
4. CO4: Solve problems involving double and triple integrals, including change of order and change of variables.
5. CO5: Develop analytical and problem-solving skills in differential and integral calculus with applications in mathematics and related fields.

GE/OE (BMT2GOE02T) -Aptitude & Reasoning

6. CO1: Solve quantitative aptitude problems related to time and work, time and distance, heights and distances, boats and streams, and trains.
7. CO2: Apply mathematical reasoning to solve problems on allegation, mixtures, and related numerical concepts.
8. CO3: Analyse and interpret logical reasoning problems involving Venn diagrams, analogies, and blood relations.
9. CO4: Solve problems based on directional sense, number series, letter series, and coding/decoding techniques.

SEC 2 : BMT2SEC02P - Financial Mathematics

10. CO1: Calculate variables using both simple and compound interest.
11. CO2: Calculate variables using annuities formulas, including bond market value calculations.
12. CO3: Describe the features of promissory notes, bonds, and annuities.
13. CO4: Judge if a project is viable based on a Net Present Value calculation.
14. CO5: Demonstrate the interaction between interest rates and market prices for bonds.
15. CO6: Communicate using financial terminology.
16. CO 7: Solve common business problems employing mathematics of finance.

B.Sc. SEM-III

DSC (Paper 5) BMT3T05 – Partial Differential Equation

1. CO1: Foundational Knowledge: Students will have the opportunity to enhance their understanding of the fundamental concepts of partial differential equations.
2. CO2: Elementary Skills: Students will gain an understanding of the significance of integral curves and surfaces associated with vector fields.
3. CO3: Basic Analytic skills: The primary objective of the course is to provide students with essential foundational analytical skills for effective problem-solving.

4. CO4: Application: By applying the principles of basic tools through the course curriculum, students can solve a variety of practical problems in science and engineering.

DSC (Paper 6) BMT3T06 – Analytical Solid Geometry

5. CO1: To understand concepts on Two and Three-Dimensional Geometry.
6. CO2: To find equations of Right lines, Planes, Spheres, Cones and Cylinders.
7. CO3: To find the Direction cosines of any line under the different given conditions.
8. CO4: To understand the intersection of any two or three, three dimensional geometrical figures.

DSC (Minor 1- Paper 1) BMT1T01 – Algebra and Trigonometry

9. CO1: Foundational Knowledge: Students will be able to update their basics of Set Theory, Matrices, Theory of equations and Complex variables and its applied aspects.
10. CO2: Elementary Skills: Students will be able to understand the importance of hyperbolic functions and their relationships with trigonometric functions.
11. CO3: Basic Analytic skills: The main outcome of the course is to equip students with necessary basic analytic skills for problem solving.
12. CO4: Application: By applying the principles of basic tools through the course curriculum, students can solve a variety of practical problems in science and engineering.

DSC (Minor 2 - Paper 2) BMT2T02 – Algebra and Trigonometry

13. CO1: Foundational Knowledge: Students will be able to update their basic knowledge of Maxima and Minima of functions of single variables and their application.
14. CO2: Elementary Skills: Students will undergo problem solving training by learning Indeterminate forms and L' Hospital's Rule and their applicability.
15. CO3: New Concepts learning: Students will be able to learn new concept of functions of two variables, Taylor series, and maxima and minima of such functions.
16. CO4: Analytic Skills: The problem-solving skills will bring forth the importance of Jacobian in understanding the existence of inverse transformation and other aspects of independence of pair of functions.
17. CO5: Application: By applying the principles of basic tools through the course curriculum, students can solve a variety of practical problems in science and engineering.

GE/OE (BG03T05) –Basic Mathematics for Coading

18. CO1: Develop logical thinking, analytical ability, and problem-solving skills useful for competitive examinations and real-life applications.
19. CO2: Develop numerical aptitude, logical thinking, and problem-solving skills for academic and competitive purposes.

VSC (BVS3P05) –Geogebra

20. CO1: Gain experimental, problem-oriented and research-oriented skills of learning of mathematics.

21. CO2: Create interactive work sheets and learning materials
22. CO3: Create interactive learning resources as web pages.

B.Sc. SEM-IV

DSC (Paper 7) BMT4T07 – Mathematical Method

1. CO2: Upon successful completion, students will have the knowledge of various types of transformations, their terminology and applications.
2. CO1: Gain experimental, problem-oriented and research-oriented skills of learning of mathematics.

DSC (Paper 8) BMT4T08 – Sequence and Series

3. CO1: The student will be able to - define a sequence; understand the meaning of convergence and divergence of a sequence; test the convergence of a sequence.
4. CO2: The student will be able to - define a series; understand the meaning of convergence and divergence of a series; test the convergence of a series; explain the difference between absolute and conditional convergence of a series.

DSC (Minor 1- Paper 3) BMT2T03 – Integral Calculus And Ordinary Differential Equation

5. CO1: Foundational knowledge: Students to update their knowledge of improper integrals, Beta and Gamma functions and their applicability.
6. CO2: Basic skills: Students will be able to understand the importance of varied methods of solving differential equations of first and second order.
7. CO3: Analytical skills: The main objective of the course is to equip students with necessary analytic skills due to integrability and solutions of differential equations.
8. CO4: Application: By applying the principles of basic tools through the course curriculum, students can solve a variety of practical problems in science and engineering.

DSC (Minor 1- Paper 4) BMT2T04– Vector Analysis

9. CO1: Foundational knowledge: To impart foundational knowledge of vector algebra and vector differentiation.
10. CO2: Basic skills: To inculcate in students foundational base of gradient of a scalar function, divergence and curl.
11. CO3: Concept learning: New concept of vector integration shall be introduced and problems of work done by force shall be solved.
12. CO4: Application of Vector Theorems: To solve variety of practical problems in science and engineering by applying Greens theorem, divergence theorem, Stokes' theorem.
13. CO5: Application: The course curriculum is so prepared that it has wide application in physics, and in other Science and Engineering subjects.

GE/OE (BG04T06) –Mathematics For Data Analysis

14. CO1: Solve problems related to average, percentage, ratio, and proportion in daily life and competitive examinations.
15. CO2: Apply the concepts of profit and loss, simple interest, and compound interest in commercial and financial calculations.

SEC BVS4P06: Applied Mathematics for Data

16. CO1: Analyse the data and interpret it.
17. CO2: Infer decisions on the basis of data interpretations.
18. CO3: Apply appropriate formats for generating data reports.
19. CO4: Enhance visual presentation of data through visualisations tools.

B.Sc. SEM-V

DSC (Paper9) BMT5T09 –Mathematical Analysis

1. CO1: Distinguish between set types and verify metric axioms.
2. CO 2: Characterize compact/connected sets and determine completeness.
3. CO 3: Establish Riemann integrability using partitions and Darboux's theorem.
4. CO 4: Evaluate integrals using the Fundamental Theorem of Calculus and Mean Value Theorems.

DSC (Paper 10) BMT5T10 – Abstract Algebra

5. CO1: Understand and apply the fundamental concepts of group theory, including groups, subgroups, cyclic groups, cosets, and Lagrange's theorem, to analyze algebraic structures.
6. CO2: Analyse advanced group theoretic concepts such as normal subgroups, quotient groups, group homomorphisms, and permutations, including cyclic decomposition.
7. CO3: Develop and apply concepts of ring theory, including rings, integral domains, fields, ideals, quotient rings.

DSC (Paper 11) BMT5T11 – Mechanics

8. CO1: Understand and analyse forces acting on particles and rigid bodies.
9. CO2 –Solve problems involving conservation laws and rigid body motion.
10. CO3 –Formulate and solve oscillation models using differential equations.

DSE (Paper 12) BMT5T12 – Graph Theory

11. CO1: Foundational Knowledge: Students will understand the fundamental concepts of graph theory such as graphs, subgraphs, degree of vertices, paths, cycles, and connectivity. Classify different types of graphs including simple graphs, multigraphs, directed graphs, and weighted graphs. Explain key concepts like Eulerian and Hamiltonian graphs, trees, and planar graphs. Understand basic terminology related to graph coloring and network flows.

12. CO2: Elementary Skills: NEP2020: Syllabus for Four Year Undergraduate (B.Sc.) Degree Programme (B.Sc. Sem-V & VI Mathematics) 22 | Page Represent graphs using adjacency matrices, incidence matrices, and adjacency lists. Construct and analyze different types of graphs based on given conditions. Determine connected components, and spanning trees.
13. CO3: Basic Analytic Skills: Analyze properties of graphs including connectedness. Solve problems related to shortest paths, minimal spanning trees, and network flows.
14. CO4: Application: Apply to Model real-world problems Apply graph algorithms to solve optimization problems. Apply tree concepts in computer science and data structures.

DSC (Minor - Paper 5) BMT3T05 – Partial Differential Equation

15. CO1: Foundational Knowledge: Students will have the opportunity to enhance their understanding of the fundamental concepts of partial differential equations.
16. CO2: Elementary Skills: Students will gain an understanding of the significance of integral curves and surfaces associated with vector fields.
17. CO3: Basic Analytic skills: The primary objective of the course is to provide students with essential foundational analytical skills for effective problem-solving.
18. CO4: Application: By applying the principles of basic tools through the course curriculum, students can solve a variety of practical problems in science and engineering.

DSC (Minor - Paper 6) BMT3T06 – Analytical Solid Geometry

19. CO1: To understand concepts on Two and Three-Dimensional Geometry.
20. CO2: To find equations of Right lines, Planes, Spheres, Cones and Cylinders.
21. CO3: To find the Direction cosines of any line under the different given conditions.
22. CO4: To understand the intersection of any two or three, three dimensional geometrical figures.

VSC: BVS5P07: Scilab Software

23. CO1: Apply basic arithmetic operations and matrix algebra using Scilab to solve mathematical problems.
24. CO2: Implement Scilab programs to perform matrix operations, determinants, inverses, eigen values, and solutions of linear systems.
25. CO3: Develop algorithms and programs in Scilab for solving numerical and algebraic problems such as polynomial roots, factorial, and Fibonacci series.
26. CO4: Analyze and process numerical data by computing statistical measures such as mean, median, and standard deviation using Scilab.
27. CO5: Visualize mathematical functions and computational results through graphical representations including 2D graphs and 3D surface plots in Scilab.

B.Sc. SEM-VI

DSC (Paper 13) BMT5T13 – Complex Analysis

1. CO1: Understand and apply the concept of limits, continuity, differentiability and analyticity of complex functions using Cauchy–Riemann equations.
2. CO2: Construct analytic functions and harmonic conjugates, and analyze properties of harmonic functions.
3. CO3: Apply conformal mappings and bilinear transformations to map complex regions and solve related problems.
4. CO4: Evaluate complex integrals using Cauchy’s Integral Theorem, Cauchy’s Integral Formula and related results.
5. CO5: Expand complex functions into Taylor and Laurent series and classify singularities.
6. CO6: Compute residues and apply the Residue Theorem to evaluate real definite and improper integrals.

DSC (Paper 14) BMT5T14 –Linear Algebra

7. CO1: Develop a strong foundation in vector spaces
8. CO2: Introduce the theory of linear transformations
9. CO3: Establish the relationship between linear transformations and matrices
10. CO4: Provide a rigorous understanding of inner product spaces
11. CO5: Equip students with computational techniques

DSC (Paper 15) BMT5T15 – Special Theory Of Relativity

12. CO1: Develop a clear understanding of the fundamental principles of Special Relativity, including frames of reference, space–time structure, and Lorentz transformations.
13. CO2: Enable students to analyze relativistic effects such as velocity transformation, time dilation, length contraction, and mass–energy equivalence.
14. CO3: Introduce the mathematical framework of Tensor Algebra necessary for understanding relativistic physics and curved space–time.
15. CO4: Analyze space–time structure using Minkowskian Space, world lines, and fourvectors.
16. CO5: Build the ability to compute and interpret geometric quantities such as Christoffel symbols and tensor operators in Riemannian spaces.

DSE (Paper 16) BMT5T16 – Transportation Problem and Game Theory

17. CO1: Explain the concept of Transportation Problems, formulate them as Linear Programming models, and represent them using transportation tables, including concepts such as duality, loops, and triangular basis.
18. CO2: Determine initial basic feasible solutions (IBFS) of transportation problems using methods such as North-West Corner Rule, Least Cost Method, and Vogel’s Approximation Method.
19. CO3: Analyze transportation problems to obtain optimal solutions using MODI (Modified Distribution) method, interpret dual variables economically, and handle degeneracy in transportation tables.
20. CO4: Solve advanced transportation models including Stepping Stone Method, Unbalanced

Transportation Problems, Time-Minimization Transportation Problems, and Transshipment Problems.

21. CO5: Construct and analyze two-person zero-sum games by forming payoff matrices and applying maximin–minimax principles to determine the presence of a saddle point.
22. CO6: Solve game theory problems without saddle points using mixed strategies, graphical methods ($2 \times n$ and $m \times 2$ games), and dominance property. NEP2020: Syllabus for Four Year Undergraduate (B.Sc.) Degree Programme (B.Sc. Sem-V & VI Mathematics) 29 | Page
23. CO7: Apply advanced methods such as arithmetic method, matrix method, iterative approximation method, and general solutions of rectangular games ($m \times n$) to determine optimal strategies.

DSC (Minor - Paper 7) BMT4T07 – Mathematical Method

24. CO1: Gain experimental, problem-oriented and research-oriented skills of learning of mathematics.
25. CO2: Upon successful completion, students will have the knowledge of various types of transformations, their terminology and applications.

DSC (Minor - Paper 8) BMT4T08 – Sequence and Series

26. CO1: The student will be able to - define a sequence; understand the meaning of convergence and divergence of a sequence; test the convergence of a sequence.
27. CO2: The student will be able to - define a series; understand the meaning of convergence and divergence of a series; test the convergence of a series; explain the difference between absolute and conditional convergence of a series.

VSC: BVS6P08: Introduction To LaTeX Software

28. CO1: Compare the advantage of LaTeX over other word processing software.
29. CO2: Create tables and figures place them within the document.
30. CO3: Develop the basics: editing, arranging, and formatting of text.
31. CO3: Write mathematical formulas and mathematical expressions.
32. CO5: Design the overall layout of a document.



**Program Specific Outcomes (PSOs) and Course Outcomes (COs) of
or B.Sc. (Zoology) Programme**
**Programme Specific Outcomes (PSOs) of Four Year Undergraduate Programme in
Zoology:**

- Students will acquire the ability to describe, identify, classify, and differentiate animals across various taxonomic hierarchies. They will develop a comprehensive understanding of morphological, anatomical, and histological features of organs and organ systems in diverse animal groups, and critically analyse evolutionary trends and relationships among taxa.
- Students will develop skills to assess physicochemical parameters of water (e.g., dissolved oxygen, carbon dioxide, pH, hardness) and interpret ecological status based on these indicators.
- Students will demonstrate an in-depth understanding of cell biology by describing and differentiating cellular organelles and components. They will be able to examine normal and abnormal cellular physiology. Perform basic biochemical estimations (proteins, lipids, carbohydrates), and identify cellular and acellular elements in tissues.
- Students will comprehend and interpret patterns of inheritance in animals, including classical and molecular mechanisms, and differentiate among various genetic regulatory processes governing heredity.
- Students will acquire applied knowledge in zoological sciences, including practices such as apiculture, sericulture, and fisheries. They will understand the economic and entrepreneurial significance of these fields and be able to communicate their applications effectively.
- Students will develop the ability to understand, analyse, and interpret innate and learned behaviours across different animal groups, integrating concepts from ethology and behavioural ecology.
- Students will be trained in experimental design and scientific methodology, enabling them to conduct experiments, test hypotheses, and analyse data using appropriate statistical tools. They will develop competencies in scientific writing, presentation, and critical argumentation, adhering to standard research practices in life sciences.

Course Outcomes

B.sc Semester I – Zoology

Course Category: Discipline Specific Core (DSC)

Name of Course: Life and Diversity of Animals Nonchordates (Protozoa to Annelida)

Course Outcomes (COS):

- Students will be able to understand about early phyla viz., Protozoa, Porifera, Coelenterata, Platyhelminthes, Aschelminthes and Annelida.
- Students could be able to identify, classify and analyze different animals belonging phylum Protozoa to Annelids on the basis of levels or grades of organization, symmetry, coelom etc. upto class.
- Students will learn, analyze, describe a representative animal belonging to phylum Protozoa to Annelida
- Students could elucidate and explain uniqueness of phylum Protozoa to Annelida and they could be able to demonstrate peculiar tissue, organs of animals belonging to these phyla.

Course Category: Generic Elective (GE)

Name of Course: Indian Birds

Course Outcomes

- After successful completion of the course, students will be able to:
- Identify common Indian birds and understand their classification.
- Explain basic features of bird morphology and adaptations.
- Describe feeding habits, migration, and behaviour of birds.
- Recognize the ecological and economic importance of birds.
- Understand threats to birds and suggest conservation strategies.

Course Category: Skill Enhancement Course (SEC)

Name of Course: Beekeeping

Course Outcomes

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

- Identify different species and castes of honeybees.
- Handle bee colonies safely using modern techniques
- Understand colony organization and developmental stages
- Use beekeeping equipment efficiently
- Analyse foraging behaviour and bee flora
- Apply practical knowledge for small-scale beekeeping enterprises

B.Sc. Semester II- Zoology

Course Category: Discipline Specific Core (DSC)

Name of Course: Life and Diversity of Animals - Non-Chordates (Arthropoda to Hemichordata)

Course Outcomes (COs)

- Students will learn, identify, explain and analyze the taxonomic position of animals belonging to phylum Arthropoda to Hemichordata.
- They could describe explain and analyze phylogeny to understand the course of evolution in animals from phylum Arthropoda to Hemichordata.
- They will able to describe explain and differentiate various morphological anatomical structures and functions of animals of phyla from Arthropoda to Hemichordata.
- Students will able to understand, describe, explain and differentiate the larval form development of the invertebrates from phylum Arthropoda to Hemichordata.
- Students will able to describe explain and analyze the ecological and economic of invertebrates.
- Students will understand, able to describe, explain and analyze the ecological to invertebrates in the biodiversity.

Course Category: Generic Elective (GE)

Name of Course: Attractive Insects

Course Outcomes

After successful completion of the course, students will be able to:

- Recognize and classify common attractive insects.
- Describe morphological features responsible for attractiveness.
- Explain behaviour and ecological roles of selected insects.
- Understand economic importance of insects like butterflies, silkworms, and honeybees.
- Develop awareness about insect conservation and sustainable practices.

Course Category: Skill Enhancement Course (SEC)

Name of Course: Water Quality Analysis

Course Outcomes

- After completion of course, students will be able to.

- Analyse basic water quality parameters.
- Perform laboratory techniques accurately.
- Interpret pollution levels and water standards.
- Apply knowledge in environmental assessment.

B.Sc. Semester –III(Zoology-Major)

DSC I: Life and Diversity of Animals – Chordates (Protochordata to Amphibia)

Course Outcomes

- Describe classes and orders of phylum Chordata.
- Identify. Classify various animals of the Phylum Chordata.
- Differentiate between Protochordate and higher Chordates upto Amphibia based on their characters.
- Analyze the anatomy and physiology of protochordates, agnathans. pisces and amphibians.
- Create interlinking and mapping between various chordate groups.

DSC II: Genetics

Course Outcomes

- Understand the Fundamental Principles of Genetics: Explain Mendelian inheritance the Chromosome Theory of Inheritance, mitochondrial DNA and plasmids, and genetic, variation and mutation, distinguish various chromosomal aberrations, recognize types of mutations (point mutation , frameshift), and evaluate their roles in genetic diversity and disease.
- Comprehend the Mechanisms of Genetic Inheritance and Gene Structure: Explore genetic inheritance mechanisms, gene structure chromosomal mapping concepts and cytoplasmic inheritance. Analyze pedigree analysts for autosomal and X-linked traits to identify inheritance patterns.
- Analyze Genetic Variation and Evolutionary Dynamics: Apply the Hardy-Weinberg principle to study genetic equilibrium and the impact of factors such as mutation, selection, and genetic drift on population genetics, explain the genetic basis of speciation, adaptation, and evolutionary processes. Use quantitative genetics to explore polygenic, traits, heritability, and their role in natural selection and evolution.
- Examine Human Genetics and Genetic Disorders: Interpret human karyotypes and identify chromosomal and genetic disorders. Understand the inheritance patterns of single-gene and multifactorial disorders. Discuss the ethical considerations in genetic counselling genetic testing, and biotechnology, especially in the context of human health.
- Explore Advanced Topics in Genetics and Their Applications: Analyze the genetic basis of cancer oncogenes, and tumour suppressor genes, and the role of mutations and environmental factors in cancer development. Discuss the role of epigenetics and environmental influences on gene expression and development; evaluate the applications of gene therapy agriculture and biotechnology, addressing ethical and societal implications.

Generic Elective/Open elective (GE\ OE): Animal Husbandry

Course Outcomes

After the completion of course students will be able to:

- Understand the basic concepts and classifications in poultry, including the systematic position, habitat, and morphology of Gallus gallus domesticus
- Identify and differentiate among various poultry breeds, such as American. Mediterranean, English. Asiatic and Indian breeds.
- Demonstrate knowledge of brooding and rearing techniques, including housing systems. Nutritional needs and equipment for poultry.
- Recognize common poultry diseases, understand their causative agents, symptoms, and implement prevention and control measures.
- Analyze the composition, nutritive value, and economic importance of poultry products. Including eggs and meat.
- Gain insights into the economic aspects of poultry farming and its role in sustainable agricultural practices.

Vocational Skill Course (VSC): Aquarium Preparation and Maintenance

Course outcomes

- Aware of the vast potential and vocational opportunities involved in aquarium fabrication and management.
- The learner gains the scientific method of fabricating and maintaining an aquarium.
- Learner can learn the common troubleshooting mechanisms in aquarium management.
- Students can analyse the optimum physical and chemical condition of water required for aquarium.
- Learner also acquainted with fish food.

B.sc Semester-IV

DSC-I: Life and Diversity of Animals- Chordates (Reptilia to Mammalia)

Course outcomes

By the completion of the course the students will able to:

- Describe, explain characters, classification of Reptile. Could analyze general pattern of different system of reptile.
- Describe, explain characters, classification of Aves. Could analyze general pattern of different system of Aves.
- Describe, explain characters, classification of Mammalia could analyze general pattern of different system of Mammalia.
- Compare integuments, urinogenital systems, heart and aortic arches in Reptilia. Aves and Mammalia Also describe and analyze autonomous nervous system in Mammalia.

DSC-II: Developmental Biology

Course outcomes:

By the completion of the course the students should able to:

- Describe, explain and differentiate various stages, pattern of development in protostomes and deuterostomes. They could also able to differentiate different types of development in insects, different types and stages of gametogenesis and different types of eggs.
- Describe, explain and differentiate various phases of fertilization cleavage they could also describe, explain different stages of development in Amphioxus and Frog.
- Describe, explain and differentiate different stages of development in Chick up to gastrulation. They could also understand, describe explain and differentiate structure and function of extra embryonic membranes in Chick.
- Describe, explain and differentiate different types of placenta Also analyse development of Mammalia up to Gastrulation. They will ably differentiate totipotency and pluripotency and analyse axis formation in Mammals.

Generic Open Elective: Communicable Diseases

Course Outcomes:

By the completion of the course the students will able to

- Describe, explain about WHO and NCDC and could analyse Influenza and Covid 19 CO 2 Describe, explain about Bacterial diseases like Tuberculosis, Pertusis. Typhoid.
- Describe, explain fungal diseases like Ring worm and Athlets foot as well as protozoan caused disease like Giardiasis.
- Describe, explain vector borne diseases like Malaria, sleeping sickness and filariasis.

Generic/ Open Elective: Biostatistics

Course Outcomes:

By the completion of the course the students will able to

- Describe, explain and analyse data and sample as well as data collection and data presentation.
- Describe, explain, analyse data diagrammatic presentation and mean and median as measure of central tendency.

- Describe, explain mode as measure of central tendency as well as measure of dispersion along with correlation and regression.
- Describe, Explain probability, concept of test of hypothesis and biostatistical software.

Skill Enhancement Course (SEC) :Clinical pathology

Course outcomes:

By the completion of the course the students will able to

- Develop proficiency in sample collection, handling, and processing techniques
- Demonstrate competency in basic laboratory tests to assess cellular components and biochemical markers.
- Analyse and interpret common clinical test results, aiding in disease diagnosis
- Acquire skills in urine, stool, and blood examination for diagnostic purposes
- Apply knowledge of safety and ethical considerations in clinical pathology Practice.

B.sc Semester III (Minor)

Minor I : Life and Diversity of Animals Nonchordates (Protozoa to Annelida)

Course Outcomes (COS):

- Students will able to understand about early phyla viz., Protozoa, Porifera, Coelenterata, Platyhelminthes, Aschelminthes and Annelida.
- Students could able to identify, classify and analyze different animals belonging phylum Protoza to Annelids on the basis of levels or grades of organization , symmetry , coelom etc. upto class .
- Students will learn, analyze, describe a representative animal belonging to phylum Protozoa to Annelida
- Students could etucidate and explain uniqueness of phylum Protozoa to Annelida and they could able to demonstrate peculiar tissue, organs of animals belonging to these phyla.

Minor II: Environmental Biology

Course Outcomes (COs):

- Students will able to describe and explain atmosphere, hydrosphere, lithosphere and energy resources.
- Students could describe, elucidate different types and components of ecosystems. They could identify, describe and explain different biotic components and could explain and analyze their role in ecosystem.
- Students will describe, explain and aware about the significance and need of biodiversity conservation. They also understand, describe and explain legislations passed to conserve the biodiversity and acquainted themselves to nearby National Parks and Wildlife Sanctuaries.
- They will elucidate and differentiate causes of different types and hazards of pollution CO 4. Students will estimate the different physico-chemical parameters of water to analyze.

B.sc Semester IV (Minor)

Minor III:Life and Diversity of Animals - Non-Chordates (Arthropoda to Hemichordata)

Course Outcomes (COs)

- Students will learn, identify, explain and analyze the taxonomic position of animals belonging to phylum Arthropoda to Hemichordata.
- They could describe explain and analyze phylogeny to understand the course of evolution in animals from phylum Arthropoda to Hemichordata.
- They will able to describe explain and differentiate various morphological anatomical structures and functions of animals of phyla from Arthropoda to Hemichordata.
- Students will able to understand, describe, explain and differentiate the larval form development of the invertebrates from phylum Arthropoda to Hemichordata.
- Students will able to describe explain and analyze the ecological and economic of invertebrates.

- Students will understand, able to describe, explain and analyze the ecological to invertebrates in the biodiversity.

Minor IV: Cell Biology

Course Outcomes (COs):

- Students will able to describe, sketch, analyze, and explain the structure and function of the cell organelles.
- Students could describe, sketch, analyze, and explain the structure and function of nucleus and chromatin structure, its location.
- Students will able to describe, sketch, analyze, and explain the basic principle of life they could also demonstrate and explain how a cell divides leading to the growth of an organism.
- Students could describe, sketch, analyze, and explain how a cell communicates with its neighbouring cells.
- Students will able to describe, sketch, analyze, and explain the abnormality in structural and functional aspects of cells.
- Students will able handle and use microscopes and oculometer to elucidate and measure and explain the minor details of tissues.
- Students will able to demonstrate osmosis. They could also demonstrate and explain mitochondria, salivary gland chromosome and Barr body in cells.

Semester-V NEP (Zoology-Major)

Course Category: Discipline Specific Core (DSC)

Name of Course: General Mammalian Physiology Paper 1

Course Outcomes (COs)

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

- To describe the structural organization and physiological aspects of mammalian digestive, respiratory circulatory and excretory systems.
- To understand biochemical and physiological mechanisms involved in digestion, respiration, blood circulation, and urine formation.
- To understand the regulatory mechanisms controlling major physiological processes in mammals
- To acquire knowledge of various physiological disorders, including respiratory disorders, cardiovascular diseases, and renal dysfunction..
- Apply theoretical physiological concepts to laboratory experiments and interpret experimental data scientifically.
- Identify and interpret the histological structure of major mammalian organs including digestive respiratory and excretory tissues.
- Develop practical laboratory skills, observation ability data interpretation skills, and understanding of clinical relevance in physiology.

Course Category Discipline Specific Course (DSC)

Name of the Course: Applied Zoology

Course Outcomes (COs)

After completion of this course, students will be able to

- Explain aquaculture practices and fisheries resources for sustainable production.
- Apply knowledge of apiculture, sericulture and lac culture for entrepreneurship.
- Understand scientific animal husbandry practices and livestock management.
- Demonstrate basic understanding of modern biological instruments and laboratory techniques.
- Apply zoological knowledge in agriculture, industry, and biotechnology sectors.
- Develop observational, documentation, and reporting skills through field visits to fish farms, apiaries, dairy or poultry units.
- Apply practical zoological knowledge for entrepreneurship pest management, aquaculture, and allied biological sectors.

Course Category: Discipline Specific Core (DSC)

Name of the Course: Evolutionary Biology

Course Outcomes (COs):

After completion of this course, students will be able to

- Explain the origin of life and major evolutionary events.
- Describe mechanisms of evolution and population genetics principles.
- Understand speciation processes and macroevolutionary patterns.
- Illustrate human evolution and molecular evolutionary concepts.
- Apply evolutionary principles in medicine, agriculture, and conservation.
- Identify and interpret major fossil forms and fossil replicas, and explain their evolutionary significance.
- Construct and interpret phylogenetic trees and cladograms to understand evolutionary relationships among organisms.
- Differentiate between homologous and analogous organs and explain evolutionary importance of connecting links such as Archaeopteryx and Peripatus.

Course Category: Discipline Specific Elective (DSE)

Name of Course: Systematic Entomology

Course Outcomes

- After completing this course, students will be able to:
- Explain foundational principles of taxonomy, systematics, and phylogenetic classification.
- Describe the evolutionary origin and diversification of insects.
- Classify insects up to order and family level using diagnostic characters.
- Apply dichotomous keys and modern systematic approaches in insect identification.
- Interpret economic and ecological significance of major insect groups.

Name of Course: Systematic Ichthyology

Course Category Discipline Specific Elective (DSE)

Course Outcomes (COs)

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

- Evaluate Taxonomic Frameworks: Critically analyze historical and modern classification systems (Berg and Nelson) and apply the principles of Cladistics and ICZN rules to the systematic identification and naming of fish species.
- Compare Fish Diversity and Evolution: Differentiate between the morphological and anatomical characteristics of Agnathans, Chondrichthyes and Osteichthyes, while explaining the evolutionary significance of Sarcopterygii in the origin of tetrapods.
- Explain Functional Physiology: Illustrate the physiological mechanisms in fishes including integumentary variations, electric organs buoyancy regulation through the swim bladder, the lateral line system and electroreception.
- Analyze applied ichthyology: Assess the socio-economic importance of fish by products, the ecological drivers of fish migration and the management of fish health through the study of pathology and harvest technologies.
- Execute Technical and Field Skills: Demonstrate proficiency in laboratory techniques including fish identification, anatomical dissection and water quality analysis- and apply field. Survey methods to document local fish diversity.

Course Category: Discipline Specific Elective (DSE)

Name of Course. Male Mammalian Reproductive Physiology

Course Outcomes (COs)

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

- Describe anatomy and histology of male reproductive organs.
- Explain spermatogenesis and hormonal regulation.
- Understand semen composition and fertilization.
- Analyze causes of male infertility and contraception methods.
- Perform basic laboratory techniques related to male reproduction.

Course Category Discipline Specific Elective (DSE)

Name of Course: Endocrinology

Course Outcomes (COs)

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

- Explain the basic concepts of endocrinology including endocrine axes, classification of hormones, mechanisms of hormone action, and regulation of hormone secretion.
- Describe the structure, hormones, physiological functions, and disorders associated with major endocrine glands such as the thyroid, parathyroid, adrenal gland, pancreas, and other hormone-secreting organs.
- Interpret the role of hormones in reproductive physiology, including endocrine functions of testes and ovaries, hormonal regulation of puberty, and reproductive anomalies.
- Analyze the role of endocrine regulation in growth, metabolism, stress, and behavior and evaluate endocrine disorders and modern techniques used in endocrinological research and diagnosis.
- Demonstrate practical understanding of endocrine glands, hormones, and related disorders through laboratory experiments and case study analysis.

Course Category: Vocational Skill Course

Name of the Course: Silkworm culture

Course Outcomes (COs):

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

- Identify and classify different types of silkworms used in sericulture.
- Demonstrate practical knowledge of cultivation practices, including nursery management and field preparation.
- Apply standard silkworm rearing techniques and manage rearing houses and appliances effectively
- Identify major diseases and pests of silkworms and describe appropriate preventive and management strategies.
- Perform cocoon harvesting, sorting, and grading based on standard sericulture practices
- Explain baste silk reeling techniques and recognize important by-products of sericulture
- Develop practical exposure to sericulture through field visits, internships, or training in sericulture farms, grainages, or silk reeling units.

B.sc Semester V (Minor)

Minor V: Life and Diversity of Animals – Chordates (Protochordata to Amphibia)

Course Outcomes

Students should be able to:

- Describe classes and orders of phylum Chordata.
- Identify. Classify various animals of the Phylum Chordata.
- Differentiate between Protochordate and higher Chordates upto Amphibia based on their characters.
- Analyze the anatomy and physiology of protochordates, agnathans, Pisces and amphibians.
- Create interlinking and mapping between various chordate groups.

Minor VI: Genetics

Course Outcomes

- Understand the Fundamental Principles of Genetics: Explain Mendelian inheritance the Chromosome Theory of Inheritance, mitochondrial DNA and plasmids, and genetic, variation and mutation, distinguish various chromosomal aberrations, recognize types of mutations (point mutation , frameshift), and evaluate their roles in genetic diversity and disease.
- Comprehend the Mechanisms of Genetic Inheritance and Gene Structure: Explore genetic inheritance mechanisms, gene structure chromosomal mapping concepts and cytoplasmic inheritance. Analyze pedigree analysts for autosomal and X-linked traits to identify inheritance patterns.
- Analyze Genetic Variation and Evolutionary Dynamics: Apply the Hardy-Weinberg principle to study genetic equilibrium and the impact of factors such as mutation, selection, and genetic drift on population genetics, explain the genetic basis of speciation, adaptation, and evolutionary processes. Use quantitative genetics to explore polygenic, traits, heritability, and their role in natural selection and evolution.
- Examine Human Genetics and Genetic Disorders: Interpret human karyotypes and identify chromosomal and genetic disorders. Understand the inheritance patterns of single-gene and multifactorial disorders. Discuss the ethical considerations in genetic counselling genetic testing, and biotechnology, especially in the context of human health.
- Explore Advanced Topics in Genetics and Their Applications: Analyze the genetic basis of cancer oncogenes, and tumour suppressor genes, and the role of mutations and environmental factors in cancer development. Discuss the role of epigenetics and environmental influences on gene expression and development; evaluate the applications of gene therapy agriculture and biotechnology, addressing ethical and societal implications.

B.Sc. Semester-VI NEP (Zoology-Major)

Course Category: Discipline Specific Core (DSC)

Name of Course: General Mammalian Physiology II

Course Outcomes (COs)

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

- Explain the structural organization and functional mechanisms of mammalian muscle nerve, endocrine reproductive and sensory systems.
- Describe physiological mechanisms such as muscle contraction, nerve impulse transmission, hormonal regulation, and reproductive processes.
- Interpret cellular and molecular basis of neuromuscular transmission, synaptic function, and hormone action.
- Correlate physiological processes with associated disorders such as endocrine imbalances, reproductive dysfunctions, concepts of infertility and assisted reproductive techniques.
- Explain the physiological basis of sensory perception (vision, hearing, taste and smell), homeostasis, thermoregulation, and stress response.

Course Category: Discipline Specific Core (DSC)

Name of Course: Parasitology

Course Outcomes (COs)

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

- Explain the fundamental principles of parasitology, including types of parasites, host parasite relationships, modes of transmission, and mechanisms of pathogenesis.
- Describe the morphology, life cycles, transmission patterns, and pathogenic effects of major protozoan parasites of medical importance.
- Understand the structural organization, classification, life cycles, and disease-causing mechanisms of helminth parasites including trematodes, cestodes, and nematode.
- Analyze the epidemiology, clinical manifestations, diagnostic techniques, and prevention and treatment strategies of important parasitic diseases.
- Identify medically and veterinary important ectoparasites and insect vectors, and evaluate their role in disease transmission and control programs.

- Interpret host immune responses and parasite adaptations, and relate parasite biology to public health Management and disease control strategies.

Course Category: Discipline Specific Core (DSC)

Name of Course: Molecular Biology

Course Outcomes (COs):

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

- Describe the structure and organization of nucleic acids, including DNA and RNA, and explain experimental evidence supporting DNA and RNA as genetic material
- Explain genome organization in prokaryotes and eukaryotes, chromatin structure, and higher-order DNA packaging in relation to gene function.
- Illustrate the mechanisms of DNA replication, repair, recombination, and regulation, and discuss their importance in maintaining genome stability.
- Describe the processes of transcription and translation in prokaryotes and eukaryotes. and explain the significance of the genetic code in protein synthesis.
- Explain mechanisms of gene regulation in prokaryotes and eukaryotes, including operon models and transcriptional control.
- Understand the principles and applications of basic and modern molecular biology techniques such as electrophoresis, blotting, PCR. DNA sequencing and molecular markers.

Course Category: Discipline Specific Elective (DSE)

Name of the Course: Insect Morphology and Physiology

Course Outcomes (COs)

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

- Describe the external morphology of insects including the structure and functional modifications of the head, thorax, abdomen, and appendages.
- Explain the structure, composition, and physiological role of the insect integument including the process of moulting and hormonal regulation of growth.
- Illustrate the organization and functioning of the insect respiratory and circulatory systems, including adaptive mechanisms in aquatic and terrestrial environments.
- Understand the structure and functional mechanisms of the insect nervous system and sense organs, and relate them to coordination, behavior, and biological rhythms.
- Analyze the role of chemical communication (pheromones and kairomones) and sensory physiology in insect behavior and vector control strategies.
- Explain the structure and functioning of the insect endocrine and reproductive systems. Including hormonal regulation of metamorphosis and specialized reproductive strategies.

Course Category: Discipline Specific Elective (DSE)

Name of Course: Fish Physiology

Course Outcomes (COs):

After completion of this course, students will be able:

- Explain the structure and functional physiology of the digestive and excretory system in fishes, including digestion, enzymatic processes, excretion and osmoregulation in different aquatic environments.
- Describe the organization and physiological mechanisms of the cardiovascular and respiratory systems in fishes, including heart structure, blood circulation, branchial respiration and accessory respiratory organs.
- Illustrate the organization and functions of the nervous and endocrine systems in fishes including neuroendocrine regulation and hormonal control of physiological processes.
- Explain the structure and functions of the reproductive systems to fishes including gametogenesis neuroendocrine regulation of reproduction, and different modes of reproduction

- Apply practical skills in fish physiology through anatomical, histological, biochemical and physiological experiments, including estimation of gonadosomatic index, fecundity, oxygen consumption and analysis of fish tissues.

Course category: Discipline Specific Elective (DSE)

Name of the course: Female Mammalian Reproductive Physiology

Course Outcomes (COs):

- To study the location, structure and functions of organs of female reproductive system.
- To reveal the phases of menstrual cycle, hormones and process of oogenesis.
- To understand the process of pregnancy and birth control methods and IUDs.
- To analyze the various prenatal diagnostic tests.

Course Category Discipline Specific Elective (DSE)

Name of Course: Biochemistry

Course Outcomes (COs)

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

- Describe the classification, structure, and biological significance of carbohydrates, proteins, lipids, and nucleic acids.
- Explain the structural organization of proteins and the functional role of enzymes. Including basic concepts of enzyme kinetics and inhibition.
- Illustrate the major metabolic pathways of carbohydrates, lipids and amino acids and explain their role in energy production and physiological regulation.
- Understand the structure and biological role of DNA and RNA, and explain the significance of ATP and bioenergetics in cellular metabolism.
- Interpret the fundamental principles of oxidative phosphorylation and the electron transport chain in energy generation.

Course Category: Vocational Skill Course (VSC)

Name of Course: Prawn Culture

Course Outcomes (COs)

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

- Identify commercially important freshwater and marine prawn species used in aquaculture
- Explain the biological characteristics and life cycle of prawns relevant to aquaculture practices
- Demonstrate pond preparation, water quality management, and feeding strategies in prawn culture.
- Identify common diseases and predators of prawns and describe preventive and management measures.
- Understand harvesting techniques, processing methods, and marketing strategies for prawn products

Develop vocational and entrepreneurial skills related to prawn farming and aquaculture industries



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PRINCIPAL
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 Hinganghat

Program Specific Outcomes (PSOs) and Course Outcomes(COs)for B.Sc. (Botany)Programme Program: B.Sc. Part I, Part II & Part III (Semester I to Semester VI)

Program Specific Outcomes (PSOs)

By the end of this course, the students will be able to:

1. **Knowledge: Width and depth:** Students acquire theoretical knowledge and understanding of the fundamental concepts, principles and processes in various branches of Botany, namely, taxonomy, cytology, genetics, physiology & development, ecology, biotechnology, molecular biology and cell biology. In depth understanding is the outcome of transactional effectiveness and treatment of specialized course contents. Width results from the choice of electives that students are offered.
2. **Laboratory Skills: Quantitative, analytical and instrument based:** A much-valued learning outcome of this programme is the laboratory skills that students develop during the course. Quantitative techniques gained through hands on methods opens choice of joining the industrial laboratory work force early on. The programme also provides ample training in handling basic laboratory instruments and their use in analytical and biochemical determinations. Undergraduates on completion of this programme can cross branches to join agro-industry, biotech industry, and biochemical labs.
3. **Communication:** Communication is a highly desirable attribute to possess. Opportunities to enhance students' ability to write methodical, logical and precise reports are inherent to the structure of the programme. Techniques that effectively communicate scientific chemical content to large audiences are acquired through oral and poster presentations and regular laboratory report writing.
4. **Capacity Enhancement:** Modern day scientific environment requires students to possess ability to think independently as well as be able to work productively in groups. This requires some degree of balancing. The Botany honoursprogramme course is designed to take care of this important aspect of student development through effective teaching learning process.
5. **Portable Skills:** Besides communication skills, the programme develops a range of portable or transferable skills in students that they can carry with them to their new work environment after completion of Botany honoursprogramme. These are problem solving, statistical analysis, plant identification, information retrieval skills, IT skills and organizational skills. These are valued across work environments.

COURSE OUTCOMES

B.Sc. SEMESTER-I

(DSC 1)-BOTANY Paper-I (BBN1DSC01T)

Scope of Plant sciences and Plant Diversity-1

Course outcomes

By the end of this course, the students will be able to:

1. Understand foundational principles and career scopes in botany.
2. Distinguish two-kingdom, five-kingdom, and modern classifications.

3. Evaluate modern, sustainable plant-based commercial innovations.
4. Describe microbial cellular structures.
5. Appraise the economic benefits of microbes.
6. Basic Botany: Morphology, anatomy, physiology, taxonomy.
7. Plant Diversity: Algae, fungi, bryophytes, pteridophytes, gymnosperms, angiosperms.
8. Applied fields: Agriculture, horticulture, forestry, plant breeding, biotechnology, pharmacognosy, and environmental science.
9. Research areas: Plant genetics, molecular biology, ecology, conservation, plant pathology, ethnobotany.
10. Career scope: Research scientist, agriculture officer, botanist, ecologist, biotech industry, pharma, teaching, forest services, conservation NGOs

SEC 1 Botany (BBN1SEC01P) Hydroponics and Micro-green Technology

Course Outcomes

:

1. Calibrate and operate pH meters, EC meters, pumps, and reservoirs.
2. Formulate standard stock nutrient solutions for various crop cycles.
3. Construct and troubleshoot the cultivation units.
4. Cultivate diverse microgreen varieties from seed selection to harvest.
5. Quantify plant biomass, shelf-life, and core nutritional parameters.
6. Develop a comprehensive project report and commercial business plan.
7. Explain the principles, scope, and importance of hydroponics and microgreen cultivation in modern agriculture.
8. Describe different hydroponic systems - NFT, DWC, Ebb & Flow, Wick, Drip, Aeroponics - and their components.
9. Prepare nutrient solutions, calculate EC/pH, and select suitable growing media for hydroponics and microgreens.
10. Select suitable crops for hydroponics and microgreens. Understand seed selection, sowing, growth conditions, and harvesting techniques.
11. Manage light, temperature, humidity, and ventilation for optimal growth in soilless systems and indoor farms.
12. Identify common problems in hydroponics & microgreens and apply preventive measures for disease and pest management.

GE/OE Botany(BBN1SEC01P) Gardening and Landscaping

Course Outcomes:

At the end of the course, students shall be able to:

1. Understand the scope, importance, and types of gardening and landscaping in urban and rural areas. Garden Planning & Design
2. Learn principles and elements of garden design - balance, proportion, color, texture, and focal points.
3. Prepare landscape layouts for home, public, and institutional gardens.
4. Select suitable ornamental plants, trees, shrubs, climbers, lawn grasses, and seasonal flowers based on climate, soil, and aesthetic value.
5. Practice propagation, planting, pruning, training, lawn making, and maintenance of gardens.
6. Know the use of hardscape and softscape elements like paths, water bodies, rock gardens, pergolas, topiary, and garden furniture.
7. Manage soil fertility, irrigation, fertilizers, and control of pests and diseases in gardens.
8. Understand kitchen gardens, terrace gardening, vertical gardens, bonsai, and indoor landscaping.
9. Appreciate the role of landscaping in beautification, recreation, environmental improvement, and entrepreneurship opportunities.

B.Sc.Semester-II
(DSC-2)-BOTANY(BBN2DSC02T)
Applied Plant sciences and Plant Diversity-II

Course Outcomes:

1. Understand the diversity, classification, and evolutionary relationships of plants from algae to angiosperms.
2. Explain the structural, anatomical and reproductive features of major plant groups - Algae, Fungi, Bryophytes, Pteridophytes, Gymnosperms and Angiosperms.
3. Apply principles of plant sciences in agriculture, horticulture, forestry, pharmacognosy, and environmental conservation.
4. Identify economically important plants and their uses in food, medicine, fiber, timber and biofuel industries.
5. Demonstrate knowledge of plant breeding, tissue culture, plant pathology and biotechnology applications in crop improvement.
6. Perform identification, collection, preservation and herbarium preparation of local plant specimens.
7. Analyze plant adaptations in different habitats and their ecological significance.
8. Use microscopes and other lab techniques to study plant morphology, anatomy and diversity.
9. Appreciate the role of plant diversity in maintaining ecosystem balance and human welfare.
10. Develop awareness about conservation of rare, endangered and medicinal plants and promote sustainable use of plant resources.

B.Sc.Semester-II
SEC 2 Botany(BBN2SEC02P) Mushroom Cultivation and Bio fertilizer

Course Outcomes:

1. Understand the types, nutritional value, and economic importance of edible and medicinal mushrooms.
2. Explain the role and types of bio-fertilizers like Rhizobium, Azotobacter, Azospirillum, PSB, VAM and their importance in sustainable agriculture.
3. Demonstrate skills in spawn production, substrate preparation, and cultivation of Oyster, Button and Milky mushrooms.
4. Apply techniques of sterilization, inoculation, spawn running, pinning and harvesting under controlled conditions.
5. Prepare and apply different bio-fertilizers and bio-pesticides for improving soil fertility and crop yield.
6. Analyze factors affecting mushroom growth - temperature, humidity, light and identify common diseases and pests.
7. Calculate cost-benefit analysis for small scale mushroom cultivation and bio-fertilizer production units.
8. Develop entrepreneurship skills for establishing mushroom farms and bio-fertilizer business.
9. Appreciate the role of mushrooms in waste recycling, nutrition and rural employment generation.
10. Promote eco-friendly farming practices by reducing chemical fertilizer use through bio-fertilizers for soil health and environmental conservation.

B.Sc.Semester-II
GEOE 2 Botany (BBN2GOE02T) Traditional Herbal Remedies

Course Outcomes:

1. Understand the basic concepts, history and importance of traditional herbal medicine systems like Ayurveda, Siddha, Unani and Folk traditions.

2. Identify and describe commonly used medicinal plants, their parts used, chemical constituents and therapeutic properties.
3. Demonstrate the preparation of traditional herbal formulations like churna, kwath, arishta, taila, and lepa for common ailments.
4. Apply knowledge of dosage, safety, and contraindications in the use of herbal remedies for first-aid and primary healthcare.
5. Perform collection, identification, drying, preservation and documentation of medicinal plants with proper ethnobotanical data.
6. Analyze the role of phytochemicals - alkaloids, flavonoids, terpenoids in disease prevention and treatment.
7. Evaluate the scientific validation of traditional claims and understand the difference between traditional knowledge and modern pharmacology.
8. Appreciate the importance of conservation of medicinal plants and protection of traditional knowledge and IPR.
9. Develop awareness about cultivation, marketing and entrepreneurship opportunities in herbal and nutraceutical industries.
10. Promote the use of safe, affordable and accessible herbal healthcare for community wellness and rural development.

B.Sc.Semester-III

(DSC-5)-BOTANY Paper-I (BBO3T05) Algae, Fungi, Lichens and Plant Pathology

COURSE OUTCOMES:

- Understand the characteristics, classification, and diversity of algae.
- Describe the structure, reproduction, and life cycles of different algal groups.
- Recognize the importance of algae in aquatic ecosystems and their economic significance.
- Understand the characteristics, classification, and diversity of fungi.
- Describe the structure, reproduction, and life cycles of different fungal groups.
- Recognize the importance of fungi in decomposition, symbiotic relationships, and disease causation.
- Understand the nature and characteristics of lichens as symbiotic organisms.
- Describe the structure, reproduction, and ecological significance of lichens.
- Recognize the importance of lichens as indicators of environmental pollution.

B.Sc.Semester-III (DSC-6)-BOTANY Paper-II (BBO3T06)

Fossil Angiosperms & Angiosperm Taxonomy

COURSE OUTCOMES:

- Understand the evolution and diversification of angiosperms through geological time.
- Describe the characteristics and classification of fossil angiosperms.
- Recognize the importance of fossil angiosperms in understanding plant evolution and paleoecology.
- Understand the principles and methods of angiosperm taxonomy, including morphological, anatomical, and molecular approaches.
- Describe the characteristics and classification of different angiosperm families and orders.
- Recognize the importance of angiosperm taxonomy in plant identification, ecology, and conservation.

B.Sc.Semester-III MINOR-1: BOTANY Paper-I (BBO1T01)

Microorganisms-Viruses, Prokaryotes, Algae and Fungi

COURSE OUTCOMES:

- Understand the structure, replication, and classification of viruses.
- Describe the mechanisms of viral infection and disease causation.
- Recognize the importance of viruses in medicine, agriculture, and biotechnology.

- Understand the structure, physiology, and classification of prokaryotes (bacteria and archaea).
- Describe the importance of prokaryotes in ecosystems, human health, and industry.
- Recognize the role of prokaryotes in nutrient cycling, symbiosis, and disease.
- Understand the characteristics, classification, and diversity of algae.
- Describe the structure, reproduction, and ecological significance of algae.
- Recognize the importance of algae in aquatic ecosystems and their potential applications.
- Understand the characteristics, classification, and diversity of fungi.
- Describe the structure, reproduction, and ecological significance of fungi.
- Recognize the importance of fungi and decomposition, symbiotic relationships, and disease causation.

MINOR-2: BOTANY Paper-II (BBO1T02) Paleobotany, Bryophyta and Pteridophyta

COURSE OUTCOMES:

- Understand the study of fossil plants and their significance in plant evolution.
- Describe the process of fossilization and types of fossils.
- Analyze the geological time scale and plant life through different eras.
- Recognize the importance of paleobotany in understanding plant evolution and biodiversity.
- Understand the characteristics, classification, and diversity of bryophytes.
- Describe the morphology, anatomy, and reproductive structures of bryophytes.
- Analyze the life cycle and alternation of generations in bryophytes.
- Recognize the importance of bryophytes in ecosystems and their economic significance.
- Understand the characteristics, classification, and diversity of pteridophytes.
- Describe the morphology, anatomy, and reproductive structures of pteridophytes.
- Analyze the life cycle and alternation of generations in pteridophytes.
- Recognize the importance of pteridophytes in plant evolution and ecosystems.

B.Sc. Semester-III GE/OE-5: BOTANY (BGO3T05) Nutraceuticals

COURSE OUTCOMES:

- Explain the Role of Nutraceuticals in Health: Describe the potential health benefits of nutraceuticals, including their antioxidant, anti-inflammatory, and immune-modulating properties.
- Identify Nutraceutical Sources: Recognize the various sources of nutraceuticals, including plants, marine organisms, and functional foods.

B.Sc. Semester-III VSC BOTANY (BVS3P05) Plant Propagation and Tissue Culture

COURSE OUTCOMES:

- Demonstrate Plant Propagation Techniques: Perform various plant propagation methods, including Seed propagation, cutting, grafting, and layering.
- Understand the Principles of Plant Propagation: Explain the underlying principles and factors influencing plant propagation, such as rooting hormones, temperature, and humidity.
- Apply Plant Propagation Techniques: Apply plant propagation techniques to produce plants for various purposes, including horticulture, agriculture, and conservation.
- Demonstrate Plant Tissue Culture Techniques: Perform various plant tissue culture techniques, including sterilization, media preparation, and explant culture.
- Understand the Principles of Plant Tissue Culture: Explain the underlying principles and factors influencing plant tissue culture, such as growth regulators, nutrient media, and aseptic conditions.

B.Sc.Semester-IV
(DSC-7)-BOTANY Paper-I(BBO4T07) Genetics, Plantbreeding, Biostatistics & Evolution

COURSE OUTCOMES:

- Understand Mendelian Genetics: Explain the laws of inheritance, gene interactions, and sex-linked traits.
 - Genetic Variation: Describe chromosomal variations, mutations, and their effects on organisms.
 - Gene Expression: Understand the regulation of gene expression in prokaryotes and eukaryotes.
 - Apply Genetic Principles: Analyze genetic data and predict outcomes of genetic crosses¹².
-
- Plant Breeding Methods: Understand selection methods, hybridization, and breeding techniques for crop improvement.
 - Breeding for Crop Improvement: Apply plant breeding principles to develop improved crop varieties.
 - Genetic Consequences: Analyze the genetic consequences of breeding methods and their impact on crop populations
 - Statistical Analysis: Apply statistical methods to analyze biological data, including measures of central tendency and variability.

B.Sc.Semester-IV(DSC-8)-BOTANY Paper-II (BBO4T08) Plant Development, Anatomy and Embryology

COURSE OUTCOMES:

- Understand Plant Growth and Development: Describe the stages of plant development, including seed germination, seedling establishment, and maturation.
 - Hormonal Regulation: Explain the role of plant hormones in regulating growth and development.
 - Environmental Influences: Discuss the impact of environmental factors on plant growth and development.
-
- Structure and Function of Plant Tissues: Describe the structure and function of different plant tissues, including meristematic, vascular, and ground tissues.
 - Anatomy of Plant Organs: Explain the anatomy of plant organs, including roots, stems, and leaves.
 - Adaptations and Specializations: Discuss the adaptations and specializations of plant tissues and organs.
-
- Embryogenesis: Understand the process of embryogenesis in plants, including fertilization, zygote formation, and embryo development.
 - Seed Development: Describe the development of seeds, including endosperm formation and seed coat development.
 - Embryonic Development: Explain the role of embryology in plant reproduction and development.

B.Sc.Semester-IVMINOR-3:BOTANYPaper-I(BBO2T03)
Spermatophyte: Gymnosperm and Angiosperm Morphology

COURSE OUTCOMES:

- Understand the characteristics and diversity of gymnosperms.
- Describe the morphology of gymnosperm structures, including cones, seeds, and leaves.
- Recognize the importance of gymnosperms in ecosystems and their economic significance.
- Understand the characteristics and diversity of angiosperms (flowering plants).
- Describe the morphology of angiosperm structures, including flowers, fruits, and seeds.
- Recognize the importance of angiosperms in ecosystems, agriculture, and human life.
- Understand the characteristics of spermatophytes (seed plants), including gymnosperms and angiosperms.
- Describe the adaptations of spermatophytes to different environments.
- Recognize the importance of spermatophytes in plant evolution and diversity.

B.Sc.Semester-IVMINOR-4:BOTANYPaper-II (BBO2T04)
Cell Biology and Genetics(Mendelism)

COURSE OUTCOMES:

- Understand the structure and function of cell organelles, including the nucleus, mitochondria, and chloroplasts.
- Describe the processes of cell division, including mitosis and meiosis.
- Explain the mechanisms of cellular transport, signaling, and communication.
- Recognize the importance of cell biology in understanding life processes and disease.
- Understand the principles of Mendelian genetics, including laws of inheritance and gene expression.
- Describe the structure and function of DNA, including replication, transcription, and translation.
- Explain the mechanisms of genetic variation, including mutation, recombination, and gene flow.
- Recognize the importance of genetics in understanding inheritance, evolution, and disease.

B.Sc.Semester-IV GE/OE-6-BOTANY(BGO4T06) Biofuels Technology, IPR

COURSE OUTCOMES:

- Understand Biofuel Production: Describe the production processes of various biofuels, including ethanol, biodiesel, and biogas.
- Biofuel Feedstocks: Identify and evaluate different feed stocks for biofuel production, including crops, algae, and waste biomass.
- Biofuel Applications: Discuss the applications of biofuels in transportation, energy generation, and industrial processes.
- Sustainability and Challenges: Analyze the sustainability and challenges associated with biofuel production, including land use, water usage, and food vs. fuel debates.

B.Sc.Semester-V
(DSC-9)-BOTANY Paper-I(BBO5T09) Biochemistry & Plant Physiology

Course Outcomes:

1. Understand the structure, function and metabolism of biomolecules - carbohydrates, proteins, lipids, nucleic acids and enzymes.
2. Explain fundamental physiological processes in plants such as water relations, mineral nutrition, photosynthesis, respiration and translocation.
3. Describe plant growth regulators, photoperiodism, vernalization, seed dormancy and germination mechanisms.
4. Analyze the role of vitamins, hormones, and cofactors in plant metabolism and human nutrition.
5. Interpret biochemical pathways like Glycolysis, Krebs Cycle, Calvin Cycle, Nitrogen and Lipid metabolism.
6. Demonstrate laboratory techniques for estimation of carbohydrates, proteins, lipids, chlorophyll and enzyme activity.
7. Perform experiments on osmosis, transpiration, stomatal physiology and plant growth measurements.
8. Use instruments like spectrophotometer, pH meter and centrifuge for biochemical analysis.
9. Apply knowledge of plant physiology in agriculture, horticulture, crop improvement and stress management.
10. Appreciate the interconnection between biochemical processes and plant adaptation to environmental stress like drought, salinity and pollution.

B.Sc.Semester-V
(DSC-10)-BOTANY Paper-II(BBO5T10) Economic Botany, Ethnobotany & Phytogeography

Course Outcomes:

1. Understand the concept, scope and importance of Economic Botany in human life and economy.
2. Describe the origin, diversity and utilization of economically important plants - cereals, pulses, fruits, vegetables, spices, oils, fibers, timber and beverages.
3. Explain the principles and scope of Ethnobotany, traditional knowledge systems and role of tribal communities in plant use.
4. Identify and classify plants of economic importance and their products used in food, medicine, industry and agriculture.
5. Analyze the relationship between plants and human societies, including folk medicine, rituals and cultural practices.
6. Understand the basic concepts of Phytogeography - distribution of plants, factors affecting distribution, phytogeographical regions of India and world.
7. Conduct field surveys for documentation of ethnobotanical knowledge and preparation of ethnobotanical reports.
8. Demonstrate techniques of herbarium preparation, plant product identification and market survey of medicinal/economic plants.
9. Evaluate the role of plant resources in rural economy, cottage industries and entrepreneurship.
10. Appreciate the need for conservation of plant genetic resources, IPR, and protection of traditional

knowledge.

11. Promote sustainable utilization of plant resources and awareness about biopiracy and benefit sharing.

B.Sc.Semester-V

(DSC-11)-BOTANYPaper-III(BBO5T11) Medicinal Plants: Cultivation and Practices

CourseOutcomes:

1. Understand the importance, scope and economic value of medicinal and aromatic plants in traditional and modern healthcare.
2. Describe the botanical features, medicinal properties and uses of commonly cultivated medicinal plants like Ashwagandha, Aloe, Tulsi, Amla, Stevia, Lemongrass, etc.
3. Demonstrate techniques of propagation, nursery management, planting, irrigation and organic cultivation of medicinal plants.
4. Apply knowledge of soil, climate, fertilizer, pest and disease management for quality production of medicinal plants.
5. Perform harvesting, post-harvest processing, drying, storage and value addition of medicinal plant produce.
6. Analyze market demand, cost-benefit and marketing channels for medicinal plants and their products.
7. Develop skills for establishing a small-scale medicinal plant nursery and cultivation unit for self-employment.
8. Evaluate quality parameters, GAP - Good Agricultural Practices and GMP for medicinal plant cultivation
9. Appreciate the need for conservation, sustainable harvesting and cultivation of rare and endangered medicinal plants.
10. Promote cultivation of medicinal plants as an alternative to forest collection and for rural livelihood generation.

B.Sc.Semester-V

(ELECTIVE-1)-BOTANYPaper-IV(BBO5T12) Pharmacognosy and Phytochemistry

CourseOutcomes:

1. Understand the history, scope and importance of Pharmacognosy in traditional and modern drug discovery.
2. Describe the classification, nomenclature and chemical nature of plant-based drugs and phytoconstituents.
3. Identify crude drugs using morphological, microscopical, physical and chemical evaluation techniques.
4. Explain the source, chemical constituents, uses and adulterants of important medicinal plants and drugs.
5. Understand the structure, properties and biosynthesis of major phytochemicals - alkaloids, glycosides, flavonoids, terpenoids, tannins and resins.
6. Demonstrate techniques of extraction, isolation and qualitative analysis of plant secondary metabolites.
7. Perform qualitative and quantitative phytochemical screening using TLC, paper chromatography and color reactions.
8. Apply knowledge of quality control, standardization and pharmacopoeial evaluation of herbal drugs.
9. Analyze the role of phytochemistry in drug development, nutraceuticals and cosmeceuticals industries.
10. Appreciate the importance of conservation, sustainable harvesting and bioprospecting of medicinal plants for new drugs.

B.Sc.Semester-VI

(DSC-13): BOTANY Paper-I (BBO6T13) Ecology & Laboratory Instrumentation

Course Outcomes:

1. Understand basic concepts, scope and importance of Ecology, ecosystem structure, energy flow and nutrient cycling.
2. Describe types of ecosystems, ecological pyramids, population dynamics, community structure and ecological succession.
3. Analyze the impact of biotic and abiotic factors on plant distribution and adaptation.
4. Evaluate environmental issues like pollution, climate change, biodiversity loss and their ecological consequences.
5. Apply principles of conservation biology, sustainable development and environmental management.
6. Demonstrate working principles and applications of common laboratory instruments - pH meter, spectrophotometer, centrifuge, microscope, autoclave.
7. Perform ecological experiments - water analysis, soil analysis, estimation of dissolved oxygen, BOD, COD, and chlorophyll.
8. Use instruments for qualitative and quantitative analysis in plant physiology and biochemistry experiments.
9. Follow safety protocols, calibration and maintenance of laboratory equipment.
10. Conduct field surveys using quadrats, transects for vegetation analysis and biodiversity assessment.
11. Interpret ecological data and present results using statistical tools and graphs.
12. Appreciate the role of technology and instrumentation in environmental monitoring and research.

B.Sc.Semester-VI

(DSC-14)- BOTANY Paper-II (BBO6T14) Biotechnology & Molecular Biology

Course Outcomes:

1. Understand basic concepts, scope and applications of Biotechnology in agriculture, medicine, industry and environment.
2. Explain structure, function and organization of DNA, RNA, proteins and central dogma - replication, transcription, translation.
3. Describe gene expression regulation, mutation, repair mechanisms and recombinant DNA technology.
4. Analyze molecular techniques like PCR, electrophoresis, blotting techniques - Southern, Northern, Western.
5. Understand concepts of genomics, proteomics, bioinformatics and genetic engineering.
6. Demonstrate aseptic techniques for plant tissue culture, microbial culture and media preparation.
7. Perform experiments on DNA/RNA isolation, quantification, gel electrophoresis and PCR.
8. Apply knowledge of fermentation technology, bioreactors and production of enzymes, antibiotics, biofertilizers.
9. Handle and operate instruments - laminar air flow, autoclave, centrifuge, spectrophotometer, thermal cycler.
10. Evaluate applications of biotechnology in crop improvement, GMO, gene therapy and bioremediation.
11. Appreciate IPR, biosafety guidelines, bioethics and regulatory aspects of biotechnology.
12. Develop skills for research, diagnostics, pharmaceutical and biotech industries.

B.Sc.Semester-VI

(DSC-15)- BOTANY Paper-III (BBO6T15) Seed Technology & Plant Nursery

CourseOutcomes:

1. Understand the concepts, scope and importance of seed technology in agriculture and horticulture.
2. Describe seed structure, classification, dormancy, germination and factors affecting seed quality.
3. Demonstrate techniques of seed production, seed testing, seed certification and seed storage.
4. Analyze seed quality parameters - purity, germination %, moisture content, vigor testing.
5. Apply knowledge of seed treatment, seed enhancement and seed health management for disease and pest control.
6. Explain principles and practices of plant propagation - sexual and asexual methods like cutting, layering, grafting, budding.
7. Demonstrate nursery establishment, management of media, irrigation, fertilization and hardening of seedlings.
8. Perform techniques of raising fruit, vegetable, ornamental and forest plant nurseries.
9. Evaluate cost-benefit analysis for setting up a commercial seed production unit and plant nursery.
10. Apply knowledge of seed laws, IPR, and marketing of seeds and nursery products.
11. Promote quality planting material production for rural employment and sustainable agriculture.

B.Sc.Semester-VI

ELECTIVE-2: BOTANY Paper-IV (BBO6T16) Molecular Biology & Bioinformatics

CourseOutcomes:

1. Understand structure, function and organization of DNA, RNA and proteins at molecular level.
2. Explain central dogma - DNA replication, transcription, translation and regulation of gene expression.
3. Describe mechanisms of mutation, DNA repair, recombination and molecular techniques like PCR, blotting, sequencing.
4. Analyze recombinant DNA technology, cloning vectors, gene expression systems and transgenic organisms.
5. Apply knowledge of genomics, proteomics and molecular markers in plant and animal improvement.
6. Understand basic concepts, scope and applications of Bioinformatics in biological research.
7. Retrieve and analyze biological data from databases like NCBI, PDB, EMBL, UniProt.
8. Perform sequence alignment, BLAST, phylogenetic tree construction and primer designing using bioinformatics tools.
9. Demonstrate skills in protein structure prediction, molecular docking and drug designing.
10. Use computational tools for gene annotation, genome mapping and data mining.
11. Apply bioinformatics in agriculture, medicine, forensics and drug discovery.
12. Appreciate ethical issues, biosafety and IPR related to molecular biology and bioinformatics.

B.Sc.Semester-VI

ELECTIVE-2: BOTANY Paper-IV (BBO6T16) Laboratory Techniques

CourseOutcomes:

1. Understand principles, scope and importance of laboratory techniques in biological and chemical research.
2. Describe working principles and applications of common laboratory instruments and glassware.
3. Demonstrate proper handling, calibration and maintenance of instruments - pH meter,

spectrophotometer, centrifuge, microscope, autoclave, laminar air flow.

4. Perform techniques of solution preparation, standardization, dilution, buffer preparation and pH measurement.
5. Apply methods of sterilization, aseptic technique and media preparation for microbial and plant tissue culture.
6. Carry out qualitative and quantitative analysis - estimation of carbohydrates, proteins, lipids, chlorophyll and enzymes.
7. Demonstrate separation techniques - chromatography, electrophoresis, centrifugation and filtration.
8. Use instruments for microscopic techniques - slide preparation, staining, sectioning and photomicrography.
9. Follow laboratory safety rules, waste disposal and Good Laboratory Practices - GLP.
10. Record, interpret and present experimental data using tables, graphs and statistical tools.
11. Develop skills for working in research labs, quality control and diagnostic laboratories.

A handwritten signature in purple ink, appearing to be 'Dr. Indira', written over a horizontal line.

PRINCIPAL
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Hinganghat

POST GRADUATION COURSES

MASTER OF SCIENCE (M.Sc.) (NEP) (Effective from 2023-24)

- ❖ **M.Sc. Botany**
- ❖ **M.Sc. Chemistry**
- ❖ **M.Sc. Mathematics**
- ❖ **M.Sc. Physics**
- ❖ **M.Sc. Zoology**

AsperNationalEducationPolicy2020

M.Sc. CHEMISTRY

M.Sc.(SemesterItoSemesterIV)

ProgramOutcome:

M.Sc. (Chemistry) programme is meant to systematize and give a method and structure to learner experiences with imparting students with an in-depth knowledge and understanding through the core courses which form the basis of Chemistry. The elective courses are designed for more specialized and/or interdisciplinary content to equip students with a broader knowledge base. The recent developments in Chemical sciences, has been included in the curricula to meet out the present day needs of academic and research, institutions, and industries. Research applications in diverse areas, methodology, on the job training and research-based projects included in the curricula will enrich the students towards new findings leading to inspiration for research degree and orientation for job opportunities. After completing this Programme the learner,

- **PO1:** Demonstrate and apply the fundamental knowledge of the basic principles in various fields of Chemistry
- **PO2:** Create awareness and sense of responsibilities towards environment and apply knowledge to solve the issues related to Environmental pollution.
- **PO3:** Apply knowledge to build up small scale industry for developing endogenous product.
- **PO4:** Apply various aspects of chemistry in natural products isolations, pharmaceuticals, dyes, textiles, polymers, petroleum products, forensic etc. and also to develop interdisciplinary approach of the subject.
- **PO5:** collaborate effectively on team-oriented projects in the field of Chemistry or other related fields.
- **PO6:** communicate scientific information in a clear and concise manner both orally and in Writing.
- **PO7:** Have developed their critical reasoning, judgment and communications skills.
- **PO8:** Augment the recent developments in the field of green and eco-friendly reactions, pharmaceutical, Bioinorganic Chemistry and relevant fields of research and development.
- **PO9:** Enhance the scientific temperament among the students so as to develop a research culture and implementation of the policies to tackle the burning issues at global and local level.

Program Specific Outcome:

While studying M.Sc., Chemistry Programme, the learners shall be able to

- **PSO1: Deep understanding of fundamental concepts:**
- Graduates should have a firm grasp of the principles of organic, inorganic, physical, and analytical chemistry.
- **PSO2: Problem-solving skills:**
- They should be able to apply chemical principles to solve problems related to chemical reactions, synthesis, and analysis.
- **PSO3: Analytical skills:**
- This includes the ability to synthesize, separate, and characterize chemical compounds, as well as

analyzedatausingsophisticatedinstruments.

- **PSO4:Laboratoryskills:**

- Graduates should be proficient in various laboratory techniques, including handling chemicals, performing experiments, and using instruments safely.

- **PSO5: Researchskills:**

- They should be able to design and conduct experiments, interpret results, and contribute to research in chemistry.

- **PSO6:Specificareasof chemistry:**

- Some programs may focus on specific areas like environmental chemistry, pharmaceutical chemistry, or materials science, with PSOs tailored to those areas.

- **PSO 7:Applicationof chemistry:**

- Graduates should understand how chemistry relates to other fields like biology, medicine, and environmental science, and be able to apply their knowledge in real-world contexts.

- **PSO8:Communication skills:**

- Graduates should be able to effectively communicate their knowledge and findings to both scientific and non-scientific audiences.

CourseOutcomes:

M.Sc.ChemistrySemest

er –I

Paper1MCH1T01:InorganicChemistry

CO1: Oncompletionofthecoursethestudentswillbeableto,

- predictthenatureofbondanditsproperties throughvarious electronicstructuralmethods;bonding models
- designnewcoordinationcompoundsbased onafundamentalunderstandingoftheir electronicproperties
- developthepossiblecatalyticpathwaysleadingtodesiredproducts
- applytheprinciplesoftransition metalcoordinationcomplexesto derivereaction mechanisms.

Paper2MCH1T02:PhysicalChemistry

CO2: Attheendofthecoursestudentswillbeableto

- Understand,analyzeandexercisetheprinciplesofclassicalthermodynamicsinvariousapplications
- Understandandexecutethequantummechanicalproblemsandtheir applications
- Understandtheconceptofadsorptionanditsapplicationinsurfacechemistry
- Analyzeandunderstandthecharacterizationtechniques for polymer
- Understandtheprinciplesofchemicalkineticsandtheir applicationsinchemicaldynamics

Paper3(Elective)MCH1T03:(d)AnalyticalSeparationTechniques

CO3: Attheend ofthecoursestudentswillbeableto

- Understand variousseparationtechniquebasedonsampleandtargetanalyte
- Elaboratetheworkingprinciplesofvariousseparationtechniques.
- Applylogicbehindworkingandapplicabilityof eachtechnique.
- Identifymostsuitableseparationtoolresolutionof mixtures.
- Developseparation methods for multicomponent analysis. 6. Evaluate efficiency of separation of mixture based on analysis parameters.

Paper4MCH1T04:ResearchMethodology

CO4: At the end of the course, student will be able to

- understand what research is and what is not.
- raise awareness of crucial aspects of the nature of Knowledge and the value of scientific method.
- Introduce the concept at the heart of every research project– the research problem - and to discuss what a researchable problem is.
- evaluate literature, from a variety of sources, pertinent to the research objectives.
- identify and justify the basic components of the research framework, relevant to the tackled research problem.
- explain and justify how researchers will collect research data.
- discuss how to cite sources, and justify this choice.
- 8. put forward a credible research proposal, and
- 9. warn the common mistakes in the field of research methodology.

M.Sc.SEMESTER II

Paper5MCH2T05:OrganicChemistry

CO5: At the end of the course students will be able to

- Implement rules of aromaticity to organic molecules
- Sketch organic molecules in different projection formula and assign its configuration.
- Apply their understanding about the organic reactions of industrial significance with respect to the chemo-selectivity, regioselectivity and enantioselectivity.
- Analyze the product distribution and the stereochemistry of various organic products.
- Evaluate the relationship between structure and reactivity

Paper6MCH2T06:AnalyticalChemistry

CO6: At the end of the course students will be able to

- Select a specific analytical technique based on sample and target analyte
- Develop analytical ability and critical thinking in selection of statistics and their use in making interpretation meaningful and productive.
- Explain the logic behind working of indicator used in each type of titration
- Elaborate interaction of radiation with matter and its application in chemical analysis.
- Develop spectral methods of analysis for desired analytes.
- Apply electroanalytical techniques based on conductance and emf measurements.

Paper7(Elective)MCH2T07:(b)OrganicReactionMechanism

CO7: At the end of the course students will be able to

- Predict the orientation and stereochemistry of the product of addition and elimination reaction
- Apply enolate chemistry to achieve molecular complexity
- Design organic reactions in order to achieve the required product(s)
- Formulate green chemistry synthesis to increase atom economy
- Application of free radicals in functional group transformation

M.Sc.SEMESTER III

Paper8MCH3T08:Spectroscopy-I

CO1: At the end of the course, student will be able to

- Understand the symmetry properties of molecules
- Interpret the structure of simple organic molecules using mass spectrometry

- Correlate the presence of functional groups with IR frequencies
- Apply the IR and Raman spectroscopy to simple molecules

Paper 9 MCH3T09: Advanced Organic Chemistry-I

CO2: At the end of the course students would be able to

- Identify a pericyclic reaction and categorize it as a cycloaddition, a group transfer reaction, a sigmatropic rearrangement, or an electrocyclic reaction,
- Apply frontier molecular orbital (FMO) theory to rationalize selectivity and reactivity aspects of pericyclic reactions.
- Understand the reaction mechanism of various common reagents employed in organic synthesis
- Understand the reactivity of sulphur, silicon and phosphorus elements.
- Apply pericyclic reactions for the synthesis of complex organic molecules

Paper 10 MCH3T10: Advanced Inorganic Chemistry

CO3: At the end of the course students would be able to

- Understand the crystal structures of simple inorganic molecules.
- 2. Understand the industrial applications of catalysis.
- 3. Apply the mechanism of metallo-enzyme reactions in various life processes.
- 4. Apply simple methods of synthesis and characterization to nanomaterials.

Paper 11 MCH3T11: Elective (b) Organic Chemistry Special-I

CO4: At the end of the course students would be able to

- Learn the important aspects of steroids and terpenoids.
- Understand the biosynthesis of natural products
- Analyze the enzyme reactions involved in various life processes
- Illustrate the structure elucidation of unknown naturally occurring organic compounds
- Apply the knowledge of organic reactions for the total synthesis of useful natural products

M.Sc. SEMESTER IV

Paper 12 MCH4T12: Spectroscopy-II

CO1: At the end of the course, student will be able to

- Interpret the structures of simple molecules using physical methods of analysis
- Understand and interpret the NMR data
- Analyze X-ray diffraction data
- Develop the skills of analytical ability
- Execute out the combined application of spectral methods

Paper 13 MCH4T13: Advanced Organic Chemistry II

CO2: At the end of the course, student will be able to

- Recognize the chemical reactions of carbonyl compounds and alkenes under photochemical conditions
- Understand the stereochemistry of complex organic molecules

- Apply the knowledge of enolate chemistry in modern organic synthesis
- Demonstrate the application of stereochemistry of common organic reactions
- Analyze the philosophy of synthesis of small molecules

Paper 14 MCH4T14: Advanced Physical Chemistry

CO3: At the end of the course, student will be able to

- Understand the types and behavior of solids based on their structure.
- Estimate various dependent parameters of under different influences.
- Understand solid state reactions and synthesis process.
- Understanding nanochemistry.
- Identification of crystals and their analysis.

Paper 15 MCH4T15: Elective (b) Organic Chemistry Special-II

CO4: At the end of the course students would be able to

- Understand the reactivity of organometallic compounds
- Demonstrate the application of organometallic reagents in C-C bond formation
- Understand the reactivity of heterocyclic compounds in various reaction conditions
- Understand the electrophilic, nucleophilic reactions and synthesis of various heterocycles
- Justify the need of protecting groups in organic synthesis




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AsperNationalEducationPolicy2020

M.Sc. Mathematics

M.Sc.PartI(SemesterIandII)

ProgramOutcome:

- **PO1.** Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.
- **PO2.** Problem Solving: Solve problems from the disciplines of concern using the knowledge, skills and attitudes acquired from mathematics/ sciences/ social sciences/ humanities.
- **PO3.** Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in wide variety of settings.
- **PO4.** Ethics: Understand multiple value systems including your own, the moral dimensions of your decisions, and accept responsibility for them.
- **PO5.** Self-directed and life-long learning: Demonstrate the ability to engage in independent and life-long learning in the broadest context socio-technological changes.
- **PO6.** Design/Development of Solutions: Design solutions for complex science problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- **PO7.** Computational Thinking: Understand data-based reasoning through translation of data into abstract concepts using computing technology-based tools.
- **PO8.** Aesthetic Engagement: Demonstrate and master the ability to engage with the arts and draw meaning and value from artistic expression that integrates the intuitive dimensions of participation in the arts with broader social, cultural and theoretical frameworks.

Program Specific Outcome:

- **PSO1:** Rational Thinking: Students be able to formulate and develop Mathematical arguments in a logical manner to unravel the gist hidden in the problem at hand.
- **PSO2:** Problem solving ability: Students should be able to think in a critical manner to process the data, and develop Mathematical problem-solving ability.
- **PSO3:** Revisiting the question: Students should be able to recall basic facts, important milestones, discoveries in Mathematics and inculcate habit of rational thinking by which the problem at hand can be revisited, time and again, that helps in solving it.
- **PSO4:** Analytical ability: In the growing field of research, it is necessary for students to learn to use some packages like Matlab, Scilab, Mathematica, Maxima, etc, so that analytical tools be available to investigate the functions, problems through graphs programming, etc.
- **PSO5:** Numerical Ability: Using packages, students can make programs to solve some problems of which exact solutions are not available, using tools of Numerical analysis.
- **PSO6:** Simulation Ability: The problems that cannot be solved directly, can at times be solved through techniques of simulation by students.
- **PSO7:** Research: Students thus motivated would prepare themselves for research studies in Mathematics and related fields.
- **PSO8:** Application: Student will be able to apply their skills and knowledge in Mathematics to various fields of studies including, science, engineering, commerce and management etc.

Course Outcomes:

MMT1T01PaperM1Algebra

- **CO1:** Foundational Knowledge: Students will be able to update their basics of Group Theory, Discuss on various topic of group in algebra.
- **CO2:** Elementary Skills: Students will be able to understand the importance of Solvable and Nilpotent, Alternating groups.
- **CO3:** Basic Analytic skills: The main outcome of the course is to equip students with necessary basic analytic skills for problem solving on Sylow theorems.
- **CO4:** Application: By applying the principles of basic theorems of Algebra through the course curriculum, students can solve a variety of logical problems in science and engineering

MMT1T02PaperM2Topology

- **CO1:** Foundational Knowledge: Students will learn the basic concepts of topological space, metric spaces, product topology, closed sets, limit points and continuous function. Students will also get to know about interrelating these concepts with one another.
- **CO2:** Elementary Skills: Students will study about the connectedness of topological spaces. They will get to know about connectedness on real line with standard examples
- **CO3:** Basic Analytic skills: Students will study about covering spaces and relate it with compactness of the spaces. Students will gain an analytical skill to relate compactness on real line, limit point compactness and local compactness.
- **CO4:** Application: Students will be able to think critically and apply the knowledge of topological spaces in the study of analysis and will be able to prove the standard results regarding countability

MMT1T03PaperM3OrdinaryDifferentialEquation

- **CO1:** Foundational Knowledge: Students will be able to study basic notions in Differential Equations and use the results in developing advanced mathematics.
- **CO2:** Elementary Skills: Students will be able to solve problems modeled using linear differential equations having ordinary points and regular singular points and solve them by method of power series.
- **CO3:** Basic Analytic skills: The main outcome of the course is to equip students to develop techniques to solve differential equations that would help students sharpen their understanding of the Mathematical solutions with their characteristics.
- **CO4:** Application: By applying the principles of basic tools through the course curriculum, students can solve a variety of practical problems involving ordinary differential equation in science and engineering.

MMT1P01Practicle1ComputationwithC/C++

- **CO1:** Execute C/C++ programs involving logical statements.
- **CO2:** Operate Mathematical operations and Logical operators in determining the general output of the problem.
- **CO3:** Determine roots of a cubic equation in general perspective.
- **CO4:** Understand in depth nuances of programming that would help them gain confidence and avail them job

MMT1T04PaperM4IntegralEquation

- **CO1:** Foundational Knowledge: The new concept of 'Integral Equations' will be introduced to students in which they will study different types of integral equations and various methods to solve them. Also, they will be taught integral transforms such as Hilbert transform.
- **CO2:** Elementary Skills: Students will be able to understand integral equations with different

types of kernel and will be able to recognize their solving methods.

- **CO3: Basic Analytics skills:** The main outcome of the course is to teach student about integral equations and solving them using various transforms such as Laplace transform, Fourier transform, Hilbert transform, etc.
- **CO4: Application:** By applying the solving techniques, students can solve Fredholm Integral equations, Volterra Integral equations, Non-linear Integral equations and Integro differential equations.

MMT1T05 Paper M5 Research Methodology in Mathematics

- **CO1:** Recall and describe the fundamental concepts and principles of mathematics. Understand the research approaches and their significance in various fields and the different types of research designs and their characteristics.
- **CO2:** Apply research methods and approaches to investigate mathematical phenomena.
- **CO3:** Analyze the effectiveness and clarity of scientific communication and presentations.
- **CO4:** Describe the roles and dynamics within a group process, including teamwork and collaboration.
- **CO5:** Explain the concept of sponsored research and its implications for research ethics

MMT2T06 Paper M6 Real Analysis

- **CO1: Foundational Knowledge:** Students will be able to update their basic knowledge in sequence, series, limit, continuity and differentiability.
- **CO2: Elementary Skills:** Students will be able to understand the importance of uniform convergence and topological manifold.
- **CO3: Basic Analytic skills:** The main outcome of the course is to equip students with necessary basic analytic skills for problems solving with functions of several variables.
- **CO4: Application:** By applying the principles of basic tools through the course curriculum, students can solve a variety of practical problems involving Manifold, sub-manifold and differentiable manifold.

MMT2T07 Paper M7 Differential Equation

- **CO1: Foundational Knowledge:** Students will be introduced to the fundamentals of Differential Geometry primarily by focusing on the theory of curves and surfaces in three dimensional space.
- **CO2: Elementary Skills:** Students will bestudy about the curves and their global properties. Students will get to know about Geodesic curve and its existence conditions.
- **CO3: Basic Analytics skills:** Students will get the knowledge of fundamental quadratic forms of a surface, intrinsic and extrinsic geometry of surface, problem of Metrization and Triangulation.

MMT2T08 Paper M8 Advance Numerical Method

- **CO1: Foundational Knowledge:** Students will learn the basic methods and tools of numerical methods in root finding for linear and non-linear equations. They will learn about Newton's method, Muller's method and System of non-linear equations.
- **CO2: Elementary Skills:** Students will develop skills in analysing the methods of interpolation for a given data using polynomial interpolation, Newton's divided difference, forward differences and Hermite interpolation.
- **CO3: Basic Analytics skills:** Students will develop skills to approximate a function using appropriate theorems and numerical methods as a solution to the problems.
- **CO4: Application:** Students will be able to think critically to use Trapezoidal rule, Simpson's rule and Newton cotes integration formula for solving Mathematics modelling problems. They will be able to compare results of the problems by different methods.

MMT2P02 Practical 2 Numerical Solution with Computer Programming

- **CO1:** Learn about the application of numerical method.
- **CO2:** Understand Newton's method, Muller's method and solve system of linear and non-linear equations.
- **CO3:** Find the errors in the solutions so obtained by various methods.
- **CO4:** Derive Numerical integration using Trapezoidal rule, Simpson's rule, Newton-Cotes formulae. Apply approximate numerical methods to solve the problems with more accuracy. Learn how to obtain solution of ordinary and partial differential equations numerically.

MMT2T09 Paper M9 Classical Mechanics

- **CO1:** Foundational Knowledge: Students will be able to update their basics of variational principle.
- **CO2:** Elementary Skills: Students will be able to understand the importance of Lagrange's equation of motion.
- **CO3:** Basic Analytic skills: The main outcome of the course is to equip students with necessary basic analytic skills for problems solving using Lagrange's and Hamilton's equations of motion.
- **CO4:** Application: By applying the course curriculum, students can solve a variety of practical problems in research.

MMT2P03 Practical 3 On Job Training

- **CO1:** Acquire hands on training
- **CO2:** Know different aspects of the Institute/Industry involved in it
- **CO3:** Learn how to work in Team setup
- **CO4:** Develop aspiration to work up the ladder in the Institute/Industry.
-

M.Sc. Mathematics

M.Sc. Part II (Semester III and IV)

Program Specific Outcome:

- **PSO1:** Rational Thinking: Students be able to formulate and develop Mathematical arguments in a logical manner to unravel the gist hidden in the problem at hand.
- **PSO2:** Problem solving ability: Students should be able to think in a critical manner to process the data, and develop Mathematical problem-solving ability.
- **PSO3:** Revisiting the question: Students should be able to recall basic facts, important milestones, discoveries in Mathematics and inculcate habit of rational thinking by which the problem at hand can be revisited, time and again, that helps in solving it.
- **PSO4:** Analytical ability: In the growing field of research, it is necessary for students to learn to use some packages like Matlab, Scilab, Mathematica, Maxima, etc, so that analytical tools be available to investigate the functions, problems through graphs programming, etc.
- **PSO5:** Numerical Ability: Using packages, students can make programs to solve some problems of which exact solutions are not available, using tools of Numerical analysis.
- **PSO6:** Simulation Ability: The problems that cannot be solved directly, can at times be solved through techniques of simulation by students.
- **PSO7:** Research: Students thus motivated would prepare themselves for research studies in Mathematics and related fields.
- **PSO8:** Application: Student will be able to apply their skills and knowledge in Mathematics to various fields of studies including, science, engineering, commerce and management etc.

Course Outcomes:

MMT3T10 Paper M10 Complex Analysis

- **CO1: Foundational Knowledge:** Students will be able to learn about complex number. They will get the knowledge about complex number in polar coordinate as well.
- **CO2: Elementary Skills:** Students will be able to learn the Mobius Transformation, they come to know about the Analytic Function and Elementary Properties, Power Series.
- **CO3: Basic Analytics skills:** The objective of this course is to study the topic like Cauchy-Riemann Equations, Poles and Residues, Mobius Transformation.
- **CO4: Application:** By applying the principles of basic tools through the course curriculum, Student can solve variety of practical problems.

MMT3T11 Paper M11 Functional Analysis

- **CO1: Foundational Knowledge:** Students will be able to update their basic knowledge in spaces, subspace, sequences, continuity and Normed space.
- **CO2: Elementary Skills:** Students will be able to understand the importance of uniform convergence, inner product space, orthogonal sets and orthonormal sets.
- **CO3: Basic Analytics skills:** The main outcome of the course is to equip students with necessary basic analytical skills and to help sharpen the student's understanding of the mathematical structure of the subject.
- **CO4: Application:** By applying the principles of basic tools through the course curriculum, students can solve a variety of practical problems in science and engineering.

MMT3T12 Paper M12 Advance Mathematical Method

- **CO1: Application in Engineering:** By applying the principles of basic formulae of Fourier series through the course curriculum, students can solve a variety of logical problems in science and engineering.
- **CO2: Application in physics to Solve Boundary value Problem:** Students will be able to understand the importance of Laplace Transform to solve physical and Electrical Problem.
- **CO3: Application to Solve Boundary Value Problem:** The main outcome of the course is to equip students with necessary basic analytic skills for problem solving on Partial Differential Equation.
- **CO4: Application in Engineering:** By applying the principles of basic formulae of Z-Transform through the course curriculum, students can solve a variety of logical problems in science and Electrical engineering.

MMT3P04 Practical 04 Python Programming

- **CO1:** Students describe basic properties of Fourier series, Laplace Transform and Z-transform using python programming.
- **CO2:** Students implement their knowledge in solving various problems on related concepts and develop the proof of countably subadditive property.
- **CO3:** Students determine questions related to Fourier series, Laplace Transform and Z-transform.
- **CO4:** Students will understand its significance and relevance to various mathematical disciplines and its applications in other fields.
- **CO5:** They will develop teamwork and communication skills while learning from each other's approaches and insight.

MMT3T13 Paper M13 General Theory of Relativity

- **CO1: Foundational Knowledge:** Students will be able to update their basics of Tensors and learn different types of tensors with their applications.
- **CO2: Elementary Skills:** Students will be able to understand the approximation theories of Newton's equations to Poisson equations and vice-versa
- **CO3: Basic Analytics skills:** The main outcome of the course is to equip students with necessary basic analytic skills for problem solving.

- **CO4:Application:**By applying the principles of basic tools, like Christoffel symbols, through the course curriculum, students can solve a variety of practical problems in cosmology.

MMT4T14 Paper 14 Dynamical System

- **CO1:Foundational Knowledge:** Students will develop a profound understanding of the basic ideas of fluid velocity, streamlines, vortex motion, rotational and irrotational flows. Students will also get to know about interrelating these concepts with one another and draw distinction between local and particle rates of change.
- **CO2: Elementary Skills:** Students will learn about Sinks, Sources and doublets, 11 Credits-4 No. of hours 60 Milne-Thomson Circle theorem and Blasius theorem. They will get to know about two- and three-dimensional inviscid fluid flows.
- **CO3:Basic Analytics skills:** Students will study and understand inviscid fluid flow and use the continuity equation to determine whether an inviscid flow is incompressible. Students will gain analytical skill and analyse properties of various fluid flows.
- **CO4:Application:** Students will get a deep understanding of fluid flow behaviours and will be able to think critically and apply the knowledge in the study of analysis of fluid motion. This course will also make the students able to prove the results related to Fluids Dynamics.

MMT4T15 Paper 15 Measure and Integration Theory

- **CO1:Foundational Knowledge:** Students will learn the basic concepts related to Dynamical System. They will also gain the knowledge about The Flow of a Differential Equation and understand their global dynamics.
- **CO2: Elementary Skills:** Students will study about the nonlinear phenomena in physical systems by using basic knowledge. They will be capable of determining fixed points and their stability and solve the mathematical problems.
- **CO3:Basic Analytic skills:** Students will study about limits sets, flow boxes, Poincaré Bendixson Theorem and its application. Students will gain analytical skill to describe the time evolution of systems which arise from biology and other subjects.
- **CO4: Application:** Students will be able to think critically about how autonomous and non-autonomous Differential equations are differentiated. They will be able to apply the knowledge of Dynamical systems in the study of analysis using mathematical Concepts and techniques.

MMT4T16 Paper 16 Partial Differential Equations

- **CO1:Foundational Knowledge:** Students will be able to understand the fundamental concept of measure and Lebesgue measure. Students should be able to understand the construction of the Lebesgue integral and know its key properties.
- **CO2:Elementary Skills:** Students will be able to investigate fundamental concepts of measure and integration theory and apply the definition and properties of Lebesgue Measure and measurable sets.
- **CO3:Basic Analytics skills:** The main outcome of the course is to equip students with necessary basic analytic skills for problem solving with various types of measurable sets, measurable functions, and solution to a problem of the Lebesgue integral of the bounded measurable functions, unbounded measurable function and integral of a non-negative functions.
- **CO4:Application:** By applying the principles of basic tools through the course curriculum, students can solve a variety of practical problems involving Borel measurability sets, measurable functions, Riemann and Lebesgue integral.

MMT4T17 Paper 17 Cosmology

- **CO1:Foundational Knowledge:** Students will be able to classify partial differential equations upon their linearity and find corresponding integral surfaces.
- **CO2:Elementary Skills:** Students will be able to solve linear partial differential equations of both first and second order.
- **CO3: Basic Analytics skills:** Students will be able to classify partial differential equations and transform second order partial differential equations into canonical form.
- **CO4:Application:** Students will be able to solve boundary value problems for Laplace's equation, the

heat equation, the wave equation by separation of variables, in Cartesian, polar, spherical and cylindrical coordinates.

MMT4P06 Research Project

- **CO1: Foundational Knowledge:** Student will be able to update their basic knowledge about cosmology studies. How the history of universe led to the stars, galaxies, and other features we can observe today.
- **CO2: Elementary Skills:** Student will be able to study of cosmology. Cosmology is the study of outer space or the universe came to be, what its structure is like, and what the future may hold.
- **CO3: Basic Analytic Skills:** The main outcome of the course is to equip student to develop techniques to solve cosmological problem to find the new model.
- **CO4: Application:** Cosmology helps to understand how the universe began and how it has evolved over the nature of the universe.



As per National Education Policy 2020

M.Sc. PHYSICS

M.Sc. (Semester I to IV)

Program Outcome:

M.Sc. (Physics) programme is meant to systematize and give a method and structure to learner experiences with imparting students with an in-depth knowledge and understanding through the core courses which form the basis of Physics. The elective courses are designed for more specialized and/or interdisciplinary content to equip students with a broader knowledge base. The recent developments in physical sciences, has been included in the curricula to meet out the present day needs of academic and research, institutions, and industries. Research applications in diverse areas, methodology, on the job training and research-based projects included in the curricula will enrich the student towards new findings leading to inspiration for research degree and orientation for job opportunities. After completing this Programme the learner,

PO1: Will have knowledge of fundamental laws and principles of physics along with their applications in diverse areas.

PO2: Will develop teaching and research skills which might include advanced Laboratory techniques, numerical methods, computer interfacing, etc.

PO3: Will become effective teacher and/or researcher; and will be able to exhibit good scientific knowledge and temperament in diverse fields/environment.

PO4: Will develop the skill to plan, execute and report on experimental and/or theoretical physics problems with effective scientific approach in future endeavour.

Program Specific Outcome:

While studying M.Sc., Physics Programme, the learners shall be able to

- **PSO1:** Provide well-defined study of theoretical and experimental physics to impart in depth

understanding in fundamental aspects of all core areas of Physics.

- **PSO2:** Acquire core as well as specialized/disciplinary knowledge in physics.
- **PSO 3:** Equip the student to pursue research and development in any areas of theoretical, experimental, and computational physics.
- **PSO 4:** Learn how to design and conduct experiments demonstrating their understanding of scientific methods/processes/phenomena; and understand analytical methods required to interpret and analyse results and draw conclusions.
- **PSO 5:** Bridge the gap between textbook knowledge and practical problems through well-designed laboratory sessions.
- **PSO 6:** Develop written and oral communications skills in communicating physics-related topics; and realize and develop an understanding of the impact of science particularly in physics.
- **PSO 7:** Apply conceptual understanding and critical thinking of the physics to general real-world situations; and learn to analyse physical problems and develop correct solutions using theoretical and experimental techniques/tools and skills.

Course Outcomes:

Sem I

Paper1:-(Core1) Mathematical Physics(MPH1T01)

- Understand the methods of mathematical physics.
- Understand the basic elements of mathematical physics and demonstrate an ability to use vector analysis in the solution of physical problems.
- Analyse the various types of matrix operations for solving problems in various branches of physics.
- Apply mathematical skills to solve problems in quantum mechanics, electrodynamics, and other fields of theoretical physics.
- Impart knowledge about various mathematical tools employed to study physics problems.

Paper2:-(Core2) Electronics(MPH1T02)

Learn the general characteristics of important semiconductor materials and P-N junction for the construction of various types of transistors.

- Understand the use of semiconductor devices in linear and digital circuits.
- Analyse and design basic op-amp circuits, particularly various linear and non-linear circuits, active filters and signal generators, and data converters.
- Evaluate the characteristics of classification of memories and sequential memory and analyse the working of various A/D and D/A Converters.
- Understand the basic principle of amplitude, frequency and phase modulation in Communication Electronics.

Paper3:-(Elective-1B) Experimental Techniques in Physics(MPH1T03B)

Understand the different types of radiation and the concept of detection of radiation using various detectors.

- Learn the fundamental aspect of classification of sensors and their principle of operation.
- Describe the principle of working of TGA, DTA, DSC used for thermal analysis.
- Understand the experimental technique for magnetic characterization using VSM and dielectric properties using impedance analyser.

- Explain the spectroscopic techniques of FTIR, UV-VIS, DRS, XPS, ESR, NMR used for materials characterization.

Paper4:-(RM)ResearchMethodology(MPH1T04)

Understand the basic concepts regarding importance of research.

- Impart knowledge about research problems identification, research question and formulation of hypotheses.
- Understand the differences of qualitative vs. quantitative research methodology, field experiments vs. laboratory experiments.
- Execute the methods of data collection and strategies of data processing and analysis.
- Learn the ethical issues including copyright, royalty, intellectual property rights, patent law, and plagiarism in publishing research.

SemII

Paper5:-(Core3)ComplexAnalysisandNumericalMethods(MPH2T05)

On completion of the course students will be able to,

- Represent complex numbers, analyse limit, continuity, and differentiation of functions of complex variables.
- Learn analytic functions, Cauchy Reimann conditions, how to find roots of nonlinear equations numerically and understand how iterations work.
- Interpolate with evenly or unevenly spaced data.
- Interpret and apply the basic methodology of numerical differentiation and numerical integration to a broad range of physics problems.
- Enrich with various computational methods like Euler, Newton-Raphson and Runge Kutta etc. to solve the problems.

Paper6:-(Core4)StatisticalPhysics(MPH2T06)

On completion of the course students will be able to,

- Understand various models in statistical mechanics and apply statistical tools to solve the problems in Physics.
- Identify the connection between statistical mechanics and thermodynamics.
- Understand Bose's concept of fifth state of matter and any possibility of sixth state of matter or not.
- Understand the significance and characteristics of phase transitions and critical phenomena.
- Learn Einstein's theoretical analysis and Langevin theory of Brownian motion.

Paper7:-(Elective-2A)Spectroscopy(MPH2T07A)

On completion of the course students will be able to,

- Explain Zeeman effect, Stark effect and hyperfine structure of spectral lines of hydrogen.
- Analyse the information from IR rotational vibrations spectroscopy to determine the bond lengths of heteronuclear diatomic molecules and applications of FTIR spectroscopy.
- Explain Raman effect and application of Raman spectroscopy.
- Describe the Bloch Equation and principle of High-Resolution NMR Spectrometer.
- Understand molecular vibrations with the interaction of matter and electromagnetic waves and explain the Mossbauer Effect.

SemIII

Paper8:-(Core5)ClassicalMechanics (MPH3T08)

- Interpret the notion of degrees of freedom, identify them for a given mechanical system and D'Alembert's principle, Formulation of Lagrangian mechanics and problem solving.
- Describe the Canonical transformations and generating functions and properties of Poisson's bracket.
- Enable to solve Hamilton-Jacobi equations and use it for the solution of harmonic oscillator problem.
- Demonstrate an understanding of intermediate classical mechanics topics such as coordinate transformations, oscillatory motion, gravitation and other central forces, and Lagrangian mechanics.
- Evaluate the Central Force Problems and Relativistic Mechanics.

Paper9:-(Core6)QuantumMechanics–I(MPH3T09)

- Introduce postulates and working principles of quantum mechanics.
- Familiarity with operator and matrix formalism of quantum mechanics.
- Solve Schrodinger equation for simple systems.
- Formulate the Heisenberg & Dirac formulation of quantum mechanics.
- Learn angular momentum operator, spin and be able to add angular momenta.

Paper10:-(Core7)Electrodynamics(MPH3T10)

- Provide basic understanding of the concepts of electricity, magnetism and electromagnetic waves.
- Describe EM waves in vacuum as well as matter to solve the difficult problems of electrodynamics.
 - Analyse and apply the laws of electromagnetism and Maxwell's equations.
- Understand the basics of electrostatics and magnetostatics to solve the electric and magnetic fields problems for different configurations.
- Describe relativistic electrodynamics to understand the magnetism as a relativistic phenomenon.

Paper11:-(Elective-3B)BasicNanoscienceandNanotechnology(MPH3T11B)

- Explain the term Nanoscience and Nanotechnology and quantum confinement, zero, one and two-dimensional nano structures.
 - Identify the various techniques to investigate the different properties such as optical, structural and morphology of nanoparticles.
- Acquire knowledge of basic approaches like Bottom up and Top down to synthesize inorganic colloidal nanoparticles and their self-assembly in solution and surfaces.
- Apply their acquired knowledge in research level to synthesis by various techniques and characterize the nanomaterials by microscopic and spectroscopic techniques.
- Understand the techniques of preparation of special nanomaterials and the properties of nanomaterials for future applications.

SemIV

Paper12:-(Core8)NuclearandParticlePhysics(MPH4T12)

- Explain the nuclear structure and properties, nuclear forces and two-body problems.
- Discuss the stability and properties of different nuclei by various nuclear models.
- Describe radioactive α, β, γ -decay of nuclei by their respective quantum mechanical theories, Conservation laws and various nuclear reactions.
- Know various nuclear radiation detectors and particle accelerators.
- Discuss the Elementary particles as the building blocks of matter and interacting fields. Describe Quark Hypothesis, Quark structures of Mesons and Baryons.

Paper13:- (Core9) Quantum Mechanics-II (MPH4T13)

- Explain the nuclear structure and properties, nuclear forces and two-body problems.
- Discuss the stability and properties of different nuclei by various nuclear models.
- Describe radioactive α, β, γ -decay of nuclei by their respective quantum mechanical theories, Conservation laws and various nuclear reactions.
- Know various nuclear radiation detectors and particle accelerators.
- Discuss the Elementary particles as the building blocks of matter and interacting fields. Describe Quark Hypothesis, Quark structures of Mesons and Baryons.

Paper14:- (Core10) Solid State Physics (MPH4T14)

- Understand the basics of free electron theory and band theory.
- Understand lattice vibrations of linear monoatomic and diatomic chains, dispersion relations, acoustic and optical phonons.
- Describe Dulong and Petit's law, Einstein and Debye models, T³ law, etc theories of lattice specific heat.
- Explain electrical conductivity, Hall effect and magnetic properties of solids.
- Describe type I and II superconductors, elements of BCS theory, and elementary of high temperature superconductor and applications.

Paper15:- (Elective-4B) Applied Nanoscience and Nanotechnology (MPH4T15B)

- Understand accurate description of optical properties of material and basics of nonlinear optics at nanoscale.
- Understand the basic magnetic parameters, the magneto-transport in nanoscale systems and gain the basic mechanisms for tuning the magnetic properties.
 - Implicate the basic knowledge of Nano-CMOS to design the circuit and physical design for the single electron transistor.
- Know the meaning of composite materials and preparation techniques.
- Analyse the essential data on nanoscale materials dispersed in, or chemically bonded with metal/ceramic/polymer matrix.



AsperNationalEducationPolicy2020

M.Sc.ZOOLOGY

M.Sc.Part I(SemesterIto IV)

ProgramOutcome:

- M.Sc. Zoology(NEP) Program: M.Sc. Zoology is a 4-semester course. All four semesters comprise of four theory papers. In addition, First semester under study consists of two skill-based practicals while Second semester entails an On Job Training (OJT) along with two skill-based Practical. Furthermore, Third semester comprises of one skill based practical based on electives and a Minor Research Project. The Fourth semester comprises of Major Research Project based discipline specific core (DSC).
- PO1-M.Sc. program produces post-graduates who have great readiness in playing an active role either in government or non-government organization by designing processes/strategies that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- PO2-Students develop analytical and creative thinking from the conducive research environments and interacting with scholars/ faculties that will help in identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.
- PO 3- To use research-based knowledge and research methods including review research literature, accession of primary literature identify relevant works for a particular topic, design of experiments, analysis, evaluation and interpretation of scientific data, and synthesis of the information to provide valid conclusions in real situations.
- PO4-To empower students to create, select, and apply appropriate techniques, resources, and ICT tools for understanding of the science.
- PO 5- Apply ethical principles and commit to professional ethics and responsibilities and norms of the work/research practice. Also, to promote learning and research aptitude and attitude to serve the society.
- PO6-Students are encouraged to develop an analytical mind as they ask questions, take part in topic-based quiz and debates, and are made aware of recent study and research on relevant topics.
- PO7-To enhance the ability of writing research project activities, problem-solving, to design and carry research project.
- PO 8 - M.Sc. program produces post-graduates who have great confidence which allows them to have a positive and realistic perception of themselves and their abilities in the scientific and social environment.
- PO9-Students acquiring skill-based education will make themselves employable and can generate employment.
- PO10-Students are encouraged to develop analytical and critical thinking minds which will help to develop scientific temperament in the community.

Program Specific Outcome(PSOs)

- PSO 1-Students will acquire techniques and skills to implement the knowledge in the design and execution of research in different branches of Zoology. This will help in careers related to teaching, research in Zoology; as well as in having innovative ideas and necessary training to initiate unique start-ups and entrepreneurship in the realm of life sciences.
- PSO2-To learn and apply the ethics in animal handling, during laboratory practices and experimentation.
- PSO 3- In addition to the curriculum, the students will also gain skill-based learning. practical knowledge
- PSO4- Function effectively as an individual, and as a member or leader in diverse team and in multidisciplinary settings. Demonstrate knowledge and understanding of

principles and apply these to one's own work, as a member and leader in a team

- PSO5. To acquire knowledge across a broad range of Zoology including recent trends which will help to solve the scientific problem logically in the context of biological process. Thus, leading to self-directed learning and evaluation.
- PSO 6- Perform laboratory procedures as per standard protocols in various areas of Zoology including Animal Diversity, Cell Biology, Genetics, Molecular Biology. Physiology, Developmental Biology, Comparative Endocrinology, Immunology, Mammalian Reproductive Physiology, Fish and Fisheries and Entomology.
- PSO7. Understand the applications of zoological science in Apiculture, Sericulture, Lac culture, Fish and Fisheries, Mammalian Reproductive Physiology and Animal Physiology.
- PSO 8- Develop knowledge and understanding of living organisms at several levels of Zoological and Biological organization from molecular level, through cells and ultimately the whole organisms and its impact on ecosystems.
- PSO9. To develop interest and elective modules by selecting specialization in various aspects and understanding the methods of zoological research.
- PSO10-The M. Sc. Program will lead the students to impart a scientific temperament which will help them to add new scientific knowledge/information in the field of Zoology research. e to facilitate experiments in the subject Zoology research.

M.Sc. Zoology Semester-I

MZOIT01 Paper-Biology of Non-Chordate

- Students will be able to identify, classify, describe, discuss and explain invertebrate specimen in the field as well as maintain and organize museum specimen.
- Develop a skill to demonstrate and explain different anatomical systems, physiological body processes and diversity of invertebrates, animal architecture and functions.
- Create the awareness of the economic importance, significance and explain structural and functional relationship between invertebrate phyla.
- Assess and evaluate taxonomic status of primitive members of arthropods and molluscs.
- Describe and analyze the sea star's body plan, elucidate the origins and evolutionary significance of echinoderm larval forms, comprehend the mechanism of movements based on fluid filled cavities in invertebrates and identify and classify minor invertebrate specimen.
- Perform the whole mount preparations of given invertebrate material.

MZO1T02-Cell Biology and Genetics

- Students will be able to describe and explain the structure and function of plasma membrane through fluid mosaic model, types of membrane proteins, transport and organization of cytoskeleton, cell organelles and endomembrane system.
- Differentiate and illustrate the mechanism of Cell division, cell cycle regulation, types of cell signaling, signal transduction pathways and various receptors involved in cell signaling. Describe and differentiate the types and functions of cellular communication, cell adherence molecule and extracellular matrix interaction.
- Differentiate Mendelian, non-Mendelian inheritance and solve the problems of inheritance based on probability.
- Explain, differentiate and compare codominance, incomplete dominance, gene interactions, linkage, crossing over, sex limited and sex influenced characters
- Illustrate and differentiate the mode of inheritance of polygenic and monogenic traits, role of genetic and environmental factors of inheritance, inbreeding and its consequences and deduce coefficient of inbreeding and consanguinity.
- Explain, distinguish and describe the mutation and its types, structural and numerical alterations of chromosomes as well as the extrachromosomal inheritance, maternal inheritance, microbial genetics, genetic mapping and human genetics by using pedigree analysis and types of genetic disorders.

- They could demonstrate metaphasic chromosomes. Bar body and polytene chromosomes.

MZO1T03- Electives

1. Mammalian Reproductive Physiology -Male

- Students will be able to describe and demonstrate the development processes and functions of different units of testis.
- Deduce the structure, functions, regulation, anomalies and disease of male reproductive and accessory reproductive organs and understand the mechanism of sperm capacitation.
- Explain and discuss the role of hormones in the regulation of reproductive behaviour and types of breeding systems.
- Recognize and identify structural and functional aspects of different types of pheromones. Illustrate and counsel about the factors responsible for infertility.
- Assess and describe reproductive health dysfunction affected by aging in males.
- They could be able to demonstrate fructose, acid and alkaline phosphatase, sialic acid and sperm count analysis.

MZO1T03

2. Digestive and Excretory Physiology

- The students will be able to differentiate and compare the types, anatomical structures secretory and endocrine cells present in the histological structure, mechanism of secretion along with the neural and chemical control secretion of different digestive glands such as the salivary gland, stomach, pancreas, liver and intestine etc. along with movement of GIT. Demonstrate the effects of various factors on the activity of digestive enzymes.
- Describe, explain and compare the brain axis, mechanism of digestion of various biomolecules such as carbohydrates, proteins and lipids and disorders associated with the GIT.
- Describe, explain and compare the anatomy of kidney, types and ultrastructure of nephron, mechanism of urine formation, concentration and dilution of urine and normal and abnormal constituents of urine along with micturition
- Determine the regulation of urine and body fluid concentration and volume along with
- water, electrolyte and acid base balance.
- Describe, explain and compare mechanism of ADH, RAAS system, renal clearance, physiology of nitrogen excretion and causes, symptoms and treatment of renal failure.
- They will be able to qualitatively demonstrate the presence of various normal and abnormal constituents of urine.
- Further, they will demonstrate the presence of normal and abnormal urine crystals.

MZO1T03

3. General Fish Biology

- Students will be able to explain and describe the evolutionary significance of fishes through the concepts of origin, classification and general characters of Ostracoderms, Placoderms and Chondrichthyes.
- Explain, describe and compare general characters and classify different ranks of Superorder Pisces. Identify different marine and freshwater fishes.
- Explain and describe peculiarities and affinities of Dipnoi, comparative account of accessory respiratory organs and different systems in fishes.
- They could estimate CO₂, dissolved O₂ and chloride of water and protein, sodium and potassium content of blood sample in fish.

MZO1T03

4. General Entomology

- Students will be able to identify, classify and differentiate the various insects belonging to different ranks.
- Describe, explain, and analyse insect social organization and its peculiarities.
- They could describe and explain structure of reproductive system, specialized reproductive mechanism, embryogenesis and metamorphosis in insect.

MZOIT04-ResearchMethodology

- Students will be able to learn, describe and imbibe animal ethics in research, as well as various guidelines provided by IAEC and CCSEA.
- Students will be able to compare the model organisms used in biological science.
- They will be able to discuss and determine the animal facilities, laboratories, transportation, hygiene, environment, maintenance, ethical, legal and policy issues.
- Encourage students to pursue their interests in research and to investigate selecting appropriate methodology of scientific research.
- Students could design the experiments properly.
- They will be able to write scientific reports, research proposals, patents, review articles, and will be aware of major funding agencies. Improve the knowledge of computer skills.
- They will be able to use basic computer programs such as MS-Office, Coral Draw, and Photoshop. Students will analyse and use statistics to analyse data in biological research. They will be acquainted with AI and its use in Life Science as well as to apply various statistical tools like central tendency, dispersion, skewness, and kurtosis measures to analyze results in the research work.
- They also learn measures of relationship tests of hypothesis testing of significance and know about statistical software.
- Students will also be able to learn and be acquainted with IPR and Patent registration.

(Practical)

MZO1P01-Biology of Non Chordata

Course outcome:

- The students acknowledge the diversity among the non-Chordata.
- The students are equipped with the techniques of preparation and study of the zooplanktons.
- The students are sensitized about the non-chordates.

(Practical)

MZO1P02-Cell Biology, Genetics and Research Methodology

Course outcome:

- The students are acquainted with the details of the structure and cell division.
- To sensitize the students about research methodologies and their applications.
- The students are acquainted with the understanding how genes affect biological functions and characteristics in organisms.

M.Sc. Zoology

Semester II

COURSE OUTCOME (COs)

MZO2T05-Biology of Chordata

- Students will be able to describe and recognize unique characters, life functions. Connecting link between non-chordates and chordates and the diversity of urochordates, cephalochordates, cyclostomes and fish. Describe the structural, physiological and evolutionary correlation of different vertebrates;
- Elaborate how kidneys represented successful evolutionary responses to the surrounding environmental pressures.
- List some migratory bird species, conduct bird tracking and watching activity. Facilitate students to explore the world of cetaceans and the marine environment.
- Gain a better understanding of the forces that drive evolution, speciation and the diversity of life on our planet. Identify, describe and differentiate the basic structure and functions of the central and peripheral nervous systems and define learning and memory.
- Compare and contrast the organization and evolution of the vertebrate circulatory system and

heart.

- Describes specialized sensory organs of vertebrates and relate their role to their habitat.
- Comprehend the gradual development and evolutionary history of man. Identify, classify, describe and explain vertebrate specimen in the field as well as maintain and organize museum specimen. Develop a skill to demonstrate and explain different anatomical systems of vertebrate, and perform whole mount preparation of given vertebrate materials, different steps of microtomy and staining procedure. They could use, handle and maintain the instruments like microtome and oven. Students will be able to identify, demonstrate, explain and compare the histological structure and functions of internal organs of vertebrates.

MZO2T06-Advanced Developmental Biology

- Students will be able to differentiate and explain the basic developmental concept of insects, cast differentiation in insects, amphibian metamorphosis and aves with its hormonal control and regeneration process in vertebrates. Illustrate and classify the type, structure, function and hormones of the placenta, analyses the cell differentiation, organ formation, cell death, and multiple physiological levels of aging.
- They will be able to analyse the process of advanced cattle breeding with the help of MOET, cloning techniques, acquire knowledge about embryonic sexing to diagnose the genetic disorder, the economic and clinical significance of embryonic stem cells
- Comprehend birth control method that uses the body's immune response and classical contraceptive techniques to prevent pregnancy, Explain different anti-androgen and anti-spermiogenic compounds and also discuss transgenic animals that elevated the potential of biological research for human welfare.
- They will be able to demonstrate the development of *Lymnaea* and mounting of Chick embryo.

MZO2T07-Elective

2. Brain and Muscle Physiology

- Students will be able to differentiate and classify the various morphological differentiation and analysis of the mammalian brain, brain stem and cerebellum.
- Elaborate on the physiology and mechanism of learning, memory and sleep.
- Classify and illustrate the ultrastructure of neurons and synapses, functional and bioelectrical properties of the neurons molecular mechanism of synaptic transmission and mechanism of neurotrophins and growth factors affecting the neuronal growth. Classify and analyse the biosynthesis, storage, release and mechanism of the action of various neurotransmitters and neuropeptides.
- Differentiate between the structure and physiology of various organs involved in photoreception and phonoreception.
- Analyse the various causes, symptoms, mechanism of pathogenesis, diagnosis and treatment of neurodegenerative disorders.
- Explain and describe the classification, ultrastructure, properties and structural proteins of muscle. Illustrate the molecular mechanism of muscular contraction, ultrastructure of the neuromuscular junction and types, causes, symptoms and treatment of various neuromuscular disorders.
- They could be able to demonstrate and estimate liver and muscle glycogen, protein and lipid.

3. Economic Aquaculture

- Students will be able to describe, explain and compare different water bodies of India, basic techniques used for fish breeding, concept of fish culture, culture of air breathing fishes, trout fish culture, Ornamental fish culture, integrated fish farming, sewage fed fisheries and cultivation of Indian major carp's.
- Describe, explain and compare advanced techniques used in aquaculture-based organisms such

as pearls, crab, prawn, and oyster.

- **Insect Morphology and Physiology**

- Students will be able to explain, describe and compare morphology of integument, head, thorax, abdomen, appendages and wings.
- They could describe, explain and differentiate structure and physiology of systems like digestive, circulatory, respiratory, nervous and neuroendocrine system etc.
- Students will be able to describe, explain and compare the sensory organs like visual organs, sound and light producing organs, bioluminescence, different mechanoreceptors and chemoreceptors.
- Describe, explain and compare mechanism of communication, colour change mimicry and camouflage.

(Practical)

MZO2PO4-Biology of Chordata

Course outcome:

- The students are acquainted with the details knowledge about the chordates.
- The student learns to analyse the developmental and evolutionary processes of chordates.
- The students learn about the physiological process and biological process of chordates.

(Practical)

MZO2P05-Advanced Developmental Biology

Course Outcomes:

- Students understanding the biological system.
- Understanding the familiarity with cutting edge biological techniques.
- Students learn to communicate complex biological concepts effectively.

M.Sc. Zoology Semester-III

MZO3T08-Parasitology and Immunology

Course Outcomes (COs)

- Students will be able to illustrate and differentiate life cycle, mode of transmission, infection and treatment of various bacterial infection and viral infections such as covid, dengue, hepatitis.
- Describe, explain, classify and differentiate organs of immune system, innate immunity, adaptive immunity, antigen, antibodies, toxin anti-toxin and their cellular target.
- Demonstrate antigen-antibody interaction with the help of ODD.
- Illustrate the maturation, activation, differentiation of T and B cell, inheritance of MHC molecules and various pathways of complement system.
- Classify, describe and differentiate various types of cytokines, hypersensitivity, autoimmunity and immunodeficiency diseases.
- Explain and describe activation and migration of leucocyte, mast cell, transplantation, tumor immunology, various infectious diseases and vaccines.
- Illustrate and differentiate working principle and significance of immunotechniques such as RIA and ELISA.

MZO3T09-WildLifeandAvianBiology

Course Outcomes (COs)

- Students will explain, describe and analyze importance of wildlife and its conservation, international conservation bodies, predator-prey relationship, population dynamics of ungulates and carnivores.
- They could also explain, describe and analyze morphology, morphometry of birds, birds diversity, techniques of bird counting, bird breeding population and breeding group maps, bird hotspots, bird sanctuaries and role of birds in ecosystem.

MZO3T10-ComparativeEndocrinology

Course Outcomes (COs)

- Students will be able to identify, classify, differentiate, describe and explain different types of cells and organs of neuroendocrine system of invertebrates.
- Illustrate the role of hormones in the regulation of various physiological processes in invertebrates such as metamorphosis, reproduction and colour change mechanisms.
- Describe, explain, and differentiate the hypothalamo-hypophyseal system, structure, hormones, functions and feedback mechanisms of pituitary, thyroid, parathyroid, pancreas, gastro-intestinal tract and adrenal gland.
- Comprehend the role of hormones in pharmaceuticals, including contraception, sex hormones, cancer, immune system and immune regulating hormones (IRH).
- Raise awareness about the significance of pharmaceutical applications.
- Students could demonstrate compare the preparation of histological slides of endocrine glands.

Elective: Blood and Cardiac Physiology Course

Outcomes (COs)

- The students will be able to illustrate the structure, properties and function of cardiac muscle along with the anatomy, histology, nerve innervation and valves of the heart.
- They will further be able to classify and compare the pacemakers and conducting fibers present in the heart, and illustrate various types, causes, symptoms, diagnosis, and factors affecting blood pressure and treatment.
- Illustrate and compare the mechanism of the cardiac cycle, heart sound, working principle of ECG, cardiac output, haemodynamic, haemorrhage, cardiac murmur, circulatory shock and cardiac failure.
- Describe, explain and compare the cellular composition and functions of blood, blood groups, blood transfusion, bone marrow aspiration and pathological conditions of blood glucose and lipids along with blood coagulation.
- Compare and illustrate the transport of gases by blood, diagnosis, symptoms and treatment of bleeding disorders and blood cancer.
- Illustrate the mechanism of formation, composition, transport and functions of lymph. Differentiate, describe and explain anaemia and polycythemia, platelets and Blood substitute.
- Students will be able to demonstrate the components of the blood such as RBCs, WBCs, DLCs. Hb etc. along with the blood group.

MZO3P07,ResearchProject(RP)MinorWork Course Outcomes (COs)

After completion of minor research project, the student will be able to search research articles online and offline. Draft scientific writeup and submit in the form of report. They will be able to check the script for plagiarism. Discuss particular topic and could arrange it in a proper manner. Learn and write bibliography by various styles.

M.Sc.ZoologySemester-IV

Course Outcomes (COs)

- Students will be able to elaborate, discuss and describe sterilization, animal cells, tissue culture, primary culture, cell lines, cell quantification, and growth kinetics and cryopreservation technique.
- Describe, demonstrate and explain the principle and working mechanism of sedimentation, centrifugation, TLC, gas chromatography and electrophoretic technique.
- Illustrate and explain the biostatistical measures such as central tendency, dispersion, probability, sampling types, methods and significance test.
- Describe and explain neuronal genetics, environmental components in the development of animal behaviour, organization and functions of animal ethics.
- Illustrate and explain about the significance of toxicity test in the projects and research. Describe and explain the importance and scope of bioinformatics, various biological databases such as BLAST and FASTA, PSI-BLAST etc. and various program runs for the construction of phylogenetic tree like MEGA.
- Students could construct, analyze and interpret phylogenetic tree.
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MZO4T13-RadiationandChronobiology Course Outcomes (COs)

- The students will be able to define and explain the scope and significance of radiobiological scope in human welfare.
- Identify ionizing radiation, linear energy transfer, radiation dose and units and conceptualize the radiation types.
- Describe, explain and analyze application of radiology and gainful and harmful effects of radiation.
- Comprehend the concept of circadian rhythm, central clock system and peripheral clock system.
- Students will describe, explain and analyze centers of biological clock, relevance of biological clock in human welfare, mechanism of regulation of biological clock and effects of irregularity of biological clock and its remedies.

MZO4T14-MolecularBiologyandBiotechnology Course Outcomes (COs)

- Students will be able to analyse the basics of cellular genome, organization of genetic material, fundamental process of duplication of genetic material in prokaryotes and eukaryotes important for cell division.
- Evaluate the different types of DNA damage and repair mechanism.
- Illustrate the fundamentals of various mobile DNA elements useful in horizontal gene transfer, evolutionary process and gene expression in prokaryotes and eukaryotes.

- Explain the mechanisms and regulation of operon models significant in regulation of gene expression in prokaryotes.
- Illustrate the fundamental process of protein synthesis with explanation of antisense and ribozyme technology.
- They could differentiate and distinguish DNA sequencing and gene amplification methods, cloning by different cloning vectors for recombinant DNA technology.
- Explain and describe the applications of molecular biology and biotechnology.
- They could demonstrate and estimate DNA, RNA, Protein and Carbohydrates.
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Elective-Mammalian Reproductive Toxicology and Fertility Course Outcomes (COs)

- Students will be able to distinguish and describe the prevalence and risk in male and female reproductive system with respect to chemical and environmental toxicants including radiations, heavy metals, pesticides etc.
- Analyse the complex but highly organized physiological and molecular processes of preimplantation, foetal programming and prenatal development till the time of labour with respect to endocrine regulator.
- Comprehend the information of different traditional and advanced contraceptives, sterilization techniques and pregnancy vaccines to prevent unintended pregnancies that help to lower the maternal ill health and the number of pregnancy related death.
- Discriminate the various contraceptive mechanism in male to create physical and chemical barrier preventing sperm from reaching the oocyte with the help of surgical technique, antagonist, antibodies, anti-androgenic and anti-spermiogenic compounds.
- Prepare, identify, differentiate and explain the histological slides of female and male reproductive organs intoxicated with some antifertility drug, heavy metals and pesticide on ovary, uterus, thyroid gland, various stages of development of mammalian egg, development of foetal membranes, types of placenta and gestational changes in uterus.

MZO4P08, Research Project (RP) Major Work Course Outcomes (COs)

After completion of major research project student will be able to select proper problem (Title). Plan and develop experimental design for projects.

- Select and learn to use the proper methods and materials for his/her research work.
- Analyse and interpret the results.
- Draft the scientific write up and submit in the form of thesis.
- Learn and write bibliography by various styles.

