Faculty of Basic and applied Sciences (PO, PSO,CO)

B.Sc. Physical Science

(Effective from Academic Year 2023-2024 onwards)

Faculty of Basic and Applied Sciences

Madhav University

Bharja, Tehsil – Pindwara, Sirohi (Rajasthan) 307026

Contact Number: Mob: +91 8875028991/92

Email Address: info@madhavuniversity.edu.in

Web: www.madhavuniversity.edu.in

Program Outcome (POs):	
PO1	A student is exposed to a wide range of topics in various subjects and is given intensive training in each of the courses that have laboratory related work. The learner is encouraged to use various analytical, theoretical and experimental methods as an application to the acquired concepts and principles that help in studying various branches of sciences.
PO2	At the end of the program, students will be able to identify, formulate and analyze scientific problems and reach concrete solutions using various principles of sciences.
PO3	Program is designed to help the students to understand the importance and judicious use of technology for the sustainable growth of mankind in synergy with nature. It makes them appreciate the role of chemicals, chemical industries and their role in improving the quality of human life.
PO4	Candidate will be capable of developing communication skills, will be able to think critically, work independently as well as in a team.
PO5	With our learners' long-term professional pursuits being quite varied, many are drawn to careers that require scientific skills or technical expertise or strong quantitative reasoning abilities.
PO6	After completion of the programme the students will be employable in functional areas like Chemical Industries, Pharmaceutical Industries, Research Institutes etc.
PO7	To develop analytical thinking and problem-solving skills needed for various entrance and competitive examinations and Post Graduate Studies. Students will be trained in laboratory skills and handling equipment along with soft skills needed for Industry ready professionals.
PO8	With the pursuit of knowledge for either personal or professional reasons, learners are also encouraged to volunteer and be self-motivated that not only enhances society values, active participation and personality development, but also enhances self-sustainability, competitiveness and employability.
Program Specific Outcomes (PSOs)	
This course enables the Students to take up advanced studies in Chemistry, Physics, and Mathematics. Students will be:	
PSO1	Capable of analyzing and solving problems using reasoning skills based on concepts of different Science subjects.
PSO2	Understand and demonstrate knowledge of concepts from different branches of Science.
PSO3	Developing the knowledge, skills, and attitudes necessary for understanding basic and applied aspects of interdisciplinary nature.
PSO4	Able to demonstrate the concepts from different branches of science.
PSO5	Developing strong understanding of applied sciences courses, preparing them for higher education and multi-disciplinary research.

Year: First	B.Sc. Certificate Course (Physical Science/Chemical Science)	Semester: I
BPH5101T	**Mechanics**	**4-0-0-4**
Course Outcome:		
1	Learn about the behavior of physical bodies. It provides the basic concepts related to the motion of all the objects around us in our daily life.	
2	Understand about the analogy between vector product and scalar product and characteristic of each. Students should develop skill in computing vector products, work done, unit vector area of parallelogram.	
3	Learn about the study of vectors, laws of motion, momentum, energy, rotational motion, gravitation, fluids, elasticity and special relativity.	
4	Understanding about Effect of force on various types of materials is described and physical properties like elasticity, different moduli etc. along with their relation.	
5	The course builds a foundation of various applied fields in science and technology; especially in the field of mechanical engineering.	
6	Understand the motion of rigid objects along the surface, so that they can calculate moment of inertia, velocity, acceleration, total kinetic energy of an object that is undergoing both translational and rotational motion and apply energy conservation in analyzing such motion.	

Year: First	B.Sc. Certificate Course (Physical Science/Chemical Science)	Semester: I
BMT5101T	**Differential Calculus**	**4-1-0-5**
Course Outcome: After studying this course, a student will able to –		
1	Learn about the flavor of various functions, their higher order derivatives by Leibnitz's Rule.	
2	Learn about the limiting value by L'Hospital Rule, and partial differentiability by Euler's theorem.	
3	Learn about the differentiation, students may find tangent and normal, minimum and maximum value, Asymptotes, Curvature, Singularity, tracing of curves etc.	
4	Learn about the differentiability, continuity, Maclaurin and Taylor's theorem.	
5	Understand the Euler's theorem, Jacobians, Total differentials.	
6	Understand the Chain rule of partial differentiation.	

Year: First	**B.Sc. Certificate Course (Physical Science/Chemical Science)**	Semester: I
BPH5101P	**Physics Practical-I**	**0-0-2-1**

Course Outcome:	
1	Identifying and applying relevant physical laws and principles to problems.
2	Developing models and articulating relevant assumptions, approximations, and limitations.
3	Applying mathematical, statistical, and computational skills to develop solutions. Evaluating, assessing, and interpreting their results.
4	Students perform basic experiments related to mechanics and also get familiar with various measuring instruments and would learn the importance of accuracy of measurements.
5	Learn about the behavior of physical bodies. It provides the basic concepts related to the motion of all the objects around us in our daily life.
6	The course builds a foundation of various applied fields in science and technology; especially in the field of mechanical engineering. The course comprises the study of vectors, laws of motion, momentum, energy, rotational motion, gravitation, fluids, elasticity and special relativity.

Year: First	**B.Sc. Certificate Course (Physical Science/Chemical Science)**	Semester: II
BPH5201T	**Electricity and Magnetism**	**4-0-0-4**
Course Outcome:		
1	Understand the characteristics and properties of electric and magnetic fields.	
2	Experiences electricity & magnetism in practice mode and students enable to understand the role of electricity in day to day life.	
3	Students will identify and compare the characteristics of the electromagnetic spectrum including speed, wavelength and frequency.	
4	Students also understand the working principles and applications of various electrical components.	
5	Use mathematical and vectorial operations to quantify and analyze the nature of electric forces and field	
6	Solve problems involving combinations of electric force, electric field and electric potential quantities	

Year: First	**B.Sc. Certificate Course (Physical Science/Chemical Science)**	Semester: II
BMT5201T	**Ordinary Differential Equations**	**4-1-0-5**
Course Outcome: After studying this course, a student will able to –		
1	Distinguish between linear, nonlinear, partial and ordinary differential equations.	
2	Recognize and solve a variable separable differential equation, homogeneous differential equation, exact differential equation, linear differential equation by use of an integrating factor.	
3	Recognize and solve equations of Bernoulli, Ricatti and Clairaut.	
4	Find particular solutions to initial value problems.	
5	Understand the Method of auxiliary equations	
6	Understand the Ordinary simultaneous differential equations.	

Year: First	**B.Sc. Certificate Course (Physical Science/Chemical Science)**	Semester: II
BPH5201P	**Physics Practical-II**	**0-0-2-1**
Course Outcome:		
1	Students gain practical knowledge about electricity and magnetism and measurements such as: Resistance, Voltage, current etc.	
2	Students understand the A.C series L.C.R. circuit and resonance in series L.C.R. circuit	
3	Students develop skill in computing Maxwell's equation problems and A.C circuit.	
4	Apply law such as Biot - Savart's and Lenz's law for selected problems in electricity and magnetism.	
5	Students understand the capacitances using De Sauty's bridge.	
6	Use the tools, methodologies, language and conventions of physics to test and communicate ideas and explanations.	

Year: Second	B.Sc. Diploma (Physical Science/Chemical Science)	Semester: III
BPH6301T	**Thermal Physics and Statistical Mechanics**	**4-0-0-4**
Course Outcome:		
1	Understand the role of internal energy, enthalpy, temperature, pressure, and specific volume thermodynamic properties.	
2	Elucidate the basics of Carnot cycle, statistics and distributions.	
3	Explain the fundamental differences between classical and quantum statistics and learn about quantum statistical distribution laws.	
4	Understand the basic concepts of statistical mechanics	
5	Able to understand the basic concepts of thermodynamics such as temperature, pressure, system, properties, process, state, cycles	
6	Understand the apply the laws of thermodynamics to heat engines and estimating thermal efficiency	

Year: Second	B.Sc. Diploma (Physical Science/Chemical Science)	Semester: III
BMT6301T	**Real Analysis**	**4-1-0-5**
Course Outcome: After studying this course, a student will able to –		
1	Describe fundamental properties of the real numbers that lead to the formal development of real analysis.	
2	Understand Root test, Ratio test and Leibnitz's test.	
3	Demonstrate an understanding of limits and how they are used in sequences, series, differentiation and integration	
4	Construct rigorous mathematical proofs of basic results in real analysis	
5	Recognize a geometric series and correctly apply the convergence theorem.	
6	Apply the ratio test to determine the radius of convergence for a power series.	

Year: Second	B.Sc. Diploma (Physical Science/Chemical Science)	Semester: III
BPH6301P	**Physics Practical-III**	**0-0-2-1**
Course Outcome:		
1	Acquire knowledge and develop understanding of concepts, fundamental laws, principles and processes in the area of physics so that relationship between cause and effects of physical phenomenon can be understood;	
2	Experimental skills (like taking observations, manipulation of equipment) and communicative skills such as reporting of observations and experimental results.	
3	Problems solving ability, e.g., analyzing a situation or data and ensuring the justification of results.	
4	Scientific temper of mind by making judgment on verified facts and not opinions, by showing willingness to accept new ideas and discoveries.	
5	Understand the concept of thermal conduction and radiation	
6	Able to apply the laws of thermodynamics and statistical mechanics to solve problems.	

Year: First	B.Sc. Diploma (Physical Science/Chemical Science)	Semester:IV
BPH6401T	**Waves and Optics**	**4-0-0-4**
Course Outcome:		
1	Understand physical characteristics of SHM and obtain solution of the oscillator using differential equations.	
2	Calculate logarithmic decrement relaxation factor and quality factor of a harmonic oscillator.	

3	Use Lissajous figures to understand simple harmonic vibrations of the same frequency and different frequencies.
4	Solve wave equation and understand the significance of transverse waves.
5	Understand interaction of light with matter through interference, diffraction and polarization.
6	Distinguish ordinary light with a laser light and to realize propagation of light through optical fibers.

Year: Second	**B.Sc. Diploma (Physical Science/Chemical Science)**	Semester: IV
BMT6401T	**Advanced Calculus**	**4-1-0-5**
Course Outcome: After studying this course, a student will able to –		
1	Understand Limit and continuity of real valued functions of two variables	
2	Knowledge about Maxima and minima of two variables and more than two variables including Lagrange's method of undetermined multiplayers, and also Beta, Gamma function and their properties.	
3	Learn about the vector integration theory through which students will be able to go into the beauty of vector integration theory.	
4	Understand the line and surface integrals, definite and indefinite integrals.	
5	Understand Taylor's Theorem and Lagrange's method of multipliers and Envelopes	
6	Apply Dirichlet's integral to solve the problems	

Year: Second	**B.Sc. Diploma (Physical Science/Chemical Science)**	Semester: IV
BPH6401P	**Physics Practical-IV**	**0-0-2-1**
Course Outcome: The course aims at developing the following abilities in the learner		
1	Acquire knowledge and develop understanding of concepts, fundamental laws, principles and processes in the area of physics so that relationship between cause and effects of physical phenomenon can be understood;	
2	Experimental skills (like taking observations, manipulation of equipment) and communicative skills such as reporting of observations and experimental result.	
3	Problems solving ability e.g., analyzing a situation or data and ensure the justification of results.	
4	Scientific temper of mind by making judgment on verified facts and not opinions, by showing willingness to accept new ideas and discoveries.	

Year: Third	**B.Sc. Degree (Physical Science/Chemical Science)**	Semester: V
BPH7501T	**Digital and Analog Circuits and Instrumentation**	**4-0-0-4**
Course Outcome:		
1	Learn about gain the knowledge of Basic Electronics circuits, network theorems and measuring instruments: They would know about common solid state devices: Semiconductor diodes and transistors.	
2	Understand about the Rectifiers, Filters and their applications, number systems and logic gates which are foundation blocks of digital electronics.	
3	Learn about electronic circuits such as Amplifiers and Oscillators.	
4	Learn about Various types of Amplifier and Oscillator circuits, their working and applications in domestic, industrial and scientific devices/equipment.	
5	Evaluate possible causes of discrepancy in practical experimental observations in comparison to theory.	
6	Prepare professional quality textual and graphical presentations of laboratory data and Computational results.	

Year: Third	**B.Sc. Degree (Physical Science/Chemical Science)**	Semester: V
BMT7501T	**Abstract Algebra**	**4-1-0-5**
Course Outcome: After studying this course, a student will able to –		
1	deals with the algebraic structure of Groups and its important properties.	
2	Students will get knowledge about abelian groups, sub-groups, Cyclic group, Lagrange's theorem for finite groups.	
3	Discuss permutation groups and their important properties.	
4	Understand integral domain.	
5	Understand Ideals, Quotient Ring and Maximal Ideal.	
6	Understand the Rings, Sub-rings and fields.	

Year: Third	**B.Sc. Degree (Physical Science/Chemical Science)**	Semester: V
BPH7501P	**Physics Practical-V**	**0-0-2-1**
Course Outcome:		
1	To construct two input OR and AND logic gates using p-n junction transistors and to verify their truth table.	
2	Make use of IC's to construct half adder and full adder	
3	Make use of IC 555 to construct an astable multivibrator	
4	Evaluate possible causes of discrepancy in practical experimental observations in comparison to theory.	
5	To draw the characteristics of a Zener diode an to study its use as a voltage regulator.	
6	Prepare professional quality textual and graphical presentations of laboratory data and Computational results, incorporating accepted data.	

Year: Third	**B.Sc. Degree (Physical Science/Chemical Science)**	Semester: V
BPH7502T	**Electrical Circuit Network Skills**	**2-0-0-2**
Course Outcome: After studying this course, a student will able to –		
1	Acquire knowledge of basic Electricity Principles.	
2	Interpret basic techniques to measure Power in ac circuits.	

3	Analyze the working of electric circuit elements.
4	Knowledge of electric generators and Solid-state devices.

Year: Third	**B.Sc. Degree (Physical Science/Chemical Science)**	Semester: V
BMT7502T	**Numerical Methods**	**2-0-0-2**
Course Outcome: After studying this course, a student will able to –		
1	Learn about the different solutions of algebraic and transcendental equations.	
2	Learn about the fixed point iteration method, Newton's Raphson's method, Bisection method and false position method.	
3	Understand the numerical solutions of ordinary differential equations.	
4	Learn about the Fourth order Euler's method and Runge – Kutta method.	
5	Understand the solution ordinary differential equations by Picard's method	
6	Understand the solution of ordinary differential equations by Taylor's series.	

Year: Third	**B.Sc. Degree (Physical Science/Chemical Science)**	Semester: VI
BPH7601T	**Nuclear & Particle Physics**	**4-0-0-4**
Course Outcome:		
1	Learn about the Basic properties of nucleus, students got the idea of inner information of the nucleus.	
2	Knew which radiations emit from radioactive material and how they are useful and harmful for the human.	
3	Understand the alpha, beta, gamma particle how many other particles are inside the nucleus.	
4	Learn by using accelerators we can produce high energy particles which can be used for research purposes.	
5	Learn about topics of interest independently, and subsequently organize and present information to each other and to a group, at an appropriate level for their target audience.	

Year: Third	**B.Sc. Degree (Physical Science/Chemical Science)**	Semester: VI
BMT7601T	**Complex Analysis**	**4-1-0-5**
Course Outcome: After studying this course, a student will able to –		
1	Define a function of a complex variable and carry out basic mathematical operations with complex numbers.	
2	Learn the condition(s) for a complex variable function to be analytic and/or harmonic. They will know the Cauchy Riemann equation.	
3	Understand the concept of sequences and series with respect to the complex numbers system.	
4	Understand limits involving the point at infinity, continuity and Properties of complex numbers.	
5	Understanding the concept of contour integral, they will also know some important beautiful theorems like Cauchy's theorem, Cauchy's integral formula, Liouville's theorem.	
6	Also understand the role of Laurent series.	

Year: Third	**B.Sc. Degree (Physical Science/Chemical Science)**	Semester: VI
BPH7601P	**Physics Practical-VI**	**0-0-2-1**

Course Outcome:	
1	This course helps the students to gain basic ideas of the construction and working of electronic devices and circuits and to understand the fundamentals of communication systems
2	The course is of much practical purpose for the students to learn the basics of digital electronics.
3	Digital electronics has wide applications in computing, process control, signal processing, communication systems, digital instruments etc.
4	Students would gain practical knowledge by performing various experiments of Electronics.
5	Students gain practical knowledge by performing various experiments related to different fields in physics and would also learn to design the experiments themselves under their supervision.

Year: Third	**B.Sc. Degree (Physical Science/Chemical Science)**	Semester: VI
BPH7602T	**Basic Instrumentation Skills**	**2-0-0-2**
Objective	To understand the basic working principles of important electrical and electronic circuit components.	% weightage

Course Outcome: Students will be able to explain basic circuit concepts and responses.	
1	Basic of Measurement: Instruments accuracy, precision, sensitivity resolution range etc.
2	Oscilloscope: Block diagram of basic CRO, CRT.
3	They will be able to use analytical techniques in resistive circuits energized by direct current voltage and current sources.
4	They will be able to understand the concepts of combinational logic circuits and sequential circuits.
5	Signal and pulse Generators: Block diagram, explanation and specifications of low frequency signal generator and pulse generator.
6	Digital Instruments: Comparison of analog & digital instruments.

Year: Third	**B.Sc. Degree (Physical Science/Chemical Science)**	Semester: VI
BMT7602T	**Linear Algebra**	**2-0-0-2**
Course Outcome: After studying this course, a student will able to –		
1	Learn about the Vector spaces, algebra of subspaces and linear combination of vectors.	
2	Understand the Linear span and independence and dimension of subspaces.	
3	Learn about the Linear transformations, null space and nullity of a linear transformation.	
4	Understand the Matrix representation of a linear transformation, algebra of linear transformations and Isomorphisms.	
5	Understand the Linear transformations.	
6	Understand the range and rank of a linear transformation.	

Year: Four	**B.Sc. Honours (Lifescience/Chemical Science/Physics/Mathematics)**	Semester: VII
BRM8701T	**Research Methodology**	**4-0-0-4**
Course Outcome: After complication of the course students will be able to:		
1	After completion of the course, students would be able to apply the knowledge of research methodology in sciences and applied sciences to solve curriculum problems with respect to remembering, understanding, apply, analyze, evaluate and create.	
2	Understand the basics in research methodology and apply them in research/ project work.	
3	Understand the limitations of particular research methods.	
4	Able to develop skills in qualitative and quantitative data analysis and presentation.	
5	Develop advanced critical thinking research skills.	
6	Understand research legitimacy and be able to provide scientifically sound findings.	
Year: Four	**B.Sc. Honours (Lifescience/Chemical Science/Physics/Mathematics)**	Semester: VII
BSM8701S	**Seminar**	**0-0-4-2**
Course Outcome: After complication of the course students will be able to:		
1	Widen the scope of knowledge of each graduate student by requiring participation in seminars related to and different from their specialization	
2	Able to identify and compare technical and practical issues related to the area of course specialization	

Year: Four	**B.Sc. Honours (Lifescience/Chemical Science/Physics/Mathematics)**	Semester: VII

BDS8701D	Dissertation (Research Plan)	0-0-12-6
Course Outcome: After complication of the course students will be able to:		
1	To develop the research problem and outline the elements of a research proposal.	
2	To gather, form, and critique knowledge from research studies and interpret the research material	

Year: Four	**B.Sc. Honours (Mathematics)**	Semester: VII
BMT8701T	**Advanced Complex Analysis**	**3-1-0-4**
Course Outcome:		
1	Know the fundamental concepts of complex analysis.	
2	Prove the Cauchy-Riemann equations and apply them to complex functions in order to determine whether a given continuous function is complex differentiable.	
3	Extend their knowledge to pursue research in this field.	
4	Solve the problems using complex analysis techniques applied to different situations in engineering and other mathematical contexts.	
5	Understand the special functions and their properties.	
6	Understand the Analytic continuation.	

Year: Four	**B.Sc. Honours (Mathematics)**	Semester: VII
BMT8702T	**Advanced Differential Equations**	**3-1-0-4**
Course Outcome:		
1	The use of the differential equation theory is to solve various types of Mathematical modeling problems.	
2	The use of the differential equation theory is to solve many problems presented in different sciences such as Biology, Chemical Sciences and Physics.	
3	The use of this theory is to solve many real-life based problems such as population problem, control problems and networking security problems etc.	
4	This theory can solve many engineering problems such as the exact trajectory path of a rocket or a missile.	
5	Students will be able to formulate and solve differential equations arising from changes in physical world.	
6	Understand the solution of Wave, Laplace equation etc.	

Year: Four	**B.Sc. Honours (Mathematics)**	Semester: VII
BMT8703T	**Advanced Abstract Algebra**	**3-0-0-3**
Course Outcome:		
1	Ability to solve non-trivial problems based on various concepts in the course.	
2	Determining the connection and transit amid formerly studied mathematics (discrete mathematics) and advanced mathematics (advanced abstract mathematics).	
3	Ability to apply abstract algebra to solve problems in other branches of mathematics and also in other disciplines.	
4	Describing relationship between Abstract Algebra and other courses in mathematics.	
5	Understanding the dependency of results on earlier results, and thereby developing a correct approach towards life realizing the deep connection among past, present and future. For example, in ring theory, the ring of polynomials over a field is a gift of the division algorithm.	
6	Understand the Minimal polynomials.	

Year: Four	**B.Sc. Honours (Mathematics)**	Semester: VII
BMT8704T	**Differential Geometry**	**3-0-0-3**
Course Outcome:		
1	Explain the geometry of different types of curves and spaces.	
2	Understand the basic concepts and results related to space curves, tangents, normal and surfaces.	
3	Understand principal directions and curvatures, asymptotic lines and then apply their important theorems and results to study various properties of curves and surfaces.	
4	Explain the physical properties of different curves and spaces.	
5	Understand the student Euler's theorem.	
6	Understand the Gauss's formulae and characteristics equations.	

Year: Four	**B.Sc. Honours (Mathematics)**	Semester: VIII
BMT8801T	**Real Analysis**	**4-1-0-5**
Course Outcome:		
1	To provide a topological study of real-valued functions.	
2	To study the concepts of convergence and uniform convergence of series and sequence of real-valued functions and their applications.	
3	To provide the methods for finding the maxima and minima values of multivariate real-valued functions with their applications.	
4	To study the concept of integrability of real-valued functions over the closed and bounded interval and their applications in different areas, such as quantum physics.	
5	This course gives a wide study of different concepts of functions of serval variables, such as limit and continuity, differentiability, partial differentiability and integrability.	
6	This course lays a foundation to study other important courses such as functional analysis, complex analysis and differential equations.	

Year: Four	**B.Sc. Honours (Mathematics)**	Semester: VIII
BMT8802T	**Partial Differential Equations**	**4-1-0-5**
Course Outcome:		
1	Understand the partial differential equation problem and analyze linear and non-linear systems.	
2	Classify second order PDE and solve boundary value problems by using separation of variable method.	
3	Determine integral surfaces passing through a curve, characteristic curves of second order PDE and compatible systems.	
4	Understand the formation and solution of some significant PDEs like wave equation.	
5	Understand the solution of diffusion equation.	
6	Understand the solution of heat equation.	

Year: Four	**B.Sc. Honours (Mathematics)**	Semester: VIII
BMT8803T	**Advanced Linear Algebra**	**4-0-0-4**
Course Outcome:		
1	Understand the notion of a vector space and linear transformation and to determine basis and dimension of a vector space.	
2	Understand the concept of linear transformation and to find the range space and null space of the linear transformation.	
3	Find the eigenvectors and Eigen-value of a square matrix and to know diagonalization of the matrix.	
4	Compute an orthogonal basis using the Gram-Schmidt process.	
5	Understand Invertibility and Isomorphisms.	
6	Understand primary decomposition theorem.	

Year: First	**B.Sc. Honours (Mathematics)**	Semester: VIII
BMT8804T	**Advanced Numerical Analysis**	**3-0-0-3**
Course Outcome:		
1	Apply their knowledge of computer programming to develop and implement their own computer codes of numerical methods for solving different types of complex problems viz. nonlinear equations, a system of linear equations, interpolation and extrapolation, numerical differentiation and integration, numerical initial and boundary value problems of ordinary differential equations, etc.	
2	Analyze and modify computer codes available in the scientific literature.	
3	Find the solution of linear and nonlinear equations and solution of differential equations.	
4	Demonstrate understanding of common numerical methods and how they are used to obtain approximate.	
5	Identify the challenging problems in continuous mathematics (which are difficult to deal with analytically) and find their appropriate solutions accurately and efficiently using computer codes.	
6	Utilize the symbolic tools of Computer Algebra System (CAS) for example MATLAB, MATHEMATICA and MAPLE independently and in their computer codes for solving a given problem	

Year: Four	**B.Sc. Honours (Lifescience/Chemical Science/Physics/Mathematics)**	Semester: VIII
BDS8801D	**Dissertation (Research Report)**	**0-0-12-6**
Course Outcome: After complication of the course students will be able to:		
1	To produce a thesis of publishable quality and demonstrate proficiency in the field.	
2	To effectively present and defend the research orally.	
3	To publish research data in quality journals.	

Year: Four	**B.Sc. Honours (Lifescience/Chemical Science/Physics/Mathematics)**	Semester: VII
BRM8701T	**Research Methodology**	**4-0-0-4**
Course Outcome: After complication of the course students will be able to:		
1	After completion of the course, students would be able to apply the knowledge of research methodology in sciences and applied sciences to solve curriculum problems with respect to remembering, understanding, apply, analyze, evaluate and create.	
2	Understand the basics in research methodology and apply them in research/ project work.	
3	Understand the limitations of particular research methods.	
4	Able to develop skills in qualitative and quantitative data analysis and presentation.	
5	Develop advanced critical thinking research skills.	
6	Understand research legitimacy and be able to provide scientifically sound findings.	

Year: Four	**B.Sc. Honours (Lifescience/Chemical Science/Physics/Mathematics)**	Semester: VII
BSM8701S	**Seminar**	**0-0-4-2**
Course Outcome: After complication of the course students will be able to:		
1	Widen the scope of knowledge of each graduate student by requiring participation in seminars related to and different from their specialization	
2	Able to identify and compare technical and practical issues related to the area of course specialization	

Year: Four	**B.Sc. Honours (Lifescience/Chemical Science/Physics/Mathematics)**	Semester: VII
BDS8701D	**Dissertation (Research Plan)**	**0-0-12-6**

Course Outcome: After complication of the course students will be able to:	
1	To develop the research problem and outline the elements of a research proposal.
2	To gather, form, and critique knowledge from research studies and interpret the research material

Year: Four	**B.Sc. Honours (Physics)**	Semester: VII
BPH8701T	**Quantum Physics-I**	**3-0-0-3**
Course Outcome:		
1	Explain the theories and phenomena of vector space, operators, Dirac‘s notations, matrices, and commentators which are very helpful in solving the various quantum mechanics problems	
2	Understand the uncertainty relation between two arbitrary operators	
3	Distinguish the actual meaning of time independent and time dependent Schrodinger‘s equations	
4	Illustrate Ehrenfest theorem, Poisson Brackets, wave packets and wave functions in position and momentum space	
5	Analyze the energy Eigenvalues and wave functions of harmonic oscillator, infinite and finite square wells, free particle, and hydrogen atom	
6	Recognize the importance of angular momentum and its applications in quantum mechanics	

Year: Four	**B.Sc. Honours (Physics)**	Semester: VII
BPH8702T	**Mathematical Method in Physics**	**3-0-0-3**
Course Outcome:		
1	To use matrices for solving linear algebraic equations and to use group theory for understanding of crystallography.	
2	To use tensor transformation and related algebra in physics.	
3	To solve real definite integrals in theoretical Physics.	
4	To find roots of a given polynomial and understand the properties of a statistical distribution of point particles	
5	Apply the principles of statistical mechanics to selected problems and also basic concepts apply for research areas.	
6	To learn the fundamental differences between classical and quantum statistics and learn about quantum statistical distribution laws	

Year: Four	**B.Sc. Honours (Physics)**	Semester:VII
BPH8701P	Physics Practical-I	**0-0-2-1**
Course Outcome:		
1	The students will have practical understanding of the characteristics of various diodes	
2	The students will have practical understanding of the transistors.	
3	The students will have practical understanding of the Op-Amp	
4	The students will have practical understanding of the designing concepts of logic gates and digital circuits.	
5	The students will have practical understanding of the basic elements and measurement using	

	multimeters and utilization of CRO.
6	The students will have practical understanding of the Amplifiers, and Oscillators.

Year: Four	**B.Sc. Honours (Physics)**	Semester:VII
BPH8702P	Physics Practical-II	**0-0-2-1**
Course Outcome:		
1	Students would be able to determine the values of Stefan's constant, Boltzmann constant and e/m ratio of electron and experimental errors in each case	
2	Students would be able to understand magnetization and related aspects in a ferromagnetic material.	
3	Students get familiarized with advanced spectroscopy.	
4	Students would be able to understand the different harmonics and their amplitudes in a Fourier series experimentally which provides a direct connection between theory and experiment.	
5	Students would be able to understand heat capacity of solids	
6	Students would be able to understand function of temperature and determine the Curie temperature	

Year: Four	**B.Sc. Honours (Physics)**	Semester: VII
BPH8703T	**Electronics**	**3-0-0-3**
Course Outcome:		
1	To understand the techniques to shape signals.	
2	To understand the principle of multivibrators	
3	To understand basic properties of analog systems	
4	To understand the fundamental designing concepts of different types of Logic Gates, Minimization techniques etc.	
5	The students will have understanding of Characteristics and applications of PN junction diodes	
6	The students will have understanding of Different types of transducers, impedence matching, filtering and noise reduction techniques, etc.	

Year: Four	**B.Sc. Honours (Physics)**	Semester: VII
BPH8704T	**Atomic and Molecular Physics**	**3-0-0-3**
Course Outcome:		
1	To Understand different models of an Atom.	
2	To derive the energy distribution corresponding to different levels of an atom.	
3	To Understand rotation spectroscopy and Understand Raman Effect and Raman spectroscopy of molecules.	
4	To understand the working of He-Ne Laser and Ruby Laser.	

Year: Four	**B.Sc. Honours (Physics)**	Semester: VIII
BPH8801T	**Plasma Physics**	**4-0-0-4**
Course Outcome:		
1	To study theoretical method to study the charge particle motion	
2	To study Idea behind the magnetic confinement	

3	To study How to generate plasma in the laboratory
4	To study plasma production is helpful to make fusion reactors
5	Discuss plasma resistivity and diffusion in plasma based on the charged particle motion
6	Discuss technical applications of plasma; explain the most important methods for production and diagnostics of plasma in the laboratory

Year: Four	**B.Sc. Honours (Physics)**	Semester: VIII
BPH8802T	**Statistical Mechanics**	**4-0-0-4**
Course Outcome:		
1	Apply the thermodynamics in ideal gas, magnetic and dielectric materials	
2	Describe various statistical approaches which describe systems of particles	
3	Evaluate the formulae of random walk and diffusion equation	
4	Understand the theories and mathematical approaches of statistical ensembles, equipartition theorem and Maxwell-Boltzmann statistics	
5	Illustrate the fundamental concepts of Bose-Einstein and Fermi-Dirac Statistics	
6	Calculate the problems related to Bosons and Fermions	

Year: Four	**B.Sc. Honours (Physics)**	Semester: VIII
BPH8801P	**Physics Practical-III**	**0-0-2-1**
Course Outcome:		
1	The students would get hands on experience on experiments and relation to theory	
2	Theoretical results for different networks matched with experiments would enable students for complex circuits	
3	The students would get equipped for applications based on solid state devices	
4	The students would be able to differentiate between analog and digital electronics	
5	Various memory devices & their applications.	
6	Digital arithmetic operations and combinational & sequential circuits.	

Year: Four	**B.Sc. Honours (Physics)**	Semester: VIII
BPH8802P	**Physics Practical-IV**	**0-0-2-1**
Course Outcome:		
1	Students will be able to have functional knowledge about push – pull amplifiers.	
2	Development of ability to design and analyze electronic circuits using discrete components	
3	Students will be able to practically verify the frequency response of feedback amplifier single and multistage amplifiers	
4	Measurement of various analog circuits and comparison of experimental results with theoretical analysis enables the student for problem solving.	
5	Students would be able to relate experiments with the theoretical aspects of the course.	
6	Students will be able to conduct experiments, as well as to analyze and interpret data.	

Year: Four	**B.Sc. Honours (Physics)**	Semester: VIII
BPH8804T	**Classical Mechanics**	**3-0-0-3**

Course Outcome:	
1	Understand the mechanics of the system of particles, D'Alembert's principle, Lagrangian mechanics, & Euler's equation of motion.
2	Learn about Hamiltonian formulation, Hamilton's Equations of Motion and Principle of least action.
3	Learn Canonical Transformations & Hamilton-Jacobi theory.
4	Learn about Rigid body dynamics including problems.
5	Understand the two body central force problem and its related aspects.
6	Use the tools, methodologies, language and conventions of physics to test and communicate ideas and explanations.

Year: Four	**B.Sc. Honours (Physics)**	Semester: VIII
BPH8805T	**Electrodynamics**	**3-0-0-3**

Course Outcome:	
1	To understand the basics of electrostatics.
2	To describe the nature of electromagnetic waves and its propagation through different media and interfaces.
3	To use Maxwell equations in analyzing the electromagnetic field due to time varying charge and current distribution.
4	The students will be able to analyze s radiation systems in which the electric dipole, magnetic dipole or electric quadrupole dominate.
5	The students will have an understanding of the covariant formulation of electrodynamics and the concept of retarded time for charges undergoing acceleration.
6	To explain charged particle dynamics and radiation from localized time varying electromagnetic sources.

Year: Four	**B.Sc. Honours (Lifescience/Chemical Science/Physics/Mathematics)**	Semester: VIII
BDS8801D	**Dissertation (Research Report)**	**0-0-12-6**

Course Outcome: After complication of the course students will be able to:	
1	To produce a thesis of publishable quality and demonstrate proficiency in the field.
2	To effectively present and defend the research orally.
3	To publish research data in quality journals.

B.Sc. Lifescience

(Effective from Academic Year 2023-2024 onwards)

Faculty of Basic and Applied Sciences

Madhav University

Bharja, Tehsil – Pindwara, Sirohi (Rajasthan) 307026

Contact Number: Mob: +91 8875028991/92

Email Address: info@madhavuniversity.edu.in

Web: www.madhavuniversity.edu.in

Program Outcome (POs):	
PO1	A student is exposed to a wide range of topics in various subjects and is given intensive training in each of the courses that have laboratory related work. The learner is encouraged to use various analytical, theoretical and experimental methods as an application to the acquired concepts and principles that help in studying various branches

	of sciences.
PO2	At the end of the program, students will be able to identify, formulate and analyze scientific problems and develop concrete solutions using various principles of sciences.
PO3	Program is designed to help the students to understand the importance and judicious use of technology for the sustainable growth of mankind in synergy with nature. It makes them appreciate the role of chemicals, chemical industries and their role in improving the quality of human life.
PO4	Candidate will be capable of developing communication skills, will be able to think critically, work independently as well as in a team.
PO5	With our learners' long-term professional pursuits being quite varied, many are drawn to careers that require scientific skills or technical expertise or strong quantitative reasoning abilities.
PO6	After completion of the programme the students will be employable in functional areas like Chemical Industries, Pharmaceutical industries, Research Institutes etc.
PO7	To develop analytical thinking and problem-solving skills needed for various entrance and competitive examinations and Post Graduate Studies. Students will be trained in laboratory skills and handling equipment along with soft skills needed for Industry ready professionals.
PO8	With the pursuit of knowledge for either personal or professional reasons, learners are also encouraged to volunteer and be self-motivated that not only enhances society values, active participation and personality development, but also enhances self-sustainability, competitiveness and employability.
Program Specific Outcomes (PSOs)	
This course enables the Students to take up advanced studies in Chemistry and Lifescience. Student will be:	
PSO1	Capable of analyzing and solving problems using reasoning skills based on concepts of different Science subjects.
PSO2	Understand and demonstrate knowledge of concepts from different branches of Science.
PSO3	Developing the knowledge, skills, and attitudes necessary for understanding basic and applied aspects of interdisciplinary nature.
PSO4	Able to demonstrate the concepts from different branches of science.
PSO5	Developing strong understanding of applied sciences courses, preparing them for higher education and multi-disciplinary research.

Year: First	**B.Sc. Certificate Course (Lifescience/Chemical Science)**	Semester: I
BCH5101T	**General Chemistry-I**	**4-0-0-4**
Course Outcome:		
1	Learn about the Basic understanding of atomic structure and periodicity of elements in periodic elements.	
2	Understand Associate polarization of a bond with electronegativity and VSEPR & MO theory.	
3	Understand the basics of solids, symmetry of elements, unit cells, Bragg's Law and defects in crystals	
4	Learn about Fundamentals of Organic Chemistry and Stereochemistry.	
5	Learn about the Surface tension and its determination using a stalagmometer.	
6	Understand the basic concept of viscosity using Ostwald viscometer.	

Year: First	**B.Sc. Certificate Course (Lifescience/Chemical Science)**	Semester: I
BBS5101T	**Animal Diversity-I**	**4-0-0-4**
Course Outcome: After completion of the course students will be able to:		
1	Define the characteristics of non-chordate animals and their classification, including the major phyla and classes.	
2	Compare and contrast the morphological and physiological features of different non-chordate groups, including their adaptations to different environments.	
3	Apply knowledge of non-chordate anatomy and physiology to understand their behavior and ecology, including their feeding habits, predator-prey interactions, and social behavior.	
4	Analyze the adaptations of non-chordate animals to different environments, including their morphological, physiological, and behavioral specializations.	
5	Develop a conservation plan for a threatened or endangered non-chordate species, including the identification of conservation priorities and the development of a management strategy.	
6	Evaluate the importance of non-chordate animals in ecosystems and their impact on human society, including their role in food chains, nutrient cycling, and ecosystem services.	

Year: First	**B.Sc. Certificate Course (Lifescience/Chemical Science)**	Semester: I
BBS5102T	**Plant Diversity**	**4-0-0-4**

Course Outcome: After completion of the course students will be able to:

1	Understand the basis of classification of algae, fungi and bryophytes.
2	Elaborate the general characters of the classes' phycomycetes, ascomycetes, basidiomycetes and deuteromycetes of fungi.
3	Know the importance of studying life cycles of type specimens of algae, fungi and bryophytes.
4	Compare, draw and describe the life cycle of algae Vaucheria, and Ectocarpus.
5	Know the classification and salient features of major groups of bryophytes, pteridophytes, and gymnosperms.
6	Understand the economic importance of various groups of plant kingdom.

Year: First	**B.Sc. Certificate Course (Lifescience/Chemical Science)**	Semester: I
BCH5101P	**Chemistry Practical-I**	**0-0-2-1**

Course Outcome: After completion of the course students will be able to:

1	Learn about the how can use the laboratory glassware and instruments, preparation of solution of different molarity and normality.
2	Understand the surface tension and viscosity measurements by Stalagmo meter and Ostwald's viscometer respectively. Learn about pH measurements of different samples and preparation of buffer solutions.
3	Learn about the purification of organic compounds by crystallization, distillation, separation of mixtures of two sugars by paper chromatography.
4	Learn about the purification of organic compounds by crystallization, distillation, separation of mixtures of two sugars by paper chromatography.
5	Gain the knowledge about systematic qualitative analysis of organic compounds having mono functional group.
6	Understand the basic of purification and learn practical aspects of purification by crystallization.

Year: First	**B.Sc. Certificate Course (Lifescience/Chemical Science)**	Semester: I
BBS5101P	**Animal Diversity Laboratory-I**	**0-0-2-1**

Course Outcome: After completion of the course students will be able to:

1	Identify and name the major non-chordate to hemichordate animals and recall the basic anatomy of representative species.
2	Explain the differences in body structure among groups and describe the life cycles and developmental stages of various non-chordate and hemichordates animals.
3	Apply knowledge of non-chordate anatomy to understand their behavior.
4	Analyze the adaptations of non-chordates to different environments.
5	Analyze the ecological niche of animals.
6	Assess the conservation status of a selected non-chordate species.

Year: First	**B.Sc. Certificate Course (Lifescience/Chemical Science)**	Semester: I
BBS5102P	**Plant Diversity Laboratory**	**0-0-2-1**
Course Outcome: After completion of the course students will be able to:		
1	Know the economic importance of plant kingdom.	
2	Study of Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperms through Permanent slides.	
3	Know preparation of specimens and slides for observation under compound microscope.	
4	Microscopic observation and identification of algae, fungi, bryophytes, lichens, pteridophytes and gymnosperm.	
5	Understand the process of permanent slide preparation for Plant materials.	
6	Understand the habitat and diversity of lower plants	

Year: First	**B.Sc. Certificate Course (Lifescience/Chemical Science)**	Semester: II
BCH5201T	**General Chemistry–II**	**4-0-0-4**
Course Outcome: After completion of the course students will be able to:		
1	To provide an insight into the carboxylic acids and their derivatives, acidic and alkaline hydrolysis of ester, Hell – Vohlard – Zelinsky reaction, Reformastsky reaction and Perkin condensation. Preparation and reaction of Amines & Diazonium Salts.	
2	Understand the preparation and reaction of Aliphatic Hydrocarbon, Wurtz reaction and Kolbe's synthesis, Saytzeff's rule, Birch reduction, Markovnikoff's and Anti-Markovnikoff's Rule, Ozonolysis and Oxidation of Alkenes & Alkynes.	
3	To learn about the Aromatic Hydrocarbon, Electrophilic Substitution Reactions, Preparation & reaction of Alkyl & Aryl halides, SN^1 & SN^2 Reactions and Benzyne mechanism.	
4	Understand the Preparation and Reaction of Alcoholes, Phenols & Ethers. Reimer – Tiemann , Gattermann-Koch and Schotten – Baumann reactions, Aldol and Cannizzaro's condensation,	
5	Learn the Wolff-Kishner, Clemensen and Meerwein- Pondorf Verley reductions and their mechanism.	
6	Understand the formation of various organic compounds via benzene diazonium chloride.	

Year: First	**B.Sc. Certificate Course (Lifescience/Chemical Science)**	Semester: II
BBS5201T	**Cell Biology & Genetics**	**4-0-0-4**

Course Outcome: After completion of the course students will be able to:

1	Define the structure and function of cellular organelles, including the nucleus, mitochondria, and chloroplasts. Recall the fundamental concepts of genetics, including Mendelian inheritance, DNA structure, and gene expression.
2	Explain the differences between prokaryotic and eukaryotic cells, including their structure and function. Compare and contrast the mechanisms of genetic inheritance, including Mendelian inheritance, genetic drift, and natural selection.
3	Use the principles of cell biology to explain the mechanisms of cellular signaling and communication. Apply the concepts of genetics to predict the outcomes of genetic crosses and to analyze genetic data.
4	Compare the mechanisms of genetic inheritance in different organisms, including bacteria, plants, and animals. Analyze the effects of genetic mutations on cellular function and organismal development.
5	Design a genetic experiment to test a hypothesis about the inheritance of a particular trait.
6	Develop a model of cellular metabolism to explain the interactions between different metabolic pathways.

Year: First	**B.Sc. Certificate Course (Lifescience/Chemical Science)**	Semester: II
BBS5202T	**Plant Anatomy**	**4-0-0-4**

Course Outcome: After completion of the course students will be able to:

1	Understand the anatomy of root, stem and different meristems.
2	Describe the anomalous growth behavior of plant stem and root, and their anatomical differences.
3	Understand the transformation of vasculature during root to stem transition, and the components and development of apical, lateral and root meristems.
4	At the end of course student will be able to understand, remember, analyze and evaluate Structure tissues organ development and morphology of male gametophyte.
5	At the end of course student will be able to understand, remember, analyze, evaluate and describe the type of tissues and tissue system
6	At the end of course student will be able to understand, remember, analyze, evaluate and describe the organization of apical meristem in plants, survival behavior of plants, and type of anomalous secondary growth

Year: First	**B.Sc. Certificate Course (Lifescience/Chemical Science)**	Semester: II
BCH5201P	**Chemistry Practical-II**	**0-0-2-1**
Course Outcome: After completion of the course students will be able to:		
1	Gain the deep insight of volumetric analysis, Estimation of Na_2CO_3 & $NaHCO_3$, Estimation of oxalic acid, Estimation of Fe (II) ions.	
2	Learn the systematic qualitative analysis of inorganic salt (single salt, one cation and one anion)	
3	Understand the preparation, reaction mechanism, and determination of melting point and calculation of quantitative yields of synthesized organic compound, Bromo phenol.	
4	Understand the preparation, reaction mechanism, and determination of melting point and calculation of quantitative yields of synthesized organic compound, Bromoaniline.	
5	Understand the preparation, reaction mechanism, and determination of melting point and calculation of quantitative yields of synthesized organic compound, Benzolyamines.	
6	Understand the preparation, reaction mechanism, and determination of melting point and calculation of quantitative yields of synthesized organic compound, benzoyl phenols.	

Year: First	**B.Sc. Certificate Course (Lifescience/Chemical Science)**	Semester: II
BBS5201P	**Cell Biology & Genetics Laboratory**	**0-0-2-1**

Course Outcome: After completion of the course students will be able to:

1	Identify and name cellular organelles and their functions. Recall the basic principles of Mendelian genetics and molecular genetics.
2	Explain the principles of experimental design and data analysis in cell biology and genetics.
3	Apply knowledge of cell biology and genetics to understand the mechanisms of disease, including cancer and genetic disorders.
4	Compare the mechanisms of gene regulation in prokaryotes and eukaryotes.
5	Evaluate the differences in different types of cells.
6	Design a genetic experiment to investigate the inheritance of a specific trait.

Year: First	**B.Sc. Certificate Course (Lifescience/Chemical Science)**	Semester: II
BBS5202P	**Plant Anatomy Laboratory**	**0-0-2-1**
Course Outcome: After completion of the course students will be able to:		
1	To understand the structural aspects of plant tissue at cell level.	
2	To analyze the structural components of stem, leaf and root of different plant groups	
3	Understand and compare the anatomy of different tissues of plants	
4	Understand the secondary growth structure of dicot stem and root	
5	Understand the Anomalous secondary growth	
6	Understand trichomes and stomata in detail	

Year: Second	**B.Sc. Diploma (Lifescience/Chemical Science)**	Semester: III
BCH6301T	**Chemistry-I**	**4-0-0-4**

Course Outcome:

1	Understand Raoult's law to ideal and non – ideal solutions. Learn about the solvent extraction, azeotropes and Nernst distribution law & its application. Understand the Phase equilibrium: degree of freedom, Gibbs phase rule, derivation of Clausius – Clapeyron equation, phase diagram of one & two component systems.
2	Understand the molar conductivity, electrolytes, Kohlrausch law, solubility & solubility products of sparingly soluble salts, ionic product of water, and hydrolysis constant of a salt.
3	Learn about the concept of EMF of a cell, measurement of EMF of a cell, Nernst equation and its importance, thermodynamics of a reversible cell, ΔG, ΔT and ΔS form of EMF data. Gain the insight of calculation of equilibrium constant and pH determination.
4	Learn about the electrolytes, ionization, Salt hydrolysis, Buffer solution, solubility and Solubility Product.
5	Understand the preparation of Amino acids, Strecker synthesis, Zwitter ion, isoelectric point, Reactions of amino acids, Structure of proteins and synthesis of simple peptides using Merrifield solid – phase synthesis.
6	Learn about the classification and general properties of carbohydrates, open and cyclic structure of glucose & fructose, Configuration of monosaccharides. Understand the structure of disaccharides and polysaccharides.

Year: Second	**B.Sc. Diploma (Lifescience/Chemical Science)**	Semester: III
BBS6301T	**Animal Diversity-II**	**4-0-0-4**

Course Outcome: After completion of the course students will be able to:

1	Define the characteristics of chordate animals and their classification, including the major phyla and classes. Identify the different types of chordate body systems and their functions.
2	Describe the life cycles and developmental stages of chordate animals, including their reproductive strategies.
3	Use taxonomic keys to identify chordate specimens and apply knowledge of chordate anatomy and physiology to understand their behavior and ecology.
4	Analyze the adaptations of chordate animals to different environments, including their morphological, physiological, and behavioral specializations.
5	Develop a conservation plan for a threatened or endangered chordate species, including the identification of conservation priorities and the development of a management strategy.
6	Evaluate the importance of chordate animals in ecosystems and their impact on human society, including their role in food chains, nutrient cycling, and ecosystem services.

Year: Second	**B.Sc. Diploma (Lifescience/Chemical Science)**	Semester: III
BBS6302T	**Biochemistry**	**4-0-0-4**

Course Outcome: After completion of the course students will be able to:

1	Remember the structures and functions of carbohydrates, proteins, lipids, nucleic acids and their enzymes
2	Understand the fundamental concepts of biochemistry.
3	Understand the basic of enzymology and its emphasize on applications where in regulation of enzymatic activity.
4	Analyze that the energy is required by and transformed in biochemical systems as governed by the laws of thermodynamics
5	Apply the concepts of biochemistry to understand the chemical relationships, as well as molecular interactions of biological systems
6	Able to understand the structures of carbohydrates, lipids, nucleic acids and lipids and their functions.

Year: Second	**B.Sc. Diploma (Lifescience/Chemistry)**	Semester: III
BCH6301P	**Chemistry Practical –III**	**0-0-2-1**

Course Outcome: After completion of the course students will be able to:

1	Learn about the basics of Physical chemistry, Study of Equilibrium, Phase Diagram of binary system, determination of critical solution temperature & composition of the phenol water system.
2	Learn about the Conductance, Determination of cell constant, Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid and perform the potentiometric titrations.
3	Understand the basics of Organic Chemistry Systematic Qualitative organic analysis of organic binary mixtures.
4	Gain the insight of Separation of amino acids by paper chromatography, Determination of concentration of glycine solution by formulation method, Titration curve of glycine.
5	Understand the basics of conductometric titrations.
6	Learn about the Surface tension measurement liquid or a dilute solution using a stalagmometer, Viscosity measurement liquid or dilute solution using an Ostwald's viscometer.

Year: Second	**B.Sc. Diploma (Lifescience/Chemical Science)**	Semester: III
BBS6301P	**Animal Diversity Laboratory-II**	**0-0-2-1**

Course Outcome: After completion of the course students will be able to:

1	Identify and name the major chordate phyla and classes. Recall the basic anatomy of representative chordate species. Describe the external and internal morphology of chordate animals.
2	Explain the differences in body structure among chordate groups. Describe the life cycles and developmental stages of various chordate animals.
3	Use taxonomic keys to identify chordate specimens. Apply knowledge of chordate anatomy to understand their behavior and ecology.
4	Analyze the adaptations of chordate animals to different environments. Evaluate the impact of human activities on chordate populations and ecosystems.
5	Develop a conservation plan for a threatened or endangered chordate species.
6	Evaluate the importance of chordate animals in ecosystems and their impact on human society. Assess the effectiveness of conservation efforts for chordate species.

Year: Second	**B.Sc. Diploma (Lifescience/Chemical Science)**	Semester: III
BBS6302P	**Biochemistry Laboratory**	**0-0-2-1**

Course Outcome: After completion of the course students will be able to:

1	Remember the basic concepts of biochemical reactions and structures of biomolecules.
2	Understand the principle behind the biochemical reactions and learn about the basic biochemistry techniques.
3	Compare the qualitative and quantitative tests for lipids, carbohydrates and proteins.
4	Analyze the effect of pH and temp on salivary amylase.
5	Apply the various bio-analytical tools to determine the concentration of biomolecules in various samples.
6	Apply the chromatography technique to separate the amino acids.

Year: Second	**B.Sc. Diploma (Lifescience/Chemical Science)**	Semester: IV
BCH6401T	**Chemistry-II**	**4-0-0-4**
Course Outcome: After completion of the course students will be able to:		
1	Students will understand properties of transition elements (3d & 4d series), their properties, various theories such as VBT, crystal field theory, IUPAC nomenclature of transition metal complexes.	
2	Students will understand the VBT, IUPAC nomenclature of transition metal complexes.	
3	Students will learn metal ligand bonding, crystal field theory, factors affecting it, Jahn-Teller distortion, CFSE for Octahedral, Tetrahedral, weak and strong field ligands.	
4	Students will learn to determine CFSE for Octahedral & Tetrahedral complexes (both weak and strong field ligands).	
5	Students will learn the kinetic theory of gases, its derivation, various gas laws, Vander walls equation, isotherms of CO2, Maxwell Boltzmann relations, and liquefaction of gases.	
6	Students will learn chemical kinetics, factors affecting the reaction rate, derivation and order of reactions, collision theory, half-life of a reaction, activation energy, theories of reaction rates etc.	

Year: Second	**B.Sc. Diploma (Lifescience/Chemical Science)**	Semester: IV
BBS6401T	**Developmental Biology**	**4-0-0-4**

Course Outcome: After completion of the course students will be able to:

1	Define the key terms and concepts in developmental biology, including embryogenesis, morphogenesis, and pattern formation. Identify the major stages of embryonic development in animals and plants.
2	Explain the differences between embryonic development in animals and plants.
3	Compare the developmental biology of different animal and plant groups, including their embryonic development, larval stages, and adult morphology.
4	Analyze the mechanisms of developmental biology in plants and animals.
5	Develop a model of developmental biology to explain the mechanisms of pattern formation and morphogenesis.
6	Evaluate the importance of developmental biology in understanding human disease and developmental disorders.

Year: Second	**B.Sc. Diploma (Lifescience/Chemical Science)**	Semester: IV
BBS6402T	**Plant Physiology**	**4-0-0-4**
Course Outcome: After completion of the course students will be able to:		
1	Understand the importance and scope of plant physiology and understand the role of light, temperature and growth hormone on plant growth and development.	
2	Know the requirements of mineral nutrition for plant growth and acquire knowledge of various physiological processes that occur in plants	
3	Understand plant nutrient uptake and translocation, photosynthesis, respiration, and nitrogen metabolism	
4	Understand enzyme nomenclature, properties, classification, mode of action and kinetics, with an emphasis on how enzymes control all cellular metabolic pathways.	
5	Know the structure, function, classification, biosynthesis and degradation of major cellular compounds.	
6	Understand the interactions involving light during photosynthesis, and the role of ATP and NADPH in CO2 fixation.	

Year: Second	**B.Sc. Diploma (Lifescience/Chemical Science)**	Semester:IV
BCH6401P	**Chemistry Practical – IV**	**0-0-2-1**
Objective	This course aims at acquainting the students with the knowledge of systematic qualitative analysis of inorganic salts.	

Course Outcome: After completion of the course students will be able to:

1	Understand the use of stalagmo meter for surface tension measurement
2	Study the hydrolysis of methyl acetate using acid
3	Study the Saponification of ethyl acetate.
4	Understand the importance of total hardness of water
5	Study of complex metric titrations using EDTA salt
6	Study of qualitative analysis of Inorganic binary salts mixture.

Year: Second	**B.Sc. Diploma (Lifescience/Chemical Science)**	Semester: IV
BBS6401P	**Developmental Biology Laboratory**	**0-0-2-1**

Course Outcome: After completion of the course students will be able to:

1	Explain the concept of developmental plasticity and its significance in animal and plant development.
2	Design and conduct simple experiments to investigate developmental processes in animals and plants.
3	Evaluate the strengths and limitations of different model organisms in studying developmental biology.
4	Develop a model or diagram to illustrate a developmental process or pathway.
5	Evaluate the effectiveness of different experimental approaches and techniques in studying developmental processes.
6	Justify the importance of developmental biology for addressing real-world problems in agriculture, medicine, and conservation.

Year: Second	**B.Sc. Diploma (Lifescience/Chemical Science)**	Semester: IV
BBS6402P	**Plant Physiology Laboratory**	**0-0-2-1**

Course Outcome: After completion of the course students will be able to:

1	Understand the structure and morphology of various tissues and components of blood.
2	Understand the Histology of various organs-prepared slides.
3	Understand the importance of plant hormone on growth of plant.
4	Understand the process and importance phenomenon of Photosynthesis, respiration etc.
5	Understand the transpiration process and the factors affecting it.
6	Understand the importance of pH in Enzyme activity.

Year: Third	**B.Sc. Degree (Lifescience/Chemical Science)**	Semester: V
BCH7501T	**Advanced Chemistry-I**	**4-0-0-4**

Course Outcome: After completion of the course students will be able to:

1	To understand the concept of Bronsted-Lowry, Arrhenius and Lux-Flood of acids & bases. Acid-Base theory of Hardness and Softness. Acid-base properties in non-aqueous media.
2	To understand the principles and methods of extraction – concentration, oxidation, reduction, electrolytic method and refining.
3	To understand the Ellingham diagrams for reduction of metal oxides using carbon and carbon monoxide as reducing agent and Methods of purification of metals.
4	To understand the Occurrence and uses, rationalization of inertness of noble gases and noble gas compounds.
5	To understand the compounds of s & p block elements with emphasis on structure, bonding, preparation, properties and uses.
6	Understand the Acids and Bases, General Principles of Metallurgy, Noble Gases

Year: Third	**B.Sc. Degree (Lifescience/Chemical Science)**	Semester: V
BBS7501T	**Immunology**	**4-0-0-4**

Course Outcome: After completion of the course students will be able to:

1	Define the key terms and concepts in immunology, including the immune system, immune responses, and immunological disorders. Identify the major components of the immune system, including cells, tissues, and organs. Recall the basic principles of immune responses, including innate and adaptive immunity.
2	Explain the mechanisms of immune responses, including the role of immune cells, cytokines, and antibodies.
3	Apply the principles of immunology to understand the applications of immunology in biotechnology, medicine, and agriculture.
4	Analyze the role of immunology in understanding the development of immunological disorders, including autoimmune diseases and immunodeficiency diseases.
5	Develop a model of the immune system, including the interactions between immune cells, cytokines, and antibodies.
6	Evaluate the importance of immunology in understanding human diseases.

Year: Third	**B.Sc. Degree (Lifescience/Chemical Science)**	Semester: V
BBS7502T	**Plant Ecology & Taxonomy**	**4-0-0-4**
Course Outcome: After completion of the course students will be able to:		
1	Describe the components of the ecosystem, and understand various interactions in the food chain and the food web.	
2	Elaborate the role of ecological adaptations in hydrophytes, xerophytes and halophytes.	
3	Know the various terms required to technically describe the plant, the use of specific characters in identifying families.	
4	Recall the basis of classification in the artificial, natural and phylogenetic classification systems of angiosperms.	
5	Grasp the basis of the Bentham and Hooker's system of classification, and the knowledge of families leguminosae, asteraceae and amaryllidaceae.	
6	Use literature available on BSI website and in IUCN-red data book, and understand the methods of plant conservation, stressing their role in preservation of biodiversity.	

Year: Third	**B.Sc. Degree (Lifescience/Chemical Science)**	Semester: V
BCH7501P	**Chemistry Practical-V**	**0-0-2-1**

Course Outcome: After completion of the course students will be able to:

1	Learn about the Systematic separation and identification of tertiary organic mixture.
2	Understand the Separation Techniques and different chromatographic Techniques
3	Learn to determine the pH of the given aerated drinks fruit juices, shampoos and soaps and soil.
4	Understand the synthesis of organic compounds.
5	Learn about the Recrystallisation, determination of melting point and calculation of quantitative yields.
6	Understand the preparation of different chemical and solvents.

Year: Third	**B.Sc. Degree (Lifescience/Chemical Science)**	Semester: V
BBS7501P	**Immunology Laboratory**	**0-0-2-1**

Course Outcome: After completion of the course students will be able to:

1	Identify the major components of the immune system, including cells, tissues, and organs. Describe the structure and function of antibodies and their role in immune responses.
2	Explain the mechanisms of immune cell activation, proliferation, and differentiation. Compare and contrast the different types of immune responses, including humoral and cell-mediated immunity.
3	Design and conduct simple immunological experiments and apply knowledge of immunology to understand the mechanisms of immune-related diseases.
4	Evaluate the strengths and limitations of different immunological techniques. Compare and contrast the different types of immune responses in various disease states.
5	Develop a model or diagram to illustrate the mechanisms of immune responses and create a presentation or poster to communicate the results of an immunological experiment
6	Integrate knowledge from immunology with other fields to address complex biological questions.

Year: Third	**B.Sc. Degree (Lifescience/Chemical Science)**	Semester: V
BBS7502P	**Ecology & Taxonomy Laboratory**	**0-0-2-1**

Course Outcome: After completion of the course students will be able to:

1	Understand the basic structure and functionality of an ecosystem along with rules applicable to it.
2	Understand the ecosystem at population level, development of species, mutation.
3	Compare plants on the basis of morphological characters and taxonomic evidences
4	To categorize plants in classification system and provide an nomenclature
5	Describe the problems related to critical assessment of numerical taxonomy
6	Apply the knowledge of taxonomy in the field

Year: Third	**B.Sc. Degree (Lifescience/Chemical Science)**	Semester: V
BCH7502T	**Analytical Methods in Chemistry**	**2-0-0-2**

Course Outcome: After completion of the course students will be able to:

1	Gain the deep insight of the Qualitative and quantitative aspects of analysis.
2	Learn about the UV-Visible Spectrometry.
3	Understand the basics of Thermal methods.
4	Understand the basics of Electro analytical methods.
5	Learn about the Solvent extraction.
6	Understand the importance of and Qualitative and quantitative aspects of chromatographic methods.

Year: Third	**B.Sc. Degree (Lifescience/Chemical Science)**	Semester: V
BBS7503T	**Ethology**	**2-0-0-2**

Course Outcome: After completion of the course students will be able to:

1	Define the key terms and concepts in ethology, including behavior, instinct, learning, and social behavior. Identify the major types of behavior, including feeding, mating, and social behavior.
2	Explain the differences between instinctive and learned behavior, including the role of genetics and environment.
3	Explain the differences between instinctive and learned behavior, including the role of genetics and environment.
4	Compare the behavior of different species, including their adaptations to different environments.
5	Develop a model of animal behavior, including the interactions between animals and their environment.
6	Evaluate the importance of ethology in understanding animal welfare, conservation, and management.

Year: Third	**B.Sc. Degree (Lifescience/Chemistry)**	Semester: V
BBS7504T	**Economic Botany**	**2-0-0-2**

Course Outcome: After completion of the course students will be able to:

1	Explore the concept of centers of origin and their importance
2	Select cereals like wheat, maize and Legumes like gram and soyabean through family and botanical name; and identify the parts used.
3	Select Spices Ginger, Turmeric, Piper through family and botanical name; and identify the parts used.
4	Select timber-, oil- and dye-yielding plants like Castor, and Groundnut through family and botanical name; and identify the parts used.
5	Select timber-, oil- and dye-yielding plants, tea, coffee through family and botanical name; and identify the parts used.
6	Understand the origin of important plant species.

Year: Third	**B.Sc. Degree (Lifescience/Chemical Science)**	Semester:VI
BCH7601T	**Advanced Chemistry-II**	**4-0-0-4**

Course Outcome: After completion of the course students will be able to:

1	Understand the electrophilic and nucleophilic substitution reaction in polynuclear hydrocarbon.
2	Know the synthesis, properties and chemical reactions of five & six membered heterocyclic compounds.
3	Understand the electrophilic and nucleophilic substitution reaction in polynuclear hydrocarbon. Learn the important Active methylene compounds.
4	Learn about application of visible, ultraviolet (UV) spectroscopy.
5	Learn about application of Infra-Red (IR) and NMR spectroscopy.
6	Understand the spectroscopic techniques for structure determination of organic compounds.

Year: Third	**B.Sc. Degree (Lifescience/Chemical Science)**	Semester: VI
BBS7601T	**Mammalian Physiology**	**4-0-0-4**
Course Outcome: After completion of the course students will be able to:		
1	Define the key terms and concepts in mammalian physiology, including the structure and function of different organ systems.	
2	Explain the mechanisms of physiological processes, including the regulation of body temperature, blood pressure, and electrolyte balance.	
3	Analyze the role of mammalian physiology in understanding the interactions between the environment and human health.	
4	Analyze the mechanisms of physiological responses to different stimuli.	
5	Develop a model of physiological responses to different stimuli.	
6	Evaluate the importance of mammalian physiology in understanding human health and disease.	

Year: Third	**B.Sc. Degree (Lifescience/Chemical Science)**	Semester: VI
BBS7602T	**Molecular Biology**	**4-0-0-4**

Course Outcome: After completion of the course students will be able to:

1	Remember the concept of molecular basis of life by knowing the structure and properties of DNA and its organization in the cell
2	Understand the nature of DNA replication in prokaryotes and eukaryotes and the maintenance of fidelity in the process
3	Apply the knowledge about mechanism of physical and chemical mutagens, and the method of mutation detection
4	Analyze the Ames test results for understanding the mechanism of DNA repair
5	Evaluate the process of transcription in prokaryotes and eukaryotes and splicing process
6	Create the knowledge for understanding mechanism of polypeptide synthesis and concept of gene regulation

Year: Third	**B.Sc. Degree (Lifescience/Chemical Science)**	Semester: VI
BCH7601P	**Chemistry Practical-VI**	**0-0-2-1**
Course Outcome: After completion of the course students will be able to:		
1	Learn the separation of mixtures by chromatography Techniques.	
2	Understand separation of Fe^{+3}, Al^{+3}.	
3	Understand separation of Cr^{+3} or Ni^{+2}, Co^{+2}, Mn^{+2} and Zn+2 by paper chromatography.	
4	Learn the preparation of metal complexes and measurement of their conductivity; compare the conductance of different metal complex in different concentrations.	
5	Know the systematic qualitative inorganic salt (tertiary mixture) analysis.	
6	Understand the conductance of the complexes.	

Year: Third	**B.Sc. Degree (Lifescience/Chemical Science)**	Semester: VI
BBS7601P	**Mammalian Physiology Laboratory**	**0-0-2-1**

Course Outcome:

1	Recall the basic principles of physiological regulation, including the role of feedback mechanisms and homeostasis. Define key terms and concepts in mammalian physiology, including homeostasis, feedback mechanisms, and physiological regulation.
2	Explain the mechanisms of physiological regulation, including the role of feedback mechanisms and homeostasis.
3	Apply the principles of physiological regulation to understand the mechanisms of human disease, including cardiovascular disease, diabetes, and neurological disorders.
4	Analyze the role of the nervous and endocrine systems in regulating physiological processes, including the regulation of body temperature, blood pressure, and electrolyte balance.
5	Develop a model of physiological regulation, including the role of feedback mechanisms and homeostasis.
6	Assess the importance of mammalian physiology in understanding human health and disease.

Year: Third	**B.Sc. Degree (Lifescience/Chemical Science)**	Semester: VI
BBS7602P	**Molecular Biology Laboratory**	**0-0-2-1**

Course Outcome: After completion of the course students will be able to:

1	Understand the working of various instruments to be used during the molecular biology expects.
2	Create various buffers used in the molecular biology laboratory.
3	Remember the preparation of various stock solutions used in the molecular biology laboratory.
4	Apply the knowledge for plasmid DNA preparation.
5	Evaluate banding pattern of electrophoresis plasmid DNA from overnight grown culture of *E. coli*.
6	Analyze the quality and quantity of isolated DNA sample using nano drop spectrophotometer.

Year: Third	**B.Sc. Degree (Lifescience/Chemical Science)**	Semester: VI
BCH7602T	**Green Methods in Chemistry**	**2-0-0-2**

Course Outcome: After completion of the course students will be able to:

1	Gain deep insight of twelve principles of green chemistry.
2	Understand the Surfactants for carbon dioxide.
3	Gain the deep insight of Designing of environmentally safe marine antifoulant.
4	Learn about the Preparation and characterization of biodiesel from vegetable oil.
5	Understand the basic concept of green catalyst.
6	Learn the concept of green chemistry to reduce environmental toxicity.

Year: Third	**B.Sc. Degree (Lifescience/Chemical Science)**	Semester: VI
BBS7603T	**Evolution**	**2-0-0-2**
Course Outcome: After completion of the course students will be able to:		
1	Explain the mechanisms of evolution, including natural selection, genetic drift, and speciation.	
2	Use knowledge of evolution to understand the characteristics of organisms, including their morphology, physiology, and behavior.	
3	Analyze the role of evolution in shaping the characteristics of organisms, including their morphology, physiology, and behavior.	
4	Develop a model of evolutionary change, including the mechanisms and processes involved.	
5	Assess the evidence for evolution, including fossil records, comparative anatomy, and molecular biology.	
6	Evaluate the importance of evolution in understanding the natural world and human society.	

Year: Third	**B.Sc. Degree (Lifescience/Chemical Science)**	Semester: VI
BBS7604T	**Plant Breeding**	**2-0-0-2**

Course Outcome: After complication of the course students will be able to:

1	Learn breeding procedures in self and cross pollinated crops
2	Understand exploitation of heterosis utilizing male sterility and other methods
3	Know about the various population improvement programmers
4	Understand about hybrid breeding.
5	Remember the study of mutation, polyploidy and wide hybridization and their role in crop improvement
6	Understand the importance of breeding

Year: Four	**B.Sc. Honours (Lifescience/Chemical Science/Physics/Mathematics)**	Semester: VII
BRM8701T	**Research Methodology**	**4-0-0-4**

Course Outcome: After complication of the course students will be able to:

1	Gain knowledge of different types of research designs, including experimental, quasi-experimental, and non-experimental designs and recall the basic principles of research ethics.
2	Explain the principles of research design, including the selection of participants, measurement instruments, and data collection procedures.
3	Use knowledge of research methodology to design a research study, including the selection of participants, measurement instruments, and data collection procedures and a pply the principles of research ethics to ensure the integrity and validity of research findings.
4	Analyze the role of research methodology in advancing knowledge and solving real-world problems.
5	Develop a research proposal, including the selection of participants, measurement instruments, and data collection procedures.
6	Assess the strengths and limitations of different research methods, including qualitative and quantitative methods.

Year: Four	**B.Sc. Honours (Lifescience/Chemical Science/Physics/Mathematics)**	Semester: VII
BSM8701S	**Seminar**	**0-0-4-2**
Course Outcome: After complication of the course students will be able to:		
1	Widen the scope of knowledge of each graduate student by requiring participation in seminars related to and different from their specialization	
2	Able to identify and compare technical and practical issues related to the area of course specialization	

Year: Four	**B.Sc. Honours (Lifescience/Chemical Science/Physics/Mathematics)**	Semester: VII
BDS8701D	**Dissertation (Research Plan)**	**0-0-12-6**
Course Outcome: After complication of the course students will be able to:		
1	To develop the research problem and outline the elements of a research proposal.	
2	To gather, form, and critique knowledge from research studies and interpret the research material	

Year: Four	**B.Sc. Honours (Lifescience)**	Semester: VII
BBS8701T	**Tools & Techniques**	**3-0-0-3**

Course Outcome: After complication of the course students will be able to:

1	Define the key terms and concepts related to tools and techniques in biology, including microscopy, spectroscopy, chromatography, and molecular biology techniques.
2	Describe the applications of spectroscopy, including infrared spectroscopy, nuclear magnetic resonance spectroscopy, and mass spectrometry.
3	Use knowledge of tools and techniques to design and conduct experiments, including the selection of appropriate methods and materials.
4	Compare and contrast the different types of tools and techniques used in biology, including their advantages and limitations.
5	Create a presentation to communicate the results of a research project to a general audience.
6	Evaluate the importance of tools and techniques in biology, including their impact on research and industry.

Year: Four	**B.Sc. Honours (Lifescience)**	Semester:VII
BBS8702T	**Stress Biology**	**3-0-0-3**

Course Outcome: After complication of the course students will be able to:

1	Define the key terms and concepts in stress biology, and identify the different types of stress.
2	Acquire advanced knowledge about environmental stresses.
3	Explain the physiological, cellular, and molecular mechanisms that occur in response to stress in animals and plants.
4	Analyze the effects of stress on the body of animals and plants.
5	Analyze the relationship between stress and disease in animals and plants.
6	Evaluate the importance of stress management in maintaining health and well-being in animals and plants.

Year: Four	**B.Sc. Honours (Lifescience)**	Semester: VII
BBS8701P	**Tools & Techniques Laboratory**	**0-0-2-1**
Course Outcome: After complication of the course students will be able to:		
1	Define the key terms and concepts related to tools and techniques in biology, including microscopy, spectroscopy, chromatography, and molecular biology techniques.	
2	Compare and contrast the different types of chromatography, including gas chromatography, liquid chromatography, and paper chromatography.	
3	Use knowledge of tools and techniques to design and conduct experiments, including the selection of appropriate methods and materials.	
4	Compare and contrast the different types of tools and techniques used in biology, including their advantages and limitations.	
5	Design a research project that incorporates multiple tools and techniques, including the selection of appropriate methods and materials.	
6	Evaluate the importance of tools and techniques in biology, including their impact on research and industry.	

Year: Four	**B.Sc. Honours (Lifescience)**	Semester: VII
BBS8702P	**Stress Physiology Laboratory**	**0-0-2-1**
Course Outcome: After complication of the course students will be able to:		
1	Recall the definition of stress and its types (physical, chemical, biological). Identify the major stress response pathways in plants and animals. List the common stress biomarkers and their significance.	
2	Explain the concept of homeostasis and its relationship to stress. Describe the effects of stress on cellular and molecular processes.	
3	Apply knowledge of stress biology to predict the effects of environmental stressors on plants and nematodes.	
4	Compare and contrast the stress response pathways in plants and nematodes.	
5	Assess the effectiveness of different stress management strategies in plants and nematodes.	
6	Design and conduct an experiment to investigate the effects of stress on a complex biological system and develop a stress management plan for a specific crop or animal species.	

Year: Four	**B.Sc. Honours (Lifescience)**	Semester: VII
BBS8703T	**Metabolomics**	**3-0-0-3**

Course Outcome: After completion of the course students will be able to:

1	Recall the definition of metabolomics and its importance in understanding biological systems.
2	Explain the concept of metabolic pathways and their regulation.
3	Apply metabolomics techniques to analyze metabolic changes in response to various stimuli, including genetic, environmental, and pharmacological factors.
4	Compare and contrast the strengths and limitations of different metabolomics approaches.
5	Assess the effectiveness of metabolomics in addressing real-world problems.
6	Design and conduct an experiment to investigate metabolic changes in response to a novel stimulus or condition.

Year: Four	**B.Sc. Honours (Lifescience)**	Semester: VII
BBS8704T	**Plant Microbe Interaction**	**3-0-0-3**

Course Outcome: After completion of the course students will be able to:

1	Identify the major types of plant-microbe interactions, including symbiotic, pathogenic, and commensal interactions.
2	Describe the role of plant-microbe interactions in plant disease development, including the mechanisms of pathogen infection and plant defense responses.
3	Apply knowledge of plant-microbe interactions to develop sustainable agricultural practices, including the use of beneficial microorganisms as biofertilizers and biopesticides.
4	Compare and contrast the different types of plant-microbe interactions, including symbiotic, pathogenic, and commensal interactions.
5	Assess the importance of plant-microbe interactions in agricultural ecosystems, including their impact on soil health, nutrient cycling, and ecosystem services.
6	Design and conduct an experiment to investigate plant-microbe interactions.

Year: Four	**B.Sc. Honours (Lifescience)**	Semester: VIII
BBS8801T	**General Microbiology**	**4-0-0-4**

Course Outcome: After completion of the course students will be able to:

1	Recall the definition of microbiology and its importance in understanding the natural world. Identify the major types of microorganisms, including bacteria, viruses, fungi, and protozoa.
2	Understand and apply knowledge of the basics of the classification of various microorganisms in the earlier and current eras.
3	Design a simple experiment to investigate microbial growth and metabolism, using a range of laboratory equipment and analytical tools.
4	Compare and contrast the different types of microorganisms, including their characteristics, habitats, and roles in ecosystems.
5	Evaluate the potential applications of microbiology in various fields, including medicine, agriculture, and environmental science.
6	Design and conduct an experiment to investigate a novel aspect of microbiology

Year: Four	**B.Sc. Honours (Lifescience)**	Semester: VIII
BBS8802T	**Bioinformatics**	**4-0-0-4**

Course Outcome: After completion of the course students will be able to:

1	Recall the definition of bioinformatics and its importance in understanding biological systems. Identify the major types of biological data, including genomic, transcriptomic, and proteomic data.
2	Explain the principles of sequence alignment and phylogenetic analysis.
3	Apply bioinformatics tools and techniques to analyze and interpret biological data, including genomic, transcriptomic, and proteomic data.
4	Analyze the role of bioinformatics in understanding complex biological systems, including gene regulation, signal transduction, and metabolic pathways.
5	Assess the effectiveness of different bioinformatics tools and techniques, including their strengths and limitations.
6	Design and conduct an experiment to investigate a novel biological interaction, including the use of bioinformatics tools and techniques.

Year: Four	**B.Sc. Honours (Lifescience)**	Semester: VIII
BBS8803T	**Genomics and Proteomics**	**4-0-0-4**

Course Outcome: After completion of the course students will be able to:

1	Define and explain key concepts in genomics and proteomics, including DNA sequencing, gene expression, and protein structure and function.
2	Describe and illustrate the relationships between genomic and proteomic data, and how they are used to understand biological systems.
3	Apply bioinformatics tools to analyze genomic and proteomic data, and interpret the results in the context of biological systems.
4	Analyze and interpret genomic and proteomic data to identify patterns, trends, and correlations, and evaluate the significance of the results.
5	Design and propose experiments to investigate biological questions using genomics and proteomics approaches.
6	Communicate effectively the results of genomics and proteomics analyses, and the implications of these results for biological research and applications.

Year: Four	**B.Sc. Honours (Lifescience)**	Semester: VIII
BBS8801P	**Microbiology Laboratory**	**0-0-2-1**
Course Outcome: After completion of the course students will be able to:		
1	Identify and describe the morphology and physiology of microorganisms, including bacteria, viruses, nematodes and fungi.	
2	Explain the principles of microbial growth, metabolism, and genetics, and how these principles relate to microbial ecology and pathogenesis.	
3	Isolate and identify microorganisms using various techniques, including culturing, staining, and biochemical testing.	
4	Design and propose experiments to investigate microbiological questions, including the development of new methods for microbial isolation and identification.	
5	Critically evaluate the results of microbiological experiments, including the assessment of experimental design, data analysis, and conclusions.	
6	Communicate effectively the results of microbiological experiments, including the use of scientific writing and presentation skills.	

Year: Fourth	**B.Sc. Honours (Lifescience)**	Semester: VIII
BBS8802P	**Bioinformatics Laboratory**	**0-0-2-1**

Course Outcome: After completion of the course students will be able to:	
1	Understand the fundamental principles of bioinformatics, including data structures, algorithms, and software tools.
2	Explain the relationships between bioinformatics tools and techniques, and how they are used to analyze biological data.
3	Apply bioinformatics tools and techniques to analyze biological data, including genomic, proteomic, and transcriptomic data.
4	Analyze and interpret biological data using bioinformatics tools and techniques, and draw conclusions about biological systems.
5	Design and propose experiments to investigate biological questions using bioinformatics tools and techniques.
6	Critically evaluate the results of bioinformatics analyses, including the assessment of data quality, algorithmic accuracy, and conclusions drawn.

Year: Four	**B.Sc. Honours (Lifescience)**	Semester: VIII
BBS8804T	**Toxicology**	**3-0-0-3**

Course Outcome: After completion of the course students will be able to:

1	Understand the fundamental principles of toxicology, including the mechanisms of toxicity.
2	Explain the relationships between toxic substances, exposure routes, and adverse health effects.
3	Apply toxicological principles to evaluate the risks and hazards associated with exposure to toxic substances.
4	Analyze and interpret data from toxicological studies to draw conclusions about the potential health effects of toxic substances.
5	Design and propose experiments to investigate the toxicological effects of substances and to develop strategies for preventing and mitigating toxic effects..
6	Critically evaluate the results of toxicological studies and the effectiveness of strategies for preventing and mitigating toxic effects.

Year: Four	**B.Sc. Honours (Lifescience)**	Semester: VIII
BBS8805T	**Biodegradation & Bioremediation**	**3-0-0-3**
Course Outcome: After completion of the course students will be able to:		
1	Understand the fundamental principles of biodegradation and bioremediation, including the biological processes involved in the degradation of pollutants.	
2	Explain the relationships between biodegradation, bioremediation, and environmental pollution.	
3	Apply biodegradation and bioremediation principles to evaluate the potential for bioremediation of contaminated sites.	
4	Analyze and interpret data from biodegradation and bioremediation studies to draw conclusions about the effectiveness of bioremediation technologies.	
5	Design and propose bioremediation strategies for contaminated sites, including the selection of appropriate bioremediation technologies and the development of monitoring plans.	
6	Critically evaluate the effectiveness of bioremediation technologies and the potential risks and benefits associated with their use.	

Year: Four	**B.Sc. Honours (Lifescience/Chemical Science/Physics/Mathematics)**	Semester: VIII
BDS8801D	**Dissertation (Research Report)**	**0-0-12-6**
Course Outcome: After complication of the course students will be able to:		
1	To produce a thesis of publishable quality and demonstrate proficiency in the field.	
2	To effectively present and defend the research orally.	
3	To publish research data in quality journals.	

Year: Four	**B.Sc. Honours (Chemical Science)**	Semester: VII
BCH8701T	**Advanced Organic Chemistry-I**	**3-0-0-3**
Course Outcome: After completion of the course students will be able to:		
1	Learn the stereochemistry of organic compounds in detail.	
2	Understand the name reaction mechanism and their applications.	
3	Understand the several rearrangements such as Beckmann, Benzil-benzilic acid, Favorskii, Stevensen, Sommelet – Hauser rearrangement, and Vilsmayer- Heck reaction, Mitsonubu reaction, Suzuki reaction and different condensation reactions.	
4	Learn Elimination (E_1, E_2 and E_{1CB}) and Addition reaction (nucleophilic and electrophilic), Hoffmann and Saytzef elimination, Bredt's rule, Pyrolytic elimination – Cope and Chugaev elimination, ozonolysis.	
5	Understand the aromatic electrophilic substitution reactions such as Fridel craft reaction, nitration, sulphonation, halogenation, orientation in benzene ring with more than one substituent. Benzyne mechanism for aromatic nucleophilic substitution reaction.	
6	Understand the aromatic nucleophilic substitution reactions, orientation in benzene ring with more than one substituent and Benzyne mechanism for aromatic nucleophilic substitution reaction.	

Year: Four	**B.Sc. Honours (Chemical Science)**	Semester: VII
BCH8702T	**Advanced Inorganic Chemistry-I**	**3-0-0-3**

Course Outcome: After completion of the course students will be able to:

1	To understand the concept of crystal field theory, Ligand field theory and Molecular orbital theory, tetragonal distortion in octahedral complexes.
2	To find out ground state terms with their energies, microstates, degeneracy and microstate table for different transition metal ions and complexes.
3	To understand the orgel diagram and tanabe sugano diagram, selection rules, interpretation of spectra.
4	To understand the magnetic susceptibility, source of paramagnetism, diamagnetic susceptibility, Pascal constant and constitutive correction, Langevin equation, Van-Vleck formula, anti-ferromagnetism, ferromagnetism and molecular field theory of ferromagnetism.
5	To understand spin orbit coupling, Lande interval rule, quenching of orbital magnetic moment by crystal field,
6	To get the deep insight of spin orbit coupling on A and E terms, spin orbit coupling on T terms, spin pairing: spin pairing in octahedral complexes, Chemistry of Lanthanides and Actinides.

Year: Four	**B.Sc. Honours (Chemical Science)**	Semester: VII
BCH8703T	**Advanced Physical Chemistry-I**	**3-0-0-3**
Course Outcome: After completion of the course students will be able to:		
1	Understand the concept of chemical thermodynamics, laws of thermodynamics, various parameters, fugacity concept, Debye Huckel theory.	
2	Understand various theories of chemical reactions, such as Arrhenius theory, collision theory, transition state theory etc, thermodynamic and chemical kinetics of molecular reactions.	
3	Learn about the electrochemistry, various theories of solutions, various equations, thermodynamics of electrolytic solutions, over potentials, Butler Volmer equation, Tafel plot etc.	
4	Understand surface chemistry, micelle, critical micelle concentration, thermodynamics of micellization, surface films on liquids, capillary action, Laplace equation, Catalytic activity at surface.	
5	Learn about the basic concept of Electrochemistry and its thermodynamics aspects.	
6	Understand the Electro-kinetic phenomenon of Surface Chemistry.	

Year: Four	**B.Sc. Honours (Chemical Science)**	Semester: VII
BCH8704T	**Biophysical Chemistry-I**	**4-0-0-4**

Course Outcome: After completion of the course students will be able to:

1	Understand the concept of chemistry of solutions, drug dissolution, solute solvent interactions, and factors affecting dissolution.
2	Understand viscosity, Newtonian systems, thixotropy, surface and interfacial phenomena, viscoelasticity, surface active agents etc.
3	Learn about the chemistry of buffer solutions its applications in pharmacological systems, pH and solubility of buffer solutions.
4	Understand emulsions and dispersion and its applications in different fields, properties of solutions, micro emulsions, and properties of suspended particles.
5	Learn about the different suspension and Their properties.
6	Understand the Adsorption of liquid interfaces: surface active agents, systems of hydrophile – lipophile classification.

Year: Forth	**B.Sc. Honours (Chemical Science)**	Semester:VII
BCH8801P	**Chemistry Laboratory**	**0-0-4-2**

Course Outcome: After completion of the course students will be able to:

1	Learn and perform named organic reactions and work up of the reaction.
2	Purify the organic compounds by different techniques.
3	Determine the boiling point of unknown samples.
4	Learn to Perform Claisen-Schmidt Reaction, Sandmeyer reaction.
5	Get basic knowledge of organic synthesis.
6	Learn to Perform test for of Phenol/Aniline

Year: Four	**B.Sc. Honours (Chemical Science)**	Semester: VIII
BCH8801T	**Organic Spectroscopy**	**2-0-0-2**

Course Outcome: After completion of the course students will be able to:

1	Understand the basic principles of IR spectroscopy and their applications in characterization of functional groups of organic molecules.
2	Fundamental knowledge of NMR spectroscopic techniques and their applications for structure elucidation of newly synthesized organic compound.
3	Basic principles of Mass spectrometry and its application for analysis of organic molecules and compounds.
4	Fundamental principles of Green Chemistry and will be able apply the knowledge of Green Chemistry in the synthesis of compounds.
5	Understand the basic principles of UV spectroscopy and their applications in characterization of functional groups of organic molecules.
6	Understand the different type of spectroscopy and use it collectively for the structure determination.

Year: Forth	**B.Sc. Honours (Chemical Science)**	Semester:VIII
BCH8802T	**Advanced Organic Chemistry-II**	**4-0-0-4**

Course Outcome: After completion of the course students will be able to:

1	To provide basic principles of stereochemistry and familiarize with the concepts of stereochemistry for their applications in organic molecules and compounds.
2	To familiarize basic principles of the structure and reactivity relationship and apply the fundamental knowledge of structure of organic molecules to determine its influences on reactivity of their reactions.
3	To enhance the knowledge of general organic reactions and familiarize with their reaction mechanisms. Apply the basic concepts of various reaction mechanisms in the synthesis of organic molecules and compounds.
4	Understand the reduction via different reagents and their mechanism.
5	Understand the oxidation via different reagents and their mechanism.
6	Understand the Some Miscellaneous Reagents in Organic Synthesis.

Year: Four	**B.Sc. Honours (Chemical Science)**	Semester: VIII
BCH8803T	**Advanced Inorganic Chemistry-II**	**3-0-0-3**

Course Outcome: After completion of the course students will be able to:

1	Students will learn Quantum chemistry, and its applications such as particle in a one dimensional and three-dimensional box, degeneracy, quantum mechanical tunneling motion of particle, wave nature.
2	Students will also learn various topics such as rotational, translational motion and hydrogen like atoms.
3	Students will learn perturbation theory and variation theory, various operators, terms symbols, wave functions. Many- electron atoms and angular momenta etc.
4	Students will understand theory of Born Oppenheimer approximations, chemical bonding of H_2 molecules, MO, LACO treatment of diatomic molecules, VBT theories
5	Students will understand the Commutation relations, Translational motion of a part Free particle.
6	Students will understand the The hydrogen like atoms, Approximation methods

Year: Four	**B.Sc. Honours (Chemical Science)**	Semester: VIII
BCH8804T	**Advanced Physical Chemistry-II**	**4-0-0-4**

Course Outcome: After completion of the course students will be able to:

1	The students will understand chemical kinetics, various types of chemical reactions their mechanisms.
2	Students will understand various theories of chemical reactions, such as Arrhenius theory, collision theory, transition state theory etc
3	Students will learn group theory, symmetry elements, great orthogonality theorem, reducible and irreducible representations, and character table.
4	Students will understand chemical applications of group theory, selection rules for electronic transitions, IR and Raman spectra.
5	Learn the thermodynamic and chemical kinetics of molecular reactions.
6	Student will understand the Concepts of symmetry in molecule and symmetry operations, Construction of character tables.

Year: Four	**B.Sc. Honours (Chemical Science)**	Semester: VIII
BCH8805T	**Biophysical Chemistry-II**	**4-0-0-4**

Course Outcome: After completion of the course students will be able to:

1	Understand and apply the principles of thermodynamics to biochemical systems and Analyze chemical equilibria and predict the behaviour of biochemical reactions. Learn to basis of energy transduction in biological systems.
2	Understand the fundamental concepts of reaction kinetic, enzyme kinetics and mechanisms of enzyme catalysis.
3	Students will be able to explain the principles behind different types of electrophoresis and chromatography and apply these techniques in practical scenarios.
4	Analyze and interpret X-ray crystallographic data for protein structure determination and Utilize molecular dynamics and bioinformatics tools for studying biomolecular systems.

Year: Four	**B.Sc (Hons.) in Chemistry**	Semester: VII
BCH8701P	**Chemistry Practical**	**0-0-4-2**

Course Outcome: After completion of the course students will be able to:

1	Understand the Inorganic chemistry practical and synthesis of inorganic metal complexes.
2	Learn the synthesis of double salts.
3	Practically learn the synthesis of anionic metal complexes with various ligands.
4	Practically learn the synthesis of cationic metal complexes with various ligands.
5	learn how to characterize metal complexes by different spectroscopic techniques such as IR, UV-Vis etc.
6	Learn qualitative analysis of inorganic mixtures.

M.Sc. Chemistry Programme

Learning Outcome Based Curriculum Framework

PROGRAMME OUTCOMES (POs)

After successful completion of the program:

PO1 Students will be able to develop experimental and scientific skills for critical thinking and ability to tackle and solve scientific problems.

PO2 Students will be able to explore new areas of research in different fields of Basic and Applied Sciences.

PO3 To develop interdisciplinary approach of the subject.

PO4 Improve the skills to succeed in research and industrial field. Moreover, students will acquire the ability to conduct experiments, operate scientific instruments, research planning, executing and performing in laboratory experiments.

PO5 To use the knowledge to develop technologies which are sustainable and eco-friendly.

PO6 To make them learn logical thinking to address a problem and become result oriented.

PO7 Students will develop communication skills for expressing ideas clearly and effectively.

PO8 To encourage and facilitate innovations, nurture startups and foster entrepreneurship. After completion of programme the students will be encouraged to apply logical reasoning based on the knowledge, skills, designing solutions to assess societal, health, safety issues and the responsibilities that go along with the scientific practice.

PO9 With the pursuit of knowledge for either personal or professional reasons, learners are also encouraged to volunteer and be self-motivated that not only enhances society values, active participation and personality development, but also enhances self-sustainability, competiveness and employability. To sensitize students and employees about their responsibilities to reach out to community for social harmony and environmental protection.

PO10 Students will learn the beginning of research during the exposure gained while persuing dissertation/project work.

PPROGRAM SPECIFIC OUTCOMES (PSOs)

This course enables the students to take up advanced studies in Chemistry, so that they can find opportunities in following:

PSO1 Students will become familiar with the different branches of chemistry like inorganic, organic, physical, analytical, polymer, bio-chemistry and environment. They will also learn to apply appropriate techniques for the qualitative and

quantitative analysis of chemistry in laboratories and in various industries.

PSO2 To inculcate research specific culture among students.

PSO3 To identify a research problem and to formulate a scientific solutions for the benefit of the society and mankind in large.

PSO4 The students will gain the knowledge of basic concepts and the scientific principles related to different scientific phenomena and their importance in the daily life.

PSO5 The Master's specialization, Organic chemistry, give the students in depth knowledge about organic-chemical reactions with an emphasis on principles for effective synthetic strategies, stereo selectivity, catalysis, as well as organometallics.

PSO6 Opputtunities to persue Ph.D. programme, orientes apporoaches CSIR-NET, UGC-NET, GATE examination.

PSO7 Develop research skills through dissertation/project work in different fields of chemistry such as organic, inorganic, analytical, physical chemistry etc.

INORGANIC CHEMISTRY-I

Course Outcomes (COs)

After transaction of the course, student teachers will be able to:

1 To understand the concept of crystal field theory, ligand field theory and molecular orbital theory, tetragonal distortion in octahedral complexes.

2 To find out ground state terms with their energies, microstates, degeneracy and microstate table for different transition metal ions and complexes.

3 To understand the Orgel diagram and Tanabe diagram, selection rules, interpretation of spectra.

4 To understand the magnetic susceptibility, source of paramagnetism, diamagnetic susceptibility, Pascal constant and constitutive correction, Langevin equation, Van-Vleck formula, anti-ferromagnetism, ferromagnetism and molecular field theory of ferromagnetism.

5 To understand spin orbit coupling, Lande interval rule, quenching of orbital magnetic moment by crystal field,

6 To get the deep insight of spin orbit coupling on A and E terms, spin orbit coupling on T terms, spin pairing: spin pairing in octahedral complexes, Chemistry of Lanthanides and Actinides.

ORGANIC CHEMISTRY-I

Course Outcomes (COs)

After transaction of the course, student teachers will be able to:

1 Learn the stereochemistry of organic compounds in detail, chirality, different projection, inter-conversion of projection formula, CIP nomenclature, enantiomeric and diastereomeric relationship, concept of stereoselective and stereospecific reactions.

2 Understand the name reaction mechanism and their applications and learn the different molecular rearrangements and condensations reactions in organic Chemistry.

3 Understand the several rearrangements which are used in synthetic organic chemistry.

4 Understand the mechanism of elimination and addition reactions, and ozonolysis of alkenes.

5 Understand the aromatic electrophilic substitution reactions and orientation in benzene ring with more than one substituent.

6 Understand the nucleophilic substitution reaction mechanism by benzyne mechanism.

PHYSICAL CHEMISTRY-I

Course Outcomes (COs)

After transaction of the course, student teachers will be able to:

1 Understand the concept of chemical thermodynamics, laws of thermodynamics, various parameters, fugacity concept, and Debye Huckel theory.

2 Understand various theories of chemical reactions, such as Arrhenius theory, collision theory, transition state theory etc., and the thermodynamic and chemical kinetics of molecular reactions.

3 Learn about electrochemistry, various theories of solutions, various equations, thermodynamics of electrolytic solutions, over potentials, Butler Volmer equation, Tafel plot etc.

4 Understand surface chemistry, micelle, critical micelle concentration, thermodynamics of micellization, surface films on liquids, capillary action, Laplace equation, Catalytic activity at surface.

5 Learn about the basic concept of Electrochemistry and its thermodynamics aspects.

6 Understand the Electro-kinetic phenomenon of Surface Chemistry.

PRACTICAL-I (MCH9101P)

Course Outcomes (COs)

After transaction of the course, student teachers will be able to:

1 Learn and perform named organic reactions and work up of the reaction.

2 Able to purify the organic compounds by different techniques.

3 Determine the boiling point of unknown samples.

4 Learn estimation of functional groups.

5 Learn basic knowledge of organic synthesis.

6 Learn estimation of Phenol/Aniline

PRACTICAL-II ((MCH9102P)

Course Outcomes (COs)

After transaction of the course, student teachers will be able to:

1 Able to assemble and handle the chemicals, instruments and glassware during preparation.

2 Understand the synthesis and estimation of inorganic metal complexes.

3 Practically learn the synthesis of anionic metal complexes with various ligands.

4 Learn qualitative analysis of inorganic mixtures.

5 learn how to characterize metal complexes by different spectroscopic techniques such as IR, UV-Vis etc.

BIOPHYSICAL CHEMISTRY

Course Outcomes (COs)

After transaction of the course, student teachers will be able to:

1 Understand the concept of chemistry of solutions, drug dissolution, solute solvent interactions, and factors affecting dissolution.

2 Understand viscosity, Newtonian systems, thixotropy, surface and interfacial phenomena, viscoelasticity, surface active agents etc.

3 Learn about the chemistry of buffer solutions its applications in pharmacological systems, pH and solubility of buffer solutions.

4 Understand emulsions and dispersion and its applications in different fields, properties of solutions, micro emulsions, and properties of suspended particles.

5 Learn about the different suspension and Their properties.

6 Understand the Adsorption of liquid interfaces: surface active agents, systems of hydrophile – lipophile classification.

POLYMER TECHNOLOGY

Course Outcomes (COs)

After transaction of the course, student teachers will be able to:

1 Understand the Characteristics of polymers.

2 Learn Correlation of structure and morphology with properties of polymers.

3 Understand the Acrylics and Vinyl polymers, Polyesters, Polyamides, Polycarbonates and Cellulosic polymers.

4 Learn about the Specialty Polymers.

5 Characterization of polymers by Mol. wt determination, Tg determination, XRD, SEM, TEM.

6 Understand the application of polymer.

INORGANIC CHEMISTRY-II

Course Outcomes (COs)

After transaction of the course, student teachers will be able to:

1 Students will learn Quantum chemistry, and its applications.

2 Students will also learn various topics such as rotational, translational motion and hydrogen like atoms.

3 Students will learn perturbation theory and variation theory, various operators, terms symbols, wave functions.

4 Students will understand theory of Born Oppenheimer approximations, chemical bonding of H_2 molecules, MO, LACO treatment of diatomic molecules, VBT theories

5 Students will understand the Commutation relations, Translational motion of a part Free particle.

6 Students will understand r-dependent part of the wave function of hydrogen like atoms and approximation methods

ORGANIC CHEMISTRY-II

Course Outcomes (COs)

After transaction of the course, student teachers will be able to:

1 To provide basic principles of stereochemistry and familiarize with the concepts of stereochemistry for their applications in organic molecules and compounds.

2 To familiarize basic principles of the structure and reactivity relationship

3 To enhance the knowledge of general organic reactions and familiarize with their reaction mechanisms.

4 Understand the oxidation and reduction via different reagents and their mechanism.

5 Able to apply the fundamental knowledge of structure of organic molecules to determine its influences on reactivity of their reactions.

6 Able to apply the basic concepts of various reaction mechanisms in the synthesis of organic molecules and compounds.

PHYSICAL CHEMISTRY-II

Course Outcomes (COs)

After transaction of the course, student teachers will be able to:

1 The students will understand chemical kinetics, various types of chemical reactions and their mechanisms.

2 Students will understand various theories of chemical reactions, such as Arrhenius theory, collision theory and transition state theory etc

3 Students will learn group theory, symmetry elements, great orthogonality theorem, reducible and irreducible representations, and character table.

4 Students will understand chemical applications of group theory, selection rules for electronic transitions, IR and Raman spectra.

5 Learn the thermodynamic and chemical kinetics of molecular reactions.

6 Student will understand the Concepts of symmetry in molecule and symmetry operations, Construction of character tables.

PRACTICAL-I (MCH9201P)

Course Outcomes (COs)

After transaction of the course, student teachers will be able to:

1 Learn various organic reactions such as acetylation, nitration, amination, and bromination.

2 Learn oxidation and reduction reactions and learn how to calculate the percentage yield and check the melting point of the compound.

3 Learn the thin layer chromatographic technique and separation of organic compounds.

4 Learn how to perform estimation of aniline, sugar estimation, percentage alcohol estimation etc.

5 Learn to isolate product and their purification

6 Learn yield optimization.

PRACTICAL-II (MCH9202P)

Course Outcomes (COs)

After transaction of the course, student teachers will be able to:

1 Learn the Quantitative Analysis.

2 Learn the Qualitative Analysis.

3 Determine the composition of complex and interference study.

4 Learn Replacement titration.

5 Learn Back Titration.

6 Learn Indirect Titration of Calcium.

SELECTED TOPICS IN POLYMERS

Course Outcomes (COs)

After transaction of the course, student teachers will be able to:

1 Understand the Fundamentals of paints, pigments, and varnish.

2 Learn about synthetic adhesives and Ion exchange polymers.

3 Understand some water-soluble polymers, & polyacrylamide, polyvinyl pyrrolidone, and polyethylene oxide

4 Learn about various engineering plastics

5 Understand the formulation of paints and varnishes.

6 Understand the use of different types of polymer.

INORGANIC DRUG CHEMISTRY

Course Outcomes (COs)

After transaction of the course, student teachers will be able to:

1 Learn Impurities in Pharmaceutical substances and their limit test.

2 Learn the mechanism of action for the antioxidants.

3 Understand Gastrointestinal agents.

4 Understand different Topical agents.

5 Understand Major Intra and Extracellular Electrolyte.

6 Learn about different Dental Products.

RESEARCH METHODOLOGY

Course Outcomes (COs)

After transaction of the course, student teachers will be able to:

1 Understand some basic concepts of research and its methodologies.

2 Explain key research concepts and issues read, comprehend, and explain research articles in their academic discipline.

3 Select and define appropriate research problem and parameters.

4 Organize and conduct research (advanced project) in a more appropriate manner.

5 Able to write a research report and dissertation.

6 Able to write a research proposal for grants.

SPECTROSCOPY-I

Course Outcomes (COs)

After transaction of the course, student teachers will be able to:

1 Understand the concept of Atomic Absorption spectroscopy.

2 Learn Molecular Luminescence Spectroscopy.

3 Understand Electron Spectroscopy (ESCA, Auger and UPS).

4 Student will learn scanning electron microscopy (SEM).

5 Student will learn Scanning tunneling microscopy (STM).

6 Student will learn atomic force microscopy (AFM).

ORGANIC SYNTHESIS: A DISCONNECTION APPROACH

Course Outcomes (COs)

After transaction of the course, student teachers will be able to:

1 Learn the Introduction to disconnections, one and two-group disconnections, disconnections and synthesis of alcohols, aryl ketones, simple ketones and acids.

2 Know the Illogical two group disconnections, disconnections and synthesis of β-hydroxy carbonyl compounds, 1, 2-diols, 1,4-dicarbonyl compounds, 1,6-dicarbonyl compounds.

3 Understand disconnections based on Diels – Alder reaction and its use in organic synthesis, functional group analysis, strategy of saturated hydrocarbon synthesis, functional group addition to intermediates.

4 Understand the disconnections and synthesis of acyclic and cyclic hetero compounds.

5 Learn about the umpolung of carbonyl group, synthesis based on umpolung of carbonyl group – synthesis of 1,2 and 1,3 diketones, cyclic ketones etc.

6 Gain deep insight of protecting groups, synthesis of some complex molecules.

HETEROCYCLIC CHEMISTRY

Course Outcomes (COs)

After transaction of the course, student teachers will be able to:

1 Understand the basics of heterocyclic compounds and its nomenclature.

2 Reactions and synthesis of fused heterocycles

3 Reactions of bicyclic heterocycles containing nitrogen

4 Synthesis of bicyclic heterocycles containing nitrogen

5 Properties of oxygen containing heterocycles.

6 Synthesis of oxygen containing heterocycles.

PRACTICAL-I (MCH9301P)

Course Outcomes (COs)

After transaction of the course, student teachers will be able to:

1 Understand the separation of Acid, phenol base and neutral compound

2 Learn the identification of Acid, phenol base and neutral compound.

3 Learn the confirmation of different acids by their confirmatory tests.

4 Learn the confirmation of different phenol by their confirmatory tests.

5 Learn the confirmation of different base by their confirmatory tests.

6 Learn the confirmation of different neutral by their confirmatory tests.

PRACTICAL-II (MCH9302P)

Course Outcomes (COs)

After transaction of the course, student teachers will be able to:

1 Understand the mechanism of synthesis of Azo dyes.

2 Learn to handle reactive intermediates like BDC's under cooling condition.

3 Learn to assemble the reaction set up for the multistep reaction

4 Understand the reaction progress via TLC

5 Learn the isolation of product from reaction mixture

6 Understand the purification of organic compound via different techniques.

SEPARATION METHODS

Course Outcomes (COs)

After transaction of the course, student teachers will be able to:

1 Students will be able to learn the chemistry of purifying compounds by various chromatographic techniques.

2 Students will understand the Adsorption Chromatography in detail.

3 Students will understand the Partition Chromatography in detail.

4 They will also learn the solvent extraction technique.

5 Students will understand the GC, HPLC & Ion Exchange Chromatography in detail.

6 Students will learn the working principle behind every chromatographic separation, various detectors employed.

ADVANCE PHARMACEUTICAL CHEMISTRY

Course Outcomes (COs)

After transaction of the course, student teachers will be able to:

1 Understand the different water treatment techniques.

2 Understand the different sterilization processes.

3 Learn Pilot plant design basic requirement and different equipments required for it.

4 Understand in process quality control system and IPQC tests.

5 Learn materials used for Quality assurance system,

6 Understand the different types of quality assurance test required for the finished product

SYNTHETIC DYES AND PIGMENTS

Course Outcomes (COs)

After transaction of the course, student teachers will be able to:

1 Understand Dye Classification and application of some commercial dye.

2 Learn dyeing methods for various textiles

3 Understand Non textile dyes

4 Learn synthesis and characteristics of functional dyes.

5 Understand near infrared absorption (NIR) dyes

6 Organic Pigments Fluorescent Brightening Agents

SELECTED TOPICS IN ADVANCED INORGANIC CHEMISTRY

Course Outcomes (COs)

After transaction of the course, student teachers will be able to:

1 Understand Boron hydrides and related structures.

2 Learn solvent extraction, methods of extraction, classification of solvent extraction

3 Understand the solvent extraction of inner complexes

4 Learn synthesis of chelating resins.

5 Understand Influence of pH on pM and effect of various parameters on pH

6 Learn about commercially important sequestration agent

SPECTROSCOPY-II

Course Outcomes (COs)

After transaction of the course, student teachers will be able to:

1 Understand the basic principles of IR spectroscopy and their applications in characterization of functional groups of organic molecules.

2 Fundamental knowledge of NMR spectroscopic techniques and their applications for structure elucidation of newly synthesized organic compound.

3 Basic principles of Mass spectrometry and its application for analysis of organic molecules and compounds.

4 Fundamental principles of Green Chemistry and will be able apply the knowledge of Green Chemistry in the synthesis of compounds.

5 Understand the basic principles of UV spectroscopy and their applications in characterization of functional groups of organic molecules.

6 Understand the different type of spectroscopy and use of it collectively for the structure determination.

NATURAL PRODUCTS

Course Outcomes (COs)

After transaction of the course, student teachers will be able to:

1 Understand the classification, source and methods of isolation of natural products, general methods for the structure determination of natural products.

2 Introduction, structure and synthesis of alkaloids such as Morphine, Sceletium, Mahanimbine, Reserpine and Tylophorine also learn about biogenesis of Alkaloids.

3 learn about the structure and synthesis of Terpenoids such as Eudesmol, Cadinene, Caryophylene, Khusimone, and Logifolene. Structure and synthesis of β-Carotene, biosynthesis of Terpenoids and Carotenoids.

4 Understand the structure and synthesis of Cholesterol, Cortisone.

5 Understand the structure and synthesis of Androgens and Oestrogens. Biosynthesis of Steroids.

6 Learn about detail study of several vitamins such as vitamin A_1, B_1, B_6, Biotin and vitamin C.

STEREOCHEMISTRY OF ORGANIC COMPOUNDS

Course Outcomes (COs)

After transaction of the course, student teachers will be able to:

1 Understand the stereochemistry and methods of resolution

2 Learn the Conformational Analysis.

3 Understand the concept of Pericyclic Reactions

4 Learn Chiroptical Properties Of Organic Compounds

5 Understand the chemical and stereochemical aspects' of DNAs

6 Learn the crown ethers and cyclodextrins.

ADVANCE TECHNIQUES OF SYNTHETIC CHEMISTRY

Course Outcomes (COs)

After transaction of the course, student teachers will be able to:

1 Student will learn Green Chemistry and Techniques of Green Chemistry.

2 Student will learn about green catalysts and phase transfer catalysis.

3 Student will understand the aqueous phase reactions.

4 Introduction of Combinatorial Chemistry and application of Combinatorial Chemistry

5 Student will learn Basic principles of Green Chemistry & Some examples.

6 Student will understand the Ionic Liquids as green solvents, applications of it in day to day life

PRACTICAL-I (MCH9401P)

Course Outcomes (COs)

After transaction of the course, student teachers will be able to:

1 Understand the synthesis of esterification, condensation reaction.

2 Understand use of hazardous reagent in organic synthesis.

3 Learn the condensation reactions.

4 Understand the purification of organic compounds.

5 Understand the yield improvement.

6 Learn solvent extraction.

PRACTICAL-II (MCH9402P)

Course Outcomes (COs)

After transaction of the course, student teachers will be able to:

1 Understand the synthesis of etherification, condensation reaction.

2 Understand use of hazardous reagent in organic synthesis.

3 Learn the coupling reactions.

4 Learn the Amide formation, oxidation and reduction reaction.

5 Understand hydrolysis reaction.

6 Understand the purification of organic compounds the yield improvement

M.Sc. Microbiology (24-25)

(PO, PSO, & CO)

Program Outcome (POs):	
PO1	Students will be able to develop experimental and scientific skills for critical thinking and ability to tackle and solve scientific problems.
PO2	Students will be able to explore new areas of research in different fields of Basic and Applied Sciences.
PO3	To develop interdisciplinary approach of the subject.
PO4	Improve the skills to succeed in research and industrial field. Moreover, students will acquire the ability to conduct experiments, operate scientific instruments, research planning, executing and performing in laboratory experiments.
PO5	To use the knowledge to develop technologies which are sustainable and eco-friendly.
PO6	To make them learn logical thinking to address a problem and become result oriented.
PO7	Students will develop communication skills for expressing ideas clearly and effectively.
PO8	To encourage and facilitate innovations, nurture startups and foster entrepreneurship. After completion of programme the students will be encouraged to apply logical reasoning based on the knowledge, skills, designing solutions to assess societal, health, safety issues and the responsibilities that go along with the scientific practice.
PO9	With the pursuit of knowledge for either personal or professional reasons, learners are also encouraged to volunteer and be self-motivated that not only enhances society values, active participation and personality development, but also enhances self-sustainability, competiveness and employability. To sensitize students and employees about their responsibilities to reach out to community for social harmony and environmental protection.
PO10	Students will learn the beginning of research during the exposure gained while persuing dissertation/project work.
PO11	Students will be able to develop and implement research projects to address scientific questions and hypotheses, including the ability to design and conduct experiments, collect and analyze data, and draw conclusions based on evidence.
PO12	Students will be able to develop and implement science-based policies and programs to address global challenges, including the ability to analyze complex scientific information, identify patterns and trends, and develop innovative solutions to scientific problems.
Program Specific Outcomes (PSOs)	

This course enables the students:	
PSO1	After completion of M.Sc. programme student will acquire complete knowledge of basic and applied aspects of Microbiology courses and will be able to analyze the mechanisms involved in life processes up to the molecular level.
PSO2	To inculcate research specific culture among students.
PSO3	To identify a research problem and to formulate a scientific solutions for the benefit of the society and mankind.
PSO4	The students will gain the knowledge of basic concepts and the scientific principles related to different scientific phenomena and their importance in the daily life.
PSO5	The students will become familier with the different brances of Microbiology. They will also learn to apply appropriate techniques for the qualitative analysis of the biomolecules in the laboratories and in all industries.
PSO6	Opputtunities to persue Ph.D. programme, orientes apporoaches CSIR-NET, UGC-NET, GATE examination.
PSO7	After completion of post graduguate, student will understand depth knowledge of modern and future emerging aspects of Microbiology and their implementation in various aspects for sustainable development.

Semester I

MMI9101T	**Course Outcome:**	**Cell and Molecular Biology**
1	Define the structure and function of cellular organelles, including the nucleus, mitochondria, endoplasmic reticulum, and ribosomes. Identify the major types of biomolecules, including carbohydrates, lipids, proteins, and nucleic acids.	
2	Explain the mechanisms of cellular transport, including passive and active transport, and the role of transport proteins.	
3	Apply knowledge of cellular and molecular biology to understand the mechanisms of disease.	
4	Analyze the structure and function of biomolecules, including proteins, nucleic acids, and lipids, and their interactions with other molecules.	
5	Design and propose new experiments to investigate cellular and molecular processes, including gene expression, protein function, and cell signaling.	
6	Evaluate the scientific evidence supporting different cellular and molecular mechanisms, including those involved in cell signaling, gene expression, and protein synthesis.	

MMI9102T	Principles of Biochemistry
Course Outcome:	
1	Define the major classes of biomolecules, including carbohydrates, lipids, proteins, and nucleic acids. Identify the key metabolic pathways, including glycolysis, gluconeogenesis, the citric acid cycle, and oxidative phosphorylation.
2	Explain the mechanisms of carbohydrate metabolism, including glycolysis, glycogen synthesis, and gluconeogenesis.
3	Use biochemical techniques, such as spectroscopy and chromatography, to analyze biomolecules and their interactions. Design and conduct experiments to investigate biochemical processes, including enzyme kinetics and metabolic pathway analysis.
4	Analyze the structure and function of biomolecules, including proteins, nucleic acids, and lipids, and their interactions with other molecules.
5	Design and propose new experiments to investigate biochemical processes, including enzyme kinetics and metabolic pathway analysis.
6	Evaluate the scientific evidence supporting different biochemical mechanisms, including those involved in energy metabolism, biosynthesis, and degradation.

MMI9103T	General Microbiology
Course Outcome:	
1	**Define the major types of microorganisms, including bacteria, viruses, fungi, and protozoa.**
2	Explain the mechanisms of microbial growth and reproduction, including binary fission and sporulation. Describe the process of microbial metabolism, including glycolysis, fermentation, and respiration.
3	Use microbiological techniques, such as microscopy, culturing, and biochemical testing, to identify and characterize microorganisms.
4	Analyze the structure and function of microbial cells, including cell walls, membranes, and organelles. Evaluate the role of microorganisms in environmental processes, including pollution, climate change, and ecosystem disruption.
5	Explore microbial growth and metabolism, and the presence and adaptations of microbes in extreme environments like deep oceans, space, and air.
6	Evaluate the scientific evidence supporting different microbiological mechanisms, including those involved in pathogenesis, symbiosis, and biodegradation.

MMI9101P	Microbiology Laboratory-I

Course Outcome:	
1	Identify and recall the different types of microbiological media, including agar, broth, and selective media.
2	Explain the principles of microbiological culturing, including the preparation of media, inoculation, and incubation.
3	Apply microbiological techniques to isolate and identify microorganisms from various sources.
4	Analyze the results of microbiological experiments, including the interpretation of data and the drawing of conclusions.
5	Design and propose new experiments to investigate microbiological phenomena, including the effects of environmental factors on microbial growth and survival.
6	Evaluate the scientific evidence supporting different microbiological techniques and methods.

MMI9102P	Microbiology Laboratory-II

Course Outcome:	
1	Identify and describe the principles and procedures of various microbiological techniques, including microscopy, culturing, and biochemical testing.
2	Explain the theoretical basis of microbiological techniques, including the principles of microbial growth, metabolism, and genetics.
3	Apply microbiological techniques to solve practical problems, including the isolation and identification of microorganisms from environmental samples.
4	Evaluate the effectiveness of different microbiological techniques and methods, including their limitations and potential biases.
5	Develop and implement a plan for the isolation and characterization of a novel microorganism, including the selection of media, inoculation of cultures, and analysis of results.
6	Evaluate the validity and reliability of microbiological data and results, including the assessment of experimental design, methodology, and statistical analysis.

MMI9104T	Genetics

Course Outcome:	
1	Identify and describe the basic principles of genetics, including Mendelian inheritance, and gene expression.
2	Describe the role of genetic elements, including promoters, operators, and enhancers, in gene regulation.
3	Design and conduct simple genetic experiments, including the construction of genetic maps and the analysis of gene function.
4	Evaluate the effectiveness of different genetic techniques, including their limitations and potential biases.
5	Develop and implement a plan for the genetic analysis of a microbial population.
6	Evaluate the validity and reliability of genetic data and results, including the assessment of experimental design, methodology, and statistical analysis.

MMI9105T	Food and Dairy Microbiology

Course Outcome:
Identify and describe the types of microorganisms associated with food and dairy products, including bacteria, viruses, and fungi.
Explain the mechanisms of microbial growth and survival in food and dairy products, including the role of nutrients, water activity, and temperature.
Apply knowledge of food and dairy microbiology to the prevention of foodborne illnesses and spoilage, including the design of experiments and the interpretation of results.
Analyze and interpret data related to food and dairy microbiology, including the detection and identification of microorganisms in food and dairy products.
Design and propose a food and dairy microbiology research project, including the formulation of hypotheses, selection of methods, and prediction of outcomes.
Assess the significance and impact of food and dairy microbiology research, including its potential applications and implications for society.

Semester II

MMI9201T	Biostatistics and Bioinformatics
Course Outcome:	
1	Identify and describe the basic principles of biostatistics, including data analysis, statistical inference, and hypothesis testing. Recognize the importance of biostatistics and bioinformatics in microbiological research, including the analysis of genomic and proteomic data.
2	Explain the concepts of probability, sampling distributions, and statistical inference in the context of microbiological research.
3	Apply biostatistical concepts to the analysis of microbiological data, including the design of experiments and the interpretation of results. Use computational tools and databases to analyze biological data, including genomic and proteomic data.
4	Evaluate the assumptions and limitations of biostatistical methods, including the impact of sample size, data quality, and model selection.
5	Design and propose a biostatistical research project, including the formulation of hypotheses, selection of methods, and prediction of outcomes. Develop and implement a plan for the analysis of biological data, including the use of computational tools and databases.
6	Evaluate the validity and reliability of biostatistical data and results, including the assessment of experimental design, methodology, and statistical analysis.

MMI9202T	Microbial Genetics and Genomics
Course Outcome:	
1	Identify and describe the basic principles of microbial genetics, including the structure and function of microbial genomes.
2	Explain the mechanisms of microbial gene expression, including transcription, translation, and regulation.
3	Use bioinformatic tools and databases to analyze and interpret genomic data.
4	Evaluate the effectiveness of different antimicrobial therapies and diagnostic tools, including their limitations and potential biases.
5	Develop and implement a plan for the analysis of genomic data, including the use of bioinformatic tools and databases.
6	Assess the significance and impact of microbial genetic research, including its potential applications and implications for society.

MMI9203T	Industrial Microbiology

Course Outcome:	
1	Identify and describe the types of microorganisms used in industrial microbiology, including bacteria, yeast, and fungi.
2	Describe the methods used to control microbial growth and product formation, including the use of temperature, pH, and oxygen levels.
3	Apply knowledge of industrial microbiology to the development of new products and processes, including the use of biotechnology and fermentation techniques.
4	Analyze and interpret complex data related to industrial microbiology, including the evaluation of microbial growth, metabolism, and product formation.
5	Develop and implement a plan for the production of a food, beverage, or other product using industrial microbiology techniques.
6	Evaluate the validity and reliability of industrial microbiology data and results, including the assessment of experimental design, methodology, and statistical analysis.

MMI9201P	Microbiology Laboratory-I

Course Outcome:	
1	Understand and apply statistical measurement scales and terms.
2	Develop skills in data collection, presentation, and summarization.
3	Calculate and interpret measures of central tendency and dispersion.
4	Apply probability concepts and distributions to solve statistical problems.
5	Conduct hypothesis testing and analyze data using statistical tests like t-tests, Chi-Squared tests, and ANOVA.
6	Explore bioinformatics applications in genomics, proteomics, and sequence analysis.

MMI9202P	Microbiology Laboratory-II

Course Outcome:	
1	Recall the types of microorganisms and their characteristics, including bacteria, viruses, fungi, and protozoa. Recognize the importance of microbiological techniques in the analysis of microbial samples.
2	Explain the mechanisms of microbiological techniques, including staining, biochemical tests, and molecular biology methods.
3	Apply knowledge of microbiological techniques to the analysis of microbial samples, including the use of various staining techniques, biochemical tests, and molecular biology methods.
4	Analyze and interpret complex microbiological data, including the identification of microorganisms and the determination of their characteristics.

5	Design and propose a microbiological research project, including the formulation of hypotheses, selection of methods, and prediction of outcomes.
6	Evaluate the validity and reliability of microbiological data and results, including the assessment of experimental design, methodology, and statistical analysis.

MMI9204T	**Medical Microbiology and Virology**
Course Outcome:	
1	Identify and describe the types of microorganisms that cause human disease, including bacteria, viruses, fungi, and parasites.
2	Explain the mechanisms of microbial pathogenesis, including the role of virulence factors and the host immune response.
3	Apply knowledge of medical microbiology and virology to the diagnosis and treatment of infectious diseases.
4	Analyze and interpret complex data related to medical microbiology and virology, including the identification of microorganisms and the determination of their characteristics.
5	Design and propose a research project to investigate a medical microbiology or virology phenomenon, including the formulation of hypotheses, selection of methods, and prediction of outcomes.
6	Evaluate the validity and reliability of medical microbiology and virology data and results, including the assessment of experimental design, methodology, and statistical analysis.

MMI9205T	**Microbial Ecology**
Course Outcome:	
1	Identify and describe the basic principles of microbial ecology, including the interactions between microorganisms and their environment.
2	Explain the mechanisms of microbial interactions, including symbiosis, competition, and predation.
3	Apply knowledge of microbial ecology to the study of microbial communities in various ecosystems, including soil, water, and the human body.
4	Analyze and interpret complex data related to microbial ecology, including the use of multivariate statistics and network analysis.
5	Design and propose a research project to investigate a microbial ecology phenomenon, including the formulation of hypotheses, selection of methods, and prediction of outcomes.
6	Critique and improve microbial ecology protocols and procedures, including the identification of areas for improvement and the development of new methods and techniques.

Semester III

MBS9301T	Bio-Instrumentation
Course Outcome:	
1	Define the fundamental principles of bio-instrumentation and its applications in medical and biological fields.
2	Students will be able to understand the use of principle of various instrumentation, principles, and techniques.
3	Apply bio-instruments to analyze data in a laboratory and troubleshoot common issues with bio-instruments and perform routine maintenance and familiar and more comfortable to handle the laboratory equipment.
4	Evaluate the performance of bio-instruments using metrics such as accuracy, precision, and sensitivity.
5	Students will be able to select the instruments and techniques involved in particular experiment.
6	Evaluate the safety and regulatory compliance of bio-instruments and bio-instrumentation systems.

MRM9301T	Research Methodology
Course Outcome:	
1	Define key terms related to research methodology, including research design, sampling, and data analysis and recall the major steps involved in the research process, including problem formulation, literature review, and data collection.
2	Explain the principles of research design, including the use of control groups and randomization and describe the process of sampling, including the use of probability and non-probability sampling methods.
3	Apply knowledge of research methodology to design a research study, including the development of a research question and hypothesis.
4	Analyze research data to identify patterns and trends, including the use of statistical methods and data analysis software.
5	Design a new research study to investigate a research question, including the development of a research proposal and methodology section.
6	Critique a research paper on research methodology, including the evaluation of methods, results, and conclusions.

MBS9301P	Bio-Instrumentation Laboratory

Course Outcome:
Remember basic principles of instruments and understand the various principles on which laboratory instruments works.
Compare and contrast different instruments and handle the laboratory equipments.
Use bio-instrumentation concepts to analyze and interpret biopotential signals, including the use of data analysis software and statistical methods.
Analyze biological signals to identify patterns and trends, including the use of statistical methods and data analysis software.
Create a research proposal to investigate a bio-instrumentation question, including the design of experiments and the analysis of data.
Evaluate the impact of the various techniques used in laboratory experimentation.

Discipline Specific Elective (DSE): Any one

MMI9301T	Industrial Microbiology and Biotechnology

Course Outcome:	
1	Identify and describe the basic principles of industrial microbiology and biotechnology, including the use of microorganisms in various industrial processes.
2	Interpret the results of industrial microbiology and biotechnology experiments, including the analysis of microbial growth, metabolism, and product formation.
3	Apply knowledge of industrial microbiology and biotechnology to the development of new products and processes, including the use of biotechnology and fermentation techniques.
4	Analyze and interpret complex data related to industrial microbiology and biotechnology, including the evaluation of microbial growth, metabolism, and product formation.
5	Design and propose a research project to investigate an industrial microbiology or biotechnology phenomenon, including the formulation of hypotheses, selection of methods, and prediction of outcomes.
6	Evaluate the validity and reliability of industrial microbiology and biotechnology data and results, including the assessment of experimental design, methodology, and statistical analysis.

MMI9302T	Agriculture Microbiology
Course Outcome:	
1	Identify and describe the basic principles of agricultural microbiology and biotechnology, including the use of microorganisms in agriculture and their impact on plant growth and soil health.
2	Explain the mechanisms of microbial interactions with plants and soil, including symbiotic relationships and nutrient cycling.
3	Apply knowledge of agricultural microbiology and biotechnology to the development of sustainable agricultural practices
4	Analyze and interpret complex data related to agricultural microbiology and biotechnology, including the evaluation of microbial communities and their role in ecosystem processes.
5	Design and propose a research project to investigate an agricultural microbiology or biotechnology phenomenon, including the formulation of hypotheses, selection of methods, and prediction of outcomes.
6	Evaluate the validity and reliability of agricultural microbiology and biotechnology data and results, including the assessment of experimental design, methodology, and statistical analysis.

MMI9303T	Environmental Microbiology
Course Outcome:	
1	Identify and describe the basic principles of environmental biology, including the interactions between organisms and their environment.
2	Describe the methods used to study environmental biology, including field observations, laboratory experiments, and statistical analysis.
3	Apply knowledge of environmental biology to the development of sustainable solutions for environmental problems, including pollution, climate change, and conservation.
4	Analyze and interpret complex data related to environmental biology, including the evaluation of ecosystem components and their interactions.
5	Design and propose a research project to investigate an environmental biology phenomenon.
6	Evaluate the validity and reliability of environmental biology data and results, including the assessment of experimental design, methodology, and statistical analysis.

MMI9304T	Cell & Tissue Banking and Cryopreservation

Course Outcome:	
1	Identify and describe the basic principles of cell and tissue banking, including the collection, processing, and storage of cells and tissues.
2	Explain the mechanisms of cryopreservation, including the use of cryoprotectants and freezing protocols.
3	Apply knowledge of cryopreservation techniques to the preservation of cells and tissues, including the use of cryoprotectants and freezing protocols.
4	Analyze and interpret complex data related to cell and tissue banking, including the evaluation of cell viability and tissue integrity.
5	Design and propose a research project to investigate a cell and tissue banking phenomenon, including the formulation of hypotheses, selection of methods, and prediction of outcomes.
6	Assess the significance and impact of cell and tissue banking research, including its potential applications and implications for society.

MMI9305T	Biology of Parasites-I

Course Outcome: After completion of the course students will be able:	
1	Define the major groups of parasites, including Protozoa, Trematode, and Cestode, and their characteristics. Identify the different types of parasitic infections and their impact on human health.
2	Interpret the epidemiological data on parasitic diseases, including their prevalence, distribution, and risk factors.
3	Design and implement experiments to study the biology and behavior of parasites, including their interactions with hosts and environments.
4	Identify and prioritize research gaps in the field of parasitology, including the development of new diagnostic tools, treatments, and control strategies.
5	Propose innovative solutions to address the challenges and limitations of current parasitology research and control efforts.
6	Justify the importance of parasitology research and its relevance to human health, including the potential benefits and applications of new discoveries and technologies.

MMI9306T	Biology of Parasites-II

Course Outcome: After completion of the course students will be able:	
1	Define and explain the fundamental concepts of parasitology, including the life cycles, morphology, and classification of nematodes and arthropods.
2	Describe the impact of parasitic nematodes and arthropods on human and plant health, including the symptoms, diagnosis, and treatment of parasitic diseases.
3	Use parasitology principles to design and interpret experiments, including the use of model organisms, molecular biology techniques, and epidemiological studies.
4	Analyze and compare the life cycles, morphology, and behavior of different parasitic nematodes and arthropods to identify commonalities and differences.
5	Design and propose an original research project in parasitology, including a clear hypothesis, experimental approach, and expected outcomes.
6	Critically evaluate the scientific literature in parasitology, including the design, methods, and conclusions of published studies.

MMI9307T	Biochemistry of Parasites

Course Outcome: After completion of the course students will be able:
Identify the key enzymes and biochemical markers involved in parasitic infections, such as lactate dehydrogenase and alkaline phosphatase.
Interpret the biochemical data from parasitological studies, including enzyme assays, chromatography, and spectroscopy.
Design and implement experiments to study the biochemical interactions between parasites and their hosts, including the effects of parasitic infection on host metabolism and immune responses.
Apply and prioritize research gaps in the field of parasitic biochemistry, including the development of new diagnostic tools, therapeutic strategies, and biochemical models.
Propose innovative solutions to address the challenges and limitations of current parasitic biochemistry research and applications.
Critique the current state of parasitic biochemistry research and identify areas for improvement, including the development of new research questions, hypotheses, and experimental approaches.

MMI9302P	Parasitology Laboratory
Course Outcome: After completion of the course students will be able:	
1	Identify and describe the different types of parasites, including protozoa, helminths, and arthropods. Recall the life cycles of various parasites, including their hosts, vectors, and transmission modes.
2	Describe the methods used to diagnose parasitic infections, including microscopy, serology, and molecular techniques. Compare and contrast the different types of parasitic infections, including their epidemiology, pathogenesis, and control measures.
3	Develop and implement protocols for the collection, processing, and analysis of parasitological samples. Design and conduct experiments to study the biology and behavior of parasites, including their life cycles, transmission dynamics, and host-parasite interactions.
4	Analyze the results of parasitological tests to identify patterns and trends in parasitic infections.
5	Create a new diagnostic tool or technique for detecting parasitic infections, including the use of molecular techniques.
6	Critique the current state of parasitology research and identify areas for improvement, including the development of new research questions, hypotheses, and experimental approaches.

MMI9308T	Animal Biotechnology
Course Outcome:	
1	Identify the different types of biotechnology techniques used in animal science.
2	Discuss the applications of regenerative medicine in animal science, including tissue engineering and stem cell therapy.
3	Apply knowledge of animal biotechnology to design and develop new biotechnology products.
4	Analyze the impact of biotechnology on animal science, including the use of case studies and data analysis..
5	Develop a novel approach to animal biotechnology, including the use of innovative techniques and technologies.
6	Evaluate and discuss public and ethical concerns over the use of animal biotechnology and understand the regulations and principles Biosafety guidelines, levels and regulations in India.

MMI9309T	Fermentation and Bioprocess Technology
Course Outcome:	
1	Identify and describe the basic principles of fermentation and bioprocess technology, including the use of microorganisms to produce bioactive compounds and biofuels.
2	Explain the mechanisms of microbial growth and metabolism, including the use of nutrients and the production of bioactive compounds.
3	Apply knowledge of fermentation and bioprocess technology to the development of new products and processes, including the use of bioreactors and downstream processing techniques.
4	Analyze and interpret complex data related to fermentation and bioprocess technology, including the evaluation of microbial growth and metabolism.
5	Design and propose a research project to investigate a fermentation and bioprocess technology phenomenon.
6	Assess the significance and impact of fermentation and bioprocess technology research, including its potential applications and implications for society.

MMI9310T	Developmental Biology
Course Outcome:	
1	Define and explain the fundamental concepts of developmental biology, including embryogenesis, morphogenesis, and pattern formation.
2	Explain the relationships between developmental processes and the formation of tissues and organs.
3	Apply experimental approaches and how they are applied to solve specific problems in cell and developmental biology.
4	Evaluate the strengths and limitations of different experimental approaches in developmental biology.
5	Design and propose an original research project in developmental biology, including a clear hypothesis, experimental approach, and expected outcomes.
6	Critically evaluate the scientific literature in developmental biology, including the design, methods, and conclusions of published studies.

MMI9303P	Biological Science Laboratory

Course Outcome:	
1	Develop proficiency in culturing and maintaining mammalian cell lines, employing proper aseptic techniques and effectively monitoring cell growth and viability.
2	Gain expertise in performing DNA extraction and quantification from animal tissues, followed by the application of polymerase chain reaction (PCR) amplification techniques.
3	Acquire the skills to design and conduct a batch fermentation process for the production of a target metabolite, while accurately monitoring key parameters such as pH, temperature, and nutrient consumption.
4	Able to analysis the purification and characterization of products obtained from fermentation processes using advanced techniques such as chromatography and spectrophotometry.
5	Attain the ability to observe and document the early developmental stages of model organisms, including zebrafish or Drosophila, from fertilization to gastrulation.
6	Develop competency in manipulating gene expression in developing embryos using techniques such as microinjection or CRISPR-Cas9, and analyzing the resulting phenotypic outcomes.

MMI9311T	Clinical Microbial Biotechnology

Course Outcome:
Identify and describe the basic principles of clinical microbial biotechnology, including the use of microorganisms to diagnose and treat diseases.
Explain the mechanisms of microbial pathogenesis, including the role of virulence factors and the host immune response.
Design and conduct simple experiments to investigate clinical microbial biotechnology phenomena.
Analyze and interpret complex data related to clinical microbial biotechnology, including the evaluation of microbial genomes and the identification of biomarkers.
Develop and implement a plan for the application of clinical microbial biotechnology techniques to address a specific problem or challenge.
Assess the significance and impact of clinical microbial biotechnology research, including its potential applications and implications for society.

MMI9312T	Molecular Medicine

Course Outcome:	
1	Identify and describe the basic principles of molecular medicine, including the application of molecular biology and genomics to the diagnosis and treatment of diseases.
2	Explain the mechanisms of gene expression and protein function, including the role of transcription factors and signaling pathways.
3	Apply knowledge of molecular medicine to the development of new diagnostic and therapeutic tools, including the use of gene editing technologies and gene therapy.
4	Analyze and interpret complex data related to molecular medicine.
5	Evaluate the ethical, legal, and social implications of advancements in molecular medicine.
6	Design and propose a research project to investigate a molecular medicine phenomenon.

MMI9313T	Biomedical Engineering

Course Outcome:	
1	Identify and describe the basic principles of biomedical engineering, including the application of engineering principles to medical devices, equipment, and procedures.
2	Explain the mechanisms of biomaterials, biomechanics, and bioelectronics, including their applications in biomedical engineering.
3	Apply knowledge of biomedical engineering to the development of new medical devices, equipment, and procedures, including the use of biomaterials, biomechanics, and bioelectronics.
4	Evaluate the effectiveness of different biomedical engineering techniques, including their limitations and potential biases.
5	Develop and implement a plan for the application of biomedical engineering techniques to address a specific problem or challenge.
6	Assess the significance and impact of biomedical engineering research, including its potential applications and implications for society..

MMI9303P	Medical Biology Laboratory

Course Outcome:	
1	Understand fundamental principles and techniques in medical biology laboratory experiments.
2	Apply scientific methods and experimental protocols effectively in laboratory settings.
3	Analyze experimental data and draw conclusions based on scientific evidence.
4	Develop practical skills in handling biological samples and using laboratory equipment.
5	Demonstrate proficiency in documenting experimental procedures and results.
6	Collaborate effectively in a laboratory setting and communicate findings clearly.

M.Sc. Physics

(Effective from Academic Year 2023-2024 onwards)

Faculty of Basic and Applied Sciences

Madhav University

Bharja, Tehsil – Pindwara, Sirohi (Rajasthan) 307026

Contact Number: Mob: +91 8875028991/92

Email Address: info@madhavuniversity.edu.in

Web: www.madhavuniversity.edu.in

Program Outcome (POs):	
PO1	Students will be able to develop experimental and scientific skills for critical thinking and ability to tackle and solve scientific problems.
PO2	Students will be able to explore new areas of research in different fields of Basic and Applied Sciences.
PO3	To develop interdisciplinary approach of the subject.
PO4	Improve the skills to succeed in research and industrial field. Moreover, students will acquire the ability to conduct experiments, operate scientific instruments, research planning, executing and performing in laboratory experiments.
PO5	To use the knowledge to develop technologies which are sustainable and eco-friendly.
PO6	To make them learn logical thinking to address a problem and become result oriented.
PO7	Students will develop communication skills for expressing ideas clearly and effectively.
PO8	To encourage and facilitate innovations, nurture startups and foster entrepreneurship. After completion of programme the students will be encouraged to apply logical reasoning based on the knowledge, skills, designing solutions to assess societal, health, safety issues and the responsibilities that go along with the scientific practice.
PO9	With the pursuit of knowledge for either personal or professional reasons, learners are also encouraged to volunteer and be self-motivated that not only enhances society values, active participation and personality development, but also enhances self-sustainability, competiveness and employability. To sensitize students and employees about their responsibilities to reach out to community for social harmony and environmental protection.
PO10	Students will learn the beginning of research during the exposure gained while pursuing dissertation/project work.
PO11	Students will develop the ability to engage in independent learning through exposure to research-oriented activities, fostering life-long learning to adapt to the evolving scientific landscape.
PO12	Students will cultivate a sense of ethical responsibility and understand the societal impact of scientific advancements, promoting professional integrity and contributing to sustainable development.
Program Specific Outcomes (PSOs)	
This course enables the Students to take up advanced studies in Physics and can find opportunities in following:	
PSO1	M.Sc in the Physical Science disciplines.
PSO2	**Identify, formulate, and solve Physics problems.**
PSO3	**Design and conduct experiments, as well as to analyze and interpret data.**
PSO4	**Apply knowledge of Physics in a different streams of science and to communicateeffectively.**
PSO5	**Ability to use the techniques, skills, and modern physical tools in real world Application.**
PSO6	**Engage in life-long learning and will have recognition.**

Mathematical Methods in Physics MPH9101T

Course Outcome:	
1	To use matrices for solving linear algebraic equations and to use group theory for understanding of crystallography.
2	To use tensor transformation and related algebra in physics.
3	To solve real definite integrals in theoretical Physics.
4	To find roots of a given polynomial and understand the properties of a statistical distribution of point particles
5	Apply the principles of statistical mechanics to selected problems and also basic concepts apply for research area.
6	To learn the fundamental differences between classical and quantum statistics and learn about quantum statistical distribution laws

MPH9102T	**Quantum Mechanics-I**
Course Outcome:	
1	Explain the theories and phenomena of vector space, operators, Dirac‘s notations, matrices, and commentators which are very helpful in solving the various quantum mechanics problems
2	Understand the uncertainty relation between two arbitrary operators
3	Distinguish the actual meaning of time independent and time dependent Schrodinger‘s equations
4	Illustrate Ehrenfest theorem, Poisson Brackets, wave packets and wave functions in position and momentum space
5	Analyze the energy Eigen values and wave functions of harmonic oscillator, infinite and finite square wells, free particle, and hydrogen atom
6	Recognize the importance of angular momentum and its applications in quantum mechanics

MPH9103T	Electronics
Course Outcome:	
1	To understand the techniques to shape of signals.
2	To understand the principle of multivibrators
3	To understand basic properties of analog systems
4	To understand the fundamental designing concepts of different types of Logic Gates, Minimization techniques etc.
5	The students will have understanding of Characteristics and applications of PN junction diodes
6	The students will have understanding of Different types of transducers, impedence matching, filtering and noice reduction techniques, etc.

MPH9101P	Practical-I
Course Outcome:	
1	The students will have practical understanding of the characteristics of various diodes
2	The students will have practical understanding of the transistors.
3	The students will have practical understanding of the Op-Amp
4	The students will have practical understanding of the designing concepts of logic gates and digital circuits.
5	The students will have practical understanding of the basic elements and measurement using multimeters and utilization of CRO.
6	The students will have practical understanding of the Amplifiers, and Oscillators.

MPH9102P	Practical-II
Course Outcome:	
1	Students would be able to determine the values of Stefan's constant, Boltzmann constant and e/m ratio of electron and experimental errors in each case.
2	Students would be able to understand magnetization and related aspects in a ferromagnetic material.
3	Students get familiarized with advanced spectroscopy.
4	Students would be able to understand the different harmonics and their amplitudes in a Fourier series experimentally which provide direct connect between theory and experiment.
5	Students would be able to understand heat capacity of solids
6	Students would be able to understand function of temperature and determine the Curie temperature

MPH9104T	Semiconductor Physics and Devices
Course Outcome:	
1	To understand the basic properties of semiconductors including the band gap, charge carrier concentration, doping and charge carrier injection/excitation.
2	To understand how to find the Fermi energy level and carrier density in ntype and p-type semiconductors.
3	To understand basic properties of PN junctions and Metal-Semiconductor junction.
4	To understand the working, design and applications of various semiconducting devices like rectifiers, clippers, LED, Solar cells.
5	To understand the working, design, and applications of BJTs and FETs.
6	To understand the working, design and applications of Operational amplifier

MPH9105T	Astronomy and Astrophysics
Course Outcome:	
1	Differentiate between various coordinate systems.
2	Know about the characteristics of Sun.
3	Know about Binary stars and their motions.
4	Know about stellar distances and other properties.
5	Ability to conduct independent research, and publish in the peer-reviewed astronomical and astrophysical literature.
6	Ability to communicate fundamental astronomical concepts and new research results to both other experts in the field and/or to people outside the field.

MPH9201T	Classical Mechanics
Course Outcome:	
1	Understand the mechanics of system of particles, D'Alembert's principle, Lagrangian mechanics, & Euler's equation of motion.
2	Learn about Hamiltonian formulation, Hamilton's Equations of Motion and Principle of least action.
3	Learn Canonical Transformations & Hamilton-Jacobi theory.
4	Learn about Rigid body dynamics including problems.
5	Understand the two body central force problem and its related aspects.
6	Use the tools, methodologies, language and conventions of physics to test and communicate ideas and explanations.

MPH9202T	Quantum Mechanics - II
Course Outcome:	
1	Understand the concepts of symmetries, conservation laws, bosons and fermions in quantum mechanics
2	Apply symmetries and conservation laws in various quantum mechanical problems
3	Illustrate the time independent and time dependent perturbation theories, the variational
4	Explain the basics of scattering theory
5	Apply the delta function's properties in various quantum mechanical problems
6	Recognize the importance and applications of relativistic quantum mechanics

MPH9203T	Statistical Mechanics
Course Outcome:	
1	Apply the thermodynamics in ideal gas, magnetic and dielectric materials
2	Describe various statistical approaches which describe systems of particles
3	Evaluate the formulae of random walk and diffusion equation
4	Understand the theories and mathematical approaches of statistical ensembles, equipartition theorem and Maxwell-Boltzmann statistics
5	Illustrate the fundamental concepts of Bose-Einstein and Fermi-Dirac Statistics
6	Calculate the problems related to Bosons and Fermions

MPH9201P	Practical-I
Course Outcome:	
1	The students would get hands on experience on experiments and relation to theory
2	Theoretical results for different networks matched with experiments would enable students for complex circuits
3	The students would get equipped for applications based on solid state devices
4	The students would be able to differentiate between analog and digital electronics
5	Various memory devices & their applications.
6	Digital arithmetic operations and combinational & sequential circuits.

MPH9202P	Practical-II
Course Outcome:	
1	Students will be able to have functional knowledge about BJT's and FET's
2	Development of ability to design and analyze electronic circuits using discrete components
3	Students will be able to practically verify the frequency response of feedback amplifier single and multistage amplifiers
4	Measurement of various analog circuits and comparison of experimental results with theoretical analysis enables the student for problem solving.
5	Student would be able to relate experiments with the theoretical aspects of the course.
6	Student will be able to conduct experiments, as well as to analyze and interpret data.

MPH9204T	Plasma Physics
Course Outcome:	
1	To study theoretical method to study the charge particle motion
2	To study Idea behind the magnetic confinement
3	To study How to generate plasma in the laboratory
4	To study plasma production is helpful to make fusion reactors
5	Discuss plasma resistivity and diffusion in plasma based on the charged particle motion
6	Discuss technical applications of plasma; explain the most important methods for production and diagnostics of plasma in the laboratory

MPH9205PT	Industrial Electronics
Course Outcome:	
1	Learn about the latest electronic devices available in industry.
2	Be able to effectively provide detailed explanation to the structure and operation of common linear components
3	Learn about the digital ICs and sensory electronic devices
4	Use tools/test equipment to analyze electronic components
5	Perform basic electronics troubleshooting
6	Apply critical thinking in solving industrial electronic problems

MRM9301T	Research Methodology
Course Outcome:	
1	Understand and equip the students with a basic understanding of the underlying principles of quantitative and qualitative research methods
2	Understand key research concepts and able to concrete understanding of the methods of doing research, data collection, and analysis
3	Able to select and define appropriate research problem and parameters and understand various research methods, including interview, content analysis, focus group discussions, and surveys.
4	Able to organize and conduct research (advanced project) in a more appropriate manner.
5	Understand the motivation of research, learn the techniques of defining and solving research

	problems, and develop skills in research report writing
6	Able to write a research report and a research proposal for grants.

MPH9301T	**Electrodynamics**
Course Outcome:	
1	To understand the basics of electrostatics.
2	To use of Maxwell equations in analyzing the electromagnetic field due to time varying charge and current distribution.
3	To describe the nature of electromagnetic wave and its propagation through different media and interfaces.
4	The students will be able to analyze s radiation systems in which the electric dipole, magnetic dipole or electric quadruple dominate.
5	The students will have an understanding of the covariant formulation of electrodynamics and the concept of retarded time for charges undergoing acceleration.
6	To explain charged particle dynamics and radiation from localized time varying electromagnetic sources.

MPH9301P	**Laboratory-I**

Course Outcome:	
1	Students will be able to understand and apply the principles of diffraction through experiments involving grating spectra and analyze the wavelength of light sources.
2	Students will gain practical skills in determining the **refractive index** of different liquids, such as water and oil, using a prism and apply Snell's law in real-world situations.
3	Students will comprehend the concept of **magneto resistance** and its dependence on magnetic fields, enabling them to explore its applications in modern sensors and devices.
4	Students will be able to determine the **temperature dependence of the Hall coefficient**, enhancing their understanding of charge carrier behavior in semiconductors and metals.
5	Students will acquire hands-on experience in using **Digital-to-Analog (DAC)** and **Analog-to-Digital (ADC)** converters, essential for interfacing analog signals with digital systems in electronic circuits.
6	Students will be able to perform **interference experiments using a Michelson**

	Interferometer and demonstrate an understanding of the **Faraday Effect**, which is crucial in studying light-matter interactions and magnetic fields' influence on polarized light.

MPH9302T	**Energy Sources**
Course Outcome:	
1	Students will understand the classification of energy sources and evaluate their significance in meeting global energy demands, distinguishing between renewable and non-renewable resources.
2	Students will analyze the production, extraction, and usage of conventional energy sources like fossil fuels and nuclear energy, and assess their environmental impact and sustainability challenges.
3	Students will explore the key features, applications, and limitations of solar energy systems, including solar water heaters, solar cells, and photovoltaic (PV) models, enhancing their knowledge of eco-friendly technologies.
4	Students will comprehend the principles of wind energy and tidal energy harvesting, including the working of wind turbines, grid interconnection systems, and ocean energy devices, and compare their potential against solar energy.
5	Students will gain insights into geothermal energy and hydro energy technologies, understanding their environmental impact, resource management, and applications in sustainable energy production.
6	Students will evaluate modern energy storage systems such as carbon capture technologies, batteries, and fuel cells, and understand their role in addressing energy consumption challenges and promoting sustainable energy practices.

MPH9303T	**Microwave Electronics**
Course Outcome:	
1	Students will gain an understanding of transmission line theory, including Telegrapher's equations, lossless and lossy lines, and the Smith Chart, which are essential for designing microwave circuits.
2	Students will learn about waveguides and microwave networks, understanding the principles of TEM, TE, and TM waves, as well as the characteristics and applications of rectangular, circular, and coaxial cables.
3	Students will be able to design and implement impedance matching techniques such as L-section matching, stub matching, and quarter-wave transformers, and understand the working of microwave passive components like cavity resonators, E-plane Tee, and circulators.
4	Students will comprehend the working principles of microwave tubes like Klystron, Magnetron, and Traveling Wave Tubes, along with solid-state devices such as GUNN diodes, PIN diodes, and IMPATT diodes, and their applications in modern communication systems.
5	Students will be able to perform microwave measurements using instruments like the Vector

	Network Analyzer (VNA) and power meters, understanding their calibration, basic measurements, and the analysis of material properties at microwave frequencies.
6	Students will develop a thorough understanding of Radar systems, including the radar range equation, probability of detection and false alarm, MTI radar, and tracking radar, along with methods such as sequential lobing, conical scanning, and monopulse radar techniques.

MPH9304T	**Optoelectronic Devices**
Course Outcome:	
1	Students will understand the properties of semiconductors, including electron and photon distribution, density of states, and the effect of temperature and pressure on the band gap, enabling them to comprehend semiconductor behavior under various conditions.
2	Students will gain insights into semiconductor optics, including the dual nature of light, light absorption and emission, and photoluminescence, which are fundamental for understanding light-matter interaction in semiconductor materials.
3	Students will learn the structure, working principles, and characteristics of semiconductor light-emitting diodes (LEDs) and lasers, including concepts like optical modes, internal/external efficiency, and quantum wells, to design efficient optoelectronic devices.
4	Students will develop knowledge of semiconductor light modulators, including direct modulation of laser diodes, electro-optic and acousto-optic modulation, and magneto-optic isolators, to understand various methods of light modulation and control.
5	Students will comprehend the working principles of semiconductor light detectors, including the I-V characteristics of p-n diodes under illumination, photocells, photodiodes, and solar cells, enabling them to apply this knowledge in designing light detection systems.
6	Students will be able to analyze and design electric circuits with photodiodes, evaluate responsivity, noise, and sensitivity of light detectors, and understand their applications in fields like solar energy, communication, and imaging systems.

MPH9305T	**Medical Physics**

Course Outcome:	
1	Students will gain an understanding of the mechanical properties of the human body, including static, dynamic, and frictional forces, as well as the composition and functions of bones and the impact of heat and pressure on different parts of the body.
2	Students will comprehend the physics of the respiratory and cardiovascular systems, including the mechanics of breathing, airway resistance, and blood flow, and will learn how to measure parameters such as lung volume and blood pressure.
3	Students will learn about electricity in the body by studying electrical potentials of nerves and signals from muscles, the eye, and heart, enabling them to understand the working of medical devices like ECG machines, EMG machines, and pacemakers.
4	Students will explore the applications of sound and light in medicine, including ultrasound imaging techniques (A-scan and B-scan), stethoscopes, and the use of lasers, UV, and IR light in medical diagnostics and treatment.

5	Students will gain knowledge about diagnostic X-ray machines and nuclear medicine, including the production, properties, and applications of X-rays, radioisotopes, and nuclear imaging devices for detecting and treating medical conditions.
6	Students will understand the principles of radiation therapy and the clinical applications of nuclear medicine, including the use of radiation sources, radioactive nuclides, and safety measures in medical imaging and cancer treatment.

MPH9306T	**Programming Using Java**
Course Outcome:	
1	Students will understand the types and paradigms of programming languages, the computer programming hierarchy, and the core features of Java, including its architecture and the role of Java Virtual Machine (JVM) in program execution.
2	Students will gain practical knowledge of the Java development environment, including the installation of Java, program structure, compilation, and execution of Java programs using various development tools.
3	Students will learn basic language elements such as lexical tokens, identifiers, keywords, primitive data types, and operators, along with mastering the use of variables and assignments in writing efficient Java programs.
4	Students will develop a strong foundation in object-oriented programming (OOP) concepts, including class fundamentals, object creation and references, garbage collection, constructors, and method overloading and recursion.
5	Students will explore advanced OOP concepts such as inheritance, interfaces, nested classes, anonymous classes, and the implementation of access control, modifiers, and static members, enhancing their ability to build scalable Java applications.
6	Students will understand cloning techniques (shallow and deep cloning), the use of generic class types, and designing accessor and mutator methods, enabling them to implement efficient object-oriented solutions and improve code reusability.

PH9307T	**Nuclear and Particle Physics**
Course Outcome:	
1	Students will understand the general properties of nuclei, including atomic number, mass number, nuclear mass, binding energy, and magnetic dipole moments, and will be able to analyze nuclear stability and energy curves.
2	Students will gain insights into the decay properties of nuclei, including the radioactive decay law, half-life, and decay modes, enabling them to explain radioactive processes and calculate decay rates in various nuclear reactions.
3	Students will comprehend the theories and kinematics of alpha, beta, and gamma decay, including angular momentum and parity selection rules, and will be able to interpret spectroscopy data related

	to nuclear transitions.
4	Students will analyze the processes of nuclear fission, including spontaneous and induced fission, fission energy distribution, and the mass distribution of fission fragments, and understand the applications of nuclear energy.
5	Students will develop an understanding of nuclear forces, particularly the general characteristics of nuclear interactions, the Deuteron problem, and the concept of nuclear potential, which forms the basis of nuclear structure.
6	Students will learn about proton-proton scattering at low energies and the equivalence of nuclear forces in different particles (p-p, n-p, n-n), including the role of exchange forces and the existence of non-central nuclear forces.

MPH9308T	**Spin- Electronics and Applications**
Course Outcome:	
1	Students will understand the concept of exchange interaction and spin relaxation mechanisms in quantum systems, including spin relaxation in quantum dots and the Spin Galvanic effect, which are key to spin-based technologies.
2	Students will learn about spin-dependent transport phenomena such as spin-dependent tunneling and Andreev reflection at ferromagnetic-superconductor interfaces, enabling them to explore advanced concepts in spin-electronic devices.
3	Students will comprehend the principles of spin transfer torques, current-driven magnetization switching, and domain wall motion, which are essential for the development of memory and data storage devices in spintronics.
4	Students will explore spin-based electronic devices such as Spin LEDs, spin photo electronic devices, and spin filtering, and gain knowledge of nanostructures and micro fabrication techniques for creating advanced spintronic systems.
5	Students will analyze the working of spin-valve devices, spin-tunneling devices, MRAMs, and spintronic biosensors, along with understanding the role of spin transistors in modern electronics and quantum computing with spins.
6	Students will develop a foundational understanding of stochastic processes and concepts like the Fokker-Planck equation and fluctuation-dissipation theorem, which are essential for modeling spin dynamics in spintronic applications.

PH9309T	Atomic and Molecular Physics
Course Outcome:	
1	Explain Rutherford's, Bohr's, and Sommerfeld's atomic models, highlighting their contributions and limitations.Review quantum numbers, the Pauli Exclusion Principle, and their applications in determining electronic configurations.
2	Investigate the relativistic corrections to energy levels in atoms.Analyze the Stark effect in weak external electric fields, distinguishing between first and second-order effects.
3	Understand spin-orbit interaction and fine structure in atomic spectra.Explain LS and JJ coupling schemes and their impact on atomic energy levels and spectra.
4	Analyze rotational and vibrational energy levels in diatomic and polyatomic molecules, using the Born-Oppenheimer approximation. Introduce experimental techniques for rotational and vibrational spectroscopy, with a focus on Raman spectroscopy.
5	Explain the concepts of spontaneous and stimulated emission, population inversion, and their roles in laser functioning.Understand the principles of Q-switching and mode locking, and their applications in generating ultra-short pulses.
6	Learn the principles, construction, and operation of He-Ne and Ruby lasers. Explore the applications of lasers in various fields, particularly in medicine and industry.

MPH9302P	Laboratory-II
Course Outcome:	
1	Construct and verify truth tables for OR, AND, NOT, NOR, and NAND gates using discrete components.
2	Construct and verify truth tables for AND, NOT, EX-NOR, and EX-OR gates using NAND gates.
3	Perform 4-bit DAC and ADC operations.
4	Arrange a data set in ascending order using the 8080 microprocessor.
5	Use the IC555 chip as astable, bistable, and monostable multivibrator.
6	Study various operations of the Arithmetic Logic Unit (ALU).

MPH9310T	Computational Method in Physics
Course Outcome:	
1	Understand the theory of random walks and simulate random walks in one, two, and three dimensions, including self-avoiding walks.
2	Explore additive and multiplicative stochastic processes, including Brownian motion and fractional Brownian motion, through theoretical and simulation methods.
3	Study percolation theory and simulate lattice models using the Hoshen-Kopelman algorithm, with applications to physical systems.
4	Learn about time-averages, molecular dynamics, and the Verlet algorithm, along with ensemble averages and Monte Carlo methods using the Metropolis algorithm.
5	Simulate physical models such as the Ising model in magnetism and the Bak-Tang-Wiesenfeld model in studies of self-organized criticality.
6	Investigate combinatorial optimization problems, including the Traveling Salesman Problem (TSP) and satisfiability (k-SAT), and apply heuristic methods like simulated annealing for problem-solving.

MPH9311T	Python Programming and Introduction to Data Science
Course Outcome:	
1	Understand the fundamentals of Python programming, including syntax, variables, data types, and control structures (if, loops), and write and execute Python programs.
2	Learn modular programming in Python by writing and using functions, understanding scope, and importing modules, along with handling files and exceptions.
3	Gain proficiency in Python's advanced data structures (lists, tuples, sets, dictionaries) and apply object-oriented programming (OOP) concepts such as encapsulation, inheritance, and polymorphism.
4	Explore advanced Python features such as functional programming (map, filter, lambda functions), decorators, generators, and an introduction to concurrency and multi-threading.
5	Learn data analysis and visualization techniques with Python using libraries like NumPy, Pandas, Matplotlib, and Seaborn, including data manipulation, statistical analysis, and hypothesis testing.
6	Understand the fundamentals of machine learning, including supervised and unsupervised learning algorithms, and use the Scikit-Learn library to implement machine learning models for classification, regression, clustering, and dimensionality reduction.

MPH9312T	Data and Computer Communication
Course Outcome:	
1	Understand the fundamentals of information theory, including entropy, mutual information, and the source and channel coding theorems, and apply them to data compression and error detection.
2	Analyze the concept of information capacity and the bandwidth and S/N trade-off, as well as understand the threshold effect and the design of linear block codes and binary cyclic codes for error detection and correction.
3	Learn the principles of digital signal transmission, including baseband and passband data transmission, binary PAM systems, and various digital modulation schemes (ASK, FSK, PSK, and differential PSK).
4	Gain knowledge about M-ray signaling schemes and the concepts of serial data communication in computers, including USART 8251 and MODEM operations.
5	Understand the fundamentals of fiber optic communication, including wave propagation, fiber types (step and graded index), material dispersion, mode propagation, and fiber losses.
6	Explore the design and application of digital optical fiber communication systems, including first and second-generation systems and their role in data communication networks.

MPH9303P	Microprocessor Laboratory-I
Course Outcome:	
1	Understand the operation of an operational amplifier (Op-Amp) and design inverting and non-inverting amplifiers.
2	Learn to configure Op-Amps as differentiators, integrators, and adders for signal processing applications.
3	Perform the measurement of charge-to-mass ratio (e/m) using the Thomson method and analyze the experimental results.
4	Understand the working principles of single-stage RC coupled amplifiers and analyze their performance.
5	Study the frequency response of a common emitter amplifier and evaluate its behavior in different frequency ranges.
6	Design and analyze Bistable, Monostable, and Astable multivibrators using Op-Amps for generating different types of waveforms.

MPH9313T	Advanced Condensed Matter Physics
Course Outcome:	
1	Understand the Boltzmann transport equation in the presence of a magnetic field and its applications in magneto-resistance, including different types such as Lorentz MR, anisotropic MR, giant MR, and tunnel MR.
2	Analyze various magneto-resistive effects and their applications, as well as apply the variation principle in magnetic fields to solve numerical problems related to transport phenomena in magnetic fields.
3	Study the concept of spin and orbital magnetism, including the simplification of the Hamiltonian, spin waves, Heisenberg Hamiltonian, and ferromagnetic interactions in linear chains.
4	Explore the theory of anti ferromagnetism and spontaneous magnetization through spin wave theory, with a focus on sub-lattice magnetization and ground state calculations.
5	Understand the behavior of dielectrics and ferroelectrics, including structural phase transitions, ferroelectric crystals, and Landau theory of phase transitions, with an emphasis on first and second-order transitions.
6	Learn about ion beam interactions in solids, including energy loss by atomic collisions, Cherenkov radiation, multiple Coulomb scattering, and ion-solid interaction models, such as the thermal spike and Coulomb explosion models.

MPH9314T	Experimental Technique in Physics
Course Outcome:	
1	Understand the basic concepts of measurement and transducers, including system configuration, problem analysis, and the calibration of measuring devices.
2	Study various types of transducers, including capacitive, photoelectric, photoconductive, and piezoelectric transducers, with a focus on temperature and pressure transducers.
3	Analyze measurement errors, including accuracy, precision, significant figures, and types of errors, and apply statistical analysis to assess the probability of errors and limiting error.
4	Explore the classification and application of measurement standards, including those for mass, length, volume, time, frequency, temperature, and luminous intensity.
5	Learn about the performance characteristics of an instrumentation system, including generalized measurement, zero-order systems, second-order systems, and dead-time elements.
6	Understand the specification and testing of dynamic response in instrumentation systems, focusing on their performance and evaluation methods.

MPH9315T	Atmospheric Physics
Course Outcome:	
1	Understand the basic concepts and definitions of atmospheric science, including the optical properties, mass, and chemical composition of the Earth's atmosphere, as well as its structure, winds, and precipitation patterns.
2	Learn about the components of the Earth system, including oceans, cryosphere, terrestrial biosphere, and the Earth's crust and mantle, with a focus on their roles in the hydrological and carbon cycles and the formation and evolution of Earth into a habitable planet.
3	Study atmospheric thermodynamics, including gas laws, virtual temperature, the hydrostatic equation, adiabatic processes, and atmospheric stability, and learn to use thermodynamic diagrams like the Skew T-lnP diagram for atmospheric analysis.
4	Explore the principles of absorption and scattering of solar radiation, including the solar spectrum, solar constant, radiative properties of materials, and the physics of scattering, absorption, and emission, as well as the effects of Rayleigh and Mie scattering.
5	Analyze the interaction of solar radiation with the atmosphere, including the computation of solar heating rates, broadening of absorption lines, and the representation of polarized light using Stokes parameters.
6	Understand the role of various processes in the Earth's atmosphere and climate system, and apply these concepts to evaluate atmospheric thermodynamics, energy transfer, and scattering processes.

MPH9304P	Microprocessor Laboratory-II
Course Outcome:	
1	Perform addition and subtraction of n 8-bit numbers using the 8085 microprocessor.
2	Implement multiplication and division of two 8-bit numbers using the 8085 microprocessor.
3	Write a program to arrange an array of data in ascending order using the 8085 microprocessor.
4	Design and construct multiplexers and demultiplexers and verify their truth tables.
5	Study the operation of encoders and decoders and understand their applications.
6	Perform BCD to binary conversion using the 8085 microprocessor.

M.Sc. Mathematics

(Effective from Academic Year 2023-2024 onwards)

Faculty of Basic and Applied Sciences

Madhav University

Bharja, Tehsil – Pindwara, Sirohi (Rajasthan) 307026

Contact Number: Mob: +91 8875028991/92

Email Address: info@madhavuniversity.edu.in

Web: www.madhavuniversity.edu.in

Program Outcome (POs):	
PO1	Students will be able to develop experimental and scientific skills for critical thinking and ability to tackle and solve scientific problems.
PO2	Students will be able to explore new areas of research in different fields of Basic and Applied Sciences.
PO3	To develop interdisciplinary approach of the subject.
PO4	Improve the skills to succeed in research and industrial field. Moreover, students will acquire the ability to conduct experiments, operate scientific instruments, research planning, executing and performing in laboratory experiments.
PO5	To use the knowledge to develop technologies which are sustainable and eco-friendly.
PO6	To make them learn logical thinking to address a problem and become result oriented.
PO7	Students will develop communication skills for expressing ideas clearly and effectively.
PO8	To encourage and facilitate innovations, nurture startups and foster entrepreneurship. After completion of programme the students will be encouraged to apply logical reasoning based on the knowledge, skills, designing solutions to assess societal, health, safety issues and the responsibilities that go along with the scientific practice.
PO9	With the pursuit of knowledge for either personal or professional reasons, learners are also encouraged to volunteer and be self-motivated that not only enhances society values, active participation and personality development, but also enhances self-sustainability, competiveness and employability. To sensitize students and employees about their responsibilities to reach out to community for social harmony and environmental protection.
PO10	Students will learn the beginning of research during the exposure gained while persuing dissertation/project work.
PO11	Students will be able to develop and implement research projects to address scientific questions and hypotheses, including the ability to design and conduct experiments, collect and analyze data, and draw conclusions based on evidence.
PO12	Students will be able to develop and implement science-based policies and programs to address global challenges, including the ability to analyze complex scientific information, identify patterns and trends, and develop innovative solutions to scientific problems.
Program Specific Outcomes (PSOs)	
This programme enables the students:	

PSO1	After successful completion of this program, the students would be able to apply knowledge of Mathematics, in all the fields of learning, including higher research and its extensions.
PSO2	To inculcate research specific culture among students.
PSO3	To identify a research problem and to formulate a scientific solutions for the benefit of the society and mankind.
PSO4	The students will gain the knowledge of basic concepts and the scientific principles related to different scientific phenomena and their importance in the daily life.
PSO5	Opputtunities to persue Ph.D. programme, orientes apporoaches CSIR-NET, UGC-NET, GATE examination.
PSO6	Demonstrate competence in using mathematical and computational skills to model, formulate and solve real life applications.
PSO7	To provide students with knowledge, abilities and insight in Mathematics and computational.
PSO8	To develop problem-solving skills and apply them independently to problems in pure and applied mathematics.

Year: First	**M.Sc. Mathematics**	Semester: I
MMT9101T	**Abstract Algebra**	**4-1-0-5**

Course Outcome: Upon completing this course, students will be able to:	
1	Define and recall the basic concepts of abstract algebra, including groups, rings, and fields.
2	Explain the concepts of group homomorphisms, ring homomorphisms, and field homomorphisms.
3	Apply the concepts of abstract algebra to solve problems in mathematics and computer science, including cryptography and coding theory.
4	Analyze the structure of groups, rings, and fields, including the study of their substructures and quotient structures.
5	Design and propose new mathematical structures, including groups, rings, and fields, with specific properties.
6	Evaluate the significance and impact of abstract algebra on mathematics and computer science, including its applications in cryptography and coding theory.

Year: First	**M.Sc. Mathematics**	Semester: I
MMT9101T	**Advanced Complex Analysis**	**4-1-0-5**

Course Outcome: Upon completing this course, students will be able to:	
1	Define and recall the basic concepts of complex analysis, including analytic functions, holomorphic functions, and meromorphic functions.
2	Explain the concept of analytic continuation and its applications in complex analysis.
3	Use the argument principle to solve problems in complex analysis, including the determination of the number of zeros and poles of a function.
4	Compare and contrast the different methods of solving problems in complex analysis, including the use of contour integration and the use of the residue theorem.
5	Design and propose new methods for solving problems in complex analysis, including the use of conformal mapping and the residue theorem.
6	Assess the strengths and limitations of different methods of solving problems in complex analysis, including the use of contour integration and the residue theorem.

Year: First	**M.Sc. Mathematics**	Semester: I
MMT9103T	**Advanced Differential Equations**	**4-1-0-5**
Course Outcome: Upon completing this course, students will be able to:		
1	Define and recall the basic concepts of differential equations, including ODEs and PDEs.	
2	Describe the process of solving differential equations using various methods, including separation of variables, integrating factors, and undetermined coefficients.	
3	Apply the concepts of differential equations to solve problems in physics, engineering, and biology, including the study of population dynamics, chemical reactions, and electrical circuits.	
4	Analyze the properties of solutions to differential equations, including their behavior at equilibrium points, limit cycles, and bifurcations.	
5	Design and propose new methods for solving differential equations, including the use of computer algebra systems and numerical methods.	
6	Evaluate the significance and impact of differential equations on mathematics, science, and engineering, including their applications in physics, and economics.	

Year: First	**M.Sc. Mathematics**	Semester: I
MMT9104T	**Mechanics**	**4-1-0-5**

Course Outcome: Upon completing this course, students will be able to:	
1	Define and recall the basic concepts of mechanics, including displacement, velocity, acceleration, force, and energy.
2	Explain the concept of kinematics, including the description of motion in terms of position, velocity, and acceleration.
3	Apply the concepts of mechanics to solve problems in physics, engineering, and other fields, including the study of motion, forces, and energy.
4	Evaluate the performance of mechanical systems, including their efficiency, power, and energy consumption.
5	Develop and evaluate new mathematical models and techniques for analyzing and solving problems in mechanics.
6	Evaluate the significance and impact of mechanics on mathematics, science, and engineering, including its applications in physics, engineering, and other fields.

Year: First	**M.Sc. Mathematics**	Semester: I
MMT9105T	**Differential Geometry**	**4-1-0-5**

Course Outcome: Upon completing this course, students will be able to:

1	Define and recall the basic concepts of differential geometry, including curves, surfaces, and manifolds.
2	Explain the concept of curvature and its relationship to the geometry of curves and surfaces.
3	Apply the concepts of differential geometry to solve problems in mathematics, physics, and engineering, including the study of curves, surfaces, and manifolds.
4	Analyze the properties of geometric objects, including their curvature, torsion, and geodesics.
5	Design and propose new mathematical models and techniques for analyzing and solving problems in differential geometry.
6	Critique and defend the use of differential geometry in solving problems in mathematics, physics, and engineering.

Year: First	**M.Sc. Mathematics**	Semester: II
MMT9201T	**Real Analysis**	**4-1-0-2**

Course Outcome: Upon completing this course, students will be able to:	
1	Define and recall the basic concepts of real analysis, including sequences, series, continuity, and differentiability.
2	Explain the concept of continuity and differentiability, including the definition of a limit and the derivative of a function.
3	Use mathematical techniques, such as integration and differentiation, to analyze and solve problems in real analysis.
4	Evaluate the convergence of sequences and series, including the use of tests for convergence and divergence.
5	Design and propose new mathematical models and techniques for solving problems in real analysis.
6	Evaluate the significance and impact of real analysis on mathematics, science, and engineering, including its applications in optimization, approximation, and numerical analysis.

Year: First	**M.Sc. Mathematics**	Semester: II
MMT9202T	**Linear Algebra**	**4-1-0-5**

Course Outcome: Upon completing this course, students will be able to:

1	Define and recall the basic concepts of linear algebra, including vector spaces, linear transformations, and matrices.
2	Explain the concept of linear independence and span, including the definition of a basis and the dimension of a vector space.
3	Apply the concepts of linear algebra to solve problems in mathematics, physics, and engineering.
4	Analyze the properties of vector spaces, including their dimension, basis, and orthogonality.
5	Design and propose new mathematical models and techniques for solving problems in linear algebra, including the use of computer algebra systems and numerical methods.
6	Evaluate the significance and impact of linear algebra on mathematics, science, and engineering, including its applications in physics, engineering, and computer science.

Year: First	**M.Sc. Mathematics**	Semester: II
MMT9203T	**Partial Differential Equations**	**4-1-0-5**

Course Outcome: Upon completing this course, students will be able to:

1	Define and recall the basic concepts of PDEs, including classification, boundary value problems, and numerical methods.
2	Explain the concept of classification of PDEs, including the use of the discriminant and the characteristics of PDEs.
3	Apply the concepts of PDEs to solve problems in physics, and engineering.
4	Analyze the properties of PDEs, including their linearity, homogeneity, and symmetry.
5	Design and propose new mathematical models and techniques for solving PDEs.
6	Evaluate the significance and impact of PDEs on mathematics, science, and engineering, including their applications in physics, engineering, and other fields.

Year: First	**M.Sc. Mathematics**	Semester: II
MMT9204T	**Advanced Numerical Analysis**	**4-1-0-5**

Course Outcome: Upon completing this course, students will be able to:	
1	Define and recall the basic concepts of numerical analysis, including numerical methods for solving partial differential equations, numerical linear algebra, and numerical optimization.
2	Explain the concept of numerical methods for solving partial differential equations, including the use of finite difference methods, finite element methods, and spectral methods.
3	Apply the concepts of numerical analysis to solve problems in mathematics, physics, and engineering.
4	Analyze the properties of numerical methods, including their convergence, stability, and accuracy.
5	Develop and evaluate new algorithms for solving numerical linear algebra and numerical optimization problems.
6	Evaluate the significance and impact of numerical analysis on mathematics, science, and engineering.

Year: First	M.Sc. Mathematics	Semester: II
MMT9205T	**Number Theory**	**4-1-0-5**
Course Outcome: Upon completing this course, students will be able to:		
1	Define and recall the basic concepts of number theory, including divisibility, congruences, and Diophantine equations. Identify and describe the different types of numbers, including prime numbers, composite numbers, and rational numbers.	
2	Explain the concept of divisibility, including the use of prime factorization and the Euclidean algorithm.	
3	Apply the concepts of number theory to solve problems in mathematics, including the study of cryptography, coding theory, and combinatorics.	
4	Analyze the properties of numbers, including their divisibility, primality, and congruence properties.	
5	Design and propose new mathematical models and techniques for solving problems in number theory.	
6	Evaluate the significance and impact of number theory on mathematics, science, and engineering, including its applications in cryptography, coding theory, and combinatorics.	

Year: Second	**M.Sc. Mathematics**	Semester: III
MMT9301T	**Topology**	**4-1-0-5**

Course Outcome: Upon completing this course, students will be able to:	
1	Identify and describe the different types of topological spaces.
2	Explain the concept of topological equivalence, including the use of homeomorphisms and homotopy equivalences.
3	Apply the concepts of topology to solve problems in mathematics, including the study of geometric topology, algebraic topology, and differential geometry.
4	Apply the concepts of topology to solve problems in mathematics, including the study of geometric topology, algebraic topology, and differential geometry.
5	Develop and evaluate new algorithms for computing topological invariants, including the use of homotopy theory and homology theory.
6	Evaluate the significance and impact of topology on mathematics, science, and engineering, including its applications in physics, computer science, and biology.

Year: Second	**M.Sc. Mathematics**	Semester: III
MMT9302T	**Advanced Discrete Mathematics**	**4-1-0-5**

Course Outcome: Upon completing this course, students will be able to:	
1	Identify and describe the properties and applications of various discrete mathematical structures.
2	Explain the relationships between different discrete mathematical concepts and structures.
3	Apply discrete mathematical concepts and techniques to solve problems in mathematics and computer science.
4	Analyze and compare different discrete mathematical structures and algorithms.
5	Develop and prove new mathematical results in discrete mathematics.
6	Evaluate the importance and relevance of discrete mathematics in various fields.

Year: Second	**M.Sc. Mathematics**	Semester: III
MRM9301T	**Research Methodology**	**3-0-0-3**

Course Outcome: Upon completing this course, students will be able to:

1	Define key terms related to research methodology, including research design, sampling, and data analysis and recall the major steps involved in the research process, including problem formulation, literature review, and data collection.
2	Explain the principles of research design, including the use of control groups and randomization and describe the process of sampling, including the use of probability and non-probability sampling methods.
3	Apply knowledge of research methodology to design a research study, including the development of a research question and hypothesis.
4	Analyze research data to identify patterns and trends, including the use of statistical methods and data analysis software.
5	Design a new research study to investigate a research question, including the development of a research proposal and methodology section.
6	Critique a research paper on research methodology, including the evaluation of methods, results, and conclusions.

Year: Second	**M.Sc. Mathematics**	Semester: III
MMT9303T	**Mathematical Statistics**	**3-0-0-3**

Course Outcome: Upon completing this course, students will be able to:

1	Define and explain the fundamental concepts of probability theory, including random variables, probability distributions, and stochastic processes
2	Describe and illustrate the principles of statistical inference, including hypothesis testing, confidence intervals, and regression analysis.
3	Apply statistical techniques to solve real-world problems, including data analysis, modeling, and forecasting.
4	Analyze and interpret complex statistical data, including identifying patterns, trends, and correlations.
5	Design and propose new statistical models and methods to solve real-world problems, including applications in engineering, economics, and social sciences.
6	Evaluate the effectiveness of different statistical techniques and models in solving real-world problems, including assessing their accuracy, precision, and robustness.

Year: Second	**M.Sc. Mathematics**	Semester: III
MMT9304T	**Advanced Operations Research**	**3-0-0-3**

Course Outcome: Upon completing this course, students will be able to:

1	Define and explain advanced concepts in operations research, including linear and nonlinear programming, integer programming, and dynamic programming.
2	Describe and illustrate the relationships between different areas of operations research, including the connections between optimization, simulation, and decision analysis.
3	Apply advanced operations research techniques to solve complex problems in logistics, supply chain management, and finance.
4	Analyze and interpret complex operations research models, including identifying patterns, trends, and correlations.
5	Design and propose new operations research models and methods to solve real-world problems, including applications in logistics, supply chain management, and finance.
6	Evaluate the effectiveness of different operations research techniques and models in solving complex problems, including assessing their computational complexity and applicability.

Year: Second	M.Sc. Mathematics	Semester: III
MMT9305T	**Advanced Topology**	**3-0-0-3**

Course Outcome: Upon completing this course, students will be able to:

1	Recall and understand the fundamental concepts of topology, including point-set topology, algebraic topology, and differential topology.
2	Explain and interpret topological concepts, such as homotopy, homology, and cohomology, and apply them to solve problems.
3	Use topological techniques to solve problems in mathematics and other fields, such as physics, computer science, and engineering.
4	Analyze and compare different topological spaces and structures, and identify their properties and relationships.
5	Construct and prove original results in topology, using a variety of techniques and tools.
6	Evaluate and critique the work of others in topology, and identify areas for further research and development.

Year: Second	M.Sc. Mathematics	Semester: III
MMT9306T	**Mathematical Cryptography**	**3-0-0-3**

Course Outcome: Upon completing this course, students will be able to:	
1	Define and explain the fundamental concepts of number theory, including prime numbers, modular arithmetic, and elliptic curves.
2	Describe and illustrate the relationships between different areas of mathematics.
3	Apply mathematical techniques to analyze and design cryptographic protocols.
4	Analyze and interpret complex cryptographic protocols.
5	Design and propose new cryptographic protocols and systems
6	Evaluate the security and efficiency of different cryptographic protocols and systems.

Year: Second	M.Sc. Mathematics	Semester: III
MMT9307T	**Functional Analysis**	**3-0-0-3**

Course Outcome: Upon completing this course, students will be able to:

1	Define and explain the fundamental concepts of functional analysis, including normed spaces, Banach spaces, Hilbert spaces, and operator theory.
2	Describe and illustrate the relationships between different areas of functional analysis.
3	Apply functional analysis techniques to solve real-world problems.
4	Analyze and interpret complex functional analysis models.
5	Design and propose new functional analysis models and methods to solve real-world problems.
6	Evaluate the effectiveness of different functional analysis techniques and models in solving real-world problems.

Year: Second	**M.Sc. Mathematics**	Semester: III
MMT9308T	**Fluid Dynamics**	**3-0-0-3**

Course Outcome: Upon completing this course, students will be able to:

1	Define and explain the fundamental concepts of fluid dynamics, including fluid properties, fluid flow, and fluid behavior.
2	Describe and illustrate the relationships between different areas of fluid dynamics.
3	Apply fluid dynamics principles to solve real-world problems, including fluid flow, heat transfer, and mass transport.
4	Analyze and interpret complex fluid dynamics models, including identifying patterns, trends, and correlations.
5	Design and propose new fluid dynamics models and methods to solve real-world problems.
6	Evaluate the effectiveness of different fluid dynamics techniques and models in solving real-world problems.

Year: Second	M.Sc. Mathematics	Semester: III
MMT9309T	**Measure and Integration**	**3-0-0-3**
Course Outcome: Upon completing this course, students will be able to:		
1	Recall and apply the fundamental concepts of measure theory, including Lebesgue measure and outer measure.	
2	Explain and illustrate the relationships between different areas of measure theory, including the connections between Lebesgue measure and Lebesgue integration.	
3	Apply measure theory and integration principles to solve real-world problems, including probability theory and functional analysis.	
4	Analyze and interpret complex measure theory and integration models, including identifying patterns, trends, and correlations.	
5	Design and propose new measure theory and integration models and methods to solve real-world problems	
6	Evaluate the effectiveness of different measure theory and integration techniques and models in solving real-world problems.	

Year: Second	**M.Sc. Mathematics**	Semester: III
MMT93010T	**Fuzzy Sets and Its Applications**	**3-0-0-3**

Course Outcome: Upon completing this course, students will be able to:	
1	Recall and apply the fundamental concepts of fuzzy sets, including fuzzy membership functions, fuzzy operations, and fuzzy relations.
2	Explain and illustrate the relationships between different areas of fuzzy sets, including the connections between fuzzy sets and crisp sets.
3	Apply fuzzy set theory to solve real-world problems, including decision-making, control systems, and data analysis.
4	Analyze and interpret complex fuzzy set models, including identifying patterns, trends, and correlations.
5	Design and propose new fuzzy set models and methods to solve real-world problems, including applications in engineering, economics, and computer science.
6	Evaluate the effectiveness of different fuzzy set techniques and models in solving real-world problems.

Year: Second	**M.Sc. Mathematics**	Semester: III
MMT93011T	**Algebraic Coding Theory**	**3-0-0-3**
Course Outcome: Upon completing this course, students will be able to:		
1	Define and explain the fundamental concepts of algebraic coding theory, including error-correcting codes, linear codes, and cyclic codes.	
2	Describe and illustrate the relationships between different areas of algebraic coding theory, including the connections between linear codes and cyclic codes.	
3	Apply algebraic coding theory principles to solve real-world problems.	
4	Analyze and interpret complex algebraic coding theory models, including identifying patterns, trends, and correlations.	
5	Design and propose new algebraic coding theory models and methods to solve real-world problems.	
6	Evaluate the effectiveness of different algebraic coding theory techniques and models in solving real-world problems, including assessing their accuracy, precision, and robustness.	

M.Sc. Biotechnology

(Effective from Academic Year 2023-2024 onwards)

Faculty of Basic and Applied Sciences

Madhav University

Bharja, Tehsil – Pindwara, Sirohi (Rajasthan) 307026

Contact Number: Mob: +91 8875028991/92

Email Address: info@madhavuniversity.edu.in

Web: www.madhavuniversity.edu.in

Program Outcome (POs):

PO1	Students will be able to develop experimental and scientific skills for critical thinking and ability to tackle and solve scientific problems.
PO2	Students will be able to explore new areas of research in different fields of Basic and Applied Sciences.
PO3	To develop interdisciplinary approach of the subject.
PO4	Improve the skills to succeed in research and industrial field. Moreover, students will acquire the ability to conduct experiments, operate scientific instruments, research planning, executing and performing in laboratory experiments.
PO5	To use the knowledge to develop technologies which are sustainable and eco-friendly.
PO6	To make them learn logical thinking to address a problem and become result oriented.
PO7	Students will develop communication skills for expressing ideas clearly and effectively.
PO8	To encourage and facilitate innovations, nurture startups and foster entrepreneurship. After completion of programme the students will be encouraged to apply logical reasoning based on the knowledge, skills, designing solutions to assess societal, health, safety issues and the responsibilities that go along with the scientific practice.
PO9	With the pursuit of knowledge for either personal or professional reasons, learners are also encouraged to volunteer and be self-motivated that not only enhances society values, active participation and personality development, but also enhances self-sustainability, competiveness and employability. To sensitize students and employees about their responsibilities to reach out to community for social harmony and environmental protection.
PO10	Integrate biotechnology knowledge with emerging disciplines such as bioinformatics, systems biology, and synthetic biology to address complex biological challenges.
PO11	Enhance entrepreneurial skills by understanding the commercialization of biotechnological research and fostering startups and innovation in the biotech industry.
PO12	Cultivate awareness of ethical, legal, and societal implications of biotechnology, focusing on biosafety, bioethics, and intellectual property rights.

Program Specific Outcomes (PSOs)

This course enables the students:

PSO1 After completion of M.Sc. programme student will acquire complete knowledge of basic and applied aspects of Biotechnology courses and will be able to analyze the mechanisms involved in life processes up to the molecular level.

PSO2 To inculcate research specific culture among students.

PSO3 To identify a research problem and to formulate a scientific solutions for the benefit of the society and mankind.

PSO4 The students will gain the knowledge of basic concepts and the scientific principles related to different scientific phenomena and their importance in the daily life.

PSO5 The students will become familier with the different brances of Biotechnology. They will also learn to apply appropriate techniques for the qualitative analysis of the biomolecules in the laboratories and in all industries.

PSO6 Opputtunities to persue Ph.D. programme, orientes apporoaches CSIR-NET, UGC-NET, GATE examination.

PSO7 After completion of post graduguate, student will understand depth knowledge of modern aspects of biotechnology such as Molecular Biology, Fermentation technology, Immunology etc., and their applications for human welfare and ecological significance.

Year: First		Semester: I
M.Sc. Biotechnology		
MBT9101T	**Introduction to Biotechnology**	**4-0-0-4**
Course Outcome:		
1	The students will be able to comprehend Biotechnology types and its significance.	
2	Able to apply Biotechnology in Industry, Agriculture, Forensic science.	
3	Identify the products of Biotechnology and its effect on human welfare.	
4	Evaluate the societal implications and ethical issues associated with biotechnology.	
5	Explore career opportunities in biotechnology and develop strategies for career advancement.	
6	Recognize the role of biotechnology in addressing environmental challenges and promoting sustainability.	

Year: First		Semester: I
M.Sc. Biotechnology		
MBT9102T	**Principles of Biochemistry**	**4-0-0-4**
Course Outcome:		
1	Understand the structure, isomerism, and functional roles of various types of charbohydrates.	
2	Understand the biochemical pathways of glycolysis, citric acid cycle, gluconeogenesis, glycogenesis, and glycogenolysis, and their significance in cellular metabolism.	
3	Gain knowledge of the building blocks and types of lipids, including their structural roles in membranes and metabolic pathways .	
4	Understand the classification of amino acids, their metabolic pathways and grasp the fundamentals of protein structure, function, and enzyme kinetics.	
5	Learn the structure and function of nucleotides and nucleic acids, including the synthesis and breakdown of purine and pyrimidine nucleotides and the structure of RNA and DNA.	
6	Identify disorders related to purine and pyrimidine metabolism and stay informed on recent advances and applications in biochemistry.	

Year: First		Semester: I
M.Sc. Biotechnology		
MBT9103T	**Introduction to Microbiology**	**4-0-0-4**

Course Outcome:	
1	Gain an understanding of the historical development of microbiology.
2	Learn various microbiological methods including maintenance and preservation of microbial cultures.
3	Understand classification systems and the use of DNA and rRNA sequencing in classifying microorganisms.
4	Understand the general features and ecological roles of different microorganisms.
5	Explore microbial growth and metabolism, and the presence and adaptations of microbes in extreme environments like deep oceans, space, and air.
6	Identify the scope and applications of microbiology.

Year: First		Semester: I
M.Sc. Biotechnology		
MBT9101P	**Biotechnology Laboratory-I**	**0-0-4-2**

Course Outcome:	
1	Students will be able to describe the structure and classification of monosaccharides, identify aldoses and ketoses, and explain their ring structures, conformations, mutarotation, and the concepts of anomers, epimers, and enantiomers.
2	Students will study the structure, properties, and biological significance of disaccharides such as maltose, lactose, and sucrose.
3	Students will distinguish between homo- and hetero-polysaccharides and understand their roles as structural and storage polysaccharides in biological systems.
4	Students will understand key metabolic pathways including glycolysis, the production of acetyl CoA, the citric acid cycle, gluconeogenesis, glycogenesis, and glycogenolysis, and their regulatory mechanisms.
5	Students will learn about the building blocks of lipids, storage lipids, structural lipids in membranes, the β-oxidation of fatty acids, the fatty acid synthase complex, and the synthesis of fatty acids.
6	Students will classify amino acids, understand their chemical reactions and physical properties, introduce protein structure and function, and understand enzyme classification, kinetics (Km, kcat, Vmax), and inhibition.

Year: First		Semester: I
M.Sc. Biotechnology		
MBT9102P	**Biotechnology Laboratory-II**	**0-0-4-2**
Course Outcome:		
1	Demonstrate proficiency in physical and chemical methods to eliminate microbial contaminants effectively.	
2	Acquire skills in isolating and maintaining pure microbial cultures using diverse cultivation methods.	
3	Learn Gram staining and acid-fast staining for visualizing and classifying bacterial cells based on their structural characteristics.	
4	Acquire techniques for long-term maintenance and preservation of microbial cultures, including cryopreservation.	
5	Understand and apply binomial nomenclature and sequencing techniques to accurately classify and explore microbial diversity and evolutionary relationships.	
6	Study symbiotic and parasitic relationships among microorganisms, exploring their ecological roles and impacts on ecosystems and human health.	

Year: First		Semester: I
M.Sc. Biotechnology		
MBT9104T	**Genetics**	**4-0-0-4**
Course Outcome:		
1	Understand and apply the principles of Mendelian inheritance, including gene interactions and molecular basis of single gene inheritance.	
2	Analyze and interpret patterns of inheritance, including codominance, incomplete dominance, and sex-linked traits.	
3	Explore mechanisms of linkage, recombination, and gene mapping through linkage analysis and genetic mapping techniques.	
4	Investigate the concepts, types, and mechanisms of genetic mutations and their consequences on genome structure and function.	
5	Examine the structure and organization of prokaryotic and eukaryotic genomes, including chromatin remodeling and epigenetic inheritance.	
6	Study gene transfer mechanisms in prokaryotes, transposons, and regulatory processes in bacterial operons and phages.	

Year: First		Semester: I
M.Sc. Biotechnology		
MBT9105T	**Analytical Techniques**	**4-0-0-4**
Course Outcome:		
1	Understand the principles of microscopy, including resolving power, magnification, and applications of various microscopy techniques.	
2	Master techniques in electrophoresis, including agarose and polyacrylamide gel electrophoresis, and their applications in protein and nucleic acid analysis.	
3	Gain proficiency in various chromatographic techniques, including paper, thin layer, column, and high-performance liquid chromatography, for the separation and analysis of biomolecules.	
4	Learn the principles and applications of centrifugation techniques for the separation of cellular components and biomolecules.	
5	Explore the principles, instrumentation, and applications of spectroscopic techniques such as UV-visible, infrared, NMR, and mass spectrometry in molecular biology.	
6	Investigate advanced molecular biology techniques, including proteomics, yeast hybrid systems, and phage display, and their recent advancements and applications.	

Year: First		Semester: II
M.Sc. Biotechnology		
MBT9201T	**Cell and Molecular Biology**	**4-0-0-4**
Course Outcome:		
1	Describe the structural and functional differences among archaea, prokaryotic, and eukaryotic cells, including animal and plant cells.	
2	Explain the structure and functions of the nucleus, ER, Golgi apparatus, lysosomes, mitochondria, chloroplasts, and peroxisomes.	
3	Understand the fluid mosaic model, membrane proteins, lipids, and mechanisms of transport across cell membranes, including passive and active transport.	
4	Describe the organization and function of cytoskeletal proteins, and the role of actin and myosin in cellular movement and muscle contraction.	
5	Analyze cell-matrix and cell-cell interactions, including various junctions like adherens, tight junctions, gap junctions, desmosomes, and plasmodesmata.	
6	Understand DNA replication, repair, recombination, gene structure, transcription, RNA processing, translation, and mechanisms of gene regulation in prokaryotes and eukaryotes.	

Year: First		Semester: II
M.Sc. Biotechnology		
MBT9202T	**Immunology**	**4-0-0-4**
Course Outcome:		
1	Explain the components of the host defense system, including hematopoiesis, immune cells, and lymphoid organs, and their roles in innate and adaptive immunity.	
2	Describe the structure, distribution, and effector functions of immunoglobulin classes and subclasses, and understand the mechanisms of antibody diversification and B cell maturation.	
3	Understand the mechanisms of complement activation, MHC organization, and the pathways of antigen processing and presentation.	
4	Describe the structure and function of T cell receptors, the development and differentiation of T cells, and the roles of effector T cells and natural killer cells in immune responses.	
5	Explain the mechanisms of immune tolerance, autoimmunity, and the different types of hypersensitivity reactions, along with the immunological basis of graft rejection and immunosuppressive therapies.	
6	Demonstrate knowledge of immunological techniques such as ELISA, Western blot, immunohistochemistry, and immunocytochemistry, and understand the principles and types of vaccines used in active and passive immunization.	

Year: First		Semester: II
M.Sc. Biotechnology		
MBT9203T	**Biosafety, Bioethics and IPR**	**4-0-0-4**
Course Outcome:		
1	Understand the principles and historical background of biosafety, including biological safety cabinets and primary containment for biohazards.	
2	Comprehend the classification and recommended biosafety levels for specific microorganisms, infectious agents, and infected animals.	
3	Gain knowledge of GMOs, LMOs, and the principles of safety assessment of transgenic plants, including risk assessment processes.	
4	Familiarize with international and Indian biosafety regulations, including the Cartagena Protocol, OECD, Codex Alimentarius, EPA act, and other regulatory frameworks.	
5	Explore bioethics in research and its implications in cloning, stem cell research, and genetically engineered food.	
6	Acquire insights into the basics of patenting, including types, procedures, international requirements, and commercialization of patented innovations.	

Year: First		Semester: II
M.Sc. Biotechnology		
MBT9201P	**Biotechnology Laboratory-I**	**0-0-4-2**
Course Outcome:		
1	**Proficiency in cellular organelle isolation and visualization:** Master techniques for isolating and visualizing nuclei, mitochondria, and chloroplasts, enhancing understanding of cellular structure and function.	
2	**Comprehensive understanding of cell membrane properties:** Analyze the fluid mosaic model, membrane proteins, and lipid composition affecting membrane fluidity, crucial for understanding cellular transport and signaling.	
3	**Expertise in cellular transport mechanisms:** Explore passive and active transport mechanisms, including ATPases, ABC transporters, ion channels, and aquaporins, critical for cellular homeostasis and signaling.	
4	**Knowledge of cell-cell and cell-matrix interactions:** Examine cellular junctions (adherens, tight, gap junctions) and their roles in cell adhesion and communication, essential for understanding tissue function and development.	

5	**Understanding of cytoskeletal dynamics:** Study cytoskeletal proteins like actin and myosin and their involvement in cellular movements, including vesicle transport and muscle contraction, crucial for cellular structure and motility.
6	**Application of omics techniques in cellular biology:** Integrate genomics, transcriptomics, and proteomics to analyze gene expression and regulation, exploring recent advancements in cellular research and biotechnology.

Year: First		Semester: II
M.Sc. Biotechnology		
MBT9202P	**Biotechnology Laboratory-II**	**0-0-4-2**
Objective	Develop comprehensive skills in isolating and identifying immune cells using flow cytometry and immunohistochemistry, investigating antigen-antibody interactions via ELISA and Western blot assays, exploring complement activation pathways, understanding MHC antigen presentation, analyzing immune responses and hypersensitivity reactions, and navigating biosafety, regulatory frameworks, and patenting processes in biotechnology.	
Course Outcome:		
1	Acquire skills in isolating and identifying immune cells using techniques such as flow cytometry and immunohistochemistry, enabling detailed cellular analysis.	
2	Apply ELISA and Western blot assays to investigate antigen-antibody interactions, epitope mapping, and antibody specificity, crucial for immunodiagnostic and therapeutic research.	
3	Explore classical, alternative, and lectin pathways of complement activation using biochemical assays, understanding their roles in immunity and disease pathology.	
4	MHC class I and II proteins, using experimental models to explore antigen processing and presentation pathways, essential for understanding adaptive immune responses.	
5	Conduct experiments to analyze immune responses like hypersensitivity reactions (Type I-IV), evaluating mechanisms, clinical implications, and potential therapeutic interventions.	
6	Understand and apply protocols for biosafety, navigate international and Indian regulatory frameworks governing GMOs and biotechnology, and gain insights into patenting procedures and IP management.	

Year: First		Semester: II
M.Sc. Biotechnology		
MBT9204T	**Genetic Engineering**	**4-0-0-4**
Objective	To provide basic and high throughput techniques in the areas of genomics and genetic engineering.	% Weightage
Course Outcome:		
1	Students will be proficient in isolating and purifying genomic DNA, plasmid DNA, and RNA using various methods.	
2	Understand and apply methods for separation and quantification of nucleic acids, including Southern and Northern hybridizations.	
3	Gain competency in various types of PCR, such as hot start PCR, gradient PCR, RT-PCR, and qPCR, and their applications in molecular biology.	
4	Learn the methods involved in constructing and screening genomic and cDNA libraries for gene discovery and expression analysis.	
5	Understand the principles of recombinant DNA technology, including the biology and applications of plasmids, phage vectors, BACs, and YACs. Gain proficiency in cloning and expression vector features, enzyme use, and large-scale protein expression and purification.	
6	Explore the applications of genetic engineering, including gene therapy, diagnostics, therapeutics, vaccines, and crop improvement. Understand genome editing techniques like CRISPR-Cas9 and their impact on biotechnology.	

Year: First		Semester: II
M.Sc. Biotechnology		
MBT9205T	**Omics in Biotechnology**	**4-0-0-4**
Objective	To provide detailed understanding of major Omics technologies such as genomics, transcriptomics, proteomics and metabolomics etc.	% Weightage
Course Outcome:		
1	Understand the principles and applications of omics techniques in various branches of biotechnology, including medical and agricultural sectors.	
2	Trace the historical development of DNA sequencing methods from early techniques to modern genome sequencing projects.	
3	Compare and contrast different sequencing platforms such as Sanger, Illumina, Nanopore, and PacBio, emphasizing their strengths and limitations.	
4	Demonstrate proficiency in the basic steps of library preparation and analysis for genomics and transcriptomics data.	
5	Evaluate genomics data using metrics like sequencing depth, coverage, and quality scores (e.g., Phred score, N50, L50).	

6	Apply omics tools and databases for tasks such as differential expression analysis, gene ontology, pathway mapping, and non-coding RNA analysis in biotechnological research.

Year: Second	**M.Sc. Biotechnology**	Semester: III
MBS9301T	**Bio-Instrumentation**	**2-0-0-2**

Course Outcome:	
1	Understand specific engineering and instrumentation methods and principles to acquire basic knowledge of design, application, and use of biological instruments.
2	Students will be able to understand the use of basic bio-instrumentation, principles, and techniques.
3	Students will be familiar and more comfortable to handle the laboratory equipment.
4	Develop a comprehensive understanding of bio-instrumentation and its applications.
5	Students will be able to select the instruments and techniques involved in particular experiment.
6	Students would gain knowledge of DNA Sequencing and genome and application of other tool in the field of molecular biology.

Year: Second	**M.Sc. Biotechnology**	Semester: III
MRM9301T	**Research Methodology**	**3-0-0-3**

Course Outcome:	
1	Understand and equip the students with a basic understanding of the underlying principles of quantitative and qualitative research methods
2	Understand key research concepts and able to concrete understanding of the methods of doing research, data collection, and analysis
3	Able to select and define appropriate research problem and parameters and understand various research methods, including interview, content analysis, focus group discussions, and surveys.
4	Able to organize and conduct research (advanced project) in a more appropriate manner.
5	Understand the motivation of research, learn the techniques of defining and solving research problems, and develop skills in research report writing
6	Able to write a research report and a research proposal for grants.

Year: Second	**M.Sc. Biotechnology**	Semester: III
MBS9301P	**Bio-Instrumentation Laboratory**	**0-0-2-1**
Course Outcome:		
1	Able to learn basic principles of instruments and understand the various principles on which laboratory instruments works	
2	Familiar and more comfortable to handle the laboratory equipments	
3	Acquire knowledge of design, application, and principles of instrumentation and gain ability to gather and handle information, and develop computational skills from various tools.	
4	To understand the handling and safety measures of laboratory instruments.	
5	Able to select the instruments and techniques involved in particular experiment.	
6	Understand the various techniques used in laboratory experimentation.	

Year: Second		Semester: III
M.Sc. Biotechnology		
MBT9301T	**Microbial Biotechnology**	**3-0-0-3**
Course Outcome:		
1	Explain principles of fermentative production for industrial products, focusing on microorganisms, inoculum preparation, fermentation, and recovery processes.	
2	Design and implement microbial production processes, prepare media, conduct fermentation, and execute downstream processing.	
3	Gain knowledge of microorganisms involved in industrial production, including inoculum management and strain roles.	
4	Acquire proficiency in using microbial enzymes, steroid transformations, and biopesticides, including recovery and purification techniques.	
5	Understand vaccine production principles, types, methods, and the role of microorganisms, including microbial products from GMOs.	
6	Identify and discuss recent advances in industrial microbiology and biotechnology, evaluating their impact on industry and society.	

Year: Second		Semester: III
M.Sc. Biotechnology		
MBT9302T	**Agriculture Biotechnology**	**3-0-0-3**
Course Outcome:		
1	Understand plant reproduction, breeding methods for self- and cross-pollinated crops, and principles like heterosis and heritability.	
2	Explain the types, properties, and applications of molecular markers, including Marker-Assisted Selection (MAS) and NGS in plant breeding.	
3	Gain proficiency in plant tissue culture methods, including callus, suspension, protoplast cultures, micropropagation, and somatic embryogenesis.	
4	Apply genetic engineering methods like Agrobacterium-mediated transformation, RNAi, CRISPR-CAS9, and develop transgenic plants for improved traits.	
5	Develop genetically engineered crops for biotic and abiotic stress tolerance and improve crop quality in terms of protein, lipids, carbohydrates, vitamins, and minerals.	
6	Understand the regulations, patenting, and ethical concerns surrounding GM crops, including GATT, TRIPS, Plant Breeders' Rights, and biosafety issues.	

Year: Second	**M.Sc. Biotechnology**	Semester: III
MBT9303T	**Environmental Biology**	**3-0-0-3**
Course Outcome:		
1	Global environmental issues, their causes, consequences and amelioration.	
2	Understand and evaluate the global scale of environmental problems.	
3	The environmental studies prepare students for carriers as leader in understanding and addressing complex environmental issues.	
4	Developing skill sets for research, employability and entrepreneurship	
5	Finding sustainable solutions to issues pertaining to environment, health, agriculture etc.	
6	Understanding environmental surroundings and sustainable development are the main objectives. It entails being conscious of how human behavior affects the environment and acting to advance sustainability.	

Year: Second		Semester: III
M.Sc. Biotechnology		
MBT9304T	**Cell & Tissue Banking and Cryopreservation**	**3-0-0-3**

Course Outcome:	
1	Explain the fundamentals, scope, and need of cell and tissue banking, including cryopreservation.
2	Describe the processing, preservation, validation, and quality control of different organ tissues.
3	Understand cord blood banking, including donor recruitment, collection, processing, testing, and regulatory issues.
4	Describe the tissue banking of skin, musculoskeletal, ocular, cardiovascular tissues, and sperm, including their structure, function, and processing.
5	Explain the principles and applications of cryopreservation, including thermodynamics, cryogenic fluids, and production of low temperatures.
6	Understand the effects of freezing on cells, thawing processes, and the use of cryoprotectants.

Year: Second	**M.Sc. Biotechnology**	Semester: III
MBT9305T	**Biology of Parasites-I**	**3-0-0-3**
Course Outcome: After completion of the course students will be able:		
1	Understand the basic concepts of parasitology and different types of parasites and their parasitic adaptation.	
2	Understand the host parasitic relationship and its specificity on endoparasites and ectoparasites.	
3	Learn the general characters, classification and life cycle of Protozoan parasites *Trypanosoma gambiense,* and *Leishmania donovani*.	
4	Learn the general classification and characters and various larval forms of Trematodes.	
5	Understand the basics of the parasitic life-mode in the context of ecological and gain knowledge about parasites and epidemiology of parasites in human and animals.	
6	Equip students with a comprehensive understanding of parasites and parasitism.	

Year: Second	**M.Sc. Biotechnology**	Semester: III
MBT9306T	**Biology of Parasites-II**	**3-0-0-3**
Course Outcome: After completion of the course students will be able:		
1	Develop expertise directly applicable to human, plant and animal health and welfare, food security and the future sustainability of food production, particularly within livestock and plant/crop production systems.	
2	Gain the opportunity to improve experience in internationally competitive laboratories.	
3	Understand the morphology, life cycles, and pathogenicity of nematode parasites, including those affecting humans and animals.	
4	Understand the importance of nematodes in various ecosystems and their impact on host ecology and the economic impacts of parasites on agriculture, the role of vectors in emerging diseases.	
5	Understand the mechanisms of nematode infection, including invasion, multiplication, and host tissue reaction and their pathology, treatment and control of major parasites which can be applied to various fields of biology.	
6	Able to identify and classify nematode parasites, including plant and animal parasites.	
	Understand advanced knowledge on some important microbial and beneficial nematodes parasites such as entomopathogenic nematodes.	

7	Gain advanced knowledge on parasitological research method.

Year: Second	**M.Sc. Biotechnology**	Semester: III
MBT9307T	**Biochemistry of Parasites**	**3-0-0-3**
Course Outcome: After completion of the course students will be able:		
1	Understanding of the basic principles of host biochemistry of parasite and acquire knowledge of chemical nature of parasite and host pathogen.	
2	develop a scientific attitude in students, enabling them to think in an open-minded manner and to understand the concepts of parasites and epidemiology of parasites in human and animals	
3	Understand biological structures and importance of molecular interactions and their implication in functional aspects of life.	
4	Able to solve problems based on Biomolecules, pathways, energetics of parasite.	
5	Able to perform biochemical and molecular techniques to plan and carry out experiments in parasitology.	
6	To develop understanding of the molecular biology of parasites and understanding of the current trends in molecular parasitology.	

Year: Second	**M.Sc. Biotechnology**	Semester: III
MBT9302P	**Parasitology Laboratory**	**0-0-2-1**
Course Outcome: After completion of the course students will be able:		
1	Understand on prevention and control measures of parasitic diseases of public health and agriculture importance through field work.	
2	Gain advanced knowledge on major veterinary parasites and phynematodes of agricultural importance.	
3	Understand the techniques of collection, processing, and identification of various parasitic pathogens.	
4	Understanding of the biology and life cycles of major parasites and their vectors or intermediate hosts	
5	Gain practical knowledge of various techniques used in examination of living hosts, collection, preservation, permanent slides preparation and identification of arthropod vectors	
6	Understand the life cycles for the major parasites of animals and agricultural crops.	

Year: Second	**M.Sc. Biotechnology**	Semester: III
MBT9308T	**Animal Biotechnology**	**3-0-0-3**

Course Outcome:	
1	Give students an intensive and in-depth learning in the field of biotechnology.
2	Understand the modern biotechnology practices and approaches with an emphasis in technology application, medical, industrial, environmental and agricultural areas.
3	Students will learn technologies of gene transfer used in human, mice, sheep, pigs, goats, caws, fish and cattle's embryo transfer and in vitro fertilization.
4	Students will learn the Public concern about the Human Genome Research and Transgenics, Ethics in Clinical Trials and Good Clinical Practices (GCP), Ethical, Legal and Social Implications (ELSI) & Human Genome Project; Ethics in Human Cloning and Patenting Human Genes.
5	Illustrate the regulations and principles Biosafety guidelines, levels and regulations in India.
6	Consolidate field and laboratory skills in animal biotechnology and an appreciation of how these skills are applied in research.

Year: Second		Semester: III
M.Sc. Biotechnology		
MBT9309T	**Fermentation and Bioprocess Technology**	**3-0-0-3**

Course Outcome:	
1	Explain the concepts and types of fermentation, including batch, fed-batch, continuous, submerged, and solid-state fermentations.
2	Describe the structure, applications, and types of bioreactors, such as stirred tank, air-lift, packed bed, fluidized, and bubble column reactors.
3	Understand sterilization processes, microbial growth kinetics, and factors affecting fermentation, including aeration, agitation, and heat transfer.
4	Apply methods for media formulation, optimization, and monitoring of bioprocesses using computer-based data acquisition and analysis.
5	Isolate and characterize industrially important microorganisms, including strain improvement techniques and the concept of primary and secondary metabolites.
6	dDemonstrate knowledge of biological mixture separation, cell disruption, and purification techniques, as well as the processing and packaging of fermentation products.

Year: Second	**M.Sc. Biotechnology**	Semester: III
MBT9310T	**Developmental Biology**	**3-0-0-3**

Course Outcome:	
1	Understand and explain the basics of developmental biology.
2	Understand the structural and functional details of the basic unit of life at the molecular level.
3	Explain the new developments in molecular biology and its implications in human welfare.
4	Understand cellular receptor mechanisms and cell signalling.
5	Understand the process Gamete development in male-female gonads and types of eggs.
6	Understand the fertilization process along with cleavage, blastulation and gastrulation process.

Year: Second		Semester: III
M.Sc. Biotechnology		
MBT9303P	**Biological Science Laboratory**	**0-0-2-1**

Course Outcome:	
1	Develop proficiency in culturing and maintaining mammalian cell lines, employing proper aseptic techniques and effectively monitoring cell growth and viability.
2	Gain expertise in performing DNA extraction and quantification from animal tissues, followed by the application of polymerase chain reaction (PCR) amplification techniques.
3	Acquire the skills to design and conduct a batch fermentation process for the production of a target metabolite, while accurately monitoring key parameters such as pH, temperature, and nutrient consumption.
4	Master the purification and characterization of products obtained from fermentation processes using advanced techniques such as chromatography and spectrophotometry.
5	Attain the ability to observe and document the early developmental stages of model organisms, including zebrafish or Drosophila, from fertilization to gastrulation.
6	Develop competency in manipulating gene expression in developing embryos using techniques such as microinjection or CRISPR-Cas9, and analyzing the resulting phenotypic outcomes.

Year: Second		Semester: III
M.Sc. Biotechnology		
MBT9311T	**Medical Biotechnology**	**3-0-0-3**
Course Outcome:		
1	Understand the fundamental principles and applications of medical biotechnology.	
2	Develop proficiency in molecular biology techniques and tools used in medical research.	
3	Analyze the genetic basis of diseases and the role of biotechnology in diagnostics and therapeutics.	
4	Apply knowledge of cell culture, immunological methods, and bioinformatics in medical biotechnology.	
5	Evaluate the ethical, legal, and social implications of advancements in medical biotechnology.	
6	Integrate interdisciplinary knowledge to address current challenges and innovations in medical biotechnology.	

Year: Second		Semester: III
M.Sc. Biotechnology		
MBT9312T	**Molecular Medicine**	**3-0-0-3**
Course Outcome:		
1	Understand the fundamental concepts and significance of molecular medicine.	
2	Apply molecular biology techniques in the context of medical research.	
3	Analyze the genetic and molecular basis of various diseases.	
4	Explore therapeutic approaches, including gene and stem cell therapies, in treating diseases.	
5	Evaluate the ethical, legal, and social implications of advancements in molecular medicine.	
6	Integrate interdisciplinary knowledge to address challenges and innovations in the field of molecular medicine.	

Year: Second		Semester: III
M.Sc. Biotechnology		
MBT9313T	**Biomedical Engineering**	**3-0-0-3**
Course Outcome:		
1	Understand the fundamental concepts and applications of biomedical engineering.	
2	Apply knowledge of human anatomy and physiology to biomedical engineering problems.	
3	Utilize signal processing techniques for analyzing biomedical signals.	
4	Explore principles and techniques of medical imaging and diagnostics.	
5	Design and develop biomedical devices using appropriate materials.	
6	Evaluate ethical, regulatory, and practical considerations in biomedical engineering.	

Year: Second		Semester: III
M.Sc. Biotechnology		
MBT9303P	**Medical Biology Laboratory**	**0-0-2-1**
Course Outcome:		
1	Understand fundamental principles and techniques in medical biology laboratory experiments.	
2	Apply scientific methods and experimental protocols effectively in laboratory settings.	
3	Analyze experimental data and draw conclusions based on scientific evidence.	
4	Develop practical skills in handling biological samples and using laboratory equipment.	
5	Demonstrate proficiency in documenting experimental procedures and results.	
6	Collaborate effectively in a laboratory setting and communicate findings clearly.	

M.Sc. Botany

(Effective from Academic Year 2023-2024 onwards)

Faculty of Basic and Applied Sciences

Madhav University

Bharja, Tehsil – Pindwara, Sirohi (Rajasthan) 307026

Contact Number: Mob: +91 8875028991/92

Email Address: info@madhavuniversity.edu.in

Web: www.madhavuniversity.edu.in

Program Outcome (POs):

PO1 Students will be able to develop experimental and scientific skills for critical thinking and ability to tackle and solve scientific problems.

PO2 Students will be able to explore new areas of research in different fields of Basic and Applied Sciences.

PO3 To develop interdisciplinary approach of the subject.

PO4 Improve the skills to succeed in research and industrial field. Moreover, students will acquire the ability to conduct experiments, operate scientific instruments, research planning, executing and performing in laboratory experiments.

PO5 To use the knowledge to develop technologies which are sustainable and eco-friendly.

PO6 To make them learn logical thinking to address a problem and become result oriented.

PO7 Students will develop communication skills for expressing ideas clearly and effectively.

PO8 To encourage and facilitate innovations, nurture startups and foster entrepreneurship. After completion of programme the students will be encouraged to apply logical reasoning based on the knowledge, skills, designing solutions to assess societal, health, safety issues and the responsibilities that go along with the scientific practice.

PO9 With the pursuit of knowledge for either personal or professional reasons, learners are also encouraged to volunteer and be self-motivated that not only enhances society values, active participation and personality development, but also enhances self-sustainability, competiveness and employability. To sensitize students and employees about their responsibilities to reach out to community for social harmony and environmental protection.

PO10 Students will learn the beginning of research during the exposure gained while persuing dissertation/project work.

Program Specific Outcomes (PSOs)

This programme enables the students:

PSO1 After completion of M.Sc. programme student will acquire complete knowledge of basic and applied aspects of Botany courses and will be able to analyze the mechanisms involved in life processes up to the molecular level.

PSO2 To inculcate research specific culture among students.

PSO3 To identify a research problem and to formulate a scientific solutions for the benefit of the society and mankind.

PSO4 The students will gain the knowledge of basic concepts and the scientific principles related to different scientific phenomena and their importance in the dalil life.

PSO5 The students will become familier with the different branches of Botany. They will also learn to apply appropriate techniques for the qualitative analysis of the biochemicalsin the laboratories and in all industries.

PSO6 Opputtunities to persue Ph.D. programme, orientesapporoaches CSIR-NET, UGC-NET, GATE examination.

PSO7 The Master's specializations inEcology/Plant Physiology/Systematic Botany give the students depth knowledge of Ecosystem/Plants/Classification of Plants, their economic importance and ecological significance.

Exit policy: As per the university NEP Ordinance.

Year: First	**M.Sc. Botany**	Semester: I
MBO9101T	**Diversity of Lower Plants**	**4-0-0-4**

Course Outcome:

1	To know about the algae, bryophyte and pteridophytes, and their ecological importance.
2	To understand the economic importance of lower plants
3	To understand the evolutionary trends in lower plants
4	To understand the structure and organization of vegetative and reproductive organs.
5	To understand the life cycle of the algae, bryophytes and pteridophytes
6	To understand the morphology and anatomy of lower plants.

Year: First	**M.Sc. Botany**	Semester: I
MBO9102T	**Diversity of SeedPlants**	**4-0-0-4**

Course Outcome:	
1	Describe the characteristics and diversity of Gymnosperms, including their evolution, structure, and reproduction.
2	Explain the principles of Angiosperm taxonomy, including the species concept, taxonomic hierarchy, and International Code of Botanical Nomenclature.
3	Identify and apply various taxonomic evidence, including morphology, anatomy, palynology, embryology, cytology, phytochemistry, and genome analysis.
4	Utilize taxonomic tools, such as herbaria, floras, and molecular techniques, to classify and identify plant species.
5	Compare and contrast different systems of Angiosperm classification, including phenetic and phylogenetic systems, and evaluate their merits and demerits.
6	Analyze the concepts of phytogeography, including endemism, hotspots, plant explorations, invasions, and introductions, and their socio-economic importance.

Year: First	**M.Sc. Botany**	Semester: I
MBO9103T	**Cell and Molecular Biology**	**4-0-0-4**

Course Outcome:	
1	Students will be able to understand the structure, chemistry, and functions of cell and cellular organelles.
2	Know molecular biology in relation to genetic material, its inheritance, modification, replication and repair.
3	Understand transcription, translation post translation modification of protein.
4	Understand structural organization and variation in chromosomes as well as karyotype analysis.
5	Learn about the extra-chromosomal inheritance in the plant system.
6	Understanding of gene structure, expression and regulation of gene expression in both prokaryotes and eukaryotes for application in molecular research.

Year: First	**M.Sc. Botany**	Semester: I
MBO9101P	**Botany Laboratory-I**	**0-0-4-2**

Course Outcome:	
1	To understand the range of thallus structure in algae.
2	To understand morphological study of available plant material of Algae, Bryophytes, Pteridophytes and Gymnosperms.
3	To know about anatomical study of available plant material of Bryophytes, Pteridophytes and Gymnosperms.
4	To Study of life cycle of available plant material of Algae, Bryophytes, Pteridophytes and Gymnosperms.
5	To understand vascular tissues and its constituents by sections and maceration, wood anatomy, TS, TLS, and RLS.
6	To know about the systematic position of Generas, Species and, and Families.

Year: First	**M.Sc. Botany**	Semester: I
MBO9102P	**Botany Laboratory-II**	**0-0-4-2**

Course Outcome:	
1	Identify and describe the different components of a cell using a light microscope.
2	Prepare and observe temporary and permanent mounts of cells and tissues.
3	Demonstrate the presence of starch, proteins, and DNA in plant and animal cells using various tests.
4	Observe and describe the mitotic stages in onion root tips and the movement of chromosomes during mitosis.
5	Extract and visualize cellular components, such as chloroplasts, using simple protocols.
6	Apply Gram staining to distinguish between Gram-positive and Gram-negative bacteria.

Year: First	**M.Sc. Botany**	Semester: I
MBO9104T	**Plant Growth and Development**	**4-0-0-4**

Course Outcome:

1	Describe the structure and function of higher plants, including cells, meristems, tissues, and tissue systems.
2	Explain the concepts of plant growth and development from an organismal perspective, including seed germination, seedling growth, and adult plant formation.
3	Identify and describe the stages of plant reproduction, including floral evocation, microsporogenesis, megasporogenesis, and fertilization.
4	Analyze the development of seeds and fruits, including endosperm development, embryogenesis, and fruit growth and ripening.
5	Compare and contrast alternative development strategies in plants, including embryonic development of somatic cells and pollen grains.
6	Apply knowledge of plant growth and development to real-world scenarios, demonstrating understanding of plant biology and its applications.

Year: First	**M.Sc. Botany**	Semester: I
MBO9105T	**Bioinstrumentation**	**4-0-0-4**

Course Outcome:

1	Discuss the applications of biophysics and principle involved in bioinstruments
2	Describe the methodology involved in biotechniques
3	Describe the applications of bioinstruments
4	Demonstrate knowledge and practical skills of using instruments in biology and medical field
5	Perform techniques involved in molecular biology and diagnosis of diseases
6	Update current knowledge regarding biomedical engineering involving new methods and the instrumentation

Year: First	**M.Sc. Botany**	Semester: II
MBO9201T	**Plant Physiology & Biochemistry**	**4-0-0-4**
Course Outcome:		
1	To distinguish secondary from primary tissues in woody stem and root growth.	
2	To understand how to apply the basic concepts of Plant Physiology in other disciplines of agriculture.	
3	To understand, to know and discuss the concept of physiological processes of plants.	
4	To understand and describe the distribution of metabolic processes in the cell.	
5	To understand the importance of mineral nutrition, transpiration, photosynthesis and respiration of plant organisms.	
6	To understand and explain the processes of growth and development of plants.	

Year: First	**M.Sc. Botany**	Semester: II
MBO9202T	**Genetics & Evolution**	**4-0-0-4**
Course Outcome:		
1	To understand the pattern of inheritance of various life forms.	
2	To develop strong fundamentals for further molecular studies.	
3	To Explore Sex chromosome and sex linked inheritance, linkage and crossing over.	
4	To Explore Ploidy, Aneuploidy and Euploidy, polyploidy and its significance.	
5	To Introduce fundamental evolutionary processes, including the sources of variation, natural selection, and the evidence for organic evolution.	
6	To Understand the role of genetic code in polypeptide formation.	

Year: First	**M.Sc. Botany**	Semester: II
MBO9203T	**Economic Botany**	**4-0-0-4**

Course Outcome:	
1	Detailed study of occurrence, mode of cultivation, process product and nutritional values of Major and minor cereals.
2	Detailed study of occurrence, mode of Cultivation, process product and nutritional values of Vegetables and Nuts.
3	Detailed study of occurrence, mode of cultivation, process product and nutritional values of sugar yielding plants and spices and condiments.
4	Detailed study of occurrence, mode of cultivation, process product and nutritional values of Medicinal plants, narcotics and Timber yielding plants.
5	Detailed study of occurrence, mode of cultivation, process product and nutritional values of various beverage plants

Year: First	**M.Sc. Botany**	Semester: II
MBO9201P	**Botany Laboratory-I**	**0-0-4-2**
Course Outcome:		
1	Operate and interpret results from pH meters, colorimeters, spectrophotometers, and fluorimeters.	
2	Analyze chlorophyll content and ratios in C3 and C4 plants.	
3	Prepare and interpret absorption spectra of chlorophyll a and estimate total chlorophyll content.	
4	Determine enzyme activity and induction in germinating seeds and estimate vitamin C content.	
5	Investigate the Hill Reaction and effects of salt stress on proline accumulation.	
6	Compare protein estimation methods and analyze enzyme activity, substrate concentration, and isozyme separation.	

Year: First	**M.Sc. Botany**	Semester: II
MBO9202P	**Botany Laboratory-I**	**0-0-4-2**
Course Outcome:		
1	Apply Mendelian genetics principles to analyze the interaction of genes and linkage, and map genes using statistical tests of goodness of fit.	
2	Design and conduct experiments to induce polyploidy using colchicine and prepare C-metaphase for karyotyping.	
3	Analyze the effects of physical and chemical mutagens on early seedling growth and isolate chlorophyll mutants using irradiation and chemical mutagenesis.	
4	Explain the meiotic process in complex translocation heterozygotes and apply knowledge of quantitative inheritance to analyze plant traits.	
5	Identify and classify economically important plants of the region through field surveys and study their local uses and products.	
6	Apply ethnobotanical or systematic botany principles to analyze plant specimens and communicate findings effectively.	

Year: First	**M.Sc. Botany**	Semester: II
MBO9204T	**Ethnobotany**	**4-0-0-4**

Course Outcome:

1	Study the interactions of people and plants.
2	Learn the functions, roles, and uses of plants in Micronesian culture.
3	Learn scientific systems of plant classification.
4	Explore Micronesian systems for organizing plants.
5	Study the diversity of plants.
6	Learn plant names, both scientific and local Micronesian names.

Year: First	**M.Sc. Botany**	Semester: II
MBO9205T	**Genetic Engineering of Plants**	**4-0-0-4**

Course Outcome:

1	Explain the principles and applications of biotechnology, including its genesis, prospects, and impacts on various fields.
2	Design and construct vectors for genetic engineering, including plasmids, bacteriophage, and viral vectors.
3	Apply restriction enzymes and other molecular biology tools to manipulate and analyze DNA molecules.
4	Analyze the impacts of biotechnology on agri-biodiversity, medicine, industry, and environment, and discuss ethical and social issues.
5	Design and execute gene cloning, expression, and targeting experiments, including DNA labeling, sequencing, and blotting techniques.
6	Develop and optimize bioprocesses for the production of cell biomass, enzymes, and organic compounds, and apply bioreactor designs and bioseparation methods for industrial applications.

Year: Second	**M.Sc. Botany**	Semester: III
MRM9301T	**Research Methodology**	**3-0-0-3**

Course Outcome:	
1	Understand and equip the students with a basic understanding of the underlying principles of quantitative and qualitative research methods
2	Understand key research concepts and able to concrete understanding of the methods of doing research, data collection, and analysis
3	Able to select and define appropriate research problem and parameters and understand various research methods, including interview, content analysis, focus group discussions, and surveys.
4	Able to organize and conduct research (advanced project) in a more appropriate manner.
5	Understand the motivation of research, learn the techniques of defining and solving research problems, and develop skills in research report writing
6	Able to write a research report and a research proposal for grants.

Year: Second	**M.Sc. Botany**	Semester: III
MBS9301T	**Bio-Instrumentation**	**2-0-0-2**
Objective	The course also aims to provide students with a comprehensive understanding of biological instrumentation principles, device design, and their applications. Additionally, the course provides the students to enable them the principles of biological instrumentation, its operation, testing, significance and their maintenance.	% weightage

Course Outcome:	
1	Understand specific engineering and instrumentation methods and principles to acquire basic knowledge of design, application, and use of biological instruments.
2	Students will be able to understand the use of basic bio-instrumentation, principles, and techniques.
3	Students will be familiar and more comfortable to handle the laboratory equipment.
4	Develop a comprehensive understanding of bio-instrumentation and its applications.
5	Students will be able to select the instruments and techniques involved in particular experiment.
6	Students would gain knowledge of DNA Sequencing and genome and application of other tool in the field of molecular biology.

Year: Second	**M.Sc. Botany**	Semester: III
MBS9301P	**Bio-Instrumentation Laboratory**	**0-0-2-1**

Course Outcome:	
1	Able to learn basic principles of instruments and understand the various principles on which laboratory instruments works
2	Familiar and more comfortable to handle the laboratory equipments
3	Acquire knowledge of design, application, and principles of instrumentation and gain ability to gather and handle information, and develop computational skills from various tools.
4	To understand the handling and safety measures of laboratory instruments.
5	Able to select the instruments and techniques involved in particular experiment.
6	Understand the various techniques used in laboratory experimentation.

Year: Second	**M. Sc. in Botany**	Semester: III
MBO9301T	**Ecology**	**3-0-0-3**

Course Outcome:

1	By understanding the concepts of ecological principles and environmental issues, the student will be able to develop attitude, value system and ethics towards environment related issues.
2	They will understand the concept, types, development and functions of various ecosystems and their communication.
3	The various environmental factors governing these ecosystems are also clearly understood.
4	Explore the concept of Ecosystem and ecology
5	Students will understand the population community ecology
6	Explore Ecosystem dynamics, Energy flow models and mineral cycling.

Year: Second	**M.Sc. Botany**	Semester: III
MBO9302T	**Stress Physiology**	**3-0-0-3**

Course Outcome:

1	Students will understand various aspects of plant physiology and molecular biology
2	To acquire advanced knowledge about environmental stresses.
3	To understand the effect of stress with emphasis on drought, high temperature, high light intensity and salt on growth, development and metabolism.
4	To know the mechanisms of physiological and biochemical adaptation to stresses.
5	To understand the physiology of desert plants and halophytes.
6	To acquire the knowledge about the improvement of crop growth and production under stress.

Year: Second	**M.Sc. Botany**	Semester: III
MBO9303T	**Forest Ecology**	**3-0-0-3**

Course Outcome:

1	Understand the fundamental principles of forest ecology, including forest structure, function, and dynamics
2	Analyze the interactions between trees, organisms, and their environment in forest ecosystems
3	Examine the impact of human activities on forest health and sustainability
4	Apply ecological principles to forest management and conservation practices
5	Develop critical thinking and problem-solving skills in addressing forest ecology issues

Year: Second	**M.Sc. Botany**	Semester: III
MBO9304T	**Population Ecology**	**3-0-0-3**

Course Outcome:

1	Understand the fundamental principles of population ecology, including population growth, decline, and extinction
2	Analyze the factors that influence population dynamics, including demographic, environmental, and evolutionary factors
3	Apply population ecology principles to conservation and management of populations
4	Develop critical thinking and problem-solving skills in addressing population ecology issues

Year: Second	**M.Sc. Botany**	Semester: III
MBO9305T	**Conservation Ecology**	**3-0-0-3**
Course Outcome:		
1	Analyze the importance of biodiversity and ecosystem services in maintaining ecological integrity and human well-being.	
2	Identify and explain the primary causes of biodiversity loss, including habitat destruction, climate change, and invasive species.	
3	Design and evaluate conservation strategies for protecting and restoring ecosystems, including protected areas, species conservation, and ecosystem restoration.	
4	Apply conservation ecology principles to real-world conservation challenges, including case studies and scenario-based exercises.	

Year: Second	**M.Sc. Botany**	Semester: III
MBO9301P	**Ecology laboratory**	**0-0-2-1**

Course Outcome:	
1	Apply Mendelian genetics principles to analyze the interaction of genes and linkage, and map genes using statistical tests of goodness of fit.
2	Design and conduct experiments to induce polyploidy using colchicine and prepare C-metaphase for karyotyping.
3	Analyze the effects of physical and chemical mutagens on early seedling growth and isolate chlorophyll mutants using irradiation and chemical mutagenesis.
4	Explain the meiotic process in complex translocation heterozygotes and apply knowledge of quantitative inheritance to analyze plant traits.
5	Identify and classify economically important plants of the region through field surveys and study their local uses and products.
6	Apply ethnobotanical or systematic botany principles to analyze plant specimens and communicate findings effectively.

Year: Second	**M.Sc. Botany**	Semester: III
MBO9306T	**Secondary Metabolites**	**3-0-0-3**

Course Outcome:	
1	Explain the definition, classification, and importance of secondary metabolites in plants.
2	Describe the biosynthetic pathways of alkaloids, glycosides, phenolics, terpenes, and polyketides.
3	Identify and explain the pharmacological and toxicological properties of secondary metabolites.
4	Discuss the medicinal applications of secondary metabolites in various diseases and disorders.
5	Analyze the regulation of secondary metabolite production in plants.
6	Apply knowledge of secondary metabolites to develop new drugs and therapeutic agents.

Year: Second	**M.Sc. Botany**	Semester: III
MBO9307T	**Biotic Stress**	**3-0-0-3**

Course Outcome:	
1	Understand the concept of biotic stress and its impact on crop production.
2	Identify different types of biotic stresses, including bacterial, viral, fungal, and parasitic stresses.
3	Explain the effects of biotic stresses on plant growth and development.
4	Describe strategies to overcome biotic stresses, including cultural, chemical, and biological controls.
5	Analyze the role of biotic stresses in crop yield and quality.
6	Develop an integrated approach to manage biotic stresses in crop production.

Year: Second	M.Sc. Botany	Semester: III
MBO9308T	**Abiotic stress**	**3-0-0-3**
Course Outcome:		
1	Define and explain the concept of abiotic stress and its impact on plant growth and development.	
2	Identify and describe the different types of abiotic stresses affecting crop production.	
3	Analyze the effects of abiotic stress on plant physiology and productivity.	
4	Discuss the strategies for mitigating abiotic stress in plants, including genetic and agronomic approaches.	
5	Apply knowledge of abiotic stress to develop sustainable crop production practices.	
6	Critically evaluate the role of abiotic stress in shaping plant evolution and adaptation	

Year: Second	M.Sc. Botany	Semester: III
MBO9302P	**Stress Physiology Laboratory**	**0-0-2-1**
Course Outcome:		
1	Explain the process and role of various genetic and molecular mechanisms in stress tolerance and resistance.	
2	Identify and explain essential ideas in biological sciences, including stress biology.	
3	Apply knowledge of molecular biology and genetics to understand stress responses in organisms.	
4	Describe the life-cycle of micro-organisms and differentiate between bacteria and algae in the context of stress biology.	
5	Understand the importance of stress management techniques and psychotherapies in controlling chronic stress.	
6	Imbibe the details of stress biology as a foundation for advanced studies in cell biology and biotechnology	

Year: Second	**M.Sc. Botany**	Semester: III
MBO9309T	**Horticulture**	**3-0-0-3**

Course Outcome:	
1	Explain the factors affecting plant growth, including light, temperature, water, and nutrients.
2	Recognize and categorize different types of horticultural crops, including fruits, vegetables, ornamentals, and nursery crops.
3	Explain the physical, chemical, and biological properties of soil and their impact on plant growth.
4	Design and implement efficient irrigation systems and water management strategies for horticultural crops.
5	Identify common pests and diseases affecting horticultural crops and develop IPM strategies for their control.
6	Explain the principles of greenhouse management, including climate control, lighting, and pest management.

Year: Second	**M.Sc. Botany**	Semester: III
MBO9310T	**Plant Pathology**	**3-0-0-3**
Course Outcome:		
1	Explain the causes of plant diseases, including biotic and abiotic factors, and classify diseases based on their causal agents.	
2	Recognize and diagnose common plant diseases caused by fungi, bacteria, viruses, nematodes, and other pathogens.	
3	Explain the principles of disease management and control, including cultural, chemical, biological, and integrated pest management (IPM) strategies.	
4	Explain the role of plant breeding in developing disease-resistant crop varieties and its significance in plant disease management.	
5	Understand the principles of plant disease forecasting and surveillance, including monitoring and prediction of disease outbreaks.	
6	Apply knowledge of plant disease management in agricultural production, including crop rotation, sanitation, and quarantine.	

Year: Second	**M.Sc. Botany**	Semester: III
MBO9311T	**Seed Technology**	**3-0-0-3**
Course Outcome:		
1	Understand the principles of seed production and processing	
2	Identify and classify different types of seeds and their characteristics	
3	Describe the importance of seed quality control and certification	
4	Explain the principles of seed storage and preservation	
5	Demonstrate knowledge of seed testing and evaluation techniques	
6	Apply knowledge of seed technology in agricultural production	

Year: Second	**M.Sc. Botany**	Semester: III
MBO9303P	**Plant Science Laboratory**	**0-0-2-1**

Course Outcome:

1	Design and implement effective seed treatment and health testing protocols to control seed-borne diseases.
2	Standardize seed testing procedures for quality control and certification.
3	Develop and promote disease-resistant and tolerant crop varieties.
4	Improve seed quality through advanced seed production and processing technologies.
5	Apply integrated pest management strategies for seed-borne diseases.
6	Develop and promote organic and biological seed treatments.

M.Sc. Zoology

(Effective from Academic Year 2023-2024 onwards)

Faculty of Basic and Applied Sciences

Madhav University

Bharja, Tehsil – Pindwara, Sirohi (Rajasthan) 307026

Contact Number: Mob: +91 8875028991/92

Email Address: info@madhavuniversity.edu.in

Web: www.madhavuniversity.edu.in

Program Outcome (POs):

PO1	Students will be able to develop experimental and scientific skills for critical thinking and ability to tackle and solve scientific problems.
PO2	Students will be able to explore new areas of research in different fields of Basic and Applied Sciences.
PO3	To develop interdisciplinary approach of the subject.
PO4	Improve the skills to succeed in research and industrial field. Moreover, students will acquire the ability to conduct experiments, operate scientific instruments, research planning, executing and performing in laboratory experiments.
PO5	To use the knowledge to develop technologies which are sustainable and eco-friendly.
PO6	To make them learn logical thinking to address a problem and become result oriented.
PO7	Students will develop communication skills for expressing ideas clearly and effectively.
PO8	To encourage and facilitate innovations, nurture startups and foster entrepreneurship. After completion of programme the students will be encouraged to apply logical reasoning based on the knowledge, skills, designing solutions to assess societal, health, safety issues and the responsibilities that go along with the scientific practice.
PO9	With the pursuit of knowledge for either personal or professional reasons, learners are also encouraged to volunteer and be self-motivated that not only enhances society values, active participation and personality development, but also enhances self-sustainability, competiveness and employability. To sensitize students and employees about their responsibilities to reach out to community for social harmony and environmental protection.
PO10	Students will learn the beginning of research during the exposure gained while persuing dissertation/project work.
PO11	Students will be able to develop and implement research projects to address scientific questions and hypotheses, including the ability to design and conduct experiments, collect and analyze data, and draw conclusions based on evidence.
PO12	Students will be able to develop and implement science-based policies and programs to address global challenges, including the ability to analyze complex scientific information, identify patterns and trends, and develop innovative solutions to scientific problems.

Program Specific Outcomes (PSOs)

This programme enables the students:

PSO1	After completion of M.Sc. programme student will acquire complete knowledge of basic and applied aspects of Zoology courses and will be able to analyze the mechanisms involved in life processes up to the molecular level.
PSO2	To inculcate research specific culture among students.
PSO3	To identify a research problem and to formulate a scientific solutions for the benefit of the society and mankind in large.
PSO4	The students will gain the knowledge of basic concepts and the scientific principles related to different scientific phenomena and their importance in the daily life.
PSO5	The students will become familier with the different brances of Zoology. They will also learn to apply appropriate techniques for the qualitative analysis of the biomolecules in the laboratories and in all industries.
PSO6	Opputtunities to persue Ph.D. programme, orientes apporoaches CSIR-NET, UGC-NET, GATE examination.
PSO7	The Master's specializations, Parasitology/Fish Biology/Entomology, give the students in depth knowledge of parasite/fish/insect life cycle, economic importance and ecological significance.

Year: First	**M.Sc. Zoology**	Semester: I
MZO9101T	**Animal Taxonomy and Economic Zoology**	**4-0-0-4**
Course Outcome: After completion of the course students will be able to:		
1	Define the principles of animal taxonomy, including the classification, nomenclature, and phylogeny of animals.	
2	Explain the principles of animal taxonomy, including the classification, nomenclature, and phylogeny of animals and compare and contrast the different types of animal products, including their uses and applications.	
3	Develop a plan for the conservation and management of animal populations, including the use of taxonomic principles.	
4	Analyze the phylogenetic relationships between different taxonomic groups of animals.	
5	Design a plan for the conservation and management of a specific animal population, including the use of taxonomic principles.	
6	Critique a scientific study on animal taxonomy or economic zoology, including the use of taxonomic principles. Develop a research proposal to study the taxonomy or economic importance of a specific group of animals.	

Year: First	**M.Sc. Zoology**	Semester: I
MZO9102T	**Evolutionary Biology**	**4-0-0-4**

Course Outcome: After completion of the course students will be able to:

1	Define the key concepts of evolutionary biology, including natural selection, genetic drift, and gene flow.
2	Explain the mechanisms of evolution, including natural selection, genetic drift, and gene flow. Describe the process of phylogenetic reconstruction, including the use of morphological and molecular data.
3	Apply the principles of evolutionary biology to real-world problems, including conservation biology and evolutionary medicine.
4	Compare and contrast the different mechanisms of evolution, including their strengths and limitations. Evaluate the evidence for evolution, including the strengths and limitations of different types of data.
5	Design a research plan to investigate the evolution of a specific group of organisms.
6	Evaluate the strengths and limitations of different theories of evolution. Assess the impact of human activities on the evolution of organisms and ecosystems.

Year: First	**M.Sc. Zoology**	Semester: I
MZO9103T	**Non-Chordata**	**4-0-0-4**
Course Outcome: After completion of the course students will be able to:		
1	Identify the different phyla of non-chordate animals, including Porifera, Cnidaria, Platyhelminthes, Nematoda, and Annelida. Recall the unique features of each phylum, including their morphology, anatomy, and physiology.	
2	Describe the adaptations of non-chordate animals to their environments, including their feeding behaviors, locomotion, and sensory systems.	
3	Use non-chordate animals as models to understand basic biological principles, including development, physiology, and ecology.	
4	Analyze the phylogenetic relationships between non-chordate animals and other animal groups, including the use of molecular and morphological data.	
5	Design an experiment to investigate the biology of a specific non-chordate animal group, including the use of laboratory and field techniques.	
6	Develop a research proposal to investigate the biology of a specific non-chordate animal group, including the use of laboratory and field techniques.	

Year: First	**M.Sc. Zoology**	Semester: I
MZO9101P	**Zoology Laboratory-I**	**0-0-4-2**

Course Outcome: After completion of the course students will be able to :	
1	Identify and describe the structure and function of various zoological specimens.
2	Explain the principles of microscopy, including the use of microscopes.
3	Apply knowledge of zoological techniques to prepare and analyze specimens, including the use of microscopy and dissection.
4	Students will understand the organization system in insects by dissection of available organism and other economic insect pest and learn their general anatomy etc.
5	Analyze the structure and function of zoological specimens, including the use of microscopy and dissection.
6	Design a new experiment to investigate a zoological question, including the use of microscopy, dissection, and experimentation.

Year: First	**M.Sc. Zoology**	Semester: I
MZO9102P	**Zoology Laboratory-II**	**0-0-4-2**
Course Outcome: After completion of the course students will be able:		
1	Recognize the safety protocols and precautions for working with zoological specimens and equipment.	
2	Discuss the importance of zoological experimentation, including the design of experiments and the analysis of data.	
3	Use laboratory equipment and instruments to conduct zoological experiments, including the measurement of physiological parameters.	
4	Compare and contrast the different types of zoological data, including morphological, physiological, and behavioral data.	
5	Develop a novel technique for preparing and analyzing zoological specimens, including the use of new equipment and instruments.	
6	Assess the validity of a zoological technique, including the evaluation of its strengths and limitations.	

Year: First	**M.Sc. Zoology**	Semester: I
MZO9104T	**Cell and Molecular Biology**	**4-0-0-4**
Course Outcome: After completion of the course students will be able to:		
1	Define the key concepts of cell and molecular biology, including the structure and function of cells, cellular metabolism, and the regulation of gene expression. Recall the major organelles and their functions, including the nucleus, mitochondria, and ribosomes.	
2	Explain the process of cellular metabolism, including glycolysis, the citric acid cycle, and oxidative phosphorylation.	
3	Apply knowledge of cell and molecular biology to understand the mechanisms of disease, including cancer, genetic disorders, and infectious diseases.	
4	Analyze the structure and function of biomolecules, including proteins, carbohydrates, and nucleic acids.	
5	Design a new experiment to investigate a specific cellular or molecular process, including the development of a hypothesis and the design of experimental protocols.	
6	Develop a reflective essay on the significance of cellular and molecular biology in understanding the natural world.	

Year: First	**M.Sc. Zoology**	Semester: I
MZO9105T	**Environmental Toxicology and Health**	**4-0-0-4**
Course Outcome: After completion of the course students will be able to:		
1	Identify the different types of pollutants, including chemicals, heavy metals, and pesticides, and their sources and effects on the environment.	
2	Explain the mechanisms of toxicity, including the absorption, distribution, metabolism, and excretion of pollutants.	
3	Apply knowledge of environmental toxicology and health to real-world problems, including the assessment and mitigation of pollution.	
4	Compare and contrast the different types of pollution, including their sources, effects, and mitigation strategies.	
5	Develop a new method for assessing and mitigating the effects of pollutants, including the use of innovative technologies and approaches.	
6	Evaluate the impact of environmental toxicology and health on policy and decision-making, including the consideration of economic, social, and environmental factors.	

Year: First	**M.Sc. Zoology**	Semester: II
MZO9201T	**Genetics and Biostatistics**	**4-0-0-4**
Course Outcome: After completion of the course students will be able to:		
1	Define key terms related to genetics and biostatistics, including genotype, phenotype, allele, and gene expression.	
2	Explain the mechanisms of genetic inheritance, including the role of DNA, RNA, and proteins in gene expression.	
3	Apply genetic and biostatistical concepts to analyze and interpret biological data, including the use of statistical software and tools.	
4	Develop basic genetics laboratory skills and problem-solving and analytical skills.	
5	Design a new experiment to investigate a genetic or biostatistical question, including the development of a hypothesis and the design of experimental protocols.	
6	Evaluate the impact of genetic and biostatistical research on our understanding of evolutionary processes and population dynamics. Reflect on the limitations and future directions of genetic and biostatistical research.	

Year: First	**M.Sc. Zoology**	Semester: II
MZO9202T	**Biotechnology & Bioinformatics**	**4-0-0-4**
Course Outcome: After completion of the course students will be able to:		
1	Define key terms related to biotechnology and bioinformatics, including DNA sequencing, genomics, and proteomics.	
2	Explain the principles of biotechnology, including the use of molecular biology and genomics to analyze and interpret biological data.	
3	Apply biotechnological and bioinformatic concepts to analyze and interpret biological data, including the use of molecular biology and genomics.	
4	Compare and contrast the results of different biotechnological and bioinformatic studies, including the identification of patterns and trends. Evaluate the evidence for biotechnological and bioinformatic concepts, including the consideration of confounding variables and biases.	
5	Design a new experiment to investigate a biotechnological or bioinformatic question, including the development of a hypothesis and the design of experimental protocols.	
6	Gain comprehensive understanding of biotechnology and bioinformatics, preparing them for careers in research, industry, and academia.	

Year: First	**M.Sc. Zoology**	Semester: II
MZO9203T	**Mammalian Physiology**	**4-0-0-4**
Course Outcome: After completion of the course students will be able to:		
1	To understand the fundamental principles of mammalian physiology	
2	Identify the different types of physiological systems, including the nervous, circulatory, respiratory, and digestive systems.	
3	Explain the mechanisms of physiological regulation, including feedback mechanisms and homeostasis.	
4	Apply knowledge of mammalian physiology to understand the mechanisms of disease and the effects of environmental factors on physiological processes.	
5	Discuss of feeding mechanisms and their control, effect of starvation.	
6	Evaluate the impact of physiological research on our understanding of health and disease.	

Year: First	**M.Sc. Zoology**	Semester: I
MZO9201P	**Zoology Laboratory-I**	**0-0-4-2**

Course Outcome: After completion of the course students will be able to:

1	Define key terms related to zoological techniques, including microscopy, dissection, and experimentation. Identify the different types of zoological equipment and instruments, including microscopes, dissecting tools, and laboratory equipment.
2	Understand the scientific knowledge of current research, elucidating their practical applications in biotechnology.
3	Discuss the importance of experimentation in zoology, including the design of experiments and the analysis of data.
4	Perform the molecular modeling and molecular dynamics methods to study structure from sequence.
5	Develop a research plan to investigate a zoological question, including the design of experiments and the analysis of data.
6	Analyze zoological data to identify patterns and trends, including the use of statistical methods and data analysis software.

Year: First	**M.Sc. Zoology**	Semester: I
MZO9202P	**Zoology Laboratory-II**	**0-0-4-2**
Course Outcome: After completion of the course students will be able to:		
1	Identify the different types of zoological equipment and instruments, including microscopes, dissecting tools, and laboratory equipment. Recall the procedures for preparing and staining zoological specimens, including histology and cytology.	
2	Describe the techniques for dissection and preparation of zoological specimens, including histology and cytology.	
3	Use laboratory equipment and instruments to conduct zoological experiments, including the measurement of physiological parameters.	
4	Understand the structure and types of carbohydrates.	
5	Design a new experiment to investigate a zoological question, including the development of a hypothesis and the design of experimental protocols.	
6	Assess the effectiveness of different zoological techniques, including their strengths and limitations.	

Year: First	**M.Sc. Zoology**	Semester: II
MZO9204T	**Biochemistry**	**4-0-0-4**

Course Outcome: After completion of the course students will be able to:

1	Identify the different types of biomolecules, including carbohydrates, proteins, lipids, and nucleic acids and recall the major metabolic pathways, including glycolysis, the citric acid cycle, and oxidative phosphorylation.
2	Compare and contrast the different types of biochemical reactions, including their mechanisms and regulation.
3	Apply knowledge of biochemistry to understand the mechanisms of biological processes, including the role of biomolecules and metabolic pathways.
4	Compare and contrast the results of different biochemical studies, including the identification of similarities and differences.
5	Create a research proposal to investigate a biochemical question, including the development of a research plan and the analysis of data.
6	Evaluate the chemical basis of biological molecules and their role in cellular processes.

Year: First	**M.Sc. Zoology**	Semester: II
MZO9205T	**Environmental Policies & Laws**	**4-0-0-4**

Course Outcome: After completion of the course students will be able to:

1	Define key terms related to environmental policies and laws, including conservation, sustainability, and environmental impact assessment.
2	Explain the principles of environmental policies and laws, including the concept of sustainability and the precautionary principle.
3	Apply knowledge of environmental policies and laws to real-world problems, including the development of environmental impact assessments and conservation plans.
4	Discuss the implications of environmental policy and law research for our understanding of environmental issues and the development of effective conservation strategies.
5	Acquire the skills needed for interpreting laws, policies and judicial decisions in a holistic perspective.
6	Assess the effectiveness of different environmental policies and laws, including their strengths and limitations.

Year: Second	**M.Sc. Zoology**	Semester: III
MRM9301T	**Research Methodology**	**3-0-0-3**
Course Outcome: After completion of the course students will be able to:		
1	Define key terms related to research methodology, including research design, sampling, and data analysis and recall the major steps involved in the research process, including problem formulation, literature review, and data collection.	
2	Explain the principles of research design, including the use of control groups and randomization and describe the process of sampling, including the use of probability and non-probability sampling methods.	
3	Apply knowledge of research methodology to design a research study, including the development of a research question and hypothesis.	
4	Analyze research data to identify patterns and trends, including the use of statistical methods and data analysis software.	
5	Design a new research study to investigate a research question, including the development of a research proposal and methodology section.	
6	Critique a research paper on research methodology, including the evaluation of methods, results, and conclusions.	

Year: Second	**M.Sc. Zoology**	Semester: III
MBS9301T	**Bio-Instrumentation**	**2-0-0-2**
Course Outcome: After completion of the course students will be able to:		
1	Define the fundamental principles of bio-instrumentation and its applications in medical and biological fields.	
2	Students will be able to understand the use of principle of various instrumentation, principles, and techniques.	
3	Apply bio-instruments to analyze data in a laboratory and troubleshoot common issues with bio-instruments and perform routine maintenance and familiar and more comfortable to handle the laboratory equipment.	
4	Evaluate the performance of bio-instruments using metrics such as accuracy, precision, and sensitivity.	
5	Students will be able to select the instruments and techniques involved in particular experiment.	
6	Evaluate the safety and regulatory compliance of bio-instruments and bio-instrumentation systems.	

Year: Second	**M.Sc. Zoology**	Semester: III
MBS9301P	**Bio-Instrumentation Laboratory**	**0-0-2-1**
Course Outcome: After completion of the course students will be able to:		
1	Remember basic principles of instruments and understand the various principles on which laboratory instruments works.	
2	Compare and contrast different instruments and handle the laboratory equipments.	
3	Use bio-instrumentation concepts to analyze and interpret biopotential signals, including the use of data analysis software and statistical methods.	
4	Analyze biological signals to identify patterns and trends, including the use of statistical methods and data analysis software.	
5	Create a research proposal to investigate a bio-instrumentation question, including the design of experiments and the analysis of data.	
6	Evaluate the impact of the various techniques used in laboratory experimentation.	

Year: Second	**M.Sc. Zoology**	Semester: III
MZO9301T	**Chordata**	**3-0-0-3**
Course Outcome: After completion of the course students will be able to:		
1	Define key terms related to Chordata, including notochord, dorsal hollow nerve cord, and pharyngeal slits and identify the different classes of Chordata, including Cephalochordata, Urochordata, and Vertebrata.	
2	Describe the evolution of chordates, including the development of the notochord and the origin of vertebrates.	
3	Use chordate anatomy and physiology to understand the functions of different systems, including the nervous, circulatory, and digestive systems.	
4	Analyze the structure and function of chordate systems, including the nervous, circulatory, and digestive systems.	
5	Develop a novel approach to studying chordates, including the use of innovative techniques and technologies.	
6	Evaluate the impact of chordate research on our understanding of animal evolution and ecology.	

Year: Second	**M.Sc. Zoology**	Semester: III
MZO9302T	**Immunology**	**3-0-0-3**
Course Outcome: After completion of the course students will be able to:		
1	Define key terms related to immunology, including antigen, antibody, and immune response identify the different types of immune cells, including T cells, B cells, and macrophages.	
2	Explain the structure and function of the immune system, including the role of immune cells and organs.	
3	Apply knowledge of immunology to understand the mechanisms of immune responses and the role of the immune system in health and disease.	
4	Analyze the mechanisms of immune responses, including the activation of immune cells and the production of antibodies.	
5	Design a new experiment to investigate a question related to immunology, including the development of a hypothesis and the design of experimental protocols.	
6	Assess the effectiveness of different immunological interventions, including vaccines and immunotherapies.	

Year: Second	**M.Sc. Zoology**	Semester: III
MZO9303T	**Environmental Biology**	**3-0-0-3**
Course Outcome: After completion of the course students will be able to:		
1	Define key terms related to environmental biology, including ecosystem, biodiversity, and conservation.	
2	Describe the impact of human activities on the environment, including deforestation, pollution, and climate change.	
3	Apply knowledge of environmental biology to understand the impact of human activities on the environment and use ecological principles to evaluate the effectiveness of conservation strategies, including habitat restoration and species reintroduction.	
4	Analyze the impact of human activities on ecosystems, including the effects of pollution, climate change, and habitat destruction.	
5	Develop a novel approach to environmental conservation, including the use of innovative technologies and strategies.	
6	Evaluate the impact of environmental biology research on understanding of the natural world and the development of effective conservation strategies.	

Year: Second	**M.Sc. Zoology**	Semester: III
MZO9304T	**Animal Biotechnology**	**3-0-0-3**
Course Outcome: After completion of the course students will be able to:		
1	Identify the different types of biotechnology techniques used in animal science.	
2	Discuss the applications of regenerative medicine in animal science, including tissue engineering and stem cell therapy.	
3	Apply knowledge of animal biotechnology to design and develop new biotechnology products.	
4	Analyze the impact of biotechnology on animal science, including the use of case studies and data analysis..	
5	Develop a novel approach to animal biotechnology, including the use of innovative techniques and technologies.	
6	Evaluate and discuss public and ethical concerns over the use of animal biotechnology and understand the regulations and principles Biosafety guidelines, levels and regulations in India.	

Year: Second	**M.Sc. Zoology**	Semester: III
MZO9305T	**Developmental Biology**	**3-0-0-3**
Course Outcome: After completion of the course students will be able to:		
1	Define and explain the fundamental concepts of developmental biology, including embryogenesis, morphogenesis, and pattern formation.	
2	Explain the relationships between developmental processes and the formation of tissues and organs.	
3	Apply experimental approaches and how they are applied to solve specific problems in cell and developmental biology.	
4	Evaluate the strengths and limitations of different experimental approaches in developmental biology.	
5	Design and propose an original research project in developmental biology, including a clear hypothesis, experimental approach, and expected outcomes.	
6	Critically evaluate the scientific literature in developmental biology, including the design, methods, and conclusions of published studies.	

Year: Second	**M.Sc. Zoology (Parasitology)**	Semester: III
MZO9306T	**Biology of Parasites-I**	**3-0-0-3**
Course Outcome: After completion of the course students will be able to:		
1	Define the major groups of parasites, including Protozoa, Trematode, and Cestode, and their characteristics. Identify the different types of parasitic infections and their impact on human health.	
2	Interpret the epidemiological data on parasitic diseases, including their prevalence, distribution, and risk factors.	
3	Design and implement experiments to study the biology and behavior of parasites, including their interactions with hosts and environments.	
4	Identify and prioritize research gaps in the field of parasitology, including the development of new diagnostic tools, treatments, and control strategies.	
5	Propose innovative solutions to address the challenges and limitations of current parasitology research and control efforts.	
6	Justify the importance of parasitology research and its relevance to human health, including the potential benefits and applications of new discoveries and technologies.	

Year: Second	**M.Sc. Zoology (Parasitology)**	Semester: III
MZO9307T	**Biology of Parasites-II**	**3-0-0-3**

Course Outcome: After completion of the course students will be able to:	
1	Define and explain the fundamental concepts of parasitology, including the life cycles, morphology, and classification of nematodes and arthropods.
2	Describe the impact of parasitic nematodes and arthropods on human and plant health, including the symptoms, diagnosis, and treatment of parasitic diseases.
3	Use parasitology principles to design and interpret experiments, including the use of model organisms, molecular biology techniques, and epidemiological studies.
4	Analyze and compare the life cycles, morphology, and behavior of different parasitic nematodes and arthropods to identify commonalities and differences.
5	Design and propose an original research project in parasitology, including a clear hypothesis, experimental approach, and expected outcomes.
6	Critically evaluate the scientific literature in parasitology, including the design, methods, and conclusions of published studies.

Year: Second	**M.Sc. Zoology (Parasitology)**	Semester: III
MZO9308T	**Biochemistry of Parasites**	**3-0-0-3**

Course Outcome: After completion of the course students will be able to:

1	Identify the key enzymes and biochemical markers involved in parasitic infections, such as lactate dehydrogenase and alkaline phosphatase.
2	Interpret the biochemical data from parasitological studies, including enzyme assays, chromatography, and spectroscopy.
3	Design and implement experiments to study the biochemical interactions between parasites and their hosts, including the effects of parasitic infection on host metabolism and immune responses.
4	Apply and prioritize research gaps in the field of parasitic biochemistry, including the development of new diagnostic tools, therapeutic strategies, and biochemical models.
5	Propose innovative solutions to address the challenges and limitations of current parasitic biochemistry research and applications.
6	Critique the current state of parasitic biochemistry research and identify areas for improvement, including the development of new research questions, hypotheses, and experimental approaches.

Year: Second	**M.Sc. Zoology (Parasitology)**	Semester: III
MZO9301P	**Parasitology Laboratory**	**0-0-2-1**
Course Outcome: After completion of the course students will be able to:		
1	Identify and describe the different types of parasites, including protozoa, helminths, and arthropods. Recall the life cycles of various parasites, including their hosts, vectors, and transmission modes.	
2	Describe the methods used to diagnose parasitic infections, including microscopy, serology, and molecular techniques. Compare and contrast the different types of parasitic infections, including their epidemiology, pathogenesis, and control measures.	
3	Develop and implement protocols for the collection, processing, and analysis of parasitological samples. Design and conduct experiments to study the biology and behavior of parasites, including their life cycles, transmission dynamics, and host-parasite interactions.	
4	Analyze the results of parasitological tests to identify patterns and trends in parasitic infections.	
5	Create a new diagnostic tool or technique for detecting parasitic infections, including the use of molecular techniques.	
6	Critique the current state of parasitology research and identify areas for improvement, including the development of new research questions, hypotheses, and experimental approaches.	

Year: Second	**M.Sc. Zoology (Fish Biology)**	Semester: III
MZO9309T	**General Fish Biology**	**3-0-0-3**

Course Outcome: After completion of the course students will be able to:

1	Define and explain the fundamental concepts of fish biology, including the classification, morphology, and anatomy of fish.
2	Describe the life cycles of different fish species, including their reproductive strategies, larval development, and growth patterns.
3	Apply knowledge of fish biology to understand the principles of aquaculture, including fish farming, hatchery management, and disease control.
4	Analyze and compare the morphological, physiological, and behavioral adaptations of different fish species to their environments.
5	Develop a model or hypothesis to explain a specific aspect of fish biology, such as the evolution of fish diversity or the impact of environmental factors on fish populations.
6	Assess the ethical implications of fish biology research, including the use of animal models, conservation efforts, and the impact of human activities on fish populations.

Year: Second	**M.Sc. Zoology (Fish Biology)**	Semester: III
MZO93010T	**Applied Fisheries**	**3-0-0-3**
Course Outcome: After completion of the course students will be able to:		
1	Define and explain the fundamental concepts of fisheries science, including the principles of fish population dynamics, fisheries management, and conservation.	
2	Explain the relationships between fish populations, fisheries, and the environment, including the impacts of habitat degradation, climate change, and pollution on fisheries.	
3	Apply knowledge of fisheries science to develop effective fisheries management plans, including the use of stock assessment models, fishing quotas, and marine protected areas.	
4	Gain fields skills in fisheries economics and engage in activities which will result in sustainable production systems and dissemination of knowledge to the society.	
5	Able to Exploit and utilize wisely fisheries resources using appropriate and innovative fishing methods.	
6	Design and propose an original research project in fisheries science, including a clear hypothesis, experimental approach, and expected outcomes and employment.	

Year: Second	**M.Sc. Zoology (Fish Biology)**	Semester: III
MZO93011T	**Morphology and Physiology of Fishes**	**3-0-0-3**

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

1	Define and explain the fundamental concepts of fish morphology, including the structure and function of different body parts.
2	Explain the relationships between fish morphology and physiology, including the adaptations of different fish species to their environments.
3	Use fish morphology and physiology principles to design and interpret experiments, including the use of laboratory and field techniques.
4	Evaluate the strengths and limitations of different research methods in fish morphology and physiology, including laboratory, field, and statistical approaches.
5	Design and propose an original research project in fish morphology and physiology, including a clear hypothesis, experimental approach, and expected outcomes.
6	Critically evaluate the scientific literature in fish morphology and physiology, including the design, methods, and conclusions of published studies.

Year: Second	**M.Sc. Zoology (Fish Biology)**	Semester: III
MZO9302P	**Fish Biology Laboratory-I**	**0-0-2-1**
Course Outcome: After completion of the course students will be able to:		
1	Recall the fundamental concepts of fish and fisheries, including the principles of fish biology, ecology, and conservation. Gain knowledge on experience in aquaculture through field trips and hands-on activities	
2	Utilize laboratory and field techniques to study fish and fisheries, including sampling methods, experimental design, and data analysis.	
3	Analyze and compare the morphological, physiological, and behavioral adaptations of different fish species to their environments.	
4	Evaluate the strengths and limitations of different research methods in fish and fisheries science, including laboratory, field, and statistical approaches.	
5	Utilize his/her skills wisely in fisheries resources by using appropriate and innovative fishing methods.	
6	Assess the ethical implications of fish and fisheries research, including the use of animal models, conservation efforts, and the impact of human activities on fish populations.	

Year: Second	**M.Sc. Zoology (Entomology)**	Semester: III
MZO93012T	**General Insect Biology**	**3-0-0-3**
Course Outcome: After completion of the course students will be able to:		
1	Recall the fundamental concepts of insect biology, including the structure and function of different body parts.	
2	Explain the relationships between insects and their environment, including the impacts of habitat degradation, climate change, and pollution on insect populations.	
3	Analyze and compare the morphological, physiological, and behavioral adaptations of different insect species to their environments.	
4	Able to demonstrate recognition of the major orders of insects and commonly encountered families.	
5	Assess the ethical implications of insect biology research, including the use of animal models, conservation efforts, and the impact of human activities on insect populations.	
6	Develop a comprehensive conservation plan for a specific insect species or ecosystem, integrating biological, ecological, and social considerations.	

Year: Second	**M.Sc. Zoology (Entomology)**	Semester: III
MZO93013T	**Anatomy and Physiology of Insect**	**3-0-0-3**

Course Outcome: After completion of the course students will be able to:

1	Recall the fundamental concepts of insect anatomy, including the structure and function of different body parts. Identify and describe the major systems of insects, including the nervous, circulatory, and digestive systems.
2	Explain the relationships between insect anatomy and physiology, including the adaptations of different insect species to their environments.
3	Apply knowledge of insect anatomy and physiology to understand the principles of insect behavior, ecology, and evolution.
4	Analyze and compare the anatomical and physiological adaptations of different insect species to their environments.
5	Evaluate the strengths and limitations of different research methods in insect anatomy and physiology, including laboratory, field, and statistical approaches.
6	Develop a comprehensive conservation plan for a specific insect species or ecosystem, integrating biological, ecological, and social considerations.

Year: Second	**M.Sc. Zoology (Entomology)**	Semester: III
MZO93014T	**Applied Entomology**	**3-0-0-3**

Course Outcome: After completion of the course students will be able to:

1	Define the scope and importance of applied entomology in agriculture, public health, and conservation.
2	Interpret the results of entomological research and its implications for agriculture, public health, and conservation.
3	Apply knowledge of entomology to identify and manage insect pests in agricultural and public health settings.
4	Evaluate the economic, environmental, and social impacts of insect pests and beneficial insects on agriculture, public health, and conservation.
5	Develop a comprehensive plan for promoting beneficial insects in agricultural and public health settings, including habitat creation and conservation.
6	Critique the current state of applied entomology research and identify areas for improvement, including the development of new research questions, hypotheses, and experimental approaches.

Year: Second	**M.Sc. Zoology (Entomology)**	Semester: III
MZO9303P	**Entomology Laboratory**	**0-0-4-2**

Course Outcome: After completion of the course students will be able to:

1	Identify and describe the different types of insects, including their characteristics and habits. Recall the life cycles of various insects, including their stages and habitats.
2	Explain the principles of insect identification, including the use of keys and taxonomic classification. Describe the role of insects in ecosystems, including their importance as pollinators, decomposers, and food sources.
3	Apply knowledge of entomology to identify and collect insects in the field. Use entomological techniques, such as sampling and monitoring, to assess insect populations and their impact on ecosystems.
4	Evaluate the effectiveness of different entomological methods and techniques, including their advantages and limitations.
5	Develop a comprehensive plan for managing insect pests and promoting beneficial insects in a specific ecosystem or agricultural setting. Create a new entomological tool or technique, such as a trap or a sampling device.
6	Evaluate the safety and efficacy of new entomological products and technologies, including pesticides and genetically modified organisms. Critique the current state of entomology research and identify areas for improvement, including the development of new research questions and hypotheses.