

## DEPARTMENT OF CHEMISTRY

### PROGRAMME SPECIFIC OUTCOMES

After successful completion of three year degree program in Physics a student shall be able to

PSO-1. Gain the knowledge of Chemistry through theory and practical's.

PSO-2. To explain nomenclature, stereochemistry, structures, reactivity, and mechanism of the chemical reactions.

PSO-3. Identify chemical formulae and solve numerical problems.

PSO-4. Use modern chemical tools, Models, Charts and Equipments.

PSO-5. Know structure-activity relationship.

PSO-6. Understand good laboratory practices and safety.

PSO-7. Develop research oriented skills.

PSO-8. Make aware and handle the sophisticated instruments/equipments

Semester I		
Paper code	Title of the paper	Learning outcome
<b>USCCHT01</b>	<b>INORGANIC CHEMISTRY</b>	CO-1. Know about atomic structure and Schrodinger wave equation. CO-2. Understand the term periodic properties and various periodic properties. CO-3. Solve numericals on effective nuclear charge. CO-4. Know about different theories of bonding like VSEPR. MOT etc CO-5. Understand knowledge of comparative study and salient features of S & P block elements. CO-6. Know about hydrogen bonding and its types. CO-7. Know about different types of Acid-base titration, Redox titration and complexometric titration.
<b>USCCHT02</b>	<b>ORGANIC CHEMISTRY</b>	CO-1. Know about various effects and electronic displacements. CO-2. Distinguish between homolysis & heterolysis. CO-3. Know about various types of hybridization with examples. CO-4. Know about various bond parameters. CO-5. Understand various types of chemical reactions. CO-6. Know about types of isomerism . CO-7. Know about optical, geometrical and conformational isomerism and their types. CO-8. Know about physical and chemical properties of alkanes, cycloalkanes ,Dienes and Alkynes. CO-9. Know about Aromatic hydrocarbon and Huckel's

		rule for aromaticity. CO-10. Know about activating and deactivating groups.
	<b>Practicals</b>	CO-1. Know about preparation of standard solution by dilution. CO-2. Know how to estimate Fe(II) by dichromate using internal indicator ( n-Phenyl Anthranilic acid) CO-3. Know about determination of Zn by complexometric titration by EDTA. CO-4. Understand how to find out total hardness of water sample CO-5. Understand about detection of extra elements ( N,S, Cl, Br, I) in organic compounds . CO-6. Know about systematic qualitative organic analysis of organic compounds possessing mono functional groups. CO-7. Understand about separation of mixtures by chromatography.
<b>Semester II</b>		
<b>USCCHT0 3</b>	<b>ORGANIC CHEMISTRY</b>	CO-1. Understand about halogen derivatives of alkyl and aryl halides.  CO-2. Know about E1 and E2 mechanism and their comparison. CO-3. Understand about benzyne mechanism. CO-4. Know about alcohols, phenols and ethers. CO-5. Know about carbonyl compounds and their preparation. CO-6. Understand concept of aromatic aldehydes. CO-7. Understand nomenclature of carboxylic acid and their derivatives. CO-8. Understand interconversion of acid derivatives by nucleophilic acyl substitution.
<b>USCCHT0 4</b>	<b>PHYSICAL CHEMISTRY</b>	CO-1. Know about mathematical concept , maxima & minima , Permutations and combinations & factorials.  CO-2. Understand ionic equilibrium , concept of common ion effect and buffer solution. CO-3. Understand about solubility and solubility product. CO-4. Know about different types of thermodynamic processes. CO-5. Know about various statements of first law of thermodynamics. CO-6. Understand concept of Joule-Thomson experiment and Joule-Thomson coefficient . CO-7. Understand concept of kinetic theory of gases. CO-8. Understand concept of different types of molecular velocities. CO-9. Understand concept of Ideal gases and real gases. CO-10. Understand properties of liquids like surface tension and viscosity.

		CO-11. Understand laws of Crystallography.
	<b>Practicals</b>	CO-1. Understand preparation and mechanism of organic preparation. CO-2: Know about how to determine heat capacity of calorimeter for different volumes. CO-3: Know about how to determine enthalpy of neutralization, enthalpy of ionization and internal heat of salts. CO-4: Understand how to determine coefficient of viscosity of the given liquid by Ostwald viscometer. CO-5. Understand about how to determine surface tension value of liquid by stalagmometer.
<b>Semester III</b>		
<b>USCCHT0 5</b>	<b>INORGANIC CHEMISTRY</b>	CO-1: Understand structure and bonding in diborane and borazine CO-2: Understand the preparation and structure of interhalogen compounds CO-3: Know about the radius ratio rule, coordination number, lattice energy CO-4: Understand the free electron theory, valence bond theory CO-5: understand the concept of Lewis acid and bases CO-6: known about the first transition series element and their properties CO-7: known about the second transition series elements and their electronic configuration CO-8: Understand the concept of Lanthanides and Actinides
<b>USCCHT0 6</b>	<b>PHYSICAL CHEMISTRY</b>	CO-1: understand definition of phase rule and their variable and their derivation CO-2 Known the application of phase rule with respect to one phase and two phase system CO-3: Understand the Raoultz law, Henry Law and non-ideal system CO-4: Understand the second law of thermodynamic, criteria of spontaneity and equilibrium CO-5: known about Helmholtz and Gibbs free energy and their relationship CO-6: Understand the concept of zero, first and second order reaction and their rate of reaction CO-7: Understand the concept of collision theory and catalysis CO-8: Know about the osmotic pressure, elevation of boiling point and depression of freezing point CO-9: Understand the concept of spin quantum number, diamagnetism, paramagnetism and Gouy Method
	<b>Practicals</b>	CO-1: Know about the semi micro qualitative analysis of inorganic salt mixture and separate the radicals CO-2: Know about the distribution method of Iodine

		<p>CO-3: Understand the construction of phase diagram</p> <p>CO-4: Understand the kinetic study iodine persulphate reaction</p> <p>CO-5: Understand the integrated rate method of acid hydrolysis of methyl acetate with hydrochloric acid.</p> <p>CO-6: Understand the saponification of ethyl acetate.</p>
<b>Semester IV</b>		
<b>USCCHT07</b>	<b>INORGANIC CHEMISTRY</b>	<p>CO-1: Understand the Werner's Coordinator and its experimental verification</p> <p>CO-2: Know about the Sidwick's theory and electronic interpretation, EAN rule</p> <p>CO-3: Understand the isomerism in coordination compound</p> <p>CO-4: Understand the classification of acid and bases, SHAB concept</p> <p>CO-5: Understand the use of redox potential data</p> <p>CO-6: Understand the concept of Crystal field theory, splitting of d-orbital in octahedral and tetrahedral and square planar complexes.</p> <p>CO-7: Know the Jahn Teller Effect, Laporte and Spin selection rule</p> <p>CO-8: Known thermodynamic and kinetic stabilities of metal complexes</p> <p>CO-9: Understand the principles of photometry, Beer Lamberts Law, Type of spectrophotometer</p>
<b>USCCHT08</b>	<b>ORGANIC CHEMISTRY</b>	<p>CO-1: Understand the preparation and chemical reactions of nitroalkane and nitroarene</p> <p>CO-2: Know the structure and reaction of amino compounds</p> <p>CO-3: Understand the stability and preparation of benzene diazonium salt</p> <p>CO-4: Understand the organometallic compound and their structure and chemical reaction</p> <p>CO-5: Know the heterocyclic compound, amino acid, peptides and proteins</p> <p>CO-6: Understand the concept of quantitative analysis of Carbon, hydrogen, nitrogen, sulphur and halogen</p> <p>CO-7: Understand the carbohydrate, synthetic dyes and drugs</p>
	<b>Practicals</b>	<p>CO-1: Understand the preparation of various complexes</p> <p>CO-2: Know the colorimetric method of JOB and mole ratio method</p> <p>CO-3: Understand the estimation of nickel and barium</p> <p>CO-4: Understand the separation and identification of organic compound from binary mixture</p> <p>CO-5: Know the estimation of glucose, amide, aspirin and preparation of paracetamol</p>
<b>Semester V</b>		
<b>USC DSE CHT 09</b>	<b>ORGANIC</b>	<p>CO-1 Know about the concept of Nuclear Magnetic Resonance(NMR), Proton Magnetic Resonance(<sup>1</sup>H</p>

	<b>CHEMISTRY</b>	<p>NMR).</p> <p>CO-2 Understand the concept of Nuclear shielding and deshielding.</p> <p>CO-3 Know about chemical shift ,spin-spin splitting and coupling constants.</p> <p>CO-4 Understand the concept of Enolates, and Active methylene compounds.</p> <p>CO-5 Understand acidity of alpha hydrogen, keto-enol tautomerism.</p> <p>CO-6 Know preparation of diethyl malonate, also know synthesis of glycine and barbutric acids from diethyl malonate.</p> <p>CO-7 Understand the introduction and classification including Di-block, tri-block and amphiphilic polymers.</p> <p>CO-8 Know about natural and synthetic Fabrics, also understand about natural and synthetic rubbers.</p> <p>CO-9 Understand green chemistry and its technology for sustainable development.</p> <p>CO-10 Know the twelve principles of green chemistry.</p> <p>CO-11 Know about use of alternative basic chemicals as feed stocs in chemical industry and research green chemistry.</p>
<b>USC DSE CHT 10</b>	<b>PHYSICAL CHEMISTRY</b>	<p>CO-1.Understand about the electrochemistry and electrical conductance in metals and electrolyte solutions.</p> <p>CO-2. Understand Kohlrausch's law, its application to determine the degree of dissociation and acid-base conductometric titration.</p> <p>CO-3. Know about Arrhenius theory, Debye-Huckel theory and Onsagar equation and its applications.</p> <p>CO-4. Understand the different kind of cell, how to calculate emf of cell and all about cell reaction.</p> <p>CO-5. Know about Faraday's law of electrolysis.</p> <p>CO-6.Understand the concept of transport number and its determination by Hittorfs method.</p> <p>CO-7. Know about the different types of reversible electrode.</p> <p>CO-8. Understand the concept of Half cell reaction, Nernst equation and calculation of emf from different electrode.</p> <p>CO-9.Understand the concept of quantum mechanics.</p> <p>CO-10.Know about the concept of Black body radiation, photoelectric effect, Plank quantum theory.</p> <p>CO-11. Understand the concept of De Broglie's hypothesis and Heisenberg's uncertainty principle.</p> <p>CO-12. Understand the concept of wave functions and Schrodinger wave equation.</p> <p>CO-13.Know about the application of wave equation and its numerical problems.</p>
	<b>Practicals</b>	<p>CO-1:Understand identification of organic compound on the basis of NMR data.</p>

	<b>USC DSE CHP 05(ORGANIC)</b>	CO-2:Know about preparation of nylon66 CO-3:Know about preparation of urea-formaldehyde resin.
	<b>Practicals USC DSE CHP 06 (PHYSICAL)</b>	CO-1.Understand how to determine strong and weak acid strength conductometrically by titration method. CO-2. Understand how to determine the solubility of different soluble salts. CO-3. Understand how to determine strength of acid and base.
<b>Semester VI</b>		
<b>USC DSE CHT 13</b>	<b>INORGANIC CHEMISTRY</b>	CO-1.Know about the sampling, evaluation of analytical data, errors, accuracy and precision CO-2. Understand method of expression, F, Q Test, rejection of data CO-3. Know about basic principles of instrumentation, effect of solvent in flame photometry CO-4. Understand the technique of atomization and sample introduction CO-5. Know about sources of chemical interference and their method of removal, limitation of flame photometry. CO-6.Understand the application of flame photometry and experimental procedure for quantitative analysis. CO-7. Know about principal, classification and technique of chromatography CO-8. Understand the application of paper and column chromatography CO-9.Understand the concept of ion exchange, their types and application of separation of binary mixture. CO-10.Know about the principle, classification and application of solvent extraction. CO-11. Understand the classification of fertilizer, chemical fertilizer and advantage, disadvantage of chemical fertilizer, manure and compost CO-12. Know the soil type, collection of soil sample and their method of analysis. CO-13.Understand the definition, nomenclature and classification of organometallic compounds. Their properties and application CO-14: Understand the basic concept of nanomaterials, preparation of gold and silver nanomaterial, carbon nanotubes and inorganics nanowires CO-15: Know the hydrological cycle, water resources, aquatic ecosystem, sources of water pollutants and their technique of measuring CO-16: Understand the water purification method and water treatment, water quality parameters for waste water, industrial water and domestic water.
<b>USC DSE CHT 14</b>	<b>PHYSICAL CHEMISTRY</b>	CO-1.Understand about the concept of Photochemistry. CO-2. Understand the concept of different law's in photochemistry like Beer-lamberts law, Grothus-Draper

		<p>law, Stark-Einstein law and Jablonski diagram.</p> <p>CO-3. Know about the concept of photochemical reactions, fluorescence, phosphorescence, chemiluminescence, and determination of quantum yield of reactions</p> <p>CO-4. Understand the concept of dipole moment and polarization of molecules.</p> <p>CO-5. Know about the application of dipole moment.</p> <p>CO-6. Understand the concept of different types of spectroscopy like Rotational and Vibrational spectroscopy.</p> <p>CO-7. Know about the rotational spectra, dipole moment and selection rule for energy levels and Selection rule for pure vibrational spectra.</p> <p>CO-8. Understand the concept of Idea of vibrational frequencies of different functional groups.</p> <p>CO-9. Know about the concept of surface chemistry, its theory and applications in adsorption.</p> <p>CO-10. Know about the concept of colloidal chemistry, different types of colloidal system, its classification and preparation.</p> <p>CO-11. Understand the basic concept of Nuclear chemistry and its classification.</p> <p>CO-12. Know about the concept of radioactivity. Different types of radioactivity, its general characteristics and applications.</p>
<b>USC DSE CH P 09</b>	<b>Practicals (INORGANIC)</b>	<p>CO-1: Understand verification of F, Q AND T test and rejection of data for acid base titration.</p> <p>CO-2: Understand analysis of soil- determination of pH of soil, total soluble salt, estimation of calcium, magnesium, phosphate and nitrate.</p> <p>CO-3: Know measurement of chloride, sulphate and salinity of water samples by simple titration method.</p>
<b>USC DSE CHP 10</b>	<b>PRACTICLAS ( PHYSICAL)</b>	<p>CO-1. Understand how to determine the concentration of given solution.</p> <p>CO-2. Determination of polarizability of given molecule by Abbesrefractometer.</p> <p>CO-3. Understand how to determine study effect of temperature on CMC on soap solution.</p>

## DEPARTMENT OF PHYSICS

### PROGRAMME SPECIFIC OUTCOMES

After successful completion of three year degree program in Physics a student shall be able to

**PSO1:** Attain a systemic understanding of core physical concepts, principles and theories along with their applications to design and execute experiments on various advanced equipment.

**PSO2:** Students are also expected to develop a written and oral communication skill in communicating physics-related topics.

**PSO3:** Acquire analytical and logical skill for higher Education.

**PSO4:** Apply conceptual understanding of the physics to general real-world situations.

**PSO5:** To motivate the students to pursue PG courses in reputed institutions.

**PSO6:** Knowledge and skills to take up competitive exams.

**PSO7:** To enhance the student's academic abilities, personal qualities and transferable skills this will give them an opportunity to develop as responsible citizens.

**PSO8:** Providing a hands-on learning experience such as in measuring the basic concepts in properties of matter, heat, optics, electricity and electronics.

**PSO9:** Students will realize and develop an understanding of the impact of physics and science on society.

<b>Semester I</b>		
Paper code	Title of the paper	Learning outcome
USPHT01	Mechanics and Relativity	<p>At the end of the course students are expected to-</p> <p>CO1: Understand laws of motion, reference frames, and its applications i.e. projectile motion, simple harmonic oscillator, Rocket motion, elastic and inelastic collisions.</p> <p>CO2: Describe the concept of centre of mass, linear momentum about it and its equation of motion.</p> <p>CO3: Understand the idea of conservation energy, angular momentum, work, force, linear momentum and angular momentum</p> <p>CO4: Understand the dynamics of rotating objects i.e. rigid bodies, angular velocity, the moment of inertia, parallel axis theorem, the motion of rigid bodies and able to derive the moment of inertia of a ring, rod, solid sphere and rectangular lamina</p> <p>CO5: Develop understanding of special theory of relativity and its applications to understand length</p>



		contraction, time dilation, and relativistic addition of velocities, conservation of momentum and variation of mass, relativistic momentum, relativistic energy, and mass energy relation.
USPHT02	Gravitation, Oscillation and Properties of Matter	<p>After this course, students shall be able to:</p> <p>CO1: Summarize Newton's Law of Universal Gravitation and model the relationship between mass and distance in the force of gravity between objects along with Gravitational Field and Gravitational potential, Gravitational potential due to spherical shell and Gravitational self-energy of a body</p> <p>CO2: Understand the motion of a particle in a central force field and verify that motion of body under central force field is always in plane, angular momentum is conserved and areal velocity is constant</p> <p>CO3: Apply Kepler's law to describe the motion of planets and satellite in circular orbit, through the study of law of Gravitation</p> <p>CO4: Discuss the effects of weightlessness on the human body and basic idea of Global Positioning System (GPS)</p> <p>CO5: Explain the phenomena of simple harmonic motion, Free, Damped and forced harmonic Oscillations and derive the differential equation of systems executing such motions.</p> <p>CO6: Derive and understand energy equation of damped oscillations and grasp the significance of terms like Power dissipation, Power absorption, Resonance, Quality factor and band width</p> <p>CO7: Understand the basics of material properties like, elasticity, elastic constants and their relation, torsion of a cylinder, Work done in stretching and in twisting a wire, Determination of Rigidity modulus by static torsion, Torsional pendulum</p>

		<p>CO8: Understand the basics of motion of fluid which includes streamlined and turbulent flows, equation of continuity, critical velocity, flow of a liquid through a capillary tube, capillaries in series and parallel, Stokes' formula.</p> <p>CO9: Explain the phenomenon of surface tension and terms related to it.</p>
<b>Semester II</b>		
USPHT03	Vector Analysis and Electrostatics	<p>At the end of the course students are expected to-</p> <p>CO1: Understand basics of vector calculus such as divergence, gradient and curl, their physical interpretation, divergence theorem, Green's theorem, Stokes' theorem and its applications.</p> <p>CO2: Understand the basic conceptual terms such as electrical charge, electrical field, electrical potential, electric dipole, electric dipole moment, and electric quadrupole.</p> <p>CO3: Demonstrate Gauss law, Coulomb's law for the electric field, and apply it to systems of point charges as well as line, surface, and volume distributions of charges.</p> <p>CO4: Develop skill to derive relations on Electric potential due to a point charge, electric dipole (along axial line and equatorial line), uniformly charged spherical shell and solid sphere, Potential energy of an electric dipole, electrostatics field energy and Flux of electric field.</p> <p>CO5: Solve mathematical problems involving electric potential, electric dipole, electrostatics field energy</p> <p>CO6: Understand the properties of Electric field in dielectric medium.</p>
USPHT04	Magnetostatics and Electromagnetic Waves	<p>At the end of the course students are expected to-</p> <p>CO1: Understand the fundamentals of Magnetostatics and develop concepts from Ampere's law in straight wire and solenoid.</p>

		<p>CO2: Explain and differentiate between diamagnetic, paramagnetic, and ferromagnetic materials.</p> <p>CO3: Apply Maxwell's equations to deduce wave equation, electromagnetic field energy density and understand Poynting vector and Poynting theorem.</p> <p>CO4: Understand the fundamentals of propagation of electromagnetic waves through vacuum and isotropic dielectric medium and transverse nature of EM wave.</p> <p>CO5: Know the construction and working of Transformer, its energy losses, parameters associated with it and different application.</p> <p>CO6: Apply Kirchhoff's rules to analyze AC circuits consisting of parallel and/or series combinations of voltage sources and resistors and to describe the graphical relationship of resistance, capacitor and inductor.</p> <p>CO7: Develop skill to solve numerical problems on Magnetostatics.</p>
<b>Semester III</b>		
USPHT05	Thermal Physics	<p>At the end of the course students are expected to-</p> <p>CO1: Learn the basic aspects of kinetic theory of gases, Maxwell-Boltzmann distribution law, equipartition of energies, mean free path of molecular collisions, viscosity, thermal conductivity, diffusion and Brownian motion.</p> <p>CO3: Understand the interrelationship of thermal conductivity and viscosity, their dependency on temperature and pressure.</p> <p>CO3: State the Zeroth, First, Second and Third Laws of thermodynamics.</p> <p>CO4: Understand all the concepts needed to state the laws of thermodynamics, such as thermodynamic equilibrium, thermodynamic variables (Intensive and Extensive), Thermodynamic process (Isothermal, Adiabatic, Isobaric, Isochoric and 'reversible' and 'irreversible' processes).</p>

		<p>CO5: Understand the meaning and significance of the variables P; V; T; U; S in particular and to manipulate these variables to solve a variety of thermodynamic problems.</p> <p>CO6: Use the laws of thermodynamics (particularly the first and second laws) to solve a variety of problems, such as the expansion of gases and the efficiency of heat engines.</p> <p>CO7: Apply the concept of Entropy and find Entropy changes in reversible and irreversible process, T-S diagram and derivation of Work done and efficiency.</p>
USPHT06	Radiation & Statistical Physics	<p>At the end of the course students are expected to-</p> <p>CO1: Understand the concept of Black body radiation, its spectral distribution and to derive classical radiation laws of black body radiation i.e. Wiens law, RayleighJeans law, ultraviolet catastrophe, Stefan's Boltzmann law.</p> <p>CO2: Know how to derive Planck's radiation law and also to derive Stefan's Boltzmann law and Wien's displacement law, RayleighJeans law from Planck's law.</p> <p>CO3: Learn to find out the probability and thermodynamic probability of any system.</p> <p>CO4: Understand the concepts of microstate, macrostate, ensemble, phase space, Constraint, Accessible and inaccessible states.</p> <p>CO5: Derive relationship between entropy and thermodynamic probability.</p> <p>CO6: Understand the studies of particles with their distinguishably or indistinguishably nature and conditions which lead to the three different distribution laws e.g. Maxwell-Boltzmann distribution, Bose-Einstein distribution and Fermi-Dirac distribution laws of particles and their derivation.</p>

		<p>CO7: Learn to calculate the macroscopic properties of degenerate photon gas using BE distribution law, Bose derivation of Plank's law.</p> <p>CO8: Understand the concept of Fermi energy and Fermi level and the application of F-D statistical distribution law to derive expression for Fermi energy of electrons in metal, Fermi energy for electron at absolute zero (<math>E_{F0}</math>).</p> <p>CO9: know the comparison between M-B, B-E and F-D statistics.</p>
<b>Semester IV</b>		
USPHT07	Waves, Acoustic & Laser	<p>At the end of the course students are expected to-</p> <p>CO1: Explain about superposition two harmonic oscillators and their result as a Lissajous figures at different frequencies and phases, application of Lissajous' s figure.</p> <p>CO2: Understand the principle of superposition of waves, thus describe the formation of standing waves.</p> <p>CO3: Understand the concept of Group velocity, Phase velocity and their relations.</p> <p>CO4: Describe the production, detection of ultrasonic waves and applications</p> <p>CO5: Learn the concept of acoustic waves, noise and intensity of loudness to gain the knowledge of design of acoustic hall and auditorium.</p> <p>CO6: Understand the laser action phenomena, properties of laser.</p>
USPHT08	Optical Physics	<p>At the end of the course students are expected to-</p> <p>CO1: Use the principles of wave motion and superposition to explain the Physics of polarisation, interference and diffraction.</p> <p>CO2: Calculate wavelength difference and fringe width from the interference pattern.</p> <p>CO3: Understand the construction and working of</p>

		<p>selected optical instruments like Fresnel's biprism, Michelson's interferometer, Newton's Rings apparatus, diffraction grating and Nicol's prism.</p> <p>CO4: Understand the theoretical formalism of Newton's rings, Michelson's rings, Haidinger's Fringes and Fizeu's fringes.</p>
<b>Semester V</b>		
USPHT09	Elements of Modern Physics	<p>At the end of the course students are expected to-</p> <p>CO1: Know main aspects of the inadequacies of classical mechanics and understand historical development of quantum mechanics and ability to discuss and interpret experiments that reveal the dual nature of matter.</p> <p>CO2: Calculate the de Broglie Wavelength of a wave associated with the particle.</p> <p>CO3: Describe the Heisenberg's Uncertainty Principle (position-momentum, Energy-time uncertainty) and its applications.</p> <p>CO4: Understand the central concepts of quantum mechanics: wave functions, momentum and energy operator, the Schrodinger equation, time dependent and time independent cases, probability density and the normalization techniques, skill development on problem solving e.g. one dimensional rigid box, tunneling through potential barrier, step potential, rectangular barrier.</p> <p>CO5: Understand the properties of nuclei like density, size, binding energy, nuclear forces and structure of atomic nucleus, nuclear stability and semi-empirical mass formula.</p> <p>CO6: Develop the concept of Radioactivity, mean-life, half-life, Range of <math>\alpha</math>-particle and study the Gammow's theory of <math>\alpha</math>-decay.</p> <p>CO7: Calculate the energy released of beta decay and Neutrinos, its properties and role in theory of beta decay.</p>

		CO8: Understand fission and fusion well as nuclear processes to produce nuclear energy in nuclear reactor and stellar energy in stars.
USPHT10	Solid State Physics	<p>At the end of the course students are expected to-</p> <p>CO1: Develop a brief idea about crystalline and amorphous substances, about lattice, unit cell, miller indices, reciprocal lattice, and concept of Brillouin zones and diffraction of X-rays by crystalline materials.</p> <p>CO2: Have knowledge of different types of magnetism from diamagnetism to ferromagnetism and hysteresis loops and energy loss.</p> <p>CO3: Understanding about the dielectric and ferroelectric properties of materials.</p> <p>CO4: Explore different kinds of polarization, its types and variation of polarizability with respect to frequency</p> <p>CO5: Understand the normal and anomalous dispersion along with relations describing dispersion curve.</p> <p>CO5: Describe the band theory of solids and must be able to differentiate insulators, conductors and semiconductors.</p> <p>CO6: Get the basic idea about superconductors and their classifications.</p>
<b>Semester VI</b>		
USPHT13	Nuclear and Particle Physics	<p>After the end of the course students are expected to-</p> <p>CO1: Learn the general properties of a nucleus – the constituents and their properties, mass number and atomic number, relation between the mass number and the radius and the mass number, average density, range of force, saturation property, stability curve, the concepts of packing fraction and binding energy, binding energy per nucleon vs. mass number graph, explanation of fusion and fission from the nature of the binding energy graph.</p> <p>CO2: Know about the nuclear models (Liquid drop model, Shell model, Fermi Gas Model) and their roles in</p>

		<p>explaining the properties of the nucleus</p> <p>CO3: Get the idea of concept of Nuclear force.</p> <p>CO4: Learn the basic aspects of nuclear reactions, the Q-value of such reaction and its derivation from conservation laws, the reaction cross-sections, the types of nuclear reactions.</p> <p>CO5: Learn some basic aspects of interaction of nuclear radiation with matter- interaction of gamma ray by photoelectric effect, Compton scattering and pair production, energy loss due to ionization, Cerenkov radiation, neutron interaction with matter &amp; neutron detection.</p> <p>CO6: Learn about the detectors of nuclear radiations- the Geiger-Mueller counter, the scintillation counter, the photo-multiplier tube, the solid state and semiconductor detectors.</p> <p>CO7: Understand the working of Particle Accelerators- Van-de Graaff generator, Linear accelerator, Cyclotron, Synchro-cyclotrons.</p>
USPHT14	Digital & Analog Circuits and Instrumentation	<p>After the end of the course students are expected to-CO1: Synthesis of Boolean functions, simplification and construction of digital circuits by employing Boolean algebra.</p> <p>CO2: Employ Logic gates for carrying out logic operations</p> <p>CO3: Have clear understanding of N- and P- type semiconductors, mobility, drift velocity, fabrication of P-N junctions; current flow mechanism in forward and reverse biased diodes.</p> <p>CO4: Study the characteristics and working of Half-wave Rectifiers, Full-wave Rectifiers, bridge Rectifiers and Zener diode as voltage regulator.</p> <p>CO5: NPN and PNP transistors and basic configurations namely common base, common emitter and common</p>



		<p>collector, and also about current and voltage gain.</p> <p>CO6: Design circuits for Cascaded amplifier, RC coupled amplifier and study the frequency response</p> <p>CO7: Understand the Classification of amplifier as Class-A, Class-B and Class-C amplifier.</p> <p>CO8: Explain the characteristics and applications of operational amplifier</p> <p>CO9: know about different configurations of Operational amplifiers namely inverting and non-inverting and applications of operational amplifiers as Adder, Subtractor, Differentiator, Integrator, Zero Crossing Detector.</p>
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## **Department of Mathematics**

### **PROGRAMME SPECIFIC OUTCOME**

**PSO1.** Think in a logical and critical manner.

**PSO2.** Know when there is a need for information, to be able to identify, locate, evaluate, and effectively use that information for the issue or problem at hand.

**PSO3.** Formulate and develop real life Mathematical problems in a logical manner.

**PSO4.** Acquire good knowledge and understanding in advanced areas of Mathematics, chosen by the student from the given courses.

**PSO5.** To understand, formulate and use quantitative models arising in social science, Engineering, Transportation, Artificial Intelligence, Queuing Models, Relativity theory, Assignment Problems, Inventory Management System and other contexts.

**PSO6.** Apply their broad knowledge of science across a range of fields, with in-depth knowledge in at least one area of study, while demonstrating an understanding of the local and global contexts in which science is practiced.

### **Course Outcome of B. Sc. Mathematics**

<b>Semester I</b>		
Paper code	Title of the paper	Learning outcome
USMT01	DIFFERENTIAL CALCULUS	After completion of this course students will be able to CO1: Solve Limits and Continuity by using $\epsilon$ and $\delta$

	<p>AND INTEGRAL CALCULUS</p>	<p>Definition.</p> <p>CO2: To understand types of discontinuities.</p> <p>CO3: Apply Theorems on limit and Continuity.</p> <p>CO4: Solve problems on differentiability.</p> <p>CO5: Understand Successive differentiation and solve problems by using Leibniz theorem</p> <p>CO6: Apply Mean Value Theorem (MVT), Rolle's Theorem and Cauchy's Mean Value Theorem (CMVT).</p> <p>CO6: <i>Solve Problems on Taylors Series and Maclaurin</i> <math>e^x, \log(1 + x), (1 + x)^m</math></p> <p>CO7: Illustrate Improper integral, Gamma function and its properties.</p> <p>CO8: Beta function and its properties of Beta functions.</p> <p>CO9: Derive relation between Beta and Gamma functions.</p> <p>CO10: Evaluate integrals by using Beta and Gamma functions.</p> <p>CO11: Understand Indeterminate forms .</p> <p>CO12: Apply L'Hospital rule to solve the problems of indeterminate forms.</p> <p>CO13: Evaluate double integrals.</p> <p>CO14: Apply change variable method to find the value of double integral.</p>
<p>USMT02</p>	<p>DIFFERENTIAL CALCULUS AND TRIGONOMETR Y</p>	<p>After completion of this course students will be able to</p> <p>CO1: Understand the Limit and Continuity for function of two variables.</p> <p>CO2: Understand Maxima and Minima of function of two variables.</p> <p>CO3: Lagrange's Multiplier method .</p> <p>CO4: Explain sub- tangent and subnormal.</p> <p>CO5: Find angle of intersection of two curves.</p>

		<p>CO6: Find circle, radius and centre of curvature.</p> <p>CO7: <i>De – Moivre’s</i> theorem and its applications.</p> <p>CO8: <i>Expand <math>\cos^n\theta, \sin^n\theta</math> and <math>\tan^n\theta</math> in terms of <math>\theta</math>.</i></p> <p>CO9: Define hyperbolic functions and inverse hyperbolic functions.</p>
<b>Semester II</b>		
USMT03	DIFFERENTIAL EQUATIONS AND DIFFERENCE EQUATIONS	<p>After completion of this course students will be able to</p> <p>CO1: Understand First order Exact Differential Equation.</p> <p>CO2: Illustrate order and degree of Differential Equations.</p> <p>CO3: Extract the solution of differential equations of the first order and of the first degree by variables separable, Homogeneous and Non-Homogeneous methods.</p> <p>CO4: Understand Linear differential equations and solve problems on Bernoulli’s equations.</p> <p>CO5: Find a solution of differential equations of the first order and of a degree higher than the first by using methods of solvable for p, x and y.</p> <p>CO6: Compute complementary function and particular integral of differential equations.</p> <p>CO7: Compute all the solutions of second and higher order linear differential equations with constant coefficients, linear equations with variable coefficients.</p> <p>CO8: Solve simultaneous linear equations with constant coefficients and total differential equations.</p> <p>CO9: Formulate Difference equation and solve problems.</p>
USMT04	PARTIAL DIFFERENTIAL EQUATIONS	<p>After completion of this course students will be able to</p> <p>CO1: Formation of partial differential equations.</p> <p>CO2: Solve linear partial differential equation of first order.</p> <p>CO3: Illustrate Lagrange’s linear differential equations.</p>

		<p>CO4: Find the solution of First order partial differential equations for some standard types.</p> <p>CO5: Homogeneous partial differential equations and its applications.</p> <p>CO5: Solve problems by using Jacobi's method.</p> <p>CO6: Non-Homogeneous differential equations.</p>
<b>Semester III</b>		
USMT05	REAL ANALYSIS	<p>After completion of this course students will be able to</p> <p>CO1: Define different types of real sequence, bounded sequence, Cauchy Sequence.</p> <p>CO2: Discuss the behavior of the geometric sequence.</p> <p>CO3: Verify the given sequence in convergent and divergent by using behaviour of Monotonic sequence.</p> <p>CO4: Prove Cauchy's theorems on limits.</p> <p>CO5: Give examples for convergence, divergence and oscillating series.</p> <p>CO6: Discuss the behavior of the geometric series.</p> <p>CO7: Verify the given series is convergent or divergent by using different test.</p> <p>CO8: Define and recognize the concept of metric spaces, open sets, closed sets, limit points, interior point.</p> <p>CO9: Define and Illustrate the concept Riemann Integrals.</p> <p>CO10: Determine fundamental theorem on calculus and MVT of integral Calculus.</p>
USMT06	SET THEORY AND LAPLACE TRANSFORM	<p>After completion of this course students will be able to</p> <p>CO1: Understand set theory.</p> <p>CO2: Determine Countable and uncountable sets.</p> <p>CO3: Define fuzzy sets, <math>\alpha</math>-cuts, fuzzy complements.</p> <p>CO4: Discuss types of operations on fuzzy sets, t-norms, fuzzy arithmetic.</p> <p>CO5: Explain extension principle of fuzzy sets, fuzzy numbers.</p> <p>CO6: Illustrate fuzzy relations, binary fuzzy relations,</p>

		<p>fuzzy equivalence relations.</p> <p>CO7: State some applications of fuzzy sets.</p> <p>CO8: Understand Laplace transform and Inverse Laplace transform.</p> <p>CO9: Apply Laplace transform to solve differential equations.</p> <p>CO10: Use inverse Laplace transform to return familiar functions.</p> <p>CO11: Apply Laplace transform to solve ODE and PDE.</p>
<b>Semester IV</b>		
USMT07	ALGEBRA	<p>After completion of this course students will be able to</p> <p>CO1: Define Group, Subgroup, Centre, Normalizer of a Subgroup.</p> <p>CO3: Find cycles and transpositions of a given permutations.</p> <p>CO4: Prove Lagrange's theorem.</p> <p>CO5: Define cyclic groups.</p> <p>CO6: Define normal subgroups, quotient groups and index of a subgroup.</p> <p>CO7: Define homomorphism, kernel of a homomorphism, isomorphism.</p> <p>CO8: Prove Cayley's theorem, the fundamental theorem of homomorphism for groups.</p> <p>CO9: Define rings, zero divisors of a ring, integral domain, field and prove theorem.</p>
USMT08	ELEMENTARY NUMBER THEORY	<p>After completion of this course students will be able to</p> <p>CO1: Illustrate Divisibility, Division and Euclidean Algorithm.</p> <p>CO2: Solve the problems of GCD and LCM.</p> <p>CO3: Describe the properties of prime numbers.</p> <p>CO4: Define congruence's and describe the properties of congruence's.</p> <p>CO5: Solve the system of linear congruence's.</p>

		<p>CO6: Solve Diophantine equations.</p> <p>CO7: State Chinese Remainder Theorem, Fermat's and Wilson's theorem and Goldbach Conjecture</p> <p>CO8: Describe Arithmetic function, Euler's theorem, Mobius <math>\mu</math> function, <math>\tau</math> and <math>\sigma</math> function.</p> <p>CO9: Illustrate Pythagorean triplets.</p>
<b>Semester V</b>		
USMT09	LINEAR ALGEBRA	<p>After completion of this course students will be able to</p> <p>CO1: Define Vector Space, Quotient space Direct sum, linear span and linear independence, basis and inner product.</p> <p>CO2: Discuss the linear transformations, rank, nullity.</p> <p>CO3: Illustrate Dual Space, Bi dual space and natural Isomorphism.</p> <p>CO4: Find the characteristic equation, eigen values and eigen vectors of a matrix.</p> <p>CO5: Prove Schwartz inequality, Gram-Schmidt Orthogonalisation process.</p>
USMT12	SPECIAL RELATIVITY-I	<p>After completion of this course students will be able to:</p> <p>CO1: Understand basic ideas involved in theory of relativity.</p> <p>CO2: Derive and geometrically interpret Lorentz transformation.</p> <p>CO3: Derive transformation equation of velocity, acceleration, Lorentz contraction factor.</p> <p>CO4: Derive Lorentz transformation in index form.</p> <p>CO5: Define time like, space like, light like intervals, proper time, and world line of particle.</p>
<b>Semester VI</b>		
USMT14	COMPLEX ANALYSIS AND VECTOR CALCULUS	<p>After completion of this course students will be able to –</p> <p>CO1: Compute sums, products, quotients, conjugate, modulus, and argument of complex numbers.</p> <p>CO2: Calculate exponentials and integral powers of</p>

		<p>complex numbers.</p> <p>CO3: Understand the significance of differentiability for complex functions and be familiar with the Cauchy-Riemann equations.</p> <p>CO4: Determine whether a given function is analytic.</p> <p>CO5: Define Bilinear transformation, cross ratio, fixed point.</p> <p>CO6: Write the bilinear transformation which maps real line to real line, unit circle to unit circle, real line to unit circle.</p> <p>CO6: Use Cauchy's integral theorem and formula to compute line integrals.</p> <p>CO7: Represent functions as Taylor, power and Laurent series.</p> <p>CO8: Classify singularities and poles.</p> <p>CO9: Find residues and evaluate complex integrals, real integrals using the residue theorem.</p> <p>CO10: Understand Vector Differentiation.</p> <p>CO11: Find and interpret the gradient curl, divergence for a function at a given point.</p> <p>CO12: Interpret line, surface and volume integrals.</p> <p>CO13: Evaluate integrals by using Green's Theorem, Stokes theorem, Gauss's Theorem</p>
<b>USMT16</b>	<b>SPECIAL RELATIVITY-II</b>	<p>After completion of this course students will be able to</p> <p>CO1: Derive transformation equation of mass, charge density, current density.</p> <p>CO2: Express Maxwell's equations in tensor form.</p> <p>CO3: Understand basic ideas involved in theory of relativity</p>

## **DEPARTMENT OF BOTANY**

### **PROGRAMME SPECIFIC OUTCOMES (PSO):**

PSO.1 Students acquire fundamental botanical knowledge through theory, practicals and environment.

PSO.2 To create awareness about cultivation, conservation, and sustainable utilization of the biodiversity.

PSO.3 To create interest in agriculture by acquiring knowledge about different modern farming techniques.

PSO.4 To develop interest in field visits for the study of biodiversity of their native places.

PSO.5 Inculcate strong fundamentals on modern and classical aspects of Botany.

PSO.6 Students will be able to understand the use of plant resources to produce valuable products.

PSO.7 Build life skills in edible mushroom cultivation, Biofertilizer production, Green house maintenance Fruit preservation, Horticulture practices, Seed technology through value added courses.

PSO.8 To know advanced techniques in plant sciences like tissue culture, Phytoremediation, Plant disease management, formulation of new herbal drugs.

PSO.9 To create platform for higher studies in Botany.

PSO.10 Facilitate students to take-up successful carrier in Botany.

### **COURSE OUTCOMES:**

<b>SEMESTER I</b>	
<b>TITLE OF THE PAPER</b>	<b>COURSE OUTCOME</b>
Plant Diversity I (Micro-organisms, Algae, Fungi Plant pathology)	CO.1 Understand the diversity among Bacteria, Viruses, Algae, Fungi. CO.2 Understand the Morphological structure of Bacteria, Virus, Algae, Fungi. CO.3 Understand the reproductive structure of Bacteria, Algae, Fungi. CO.4 know about the economic importance (both harmful and Useful activities) of Viruses, Bacteria, Algae, Fungi. CO.5 Understand the Life cycle patterns of Algae, Fungi. CO.6 Understand the feature of Lichens. CO.7 Understand the scope and importance of plant Pathology CO.8 Know the control measures of plant



	diseases.
Plant Diversity II(Bryophytes, Pteridophytes, Gymnosperm, Paleobotany)	<p>CO. 1 Understand the morphological diversity of Bryophytes, Pteridophytes, Gymnosperm.</p> <p>CO.2 Understand the classification of Bryophytes, Pteridophytes, Gymnosperm.</p> <p>CO.3 Understand the life cycle of Bryophytes, Pteridophytes, Gymnosperm.</p> <p>CO.4 Understand the Economic importance of of the Bryophytes, Pteridophytes, Gymnosperm.</p> <p>CO.5 Know the evolution of Bryophytes, Pteridophytes, Gymnosperm.</p> <p>CO.6 Understand the telome theory and stellar organization.</p> <p>CO.7 Understand the concept of Heterospory and seed habit.</p> <p>CO. 8 Explain fossils and fossilization.</p> <p>CO.9 Understand Geological time scale.</p>
Practical course (Based on both Paper I and Paper II)	<p>CO.1 Understand Working principle and handling of compound and Dissecting Microscope.</p> <p>CO.2 Explain Gram staining of Bacteria.</p> <p>CO.3 Identification of Various bacterial forms</p> <p>CO.4 Study various forms of algae, systematic position and morphology.</p> <p>CO.5 Study Various forms of Algae, Systematic position and morphology of Fungi.</p> <p>CO.6 Study of Bacterial diseases and control measures.</p> <p>CO.7 Study of Viral diseases, causal organism, symptoms, and control measures.</p> <p>CO.8 Study of Bacterial diseases, causal organism, symptoms and control measures.</p> <p>CO.9 Study of fungal diseases, causal organisms, symptoms. control measures.</p> <p>CO.10 Study of diversity of Bryophytes and Pteridophytes w.r.t. systematic position and morphology.</p> <p>CO.11 Identification of morphological and Anatomical characters of Riccia, Funaria, Marchantia, Selaginella, Equisetum and, Marsilea.</p> <p>CO.12 Identification of morphological and anatomical characters of Gymnosperm Pinus and Cycas .</p> <p>CO.13 Study of types of fossils of both pteridophytes and Gymnosperm.</p>

<b>SEMESTER II</b>	
<b>TITLE OF THE PAPER</b>	<b>COURSE OUTCOME</b>
Morphology and Anatomy of Angiosperms	CO.1 Understand the habit of the angiosperm plant body. CO.2 Know the vegetative characteristics of the plant. Learn about the reproductive characteristics of the plant. CO. 3 Understand the plant morphology. CO.4 Know the Anatomy of plant. CO.5 Understand the Simple, Complex and Secretary tissues of plant. CO.6 Know the primary and secondary structure of monocot and Dicot plant. CO.7 Understand the Secondary structure of both Monocot and Dicot plant. CO.8 Know Anomolous secondary structure in Bignonia, Boerhaavia, Dracaena, Beta vulgaris.
Taxonomy and Diversity of Angiosperms	CO.1 Understand the diversity of angiosperm. CO.2 Understand the comparative account among the families of angiosperm. CO.3 Understand the distinguishing features of angiosperm Dicot families. CO.4 Understand the distinguishing features of Monocot families. CO.5 Understand the fossils of angiosperm. CO.6 Understand the Botanical Nomenclature of plants. CO.7 Know the classification of Angioperm. CO.8 Understand the Herbarium techniques (Classical and Virtual(Digital) of plants.
Practical course (Based on both Paper I and Paper II)	CO.1 Describe Morphology of root and stem with its modification. CO.2 Describe Morphology of Leaf and its modification. CO.3 Study of flower, Inflorescence and its types of Inflorescence. CO.4 Study fruit Morphology and types. CO.5 Identification of primary structure in Dicot Root, Stem and Leaf of Sunflower. CO.6 Identification of primary structure in Monocot root, Stem and Leaf of Maize. CO.7 Identification of secondary structure in Dicot stem Moringa. CO.8 Study of Anamolous secondary growth in stem of Bignonia, Boerhaavia, Dracaena. CO.9 Study of fossil Angiosperms Sahanianthus, Enigmocorpon. CO.10 Study of plant families w.r.t. Systematic

	<p>position, Morphological characters, floral formula and floral diagram.</p> <p>CO.11 Study of locally available plants belonging to families included in the syllabus.</p> <p>CO.12 To construct Virtual herbarium by the collection of photograph of plants of available in the area.</p>
<b>SEMESTER III</b>	
<b>TITLE OF THE PAPER</b>	<b>COURSE OUTCOME</b>
Reproductive Biology of Angiosperm, Plant Growth and Development	<p>CO.1 Understand the structure of stamen, Microsporogenesis and Male gametophyte.</p> <p>CO.2 Understand the structure and development in microsporangium</p> <p>CO.3 Understand microsporogenesis and megasporogenesis.</p> <p>CO.4 Understand male and female gametophytes.</p> <p>CO.5 Know fertilization , endosperm and embryogeny.</p> <p>CO.6 Learn about double fertilization and their significance.</p> <p>CO.7 Know about the structure and development of dicot and monocot embryo.</p> <p>CO.8 Understand the different methods to break seed dormancy.</p> <p>CO.9 Know about the seed dispersal Strategies.</p> <p>CO.10 Know about phases of growth and development.</p> <p>CO.11 Know about the plant growth hormones (Auxins, Gibberlins, Cytokinins, Ethylene)</p> <p>CO.12 Learn about the plant movement (Tropic and Nastic movements).</p> <p>CO.13 Learn about the Photoperiodism (Short-day pant, Long -day plant, Day-neutral plant).</p> <p>CO.14 Understand the physiology of flowering.</p> <p>CO.15 Know about the senescence and Abscission in plants.</p>
Plant Biochemistry and Physiology	<p>CO.1 Understand the Properties and role of carbohydrates</p> <p>CO.2 Understand the Properties and role of Lipids</p> <p>CO.3 Understand the properties and role of Proteins.</p> <p>CO.4 Learn about the basic enzymology in plants.</p> <p>CO.5 Understand the Nitrogen metabolism and Mineral nutrition in plants.</p> <p>CO.6 Explain the role of micronutrients and</p>

	<p>macronutrients in plant growth and development.</p> <p>CO.7 Understand the plant water relations .</p> <p>CO.8 Learn about the Transpiration and Phloem transport in plants.</p> <p>CO.9 Understand the physiological details of photosynthesis and respiration.</p>
Practical course(Based on both Paper I and Paper II)	<p>CO.1 Describe Structure of anther and pollen grains.</p> <p>CO.2 Calculate the percentage of pollen germination in Vinca flower.</p> <p>CO.3 Describe the Detail structure of ovule and embryo sac.</p> <p>CO.4 Floral adaptations for different types of pollinations based on pollinators.</p> <p>CO.5 Explain Phenomenon of nastic movement in plants.</p> <p>CO.6 Explain Various methods of breaking seed dormancy.</p> <p>CO.7 Study the activity of enzyme Amylase from germination Wheat grains.</p> <p>CO.8 Explain Phenomenon of Dispersion, Adsorption, Imbibitions.</p> <p>CO.9 Explain Fermentation by Kuhne's tube.</p> <p>CO.10 To separate chloroplast pigments by Paper chromatography.</p>
<b>SEMESTER IV</b>	
<b>TITLE OF THE PAPER</b>	<b>COURSE OUTCOME</b>
Cell biology, Genetics and Biotechnology	<p>CO.1 Understand cell wall, Plasma membrane, cell organelles and cell division.</p> <p>CO.2 Understand the structure and replication of DNA.</p> <p>CO.3 Understand the fundamental of totipotency plant tissue culture techniques.</p> <p>CO.4 Realize the role of genes in evolution of species .</p> <p>CO.5 Learn about the Mendelian inheritance.</p> <p>CO.6 To understand linkage , segregation and mutation of genes during evolution.</p> <p>CO.7 Explain the Numerical and Structural changes in chromosome.</p> <p>CO.8 Explain the tools and techniques of Recombinant DNA technologies.</p> <p>CO.9 Describe the process of protein synthesis both transcription and translation.</p> <p>CO.10 Explain the regulation of gene action in Prokaryotes by Lac-operon concept.</p>

Plant ecology	<p>CO.1 Understand ecological relationships between organisms and their environment.</p> <p>CO.2 Understand the Climatic factors, Edaphic factors and Biotic factors.</p> <p>CO.3 Identify diversity of life forms in an ecosystem.</p> <p>CO.4 Understand Biogeochemical cycle (Air, Water, Nitrogen).</p> <p>CO.5 Describe Air and Water Pollution and its Control.</p> <p>CO.6 Learn the approaches to the study of Autecology and synecology.</p> <p>CO.7 Describe the Plant succession.</p> <p>CO.8 Understand the phytogeographical studies of Chandrapur and Gadchiroli districts.</p>
Practical course (Based on both Paper I and Paper II)	<p>CO.1 Identification of various stages of Mitosis and Meiosis using Onion root tips and flower buds.</p> <p>CO.2 Study of cytoplasmic organelles Mitochondria, Chloroplast, Endoplasmic reticulum, Golgi bodies.</p> <p>CO.3 Learn about the Mendelian inheritance using plastic beads.</p> <p>CO.4 Get acquainted with the Laboratory organization.</p> <p>CO.5 Learn about the working principles of Laboratory instruments and tools of Genetic engineering.</p> <p>CO.6 Study the different methods of sterilization.</p> <p>CO.7 Know about media preparation for tissue culture.</p> <p>CO.8 Study the structure of Vectors Plasmid, Bacteriophage, and Agrobacterium.</p> <p>CO.9 Understand the techniques of anther culture.</p> <p>CO.10 Study the morphological and anatomical characters of the Hydrophytes, Xerophytes, Halophytes, Epiphytes, Parasites by using permanent micro preparation/ specimens.</p> <p>CO.11 Ecological field study –quadrants and Line transect methods of vegetation study.</p>
<b>SEMESTER V</b>	
<b>DISCIPLINE SPECIFIC ELECTIVE-I DSE-I</b>	
<b>TITLE OF THE PAPER</b>	<b>COURSE OUTCOME</b>
Molecular Biology -I	<p>CO.1 Learn about the chemical nature and types of nucleic acid.</p> <p>CO.2 Understand the Nucleic acid is the carrier of genetic information by Griffith's, Hershey &amp; Chase, Avery Mcleod, Fraenkel-Courat's</p>

	<p>experiments.</p> <p>CO.3 Understand the structure of Genetic material DNA/RNA.</p> <p>CO.4 Know about the types of DNA and RNA.</p> <p>CO.5 Understand the prokaryotic and Eukaryotic organization of DNA.</p> <p>CO.6 Know the molecular biology in relation to DNA replication and repair in both Eukaryotes and Prokaryotes.</p>
Practical course (Paper I)	<p>CO.1 Describe the structure of DNA double helix using model/Chart.</p> <p>CO.2 Study structure of different types of DNA using Model/Charts/Video.</p> <p>CO.3 Study organization of eukaryotic chromatin using Model/charts/Video.</p> <p>CO.4 Explain DNA replication mechanism (Rolling circle, Theta replication and Semi-replication)through model/charts/Video</p> <p>CO5.Isolation of plant DNA and its quantification by spectrophotometric method.</p>
Molecular Biology II	<p>CO.1Understand key experiments establishing central dogma.</p> <p>CO.2 Know about genetic code and its sailent features.</p> <p>CO.3 Describe the process of Transcription in both prokaryotes and Eukaryotes.</p> <p>CO.4 Explain the principle of transcriptional regulation in prokaryotes and Eukaryotes.</p> <p>CO.5 Understand the processing and modification of RNA.</p> <p>CO.6 Describe the process of Translation in both prokaryotes and Eukaryotes.</p>
Practical Course (Paper II)	<p>CO.1Describe the structure of different types of RNA using models./Charts/Videos/ppt/photographs.</p> <p>CO.2 Preparation of LB medium for culturing Bacteria.</p> <p>CO. 3 Study table of Genetic Code and find amino acid sequeene from mRNA codons.</p> <p>CO.4 Study mechanism of transcription in prokaryotes using models/charts/photographs/ppt/videos.</p> <p>CO.5Study mechanism of transcription in eukaryotes using model/charts/photographs/ppt/video.</p> <p>CO.6 Study mechanism of translation in prokaryotes using model /charts/photographs/ppt/video.</p> <p>CO.7 Study mechanism of translation in eukaryotes using</p>

	model/charts/photographs/ppt/video.
<b>SKILL ENHANCEMENT COURSE (SEC III)</b>	
Mushroom Culture Technology.	CO.1 Understand the nutritional and medicinal value of edible mushrooms. CO.2 Know the types of edible mushroom cultivated in India. CO.3 Learn about the Substrate. Mushroom unit, Pure culture, Mushroom bed preparation. CO.4 Understand Storage and nutrition. CO.5 Learn about the Mushroom recipe, Research centres, and cost benefit ratio.
<b>SEMESTER VI</b>	
<b>DISCIPLINE SPECIFIC ELECTIVE-II (DSE-II)</b>	
<b>TITLE OF THE PAPER</b>	<b>COURSE OUTCOME</b>
Plant Biotechnology -I	CO.1 To Explain the main techniques of in-vitro culture of plant cell and tissues CO.2 To know the methods used for bio-production of plant secondary metabolites CO.3 To know the main techniques of genetic manipulation of plant organisms. CO.4 Understand the fundamental of totipotency plant tissue culture techniques.. CO.5 Understand the advantages of in vitro propagation in various areas. CO.6 Realize the application and importance of plant tissue culture and transgenic plants.
Practical Course (Paper I)	CO.1 Study laboratory setup for plant tissue culture techniques. CO.2 Learn about working principle of Instruments and Equipments used in Plant Biotechnology laboratory. CO.3 Study various sterilization methods used in plant biotechnology laboratory. CO.4 Preparation of Murashige and Skoog plant tissue culture medium. CO.5 Learn about anther culture.
Plant Biotechnology -II	CO.1 Know about methods of gene transfer Direct and Indirect gene transfer. CO.2 Know the transgenic technology for the improvement of quality and quantity of plant and thereby products. CO.3 Understand the application of plant biotechnology in producing edible vaccine, biodegradable plastic.
Practical course (Paper II)	CO.1 Understand micropropagation from callus/explants. CO.2 Study different methods of direct gene transfer using

	models/charts/photographs/ppt/video. CO.3 Study steps involved in the production of Bt cotton/ Golden rice through models/charts/photographs/ppt/video. CO.4 Study steps involved in the production of transgenic plants producing edible vaccine/biodegradable plastic using models/charts/photographs/ppt/video.
<b>SKILL ENHANCEMENT COURSE (SEC IV)</b>	
Modern farming Techniques	CO.1 Understand the difference between Traditional and Modern agriculture. CO.2 Learn about Aeroponics, Aquaponics, and Hydroponics technology. CO.3 Understand the use of tissue culture techniques in Modern farming. CO.4 Understand the hybrid seed technology.

## **Department of Microbiology**

### **PROGRAMME SPECIFIC OUTCOME**

#### **Statement of PSOs-----**

By the end of this course, the student will be able to –

1. Understand the contributions of various scientists in Microbiology and scope of various branches viz. Soil microbiology, Medical Microbiology, Immunology, Industrial microbiology, Molecular biology.
2. Acquire knowledge on fundamentals of Microbiology.
3. Understand details of bacterial, fungal, algal and viral morphology and physiology and microbial interactions.
4. Competently be able to cultivate and characterize bacterial and fungal forms.
5. Grasp the fundamental concepts of immunity and the contribution of organs and cells in the development of immune response.
6. Able to explain and describe the importance of organic compounds and its chemistry found in living cells.
7. Students are able to explain DNA RNA and protein structure and their synthesis. Through medical microbiology students understand the concept of disease development, spread, control and eradication from society
8. Genetics and molecular biology make the students able to understand the basic concept of gene and their regulation of their action.
9. Explain and write various industrial fermentation and bioinstrumentation concept.



10. Understand and explain various process of metabolism of carbohydrate, amino acid, Lipid.

11. Understand the fundamentals of R-DNA technology and vectors used in genetic engineering and production of various genetically engineered products.

### **Course outcome of Microbiology**

<b>Semester I</b>		
Paper code	Title of the paper	Learning outcome
USMBT1	FUNDAMENTALS OF MICROBIOLOGY	The students know about the Development of Microbiology as a discipline with special reference to the work of scientist. He/she also knows about the theory of Abiogenesis and Biogenesis: various theories which explain it. He/she also comes to know about the Germ theory of disease – Koch’s postulates & River’s postulates. Students are familiar with the various branches of Microbiology. He/she is can distinguish between Eukaryotic and Prokaryotic cell. And familiar with the Structure and functions of various bacterial cell components he / she also know the general ideas about Spore: Structure, Stages in sporulation. The students are familiar with the Aim, Principles and Parts of Taxonomy and General Criteria used for bacterial classification and Various approaches of bacterial taxonomy students also knows about Methods of classification of bacteria. Students come to know the general characteristics of viruses reproduction in virus and its classification. He/she knows about the general characteristics of archaeobacteria. Students are familiar with general characteristics, Methods of reproduction of Molds and Yeasts.
USMBT2	MICROBIAL TECHNIQUES	<ul style="list-style-type: none"> <li>• Know about the different parts and working mechanisms of basic lightmicroscope up to electron microscopes with deep knowledge on the sample preparation and staining techniques.</li> <li>• Acquire knowledge on sterilization techniques with</li> </ul>

		<p>adequate information on sterile, aseptic conditions.</p> <ul style="list-style-type: none"> <li>• Microbial culture media and pure culture techniques for aerobic and anaerobic cultivation methods for bacteria.</li> </ul>
	PRACTICAL	<p>At the end of the course students understand the details of Microbiology Goods Laboratory Practices and Biosafety. They can competently Prepare Cotton Plug, and Clean Glasswares. They come to know about Study of principle and applications of important instruments,(Anaerobic Jar, Autoclave, Incubator, Hot air oven, Microscope, Colony counter, Membrane filter assembly, pH meter, Laminar Air Flow, Spectrophotometer). Students are proficient in Staining Techniques Monochrome / Simple staining, Negative Staining, Gram Staining, Flagella Staining Students will realize the application oriented Special Staining Procedures such as Endospore staining. They acquire the knowledge on Preparation of Culture Media: Saline, Peptone Water, Nutrient Broth, Nutrient agar, MacConkey's agar, Starch Agar, Milk agar, PD- agar, Baired-Parker Agar. They will realize the significance of Demonstration of presence of Microbes and their colony characters present in Air, Skin, Soil, Teeth, and Water. They can good hands in Isolation of pure culture by Streak plate and Spread plate methods. They can Enumerate of bacteria by standard plate count method. They can be able to Study of Motility by Hanging Drop technique Students can competently Cultivate and Staining of Fungi. They will have the good hands on Antibiotic sensitivity test by Kirby-Bauer disc diffusion method They will know the importance of Oligodynamic action of heavy metals.</p>
<b>Semester II</b>		

USMBT03	GENERAL BIOCHEMISTRY	<p>Students are aware of biochemical principles. Types of Isomers and their importance in biology.</p> <p>Types of bonds and their importance. Student have the brief idea about Amino Acids &amp; Proteins</p> <p>General structure and features of amino acids List of 20 amino acids with structure.</p> <p>Classification of amino acids</p> <p>He/she also knows about the classification of Proteins and the Biological significance of proteins.</p> <p>Students will have the knowledge about Carbohydrates &amp; Lipids and Biological significance of carbohydrates and lipids.</p> <p>Students are familiar with the</p> <p>Basic Structure of DNA (Watson-Crick model), Forms of DNA also they comes to know about RNA, Structure of m-RNA, t-RNA, r-RNA.</p>
USMBT04	APPLIED MICROBIOLOGY	<p>Students come to know about definition and composition of air, various Sources of microorganisms in air.</p> <p>Enumeration of microorganisms in air.</p> <p>How to sterilize the room and its techniques. He/she knows about the air borne diseases with its causative organisms.</p> <p>Students also knows about the various Sources and types of microorganisms in water</p> <p>Students can distinguish between Pure (safe/potable) &amp; polluted water.</p> <p>He/she can clearly identify the indicators of excretal pollution. The students have the practical hand on collection and handling of water sample for analysis</p> <p>Students can analyse the water for coliforms(MTDT, MPN)</p> <p>students can identify faecal and non-faecal coliforms by (IMViC and Eijkmann test)</p> <p>Students are aware of mechanism of chlorination of water</p>

		<p>They will get the knowledge about the water borne diseases(List with causative organisms)</p> <p>Sewage Microbiology</p> <p>Students are also comes to know about definition and composition of milk, sources of contamination of milk.</p> <p>Students can clearly identify the desirable and undesirable changes in milk.</p> <p>Students comes to know about the milk borne diseases</p> <p>Students can perform the Bacteriological examination of milk by SPC, DMC, Reductase test (MBRT), checking of pasteurization of milk by phosphatase test.</p>
	<p>PRACTICAL</p>	<p>Students will have the good hands in Qualitative estimation of carbohydrate.</p> <p>Qualitative estimation of proteins.</p> <p>Qualitative estimation of lipids.</p> <p>Students can proficiently estimate the concentration protein by Lowry method.</p> <p>Student will have the good hands on Estimation of sugar by DNS method.</p> <p>Estimation of DNA by Diphenylamine method</p> <p>Estimation of RNA by Orcinal method</p> <p>Students can determine the acid value of fat.</p> <p>Students able to Bacteriological examination of water for potability (MTDT)</p> <p>Presumptive (MPN) test ii)Confirmatory test iii) completed test;</p> <p>Students can Identify of Coliforms by IMViC test.</p> <p>Can students can Determination of quality of Milk by Methylene blue reduction test.</p> <p>Checking of Pasteurization of milk by phosphatase test.</p> <p>Students can Determine BOD/DO of water</p> <p>Students can Determine residual chlorine of water</p> <p>students can gain insight the Isolation and study of Air</p>

		micro flora
<b>Semester III</b>		
USMBT05	MICROBIAL PHYSIOLOGY AND METABOLISM	<p>Students comes to know about ,Concept of Growth, Bacterial Growth Curve and its phases</p> <p>He/she comes t know about the generation time, mathematical expression, growth rate constant</p> <p>Students can Measure bacterial Growth by Breed’s method, Hemacytometer, Coulter counter, Plate count, membrane filter count.</p> <p>Students are familiar with Physical conditions required for growth</p> <p>Students have the brief idea about the Enzyme and mechanism of enzyme action</p> <p>Students also knows the enzyme kinetics Michaelis–Menten equation and Line Weaver-Burk Plot</p> <p>Students will have the comparative knowledge on Competitive, Uncompetitive and non- competitive inhibition.</p> <p>Students are familiar with the Factors affecting enzyme activity: pH, temperature and substrate concentration.</p> <p>He/she will have the brief information regarding Microbial Metabolism and Energy Metabolism</p> <p>Students also come to know about the General concept of respiration and Fermentation.</p>
USMBT06	FOOD,SOIL MICROBIOLOGY AND MICROBIAL ECOLOGY	<p>students comes to know about the various Sources of contamination in food</p> <p>Will have the knowledge about the microbial examinations of food.</p> <p>students are familiar with Spoilage and its types</p> <p>Students comes to know about Preservation of food.</p> <p>He/she aware about the Food borne diseases, food infections and food poisoning.</p> <p>Students have the brief knowledge about the Concept of</p>

		<p>HACCP.</p> <p>Students get knowledge about the Humus Formation (Nature and Characteristics)</p> <p>He/she is very well known about the Compost , aerobic and anaerobic methods of composting</p> <p>He/she also get the knowledge about the elemental transformation in Carbon cycle; Nitrogen cycle; Phosphorous cycle</p> <p>Students will get the detail knowledge about Biofertilizers and Biopesticides</p> <p>He/she is aware about Microbial Association and its benefits and drawbacks</p> <p>Students also comes to know about the Biological Nitrogen fixation</p> <p>Students are aware about the microbial leaching</p> <p>He/she knows about the advantages of Bioremediation</p> <p>Students gets the information about Biogas plant, construction and working mechanism</p>
	<p>PRACTICAL</p>	<p>Students can understand the Demonstration of enzymes activity: Catalase, Lecithinase (lipase), Amylase, Caseinase (protease), Urease, Gelatinase</p> <p>can Isolate and study of Rhizobium from root nodules.</p> <p>Can competently Isolate and study of Azotobacter from soil</p> <p>Student can assimilate the technical skills on demonstration of Synergism.</p> <p>Student will have the practical knowledge on Demonstration of Antibiosis</p> <p>students will gets the knowledge on Demonstration of Syntrophism.</p> <p>Students can easily isolate and Study of Rhizospheric microflora.</p> <p>Students will have thorough knowledge on Demonstration</p>

		<p>of: Ammonification, Nitrification, Nitrate reduction.</p> <p>Students can perform Microbiological examination of food by SPC, YMPC.</p> <p>Students can perform Demonstration of cellulose degradation.</p> <p>Students gets insight Study of Phosphate solubilization by mycorrhizae.</p> <p>Students can Produce amylase enzyme and its assay at lab scale</p> <p>Students can Prepare Rhizobium Biofertilizer.</p> <p>can study Study of bacterial growth curve.</p> <p>Study of effect of PH , temperature on enzyme activity</p> <p>They can Detect food adulteration</p>
<b>Semester IV</b>		
USMBT07	INDUSTRIAL MICROBIOLOGY	<p>Students will comes to know about the Basics of Industrial Microbiology</p> <p>Scope and Development of Industrial Microbiology, and General design and Different parts of typical Fermenter.</p> <p>He/she will gets the knowledge about the types of Fermenter.</p> <p>Students will get the comparative knowledge about Batch and Continuous, Solid and Liquid state, Surface and Submerged culture, Single, Dual / Multiple culture.</p> <p>He/she wil be aware of Fermentation Media and Microbes in Industrial Microbiology</p> <p>and Commonly used raw materials for the fermentation process with composition.</p> <p>Students also knows Industrially important microorganisms &amp; their products.</p> <p>He /she gets the knowledge about upstream and downstream process</p> <p>Students will get the detailed knowledge about the production of Important Fermentation products</p>

		<p>Beverages (Production of Wine, concept of Beer and its types)</p> <p>Organic acid (Citric acid)</p> <p>Antibiotics(Penicillin)</p> <p>Amino acids(Lysine)</p> <p>Enzymes (Amylase)</p> <p>Biomass – Baker’s Yeast</p> <p>Fermented food – Idli</p>
USMBT08	MICROBIAL GENETICS AND MOLECULAR BIOLOGY	<p>Student will get the knowledge about Gene Regulation and Gene Action</p> <p>Concept of Gene, He/she knows about the Structural organization of DNA in cell (Nucleosome Model).</p> <p>Students will also aware about the Central dogma of gene action</p> <p>He/she gets the knowledge about Regulation of Gene Expression</p> <p>He/she gets the detailed knowledge about Operon Model – Lac operon and trp operon in E.coli</p> <p>How SiRNAs and MiRNAs plays role in regulation.</p> <p>He/she also aware about Mutation and Replication</p> <p>Students also knows about different Physical and Chemical agents mutagenic agents</p> <p>Student can Detect Mutation by using Replica plating technique and Ame’s Test</p> <p>Students knows about the Enzymes that plays important role in in DNA replication –</p> <p>He/she also knows how DNA replication occurs and how DNA can damage and the mechanism of DNA repair</p> <p>He/she gets the detailed knowledge about the RNA synthesis, Processing and Translation</p> <p>The students comes to knows about the brief idea about the Genetic codes and its different characteristics.</p> <p>Students also gets knowledge about the how protein</p>



		<p>synthesis takes place in bacteria and its mechanism (Translation)</p> <p>Students will gets some idea about the Genetic Recombination</p> <p>He /she comes to How Transformation takes place in bacteria</p> <p>Students will gets the rough idea about Transposable Genetic Element</p> <p>He /She aware about mechanism of Transduction and Conjugation</p>
	<b>PRACTICAL</b>	<p>Student can perform the Primary screening of antibiotic producers, amylase producers, and organic acid producers.</p> <p>Students wil have the good hand in Preparation of fermented food – Idli.</p> <p>Students gains the knowledge on Production of Penicillin by Fermentation and its Bioassay.</p> <p>Students also gets insight of the Production of Wine by Fermentation and its estimation by Titration.</p> <p>they Will aquitize the Production of Ethanol by Fermentation and its estimation by Titration.</p> <p>They can proficiently Produce Citric acid by Surface/submerged fermentation and its estimation by titration.</p> <p>Students will assimilate technical skill on Replica Plate method.</p> <p>Students will gets the knowledge about the demonstration of bacterial plasmid DNA</p> <p>Students will aquitize Demonstration of Transformation</p> <p>Assimilate the knowledge on demonstration of Conjugation</p> <p>Students can Quantitatively Estimate DNA and RNA</p>
<b>Semester V</b>		
USMBT09	MEDICAL	Students comes to know about the Host-Parasite

	MICROBIOLOGY	<p>Relationship</p> <p>they have the brief knowledge about the Infection and types of infections and various stages of infection</p> <p>He/she knows about the Disease, Sign, Symptom, Syndrome and Types of disease Infectious &amp; non-infectious disease, Epidemic, Endemic, Pandemic, Prosodemic, Sporadic, Exotic, Venereal, Zoonotic, Epizootic, Exotic</p> <p>Students also knows about the Various Stages of Infectious disease. Students will have the knowledge about Normal flora of human body and its characteristic of normal flora, beneficial and harmful effects of normal flora.</p> <p>Students aware about the dynamics of Disease Transmission and Control.</p> <p>He/she will have the brief knowledge about the Diseases of skin, eye, digestive tract, respiratory tract, urinary tract, reproductive system, nervous system, cardiovascular and lymphatic system.</p> <p>they will aware about the Sources/reservoir of infections- endogenous sources, exogenous sources, case, carriers, animals, insect, non-living sources.</p> <p>students are aware about the Portals of exit, Portals of entry.</p> <p>Modes of transmission- Contact, Vehicle, Vector, airborne, Trans-placental, Laboratory, Hospital.</p> <p>They have the knowledge about how to control communicable diseases - different methods.</p> <p>Students have the thorough knowledge about the Epidemiology, Pathogenesis, laboratory diagnosis, Treatment and Prevention of some important diseases</p>
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USMBT10	BIOINSTRUMENTATION	<p>Student will come to know about the Spectrophotometry and Concept of electromagnetic radiation and spectrum of light,</p> <p>Students are aware about Beer's law and its deviations, Difference between spectrophotometer and colorimeter. Its basic principles Basic principle, Instrumentation and Application - UV and visible Spectrophotometer, IR Spectrophotometer and Mass spectrophotometer.</p> <p>Students have the theoretical knowledge Chromatography Partition principle, partition coefficient, Nature of partition forces.</p> <p>Students will come to know about the Electrophoresis and Blotting Migration of ions under electric field and factors affecting electrophoretic mobility,</p> <p>They are also aware about the Centrifugation and Radioactivity</p> <p>They have the theoretical knowledge about Measurement of radioactivity GM counter and Scintillation counter Radioactive labelling and Autoradiography.</p>
	PRACTICAL	<p>Student will have the good hands on the Laboratory diagnosis of i) E.coli ii) P. vulgaris iii) S. typhi</p> <p>Student proficiently can Isolate and detect S. aureus from pus sample.</p> <p>Students will acquire knowledge on study normal flora of skin and oral cavity.</p> <p>Students will acquire the skills on Detection of Malaria parasite from blood sample.</p> <p>Student will have the good hands on Determination of Minimum Inhibitory Concentration (MIC) of Antibiotics.</p> <p>They can Estimate Blood sugar by GOD-POD method</p> <p>Students can perform Liver function test - SGOT and SGPT</p> <p>They also have the hands on Kidney function test- Creatinine, Urea</p>

		<p>Students will competently detect Bilirubin.</p> <p>Students can easily Estimate Blood cholesterol.</p> <p>Students also have the hands on Estimation of blood urea by Diacetylmonoxime method (DAM)</p> <p>Students can acquire knowledge over the Paper chromatography of amino acids/sugars. and TLC of lipid/amino acids.</p> <p>Students can separation of components of serum by paper electrophoresis</p> <p>Also students can Separate protein by SDS-PAGE (Sodium dodecyl sulfate-Polyacrylamide gel electrophoresis)</p> <p>Students also have the good hans in Blotting of DNA by Southern Blotting technique</p>
<b>Semester VI</b>		
USMBT11	RECOMBINANT DNA TECHNOLOGY	<p>the learning outcome of this paper is that students are aware about the Tools of Genetic Engineering</p> <p>They are familiar with the DNA Cutting Enzymes also the DNA modifying enzymes</p> <p>They will well intoduce about the Cloning Vectors and it Features an types of the clonning vector.</p> <p>They will have the brief idea about the Techniques of Genetic Engineering such as Methods of DNA isolation,Isolation of Genomic and Plasmid DNA.How the insertion of r-DNA can be carried out into vector</p> <p>They will comes to know how to select recombinant host cells</p> <p>The students will gets the theorotical knowledge about the Types of Gene Libraries – Genomic and cDNA libraries. Methods of DNA sequencing,Polymerase Chain Reaction (PCR) – Principle, Procedure and Application.</p> <p>They will also gets the knowledge over the detection of DNA sequece and Application of Genetic Engineering Applications in Medical Field – Hybridoma technology and</p>

		<p>Monoclonal antibody production</p> <p>Gene therapy- Types and applications, Stem Cell technology, Transgenic Animal – Knockout Mice. Applications in Agriculture Field –</p>
USMBT12	IMMUNOLOGY	<p>Student will familiar with the Structure and functions of Immune system</p> <p>General concept and short history of immunology</p> <p>They also comes to know about hte structure and function of the primary and secondary Lymphoid organs</p> <p>They are also familiar with the Cells of immune system-and Other immune-competent cells</p> <p>Students are familiar with the Types of immunity.</p> <p>Non-specific resistance</p> <p>Factors influencing Innate immunity</p> <p>Mechanism of Innate immunity</p> <p>Students also knows about the general structure of antibody, Classes of immunoglobulins, Structure and their functions</p> <p>Student also knows the mechanism of Antigen-Antibody reactions.</p> <p>They have brief knowledge about Tagged Antibody test such as ELISA, Radioimmunoassay (RIA), Immunofluorescence.</p> <p>They have the brief knowledge about Definition of Hypersensitivity,</p> <p>They also gets the information on autoimmune disorders.</p>
	PRACTICAL	<p>Students will acquire the knowledge on Isolation of plasmid DNA</p> <p>Students will assimilate the technical skills on Isolation of genomic DNA from bacterial cell and separation of isolated genomic DNA by agarose gel electrophoresis</p> <p>Students will acquire the the knowledge on Digestion of DNA using restriction enzyme and analysis by agarose gel electrophoresis</p> <p>They also have the good hands on Ligation of digested DNA</p>

		<p>fragment</p> <p>They also gain the knowledge on DNA amplification by PCR (Demonstration) and Gene cloning- cloning of GFP gene</p> <p>They can easily determine Blood group and Rh factor proficiently find out Total Leucocyte count ,Differential Leucocyte count,Haemoglobin % in Blood.</p> <p>They can get the good hands on the Detection of Typhoid and Paratyphoid fever by slide/tube agglutination test (WIDAL)</p> <p>Students will grasp the fundamental concept of Detection of Syphilis by TRUST antigen test.</p> <p>Students can easily Detect Pregnancy in women by strip method</p> <p>They get practical knowledge on Demonstration of HBsAg by Hepacard test</p> <p>Students can estimate Antigen by Single Radial Immune Diffusion (RIA).</p> <p>Students also have the hands on Detection of AIDS by ELISA test.</p> <p>Student will assimilate the technical skills on Test for Rheumatoid arthritis (RA)</p>
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## **DEPARTMENT OF ZOOLOGY**

### **PROGRAM SPECIFIC OUTCOME (PSO) OF ZOOLOGY:**

**PSO 1:** To know the scope and importance of Zoology and scientific temper among students.

**PSO 2:** To develop ability for the application of the acquired knowledge to improve applied field to make the country self-reliant and sufficient.

**PSO 3:** Students can aware details and information about the evolution, anatomy, morphology, systematics, genetics, physiology, developmental biology, microtechnique, ecology, and conservation of animals.

**PSO 4:** Students can recall details of the unique ecological and evolutionary features of the fauna.

**PSO 5:** The students are expected to acquire knowledge of zoology and related subjects so as to understand natural phenomenon of nature and environment in the benefit of human beings.

**PSO 7:** To develop interest in nature and living forms and their conservation.

**PSO 8:** To make the students eco-friendly by creating a sense of environmental awareness in them.

**PSO 9:** To give better exposure to the diversity of life forms.

**PSO 10:** To give awareness about natural resources and their importance in sustainable development.

**PSO 11:** To study different ecological sites for animals in their natural habitats by field study.

**PSO 12:** To provide opportunities for the application and training of the acquired knowledge in day- to -day life.

**PSO 13:** To develop skills in doing experiments, familiarizing equipment and biological Slide and specimens by PPT and Video demonstration.

**PSO 15:** To expose students to various fields in biological sciences and to develop interest in related disciplines.

**PSO 16:** To attain an interdisciplinary approach to understand the application of the life science subject in daily life.

**PSO 17:** To familiarize the emerging new areas of Zoology and their applications in various spheres of biological sciences and to the students of its relevance in future studies.

**PSO 18:** Understand the nature and basic concepts of cell biology, genetics, molecular biology, taxonomy, physiology, ecology, diseases, and disease spreading agents and applied Zoology

**PSO 19:** Understand the relationships among animals, plants and microbes

**PSO 20:** Perform procedures as per laboratory standards in the areas of Taxonomy, Physiology, Ecology, Cell biology, Genetics, Molecular Biology, Immunology, Applied Zoology, Clinical science, tools and techniques of Zoology, Toxicology, Entomology, Nematology Sericulture, Biochemistry, Fish biology, Animal biotechnology and research methodology

**COURSE SPECIFIC OUTCOME:**

<b>BSC I</b>
<b>SEMESTER I</b>

Paper Code	Core Paper	Title of the Paper	Course Outcome
USCZOT01	I	Animal Diversity of Nonchordates (Protozoa to Annelida)	<p><b>CO 1.</b> Describe general taxonomic rules on animal classification.</p> <p><b>CO 2.</b> Classify Protozoa up to phylum using Examples from parasitic adaptation.</p> <p><b>CO 3.</b> Describe different mode of adaptation in Protozoa through locomotion, nutrition and reproduction.</p> <p><b>CO 4.</b> Classify Phylum Porifera with taxonomic keys.</p> <p><b>CO 5.</b> Describe morphology, anatomy and histology of Porifera.</p> <p><b>CO 6.</b> Classify Phylum Cnidaria with taxonomic keys.</p> <p><b>CO 7.</b> Describe Phylum Cnidaria with Structure, life cycle, Polymorphism, Alternation of generation, Locomotion, Nutrition, Nematocyst, Coral reef.</p> <p><b>CO 8.</b> Classify Phylum Platyhelminthes to Annelida with taxonomic keys.</p> <p><b>CO 9.</b> Describe Phylum Platyhelminthes to Annelida with Structure and Life history and various modes of adaptations.</p>
USCZOT02	II	Cell Biology	<p><b>CO1:</b> Explain ultra-structure of Prokaryotic and Eukaryotic cell.</p> <p><b>CO2:</b> Explain Structure of Fluid mosaic model of plasma membrane and its functions.</p> <p><b>CO3:</b> Explain structure and functions of nucleolus and nuclear membrane</p> <p><b>CO4 :</b> Describe the Structure, types of chromosome and structure of nucleosome, Lamp-brush and polytene chromosome</p>



			<p><b>CO5:</b> Explain ultra-structure of mitochondria and oxidative phosphorylation, Electron transport chain and terminal oxidation</p> <p><b>CO6:</b> Describe ultra-structure and function of Endoplasmic reticulum and Golgi apparatus.</p> <p><b>CO7:</b> Describe Ultra-structure of Golgi Complex.</p> <p><b>CO8 :</b> Describe Structure, polymorphism and functions of Lysosomes.</p> <p><b>CO9:</b> Explain structure, types of Ribosome and Lake's model.</p> <p><b>CO10:</b> Describe the Cell cycle, Mitosis, Meiosis and synaptonemal complex.</p>
USCZOP01	PRACTICAL	CORE COURSE I & II PRACTICALS BASED ON PAPER I AND PAPER II	<p><b>CO 1.</b> Study of Animal Specimen upto classes from Phylum Protozoa to Annelida.</p> <p><b>CO 2.</b> Study of Slides to understand the structure, histology of Phylum Protozoa to Annelida.</p> <p><b>CO 3.</b> Anatomical observations, demonstration and detailed explanation of the following with the help of ICT tools/ models/ charts/ photographs etc.</p> <p><b>CO 4.</b> Study of Structure, Functions of Compound and Dissecting microscope and uses.</p> <p><b>CO 5.</b> Study of Effect of Osmosis on eukaryotic cell through RBC.</p> <p><b>CO 6.</b> Demonstration of mitotic cell division, polytene chromosome in dipteran larvae, mitochondria in buccal epithelium.</p> <p><b>CO 7.</b> Use of ocular micrometer and measurement of micro objects.</p>
<b>SEMESTER II</b>			

Paper Code	Core Paper	Title of the Paper	Course Outcome
USCZOT03	III	Animal Diversity of Nonchordates (Arthropoda to Hemichordata)	<p><b>CO1.</b> Describe general taxonomic rules on animal classification</p> <p><b>CO2.</b> Classify Arthropoda up to phylum Hemichordata using examples and adaptation.</p> <p><b>CO3.</b> Classify Phylum Arthropoda to Hemichordata with taxonomic keys.</p> <p><b>CO4:</b> Describe External Morphology, Digestive system, Circulatory system, Nervous system, Reproductive system and Sense organs of Arthropoda, Mollusca, Echinodermata and Hemichordata</p> <p><b>CO 5:</b> Pearl formation, Bipinnaria and Brachiolaria larva, Regeneration and Autotomy in Echinoderm and Affinities of Balanoglossus</p>
USCZOT04	IV	Genetics & Evolution	<p><b>CO1:</b> Introduction to Genetics, Mendel's work on transmission of traits, Laws of Genetics</p> <p><b>CO2:</b> Interaction of genes, Sex linked inheritance, extra-chromosomal inheritance</p> <p><b>CO3:</b> Linkage, Crossing Over, Syndrome and Mutation</p> <p><b>CO4:</b> Major Events in History of Life - Urey-Miller Experiment, Oparin theory</p> <p><b>CO5:</b> Introduction to Evolutionary Theories: Lamarckism, Darwinism, Neo-Darwinism</p> <p><b>CO6:</b> Describe Types of fossils and Evolution of horse</p> <p><b>CO7:</b> Processes of Evolutionary Change, Micro, Macro and Mega-evolution</p> <p><b>CO8:</b> Mass extinction: Causes, and Role of extinction in evolution.</p>

USCZOP02	PRACTICAL	CORE COURSE III & IV PRACTICALS BASED ON PAPER III AND PAPER IV	<p><b>CO 1.</b> Observation, classification (upto classes) and sketching of the following animals through specimen/model of phylum Arthropoda to Hemichordata.</p> <p><b>CO 2.</b> Study of Slides to understand the structure, histology of Phylum Arthropoda to Hemichordata.</p> <p><b>CO 3.</b> Anatomical observations, demonstration and detailed explanation of the following with the help of ICT tools/ models/ charts/ photographs.</p> <p><b>CO 4.</b> Identification of wild and mutant type Drosophila.</p> <p><b>CO 5.</b> Demonstration of monohybrid, Dihybrid crosses by colour beads.</p> <p><b>CO 6.</b> Study of sickle cell anemia, Thalassemia, ABO and Rh blood groups, Drum stick in the human blood, Barr body in vaginal smear or buccal epithelium.</p> <p><b>CO 7.</b> Study of human genetic trait by using Hardy-Weinberg equations- Rolling of tongue, baldness, widow peak, length of index and ring finger, attached and free ear lobe.</p> <p><b>CO 8.</b> Study of pictures of human chromosome abnormalities, Adaptive radiations in Reptilia and Mammals, Parallel, Convergent and Divergent evolution, Stabilizing, Directional and Disruptional evolution.</p> <p><b>CO 8.</b> Preparation of models on genetics.</p>
<b>BSC II</b>			
<b>SEMESTER III</b>			
<b>Paper Code</b>	<b>Core Paper</b>	<b>Title of the Paper</b>	<b>Course Outcome</b>

USCZOT05	V	Animal Diversity (Chordates) And Comparative Anatomy	<p><b>CO1:</b> General characters and Classification up to order; Urochordata, Cephalochordata, Cyclostomata, Pisces, Amphibia, Reptilia, Aves, Mammals</p> <p><b>CO2:</b> Explain external morphology and digestive system Urochordata, Cephalochordata, Cyclostomata.</p> <p><b>CO3:</b> Describe osmoregulation in Fishes, Accessory respiratory organs.</p> <p><b>CO4:</b> Write Parental care and Neoteny of Amphibia</p> <p><b>CO5:</b> Study of Snake venom, Poison apparatus &amp; biting mechanism, Poisonous and non poisonous snake</p> <p><b>CO6:</b> Write Flight adaptations, Birds migration and its significance</p> <p><b>CO7:</b> Describe Comparative account of derivatives of integuments and aortic arches, Heart and urinogenital system.</p>
USCZOT06	VI	Physiology & Biochemistry - I	<p><b>CO1.</b> Seeks to understand the mechanisms that work to keep the human body alive and functioning</p> <p><b>CO2.</b> Physiological and biochemical understanding through scientific enquiry into the nature of mechanical, physical, and biochemical functions of humans, their organs, and the cells of which they are composed.</p> <p><b>CO3.</b> Interactions and interdependence of physiological and</p>

			<p>biochemical processes.</p> <p><b>CO4:</b> Describe Metabolism of Carbohydrates, Protein and Lipid.</p> <p><b>CO5:</b> Explain General properties, Classification, Distribution and chemical nature of Enzyme.</p> <p><b>CO6:</b> Describe the Structure and functions of digestive glands</p> <p><b>CO7:</b> Study of Gastro-intestinal hormones and Vitamins.</p> <p><b>CO8:</b> Explain Digestion and absorption of proteins, carbohydrates and lipids. 23</p> <p><b>CO9:</b> Describe the Mechanism of Respiration, Transport of O<sub>2</sub> and CO<sub>2</sub>.</p> <p><b>CO10:</b> Describe the Respiratory pigments and effects of smoking.</p>
USCZOP03	PRACTICAL	CORE COURSE V & VI	<p><b>CO1.</b> Identification and Classification of museum specimens from Urochordata to Mammals.</p> <p><b>CO2.</b> Anatomical observations, demonstration and detailed explanation of the following with the help of ICT tools/ models/ charts/ photographs etc. (Any locally available fish).</p> <p><b>CO3.</b> Study of skeleton of Rabbit or Fowl and permanent slides.</p> <p><b>CO4.</b> Study of histological slides of Mammal– Duodenum, Liver, Lung, Bone and Cartilage.</p> <p><b>CO5.</b> Demonstration of</p>

			<p>carbohydrates, proteins and lipids by histochemical methods</p> <p><b>CO6.</b> Estimation of total protein in given solution by Lowry's method</p> <p><b>CO7.</b> Study of activity of salivary amylase under optimal condition.</p> <p><b>CO8.</b> Qualitative test to identify functional group carbohydrate in given solution (glucose, fructose, sucrose, lactose).</p>
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**SEMESTER IV**

<b>Paper Code</b>	<b>Core Paper</b>	<b>Title of the Paper</b>	<b>Course Outcome</b>
USCZOT07	VII	Developmental Biology	<p><b>CO1:</b> Describe Classification on the basis of amount and distribution of yolk. Chemical composition of yolk.</p> <p><b>CO2:</b> Explain mechanism and significance of Fertilization.</p> <p><b>CO3:</b> Describe the Types of cleavages and blastulation process.</p> <p><b>CO4:</b> Study of Morphogenetic movements in the early development of Frog.</p> <p><b>CO5:</b> Explain Development of Chick up to the formation of primitive streak and extra embryonic membranes.</p> <p><b>CO6:</b> Describe the Gametogenesis, Structure of a Sperm and Ovum.</p> <p><b>CO7:</b> Describe Implantation and Placentation.</p> <p><b>CO8:</b> Describe Mechanism and significance of Apoptosis</p> <p><b>CO9:</b> Explain In Vitro fertilization, Semen bank, Artificial inseminations</p>

			<p>and Contraceptives.</p> <p><b>CO10:</b> Gains knowledge about gametogenesis, cleavage mechanisms, gastrulation and role of hormones in metamorphosis and regeneration.</p>
USCZOT08	VIII	Physiology & Biochemistry - II	<p><b>CO1:</b> Describe Structure of Uriniferous tubule and Mechanism of urine formation.</p> <p><b>CO2:</b> Explain Normal and abnormal constituents of urine. Elementary idea of dialysis.</p> <p><b>CO3:</b> Describe the Structure and functions of pituitary gland, thyroid and adrenal gland.</p> <p><b>CO4:</b> Study of Oestrous and menstrual cycle, Male and female sex hormones.</p> <p><b>CO5:</b> Explain Types of neurons, E.M. structure of neuron 3</p> <p><b>CO6:</b> Describe the Ultra-structure and Properties muscle</p> <p><b>CO7:</b> Describe Composition and functions of blood, Blood clotting, Cardiac cycle, E.C.G. and Blood pressure.</p> <p><b>CO8:</b> Seeks to understand the mechanisms that work to keep the human body alive and functioning.</p> <p><b>CO9:</b> Physiological and biochemical understanding through scientific enquiry into the nature of mechanical, physical, and biochemical functions of humans, their organs, and the cells</p>

			<p>of which they are composed.</p> <p><b>CO10:</b> Interactions and interdependence of physiological and biochemical processes.</p>
USCZOP04	PRACTICAL	Core Course VII & VIII	<p><b>CO1:</b> Study of T.S. of Tadpole through internal and external gills, V.S. of Blastula, Gastrula and Neurula, Chick embryology : Whole mount of 18 hrs, 24 hrs, 30 hrs, 36 hrs and 72 hrs.</p> <p><b>CO2:</b> Detection of urea, albumin, sugar and creatin in urine</p> <p><b>CO3:</b> Sperm count of any domestic animal.</p> <p><b>CO4:</b> Study of histological slides of Mammal– T.S. of Kidney, Pituitary, Thyroid and Adrenal glands, Testis, Ovary, Uterus, Placenta, Medulated and Non medulated nerve fibres, Smooth and Striated muscle, Spinal cord.</p> <p><b>CO5:</b> Preparation of haemin and haemochromogen crystal</p> <p><b>CO6:</b> Quantitative estimation of amino acids using ninhydrin reaction</p> <p><b>CO7:</b> Estimation of glycin by Sorenson formal titration</p> <p><b>CO8:</b> Examination of gametes of Frog – Sperm and Ova through permanent slide or microphotograph.</p>
<b>BSC III</b>			
<b>SEMESTER V</b>			
<b>DISCIPLINE SPECIFIC ELECTIVES (DSE) (ANY TWO)</b>			



Paper Code	Core Paper	Title of the Paper	Course Outcome
USCZOT09	IX	Parasitology	<p><b>CO1:</b> Study of introduction and history of Parasitology and Host Parasite Relationship.</p> <p><b>CO2:</b> Explain Modes of Infection Structure, Life Cycle, Pathogenicity and treatment of Parasitic Protozoan</p> <p><b>CO3:</b> Describe the Structure, Life Cycle, Pathogenicity and Treatment of helminthes Parasites and Nematode parasites</p> <p><b>CO4:</b> Study ultrastructure of body wall of parasite, Respiration and excretion of helminthes</p> <p><b>CO5:</b> Explain Parasitic adaptations, Morphology of Arthropod parasite and Causes and treatment of Arthropod parasite.</p> <p><b>CO6:</b> Describe Structure, Pathogenicity and treatment of bacterial and fungal diseases in Fishes.</p> <p><b>CO7:</b> Describe Pathogenicity and treatment of (Typhoid, T.B ).</p> <p><b>CO8:</b> Describe Zoonotic diseases and pathogenicity (Swine flu, Bird Flu).</p> <p><b>CO9:</b> Explain Study of Vectors as disease transmitters ( Flea, TseTse fly).</p>
USCZOT10	X	Applied Zoology	<p><b>CO1:</b> Students will applications of Zoology in Agriculture and other industries.</p>

			<p>CO2: Identify various methodology and perspectives of applied branches of zoology for the possibilities of self-employment.</p> <p>CO3: Learn the basic principles involved in the culture and breeding of common edible and ornamental fishes of Kerala and the art of aquarium keeping.</p> <p>CO4: Get a basic understanding of human genomics and reproductive biology.</p> <p>CO5: Aware about stem cell research and prenatal diagnostic techniques.</p>
USCZOT11	XI	Insect Vector And Diseases	<p><b>CO1:</b> Describe general Features of Insects</p> <p><b>CO2:</b> Explain types of Mouth parts and antennae.</p> <p><b>CO3:</b> Describe the mechanical and biological vector.</p> <p><b>CO4:</b> Study Host-vector relationship, Adaptations as vectors.</p> <p><b>CO5:</b> Explain Classification of insects up to orders, detailed features of orders with insects as a Vectors – Diptera, Siphonaptera, Siphunculata, Hemiptera</p> <p><b>CO6:</b> Describe dipterans as important insect vectors – Mosquitoes, Houseflies;</p> <p><b>CO7:</b> Study of mosquito-borne diseases – Chickungunya, Filariasis</p> <p><b>CO8:</b> Describe Breeding and control</p>

			<p>of mosquitoes</p> <p><b>CO9:</b> Study of sand fly-borne diseases and house fly as important mechanical vector.</p> <p><b>CO10:</b> Describe Bugs as insect vectors; Blood-sucking bugs; Chagas disease.</p> <p><b>CO11:</b> Explain Fleas as important insect vectors and Host-specificity,</p> <p><b>CO12:</b> Study of Flea-borne diseases – Plague, Typhus fever; Control of fleas.</p> <p><b>CO13:</b> Study Human louse (Head, Body and Pubic louse) as important insect vectors.</p> <p><b>CO14:</b> Explain Relapsing fever, Trench fever, Control of human louse.</p>
USCZOT12	XII	Aquatic Biology	<p><b>CO1:</b> Course provides them comprehensive understanding about aquatic ecosystem and various economical important fishes.</p> <p><b>CO2:</b> Students gain knowledge in the areas of responses characterization and classification of Ostracoderms, placoderms, acanthodians, holocephali, elasmobranchs.</p> <p><b>CO3:</b> Students will get information about zooplanktons, rotifers and other microscopic organisms.</p>
USCZOP05 USCZOP06 USCZOP07 USCZOP08	Practicals	Core Course Any Two Form Core Paper IX, X, XI, XII	Practicals on Any Two Form Core Paper IX, X, XI, XII

<b>SKILL ENHANCEMENT COURSES (SEC) (ANY ONE)</b>			
		Apiculture	<p><b>CO1:</b> Describe history of bee keeping: Definition, Bee keeping in worldwide and India</p> <p><b>CO2:</b> Describe traditional and Modern beekeeping, Urban or backyard beekeeping.</p> <p><b>CO3:</b> Describe types of honey bees, Life cycle – Queen, Drone, Worker</p> <p><b>CO4:</b> Explain basic requirements of Tools for starting bee keeping.</p> <p><b>CO5:</b> Describe bee keeping equipment - introduction to types of bee boxes.</p> <p><b>CO6:</b> Explain economic importance of honey and processing of honey.</p>
		Sericulture	<p><b>CO1:</b> Gives knowledge of silk worm rearing. <b>CO2:</b> Mulberry cultivation</p> <p><b>CO3:</b> Pests and diseases associated with silk worm and mulberry.</p> <p><b>CO4:</b> Various process involved in silk production.</p>
<b>BSC III</b>			
<b>SEMESTER VI</b>			
<b>DISCIPLINE SPECIFIC ELECTIVES (DSE) (ANY TWO)</b>			
<b>Paper Code</b>	<b>Core Paper</b>	<b>Title of the Paper</b>	<b>Course Outcome</b>
USCZOT13	XIII	Immunology	<p><b>CO1:</b> Describe the historical Perspective and basic concepts in immunology of Immunology</p> <p><b>CO2:</b> Explain Innate Immunity and Adaptive immunity.</p> <p><b>CO3:</b> Describe the Haematopoeisis,</p>

			<p>Primary and Secondary lymphoid organs.</p> <p><b>CO4:</b> Study basic properties of antigens, Haptens and adjuvants.</p> <p><b>CO5:</b> Explain structure, classes and functions of antibodies.</p> <p><b>CO6:</b> Describe B and T cell epitopes and monoclonal antibodies.</p> <p><b>CO7:</b> Describe Structure and functions of MHC I and II.</p> <p><b>CO8:</b> Describe autoimmunity - Type I Diabetes mellitus, Psoriasis, Systemic Lupus Erythematosus.</p> <p><b>CO9:</b> Explain Vaccines: Live, killed, recombinant and toxoid.</p>
USCZOT14	XIV	Animal Biotechnology	<p><b>CO1:</b> It gives insight into various cell/tissues culture techniques.</p> <p><b>CO2:</b> Understanding of in vitro culturing of organisms and production of transgenic animals.</p> <p><b>CO3:</b> Understanding of cloning of mammals, large scale culture and production from recombinant microorganisms</p> <p><b>CO4:</b> Gains skills in medical, environmental biotechnology, biopesticides, Biotechnology of aquaculture and use of animals as bioreactors</p> <p><b>CO5:</b> This insight allows students to</p>

			<p>take into consideration about ethical issues involved in production transgenic animals and BT products.</p>
USCZOT15	XV	Microtechnique, Bioinformatics And Biostatistics	<p><b>CO1:</b> Students gain knowledge about various tools and techniques used in biological systems and gives them insight about their use in research.</p> <p><b>CO2:</b> Biostatistics teaches them to use the best data analysis methods in their research projects.</p> <p><b>CO3:</b> Students gains knowledge about statistical methods like measures of central tendencies, Probability.</p> <p><b>CO4:</b> Learns about hypothesis testing and inferential statistics</p> <p><b>CO5:</b> Learns the problem-solving methods.</p>
USCZOT16	XVI	Reproductive Biology	<p><b>CO1:</b> Describe reproductive System and abnormalities of Human Sex Development.</p> <p><b>CO2:</b> Hypothalamo – Hypophyseal – Gonadal axis and Gonadal hormones.</p> <p><b>CO3:</b> Describe Reproductive Endocrine Disorders in Male and Female</p> <p><b>CO4:</b> Study histology of male and female reproductive system in rat and human</p> <p><b>CO6:</b> Describe androgen metabolism and Biochemistry of Semen.</p>

			<p><b>CO7:</b> Describe cryptorchidism and Castration</p> <p><b>CO8:</b> Describe reproductive cycles in rat and human and their regulation.</p> <p><b>CO9:</b> Describe mechanism of parturition and its hormonal regulation, Lactation and its regulation.</p> <p><b>CO9:</b> Explain Infertility in male and female and assisted Reproductive Technology</p> <p><b>CO10:</b> Describe modern contraceptive measures.</p> <p><b>CO11:</b> Demographic terminology used in family planning.</p>
USCZOP09 USCZOP10 USCZOP11 USCZOP12	PRACTICAL	Core Course - Any Two Form Core Paper XIII, XIV, XV and XVI	Practical on Any Two Form Core Paper XIII, XIV, XV and XVI.
<b>SKILL ENHANCEMENT COURSES (SEC) (ANY ONE)</b>			
		Medical Diagnostics	<p><b>CO1:</b> Gives knowledge related to the techniques involved in detection of various diseases.</p> <p><b>CO2:</b> Pathology associated with various diseases.</p> <p><b>CO3:</b> Practical skills of conducting basic clinical lab experiments</p> <p><b>CO4:</b> Application of knowledge of clinical science and pathology to one's own life.</p>
		Public Health And Hygiene	<p><b>CO1:</b> Realize the factors affecting Health.</p> <p><b>CO2:</b> Apply the knowledge to lead a</p>

			healthy Lifestyle.
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