Session-2021-22
School of Applied Sciences

B.Sc.
(PCM, CBZ, Biotechnology, Virology & Immunology, Forensic Sciences)

Program Outcome:

PO1: Proficient knowledge in the lead domains of biotechnology, microbiology, Virology and Immunology and Basic and Advanced Laboratory technology.

PO2: Competency to critically relate and analyze existing situation and to provide economically and scientifically viable solutions.

PO3: Efficient and equipped individuals with complex problem solving and technical expertise. Also, ability to install public awareness on environment and health through data collection, analysis, interpretation and presentation adeptness.

PO4: Intellectual candidates embossed with managerial work ethics and entrepreneurial skills

PO5: Substantial understanding in the mechanisms of life forms for the involvement in medicine and research

Biotechnology

Program Specific Outcomes:

PSO1: To inculcate the basics of technology intervention and driven advancements in biological sciences.

PSO2: Attainment of practical skill sets to apply the theoretical knowledge in real time working scenario of Industry and R&D of healthcare, diagnosis, agriculture etc.

PSO3: Application of knowledge and techniques of Biotechnology. Scale up of biochemical and molecular process after designing, optimization and analysis for developing products required for society.

Course Outcomes:

Course code	Course name	Course outcomes
SC 105	Biochemistry & Metabolism	CO.1 Understand the basic metabolic processes of a cell and the kinetics behind the pathways.
		CO.2 Understand the role of biochemistry & enzyme technology in Biotechnology Industries.
		CO.3 Understand the coordination between different metabolic pathways and the mechanism of energetics maintenance for cellular homeostasis.
SC 101	Cell Biology	CO.1 Understand the cellular organelles and cellular homeostasis.
		CO.2 Know the role of each cellular compartment and cellular signaling to execute the critical metabolic and regulatory pathways.
		CO.3 Know the phenomena of compartmentalization and understand the membrane Biology.
SC 103	General Microbiology	CO.1 To create an understanding regarding the cultivation and Maintenance of microorganisms.
		CO.2 Understand the applications of important microorganism in food Microbiology.
		CO.3 Understand the role of microbes in Industrial product synthesis relevant for different sectors.
SC 201	Bioanalytical techniques	CO.1 The concept of Chromatography - General principle and application of all the types
		CO.2 The technique of Electrophoresis - General principle and application
		CO.3 Study of Spectroscopic methods: principle and applications
SC 302	Animal Biotechnology	CO.1 To create an understanding regarding the Gene transfer methods in Animals.
		CO.2 Understand about Introduction to transgenesis and Transgenic Animals.
		CO.3 To create knowledge about Stem Cell Technology and its applications.
SC 106	Genetics & Molecular Biology	CO.1 To create an understanding regarding the Mendelian genetics.
		CO.2 To understand the process of transcription and translation.
		CO.3 To create knowledge about replication of DNA in prokaryotes and eukaryotes
SC 203	Environmental Biotechnology	CO.1 To create an understanding regarding the impact of conventional fuel on environment.
		CO.2 To understand the advancement of biological methods of waste water treatment.
		CO.3 To create knowledge about process of bioremediation and biodegradation.
SC 202	Chemistry-II	CO.1 To apply the basic concepts of chemical thermodynamics.

		CO.2 To explain chemical behavior of aliphatic and aromatic hydrocarbons.
		CO.3 To solve problems of chemical equilibrium.
SC 104	Biotechnology and Human Welfare	*CO.1 Understand the role of biotechnology in human welfare.*
		CO.2 Know the biotechnology intervention in health and associated sector.
		CO.3 Understand the concepts of Industrial applications of Biotechnology.
SC 305	Plant Biotechnology	CO.1 Create an understanding regarding the plant tissue culture techniques.
		CO.2 Understand about In vitro haploid production Androgenic methods.
		CO.3 Create knowledge about Plant Growth Promoting bacteria.
SC 206	Biostatistics	CO.1 To create an understanding regarding the tabulation of data – Diagrammatic and Graphical representation of data.
		CO.2 To understand about measures of Central Tendency and their significance in statistics.
		CO.3 To create knowledge about Basics of Probability theory and its applications.
SC 207	Chemistry-I	CO.1 Students will be able to explain basics of atomic structure and chemical bonding.
		CO.2 Students will be able to apply fundamentals of stereochemistry.
		CO.3 Student will be able to understand chemistry of alkanes and alkenes.
SC 102	Basics of Immunology	CO.1 The concept of Immune Response - An overview, components of mammalian immune system, molecular structure of Immuno-globulins or Antibodies
		CO.2 The Systems of genome rearrangements during B-lymphocyte differentiation, Antibody affinity maturation class switching
		CO.3 Mechanism of Blood grouping, Antigen-Antibody reactions : agglutination, precipitation, immuno-electrophoresis, Coomb's test, ELISA, RIA
SC 205	Biosafety and Bioethics	CO.1 The concept and Historical background, introduction to biological safety cabinets, primary containment for biohazards, biosafety levels of specific microorganisms
		CO.2 The rules and Government of India definition of genetic modified organism (GMOs) and living modified organisms (LMOs), roles of institutional biosafety committee, review committee on genetic manipulation (RCGM).
		CO.3 Study of "Bioethics" in relation to profession, society, and biomedicine, learn about gradation of moral and ethical norms.

SC 204	Genetic Engineering	CO.1 To create an understanding regarding the Molecular tools used in genetic engineering.
		CO.2 To understand about Restriction and modification system.
		CO.3 To create knowledge about random and site-directed mutagenesis and its applications.
SC 301	Bioprocess Engineering	CO.1 To create an understanding regarding the Introduction to bioprocess technology.
		CO.2 To understand about methods of downstream processing.
		CO.3 To create knowledge about production of industrial chemicals, biochemicals and chemotherapeutic products.
SC 303	Bioinformatics	CO.1 History of Bioinformatics. The notion of Homology. Sequence Information Sources like EMBL.
		CO.2 About common Protein Information Sources, PDB, SWISSPROT, TREMBL, Understanding the structure of each source and using it on the web.
		CO.3 Understand Phylogenetic Analysis. Searching Databases: SRS, Entrez, Sequence.
SC 306	Genomics & Proteomics	CO.1 Create an understanding regarding the Introduction to Genomics and DNA sequencing methods.
		CO.2 Understand about software for genome analysis: ENSEMBL, VISTA, UCSC Genome Browser, NCBI genome.
		CO.3 Create knowledge about Mass spectrometry based methods for protein identification.
SC 304	Medical biotechnology	CO.1 To create an understanding regarding the assisted reproductive technology.
		CO.2 To understand about maintenance and culture of primary, secondary and continuous cell lines.
		CO.3 To create knowledge about Gene therapy Models.
SC 347	Baiscs of forensic science	CO.1 To create an understanding regarding the forensic science laboratory and its organization and service, tools and techniques in forensic science.
		CO.2 To understand about role of modus operandi in criminal investigation
		CO.3 To create knowledge about classification of fingerprints, development of finger print as science for personal identification.
SC 324	Molecular Modelling and Drug Designing	CO.1 Create an understanding regarding the basic concepts of molecular structure.
		CO.2 Understand about basic principles of molecular dynamics and Monte Carlo Simulation for conformational analysis.
		CO.3 Create knowledge about structural bioinformatics in drug discovery.
SC 345	Molecular Diagnostics	CO.1 Create an understanding regarding the basic concepts of single nucleotide polymorphism and plasmid finger printing in clinical microbiology.

		CO.2 Understand about basic principles of enzyme immunoassays.
		CO.3 reate knowledge about Automated procedures for antimicrobial susceptibility tests.
SC 322	Basics of Forensic Science	CO.1 To create an understanding regarding the forensic science laboratory and its organization and service, tools and techniques in forensic science.
		CO.3 To understand about role of modus operandi in criminal investigation
		CO.3 To create knowledge about classification of fingerprints, development of finger print as science for personal identification.
SC 328	Biophysics	CO.1 To create an understanding regarding the principle and application of spectroscopy.
		CO.2 To understand the advancement of bioinstrumentation.
		CO.3 To create knowledge about principle and applications of various types of microscopy.
Sc 326	Nanobiotechnology	CO1: At the end of the course the student would Gain knowledge on the variou process techniques to synthesis nanostructured materials by clear understanding of growth controlling actors of nanomaterial
		CO2: The students acquire knowledge about various kind of nanoporous materials
		CO3: The course also gives clear knowledge on the application and implementation of nanomaterials to solve the societal problems

B.Sc. Virology & Immunology

Program Specific Outcomes:

PSO1: This course administers the scholars by enriching them with vast knowledge in biomedical sciences combined with the complete information about viruses and associated diseases.

PSO2: The designed curriculum incorporating the study of the immune system along with its complete patho-physiology, students shall be gaining the in-depth understanding of the basic fundamentals of Immunology.

PSO3: The program inspires students to training them and attains hands on skills to become an elite Virologist and Immunologist. The main emphasis is on viral diseases particularly affecting mankind in every aspect in terms of pathogenesis, epidemiology and molecular biology, etc.

PSO4: This program also provides the Ability to formulate and analyse cell functioning and associated problems.

PSO5: Scholars acquire information cutting edge technology related to finding out solutions of immunology and virology problems that leads towards epidemics and pandemics.

Course Outcomes:

Course code	Course name	Course outcomes
SC 105	Biochemistry & Metabolism	CO.1 Students will understand the basics concept of Amino acids & Proteins.
		CO.2 Enzymes: Nomenclature and classification of Enzymes, Holoenzyme, apoenzyme will be cleared.
		CO.3 Understand the formulation of carbohydrate and metabolism
SC 103	General Microbiology	CO.1 To create an understanding regarding the cultivation and Maintenance of microorganisms.
		CO.2 Understand the applications of important microorganism in food Microbiology.
		CO.3 Understand the role of microbes in Industrial product synthesis relevant for different sectors.
SC 101	CELL BIOLOGY	CO.1 Students will understand concept of Cell: Introduction and classification of organisms by cell structure.
		CO.2 System of Membrane, Vacuolar system, cytoskeleton and cell motility will be cleared.
		CO.3 Deep understanding of Extracellular Matrix: Composition, molecules that mediate cell adhesion will be understood.
SC 108	Basics of Virology	CO.1 The concept of Background/Discovery, General Concepts of Virus history, Diversity, shapes, sizes and components of genomes will be cleared.
		CO.2 The Systems of Classification of viruses and nomenclatures. +strand RNA viruses- Picornaviruses, Flaviviruses.
		CO.3 Understand the Structural basis of assembly, dynamics and function of viruses,
SC 102	Basics of Immunology	CO.1 The concept of Immune Response - An overview, components of mammalian immune system, molecular structure of Immuno-globulins or Antibodies
		CO.2 The Systems of genome rearrangements during B-lymphocyte differentiation, Antibody affinity maturation class switching
		CO.3 Mechanism of Blood grouping, Antigen-Antibody reactions : agglutination, precipitation, immuno-electrophoresis, Coomb's test, ELISA, RIA
SC 106		CO.1 The concept of Mendelian genetics: Mendel's experimental design, monohybrid, di-hybrid and tri

	Genetics and Molecular Biology	hybrid crosses, Law of segregation & Principle of independent assortment
		CO.2 The Systems of Non allelic interactions: Interaction producing new phenotype complementary genes, epistasis (dominant & recessive),
		CO.3 Study of Replication of DNA in prokaryotes and eukaryotes: Semiconservative nature of DNA replication, Bi-directional replication,
SC 201	Bioanalytical Techniques	CO.1 The concept of Chromatography - General principle and application of all the types
		CO.2 The technique of Electrophoresis - General principle and application,
		CO.3 Study of Spectroscopic methods: principle and applications
SC 205	Biosafety and Bioethics	CO.1 The concept and Historical background, introduction to biological safety cabinets, primary containment for biohazards, biosafety levels of specific microorganisms
		CO.2 The rules and Government of India definition of genetic modified organism (GMOs) and living modified organisms (LMOs), roles of institutional biosafety committee, review committee on genetic manipulation (RCGM).
		CO.3 Study of "Bioethics" in relation to profession, society, and biomedicine, learn about gradation of moral and ethical norms.
SC 209	Anatomy and Physiology	CO.1 The concept of Internal environment and homeostasis- coordinated body functions.
		CO.2 The functional anatomy of heart- genesis and spread of cardiac impulses- cardiac cycle.
		CO.3 Study of Nerve and Renal physiology.
SC 211	Clinical Microbiology	CO.1 The concept of Bacteriology; Classification of Pathogenic bacteria; General methods of isolation and identification of pathogenic bacteria.
		CO.2 The Infections associated with *Mycoplasma, Mycobacterium tuberculosis.*
		CO.3 Study of Poxvirus, Herpes virus, Adeno virus, Hepatitis B virus, Retrovirus, Picorna virus.
SC 204	Genetic Engineering	CO.1 Study of Molecular tools and applications- restriction enzymes, ligases, polymerases, Alkaline phosphatase.
		CO.2 The Restriction and modification system, restriction mapping. Southern and Northern hybridization.
		CO.3 Study of Genetic engineering in plants: Use of Agrobacterium tumefaciens and A. rhizogenes, Ti plasmids.
SC 206	Biostatistics	CO.1 Study of Statistics – Definition, functions and its limitations.

		CO.2 Correlation – Types, scatter diagram – Karl Pearson's coefficient of correlation.
		CO.3 Understand test for Mean – Test for the difference between two means – Test for proportion.
SC 208	Antivirals and Vaccines	CO.1 The Introduction, Multivalent subunit vaccines, Purified macromolecules, Synthetic peptide vaccines, Immuno-adhesions, Recombinant antigen vaccines,
		CO.2 Importance of Vaccine induced immune response and immune markers of protection, Immunophenotyping, Immunotherapy,
		CO.3 Understand the Drug targeting and drug delivery systems: Introduction, Historical perspectives, Drug targeting, Cellular levels events in targeting.
SC 307	Viral Epidemiology	CO.1 Brief Introduction Scope and applications of epidemiology in health care; Role, ethics and responsibilities of an epidemiologist
		CO.2 Sources of infection; Modes of viral transmission; Disease cycle; Role of remote sensing and geographical information.
		CO.3 Cycle of epidemics; Emerging and re-emerging Viral infectious diseases and pathogens; Control of transmission: Isolation
SC 309	Clinical Virology	CO.1 Normal micro-biota of human body; Role of resident flora and human host; Routes of transmission of pathogens.
		CO.2 About common clinical features of Viral Haemorrhagic Fevers, History and Disease burden, Risk factors and geographical distribution
		CO.3 Understand clinical presentation and epidemiology of viral hepatitis. Physiology of Jaundice, clinical features and differential diagnosis, presentations of hepatitis caused by different hepatitis viruses, Diagnostics.
SC 303	Bioinformatics	CO.1 History of Bioinformatics. The notion of Homology. Sequence Information Sources like EMBL.
		CO.2 About common Protein Information Sources, PDB, SWISSPROT, TREMBL, Understanding the structure of each source and using it on the web.
		CO.3 Understand Phylogenetic Analysis. Searching Databases: SRS, Entrez, Sequence.
SC 308	Advanced Immunology	CO.1 Mucosal immunity, Peyer's patches, gut barriers oral immunization Oral tolerance Cytotoxic response.
		CO.2 About flow cytometry and immunoelectron microscopy; surface Plasmon resonance, biosensor assays for assessing ligand.
		CO.3 Understand Active and passive immunization; live, killed, attenuated, subunit vaccines; vaccine technology.
SC 314	Pathology	CO.1 Etiology and Pathogenesis with a brief recall of important aspects of normal cell Structure. Reversible cell

		injury.
		CO.2 About Immune system: General concepts. Hypersensitivity: type and examples, antibody and cell mediated tissue.
		CO.3 Understand Leukocytic disorders: Leukocytosis, Leukopenis, Leukemoid reaction. Leukemia.
SC 310	Pharmacology	CO.1 Classification of drugs, Sources of drugs, Routes of drug administration.
		CO.2 About General considerations – The Sympathetic and Parasympathetic Systems, Receptors, Somatic ,Nervous System Cholinergic and Anti-Cholinergic drugs.
		CO.3 Understand Active and passive immunization; live, killed, attenuated, subunit vaccines; vaccine technology.
SC 212	Drug designing an development	CO.1 Brief Introduction, Stability profile, Barriers to proteins and peptide delivery information.
		CO.2 Drug targeting and drug delivery systems: Introduction, Historical perspectives, Drug targeting, Cellular levels events in targeting
		CO.3 About molecular modeling: Quantum mechanical and molecular orbital methods,
SC 210	Animal tissue culture nad biotechnology	CO.1 Gene transfer methods in Animals – Microinjection, Embryonic Stem cell, gene transfer, Retrovirus & Gene transfer.
		CO.2 Study about Animal propagation – Artificial insemination, Animal Clones. Conservation Biology – Embryo transfer techniques
		CO.3 About Cell cloning, micromanipulation and types of cloning. Cell transformation. Application of animal cell culture,

B. Sc. CBZ

Program Specific Outcomes:

PSO1: To learn all basic concepts in biological and chemical sciences which are required to make them employable in respected fields.

PSO2: To get the knowledge of all the instruments and applications in the field of chemical and biological sciences.

PSO3: To encourage the student for advanced studies and research in Botany, Zoology and Chemistry.

Course Outcomes:

Course code	Course name	Course outcomes
SC 111		CO.1 To create an understanding regarding plant

	Botany-I Biodiversity (Microbes, Algae, Fungi and Archegoniatae)	taxonomy
		CO.2 To explain plant diversity and morphology of microbes.
		CO.3 To develop concept of Archegoniate
SC 113	Chemistry-I (Fundamentals of Chemistry-I)	CO.1 Students will be able to explain basics of atomic structure and chemical bonding.
		CO.2 Students will be able to apply fundamentals of stereochemistry.
		CO.3 Student will be able to understand chemistry of alkanes and alkenes.
SC115	Zoology-I Systematics and Animal Diversity	CO.1 To apply the concept of zoological species and its diversity.
		CO.2 To gain knowledge and skill in the fundamentals of animal sciences
		CO.3 To understand the complex interactions among various living organisms.
SC 116	Botany-II Plant Anatomy and Embryology	CO.1 To understand the scope & importance of Anatomy and Embryology.
		CO.2 To explain various tissue systems.
		CO.3 To understand the normal and anomalous secondary growth in plants and their causes.
		CO.4 To perform the techniques in anatomy
SC 114	Chemistry-II (Fundamentals of chemistry-II)	CO.1 To apply the basic concepts of chemical thermodynamics.
		CO.2 To explain chemical behavior of aliphatic and aromatic hydrocarbons.
		CO.3 To solve problems of chemical equilibrium.
SC 118	Zoology-II Animal Physiology and Biochemistry	CO.1 To create an understanding regarding the Protein, Lipids and Carbohydrates
		CO.2 To gain knowledge about Nerve and muscle.
		CO.3 To explain respiratory, digestive, excretory, cardiovascular and reproduction systems.
SC 225	Botany III-Bryophyta and Pteridophyta	CO.1 To create an understanding regarding the Bryophytes
		CO.2 To gain knowledge about Pteridophyta.
		CO.3 To explain structural, economic and ecological characteristics of Lichens.
SC 221	Chemistry –III (Inorganic Chemistry – I)	CO.1 To provide a deep understanding of s- and p- block elements.
		CO.2 To develop concepts of oxidation-reduction process and organometallic compounds.
		CO.3 To explain fundamentals of Ionic solids.
SC 223	Chemistry –IV (Organic chemistry - I)	CO.1 To evaluate applications of NMR spectroscopy.
		CO.2 To explain chemistry of heterocyclic compound and enolates.

		CO.3 To apply concepts of biomolecules, synthetic dyes and polymers.
SC 227	Zoology III-Genetics and Evolutionary Biology	CO.1 Understands the complex evolutionary processes and behavior of animals
		CO.2 Correlates the physiological processes of animals and relationship of organ systems
		CO.3 Understanding of environmental conservation processes and its importance, pollution control and biodiversity and protection of endangered species
SC 229	Zoology IV-Endocrinology and Ethology	CO.1 To create an understanding regarding the Endocrinology
		CO.2 To gain knowledge about hormone regulation
		CO.3 To have understanding about the ethology, Able to understand MRI and CT scan
SC 236	Botany IV-Gymnosperm and Angiosperms	CO.1 Learn about the structure, pigmentation, food reserves and methods of reproduction of Algae
		CO.2 Learn about the structure, pigmentation, food reserves and methods of reproduction of Fungi
		CO.3 Know about the Economic importance of algae, Fungi and lichen
		CO.4 Studied some plant diseases with special reference to the causative agents, symptoms, etiology and control measures.
SC 238	Botany V (Cell Biology and Genetics)	CO.1 To create an understanding regarding the structure and function of cell organelles.
		CO.2 To gain knowledge about recombination and tools used in molecular Biology.
		CO.3 To have understanding about application of genetics in botany.
SC 234	Chemistry- V (Physical Chemistry-I)	CO.1 To solve problems related to chemical kinetics and thermodynamics.
		CO.2 To explain concepts related to colloidal state chemistry.
		CO.3 To apply principles of electrochemistry.
SC 240	Zoology-V Comparative Anatomy and Developmental Biology of Vertebrate	CO.1 To conceptualize about cloning of animal, Able to understand biology of ageing.
		CO.2 To understand the detailed concept of developmental biology.
		CO.3 To explain comparative anatomy.
SC 319	Botany VI (Analytical Techniques in Plant Sciences)	CO.1 To learn Spectrophotometry and Chromatography
		CO.2 To understand the ccharacterization of proteins and nucleic acid.
		CO.3 To learn basic principles of biostatistics.
SC 315	Chemistry –VI (Inorganic Chemistry-II)	CO.1 To compare chemical properties of transition and inner transition elements.
		CO.2 To explain recent advances in inorganic chemistry.

		CO.3 To develop basic concepts of coordination chemistry.
SC 321	Zoology VI (Environmental Biology)	CO.1 To understand the concept of ecology and habitat ecology.
		CO.2 To explain relationship between man and environment.
		CO.3 To explain different waste management technologies and diseases.
SC 323	Zoology VII (Microbiology)	CO.1 To understand history and classification of microbiology.
		CO.2 To explain microbial cell organization and genes.
		CO.3 To apply concepts of microbiology in food industry.
SC 342	Botany VII- (Plant Physiology)	CO.1 Learn and understand about mineral nutrition in plants.
		CO.2 Understand the growth and developmental processes in plants.
		CO.3 Know about Photosynthesis and Respiration in plants.
SC 344	Botany VIII- (Biotechnology and Utilization of Plants)	CO.1 To learn and understand basics of biotechnology and genetic engineering.
		CO.2 To explain commercial utilization of plants.
		CO.3 To understand industrial applications of biotechnology.
SC 346	Chemistry- VII (Physical & Misc. Chemistry-II)	CO.1 To solve problems related to colligative properties of solutions and phase equilibrium.
		CO.2 To explain concepts related to soil and environmental biochemistry.
		CO.3 To apply fundamentals of nuclear chemistry and green chemistry.
SC 348	Chemistry-VIII (Organic Chemistry-II)	CO.1 To apply concepts related to aldehydes, ketones, carboxylic acids and conjugated systems.
		CO.2 To understand chemistry of polymers.
		CO.3 To gain knowledge of advanced organic chemistry.
SC 350	Zoology VIII (Applied Zoology)	CO.1 To understand basic principles of aquaculture.
		CO.2 To develop concepts of sericulture, lac culture and apiculture.
		CO.3 To understand pisciculture, aquarium fish keeping and poultry keeping.
		CO.4 To explain economic and medicinal importance of insects.

B.Sc. PCM

Program outcomes

PO1: Bachelor of Science offers theoretical as well as practical knowledge about different subject areas which helps student to think critically, follow innovations and developments in science and technology

PO2: This course forms the basis of science for coherent understanding of the academic field to pursue multi and interdisciplinary science careers in future. These subject areas include Physics, Chemistry, Mathematics, Computer Science and Botany and Zoology.

PO3: Able to plan and execute experiments or investigations, analyse and interpret data information collected using appropriate methods.

PO4: It helps to develop scientific temper and thus can prove to be more beneficial for the society as the scientific developments can make a nation or society to grow at a rapid pace through research.

PO5: Students will become employable; they will be eligible for career opportunities in Industry, or will be able to opt for entrepreneurship.

Program Specific Outcomes

PSO1: To learn all basic concepts in Mathematics, Physical and chemical sciences which are required to make them employable in respected fields.

PSO2: To get the knowledge of all the instruments and applications in the field of chemical and Physics sciences.

PSO3: To encourage the student for advanced studies and research in Mathematics, Physics and Chemistry.

Course Outcomes:

Course code	Course name	Course outcomes
SC 117	Physics- I (Mechanics & Relativity)	CO.1 To create an understanding the concept of Inertia and Moments.
		CO.2 To explain the concept of relativity and law of energy
		CO.3 To understand the application of Hooke's law
SC 113	Chemistry-I (Fundamentals of Chemistry-I)	CO.1 Students will be able to explain basics of atomic structure and chemical bonding.
		CO.2 Students will be able to apply fundamentals of stereochemistry.
		CO.3 Student will be able to understand chemistry of alkanes and alkenes.

SC 119	Mathematics-I (Calculus)	CO.1 To understand the Concept of partial differentiation.
		CO.2 To apply the double and triple integral to find the area and volume of curve.
		CO.3 To find out the the curvature, Asymptotes of curve.
SC 121	Mathematics-II (Three Dimensional geometry and Vector calculus)	CO.1 To understand the concept of 3D shapes like Sphere, Cone and Cylinder.
		CO.2 To understand the concept of vector and get knowledge of Line, Surface integral..
		CO.3 To apply the Green, Stokes and Gauss theorem which have significant role in physical science.
SC 120	Physics II (Mathematical physics and special theory of relativity)	CO.1 Have a deep understanding of theorems and mathematical techniques.
		CO.2 Be able to solve the equations for simple configurations using various methods.
		CO.3 Understand the foundations of mathematical concepts and their applications in physics.
SC 235	Physics-IV (Thermodynamics and statical analysis)	CO.1 Be able to understand the Law's of Thermodynamics.
		CO.2 Be able to understand the Isothermal and adiabatic process of thermodynamics .
		CO.3 Be familiar with important process of engines and Carnot cycle.
		CO.4 to understand the basics of statistical analysis
SC 114	Chemistry-II (Fundamentals of chemistry-II)	CO.1 To apply the basic concepts of chemical thermodynamics.
		CO.2 To explain chemical behaviour of aliphatic and aromatic hydrocarbons.
		CO.3 To solve problems of chemical equilibrium.
SC 124	Mathematics-III (Algebra)	CO.1 To understand the concept of Group and Subgroup.
		CO.2 To gain knowledge about Normal Subgroup and relation with Quotient group
		CO.3 To understand the concept of Ring, Ideal and Integral domain.
SC 126	Mathematics-IV (Differential equation)	CO.1 To understand the Differential equation order and degree.
		CO.2 To solve the Differential equation of higher order with some important methods.
		CO.3 To understand the concept of Partial Differentiation and use to solve Heat and Wave equation.
SC 237	Physics V (Electricity and Magnetism)	CO.1 Be able to understand the concept of vector and scalar field.
		CO.2 Be able to read, present and/or discussion about the different relation of vectors and their important theorem like Green, Stokes.

		CO.3 Be familiar with important concept of Magnetic force and its application.
SC 221	Chemistry –III (Inorganic Chemistry – I)	CO.1 To provide a deep understanding of s- and p-block elements.
		CO.2 To develop concepts of oxidation-reduction process and organ metallic compounds.
		CO.3 To explain fundamentals of Ionic solids.
SC 223	Chemistry –IV (Organic chemistry - I)	CO.1 To evaluate applications of NMR spectroscopy.
		CO.2 To explain chemistry of heterocyclic compound and enolates.
		CO.3 To apply concepts of bio molecules, synthetic dyes and polymers.
SC 231	Mathematics V- Numerical Analysis and Probability	CO.1 Understands the Interpolation with equal and unequal interval.
		CO.2 To solve the Integration with Numerical method.
		CO.3 Understand the probability, joint probability and probability distribution function.
SC 233	Mathematics VI (Discrete Mathematics)	CO.1 Understands the ordered sets, relation and relation between sets.
		CO.2 To solve the algebra with graph theory
		CO.3 Understand the relation between graph theory and find out the critical path.
SC 248	Physics VII (Solid State Physics)	CO.1 be able to understand elastic properties of solids and lattice vibrations
		CO.2 be able to understand the properties of metals on the basis of the free electron gas models
		CO.3 be able to understand the essence of dielectric properties of materials and super conductivity
SC 246	Physics VI (Electronics and solid state devices)	CO.1 Be able to understand the bipolar junction and hybrid devices.
		CO.2 Be able to understand the working procedure of amplifier.
		CO.3 Be familiar with important application of Oscillator and R-C Oscillator.
SC 234	Chemistry-V (Physical Chemistry-I)	CO.1 To solve problems related to chemical kinetics and thermodynamics.
		CO.2 To explain concepts related to colloidal state chemistry.
		CO.3 To apply principles of electrochemistry.
SC 242	Math -VII (Real Analysis)	CO.1 To understand the concept of limit point and closure of sets.
		CO.2 To understand the detailed concept open and close set. And the concept of Bolzano Weistress theorem.
		CO.3 To explain Metric space, Open and Close Sphere and also concept of compactness.
SC 244		CO.1 To understand the concept of optimization.

	Math –VIII (Operation Research)	CO.2 To understand the detailed concept of Linear programming, non-linear programming methods
		CO.3 To explain the queuing method and the model of service FCFS.
SC 122	Physics III (Optics)	CO.1 Be able to understand the concept of light and radiation.
		CO.2 Be able to understand the Coherent series and concept of Newton ring.
		CO.3 Be familiar with working principle of laser.
SC 317	Physics VIII (Nuclear Physics)	CO.1 Be able to understand the concept of Radioactivity and source of radioactive element.
		CO.2 Be able to understand the concept of radioactive reaction.
		CO.3 A working knowledge of p-n and n-p binding of radioactive element.
SC 315	Chemistry –VI (Inorganic Chemistry-II)	CO.1 To compare chemical properties of transition and inner transition elements.
		CO.2 To explain recent advances in inorganic chemistry.
		CO.3 To develop basic concepts of coordination chemistry.
SC 313	Maths X (Complex analysis)	CO.1 To understand the concept complex number as per real number.
		CO.2 To explain the complex function, analytical function and complex integration with Cauchy formula.
		CO.3 To explain the singularities and solution of integration with Residue theorem.
SC 311	Maths IX (Linear Algebra)	CO.1 To understand the concept vector space and subspace.
		CO.2 To explain the Linear transformation, Linear combination and Matrices representation of L.T.
		CO.3 To explain the Matrix Rank, and Eigen values and Eigen vectors properties.
SC 374	Physics IX- (Classical and Quantum Mechanics)	CO.1 Be able to understand the Bohr's law and stability of atom.
		CO.2 Be able to understand the concept of Quanta and plank constant..
		CO.3 Be able to understand the concept of wave equation and Schrodingar equation.
SC 346	Chemistry- VII (Physical & Misc. Chemistry-II)	CO.1 To solve problems related to colligative properties of solutions and phase equilibrium.
		CO.2 To explain concepts related to soil and environmental biochemistry.
		CO.3 To apply fundamentals of nuclear chemistry and green chemistry.
SC 348	Chemistry-VIII (Organic Chemistry-II)	CO.1 To apply concepts related to aldehydes, ketones, carboxylic acids and conjugated systems.
		CO.2 To understand chemistry of polymers.

		CO.3 To gain knowledge of advanced organic chemistry.
SC 312	Mathematics XI (Number Theory)	CO.1 To understand basic division algorithm, and fundamental theorem of arithmetic.
		CO.2 To develop concepts of Linear congruence, Fermat little and Wilson theorem.
		CO.3 To understand the Diophanline equation, and Quadratic formula.
SC 314	Mathematics XII (Statistics and dynamics)	CO.1 To understand basic concept of Inertia and Centre of Gravity.
		CO.2 To find the solution of dynamic rigid body motion equation and momentum of the body.
		CO.3 To understand the concept of Moment of inertia and Kepler's laws.

B.Sc. Forensic Sciences

Program Outcomes:

PO1: Bachelor of Science (Forensic Science) offers theoretical as well as practical knowledge about different Forensic disciplines which helps student to think critically, examine and inference their opinion related to crime scene cases.

PO2: This course forms the basis of Forensic science for coherent understanding of the academic field to pursue multi and interdisciplinary science careers in future. These subjects emphasize the importance of scientific methods in crime detection.

PO3: Able to highlight the importance of Forensic science for perseverance of the society

PO4: It helps to generate talented human resource, commensuration with latest requirements of Forensic science.

PO5: It provide a platform for students and forensic scientists to exchange views, chalk-out collaborative programs and work in a holistic manner for the advancement of forensic science Students.

Program Specific Outcomes:

PSO1: Organize and develop the knowledge about various domains of Forensic Science, importance of allied subjects, various organizations running across the globe in Forensic Science and their key role in Forensic Science.

PSO2: Apply the professional ethics, values, principle; of forensic science to solve the crimes and develop the new research tools in drawing a solutions and suggestions to the existing problems in the society by the use of Forensic Science.

PSO3: Analyse the current scenario about the crime, lacunas in the investigation and find the remedial measures in order to bring the quality, speed, truthiness, in the investigation process as a trained professional Forensic expert/ scientist. Incorporate

the acquired Forensic knowledge and techniques in the field of crime investigation.

PSO4: Employ and execute the real time remedial measures to the crime investigation and legal need using forensic science knowledge.

PSO5: Gain the knowledge about crime, historical perspective, and its classification, importance of criminology, penal laws and Criminal Justice System from Forensics viewpoint.

Course Outcomes:

Course code	Course name	Course outcomes
SC107	Introduction to Forensic Science	CO.1 Infer the concepts of Forensic science and its history and interpret the domains of forensic science, Organizational setup of FSL in India.
		CO.2 Articulate and execute the professional code of ethics and execute the skills of Forensic Scientist/ expert.
		CO.3 Integrate the Forensic Science knowledge in the investigation of various types of crimes.
SC109	Instrumental methods (Biology)	CO.1 Infer the concepts of microscopy in visualizing trace evidence and comparing it with control Samples *and* interpret the domains of basic analytical instrumentation.
		CO.2 Articulate and Execute the use of Centrifuge techniques, Electrophoresis and Immunochemical methods in identifying chemical and biological materials.
		CO.3 Integrate the Forensic applications on different instrumentations like Electrophoresis, Microscopy, Centrifuge, etc.
SC110	Criminalistics, Criminal law and Criminal Justice system	CO.1 Outline the Initiation of Investigation proceeding and Interpret the silent features of The Criminal Procedure Code, The Indian Evidence Act 1872 and IPC and steps and protocols to be followed for processing the crime scene.
		CO.2 Chart out and develop the knowledge about various judicial agencies.
		CO.3 Integrate and apply the various methods and procedures for evidences that are admissible in courts.
SC112	Instrumental methods (Physical)	CO.1 Infer the different types of spectroscopy, Identify the principles and Techniques and their significance in visualizing trace evidence and comparing it with control Samples.
		CO.2 Interpret the basic importance of Radiochemical techniques in processing crime scene evidence.
		CO.3 Make use of advance instrumentation and working technique for Separation and detection.

SC213	Forensic Documents Examination	CO.1 Outline the preliminary examinations of documents.
		CO.2 Explain the natural variations and fundamental divergent in hand witting and Identify the disguised writing .
		CO.3 Classify and identify the various types of forgeries and their examination.
SC215	Finger prints, Impressions & Biometrics	CO.1 Explain the basic of fingerprinting and Identify the various classification system in fingerprints.
		CO.2 Explain the formation and preservation of developed fingerprints and apply the examination methods for fingerprints.
		CO.3 Analyze the various impression evidences and their significance of foot, palm, tyre print and lip print and Biometrics.
SC217	Cyber Security	CO.1 Outline the understanding regarding the cybercrime and related investigations and Infer the Knowledge about computer forensics investigation and its components.
		CO.2 Analysis and examine the cases which fall under the purview of digital crimes.
		CO.3 Classified and identification various types of digital crimes.
SC222	Forensic Biology and Serology	CO.1 Interpret the significances of forensic biology and Summarized the concept of forensic microbiology.
		CO.2 Identify the fundaments of wildlife forensic Examine the forensic Entomology.
		CO.3 Conclude the importance of various entomological Evidences.
SC 113	Chemistry-I (Fundamentals of Chemistry-I)	CO.1 Students will be able to explain basics of atomic structure and chemical bonding.
		CO.2 Students will be able to apply fundamentals of stereochemistry.
		CO.3 Student will be able to understand chemistry of alkanes and alkenes.
SC 114	Chemistry-II (Fundamentals of chemistry-II)	CO.1 To apply the basic concepts of chemical thermodynamics.
		CO.2 To explain chemical behaviour of aliphatic and aromatic hydrocarbons.
		CO.3 To solve problems of chemical equilibrium.
SC 219	Chemistry –III (Organic chemistry)	CO.1 To evaluate applications of NMR spectroscopy.
		CO.2 To explain chemistry of heterocyclic compound and enolates.
		CO.3 To apply concepts of bio molecules, synthetic dyes and polymers.
SC 250		CO.1 To solve problems related to chemical kinetics and thermodynamics.

	Chemistry-IV (Physical Chemistry)	CO.2 To explain concepts related to colloidal state chemistry.
		CO.3 To apply principles of electrochemistry.
SC 224	Forensic chemistry and toxicology	CO.1 To explain the significance of toxicological studies in forensic science, the classification of poisons and their modes of actions and the absorption of poisons in body fluids
		CO.2 To attain skills in the forensic identification of illicit liquors
		CO.3 To explain the classification and characteristics of the narcotics, drugs and psychotropic substances, analyse the menace of designer drugs and demonstrate the methods of identifying and purifying narcotics, drugs and psychotropic substances
SC 329	Forensic physics photography, forensic ballistics and explosives	CO.1 Identify the various classification of firearms and their firing mechanisms and Identify the Classification of Explosives
		CO.2 Explain the methods of identifying firearms, importance of firearm evidence and Infer the characteristics of ammunition, methods for characterization of gunshot residue.
		CO.3 Explain the features of Photography and Conclude the importance of Forensic Photography
SC 331	DNA Forensics	CO.1 Analyze the structure and function of DNA and Examine the methods and application in DNA fingerprinting
		CO.2 Explain the Role of DNA typing in disputed paternity and maternity testing, child swapping, kidnapping, murder, rape cases and immigration cases
		CO.3 Illustrate the importance of Short Tandem Repeats and Restriction Fragment Length Polymorphism in DNA technique and Conclude the basic principle of DNA analysis, Forensic significance of DNA typing
SC 333	Chemistry-V (Inorganic Chemistry)	CO.1 To compare chemical properties of transition and inner transition elements.
		CO.2 To explain recent advances in inorganic chemistry.
		CO.3 To develop basic concepts of coordination chemistry.
SC 330	Forensic medicine, anthropology and odontology	CO.1 Explain the importance of Forensic Medicine and types, modes, manner and stages of death
		CO.2 Analyse the Nature and extent of wounds, Classification. Introduction to Forensic Anthropology
		CO.3 Determination of race, age, sex, stature, anthropometric techniques and Examine the Teeth-marks and bite marks for resolving the cases of crime scene
SC 332		CO.1 Determine and develop the knowledge about Forensic Engineering and Forensic Archaeology

	Advancement in forensic science	CO.2 Examine and apply the Forensic Intelligence in real life
		CO.3 Identify and implement the importance of various techniques of Forensic Nursing, Forensic Pathology, polygraphy, narco analysis and brain electrical oscillation signatures
SC 364	Criminology, crime and society	CO.1 Categories the various forms of crimes & identify the Forensics scenario in India
		CO.2 Examine the causes of criminal behaviour and conclude the significance of criminal profiling to mitigate crime
		CO.3 Analyze the consequences of crime in society and Examine the importance of criminology

SURESH GYAN VIHAR UNIVERSITY

Accredited by NAAC with 'A' Grade

SYLLABUS
of

B. Sc. Mathematics
(Physics, Chemistry, Mathematics)

Session2021-24

Salient features in proposed Curriculum

1. The curriculum is restructured to have 3 years (6 semesters) with Institution and 6 months Industrial training in an Organization / Industry relevant to the field of specialization. This is mainly aimed to improve the practical skills in the students to make them ready to cater the needs of Industry with hands on experience and with a very good practical vision.
2. An effort has been made to improve the communication skills and personality development of the students, by restructuring the English Language / communication subject.
3. Primarily to develop verbal communication skills in English among students.
4. The main intention behind this is to improve their communication / presentation skills and to develop their personality to enable them to stand as a useful product in the global market.
5. Practical's on Information Technology is introduced in the I year curriculum itself. This enables the student to have good acquaintance with computers, internet, e-Mailing from First year onwards. It also enables the student to keep pace with latest trends of the present day technology.
6. Their knowledge and skills in computers are continued by introducing practical.
7. Developing reading & writing skills in students, especially among students who lack confidence in communicating in English.
8. Every effort has been made while restructuring the curriculum to mould the students to become very good — Technicians — with more practical visualization. This has been done by deleting UN necessary and extra information and regrouping the subjects to impart theoretical inputs to the students up to sufficient depth. This saving in time has been utilized in slightly improving on the practical inputs during in-house training itself.
9. Seminars also form a part of the curriculum in all the three years. This will surely improve the abilities of the students in communication / presentation skills.
10. Training to isolate important information from a written text and represent the same in note form.
11. Increase ability to write short paragraphs and to write technical reports.
12. To improve speaking skill of students through active listening & speaking practice.
13. Visualization and analytical approach towards the subject is necessary
14. To increase power of comprehending a written text.
15. Basic Mathematics knowledge to solve the problems.
16. Knowledge of basic concepts sciences such as physics, chemistry and mathematics
17. Much emphasis has been given for practical subjects by dividing the combined practical subjects in the earlier curriculum into individual subjects by allotment of separate subject codes. Also, the examination timefor all practical subjects is common and is fixed as 3 Hrs duration. This allows the examiners (both internal and external) to pay much attention towards the examinee during practical's.

Program Aims and Objectives:

Undergraduate ProgramsLearning Objectives

Students will be prepared with a sufficient depth of knowledge in their specific major program to assure their admission to graduate or professional school or be prepared for entry-level employment. Largely, it is studied to allow a person to enter a specific field of employment. Other aims for studying biology are intellectual, ethical and pragmatic: to increase knowledge about all aspects of organisms, to encourage greater benevolence in the relationship between humans and the natural environment and to implement biological factors into various technologies or management techniques.

SURESH GYAN VIHAR UNIVERSITY
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Teaching and Examination Scheme

To commence from the Academic year: 2021-2024

Department: School of Applied Sciences **Year: I**

Program: B.Sc. Course (PCM) **Semester-I**

S. No.	Course Code	Course Name	Types of course core/ elective	Credits	Contact Hrs/Wk.			Exam Hrs.	Weightage (in%)	
					L	T/S	P		CE	ESE
1.	EN-101	English Language – I	University Core	2	2	-	-	3	40	60
2.	CP-101	Elementary Computers	University Core	3	3	-	-	3	40	60
3.	PC 101	Proficiency in co-curricular activities	University Core	2	0	0	0	0	100	0
4.	FD102	Foundation Course-I	University Core	1	1	0	0	3	25	75
5.	ES 101	Environmental Studies	University Core	2	2	0	0	3	40	60
6.	SC 113	Chemistry-I (Fundamentals of Chemistry-I)	Program Core	4	3	1	-	-	40	60
7.	SC 117	Physics-I (Mechanics)	Program Core	4	3	1	-	3	40	60
8.	SC 119	Mathematics-I(Calculus)	Program Core	4	3	1	-	3	40	60
9.	SC 121	Mathematics-II (Three Dimensional Coordinate Geometry and Vector Calculus	Program Core	4	3	1	-	3	40	60
10.	SC 167	Chemistry-I Lab	Program Core	2	-	-	2	3	60	40
11.	SC 165	Physics-I Lab	Program Core	2	-	-	2	3	60	40
		Total		30	20	04	04	-	-	-

L – Lecture
T – Tutorial
P – Practical

CIE – Continuous Internal Evaluation
ESE – End Semester Examination

Signature of Concerned Teacher **Signature of Convener-BoS_____**

Signature of Member Secretary

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Teaching and Examination Scheme

To commence from the Academic year: 2021-2024

Department: School of Applied Sciences **Year: I**

Program: B.Sc. Mathematics Course **Semester-II**

S. No.	Course Code	Course Name	Types of course- Core/ Elective	Credits	Contact Hrs/Wk.			Exam Hrs.	Weightage (in%)	
					L	T/S	P		CE	ESE
1	EM102	Employability Skills	**University Core**	1	1	0	0	0	60	40
2	PC 102	Proficiency in co-curricular activities	**University Core**	2	0	0	0	0	100	00
3	EN 104	English Language – II	**University Core**	2	2	-	-	3	40	60
4	HUM 102	Human values and Ethics	**University Core**	1	1	0	0		40	60
5	FD104	Foundation Course-II	**University Core**	1	1	0	0	3	25	75
6	SC 114	Chemistry-II (Fundamentals of chemistry-II)	**Program Core**	4	3	1	-	-	40	60
7	SC 120	Physics-II(Mathematical Physics and Special theory of relativity)	**Program Core**	4	3	1	-	3	40	60
8	SC 122	Physics-III (Optics)	**Program Core**	4	3	1	-	3	40	60
9	SC 124	Mathematics-III (Algebra)	**Program Core**	4	3	1	-	3	40	60
1	SC 126	Mathematics-IV (Differential Equations	**Program Core**	4	3	1	-	3	40	60
		Practical								
1	SC 168	Chemistry-II Lab		2	-	-	2	3	60	40
1	SC 172	Physics-II Lab		2	-	-	2	3	60	40
		Total		31	20	05	04	-	-	-

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Signature of Member Secretary

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Teaching and Examination Scheme

To commence from the Academic year: 2021-2024

Department: School of Applied Sciences **Year: II**

Program: B.Sc. Mathematics Course **Semester-III**

S. No.	Course Code	Course Name	Types of course core/elective	Credits	Contact Hrs/Wk.			Exam Hrs.	Weightage (in%)	
					L	T/S	P		CE	ESE
1	EM 203	Employability Skills-II	University Core	1	1	0	0	2	60	40
2	PC 203	Proficiency in Co-curricular Activities -III	University Core	2	0	0	0	0	100	0
3	SC 231	Mathematics –V (Numerical Analysis and Theory of Probability)	Program Core	4	3	1	0	3	40	60
4	SC 233	Mathematics –VI (Discrete Mathematics)	Program Core	4	3	0	0	3	40	60
5	SC 221	Chemistry –III (Inorganic Chemistry – I)	Program Core	4	3	1	0	3	40	60
6	SC 223	Chemistry –IV (Organic chemistry -I)	Program Core	4	3	1	0	3	40	60
7	SC 235	Physics -IV(Thermodynamics and Statistical Physics)	Program Core	4	3	1	0	3	40	60
8	SC 237	Physics-V (Electricity and Magnetism)	Program Core	4	3	1	0	3	40	60
9	SC 265	Chemistry- III Lab		2	0	0	2	3	60	40
10	SC 271	Physics Lab- III		2	0	0	2	3	60	40
		Total		31	19	05	04	-	-	-

L – Lecture
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P – Practical

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Teaching and Examination Scheme

To commence from the Academic year: 2021-2024

Department: School of Applied Sciences **Year: II**

Program: B.Sc. Mathematics Course **Semester-IV**

S. No.	Course Code	Course Name	Types of course-Core/Elective	Credits	Contact Hrs/Wk.			Exam Hrs.	Weightage (in%)	
					L	T/S	P		CE	ESE
1	EM 204	Employability Skills-III	University Core	1	1	0	0	2	60	40
2	PC 204	Proficiency in Co-curricular Activities-IV	University Core	2	0	0	0	0	100	0
1.	SC 242	Mathematics -VII (Real Analysis)	Program Core	4	3	1	0	3	40	60
2.	SC 244	Mathematics -VIII (Operation Research)	Program Core	4	3	1	0	3	40	60
3.	SC 234	Chemistry- V (Physical Chemistry-I)	Program Core	4	3	1	0	3	40	60
4.	SC 246	Physics –VI (Electronics and Solid-State Devices)	Program Core	4	3	1	0	3	40	60
5.	SC 248	Physics- VII (Solid State Physics)	Program Core	4	3	1	0	3	40	60
		Practical & Sessional								
6.	SC 268	Physics Lab- IV	Program Core	2	0	0	2	3	40	60
7.	SC 262	Chemistry -IV Lab	Program Core	2	0	0	2	3	60	40
		Total		27	16	05	04	-	-	-

L – Lecture
T – Tutorial

CIE – Continuous Internal Evaluation
ESE – End Semester Examination

P – Practical

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Teaching and Examination Scheme

To commence from the Academic year: 2021-2024

Department: School of Applied Sciences **Year: III**

Program: B.Sc. Mathematics Course **Semester-V**

S.N.	Course Code	Course Name	Types of course –Core/Elective	Credit	Contact Hrs/Wk.			Exam Hrs	Weightage (in%)	
					L	T	P		CIE	ESE
1	EM 301	**Employability Skills**	University Core	1	1	0	0	3	60	40
2	PC 301	**Proficiency in Co-curricular Activities**	University Core	2	0	0	0	0	100	0
3	SC 311	**Mathematics –IX (Linear Algebra)**	Program Core	4	3	1	0	3	40	60
4	SC 313	**Mathematics –X (Complex Analysis)**	Program Core	4	3	1	0	3	40	60
5	SC 315	**Chemistry VI (Inorganic Chemistry-II)**	Program Core	4	3	1	0	3	40	60
6	SC 317	**Physics-VIII (Nuclear Physics)**	Program Core	4	3	1	0	3	40	60
7	SC 365	**Chemistry -V Lab**	Program Core	2	0	0	2	3	60	40
8	SC 367	**Physics-V Lab: Project**	Program Core	2	0	0	2	3	60	40
		Total		23	13	4	4			

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T – Tutorial
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CIE – Continuous Internal Evaluation
ESE – End Semester Examination

Signature of Concerned Teacher **Signature of Convener-BoS_____**

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SURESH GYAN VIHAR UNIVERSITY
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Teaching and Examination Scheme

To commence from the Academic year: 2021-2024

Department: School of Applied Sciences **Year: III**

Program: B.Sc. Mathematics Course **Semester-VI**

S.N.	Course Code	Course Name	Types of courses-Core/Elective	Credit	Contact Hrs/Wk.			Exam Hrs	Weightage (in%)	
					L	T	P		CIE	ESE
1.	SC 312	**Mathematics –XI (Number Theory)**	Program Core	4	3	1	0	3	40	60
2.	SC 314	**Mathematics –XII (Statics and Dynamics)**	Program Core	4	3	1	0	3	40	60
3.	SC 346	**Chemistry VII (Physical & Misc. Chemistry-II)**	Program Core	4	3	1	0	3	40	60
4.	SC 348	**Chemistry VIII (Organic Chemistry-II)**	Program Core	4	3	1	0	3	40	60
5.	SC 374	**Physics-IX (Classical & Quantum Mechanics)**	Program Core	4	3	1	0	3	40	60
6.	SC 368	**Chemistry -VI Lab**	Program Core	2	0	0	2	3	60	40
7.	SC 372	**Physics-VI Lab: Project**	Program Core	2	0	0	2	3	60	40
		Total		24	15	5	4			
		TotalTeaching Load			**24**					

L – Lecture
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CIE – Continuous Internal Evaluation
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Signature of Member Secretary

(Common for Mathematics and Biology Streams)

SC 113	**Fundamentals of Chemistry-I**	**C (L, T, P) = 3 (3, 0, 0)**
Version	1.0	
Prerequisite	Upto XII physics	
Objectives:	To teach about atomic structure and various bonding's. To provide basic knowledge of organic chemistry. To provide knowledge of stereochemistry and hydrocarbons	
Expected Outcome:	Student will able to explain structure and bondings with basics of organic chemistry and stereochemistry and hydrocarbons	
Unit I	**Atomic Structure: Recapitulation7 Hrs**	
Bohr's theory Time independent Schrodinger equation (H Ψ = EΨ). Schrodinger equation for hydrogen atom. Radial and angular nodes and their significance. Radial distribution functions (1s and 2s AO). Significance of quantum numbers, orbital angular momentum and quantum numbers mr and ms. Shapes of s, p and d AO. Electronic configurations of the elements. Concept of exchange energy. Relative energies of AO, Anomalous electronic configurations.		
Unit II	**Covalent Bonding Hrs**	**8**
Covalent bonding: VB Approach: Concept of hybridization and VSEPR theory. Resonance and resonance energy Molecular Orbital Approach : LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combination of atomic orbital's, non- bonding combination of orbital's ,MO treatment of homonuclear diatomic molecules of 1st and 2nd periods and heteronuclear diatomic molecules such as CO, NO and NO+		
Unit III	**Fundamentals of Organic Chemistry Hrs**	**6**
Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape and reactivity of organic molecules Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions free radicals. Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Huckel's rule		
Unit IV	**Stereochemistry 7Hrs**	
Conformations ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newman, Sawhorse and Fischer representations. Concept of chirality (up to two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and Erythro; D and L; cis - trans nomenclature; R/ S (for up to 2 chiral carbon atoms) and E / Z Nomenclature (for up to two C=C systems).		
Unit V	**Alkanes 8Hrs**	
Alkanes: Preparation: Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. Reactions: Free radical Substitution: Halogenations. Alkenes: Preparation, Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes.		
Total Hrs		36Hrs

References and Text Books:

1 Barrow, G. M. Physical Chemistry Tata McGraw-Hill (2007).
2. Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004).
3. Mahan, B. H. University Chemistry 3rd Ed. Narosa (1998).
4. I. L. Finar: Organic Chemistry (Vol. I & II), E. L. B. S.
5. R. T. Morrison & R. N. Boyd: Organic Chemistry, Prentice Hall.
6. Arun Bahl and B. S. Bahl: Advanced Organic Chemistry, S. Chand

Mode of Evaluation: (Percent Weightage)	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)

Recommended by BOS on:	
Approved by Academic Council on :	

SC 117	**Physics-I (Mechanics) C (L, T, P) = 4 (3, 1, 0)**
Version	1.0
Prerequisite	Upto XII physics
Objectives:	● The students will introduce about the forces, angular momentum and knowledge about the Constraint. ● The course will give knowledge about the general parameter like velocity, acceleration. ● The course provide the students about the knowledge of M.I. The course provide the students about the knowledge of hollow cylinder and solid Cylinder.
Expected Outcome:	● Students will understand the vectorial and scalar representation of forces and moments. ● Student will describe static equilibrium of particles and rigid bodies both in two dimensions and also in three dimensions ● Students will analyse the properties of surfaces & solids in relation to moment of inertia. ● Students will illustrate the laws of motion, kinematics of motion and their interrelationship. ● Students will comprehend the effect of Friction on general plane motion.
UNIT-**I**	**Work and Energy Theorem**
Work and Kinetic Energy Theorem. Conservative and Non-Conservative Forces. Potential Energy. Energy Diagram. Stable and Unstable Equilibrium. Gravitational Potential Energy. Elastic Potential Energy. Force as Gradient of Potential Energy. Work and Potential energy. Work done by Non-conservative Forces. Law of Conservation of Energy. Elastic and Inelastic Collisions between particles. Centre of Mass and Laboratory Frames..	
UNIT-**II**	**Rotational Dynamics**
Angular Momentum of a Particle and System of Particles. Torque. Conservation of Angular Momentum. Rotation about a Fixed Axis. Moment of Inertia. Calculation of Moment of Inertia for Rectangular, Cylindrical, and Spherical Bodies. Kinetic Energy of Rotation. Motion involving both Translation and Rotation.	
UNIT **-III**	**Elasticity**
Hooke's law- Stress-strain diagram - Elastic moduli-Relation between elastic constants- Poisson's Ratio-Expression for Poisson's ratio in terms of elastic constants- Work done in stretching & work done in twisting a wire- Twisting couple on a	

cylinder- Determination of Rigidity modulus by static torsion- Torsional pendulum-Determination of Rigidity modulus and moment ofinertia - q, η & **?** by Searles method.	
UNIT-**IV**	**Gravitation**
Newton's Law of Gravitation. Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant). Kepler's Laws (statement only). Satellite in circular orbit and applications.	
UNIT-**V**	**Inertial and non-Inertial systems**
Reference Frames: Inertial Frames and Galilean Transformations. Galilean Invariance and Conservation Laws. Non-inertial Frames and Fictitious Forces. Uniformly Rotating Frame. Physics Laws in Rotating Coordinate Systems. Centrifugal forces: Coriolis Force and its Applications. Components of Velocity and Acceleration in Cylindrical and Spherical Coordinate Systems	
Text Book	1. Daniel Kleppner, Robert J. Kolenkow: An introduction to mechanics, McGraw-Hill, 1973. 2. Charles Kittel,Walter Knight: Malvin Ruderman,CarlHelmholz, Burton Moyer, Mechanics Berkeley physics course.
Reference Books	1. D. S. Mathur: Mechanics, S. Chand & Company Limited, 2000.
Mode of Evaluation: (Percent Weightage)	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) 2. Written examination (60%)
Recommended by BOS on:	
Approved by Academic Council on :	

SC 119	Mathematics-I(Calculus) C (L, T, P) = 4 (3, 1, 0)
Version	**1.0**
Prerequisite	Knowledge of Differential and Integral Calculus upto Senior Secondary School level is required.
Objectives:	Students will be exposed to computational techniquesand applications of differentiation and integration. The objective is to develop a competent working knowledge of the main concepts and methods introduced.
Expected: outcome	Students will find applications of the topics covered, in Physical Sciences and Engineering.
UNIT-**I**	**Differential Calculus: 7 Hrs**
Derivative of length of an arc. Pedal equations. Curvature (various formulae), Centre of curvature and Chord of curvature .Envelopes.	
UNIT-**II**	**Differential Calculus: 7 Hrs**
Partial differentiation, Total differential coefficient, Change of variables, Euler's theorem for homogeneous functions. Maxima and Minima of functions of two variables. Lagrange's method of undermined multipliers.	
UNIT **-III**	**Differential Calculus: 7 Hrs**
Asymptotes. Multiple points. Curve tracing of standard curves (Cartesian and Polar curves)	
UNIT-**IV**	**Integral Calculus: 8 Hrs**
Rectification, Areas. Volumes and Surfaces of solids of revolution.	
UNIT-**V**	**Integral Calculus: 7 Hrs**
Double integrals in Cartesian and Polar coordinates, Change of order of integration. Triple integration. Application of double and triple in integrals in finding areas and volumes. Dirichlet's integral.	
Text Book	1. Elements of Differential Calculus by Sharma, Gokhroo, Saini 2. Elements of Integral Calculus by Gokhroo, Saini, Agrawal
Reference Books	1. Differential Calculus by GorakhPrasad.. 2. Integral Calculus by Gorakh Prasad. 3. Mathematical Analysis by Gabriel Klambauer. 4. Differential Calculus: RBD Publication. 5. Integral Calculus: RBD Publication.
Mode of Evaluation: (Percent Weightage)	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended by BOS on:	
Approved by Academic Council on :	

SC 121	**Mathematics-II (Three Dimensional Coordinate Geometry and Vector Calculus)** **C (L, T, P) = 4 (3, 1, 0)**
Version	**1.0**
Prerequisite	Knowledge of Three Dimensional Coordinate Geometry and Vectorsupto Senior Secondary School level is required.
Objectives:	The objective is to develop a competent working knowledge of the main concepts and methods introduced.
Expected outcome:	Students will find applications of the topics covered, in Physical Sciences and Engineering.
UNIT-**I**	**Three Dimensional Coordinate Geometry: 7 Hrs**
Sphere, Plane section of a sphere, Tangent plane. Pole and Polar plane. Orthogonal spheres,Radical plane and Radical Centre.	
UNIT-**II**	**Three Dimensional Coordinate Geometry: 7 Hrs**
Cone, Reciprocal Cone, Right-circular cone, Enveloping cone.Cylinder, Right circular cylinder, Enveloping cylinder.	
UNIT **-III**	**Three Dimensional Coordinate Geometry: 8 Hrs**
Ellipsoid, Tangent plane, Condition of tangency for a plane, Director Sphere, Polar planes, Polar lines, Section with a given centre. Normal's, Conjugate diameters and Diametral planes and their properties.	
UNIT-**IV**	**Vector Calculus: 7 Hrs**
Scalar point function, Vector point function. Differentiation and Integration of vector point function.Directional derivative. Gradient, Divergence and Curl. Line, Surface and Volume integrals.	
UNIT-**V**	**Vector Calculus: 7 Hrs**
Theorem of Gauss, Green, Stokes (without proofs) and problems based on these theorems.	
Text Book	1. Analytical solid Geometry by Golas,Tandon,Bhargava. 2. A Text Book of Vector Calculus by Gaur , Mathur , Goyal
Reference Books	1. Analytical Solid Geometry by Shanti Narain. 2. Elementary Treatise on coordinate Geometry of three dimensions by R.J.T. Bell. 3. Elements of Coordinate Solid Geometry by Gupta, Bansal. 4. Coordinator Geometry (3D) : RBD Publication 5. Vector Analysis by Chatterjee (PHI Learning)
Mode of Evaluation: (Percent Weightage)	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended by BOS on:	
Approved by Academic Council on :	

(Common for Mathematics and Biology Streams)

SC114	**Fundamentals of Chemistry-II**	**C (L, T, P) = 3 (3, 0, 0)**
Version	**1.0**	
Prerequisite	**Upto class XII basic knowledge**	
Objectives:	To provide knowledge related to thermodynamics, various chemical equilibrium, hydrocarbons and compounds	
Expected Outcome:	Students will explain thermodynamics, various chemical equilibrium, hydrocarbons and compounds in chemistry	
Unit	**Contents of the Course**	**Hrs**
I	**Chemical Thermodynamics:** (a)State of a system, state variables, intensive and extensive variables, concept of heat and work, First Law of thermodynamics. Calculation of work (w), heat (q), changes in internal energy (ΔU) and enthalpy(ΔH) for expansion or compression of ideal gases under isothermal and adiabatic conditions Calculation of w, q, ΔU and ΔH for processes involving changes in physical states. (b)Thermo chemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution.	8
II	**Chemical Equilibrium:** (a)Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. (b)Distinction between ΔG and $\Delta G^{\ominus}$, Le Chatelier's principle. Relationships between Kp, Kc and Kx for reactions involving ideal gases.	7
III	**Ionic Equilibrium:** **(a)**Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common in effect, (b)Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.	7
IV	**Aromatic hydrocarbons** (a)Preparation of benzene from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid. Reactions of benzene): Aromatic electrophilic substitution: nitration, halogenations and sulphonation. Friedel Craft's reaction (alkylation and acylation). Side chain oxidation of alkyl benzenes (Upto 4 carbons on benzene). (b)Organic Halogen Compounds Types of Nucleophiles Substitution (SN^2, SN^1) reactions. Preparation of Alkyl Halides from alkenes and alcohols. Reactions: hydrolysis, nitrite & nitro formation, nitrile & iso-nitrile formation. Williamson's ether synthesis: Elimination and substitution.	8
V	**Aliphatic and Aromatic Hydroxy Compounds** (a)Alcohols: Preparation: Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters. Reactions: With sodium, HX, Oppeneauer oxidation Diols: oxidation of diols. Pinacol-Pinacolone rearrangement. (b)**Phenols**: Preparation and Reactions, acidic nature: Electrophilic substitution: Nitration, halogenations and sulphonationn. Reimer - Tiemann Reaction, Gattermann-Koch Reaction,	8
Total Hrs		38

References and Text Books:

1 Barrow, G. M. Physical Chemistry Tata McGraw-Hill (2007).
2. Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004).
3. Mahan, B. H. University Chemistry 3rd Ed. Narosa (1998).
4. I. L. Finar: Organic Chemistry (Vol. I & II), E. L. B. S.
5. R. T. Morrison & R. N. Boyd: Organic Chemistry, Prentice Hall.

Mode of Evaluation: (Percent Weightage)	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended by BOS on :	

Approved by Academic Council on	

SC 120	**Physics-II (Mathematical Physics and Special theory of relativity)** **C (L, T, P) = 4 (3, 1, 0)**
Version	1.0
Prerequisite	Upto XII physics
Objectives:	● To understand the linear equations, vector spaces, matrices, linear transformations, determinants, eigenvalue, eigenvectors, etc. ● To Learn to use Laplace transform methods to solve differential equations. ● To introduce the Fourier series and its application to the solution of partial differential equations.
Expected Outcome:	● Learn about Gradient, Divergence and Curl in orthogonal curvilinear and their typical applications in physics. ● Learn about special type of matrices that are relevant in physics and then learn about tensors. ● Get introduced to Special functions like Gamma function, Beta function, Delta function, Dirac delta function, Bessel functions and their recurrence relations ● Learn different ways of solving second order differential equations and familiarized with singular points and Frobenius method. Learn the fundamentals and applications of Fourier series, Fourier and Laplace transforms, their inverse transforms etc
UNIT-**I**	**Curvilinear Coordinate system and Tensor** **7 Hrs**
Curvilinear coordinate system; orthogonal curvilinear coordinate system and scale factor; gradient of scalar field; divergence and curl of a vector field; Relations among all three coordinate systems; Jacobian; Tensor: Invariant, contravariant, covariant and mixed tensor, Metric tensor, Fundamental operations of tensors.	
UNIT-**II**	**Special Theory of Relativity** **8 Hrs**
Dirac Delta Function; Fourier Series; Michelson Morley Experiment; General and special theory of relativity; Lorentz transformation and its consequences and geometrical interpretation; World line, space time interval, space like and time like vectors and macrocasuality; Relativistic Doppler's effect.	
UNIT **-III**	**Relativistic dynamics and electrodynamics** **7 Hrs**
Four vector formulation; four velocity, four momentum and four force vectors; Four momentum conservation; Transformation between laboratory and centre of mass frame of reference; Transformation of C frame to L frame of reference; Kinematics of decay products of unstable particles; threshold reaction energy; pair production; Compton effect;	

Law of conservation of charge and equation of continuity; Lorentz transformation of charge and current densities; Lorentz transformation of four potentials; Lorentz transformation of an electric field and magnetic field.	
UNIT-**IV**	**Differential equations of second order and special functions** **8 Hrs**
Differential equation; Linear differential equation with variable coefficients and series solution method; Legendre differential equation; Rodrigue's formula; orthogonality relation of Legendre equation; Bessel differentia lequation; Hermite differential equation; Laguerre differential equation.	
UNIT-**V**	**Partial differential equation and boundary value problems** **6 Hrs**
Laplace equation in two and three dimensional cartesian coordinates; Laplace equation in spherical coordinate system; Helmholtz equation in circular cylindrical coordinates; wave equation in spherical coordinates.	
Text Book	Mathematical Physis by H.K. Dass, Rama Verma, S.Chand Publication
Reference Books	1. Mathematical Physics & Special Theory of relativity by P. Dashora and D. Bhatnagar, RBD pub. 2. Mathematical physics by M.P. Saxena, S.S. Rawat, P.R. Singh, CBH publishing.
Mode of Evaluation: (Percent Weightage)	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended by BOS on:	
Approved by Academic Council on :	

SC122	**Physics-III (Optics)** **C (L, T, P) = 4 (3, 1, 0)**
Version	1.0
Prerequisite	Upto XII physics
Objectives:	● To understand basic concepts and principles of geometrical, physical and modern optics. ● To help students understanding the nature of light, its propagation and interaction with matter. ● To help students in handling and aligning the optical elements and operate the devices and equipment. ● To help students in applying the fundamental concepts of optics in lasers, fiber optics, holography etc..
Expected Outcome:	● A general idea of defining and explaining various phenomena of light propagation. ● Apply wave optics to interference, diffraction phenomena and related problems.

	● Identify the different applications of optics including laser, fiber optics etc. ● Analyze different laser systems and their working principles.
UNIT-**I**	**Nature and Behavior of Light: Wave Theory** **9 Hrs**
Introduction and History; Four important theories to explain the nature of light: Corpuscular Theory, Wave Theory, Electromagnetic theory, Quantum Theory; Basic Properties of light: Reflection, Refraction, Dispersion, Velocity of light, refractive index, optical path, dual nature; Fermat's principle of least time: deduction of laws of reflection and refraction; Introduction to wave optics: Oscillations and waves, travelling waves, wave front and wave surface; Mathematical presentation of travelling wave; General wave equation; Complex representation of a plane wave; Wave packet and bandwidth; Fourier series and transforms; Group and Phase velocity; Maxwell's equation; Wave equation for free space; Uniform plane waves; Boundary conditions for light waves: normal incidence and oblique incidence.	
UNIT-**II**	**Interference** **7 Hrs**
Superposition of Waves; Interference; Young's Double slit experiment – Wave front division; Coherence; Conditions for Interference; Fresnel Biprism; Interference due to transmitted light; Haidinger Fringes; Newton's rings: Determination of wavelength of monochromatic light; Michelson Interferometer: Construction and working. Determination of wavelength of light and wavelength separation of two nearby wavelengths.	
UNIT **-III**	**Diffraction** **6 Hrs**
Fresnel Diffraction. Huygens-Fresnel Theory; Fresnel's Assumptions; Distinction between Interference and Diffraction; Diffraction at Circular Aperture; Diffraction at an Opaque circular disc; Diffraction pattern due to straight edge and narrow slit.Fraunhofer Diffraction. Fraunhofer diffraction at single slit; Fraunhofer diffraction at a circular aperture; Fraunhofer diffraction at double slit; Plane diffraction grating.	
UNIT-**IV**	**Polarization** **8 Hrs**
Preferential direction in wave; Polarized light; Types of polarized light; Production of linearly polarized light; Superposition of waves linearly polarized at right angles; Retarders or wave plates; Production of elliptically polarized light; production of circularly polarized light, Analysis of polarized light; Polarizer and analyzer.	
UNIT-**V**	**LASER, Holographyand Optical Fiber** **6 Hrs**
LASER. Attenuation of light in an optical medium; Interaction of light with matter; Spontaneous and stimulated Emission; Population Inversion; LASER Principle- Einstein's coefficients, Types of LASER- He-Ne LASER, Ruby LASER. Application of lasers. Holography. Principle of Holography: Theory; Important properties of Hologram; Advances; Applications. Optical Fiber. Total Internal reflection; Optical Fiber; Propagation of light through optical fiber; Fractional refractive index change; Numerical aperture; Modes of propagation; Classifications of optical fibers; Merits of optical fiber	
Text Book	● **Optics by AjoyGhatak, The Mc Graw Hill Companies** ● **Optics by Subrahmanyam and BrijLal, S. Chand & Co.** ● **Fundamentals of Optics by Jenkin's A. Francis & White E Harvey, Mc Graw Hill Inc**
Reference Books	● **Fundamentals of Optics by Jenkin's A. Francis & White E Harvey, Mc Graw Hill Inc**

Mode of Evaluation: (Percent Weightage)	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended by BOS on:	
Approved by Academic Council on :	

SC 124	**Mathematics-III (Algebra)** **C (L, T, P) = 4 (3, 1, 0)**
Version	**1.0**
Prerequisite	Knowledge of Sets , Relations and Functions is required.
Objectives:	The objective of this course is to develop the learning capabilities and problem solving skills of talented students at the mathematically deeper and more rigorous level.
Expected: outcome	Abstract Algebra is used in variety of areas such as Coding Theory and Cryptography.
UNIT-**I**	**Groups** **7 Hrs**
Definition and simple properties of groups, Order of an element of a group. Cyclic group, Permutation group.	
UNIT-**II**	**Subgroups** **7 Hrs**
Subgroups, Cosets.Lagrange's theorem on order of subgroups of a finite order group.	
UNIT **-III**	**Homomorphism and Isomorphism** **7 Hrs**
Homomorphism and Isomorphism, Cayley's theorem. Normal subgroups and Quotient groups. Fundamental theorem on homomorphism.	
UNIT-**IV**	**Rings , Integral domains and Fields** **7 Hrs**
Definition and simple properties of Rings, Subrings, homomorphism of rings.Embedding rings. Integral domains and Fields. Characteristics of an integral domain and field.	
UNIT-**V**	**Ideals and Quotient Rings** **8 Hrs**
Ideals and Quotient Ring. Maximal ideal and Prime ideal. Principal Ideal domain. Field of quotients of an integral domain. Prime fields.	
Text Book	Elements of Abstract Algebra by Sharma, Gokhroo, Saini
Reference Books	1.Topics is Algebra by N. Herstain. 2.Basic Algebra (Vol. I & II) by N.Jacobson. 3.Modern Algebra by S. Singh.
Mode of Evaluation: (Percent Weightage)	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended by BOS on:	
Approved by Academic Council on :	

SC 126	**Mathematics-IV (Differential Equations)** **C (L, T, P) = 4 (3, 1, 0)**
Version	**1.0**
Prerequisite	Deep knowledge of Integral Calculus is required to find solution of Differential Equations.
Objectives:	The objective of this course is to develop a competent working knowledge of the main concepts and methods introduced.
Expected Outcome :	It provides the fundamental concepts and mathematical methods needed for the analytical solution of many Ordinary and Partial Differential Equations which arise in the modeling of basic phenomena in Science , Engineering and Technology.
UNIT-**I**	**Differential Equations: 7 Hrs**
Linear differential equations and equations reducible to linear form. Exact differential equations and equations which can be made exact.First order but higher degree differential equations solvable for x, y and p. Clairauts form and Singular solutions.	
UNIT-**II**	**Differential Equations: 7 Hrs**
Linear differential equations with constant coefficients. Homogeneous linear differential equations. Simultaneous differential equations.	
UNIT-**III**	**Differential Equations 7 Hrs**
Linear differential equations of second order with variable coefficients. Solution by transforming the equation by changing the dependent variable and independent variable. Method of variation of parameters.	
UNIT-**IV**	**Differential Equations 7 Hrs**
Partial differential equations of first order. Lagrange's form. Standard forms. Charpits method	
UNIT-**V**	**Differential Equations :8 Hrs**
Homogeneous and non-homogeneous linear partial differential equations with constant coefficients.Equations reducible to equations with constant coefficient's.	
Text Book	1. Differential Equations Vol. I byBansal,Dhami. 2. Differential Equations Vol. II byBansal,Dhami.
Reference Books	1. Introductory course in Differential Equations by D.A. Murray. 2.An Introduction to Ordinary Differential Equations by E.A. Codington. 3. Elements of Differential Equations by Gokhroo, Saini, Agrawal. 4. Differential Equations (Vol. I & II) : RBD Publications 5. Introduction to Partial Differential Equations byFolland (PHI Learning)
Mode of Evaluation: (Percent Weightage)	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended by BOS on:	
Approved by Academic Council on :	

SC 231	**Mathematics-V (Numerical Analysis and Theory of Probability) C(L, T, P)=4(3, 1, 0)**
Version	**1.0**
Prerequisite	Basic knowledge of Difference Calculus and Statistics is required.
Objectives:	The students will be equipped with a number of commonly used numerical algorithms , knowledge and skills in performing numerical computation using MATLAB.
Expected outcome:	The students will gain an understanding of how in practice mathematically formulated problems are solved using computers and how computational errors are analysed and tackled.
UNIT-**I**	**Finite Differences and Interpolation : 7 Hrs**
Differences. Relation between differences and derivatives. Newton`s formulae for forward and backward interpolation. Divided differences. Newton`s divided difference. Interpolation formulae. Lagrange`s interpolation formula.	
UNIT-**II**	**Central differences , Numerical Differentiation and Integration : 7 Hrs**
Central differences. Gauss`s Stirling`s and Bessel`s interpolation formulae. Numerical Differentiation. Derivatives from interpolation formula. Numerical integration. Newton-Cote`s formula. Trapazodial rule, Simpson`s one-third, Simpson`s three-eight and Gass quadrature formula	
UNIT **-III**	**Numerical solutions : 7 Hrs**
Numerical solution of algebraic and transcendental equations. Bisection Method. Regula-Falsi method. Method of iteration. Newton-Raphson method. Gauss eliminationand Iterative methods for solving system of linear algebraic simultaneous equations.Solution of ordinary differential equations of first order with initial and boundary conditions using Picard`s and modified Euler`s method.	
UNIT-**IV**	**Theory of Probability : 7 Hrs**
Mathematical definition of probability. Addition and Multiplication theorems of Probability. Probability of atleast one event. Conditional probability. Baye`s theorem.Random variable, Mathematical expectation, Mean, Variance and Moment Generating Functions.	
UNIT-**V**	**Discrete and Continuous Probability Distribution : 8 Hrs**
Discrete Probability Distribution : Binomial and Poisson`s distribution. Mean , Variance and M.G.F. of Binomial and Poisson`s distribution. Continuous Probability Distribution : Rectangular and Normal distribution. Mean and Variance of Normal distribution. Area under Normal curve.	
Text Book	1. Numerical Analysis by J.L.Bansal and J.P.N.Ojha 2. Elements of Mathematical Statistics by D.C.Gokhroo, S.L.Bhargava, S.M.Agrawal
Reference Books	1. Numerical Analysis by P.C.Biswal 2. Numerical Methods for scientists and Engineers by Sankara Rao 3. Numerical Methods for scientific and Engg. Comp. by M.K.Jain, S.R.K.Iyengar ,R.K.Jain
Mode of Evaluation: (Percent Weightage)	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended by BOS on:	
Approved by Academic Council on :	

SC 233	**Mathematics-VI(Discrete Mathematics) C(L, T, P)=4(3, 1,0)**
Version	**1.0**
Prerequisite	Knowledge of Sets , Relations and Functions is required.
Objectives:	Discrete mathematics is a bridge connecting mathematics with various branches of Computer Science. Discrete mathematics is of genuine use in Computer Science and hence a study of this branch of mathematics is of great importance to the students of Computer Science.
Expectedoutcome	Discrete mathematics enables students to think mathematically to model computation related problems and to apply various discrete structure.
UNIT-**I**	**Sets and Propositions, Relations and Functions: 6 Hrs**
Cardinality,Principal of inclusion and exclusion. Mathematical Induction.Binary relations, Equivalence relations and Partitions. Partial ordered relations and Lattices.	
UNIT-**II**	**Algebraic Structures , Boolean Algebra : 8 Hrs**
Groups, Rings, Integral domains. Fields (Definitions, simple examples and elementary properties only)Lattices and Algebraic structure, Duality, Distributive and Complemented Lattices. Boolean Lattices.	
UNIT **-III**	**Computability and Formal Languages :8 Hrs**
Ordered sets, Languages, Phrase, Structure, Grammars, Types of Grammars and Languages. Discrete numeric functions and Generating functions . Recurrence relations and Recursive Algorithms, Linear Recurrence relation with constant coefficients. Homogeneous solutions. Particular solution, Total solution.	
UNIT-**IV**	**Graphs 7 Hrs**
Basic terminology, Multigraphs, Weighted graphs, Paths and Circuits, Shortest paths , Eulerian paths and circuits. Travelling Salesman problem. Union, Join, Product and composition of graphs.	

UNIT-**V**	**Trees , Digraphs : 7 Hrs**
Properties, Spanning tree, Binary and Rotted tree, Simple digraph, Asymmetric digraphs. Symmetric digraphs and complete digraphs. Digraph and Binary relations. Matrix representation of graphs and digraphs.	
Text Book	1. Discrete Mathematics by Chauhan and Pandey 2. Graph Theory by G.N.Purohit
Reference Books	1. Discrete Mathematics by N.Chandrasekaran&M.Umaparvathi 2. Discrete Mathematics and Graph Theory by P.C.Biswal 3. Discrete Mathematics with Graph Theory by Goodaire& Parmenter 4. Graph Theory with Applications by C.Vasudev (New Age Pub.)
Mode of Evaluation: (Percent Weightage)	Mid-Term I (10%) Mid-Term II (10%,) Weekly test (10%), Graded assignment (10%) Written examination (60%)
Recommended by BOS on :	
Approved by Academic Council on :	

SC 221	Chemistry –III (Inorganic Chemistry-I) C (L, T, P) = 3 (3, 1, 0)	
Version	1.0	
Prerequisites	Basic knowledge of chemistry and previous class	
Objective	To encourage Inorganic aspects of Chemistry and knowledge is added To develop knowledge by teaching Knowledge dissemination	
Expected outcome	Student will know more about fundamental of chemistry and can relate to daily life	
Unit I	**S & P block elements**	**7 Hrs**
Comparative study, diagonal relationship, salient features of hydrides, salvation and complexation tendencies including their function in biosystems, an introduction to alkyls and aryls. **Periodicity of p-block elements:** Periodicity in properties of p-block elements with special reference to atomic and ionic radii, ionization energy, electron affinity, electronegativity, diagonal relationship, catenation.		
Unit II	**Noble gases**	**8 Hrs**
Some important compounds of P-block elements; Hydrides of boron, diborane and higher borane, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates, tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides,**Chemistry of noble gases:** Chemical properties of noble gases, chemistry of xenon, structure and bonding in xenon compounds.		
Unit III	**Oxidation reduction**	**7 Hrs**
Concepts of Oxidation and reduction, Redox reactions, Strengths and equivalent weights of oxidizing and reducing agents, Theory of Redox titrations, Redox indicators, Cell representations, Measurement of electrode potential, Oxidation-reduction curves, Iodimetry and Iodometry, Titrations involving ceric sulphate, potassium iodate, potassium bromate, potassium permanganate, Corrosion and Industries		
Unit IV	**Organometallic compounds**	**7 Hrs**
Definition Nomenclature, Preparation properties and application and bonding of alkyl and Aryl compound. Electronic and Ionic Conduction ,Metals, insulators and semiconductors, electronic structure of solids application in electronic and electrical industries		
Unit V	**Ionic solid**	**7Hrs**
Definition of space lattice, unit cell; Ionic structure, radius ratio effect and coordination number, limitations of radius ratio rule, lattice defects, semiconductors, lattice energy and born haber cycle, salvation energy and solubility of ionic solids, polarizing power, and polarisability of ions, fajan's rule. Metallic bond; free electron, valence bond and band theories. Weak interactions; Hydrogen bonding, vanderwaals forces.		
Total Hrs		**36Hrs**

References and Text Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P.L. Gaus. Wiley.
2. Concise Inorganic Chemistry, J.D. Lee ELBS.
3. Concepts of Models Inorganic Chemistry B.Douglas. D.McDaniel and J.Alexander, John Wiley.
4. Inorganic Chemistry. D.E. Shriver P.W. Atkins and C.H. Langfor, Oxford.
5. Inorganic Chemistry, W.W. Porterfield Addison Wesley.

Mode of Evaluation: (Percent Weightage)	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended by BOS on :	
Approved by Academic Council on	

SC 223	Chemistry-IV (organic Chemistry-I)
Prerequisite	All students are expected to have a general knowledge of basic chemistry principles.
Learning objective	The learning objective of course are: To create an understanding regarding principle of spectroscopy, To gain knowledge about heterocyclic compound, To have understanding about biomolecules, Able to understand polymer.
Expected outcomes	The student will be able to conceptualize about NMR spectroscopy, Able to analyse structure of protein.
Unit-I	**NMR Spectroscopy** **9hr**
Proton magnetic resonance spectroscopy (1H-NMR): Nuclear Shielding and Deshielding, Chemical shift and molecular, spin-spin splitting and coupling constants, Interpretation of NMR spectra, of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, ethyl acetate, toluene, and acetophenone.	
Unit- II	**Heterocyclic Compounds** **7hr**
Introduction, MO Picture, Aromatic Characteristics, Methods for preparation and chemical reactions of Pyrrole, furan, and thiophene, with particular emphasis on the mechanism of electrophilic substitution. Diels-Alder reaction of furan. Pyridine: synthesis and Mechanism of its Nucleophilic substitution reactions.	
Unit-III	**Organic Synthesis via Enolates** **6hr**
Organic Synthesis via Enolates: Acidity of alpha Hydrogen in reactive methylene compounds, Alkylation of diethyl Malonate and ethyl acetate. Synthetic applications of ethyl acetoacetate and malonic ester. Claisen condensation and keto-enol tautomerism.	
Unit-IV	**Biomolecules** **7hr**
Carbohydrates: Classification and Nomenclature and structure and synthesis of Glucose and fructose. Ribose and Deoxyribose, Interconversion of mannose, glucose and fructose. Classification of Amino Acids. Peptides, Proteins and Nucleic Acids: Structure and nomenclature of Peptides and Proteins, Constituents of Nucleic Acids.	
Unit-V	**Synthetic polymer and Synthetic Dyes** **7hr**
Synthetic Polymers: Addition and chain growth polymerization. Free radical and ionic polymerization. Condensation and step growth polymerization. Polyester, polyamides, Phenol-formaldehyde resins, urea formaldehyde resins. Natural and synthetic rubber. Ziegler-Natta Catalyst. Synthetic Dyes: Classification Color and constitution (electronic concept). Classification of dyes. Chemistry and synthesis of Methyl orange, Congo red and Malachite green, phenolphthalein, fluorescein, alizarin and indigo.	
Reference books	1. I. L. Finar : Organic Chemistry (Vol. I & II), E. L. B. S. 2. R. T. Morrison & R. N. Boyd : Organic Chemistry, Prentice Hall. 3. Arun Bahl and B. S. Bahl : Advanced Organic Chemistry, S. Chand 4. Peter Sykes: A Guide Book to Mechanism in Organic Chemistry, Orient Longman. 5. Jonathan Clayden, Nick Geeves, Stuart Warren, organic chemistry, Oxford University Press
Mode of Evaluation: (Percent Weightage)	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended by BOS on:	
Approved by Academic Council on :	

SC 235	Physics-IV (Thermodynamics and statistical Physics) C (L, T, P) = 4 (3, 1, 0)
Version	1.0
Prerequisite	Upto B. Sc. First year
Objectives:	• To explain the fundamental concepts relevant to thermodynamics. • To explain zeroth, first, second and third law of thermodynamics. • To gain knowledge about the concepts related to ideal gas, real gas, energy, heat, work etc. To understand the entropy, Van der Waals' gas, Clausius – Clapeyron heat equation. • To learn statistical physics (classical and quantum statistics)
Expected Outcome:	Understanding of kinetic theory of matter. A general idea of the basic definitions related to heat, energy, power etc. Understanding of the fundamental laws of thermodynamics. Understanding about the radiation and its quantum explanation. Understanding the statistical physics and its connection with thermodynamics. Understanding of Quantum statistics.
UNIT-**I**	**Kinetic Theory of Matter**
Matter and its states; Postulates of Kinetic theory of gases. Ideal Gas and its equation; Expression for the pressure exerted by a gas; Derivation of gas equation; Derivation of gas laws: Boyle's law, Charles law, Regnault's law; Avogadro's hypothesis; Grahm's law of diffusion; Brownian motion; Degree of freedom; Maxwell's law partition of energy; Adiabatic expansion of ideal gas. Difference between real and ideal gas; Change of state and continuity; Andrew's experiment on carbon dioxide: Critical constants; Bahaviour of gases at high pressure; Boyle Temperature; Van der Waals equation of state; Critical coefficient. Expression for mean free path; Transport phenomena and the governing laws; coefficient of each transport phenomena and their inter-relation.	
UNIT-**II**	**Thermodynamics-I**
Thermodynamic system and its types; Zeroth law of thermodynamics; 1st law of thermodynamics; specific heat of gases; Applications of first law: specific heat of gas, isochoric process, isobaric process, adiabatic process; Reversible and irreversible process; Heat engine; Carnot's cycle and heat engine; Second law of thermodynamics; Carnot's theorem and its proof; Entropy, Physical concept of entropy; Change of entropy in reversible and irreversible cycle; T-S diagram; Entropy of perfect gas.	
UNIT **-III**	**Thermodynamics-II**
Thermodynamic Variables and their types; Maxwell's thermodynamic relations; Thermodynamic potentials and their significance; Relation of thermodynamic potentials with their variables; Applications of Maxwell's thermodynamic relations: specific heat equation, Clausius-Clapeyron's equation, Joule Thomson Cooling; T.dS equations. Concept of absolute zero; Different methods of liquefaction: Method of freezing mixture, Evaporation of liquid under reduced pressure, adiabatic expansion of gas, Joule Thomson expansion, regenerative cooling, Adiabatic demagnetization of a paramagnetic salt; Third law of thermodynamics: Nernst's theorem.	
UNIT-**IV**	**Radiation**
Radiation and Thermal Radiation; Pervost's theory of heat exchange; Blackbody; Kirchoff's law; Pressure of radiation; Stefan Boltzman's law, Distribution of Energy in Black body spectrum; Wien's displacement law; Rayleigh-Jeans law; The failure of classical theory; Planck's Quantum Postulates. Planck's radiation law and deduction of Stefan's law, Wien's law and Rayleigh-Jeans law; Pyrometer; Solar constant; Temperature of the Sun; Pyrheliometer.	
UNIT-**V**	**Statistical Physics**

Statistical basis of thermodynamics; Probability; Principle of equal a priori probability; Some basic rules of probability theory; Permutations and Combinations; Macrostate and microstate; Thermodynamic probability; Constraints on a system; Accessible states; Static and dynamic systems; Most probable state; Degree of freedom; Position, momentum and phase space; Mu and Gamma space; Fundamental postulates of statistical mechanics; Statistical ensembles; Equilibrium between two systems in thermal contact; Boltzmann's entropy probability relation; Boltzmann's Canonical Distribution law; Partition function; Relation between partition function and thermodynamic quantities; Three kinds of particle; Maxwell-Boltzmann statistics applicable to ideal gas; Maxwell-Boltzmaan Energy Distribution law; Applications of Maxwell-Boltzmann Energy Distribution law; Mean, RMS and Most Probable Speeds; Limitations of Maxwell-Boltzmann Method; Gibbs Paradox; Bose-Einstein Statistics; Fermi-Dirac Statistics	
Text Book	l. Heat and Thermodynamics: K.W. Zeemansky. 2. Thermal Physics: B.K. Agarwal. 3. Heat and Thermodynamics: Brij Lal and N. Subramanyam. 4. Heat and Thermodynamics: Dayal, Verma and Pandey. 1.
Reference Books	l. Heat and Thermodynamics: K.W. Zeemansky. 2. Thermal Physics: B.K. Agarwal. 3. Heat and Thermodynamics: Brij Lal and N. Subramanyam. 4. Heat and Thermodynamics: Dayal, Verma and Pandey.
Mode of Evaluation: (Percent Weightage)	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended by BOS on:	
Approved by Academic Council on :	

SC 237	**Physics-V (Electricity and Magnetism) C (L, T, P) = 4 (3, 1, 0)**
Version	1.0
Prerequisite	Upto B. Sc. First year
Objectives:	● Gain deeper understanding of Electricity and Magnetism. ● Advance skills and capability for formulating and solving problems. ● Increase mathematical and computational sophistication
Expected Outcome:	● Apply knowledge of electricity and magnetism to explain natural physical processes and related technological advances. ● Use an understanding of calculus along with physical principles to effectively solve problems encountered in everyday life, further study in science, and in the professional world. ● Design experiments and acquire data in order to explore physical principles, effectively communicate results, and critically evaluate related scientific studies. ● Assess the contributions of physics to our evolving understanding of global change and sustainability while placing the development of physics in its historical and cultural context.
UNIT-**I**	**Electrostatics**
Electrostatics: Electric charge; Conservation of Charge; Coulomb's law; Charge distributions; Flux; Gauss's law; Field of spherical charge distribution; Electric Potential: Line integral of electric field; Potential difference and potential function; Potential of charge distribution; Gradient of a scalar function; divergence of a vector function; The Laplacian, Laplace equation; Curl of a vector function; Stokes' theorem	
UNIT-**II**	**Electric field and electric currents**
Conductors and insulators; Conductors in electrostatic field; Capacitance and Capacitors; Energy stored in a capacitor; Electric current and current density; Steady current and charge conservation; Electrical conductivity and Ohm's law; Electromotive force and the voltaic cell; Variable currents in capacitors and resistors; Alternating current; alternating current networks; Admittance and impedance; Power and energy in alternating circuits	
UNIT **-III**	**Magnetic force and field**
Magnetic forces; Measurement of charge in motion; Force on a moving charge; Definition and properties of Magnetic field; Field of any current carrying wire; Fields of rings and coils; Change in B at a current sheet; Electric conduction in a magnetic field: Hall effect.	
UNIT-**IV**	**Electric field and magnetic field in matter**
Dielectrics; The moments of a charge distribution; The potential and field of dipole; The torque and the force on a dipole in an external field; Atomic and molecular dipoles; Induced dipole moment; permanent dipole moment; A dielectric sphere in a uniform field. Response of various substances to a magnetic field; The absence of a magnetic charge; the field of current loop; the force on a dipole in an external field; Electronic spin and magnetic moment; Magnetic susceptibility; The magnetic field caused by magnetized matter; the field of a permanent magnet; di, para and Ferromagnetism.	
UNIT-**V**	**Electromagnetic induction**
Faraday's discovery; conducting rod moving through a uniform magnetic field, Loop moving through a nonuniform magnetic field; stationary loop with the field source moving; Universal law of induction; Mutual inductance; Reciprocity theorem; Self inductance; Energy stored in a magnetic field.	
Text Book	l. Electricity and Magnetism: Purcell and Morin, Cambridge University press. 2. Electricity and Magnetism: Brij Lal and N. Subrahmanyam, S.Chand Publications. 3. Electricity and Magnetism: R. Murugeshan, S. Chand Publications. 4. Heat and Thermodynamics: Dayal, Verma and Pandey. 2.
Reference Books	l. Electricity and Magnetism: Purcell and Morin, Cambridge University press. 2. Electricity and Magnetism: Brij Lal and N. Subrahmanyam, S.Chand Publications.

Mode of Evaluation: (Percent Weightage)	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended by BOS on:	
Approved by Academic Council on :	

SC 242	**Mathematics –VII (Real Analysis) C(L, T, P)=4(3, 1,0)**
Version	**1.0**
Prerequisite	Knowledge of Sets , Relations and Functions, Limits, Continuity and Differentiability is required.
Objectives:	In the recent years the set theoretic concepts, the terminology and symbols associated with it are widely used in almost all branches of mathematics. So much so that one who is not familiar with these concepts, terminology and symbols cannot make any headway into the study of recently developed branches of mathematics, so called modern mathematics.
Expected outcome:	The topics covered in this course will enable students to understand the topics of modern mathematics.
UNIT-**I**	**Real Numbers : 7 Hrs**
Real numbers as complete ordered field, Limit point , Bolzano-Weierstrasstheorem.Closed and Open sets. Union and intersection of such sets. Concept of compactness. Heine-Borel theorem. Real sequences, limit and convergence of a sequence. Monotonic sequences. Rea l sequences, limit and convergence of a sequence. Monotonic sequences. Real numbers as complete ordered field, Limit point , Bolzano-Weierstrass theorem. Closed and Open sets. Union and intersection of such sets. Concept of compactness. Heine-Borel theorem. Rea l sequences, limit and convergence of a sequence. Monotonic sequences.	
UNIT-**II**	**Cauchy`s sequence ,Darboux`s and Rolle`s theorem. 7 Hrs**
Cauchy`s sequences. Subsequences, Cauchy`s general principle of convergence. Properties of continuous functions on closed intervals. Properties of derivable functions. Darboux`s and Rolle`s theorem.	
UNIT **-III**	**Riemann integration : 7 Hrs**
Riemann integration, Lower and Upper Riemann integrals, Riemann integrability.Mean value theorem of integral calculus. Fundamental theorem of integral calculus.	
UNIT-**IV**	**Sequence and series of functions : 7 Hrs**

Sequence and series of functions, Pointwise and Uniform convergence. Cauchy`s criterion, Weierstrass M-test, Abel`s test, Dirichlet`s test for uniform convergence of series of functions. Term by term differentiation and integration.	
UNIT-**V**	**Matric space :** **7 Hrs**
Definition and examples. Subspace of a metric space, Product space, Continuous mappings, Sequence in a matric space. Cauchy`s sequence, Complete matric space, Baire`s theorem. Compact sets and Compact spaces, connected metric spaces.	
Text Book	Elementary Real Analysis by D.C.Gokhroo, S.R.Saini, J.P.N.Ojha
Reference Books	1. Real Analysis by Dipak Chatterjee 2. Real Analysis byH.L.Royden 3. Principals of Real Analysis by S.C.Malik
Mode of Evaluation: (Percent Weightage)	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended by BOS on:	
Approved by Academic Council on :	

SC 244	**Mathematics –VIII (Operation Research) C(L, T, P) =4(3, 1, 0)**
Version	**1.0**
Prerequisite	Knowledge of Mathematics uptoSeniorSecondary School level is required.
Objectives:	All the engineers in industry and business organizations are being continuously pressed for improving production and sales in reducing human efforts and to lower production costs to with stand increasing competation. This requires the use of rigorous methods of decision making, such as optimization techniques which result into more efficient and economical activities.
Expected outcome:	Students will be able to use Optimization techniques in solving problems in complex situations which are greatly aided by the advanced computer technology.
UNIT-**I**	**Linear Programming :** **8 Hrs**
The Linear Programming problem. Graphical solution of Linear Programming problems. Basic solution. Some basic properties of convex sets. Theorems based on convex sets. Fundamental theorem of L.P.P. Application of Simplex Method for solution of a L.P.P. to simple problems.	
UNIT-**II**	**Duality of L.P.P. :** **7 Hrs**
Duality. Fundamental theorem of duality. Properties and simple problems of duality. Transportation problems. Transportation algorithm for minimization problem.	
UNIT **-III**	**Assignment Models , Theory of Games :** **7 Hrs**

Assignment Models : Mathematical formulation. Hungarian method. Variations of the assignment problem. Travelling salesman problem. Theory of Games : Basic definitions, Minimax(Maximin) criterion and optimal strategy, Saddle point, Minimax-Maximin principle for mixed strategy games. Fundamental theorem of Game theory. Two-by-two games without saddle point. Arithmetic method for 2x2 games.	
UNIT-**IV**	**Inventory Models : 7 Hrs**
Inventory Models :Definition, types of inventory models. Classification of inventory models. Economic ordering quantity(EOQ). EOQ models without shortage, EOQ models with shortage. EOQ models with constraints.	
UNIT-**V**	**Queueing Theory : 7 Hrs**
Introduction, Probability distributions in queueing systems. Models : Erlang model, general Erlang model, Model III (M/M/I) : (N/FCFS).	
Text Book	1. Elements of Linear Programming by D.C.Gokhroo, S.L. Bhargava, S.R.Saini 2.Optimization Techniques by S.K.Jain, D.M.Mehta
Reference Books	1.Operations Research:Methods and Practice by C.K.Mustafi 2.Mathematical Methods by Dr.S.Sivaiah 3. Mathematical Techniques by Jordan, Smith
Mode of Evaluation: (Percent Weightage)	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended by BOS on:	
Approved by Academic Council on :	

(Common for Mathematics and Biology Streams)

SC 234	**Chemistry- V (Physical chemistry-I) C (L, T, P) = 3 (3, 0, 0)**	
Vision	**1.0**	
Prerequisites	Physical Chemistry I needs Chemistry I and II and Organic and Inorganic I Papersv	
Objectives	This course deals with the application of structure and theory to the study of physical aspects including reaction dynamics, isotope effects and molecular orbital theory applied. Electrochemistry for fuel systems of daily life	
Expected outcomes	Better Science understanding	
Unit I	**Colloidal States 7 Hrs.**	
Definition of colloids, classification of colloids; Solids in liquids (sols): properties – kinetic, optical and electrical; stability of colloids, protective action, Hardy-Schulze law, gold number. Liquids in liquids (emulsions): types of emulsions, preparation, Emulsifier, Liquids in solids (gels): classification, preparation and properties, inhibition, general application of colloids, colloidal electrolytes.		
Unit II	**Chemical Kinetics I 8 Hrs**	

Chemical Kinetics I Chemical kinetics and its scope, rate of a reaction, factors influencing the rate of a reaction, concentration dependence of rates, mathematical characteristics of simple chemical reactions – zero order, first order, second order, pseudo order, half life and mean life, electro kinetics phenomena.		
Unit III	**Chemical Kinetics I**	**8 Hrs**
Chemical kineticsII: Theories of chemical kinetics. Simple collision theory based on hard sphere model, transition state theory (equilibrium hypothesis), Expression for the rate constant based on equilibrium constant and thermodynamic aspects, Catalysis.Introduction to corrosion, homogeneous theory, forms of corrosion, corrosion monitoring and prevention methods.		
Unit IV	**Electrochemistry**	**7 Hrs**
Electrochemistry Electrolyte Solutions , Electrical Conductivity , Electrified Interfaces, Equilibrium Electrochemistry , Dynamic Electrochemistry , Electrolysis , Applications of electrolysis, Galvanic cell, electrochemical cell, Nernst equation, electrodes, cell reaction, primary and secondary storage, applications., Biological Electrochemistry.		
Unit V	**Thermodynamics – II**	**8 Hrs**
Thermodynamics – II Statistical thermodynamics , Thermodynamic equilibrium , Quasi-static transfers between simple systems are nearly in thermodynamic equilibrium and are reversible , Non-equilibrium thermodynamics Account in terms of states of thermodynamic equilibrium , Thermodynamic processes between states of thermodynamic equilibrium , Dependent and independent variables for a process,industrial applications of thermodynamics.		
Total Hrs		**36**

References and Text Books:

1. R.G. Compton and G.H.W. Saunders, Electrode Potentials Oxford Chemistry Primer
2. A.C. Fisher Electrode Dynamics Oxford Chemistry Primer
3. Barrow, G. M. Physical Chemistry Tata McGraw-Hill (2007).
4. Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004).
5. Mahan, B. H. University Chemistry 3rd Ed. Narosa (1998).

Mode of Evaluation: (Percent Weightage)	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended by BOS on:	
Approved by Academic Council on :	

SC 246	**Physics-VI(Electronics and Solid-State Devices)C (L, T, P) = 4 (3, 1, 0)**
Version	1.0
Prerequisite	Upto B. Sc. First year
Objectives:	• To allow students for the understanding how physics grounds and affects the electronics and vice versa • To help students understanding the importance of electronics in our daily life. • To allow students understanding the basic concepts and working of electronics. • To understand the wonder world of Semiconductors and their applications.

Expected Outcome:	● A general idea of the mutual connection between Physics and Electronics. ● Understanding of the basic circuits and their working, which is commonly used in our daily life. ● A basic knowledge of semiconductors and their magical presence in daily life electronic devices. ● Learning of the basic principles of diodes, rectifiers, transistors etc. ● A general idea of the implementation of principle of electronics in several devices.
UNIT-**I**	**Circuit analysis and theorems**
Networks-some important definitions; loop and nodal equations based on DC and AC circuits (Kirchhoff Laws);Ampere- volt conventions; open, close and hybrid parameters of any four terminal networks; Input, output and mutual impendence for an active four terminal network;Superposition Theorem; Thevenin Theorem; Norton Theorem.	
UNIT-**II**	**Semiconductors**
Basic information about Semiconductors; Mass Action law; Charge densities in N and P materials; Conduction by drift and diffusion of charge carriers, P-N Junction; PN diode; V-I characteristics of PN junction diode; capacitance effects.	
UNIT **-III**	**Rectifiers and Filters**
Rectifiers: Half-wave, full wave and bridge rectifier; calculation of ripple factor; efficiency and regulation; Filters: Series inductor, shunt capacitor, L section and π section filters; Voltage regulation: Voltage regulation and voltage stabilization by Zener diode; voltage multiplier.	
UNIT-**IV**	**Transistors**
Transistor and transistor bias circuits: Notations and volt-ampere; Characteristics for bipolar junctions transistor; Concept of load line and operating point; Hybrid parameters. Transistor as amplifier: CB; CE, CC configurations; Analysis of transistor amplifiers using hybrid parameters and its gain-frequency response.	
UNIT-**V**	**Solid state Devices**
Amplifiers: Cascade amplifiers, basic idea of direct coupled and R-C coupled amplifiers; "Differential amplifiers. Need of bias and stability of Q point: stability factors, various types of bias circuits for thermal bias stability: fixed bias, collector to base feedback bias and four resistor bias; Amplifier with feedback: Concept of feed back, positive and negative feedback, voltage and current feed back circuits. Advantages of negative feed back: Stabilization of gain, effect of negative feed back on output and input resistance, reduction of nonlinear distortion, effect on gain – frequency response. **Oscillators:** Oscillators: Criteria for self excited and self sustained oscillations, circuit requirement for build-up of oscillation; Basic transistor oscillator circuit and its analysis: Colpitfs and Hartely oscillators, R.C Oscillators, crystal oscillators and its advantages. **Field effect transistors**: Junction field effect transistor (JFET) and metal oxide semiconductor field effect transistor (MOSFET): circuit symbols, biasing and volt-ampere characteristics, source follower operation of JFET, FET as variable voltage resister	
Text Book	● John D. Ryder, Electronic Fundamentals and Applications,Prentice Hall of India Pvt. Ltd., New Delhi. ● John D. Ryder, Engineering Electronics, McGraw Hill BookCompany, New Delhi.
Reference Books	● Jacob Millman and ChristoscHailkias, Integrated Electronics.Analog and Digital Circuits and systems: McGraw-Hill Ltd.(1-972) ● Basic Electronics, B.L. Theraja, S. Chand Publication.
Mode of Evaluation: (Percent Weightage)	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended by BOS on:	

Approved by Academic Council on :	

SC 248	**Physics-VII (Solid State Physics) C (L, T, P) = 4 (3, 1, 0)**
Version	1.0
Prerequisite	Upto B. Sc. First year
Objectives:	To introduce solid state physics to the student and enable them to employ classical and quantum mechanical theories needed to understand the physical properties of solids. To understand how solid state physics contribute to the existence of a number of important technological developments of importance in our lives now and in the future.
Expected Outcome:	● Understanding of the elastic properties of solids and lattice vibrations. ● Understanding of the properties of metals on the basis of the free electron gas models. ● Understanding of the essence of dielectric properties of materials. ● Understanding of the superconductivity of condensed matter.
UNIT-**I**	**Crystal Structure:**
Solids: Amorphous and Crystalline Materials. Lattice Translation Vectors. Lattice with a Basis – Central and Non-Central Elements. Unit Cell. Reciprocal Lattice. Types of Lattices. Brillouin Zones. Types of Bonds. Ionic Bond. Covalent Bond. Van der Waals Bond. Diffraction of x-rays by Crystals. Bragg's Law	
UNIT-**II**	**Elementary Lattice Dynamics:**
Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic Chains. Acoustical and Optical Phonons. Qualitative Description of the Phonon Spectrum in Solids. Einstein and Debye Theories of Specific Heat of Solids. T3 Law	
UNIT **-III**	**Dielectric Properties of Materials:**
Dielectric Polarization. Local Electric Field at an Atom. Depolarization Field. Dielectric Constant. Electric Susceptibility. Polarizability. Classical Theory of Electric Polarizability. Clausius- Mosotti Equation. Normal and Anomalous Dispersion. Complex Dielectric Constant.	
UNIT-**IV**	**Electrical Properties of Materials:**
Elementary Band Theory of Solids. Bloch Theorm. Kronig-Penney Model. Effective Mass of Electron. Concept of Holes. Band Gaps. Energy Band Diagram and Classification of Solids. Law of Mass Action. Insulators, and Semiconductors. Direct and Indirect Band Gap. Intrinsic and Extrinsic Semiconductors. p- and n- Type Semiconductors. Conductivity in Semiconductors. Hall Effect in Semiconductors (Qualitative Discussion Only)	
UNIT-**V**	**Superconductivity:**
ExperimentalResults; CriticalTemperature; Criticalmagneticfield; Meissner effect; Type I and type II Superconductors; London's Equation and Penetration Depth. Isotope effect. Idea of BCS theory (No derivation): Cooper Pair and Coherence length; Variation of Superconducting Energy Gap with Temperature; Experimental Evidence of Phonons; Josephson Effect.	
Text Book	1. Charles Kittel: Introduction to Solid State Physics, 7th Edition, John Wiley and Sons, Inc. 2. A. J. Dekkar: Solid State Physics, Macmillan India Limited, 2000. 3. J. S. Blackmore: Solid State Physics, Cambridge University Press, Cambridge. 4.N. W. Ascroft and N. D. Mermin: Solid State Physics, (Harcourt Asia, Singapore 2003).

Reference Books	1.Charles Kittel: Introduction to Solid State Physics, 7th Edition, John Wiley and Sons, Inc. 2.A. J. Dekkar: Solid State Physics, Macmillan India Limited, 2000. 3.J. S. Blackmore: Solid State Physics, Cambridge University Press, Cambridge. 4. N. W. Ascroft and N. D. Mermin: Solid State Physics, (Harcourt Asia, Singapore 2003).
Mode of Evaluation: (Percent Weightage)	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended by BOS on:	
Approved by Academic Council on :	

SC 311	**Mathematics –IX (Linear Algebra) C(L, T, P) =4(3, 1, 0)**
Version	**1.0**
Prerequisite	Knowledge of basic concepts of Abstract Algebra i.e. Groups, Rings , Fields, Ideals , Vector Spaces etc. is required.
Objectives:	The objective of this course is to develop the learning capabilities and hone the problem solving skills of talented students at a mathematically deeper and more rigorous level.
	System of liner equations appear in numerous applications of Mathematics studying solution of sets to such system leads to the abstract notions of a vector space and a linear transformation. Matrices can be used to represent linear transformation and to do concrete calculations.
Expected outcome:	Linear Algebra has evolved as a branch of Mathematics with wide range of applications to the natural sciences, to engineering, to computer science, to management and social sciences.
UNIT-I	**Linear Transformations : 7 Hrs**
Linear Transformations, Operators, Properties of Linear Transformations. Range space and Null space of Linear Transformations.Properties of Linear Transformations.	
UNIT-II	**Representation of Transformations by Matrices : 8 Hrs**
Representation of Transformations by Matrices, Matrices of Identity and Zero Transformations.Matrix of an Inverse Transformation, Change of Basis.Traces of a Linear Transformations of a Finite Dimensional Vector Space.	
UNIT -III	**Characteristic Values and Vectors : 7 Hrs**
Characteristic Values and Characteristic Vectors of Linear Transformation. Cayley- Hamilton Theorem, Diagonalizable Transformations.	
UNIT-IV	**Inner Product Spaces : 7 Hrs**
Inner Product Spaces, Cauchy-Schwarz`s inequality.Orthogonal Vectors, Orthogonal Basis, Bessel`s inequality.Gram-Schmidt Orthogonalization process.	
UNIT-**V**	**Bilinear forms : 7 Hrs**
Bilinear forms, Vector Space of Bilinear forms, Matrices of Bilinear forms, Vector Space and Subspce, Properties of Subspace and direct sum of space.Symmetric Bilinear forms, Skew-symmetric Bilinear forms, Linear combination, basis , linear span.	

Text Book	1. Linear Algebraby S.D.Sharma, KedarNath Ram Nath& Co.
Reference Books	1. Matrix and Linear Algebra by K.B.Datta, Prentice Hall of India Pvt. Ltd. 2. Basic Algebra Vol. I & II by N.Jacobson, Hindustan Publishing Company. 3. Linear Algebra by K.Hoffman and R.Kunze, Prentice Hall of India Pvt. Ltd.
Mode of Evaluation: (Percent Weightage)	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended by BOS on:	
Approved by Academic Council on :	

SC 313	**Mathematics –X (Complex Analysis) C(L, T, P) =4(3, 1, 0)**
Version	**1.0**
Prerequisite	Knowledge of Advanced Calculus and elementary Modern Algebra is required.
Objectives:	The students will learn the basic theory and techniques of complex analysis as well as some of its applications. Students will also learn computation of improper integrals.
Expected outcome:	Study of complex analysis is remarkable in its directness and elegance and leads to many useful applications.
UNIT-I	**Complex plane : 7 Hrs**
Complex plane. Curves and Regions in Complex plane, Jorden curve theorem (Statement only). Extended Complex plane.Stereographic projection. Limits, Continuity and Differentiability of complex functions.Analytic functions, Cauchy-Riemann equations.	
UNIT-II	**Complex Integration : 8 Hrs**
Complex Integration, Complex line integrals, Cauchy Integral theorem, Indefinite integral.Fundamental theorem of Integral calculus for complex functions. Cauchy Integral Formula.Analyticity of the derivative of an analytic function, Morera`s theorem.	
UNIT -III	**Theorems and Power Series : 7 Hrs**
Taylor`s theorem , Laurent`s theorem, Maximum modulus theorem. Power series-Absolute convergence ,Able`s theorem.Cauchy-Hadamardtheorem , Circle and Radius of convergence.	
UNIT-IV	**Singularities of an analytic function : 7 Hrs**
Singularities of an analytic function , Branch point, Meromorphic and Entire functions.Riemann`s theorem. Residue at a singularity, Cauchy`s residue theorem.Rouche`s theorem, Fundamental theorem of Algebra.	
UNIT-V	**Conformal mapping : 7 Hrs**

Conformal mapping. Bilinear transformation and its properties.Elementary mappings : $w(z) = \frac{1}{2}\left(z + \frac{1}{z}\right)$, z^2, e^z, $\sin sin\, z$, $\cos cos\, z$ .Evaluation of a real definite integral by contour integration.	
Text Book	1. Complex Analysis by G.N. Purohit and S.P. Goyal, Jaipur Publishing House.
Reference Books	1. Theory of Functions of a Complex Variable by S. Chand & Co. , New Delhi. 2. Complex Variables and Applications by R.V.Churchil&J.Brown, McGraw-Hill. New York. 3. Complex Variables: Intro. and Application by MarhJ.,Ablowitz&A.S.Fokas, Cambridge Uni. Press.
Mode of Evaluation: (Percent Weightage)	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended by BOS on:	
Approved by Academic Council on :	

SC 315	Chemistry-VI (Inorganic Chemistry-II) C (L, T, P) = 3 (3, 0, 0)
Version	**I**
Prerequisite	Chemistry study of earlier semester
Objectives:	1. To train qualified, adaptable, motivated, and responsible Mathematicians who will contribute to the scientific and technological development. 2.To impact knowledge by teaching 3.To advance knowledge by research
Expected outcome:	Better outcomes in chemistry specialization
Unit-I	**Coordination Chemistry** **7 Hrs**
Coordination Compounds: Nomenclature Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory crystal field theory of transition metal complexes. Application in Industries by Magnetic properties of transition metal complexes	
Unit-II	**Chemistry of Transition Metals:** **8 Hrs**
Properties of d-block elements. Binary compounds (hydrides, carbides and oxides) of the elements of the first transition series and complexes with respect to relative stability of their oxidation states, coordination number and geometry. Chemistry of Elements of Second and Third Transition Series: General characteristics, comparative treatment of Zr/Hf, Nb/Ta, Mo/W in respect of ionic radii, oxidation states. Industrial application of transition metals	
Unit-III	**Inner Transition Elements: Actinides and Lanthanides** **6 Hrs**
Definition of the f elements; position in the periodic table; Properties of the atoms and ions: ionization energies, electrode potentials, metallic and ionic radii; Colour and electronic spectroscopy; Magnetism; Solid state compounds: halides and oxides; Coordination chemistry of the lanthanides and actinides; Commercial applications;Rare earth Oxides used for Industries.	
Unit-IV	**Organometallic compounds** **7 Hrs**
Organometallic compounds; Definition Nomenclature, Preparation properties and application and bonding of alkyl and Aryl compound. Electronic and Ionic Conduction , Metals, insulators and semiconductors, electronic structure of solids application in electronic and electrical industries. Bonding of ligands, Reactions of organometallic, Electron accountancy, Oxidative addition and reductive elimination, Insertion and α/β-elimination, Industrial organometallic catalysis, Olefin catalysis Organometallic compounds and application in electronic materials.	
Unit-V	**Recent Advances In Inorganic Chemistry** **8 Hrs**
Borane, Silanes, Inorganic nanotechnology, Zeolite, Bio-inorganic chemistry (must emphasize the metal) Ceramics, Inorganic thin films, Intercalation compounds, Super acids , High-temperature superconductors, nanowire battery, Perovskites nonvolatile memory materials.	
Reference Books	1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P.L. Gaus. Wiley. 2. Concise Inorganic Chemistry, J.D. Lee ELBS. 3. Concepts of Models Inorganic Chemistry B.Douglas. D.McDaniel and J.Alexander, John Wiley. 4. Inorganic Chemistry. D.E. Shriver P.W. Atkins and C.H. Langford, Oxford. 5. Inorganic Chemistry, W.W. Porterfield Addison Wesley. 6. Inorganic Chemistry, A.G. Sharpe. ELBS. 7. Inorganic Chemistry, G.L. Miessler and D.A. Tarr, Prentice Hall. 8. Group Theory and Its Chemical Applications: P. K. Bhattacharya 9. Inorganic Chemistry: J. E. Huyee, Principles of Structure & Reactivity, 3rd Ed. 10. Selected Topics in Inorganic Chemistry: W. U. Malik, G. D. Tuli and R. Madan
Mode of Evaluation	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended by BOS on:	
Approved by Academic Council on :	

SC 317	Physics-VIII (Nuclear Physics) C (L, T, P) = 4 (3, 1, 0)
Version	1.0
Prerequisite	Upto B. Sc. second year
Objectives:	● Impart the knowledge and understanding of Nuclear Physics. ● Apply the basic theory and principles of nuclear physics to the applications. ● To help students in understanding of nuclear reactions such as fission and fusion. ● To explore the interior of nucleus and interaction between nucleons.
Expected Outcome:	● The course will give the knowledge of nuclear structure and related properties. ● A student would be able to express the basic concepts of nuclear physics after studying this course. ● It enables the students to understand about the nuclear reactions thoroughly. ● It will enable students to grasp the knowledge about nuclear detectors and their working principles.
UNIT-I	**Nuclear Structure and Properties**
Thomson Plum Pudding model and its failure; Rutherford Scattering and planetary model; Discovery of Proton and Neutron; Proton-Electron and Proton-Neutron Hypothesis of Nuclei; Classification of Nuclei; Mass of Nuclei and Atomic Mass, Mass defect, Mass excess, Packing Fraction; Binding Energy; Size of Nucleus; Nuclear Spin and angular momentum; Parity of Nuclear states; Nuclear Magnetic Moment and Schmidt lines; Nuclear electrical quadrupole moment; Nuclear Isospin.	
UNIT-II	**Nuclear Force and Models**
Properties of Nuclear forces; Meson theory of Nuclear force; Nuclear Potential; Segre Chart: Nuclear stability and N/Z ratio; Liquid drop model; Semi-empirical mass formula; Fermi Gas model; Magic numbers; Evidence of shell structure; Shell model of nucleus; Succes and limitation of shell model.	
UNIT -III	**Nuclear Reactions and Reactor**
Basic classification of Nuclear reactions; Types of nuclear reactions; Conservation laws for nuclear reactions; Mass-energy balance and Q-value; The Q-equation (kinematics of nuclear reaction); Nuclear Fusion; Energy released in nuclear fusion; Controlled fusion and its problems. Nuclear Fission; Mechanism (Bohr-Wheeler) of Nuclear Fission; Nuclear reactor; classification of nuclear reactor.	
UNIT-IV	**Radioactive Decay**
Radioactive decay (one substance); Statistical nature of radioactive decay; Radioactive equilibrium; Radioactive decay (more than one substance); Radioactive series; Applications of radioactivity; Alpha decay: characteristics, kinematics; Geiger Nuttall law; Gamow theory of alpha decay; Beta decay and its spectrum; Pauli' neutrino hypothesis; Kinematics of beta decay; Gamma decay: emission and kinematics.	
UNIT-V	**Radiation Detectors**

Energy loss by heavy charged particles, fast electrons and gamma rays in matter; Detectors: Gas-filled detectors, Ionisation chamber, Proportional Counter, Geiger Muller Counter, Scintillation Counter.	
Text Book	1. Nuclear Physics by D. C. Tayal, Himalaya Publishing House 2. Nuclear Physics by S.N., Ghoshal, S.Chand Publication.
Reference Books	1. Nuclear Physics by Irving Kaplan- Narosa Publishing House
Mode of Evaluation: (Percent Weightage)	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended by BOS on:	
Approved by Academic Council on :	

SC 312	**Mathematics –XI (Number Theory) C(L, T, P) =4(3, 1, 0)**
Version	**1.0**
Prerequisite	Knowledge of Elementary Algebra and Advanced Calculus is required.
Objectives:	The security of our Phone calls, Bank transfers etc. all rely one area of Mathematics i.e. Number Theory.
Expected outcome:	Number Theory is used in solving Diophantine equations which has got wide range of applications in engineering , social and physical sciences.
UNIT-I	**Divisibility : 7 Hrs**
Divisibility—Division Algorithm, g.c.d. the Euclidean Algorithm. l.c.m,.Prime, Infinitude of primes, Fundamental theorem of Arithmetic. Fibonacci sequence.	
UNIT-II	**Congruence : 8 Hrs**
Congruence—Linear congruence, Fermat, Little and Wilson`s theorems.Chinese remainder theorem. Fermat`s last theorem.Euler`s factorization, Mersenne`s factorization.	
UNIT -III	**Functions : 7 Hrs**
Number theoretic functions, π and σ-functions.The Mobius function, Greatest integer function.Euler Phi function and the properties of Phi function.	
UNIT-IV	**Diophantine equations : 7 Hrs**
Diophantine equations—$ax + by = c,\ ax + by + cz = d,\ x^2 + y^2 = z^2,\ x^4 + y^4 = z^4$. General Integers solution of the equation $x^2 + y^2 + z^2 = w^2(x, y, z, w = 1)$	
UNIT-V	**Quadratics : 7 Hrs**
Quadratic residues, Quadratic reciprocity. Quadratic congruence.Primitive roots for primes, Composite numbers having primitive roots. Theory of indices.	
Text Book	1. Elementary Number Theory by David M. Burton, Wm. C. Brown Publishers.

Reference Books	1. Elementary Number Theory by G.A.Jones and J.M.Jones, Springer—Verlag. 2. Elementary Theory of Numbers by W.Sierpinski, North-Holland,Ireland. 3. An Intro. to the Theory of Numbers by Niven, S.H.Zuckerman and L.H.Montgomery, John Wiley
Mode of Evaluation: (Percent Weightage)	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended by BOS on:	
Approved by Academic Council on :	

SC 314	**Mathematics –XII (Statics and Dynamics) C(L, T, P) =4(3, 1, 0)**
Version	**1.0**
Prerequisite	Knowledge of Elementary Statics , Dynamics, Calculus, Trigonometry, Ordinary Differential Equations is required.
Objectives:	The objective of this course is to develop the learning capabilities and hone the problem solving skills of talented students at a mathematically deeper and more rigorous level.
Expected outcome:	Study of Principles of Statics and Dynamics is remarkable which helps in solving many problems of engineering and physical sciences which appears in daily life.
UNIT-I	**Statics : 8 Hrs**
General Conditions of Equilibrium when more than three forces act on a rigid body. Virtual work, Principle of virtual work for a system of coplanar forces acting on a particle. Principle of virtual work for a system of coplanar forces acting at different points of a rigid body.	
UNIT-II	**Statics : 7 Hrs**
Centre of Gravity. C.G. of an arc, C.G. of a plane area. C.G. of a solid of revolution, C.G. of a surface of revolution, C.G. when the density varies.	
UNIT -III	**Dynamics : 7 Hrs**
Velocity and Acceleration—along radial and transverse directions, along tangential and normal directions. S.H.M., Hooke`s Law. Motion along horizontal and vertical elastic strings.	
UNIT-IV	**Dynamics : 7 Hrs**
Motion in resisting medium—Resistance varies as velocity and square of velocity. Motion on a smooth curve in a vertical plane. Motion on the inside and outside of a smooth vertical circle.	

UNIT-V	**Dynamics :** **7 Hrs**
Central Orbits—p-r equations, Apses. Time in an orbit, Kepler`s Law of planetary motion. Moment of Inertia—M.I. of rods, Circular rings, Circular disks, Solid and Hollow spheres, Rectangular lamina, Ellipse and Triangle.	
Text Book	1. Elements of Statics by K.C.Sharma, D.C.Gokhroo, S.R.Saini, J.P.H., Jaipur. 2. Dynamics byY.N.Gaur, A.K.Mathur, M.C.Goyal, Ramesh Book Depot, Jaipur.
Reference Books	1. A Text Book of Statics byR.S.Verma, PothishalaPvt. Ltd., Allahabad 2. Principles of Mechanics by J.L.Synge& Griffith, Tata McGraw-Hill.
Mode of Evaluation: (Percent Weightage)	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended by BOS on:	
Approved by Academic Council on :	

SC 346	**Chemistry-VII (Physical &MiscChemistry-II) C (L, T, P) = 3 (3, 0, 0)**
Version	**I**
Prerequisite	Chemistry of Sem I II, III and IV
Objectives:	This course deals with the application of structure and theory to the study of Solution colligative properties , Nuclear chemistry and heterogeneous system
Expected outcome:	Going green can save money while helping to relates with development of physical chemistry.
Unit-I	**Solution and Colligatives : 7 Hrs**
Expression of Concentration of Solids in Liquids ,Solid Solutions ,Colligative Properties -Relative Lowering of Vapor Pressure ,Raoult's Law Elevation of Boiling Point ,Depression of Freezing Point ,Osmotic Pressure ,Determination of Molecular Masses using Colligative Properties 'Van't Hoff Factor and Calculations involving it ,	
Unit-II	**Nuclear Chemistry 8 Hrs**
Nuclear chemistry; Fundamental particles of nucleus (nucleons); Concept of nuclides and its representation; Isotopes, isobars and isotones (with specific examples); Forces operating between nucleons (n-n, p-p, & n-p); Qualitative idea of stability of nucleus (n/p ratio). Radiochemistry: Natural and artificial radioactivity; Radioactive disintegration series, Radioactive displacement law, Radioactive decay rates, Half-life and average life, Nuclear binding energy, Mass defect and binding energy. Nuclear reactions; spallation, nuclear fission and fusion. Application radioactive waste management radioactivity.	
Unit-III	**Phase equilibrium 6 Hrs**
Heterogeneous system, Phase diagram of one and two component system. **Surface chemistry:** Interface (chemistry) Surface modification of biomaterials with proteins, Surface finishing, Surface modification, Surface phenomenon, Tribology **electrocardiography. Polarography theory, Ilkovic equation; half wave potential and its significance**	
Unit-IV	**Soil and Environmental Biogeochemistry 7 Hrs**
Soil Chemistry, Chemistry of Soils: interactions between soil solids, precipitates and solution phases including: mineralogy, ion exchange, adsorption, weathering and buffering, soil colloidal .SoilHumic Substances. **Soil Testing's and salinity**	
Unit-V	**Environmental and Green Chemistry 8 Hrs**
Environmental Issues :Go Green ,Consumer Health & Food Safety Concerns , Environmental Disasters, Chemical reactions in environment, Impact of primary and secondary pollutants **Basics of Green Chemistry.** Definition of green chemistry, How green chemistry differs from cleaning up pollution, Green chemistry's 12 principles Green chemistry's roots in the Pollution Prevention Act of 1990 **.**Intellectual property Right	
Reference Books	1 Barrow, G. M. Physical Chemistry Tata McGraw-Hill (2007). 2. Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004). 3. Mahan, B. H. University Chemistry 3rd Ed. Narosa (1998).
Mode of Evaluation: (Percent Weightage)	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended by BOS on:	
Approved by Academic Council on :	

SC 348	Chemistry-VIII (Organic Chemistry-II) C (L, T, P) = 3 (3, 0, 0)
Version	**II**
Prerequisite	Organic chemistry is a growing subset of chemistry. To put it simply, it is the study of all carbon-based compounds; their structure, properties, and reactions and their use in synthesis.
Objectives:	It focuses on the methods used to identify the structure of organic molecules, advanced principles of organic stereochemistry, organic reaction mechanisms, and methods used for the synthesis of organic compounds. Additional special topics include illustrating the role of organic chemistry in biology, medicine, and industry.
Expected outcome:	Organic chemistry has expanded our world of knowledge and it is an essential part of the fields of biochemistry, biology, industry, nanotechnology, rocket science, and many more!
Unit-I	**Aldehyde and Ketone** **7 Hrs**
Aldehyde synthesis by deportation or hydrolysis ,Aldehyde synthesis by oxidation of alcohols and rearrangements , 1,3-Dike tone synthesis by oxidation , Insole synthesis Ketone synthesis by oxidation of alcohols, Nucleophilic addition reactions.	
Unit-II	**Carboxylic Acids** **8 Hrs**
Structure , Acidity, Synthesis , Carboxylic Acid Derivatives : Acryl Transfer Reactions : Background , Acid Chlorides/Anhydrides , Esters Amides , Chemistry of Nitriles : Formation Reactions. Acids, Tartaric acid Citric acid	
Unit-III	**Conjugated Systems** **6 Hrs**
Molecular Orbital Theory: Conjugated Systems and frontier Molecular Orbital Theory Correlation diagrams, Pericyclic Reactions – Introduction to Electrocyclic– and Cycloadditionsreactions, 1,3 and 1,5 Sigmatropic Rearrangements.	
Unit-IV	**Polymers** **7 Hrs**
Thermoplastcs and Thermosetts, polymerization classification, compounding of plastics, Elastomers natural and artificial rubber Industrial application of polymers biodegradable plastics.Industrial Process in polymers injection molding, foaming, reinforcing and fiber spinning.	
Unit-V	**Advanced Organics** **8 Hrs**
Reaction intermediates and determination of reaction mechanism, concept of medicinal chemistry and drug design. Photochemistry, laws of photochemistry, Jablonski diagram, Norish-I & II reactions, Concept of Spectroscopy, IR, NMR, Mass, Raman and UV-visible spectroscopy for organic compounds, sample handling, instrumentation and applications	
Reference Books	1. Carey, F. A., and R. J. Sundberg. Advanced Organic Chemistry, Part A: Structure and Mechanisms. 4th Ed. New York, NY: Springer, 2000. 2. Joule, J. A., and K. Mills. Heterocyclic Chemistry. 4th ed. Malden, MA: Blackwell Science, 2000. 3. L. Finar: Organic Chemistry (Vol. I & II), E. L. B. S. 4. R. T. Morrison & R. N. Boyd: Organic Chemistry, Prentice Hall. 5. ArunBahl and B. S. Bahl: Advanced Organic Chemistry, S. Chand 6. Peter Sykes: A Guide Book to Mechanism in Organic Chemistry, Orient Longman. 7. S.M.Mukherjee and S.P.Singh ,Reaction Mechanism in Organic Chemistry,Mc Millan (2004). 8. Bhupinder Mehta and Manju Mehta, Organic Chemistry, PHI Learning (2009).
Mode of Evaluation: (Percent Weightage)	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended by BOS on:	
Approved by Academic Council on :	

SC 374	Physics-IX (Classical and Quantum Mechanics) C (L, T, P) = 4 (3, 1, 0)
Version	1.0
Prerequisite	Upto B. Sc. Second year
Objectives:	● To acquire the knowledge about the drawbacks of classical mechanics and the origin of quantum mechanics. ● To enable student's understanding about the postulates of quantum mechanics. ● To allow students understanding the basic definitions related to wave function. To understand Schrodinger equation and its applications.
Expected Outcome:	● A general idea of the failure of classical mechanics and need of quantum mechanics. ● Ability to solve Schrodinger equation. ● Ability to understand the application of Schrodinger's wave equation.
UNIT-I	**Basic concept of classical mechanics**
Mechanics of particle, Mechanics of system of particles, Constraints, Holonomic and non-Holonomic constraints, Virtual work, Alembert's principle, Lagrange's equation, Simple applications of Lagrange's formulation-Linear Harmonic Oscillator, Simple pendulum.	
UNIT-II	**Failure of Classical Physics and evolution of new concepts**
Spectral radiation; Planck Law; Photo Electric Effect-Einstein's Photo Electric Equation; Compton's Effect; Stability of an atom- Bohr's Atomic theory; de- Broglie hypothesis- wavelength of matter waves; Properties of matter waves; Phase and group velocities; Davisson's &Germer Experiment; Double slit Experiment; Standing de-Broglie waves of electron in Bohr's orbits. Heisenberg Principle for position and momentum, energy and time. Gamma ray microscope, Diffraction by a single slit, Position of an electron in a Bohr's orbit.	
UNIT -III	**Schrodinger Equation**
Limitations of old theory; Wave function, properties and significance; Postulates of Quantum Mechanics; Operators, Eigen function, Eigen values and expected values; Schrodinger time independent and time dependent wave equation;	
UNIT-IV	**Applications of Schrodinger wave equation**
Application of Schrodinger wave equation to particle in one and three dimensional boxes; Potential step and Potential barriers; Quantum Phenomenon of Tunneling: Tunnel Effect. Tunnel Diode.	
UNIT-V	**Bound State Problems:**
General Features of a Bound Particle System, (1) One DimensionalSimple Harmonic Oscillator: Energy Levels and Wave Functions. Zero Point Energy, (2) Quantum Theory of Hydrogen Atom: Particle in a Spherically Symmetric Potential. Schrodinger Equation. Separation of Variables. Radial Solutions and Principal Quantum. Number, Orbital and Magnetic Quantum Numbers Simple Harmonic Oscillator: Energy Levels and Wave Functions. Zero Point Energy, (2) Quantum Theory of Hydrogen Atom: Particle in a Spherically Symmetric Potential. Schrodinger Equation. Separation of Variables. Radial Solutions and Principal Quantum. Number, Orbital and Magnetic Quantum Numbers Simple Harmonic Oscillator: Energy Levels and Wave Functions. Zero Point Energy, (2) Quantum Theory of Hydrogen Atom: Particle in a Spherically Symmetric Potential. Schrodinger Equation. Separation of Variables. Radial Solutions and Principal Quantum. Number, Orbital and Magnetic Quantum Numbers	

Text Book	1. Classical mechanics by Herbert Goldstein 2. Classical Mechanics by J.C. Upadhyaya 3. Quantum Physics by Eyvind H. Wichman, vol 4, The Mcg raw Hill Companies. 4. Quantum Mechanics by Mahesh C Jani, Eastern Economy Edition.
Reference Books	1. Classical Mechanics by J.C. Upadhyaya 2. Quantum Physics by Eyvind H. Wichman, vol 4, The Mcg raw Hill Companies. 3. Quantum Mechanics by H.C. Verma TBS publication.
Mode of Evaluation: (Percent Weightage)	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended by BOS on:	
Approved by Academic Council on :	

SURESH GYAN VIHAR UNIVERSITY

Accredited 'A' Grade by NAAC

SYLLABUS

B.Sc. Chemistry, Botany and Zoology

SCHOOL OF APPLIED SCIENCES

EDITION 2021-24

SURESH GYAN VIHAR UNIVERSITY
Accredited 'A' Grade by NAAC

Teaching and Examination Scheme
To commence from the Academic year: 2021-24

Department: School of Applied Sciences **Program: B.Sc. CBZ** **Semester: I**

S.No.	Course Code	Course Name	Type of Course Core/Elective	Credit	Contact Hrs/Wk.			Exam Hours	Weightage (in%)	
					L	T	P		CIE	ESE
1.	EN 101	**English Language I**	University Core	2	2	0	0	3	40	60
2.	PC 101	**Proficiency in co-curricular activities**	University Core	2	0	0	0	0	100	0
3.	CP 101	**Elementary Computer**	University Core	3	3	0	0	3	40	60
4.	FD102	**Foundation Course-I**	University Core	1	1	0	0	3	25	75
5.	ES 101	**Environmental Studies**	University Core	2	2	0	0	3	40	60
6.	SC 111	**Botany-I Biodiversity (Microbes, Algae, Fungi and Archegoniatae)**	Program Core	4	4	0	0	3	40	60
7.	SC 159	**Botany-I Biodiversity (Microbes, Algae, Fungi and Archegoniatae) Lab**	Program Core	1	0	0	2	3	60	40
8.	SC 113	Chemistry-I (Fundamentals of Chemistry-I)	Program Core	4	3	1	0	3	40	60
9.	SC 167	**Chemistry-I Lab**	Program Core	1	0	0	2	3	60	40
10.	SC 115	**Zoology-I Systematics and Animal Diversity**	Program Core	4	4	0	0	3	40	60
11.	SC 163	**Zoology-I Animal Diversity Lab**	Program Core	1	0	0	2	3	60	40

L – Lecture
T – Tutorial
P – Practical

CIE – Continuous Internal Evaluation
ESE – End Semester Examination

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Teaching and Examination Scheme
To commence from the Academic year: 2021-24

Department: School of Applied Sciences **Program: B.Sc. CBZ** **Semester: II**

S. No.	Course Code	Course Name	Type of Course Core/Elective	Credit	Contact Hrs/Wk.			Exam Hours	Weightage (in%)	
					L	T	P		CIE	ESE
1.	EM 102	Employability Skills	University Core	1	0	0	2	3	60	40
2.	PC 102	Proficiency in co-curricular activities	University Core	2	0	0	0	0	100	00
3.	HUM102	Human Value s & Ethics	University Core	1	1	0	0	3	40	60
4.	FD104	Foundation Course-I	University Core	1	1	0	0	3	25	75
5.	EN 104	English language II	University Core	3	3	0	0	3	40	60
6.	SC116	Botany-II Plant Anatomy and Embryology	Program Core	4	4	0	0	3	40	60
7.	SC170	Botany-II Plant Anatomy and Embryology Lab	Program Core	1	0	0	2	3	60	40
8.	SC114	Chemistry-II (Fundamentals of chemistry-II)	Program Core	4	3	1	0	3	40	60
9.	SC168	Chemistry II Lab	Program Core	1	0	0	2	3	60	40
10.	SC118	Zoology-II Animal Physiology and Biochemistry	Program Core	4	4	0	0	3	40	60
11.	SC166	Zoology-II Physiology and Biochemistry Lab	Program Core	1	0	0	2	3	60	40

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Teaching and Examination Scheme
To commence from the Academic year: 2021-24

Department: School of Applied Sciences **Program: B.Sc. CBZ** **Semester: III**

S. No.	Course code	Course Name	Type of Course Core/Elective	Credits	Contact Hrs/Wk.			Exam Hrs.	Weightage (in%)	
					L	T/S	P		CE	ESE
1.	PC 103 103	Proficiency in Co-curricular Activities	**University Core**	2	0	0	0	0	100	0
2.	EM 203	Employability Skills	**University Core**	1	0	0	2	3	60	40
3.	SC225	Botany III- Bryophyta and Pteridophyta	**Programme Core**	4	4	0	0	3	40	60
4.	SC221	Chemistry –III (Inorganic Chemistry – I)	**Programme Core**	4	3	1	0	3	40	60
5.	SC223	Chemistry –IV (Organic chemistry -I)	**Programme Core**	4	3	1	0	3	40	60
6.	SC227	Zoology III- Genetics and Evolutionary Biology	**Programme Core**	4	4	0	0	3	40	60
7.	SC229	ZoologyIV-Endocrinology and Ethology	**Programme Core**	4	4	0	0	3	40	60
8.	SC267	Botany III-Bryophyta and PteridophytaLab	**Programme Core**	2	0	0	3	3	60	40
9.	SC265	Chemistry- III Lab	**Programme Core**	2	0	0	3	3	60	40
10.	SC269	Zoology III- Genetics and Evolutionary Biology Lab	**Programme Core**	2	0	0	3	3	60	40

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Teaching and Examination Scheme
To commence from the Academic year: 2021-24

Department: School of Applied Sciences **Program: B.Sc. CBZ** **Semester: IV**

S. No.	Course code	Name of Course	Type of Course Core/Elective	Credits	Contact Hrs/Wk.			Exam Hrs.	Weightage (in%)	
					L	T/S	P		CE	ESE
1.	PC204	Proficiency in Co-curricular Activities	**University Core**	2	0	0	0	0	100	0
2.	EM 204	Employability Skills	**University Core**	1	0	0	2	3	60	40
3.	SC236	Botany IV-Gymnosperm and Angiosperms	**Programme Core**	4	4	0	0	3	40	60
4.	SC238	Botany V (Cell Biology and Genetics)	**Programme Core**	4	4	0	0	3	40	60
5.	SC234	Chemistry- V (Physical-I)	**Programme Core**	4	3	1	0	3	40	60
6.	SC240	Zoology-V Comparative Anatomy and Developmental Biology of Vertebrate	**Programme Core**	4	4	0	0	3	40	60
7.	SC264	Botany IV-(Gymnosperm and Angiosperms) Lab	**Programme Core**	2	0	0	3	3	60	40
8.	SC266	Zoology-IV Comparative Anatomy and Developmental Biology of Vertebrate Lab	**Programme Core**	2	0	0	3	3	60	40
9.	SC262	Chemistry -IV Lab	**Programme Core**	2	0	0	3	3	60	40

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Teaching and Examination Scheme
To commence from the Academic year: 2021-24

Department: School of Applied Sciences **Program: B.Sc. CBZ** **Semester: V**

S. No.	Course code	Course Name	Type of Course Core/Elective	Credits	Contact Hrs/Wk.			Exam Hrs.	Weightage(in%)	
					L	T/S	P		CIE	ESE
1.	PC 301	Proficiency in Co-curricular Activities	**University Core**	2	0	0	0	0	100	0
2.	EM 301	Employability Skills	**University Core**	1	0	0	2	3	60	40
4.	SC319	Botany VI (Analytical Techniques in Plant Sciences)	**Programme Core**	4	4	0	0	3	40	60
5.	SC315	Chemistry –VI (Inorganic Chemistry-II)	**Programme Core**	4	4	0	0	3	40	60
6.	SC321	Zoology VI (Environmental Biology)	**Programme Core**	4	4	0	0	3	40	60
7	SC323	Zoology VII (Microbiology)	**Programme Core**	4	4	0	0	3	40	60
8.	SC371	Botany V (Analytical Techniques in Plant Sciences) Lab	**Programme Core**	2	0	0	3	3	60	40
9.	SC369	Zoology V (Environmental Biology) Lab	**Programme Core**	2	0	0	3	3	60	40

10	SC365	Chemistry –V Lab	**Programme Core**	2	0	0	3	3	60	40

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Teaching and Examination Scheme
To commence from the Academic year: 2021-24

Department: School of Applied Sciences **Program: B.Sc. CBZ** **Semester: VI**

S. No.	Course code	Course Name	Type of Course Core/Elective	Credits	Contact Hrs/Wk.			Exam Hrs.	Weightage (in%)	
					L	T/S	P		CE	ESE
1.	SC342	Botany VII- (Plant Physiology)	**Programme Core**	4	4	0	0	3	40	60
2.	SC344	Botany VIII- (Biotechnology and Utilization of Plants)	**Programme Core**	4	4	0	0	3	40	60
3.	SC346	Chemistry- VII (Physical&Misc Chemistry-II)	**Programme Core**	4	4	0	0	3	40	60
4.	SC348	Chemistry- VIII (Organic Chemistry-II)	**Programme Core**	4	4	0	0	3	40	60
5.	SC350	Zoology VIII (Applied Zoology)	**Programme Core**	4	4	0	0	3	40	60
6.	SC366	Botany VI- (Plant Physiology and Biochemistry) Lab	**Programme Core**	2	0	0	3	4	60	40
7.	SC 368	Chemistry- VI Lab	**Programme Core**	2	0	0	3	3	60	40
8.	SC370	Zoology VI-(Applied Zoology) Lab	**Programme Core**	2	0	0	3	4	60	40

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SC111	BOTANY-I BIODIVERSITY (MICROBES, ALGAE, FUNGI AND ARCHEGONIATAE) C (L, T, P) = 4 (4, 0, 0)
Version	**I**
Learning objective	The learning objectives of course are: To create an understanding regarding plant taxonomy, To gain knowledge about plant diversity and morphology of microbs, To have understanding about algae and fungi.
Course Outcome	The student will be able to conceptualize about identification and classification of microbs, Able to know economic importance of families of algae and fungi.
Unit-I	**Plant Taxonomy** **7hr**
Plant Taxonomy. Principles of classification, nomenclature; comparative study of different classification systems, viz. Linnaeus, Bentham & Hooker, Engler & Prantl, Hutchinson, and Cronquist. Herbarium techniques and important Botanic Gardens.	
Unit- II	**Microbes** **7hr**
Viruses- Discovery, general structure, replication (general account), DNA virus (T-phage) Lytic and lysogenic cycle, RNA virus (TMV); Economic iDJ.portance; Bacteria- Discovery, General characteristics and cell structure; Reproduction- vegetative, asexual and recombination (conjugation, transformation and transduction); Economic importance.	
Unit-III	**Algae** **7hr**
General characteristics; Ecology and distribution; Range of thallus organization and reproduction; Classification of algae; Morphology and life-cycles of the following: Nostoc, Chlamydomonas, Oedogonium, Vaucheria, Fucus, Polysiphonia. Economic importance of algae	
Unit-IV	**Fungi** **7hr**
Introduction- General characteristics , ecology and significance, range of thallus organization, cell wall composition , nutrition, reproduction and classification; True Fungi- General characteristics, ecology and significance, life cycle of Rhizopus (Zygomycota) Penicillium, Alternaria (Ascomycota), Puccinia, Agaricus (Basidiomycota); Symbiotic Associations-Lichens: General account, reproduction and significance; Mycorrhiza: ectomycorrhiza and enclomycorrhiza and their signiticance	
Unit-V	**Archegoniate** **8hr**
Unifying features of archegonintes, Transition to land habit , Alternation of generations. General characteristics , adaptations to land habit , Classification, Range of thallus organization. general characteristics, classification, Early land plants (Cooksonia and Rhynia).	
Reference books	Eames, A. J. 1981. Morphology of Angiosperms .McGraw Hill, New York. Gifford, E.M. and Foster, A.S. 1989. Morphology and Evolution of Vascular Plants. W.H. Freeman, New York. Sporne, K.R. 1974. Morphology of Angiosperms. Hutchinson University Press, London.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

SC 115	**ZOOLOGY I- SYSTEMATICS AND ANIMAL DIVERSITY** **C (L, T, P) = 4 (4, 0, 0)**
Version	**I**
Learning objective	The learning objective of course are: To create an understanding regarding the multicellular animal, To gain knowledge about reproduction in non-chordates, To have understanding about hemichordate.
Course outcome	The student will be able to conceptualize about concept of five kingdom, Able to analyze economic importance of chordates.
Unit-I	**Classification of multicellular animals** **8hr**
Criteria for classification of multicellular animals. Taxonomy and classification: General principles of taxonomy - Binomial nomenclature, -Trinomial nomenclature, Rules of nomenclature, Concept of Five kingdom, concept of protozoa, metazoan and levels of organization. Basis of Classification: symmetry, coelom, segmentation and embryology.	
Unit- II	**Non–Chordates** **8hr**
General characters and Outline Classification upto class, Economic importance:-Protozoans - Entamoebahistolytica. Poriferans - Skeleton and canal system of sponges.Coelenterates - Coral and coral reefs.Platyhelminths - Parasitic adaptations. Aschelminthes - Nematodiasis.	
Unit-III	**Non–Chordates** **7hr**
General characters and Outline Classification up to class, Economic importance:-Annelids –Vermiculture. Arthropods - Larval forms. Molluscs - Pearl culture. Echinoderms - Water vascular system	
Unit-IV	**Hemichordata** **7hr**
Classification (up to class) and Habit, habitat, distribution and General characters:-Protochordates: Urochordates, Cephalochordates**.** Cyclostomes	
Unit-V	**Chordates** **6hr**
General characters and Outline Classification up to order, Economic importance:- Fishes, Amphibian, Reptiles, Birds and Mammals.	
Reference books	1. R .L.Kotpal :Modern text book of biology – Invertebrate –(Rastogi Publication, Meerut). 2. Jordan, E. L. : Invertebrate Zoology (S. Chand Co. New Delhi.). 3. Dhami and Dhami : Invertebrate Zoology (S. Chand & Co. New Delhi). 4. Shrivastava, : Economic Zoology. (CommercialPub.brue,N.Delhi). 5. Vishwapremi K.K., : Economic Zoology (AkashdeepPub.House,New Delhi). 6. V.P.Agrawal and L. D.Chaturvedi: A text book of Invertebrate Zoology –(Jagmander Book Agency, New Delhi). 7. R.L.Kotpal :Modern text book of biology –Vertebrate –(Rastogi Publication, Meerut). 8. Young, J.Z. : Life of Vertebrate.(E L B S) 1983.Oxford. 9. Dalela, R.C. : A text book of Chordate Zoology, (Jai Prakash Nath publications, Meerut.). 10. Newman, H.H. : The phylum Chordate, (Satish Book Enterprise, Agra). 11. Jordon, E.L. :Vertebate Zoology, (S.Chand and Co., New Delhi.).
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

SC 113	Chemistry I (Fundamentals of Chemistry-I) C (L, T, P) = 3 (3, 0, 0)	
Version	**I**	
Learning objective	The learning objective of course are: To create an understanding regarding atomic structure, types of bonding, fundamentals of organic chemistry and conformational chemistry	
Course outcome	The student will be able to conceptualize about atomic structure, bonding between molecules, structural confirmations and organic chemistry	
Unit	**Contents of the Course**	Hrs.
I	**Atomic Structure: Recapitulation**: Bohr's theory Time independent Schrodinger equation (H Ψ = EΨ). Schrodinger equation for hydrogen atom. Radial and angular nodes and their significance. Radial distribution functions (1s and 2s AO).Significance of quantum numbers, orbital angular momentum and quantum numbers mr and ms. Shapes of s, p and d AO. Electronic configurations of the elements. Concept of exchange energy. Relative energies of AO, Anomalous electronic configurations.	7
II	**Covalent bonding:** VB Approach: Concept of hybridization and VSEPR theory. Resonance and resonance energy Molecular Orbital Approach : LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combination of atomic orbital's, non- bonding combination of orbital's ,MO treatment of homonuclear diatomic molecules of 1st and 2nd periods and heteronuclear diatomic molecules such as CO, NO and NO+	08
III	**Fundamentals of Organic Chemistry**: Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape and reactivity of organic molecules Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions free radicals. Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Huckel's rule	06
IV	**Stereochemistry: Conformations** ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newman, Sawhorse and Fischer representations. Concept of chirality (up to two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and Erythro; D and L; cis - trans nomenclature; R/ S (for up to 2 chiral carbon atoms) and E / Z Nomenclature (for up to two C=C systems).	07
V	**Aliphatic Hydrocarbons** Alkanes: Preparation: Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. Reactions: Free radical Substitution: Halogenations. Alkenes: Preparation, Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes.	8
Total Hours		36

References and Text Books	1 Barrow, G. M. Physical Chemistry Tata McGraw-Hill (2007). 2. Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004). 3. Mahan, B. H. University Chemistry 3rd Ed. Narosa (1998). 4. I. L. Finar: Organic Chemistry (Vol. I & II), E. L. B. S. 5. R. T. Morrison & R. N. Boyd: Organic Chemistry, Prentice Hall. 6. Arun Bahl and B. S. Bahl: Advanced Organic Chemistry, S. Chand
Mode of Evaluation: (Percent Weightage)	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%); Written examination (60%)
Recommended by BOS on:	
Approved by Academic Council on :	

SC 116	BOTANY-II PLANT ANATOMY AND EMBRYOLOGY C (L, T, P) = 4 (4, 0, 0)
Version	**I**
Learning objective	The learning objectives of course are: To create an understanding regarding plant anatomy, To gain knowledge about plant diversity and anatomy of plants, To have understanding about medicinal plants and economic botany.
Course outcome	The student will be able to conceptualize about identification and classification of plant, Able to understandApomixis and polyembryony.
Unit-I	**Meristematic, permanent tissues and Organs** **7hr**
Root and shoot apical meristems; Simple and complex tissues**.** Structure of dicot and monocot root stem and leaf.	
Unit- II	**Secondary Growth, Adaptive and protective systems** **7hr**
Vascular cambium- structure and function, seasonal activity. Secondary growth in root and stem , Wood (heartwood and sapwood). Epidermis, cuticle, stomata; General account of adaptations in xerophytes and hydrophytes.	
Unit-III	**Structural organization of flower** **7hr**
Structure of anther and pollen; Structure and types of ovules ; Types of embryo sacs, organization and ultrastructure of mature embryo sac. Pollination mechanisms and adaptations; Double fertilization; Seed-structure appendages and dispersal mechanisms.	
Unit-IV	**Embryo and endosperm** **7hr**
Endosperm types, structure and functions; Dicot and monocot embryo; Embryo endosperm relationship.	
Unit-V	**Apomixis and polyembryony** **8hr**
Definition, types and practical applications, reproductive behaviour of the species, type of endosperm development, effect of pollination on embryo development, the effect of pollination on polyembryony.	
Reference books	1. Bhojwani, S.S. & Bhatnagar, S.P. (2011). Embryology of Angiosperms. Vikas Publication House Pvt. Ltd. New Delhi. 5th edition. 2. Mauseth, J.D. (1988). Plant Anatomy. The Benjamin/Cummings Publisher, USA.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

SC 118	ZOOLOGY-II ANIMAL PHYSIOLOGY AND BIOCHEMISTRY C (L, T, P) = 4 (4, 0, 0)
Version	**I**
Learning objective	The learning objectives of course are: To create an understanding regarding the animal physiology, To gain knowledge about biomolecules, To have understanding about carbohydrate metabolism.
Course outcome	The student will be able to conceptualize about protein and their use in biology, Able to analyse classification of proteins.
Unit-I	**Introduction to cell** **7hr**
Introduction to cell: Morphology, size, shape and characteristics of Prokaryotic, Eukaryotic, Plant and animal cells; cell-theory. Cell membrane: Characteristics of cell membrane molecules, fluid mosaic model of Singer and Nicolson, concept of unit membrane. Cell membrane transport: Passive (diffusion and osmosis facilitated (mediated) and active transport.	
Unit- II	**Digestion, Respiration and Excretion** **7hr**
Physiology of digestion, Absorption of carbohydrates, proteins, lipids, Pulmonary ventilation, Respiratory volumes and capacities, Transport of Oxygen and carbon dioxide in blood, Structure of nephron, Mechanism of Urine formation, Counter-current Mechanism	
Unit-III	**Cardiovascular and Reproduction System** **7hr**
Composition of blood, Hemostasis, Structure of Heart, Origin and conduction of the cardiac impulse, Cardiac cycle, Physiology of male reproduction: hormonal control of spermatogenesis; Physiology of female reproduction: hormonal control of menstrual cycle.	
Unit-IV	**Protein, Lipids and Carbohydrates 7hr**
Protein classification, Amino acids, zwitterion, Structure of Protein, Transamination, Deamination and Urea Cycle Carbohydrates and lipid Classification, Structure and physiochemical Properties of Monosaccharides, Oligosaccharides and polysaccharides, Lipids, Wax, Glycerol and Triacyl Glycerol, Glycolysis, Krebs Cycle, Pentosc phosphate pathway , Gluconeogenesis, Glycogen metabolism, electron transport chain, Biosynthesis and oxidation of lipid	
Unit-V	**Nerve and muscle** **8hr**
Structure of a neuron, Resting membrane potential, Graded potential, Origin of Action potential and its propagation in myelinated and non-myelinated nerve fibres, Ultra-structure of skeletal muscle, Molecular and chemical basis of muscle contraction	
Reference books	1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc. 2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia. 3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5 th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA. 4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco. 5. Nelson, D.L., Cox, M.M. (2004) Lehninger Principles of Biochemistry, 4th Edition, WH Freeman and Company, New York, USA
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

SC 114	Chemistry II (Fundamentals of Chemistry-II) C (L, T, P) = 3 (3, 0, 0)	
Version	**I**	
Learning objective	The learning objective of course are: To create an understanding regarding chemical thermodynamics, equilibrium, and basics of aromatic and aliphatic hydrocarbons	
Course outcome	The student will be able to conceptualize about chemical thermodynamics, equilibrium and structure of aromatic compounds	
Unit	**Contents of the Course**	**Hrs**
I	**Chemical Thermodynamics:** (a)State of a system, state variables, intensive and extensive variables, concept of heat and work, First Law of thermodynamics. Calculation of work (w), heat (q), changes in internal energy (ΔU) and enthalpy(ΔH) for expansion or compression of ideal gases under isothermal and adiabatic conditions Calculation of w, q, ΔU and ΔH for processes involving changes in physical states. (b)Thermo chemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution.	8
II	**Chemical Equilibrium:** (a)Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. (b)Distinction between ΔG and $\Delta G\theta$, Le Chatelier's principle. Relationships between Kp, Kc and Kx for reactions involving ideal gases.	7
III	**Ionic Equilibrium :** **(a)**Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common in effect, (b)Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.	7
IV	**Aromatic hydrocarbons** (a)Preparation of benzene from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid. Reactions of benzene): Aromatic electrophilic substitution: nitration, halogenations and sulphonation. Friedel Craft's reaction (alkylation and acylation). Side chain oxidation of alkyl benzenes (Upto 4 carbons on benzene). (b)Organic Halogen Compounds Types of Nucleophiles Substitution (SN^2, SN^1) reactions. Preparation of Alkyl Halides from alkenes and alcohols. Reactions: hydrolysis, nitrite & nitro formation, nitrile & iso-nitrile formation. Williamson's ether synthesis: Elimination and substitution.	8
V	**Aliphatic and Aromatic Hydroxy Compounds** (a)Alcohols: Preparation: Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters. Reactions: With sodium, HX, Oppeneauer oxidation Diols: oxidation of diols. Pinacol-Pinacolone rearrangement. (b)**Phenols**: Preparation and Reactions, acidic nature : Electrophilic substitution: Nitration, halogenations and sulphonationn. Reimer - Tiemann Reaction, Gattermann-Koch Reaction,	8
Total Hours		38

Books	**References and Text Books:** 1 Barrow, G. M. Physical Chemistry Tata McGraw-Hill (2007). 2. Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004). 3. Mahan, B. H. University Chemistry 3rd Ed. Narosa (1998). 4. I. L. Finar: Organic Chemistry (Vol. I & II), E. L. B. S. 5. R. T. Morrison & R. N. Boyd: Organic Chemistry, Prentice Hall.
Mode of Evaluation: (Percent Weightage)	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended by BOS on :	

Approved by Academic Council on	

SC 225	**BOTANY III BRYOPHYTA AND PTERIDOPHYTAC (L, T, P) = 4 (4, 0, 0)**	
Version	**I**	
Learning objective	The learning objectives of course are: To create an understanding regarding the Bryophytes, To gain knowledge about Pteridophyta.	
Course outcome	The student will be able to understand Bryophytes and Lichens, Able to understand economic importance of these lower plants and role of lichens as indicators of pollution.	
Unit-I	**Bryophyta: Introduction**	**7 hrs**
Bryophytes: General characters and classification Sporophytic generation, Gametophytic generation, alternation of generations, Affinities of Bryophyta with algae and Pteridophyta.		
Unit- II	**Bryophyta: Type Studies**	**7 hrs**
Structure, Reproduction , life cycle, systematic position and economic importance of Hepaticopsida: *Riccia*, *Marchantia* and *Porella*, Anthoceratopsida-*Anthoceros*, Polytrichum, Bryopsida-*Sphagnum, Funaria*.		
Unit-III	**Pteridophytes- Introduction**	**7 hrs**
The first vascular land plant, general characters of pteridophytes, types of steles, development of sporangia (eusporangiate and leptosporangiate), life cycle of pteridophytes (homosporus and heterosporus), Important characteristies of Psilopsida, Lycopsida, Sphenopsida, and Pteropsida, classification of Pteridophyta. Economic importance of Pteridophytes.		
Unit-IV	**Pteridophyta: Type Studies**	**7 hrs**
General characters and classification (Sporne's), Structure, reproduction, life cycle and systematic position of Rhynia, Lycopodium, Equisetum and Marsilea psilotopsida: psilotum, sphenopsida: equisetum, .Stelar evolution, heterospory and seed habit in Pteridophytes. Morphology, anatomy and reproduction of Lycopodium, Selaginella, Equisetum, Adiantum and Marsilea.		
Unit-V	**Lichens**	**8 hrs**
Lichens- General characters, Types of lichens: Crustose, Foliose and Fructicose, habitat, structure, reproduction, economic and ecological importance of lichens, indicators of environment		
Reference books	M. S. 1985. Cryptpogamic Botany. Vol. I and II second edition. Tata McGraHillPublishing Co. Ltd., New Delhi. a Manjula K. and Tyagi, Annuja (2015), Algae, Lichens and Bryophyta, B.Sc. Pt-I, Paper I, University of Rajasthan, CBH, Jaipur. E.V. 1971. The structure and life of Bryophytes. Hutchinson University Library, London K.R. 1967. The Morphology of Bryophytes. Hutchinson University Library, London. G.M. 1938. Crytogramic Botany Vol. II. Bryophytes and Pteridophytes. Mc Graw Hill Book Company, London. Parihar, N.S. 1965. An Introduction to Bryophyta. Central Book Depot, Allahabad. Vashishta, B. R., Sinha, A. K. and Kumar, A. 2011. Botany for degree students, Bryophyta. S. Chand and Co. New Delhi.	
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT	
Recommended By BOS on:		

Approved by academic council on:	

SC 227	ZOOLOGY III- GENETICS AND EVOLUTIONARY BIOLOGY C (L, T, P) = 4 (4, 0, 0)
Version	**I**
Learning objective	The learning objectives of course are: To create an understanding regarding Mendelian genetics, To gain knowledge about genetic disorder, To have understanding about molecular genetics, Able to understand environmental biotechnology.
COURSE OUTCOME	The student will be able to conceptualize about sex determination, Able to understand evolution.principle..
Unit-I	**Mendelian Genetics** **7 HRS**
Mendelian Genetics: - Mendel's laws of inheritance. Monohybrid and dihybrid cross. Dominance. Incomplete dominance. Current status of Mendelism. Genetic variation: Variation in chromosome number (Euploidy and Aneuploidy).	
Unit- II	**Genetic disorders in Human beings** **7 HRS**
Genetic disorders in Human beings (Down's, Turner's, Klinefelter's and Edward's syndrome) Types of chromosomal mutations. Molecular basis of gene mutation, mutagens, crossing over and linkage.	
Unit-III	**Sex-determination** **7 HRS**
Sex-determination XX-XY. XO-XY and WZ mechanisms. Sex-linked inheritance (X-and Y-linked) Color blindness. Haemophilia.Gene interactions. Supplementary, complementary, epistasis and inhibitory. Multiple allele-ABO, Rh and MN blood groups and their inheritance, polymorphic genes.	
Unit-IV	**Molecular genetics** **7 HRS**
Molecular genetics: Nucleic acids, structure, function and type of DNA. Structure, function and types of RNA, genetic code. Transcription, protein synthesis. Gene structure (Recon. muton, cistron) and regulation of gene (lac operon: inducible and repressible system). Bacterial genetic transformation, Transduction and conjugation. Lytic and lysogenic cycle. Elementary idea about eugenics. Elementary idea about genetic engineeering. Gene cloning and recombinant DNA technology (Vectors for gene transfers. Plasmids and phages). Restriction enzymes.	
Unit-V	**Evolution** **8 HRS**
Natural selection as a guiding force – Its attributes and action Basic characteristics of natural selection. Colouration, camouflage and mimicry, Co-adaptation and co-evolution, Man-made causes of change – Industrial melanism; brief mention of drug, pesticide, antibiotic and herbicide resistance in various organisms. Modes of selection, Polymorphism, Heterosis and Balanced lethal systems. Genetic Drift (Sewall Wright effect) as a stochastic/random force – Its attributes and action. Basic characteristics of drift; selection vs. drift, Bottleneck effect. Founder principle	
Reference books	1.Microbial genetics – Friedfelder 2. Principles of gene manipulation – Old and Primrose 3. Genes VII by Lewine 4. Microbiology –Pelczar 5Text book of Microbiology by Tortora 6. Microbiology by Brock
Mode of Examination	
Recommended By BOS on:	

Approved by academic council on:	

SC 229	**ZOOLOGY IV-ENDOCRINOLOGY AND ETHOLOGY** **C (L, T, P) = 4 (4, 0, 0)**
Version	**I**
Learning objective	The learning objectives of course are: To create an understanding regarding the Endocrinology, To gain knowledge about hormone regulation, To have understanding about the ethology, Able to understand MRI and CT scan.
COURSE OUTCOME	The student will be able to conceptualize about structure and function of endocrine gland, Able to understand animal behavior.
Unit-I	**Endocrinology** **8hr**
Introduction, basics and functions. Glands: Exocrine and endocrine; Secretions: Autocrine and paracrine. Hormones: Chemical nature and properties, role in homeostasis. Structure and functions of major endocrine glands: Pituitary, thyorid, parathyroid, adrenal gland, pancreas; their hormones, role and abnormalities due to hyposecretion and hypersecretion. Structure and functions of minor endocrine glands: Thymus, pineal, GIT, kidney, heart; endocrine glands in insects; their hormones and role.	
Unit- II	**Endocrinology** **7hr**
Control and regulation of secretion and molecular mechanism. Regulation of hormone secretion; positive and negative feedback control mechanism. Extra cellular and intracellular receptors. Second messengers: Cyclic AMP, PIP2, IP3, DG, G-protein, protein kinase and role of Ca++ as messenger; cell signalling; amplification of signal. Molecular mechanism of insulin action.	
Unit-III	**Endocrinology** **6hr**
Role in reproduction. Hormones from testis, ovary and placenta, their structure and functions. Importance of hormones in sexual differentiation in embryo. Hormonal control of menstrual cycle, implantation, pregnancy. Parturition and lactation. Different types of contraceptives, their composition and effects.	
Unit-IV	**Ethology** **7hr**
Introduction and basics. Introduction and history of behaviour, approaches and study of animal behaviour (ecological, physiological, evolutionary and neural methods) MRI and CAT scan. Genetic basic of animal behaviour and evolution of ethology.Biological clock; circadian and circannual rhythms.Learning and imprinting, instinct behaviour.	
Unit-V	**Ethology** **8hr**
Areas of behavior. Searching of food: Honey bee, rhesus monkey and langoor. Social behaviour and organization : Honey bee, termite, mammals (black-buck and monkeys).Communication, fights and alarm call : Vocal, visual, tactile, olfactory and acoustic; honey bee language; pheromonal and hormonal basis of aggression, brain hormone relation in sexual behaviour. Migration in fishes and birds. Orientation: Taxes and kinesis.	
Reference books	1. Barrington EJW -General & comparative 2. Endoctrinology-Oxford, Claredon Press 3. Williams R.H. -Text Book of Endocrinology-W.B. Saunders 4. Martin C. R. - Endocrine Physiology-Oxford University Press.

	5. Darnell, J. Lodish H. and Baltimore D. Molecular CellBiology- -Scientific, American Book USA
Mode of Examination	
Recommended By BOS on:	
Approved by academic council on:	

SC 236	**BOTANY IV- GYMNOSPERM AND ANGIOSPERMS C (L, T, P) = 4 (4, 0, 0)**
Version	**I**
Learning objective	The learning objectives of course are: To create an understanding regarding diversity of Gymnosperms and their classification, structure and reproduction, To gain knowledge about economic importance of Gymnosperms and Angiosperms, To have understanding about fossil plants, their formation.
COURSE OUTCOME	The student will be able to conceptualize about characteristics of anatomy of Gymnosperms and Angiosperms.
Unit-I	**Gymnosperm: Introduction** **7hr**
Gymnosperms: Important Characteristics, distribution, Classification up to classes, Anatomy, Life cycle patterns: Sporophyte: male and female cones, Gemetophyte, Male and female gametophytes, fertilization, embryo and seeds, Ecological and Economic importance of Gymnosperms, affinities of Gymnosperm with Pteridophytes and Angiosperm.	
Unit- II	**Gymnosperm: Type Studies8hr**
General characteristics of Cycadales, Coniferales and Ephadrales, Morphology, anatomy, reproduction and life cycle of *Cycas*, *Pinus* and *Ephedra*	
Unit-III	**Angiosperms Introduction** **7hr**
Classification as per Bentham and Hooker with economic importance, dicotyledons: Polypetalae: Menispermaceae, Meliaceae, Anacardiaceae, Umbelliferae. Gamopetalae: Sapotaceae, Verbenaceae, Asteraceae Apetalae: Urticaceae, Polygonaceae, Monocotyledons: Cannaceae.	
Unit-IV	**Anatomy** **7hr**
Anomalous secondary growth: Abnormal behavior of normal cambium Eg.Achyranthes and Mirabilis stem. Accessory cambium formation and its activity. Eg. Bougainvillea and Boerhaavia stem, Abnormal secondary growth in fleshy roots. Eg. Carrot, Raphanus and Beet root, Nodal Anatomy:-Unilacunar, Trilacunar, Multilacunar. Leaf Trace and Leaf Gaps, Branch trace and Branch gaps	
Unit-V	**Palaeobotany** **7hr**
Fossilization, Types of fossils, Techniques of fossil study, Geological time scale. Fossil Pteridophytes: General characters, structure and spore producing organs of *Rhynia*, reconstructed plants of *Lepidodendron* and *Calamites,* Fossil Gymnosperms: *Glossopteris* and *Williamsonia*	

Reference books	1. Smith G. N. 1955. Cryptogamic Botany Vol. II – Bryophyta and Pteridophyta. Tata Mc Graw Hill Publishing Co. Ltd. New Delhi. 2. Vashishta, P.C.1972 Botany for Degree Students, Vol IV- Vascular Cryptogams (Pteridophyta), S.Chand& Co. Pvt. Ltd. 3. Vashishta, P.C. 1976 Gymnosperms, S.Chand& Co. Pvt. Ltd. 4. Pandey, B.P.1997. A text book of Bryophyta, Pteridophyta and Gymnosperms. K.Nanth and Co., Meerut 5. P.C. Trivedi, Meena, P and Verma, L. Pteridophyta, Gymnosperm and Palaeobotany, RBD Publication House, Jaipur & New Delhi.
Mode of Examination	
Recommended By BOS on:	
Approved by academic council on:	

SC 240	**ZOOLOGY-V COMPARATIVE ANATOMY AND DEVELOPMENTAL BIOLOGY OF VERTEBRATE C (L, T, P) = 4 (4, 0, 0)**
Version	**I**
Learning objective	The learning objectives of course are: To create an understanding regarding the comparative anatomy, To gain knowledge about developmental biology, To have understanding about the embryonic adaptation.
COURSE OUTCOME	The student will be able to conceptualize about cloning of animal, Able to understand biology of ageing.
Unit-I	**Comparative Anatomy 7 HRS** **7hr**
Derivatives of integument w.r.t. gland s and digital tips, digestive glands, Sense Organs, Types of receptors. Comparative account of brain, Digestive, Urinogenital, circulatory, Skeletal, respiratory system.	
Unit- II	**Developmental Biology-Scope and Early Events 7 HRS 6hr**
Developmental Biology-Scope and Early Events:Historical review and types and scope of embryology.Gametogenesis:Formation of egg and spemi.Vitellogenesis Fertilization: Activation of ovum, essence of activation: changes in the organization of the egg cytoplasm.Parthenogensis.	
Unit-III	**Developmental Biology-Pattern and Processes 8 HRS**
Developmental Biology-Pattern and Processes:Cleavage: Definition, planes and patterns among non-chordatesand chordates_ significance of cleavage. blastulationandmorulation. Fate maps, morphogenetic cell movements, significance of gastrulation. Embryonic induction; primary organizer, differentiation and competence. Development of chick up to 96 hours stage.	

Unit-IV	**Embryonic adaptations**	**7 HRS 8hr**
Embryonic adaptations: i. Extra-embryonic membranes in cheek_ their development and functions. ii. Placentation in Mammals: Definition. Types. classification on the basis of morphology and histology; ltmctiottsol placenta		
Unit-V	**Dimensions in Developmental Biology**	**7 HRS 7hr**
Dimensions in Developmental Biology. Regeneration Various types of stem cells and their applications. Cloning of animals: i. Nuclear transfer technique. ii. l-. Embryo transfer technique.Teratology. Biology of aging.		
Reference books	1. Principles of Development. Lewis Wolpert, Oxford universityPress. Oxford. 2. An Introduction to Embryology. Balinsky, B.l. : W.B. Sauders.Philadelphia. 3. Development Biology. Berrill. NJ. McGraw Hill book Company. New York. 4. Principles of Animal Developmental Biology :Goyal S.C. I, Himalaya Publishing Co., Mumbai. 5. Fundamentals of Comparative Embryology :Huettner, A.F.Millan, New York. _ 6. Elements of Chordate Embryology Jain P.C. Visual Publication.Delhi. 7. Chordate Embryology :Verma. P .S. Agrawal. V.K. and Tyagi,B.S.. S. Cltand and Co. New Delhi. 8. Development Biology. Veer BalaRastogi and M.S. Jayaraj, KedarNathRamnath, Meerut	
Mode of Examination		
Recommended By BOS on:		
Approved by academic council on:		

SC 238	BOTANY V (CELL BIOLOGY AND GENETICS)C (L, T, P) = 4 (4, 0, 0)
Version	Ist
Prerequisite	All students are expected to have a general knowledge of plant cell.
Learning objective	The learning objectives of course are: To create an understanding regarding the structure and function of cell organelles, To gain knowledge about recombination and tools used in molecular Biology, To have understanding about application of genetics in botany.
COURSE OUTCOME	The student will be able to understand molecular Biology mechanism of mutations, Able to analyze importance of cell and molecular biology for human welfare.
Unit-I	**Cell and Cell Organelles** **7Hrs**
The Cell Theory; Prokaryotic and eukaryotic cells; Cell size and shape; Eukaryotic Cell components. Mitochondria:- Structure, marker enzymes, composition; Semiautonomous nature; Symbiont hypothesis; Proteins synthesized within mitochondria; mitochondrial DNA. Chloroplast-Structure, marker enzymes, composition; semiautonomous nature, chloroplast DNA. ER, Golgi body &Lysosomes:-Structures and roles. Peroxisomes and Glyoxisomes:_Structures, composition, functions in animals and plants and biogenesis. Nucleus:- Nuclear Envelope- structure of nuclear pore complex; chromatin; molecular organization, DNA packaging in eukaryotes, euchromatin and hcterochromatin, nucleolus and ribosome structure (brief).	
Unit- II	**Molecular Biology** **7Hrs**
History of molecular biology, DNA, Meselson and Stahl's Replication experiment. chromatin, molecular organisation of chromosome: Nucleosome-solenoid Model, Gene Concepts and expression, Polymerase Chain Reaction, DNA sequencing, DNA finger printing Central Dogma. Reverse transcriptase and its application, Transcription and Translation, RNA processing, capping, splicing, and polyadenylation, Transcription in eukaryotes, Translation, initiation,elongation and termination, Jacob-Monad and lac operon, negative and positive control, structure of promoter.	
Unit-III	**Mendelian Genetics and its Extension** **7Hrs**
Principles of inheritance, Incomplete dominance and co-dominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Sex-linked, sexinfluenced and sex-limited characters inheritance. Linkage and crossing over, Cytological basis of crossing over, Molecular mechanisms of crossing over including models of recombination, Recombination frequency as a measure of linkage intensity, Two factor and three factor crosses, Interference and coincidence, Somatic cell hybridization.	
Unit-IV	**Mutations** **8Hrs**
Types of gene mutations (Classification), Types of chromosomal aberrations (Classification, figures and with one suitable example of each), Molecular basis of mutations in relation to UV light and chemical mutagens; Detection of mutations: CLB method, attached X method. Chromosomal mechanisms of sex determination in Drosophila and Man	
Unit-V	**combination in Bacteria and Viruses** **7Hrs**
Conjugation, Transformation, Transduction, Complementation test in Bacteriophage, Transposons in bacteria, Ac-Ds elements in maize and P elements in Drosophila, Transposons in humans	
Reference books	1. Brown, T. A. 2010. Gene cloning and DNA analysis: An Introduction. Blackwell Publication, USA. 2. Buchanan, B., Gruissem, W. and Jones, R. 2000. Biochemistry and Molecular Biology of Plants. American Society of Plant Biologists., USA. 3. An Introduction to Plant Tissue Culture, M.K. Razdan, Oxford and IBH Publishing 4. Experiments in Plant Tissue Culture, J.H. Dodds and L.K. Roberts, Cambridge University Press 5. Plant Biotechnology and Transgenic Plants, K.M.O. Caldenty, W.H. Barz and H.L. Wills, Marcel Dekker 6. Plant Biotechnology, J. Hammond, P. McGarvy and V. Yusibov, Springer Verlag. 7. Plant Cell & Tissue Culture for the production of Food Ingredients, T-J Fu, G. Singh and W.R. Curtis, Kluwer Academic/Plenum Press
Mode of Examination	**Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT**
Recommended By BOS on:	
Approved by acadmic council on:	

SC 221	Chemistry –III (Inorganic Chemistry-I) C (L, T, P) = 3 (3, 1, 0)	
Version	**1**	
Prerequisites	To study Inorganic Chemistry I needs Chemistry I and II and Senior Secondary Course	
Objectives	1. To encourage Inorganic aspects of Chemistry and knowledge is added **2.** To develop knowledge by teaching **3.** Knowledge dissemination	
Unit	**Contents of the Course**	**Hrs**
I	**S-Block elements:** Comparative study, diagonal relationship, salient features of hydrides, salvation and complexation tendencies including their function in biosystems, an introduction to alkyls and aryls. **Periodicity of p-block elements:** Periodicity in properties of p-block elements with special reference to atomic and ionic radii, ionization energy, electron affinity, electronegativity, diagonal relationship, catenation.	**7**
II	**Some important compounds of P-block elements;** Hydrides of boron, diborane and higher borane, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates, tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides, **Chemistry of noble gases:** Chemical properties of noble gases, chemistry of xenon, structure and bonding in xenon compounds.	**8**
III	**Oxidation Reduction:** Concepts of Oxidation and reduction, Redox reactions, Strengths and equivalent weights of oxidizing and reducing agents, Theory of Redox titrations, Redox indicators, Cell representations, Measurement of electrode potential, Oxidation-reduction curves, Iodimetry and Iodometry, Titrations involving ceric sulphate, potassium iodate, potassium bromate, potassium permanganate, **Corrosion and Industries**	**7**
IV	**Organometallic compounds; Definition** Nomenclature, Preparation properties and application and bonding of alkyl and Aryl compound. Electronic and Ionic Conduction ,Metals, insulators and semiconductors, electronic structure of solids application in electronic and electrical industries	**7**
V	**Ionic Solid:** Definition of space lattice, unit cell; Ionic structure, radius ratio effect and coordination number, limitations of radius ratio rule, lattice defects, semiconductors, lattice energy and born haber cycle, salvation energy and solubility of ionic solids, polarizing power, and polarisability of ions, fajan's rule. Metallic bond; free electron, valence bond and band theories. Weak interactions; Hydrogen bonding, vanderwaals forces.	**7**
Total Hours		**36**
References and Text Books	1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P.L. Gaus. Wiley. 2. Concise Inorganic Chemistry, J.D. Lee ELBS. 3. Concepts of Models Inorganic Chemistry B.Douglas. D.McDaniel and J.Alexander, John Wiley. 4. Inorganic Chemistry. D.E. Shriver P.W. Atkins and C.H. Langfor, Oxford. 5. Inorganic Chemistry, W.W. Porterfield Addison Wesley	
Mode of Evaluation: (Percent Weightage)	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)	
Recommended by BOS on :		
Approved by Academic Council on		

SC 223	Chemistry-IV (organic Chemistry-I)
Prerequisite	All students are expected to have a general knowledge of basic chemistry principles.
Learning objective	The learning objective of course are: To create an understanding regarding principle of spectroscopy, To gain knowledge about heterocyclic compound, To have understanding about biomolecules, Able to understand polymer.
Course outcome	The student will be able to conceptualize about NMR spectroscopy, Able to analyse structure of protein.
Unit-I	**NMR Spectroscopy** **9hr**
Proton magnetic resonance spectroscopy (1H-NMR): Nuclear Shielding and Deshielding, Chemical shift and molecular, spin-spin splitting and coupling constants, Interpretation of NMR spectra, of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, ethyl acetate, toluene, and acetophenone.	
Unit- II	**Heterocyclic Compounds** **7hr**
Introduction, MO Picture, Aromatic Characteristics, Methods for preparation and chemical reactions of Pyrrole, furan, and thiophene, with particular emphasis on the mechanism of electrophilic substitution. Diels-Alder reaction of furan. Pyridine: synthesis and Mechanism of its Nucleophilic substitution reactions.	
Unit-III	**Organic Synthesis via Enolates** **6hr**
Organic Synthesis via Enolates: Acidity of alpha Hydrogen in reactive methylene compounds, Alkylation of diethyl Malonate and ethyl acetate. Synthetic applications of ethyl acetoacetate and malonic ester. Claisen condensation and keto-enol tautomerism.	
Unit-IV	**Biomolecules** **7hr**
Carbohydrates: Classification and Nomenclature and structure and synthesis of Glucose and fructose. Ribose and Deoxyribose, Interconversion of mannose, glucose and fructose. Classification of Amino Acids. Peptides, Proteins and Nucleic Acids: Structure and nomenclature of Peptides and Proteins, Constituents of Nucleic Acids.	
Unit-V	**Synthetic polymer and Synthetic Dyes** **7hr**
Synthetic Polymers: Addition and chain growth polymerization. Free radical and ionic polymerization. Condensation and step growth polymerization. Polyester, polyamides, Phenol-formaldehyde resins, urea formaldehyde resins. Natural and synthetic rubber. Ziegler-Natta Catalyst. Synthetic Dyes: Classification Color and constitution (electronic concept). Classification of dyes. Chemistry and synthesis of Methyl orange, Congo red and Malachite green, phenolphthalein, fluorescein, alizarin and indigo.	
Reference books	1. I. L. Finar : Organic Chemistry (Vol. I & II), E. L. B. S. 2. R. T. Morrison & R. N. Boyd : Organic Chemistry, Prentice Hall. 3. Arun Bahl and B. S. Bahl : Advanced Organic Chemistry, S. Chand 4. Peter Sykes: A Guide Book to Mechanism in Organic Chemistry, Orient Longman. 5. Jonathan Clayden, Nick Geeves, Stuart Warren, organic chemistry, Oxford University Press
Mode of Evaluation: (Percent Weightage)	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended by BOS on:	
Approved by Academic Council on :	

SC 234	**Chemistry- V (Physical chemistry-I)**	**C (L, T, P) = 3 (3, 0, 0)**
Version	**I**	
Prerquisites	Physical Chemistry I needs Chemistry I and II and Organic and Inorganic I Papers	
Objectives	This course deals with the application of structure and theory to the study of physical aspects including reaction dynamics, isotope effects and molecular orbital theory applied. Electrochemistry for fuel systems of daily life	
Course outcome	Students will be able to understand the concept of chemical kinetics, colloidal states, electrochemistry etc	

Unit	**Contents of the Course**	**Hrs.**
I	**Colloidal States**: Definition of colloids, classification of colloids; Solids in liquids (sols): properties – kinetic, optical and electrical; stability of colloids, protective action, Hardy-Schulze law, gold number. Liquids in liquids (emulsions): types of emulsions, preparation, Emulsifier, Liquids in solids (gels): classification, preparation and properties, inhibition, general application of colloids, colloidal electrolytes.	**07**
II	**Chemical Kinetics I** Chemical kinetics and its scope, rate of a reaction, factors influencing the rate of a reaction, concentration dependence of rates, mathematical characteristics of simple chemical reactions – zero order, first order, second order, pseudo order, half life and mean life, electro kinetics phenomena.	**08**
III	**Chemical kineticsII:** Theories of chemical kinetics. Simple collision theory based on hard sphere model, transition state theory (equilibrium hypothesis), Expression for the rate constant based on equilibrium constant and thermodynamic aspects, Catalysis.Introduction to corrosion, homogeneous theory, forms of corrosion, corrosion monitoring and prevention methods.	**06**
IV	**Electrochemistry** Electrolyte Solutions , Electrical Conductivity , Electrified Interfaces, Equilibrium Electrochemistry , Dynamic Electrochemistry , Electrolysis , Applications of electrolysis, Galvanic cell, electrochemical cell, Nernst equation, electrodes, cell reaction, primary and secondary storage, applications., Biological Electrochemistry.	**07**
V	**Thermodynamics – II** Statistical thermodynamics , Thermodynamic equilibrium , Quasi-static transfers between simple systems are nearly in thermodynamic equilibrium and are reversible , Non-equilibrium thermodynamics Account in terms of states of thermodynamic equilibrium , Thermodynamic processes between states of thermodynamic equilibrium , Dependent and independent variables for a process,industrial applications of thermodynamics.	**08**
Total Hours		**36**

References and Text Books	1. R.G. Compton and G.H.W. Saunders, Electrode Potentials Oxford Chemistry Primer 2. A.C. Fisher Electrode Dynamics Oxford Chemistry Primer 3. Barrow, G. M. Physical Chemistry Tata McGraw-Hill (2007). 4. Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004). 5. Mahan, B. H. University Chemistry 3rd Ed. Narosa (1998).
Mode of Evaluation: (Percent Weightage)	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended by BOS on:	
Approved by Academic Council on :	

SC 319	BOTANY-VI ANALYTICAL TECHNIQUES IN PLANT SCIENCES C (L, T, P) = 4 (4, 0, 0))
Version	**I**
Learning objective	The learning objectives of course are: To create an understanding regarding imaging techniques, To gain knowledge about cell fractionation, To have understanding about spectroscopy and chromatographic techniques.
Course outcome	The student will be able to conceptualize about biostatistics, Able to analyze data and characterization method used for protein and nucleic acids.
Unit-I	**Imaging and Related Techniques** **7hr**
Principles of microscopy; Light microscopy; Fluorescence microscopy; Confocal microscopy; use of fluorochromes: Flow cytometry (FACS), instrumentation and applications of fluorescence microscopy. Chromosome Karyotyping, FISH, chromosome painting; Transmission and Scanning electron microscopy, sample preparation for electron microscopy, cryofixation, negative staining, shadow casting, freeze fracture, freeze etching.	
Unit- II	**Cell fractionation** **7hr**
Centrifugation: Differential and density gradient centrifugation, sucrose density gradient, CsCl gradient, analytical centrifugation, ultracentrifugation. Marker enzymes: Use in biological research, auto-radiography, pulse chase experiment.	
Unit-III	**Spectrophotometry and Chromatography** **7hr**
Principle and its application in biological research. Principle; Paper chromatography; Column chromatography, TLC, GLC, HPLC, Ionexchange chromatography; Molecular sieve chromatography; Affinity chromatography.	
Unit-IV	**Characterization of proteins and nucleic acid** **7hr**
Mass spectrometry; X-ray diffraction; X-ray crystallography; Characterization of proteins and nucleic acids; Electrophoresis: AGE, PAGE, SDS-PAGE	
Unit-V	**Biostatistics** **8hr**
Statistics, data, population, samples, parameters; Representation of Data: Tabular, Graphical; Measures of central tendency: Arithmetic mean, mode, median; Measures of dispersion: Range, mean deviation, variation, standard deviation; Chi-square test for goodness of fit.	
Reference books	1. An Introduction to Practical Biochemistry (1996) 3rd ed., Plummer, D.T. Tata McGraw-Hill Publishing Co. Ltd. (New Delhi). 2. Plant Microtechnique and Microscopy (1999) Ruzin, S.E. Oxford University Press, (New York) U.S.A. 3. Short Protocols in Molecular Biology (1995) 3rd ed., Ausubel, F., Brent, R., Kingston, R. E., Moore, D.D., Seidman, J.G., Smith, J.A., Struhl, K. John Wiley & Sons. 4. Biostatistical Analysis (2012) 4th ed., Zar, J.H. Pearson Publication U.S.A.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

SC 342	BOTANY VII (PLANT PHYSIOLOGY) C (L, T, P) = 4 (4, 0, 0)
Version	I
Prerequisite	All students are expected to have a general knowledge of botany and plant science.
Learning objective	The learning objectives of course are: To create an understanding regarding the plant water relation, To gain knowledge about mineral nutrition, To have understanding about photosynthesis.
Course outcome	The student will be able to conceptualize about plant growth and their development, Able to significance of photorespiration.
Unit-I	**Plant Water Relations** **8hrs**
Structure and properties of water Absorption of water (active and passive), Ascent of sap; Pathway of water movement; co symplast and apoplast,Guttationand transpiration, Significance of transpiration Physiological role of stomata	
Unit- II	**Mineral Nutrition** **7Hrs**
Macro and Micro nutrients; Role of essential nutrients in plant metabolism and their deficiency symptoms, Absorption of elements, Active and passive absorption, Simple and facilitated diffusion,Donnan equilibrium Role of ATP, Carrier systen proton pump and ion flux.	
Unit-III	**Photosynthesis** **7Hrs**
Definition and Significance**,** Site of photosynthesis, Photochemical phase, Electron transport chain.Photophosphorylation- (cyclic and non cyclic)	
Unit-IV	**Photorespiration** **7Hrs**
- Biosynthetic phase, Benson and Calvin cycle, Hatch and Slack pathway, Photorespiration Significance	
Unit-V	**Plant Growth And Development 7Hrs**
Physiological effect of Auxin. Cytokinins, Gibberellinsand Ethylene and their role in plant development. Physiology of senescence and abscission Brief outlines on, Photoperiodism, Vernalization. Phytochrome.	
Reference books	1) Daubenmier, RF.1970. Plants and Environment: A text book of Plant Autoecology, Wiley Eastern Private Limited 2) Dennis, D.T., Layzell, D.B., Lefebre, D.D. and Turpin, D.H. (1997) Plant Metabolism. Addison Wesley Longman. 3) Hopkins, W.G. and Huner, P.A. (2008) Introduction to Plant Physiology. John Wiley and Sons. 4) Kaul RP (2009) Plant Metabolism. Swastik Publishers and Distributors. 5) Koromondy EJ 1996 Concepts of Ecology 4th Edition Prentice-Hall of India Pvt. Ltd. New Delhi 6) Misra KC 1988 Manuals of Plant Ecology (3rd Edition) Oxford and IBH Publishing Co., New Delhi. 7) Mukherjee S., Ghosh AK., 2006 Plant Physiology New Central Book Agency Calcutta
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT

Recommended By BOS on:	
Approved by academic council on:	

SC 344	BOTANY-VIII BIOTECHNOLOGY & UTILIZATION OF PLANTS C (L, T, P) = 4 (4, 0, 0)
Version	**Ist**
Learning objective	The learning objectives of course are: To create an understanding regarding biotechnology, To gain knowledge about genetic engineering, To have understanding about medicinal plants and economic botany.
Course outcome	The student will be able to understand about tools and techniques of recombinant DNA technology in biotechnology.
Unit-I	**Biotechnology** **7hr**
Functional definition; basic aspects of plant tissue culture; cellular totipotency differentiation and morphogenesis; biology of Agrobacterium; vectors for gene delivery and marker genes; salient achievements in crop biotechnology.	
Unit- II	**Genetic engineering** **7hr**
Tools and techniques of recombinant DNA technology; cloning vectors; genomic and cDNA library; transposable elements; techniques of gene mapping and chromosome walking.	
Unit-III	**Utilization of plants 7hr**
Centres of origin distribution, cultivation, harvesting & economic values of the following. Food plants : Rice, wheat, maize, potato and sugarcane. Fibers : Cotton, coir and jute with reference to their sources, characteristic, classification & uses. Vegetable oils : Groundnut, mustard and cocount with reference to properties, extraction & classification.	
Unit-IV	**General account of sources** **7hr**
General account of sources of firewood, timber and bamboos. Spices : Medicinal plants : General account with special reference to Rauwolfia, Cinchona, Neem & Opium. Beverages : Tea and coffee with reference to cultivation, harvesting & processing & utility. Rubber : Technique for manufacture, properties & uses.	
Unit-V	**Useful microbes in biotechnology** **8hr**
Useful microbes in biotechnology; strain selection and improvement with special reference to the role of genetic engineering in strain development, Importance and application of plant tissue and animal cell culture, development of transgenic plants and animals, Prospects of microbial biotechnology in the context of agriculture, environment, medicine and energy, Regulation of the safety of biotechnology procedures and products, Genetically engineered microbes: fate and effects	
Reference books	1. Brown, T.A. (1998). Molecular Biology Labfax II: Gene Cloning and DNA Analysis. II Edition, Academic Press, California, USA. 2. Glick, B.R. and Pasternak, J.J. (2009). Molecular Biotechnology - Principles and Applications of Recombinant DNA. IV Edition, ASM press, Washington, USA. 3. Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009). An Introduction to Genetic Analysis. IX Edition. Freeman and Co., N.Y., USA. 4. Snustad, D.P. and Simmons, M.J. (2009). Principles of Genetics. V Edition, John Wiley and Sons Inc. 5. Watson, J.D., Myers, R.M., Caudy, A. and Witkowski, J.K. (2007). Recombinant DNA-Genes and Genomes- A Short Course. III Edition, Freeman and Co., N.Y., USA. 6. Beauchamp, T.I. and Childress, J.F. (2008). Principles of Biomedical Ethics. VI Edition, Oxford University Press.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

SC 321	ZOOLOGY VI (ENVIRONMENTAL BIOLOGY) C (L, T, P) = 4 (4, 0, 0)
Version	I
Learning objective	The learning objectives of course are: To create an understanding regarding concepts of ecology, To gain knowledge about habitat ecology, To have understanding about waste water technology, Able to understand environmental biotechnology.
Course outcomes	The student will be able to conceptualize about wild life conservation, Able to Causes, symptoms and control of Social and economic factors of disease including role of health services.
Unit-I	**Concept of Ecology** **8Hrs**
Abiotic and Biotic Factors • Energy flow in ecosystem • Food chain and Food web • Biogeochemical cycle: C02. Nand P • Population Concept- Characteristics of population. Factors affecting population growth. • Community Concept-Succession, Periodicity ,Indicators	
Unit- II	**Habitat Ecology** **7Hrs**
Fresh water habitat - Factors and classification. • Marine habitat- Factors and classification • Terrestrial habitat - Factors and classification. • Ecological divisions of India. • Natural resources and their Conservation with special reference to forests	
Unit-III	**Man and Environment** **7Hrs**
Wild life conservation (Laws, National Parks and Sanctuaries of MP) • Environmental degradation and pollution. • Thermal and Noise pollution • Radiation Ecology ,Global Warming and Green House Effect • Urbanisation and effect of human population on environment.	
Unit-IV	**Waste Management Technologies** **7Hrs**
Sources of waste, types and characteristics, Sewage disposal and its management, Solid waste disposal, Biomedical waste handling and disposal, Nuclear waste handling and disposal, Waste from thermal power plants, Case histories on Bhopal gas tragedy, Chernobyl disaster, Seveso disaster and Three Mile Island accident and their aftermath.	
Unit-V	**Diseases** **7Hrs**
Causes, symptoms and control of Social and economic factors of disease including role of health services and other organizations: Infectious (Bacterial-Tuberculosis, Typhoid; Viral- AIDS, Poliomyelitis, Hepatitis; Protozoan-Leishmaniasis, Malaria,Cholera, Lifestyle and Inherited/genetic diseases, Immunological diseases; Cancer; Diseases impacting on Western versus developing societies.	
References	1. OdumE.P.,Fundamental of Ecology- WB Saunders 2. Call man, Ecology- Johnwilley& Sons 3. K. Clark, Elements of Ecology - Wiley • Harper & Row, Elements of Ecology Smith R.S. - New York 4. K.C. Agarwal, Wild Life in India Conservation and Management- Nidhi Pub. 5. M ..ShamimJairajPuri, Biological Diversity and Environment 6. Kumar &Asija , Biodiversity Principles & Conservation- Agrobios 7. Saharia, Wild life of India- Natraj Publisher • K.C. Agarwal, Biodiversity- Botanica 8. Jha, Genes & Evolution- John Pub. • Colbert, Evolution- Wiley- Liss 9. B.D. Sharma, Indian Wild life Resource & Development, Daya Pub.

Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by acadmic council on:	

SC 323	**ZOOLOGY-VII MICROBIOLOGY**	**C (L, T, P) = 4 (4, 0, 0)**
Version	**I**	
Learning objective	The learning objectives of course are: To create an understanding regarding microbiology, To gain knowledge about microbial nutrition and growth, To have understanding microbial cell organization.	
Course outcomes	The student will be able to conceptualize about microbial genetics, Able to analyze importance of microbiology in food science.	
Unit-I	**History of Microbiology and classification**	**7hr**
History of development of microbiology as a discipline, Spontaneous generation versus biogenesis, development of various microbiological techniques, concept of fermentation, establishment of fields of medical microbiology, immunology and environmental microbiology Molecular methods of assessing microbial phylogeny- molecular chronometer, phylogenetic trees, rRNA, DNA and proteins as indicator of phylogeny. Major Divisions of life-Domains, Kingdoms.		
Unit- II	**Microbial Nutrition and Growth**	**7hr**
Nutritional types of microorganisms, growth factors, culture media- synthetic and complex, types of media; isolation of pure cultures, growth curves, mean growth rate constant, generation time; general concept of effect of environmental factors on growth of microbes; sterilization and disinfection; activity, use of physical methods (heat, low temperature, filtration, radiation)and chemical agents (phenolics, halogens, heavy water, sterilization gases).		
Unit-III	**Microbial Cell organization**	**7hr**
Cell size, shape and arrangement, glycocalyx, capsule, flagella, fimbriae and pili; Cell-wall: Composition and detailed structure of Gram positive and Gramnegative cell walls, Archaebacterial cell wall, Gram and acid fast staining mechanisms, lipopolysaccharide (LPS) and protoplasts. Effect ofantibiotics and enzymes on the cell wall; Cell Membrane: Structure, function and chemical composition of bacterial and archaeal cell membranes; Cytoplasm: Ribosomes, mesosomes, inclusion bodies, nucleoid, chromosome and plasmids; Endospore: Structure, formation, stages of sporulation.		
Unit-IV	**Microbial Genetics**	**7hr**
Bacterial recombination: general and site specific and replicative; Bacterial plasmids - fertility factor, col plasmid; Bacterial conjugation- (Hfr, F`, F+ X F-); Transformation; Transduction- generalized and specialized.		
Unit-V	**Food and Microbiology**	**8hr**
Overview of importance of microbiology in food and industrial microbiology; Microorganism growth in food; extrinsic and intrinsic factors for food spoilage; microorganisms causing food spoilage in fresh food, milk, and canned food; Preservation of foods by aseptic handling, high temperature, low temperature, dehydration, osmotic pressure, chemicals and radiations; preparation of fermented food products, fermented milk such as yoghurt, curd and cheese.		
Reference books	Sharma P.D. Microbilogy - Rastogi Pub. Meerut. Madigan and Martinko: Brock Biology of Microorganisms (2006, Prentice Hall) Prescott, Harley and Klein: Microbiology (1999, McGraw)	
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT	
Recommended By BOS on:		

Approved by academic council on:	

SC 350	ZOOLOGY-VIII APPLIED ZOOLOGYC (L, T, P) = 4 (4, 0, 0)
Version	**I**
Learning objective	The learning objectives of course are: To create an understanding regarding aquaculture, To gain knowledge about sericulture, To have understanding about lac culture and apiculture.
Course outcome	The student will be able to conceptualize about poultry keeping, Able to understand economic importance and medicinal importance of insects.
Unit-I	**Principles of Aquaculture** **7hr**
Concept of Commercial Fish Production, Site, Species, System, Business Selection/Evaluation/Permits and Regulations Production Planning/Types of Production Systems, Record Keeping, Water Budgets, Pond Preparation-Liming and Fertilizing, Pond Preparation.	
Unit- II	**Sericulture, Lac culture and Apiculture** **7hr**
History, Classification and Biology of Honey Bees Social Organization of Bee Colony, Artificial Bee rearing (Apiary), Beehives – Newton and Langstroth Bee Pasturage Selection of Bee Species for Apiculture Bee Keeping Equipment Methods of Extraction of Honey (Indigenous and Modern). Sericulture, Lac culture.	
Unit-III	**Pisciculture and Aquarium fish keeping** **7hr**
Genetic improvements in aquaculture industry; Induced breeding and transportation of fish seed, The potential scope of Aquarium Fish Industry as a Cottage Industry, Exotic and Endemic species of Aquarium Fishes Insect & Unwanted Fish Control, Handling/Grading/Transportation/Harvesting.	
Unit-IV	**Poultry keeping** **7hr**
Principles of poultry breeding, Management of breeding stock and broilers, Processing and preservation of eggs.	
Unit-V	**Insects of Economic and Medicinal Importance** **8hr**
Biology, Control and damage caused by Helicoverpaarmigera, Pyrillaperpusilla and Papiliodemoleus, Callosobruchus chinensis, Sitophilus oryzae and Triboliumcastaneum, Medical importance and control of Pediculus humanus corporis, Anopheles, Culex, Aedes, Xenopsyllacheopis	
Reference books	Dunham R.A. (2004). Aquaculture and Fisheries Biotechnology Genetic Approaches. CABI publications, U.K. Prost, P. J. (1962). Apiculture. Oxford and IBH, New Delhi. Bisht D.S., Apiculture, ICAR Publication. Singh S., Beekeeping in India, Indian council of Agricultural Research, New Delhi.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

SC 315	Chemistry-VI (Inorganic Chemistry-II) C (L, T, P) = 3 (3, 0, 0)
Version	**I**
Prerequisite	Chemistry study of earlier semester
Objectives:	1. To train qualified, adaptable, motivated, and responsible Mathematicians who will contribute to the scientific and technological development. 2.To impact knowledge by teaching 3.To advance knowledge by research
Expected outcome:	Better outcomes in chemistry specialization
Unit-I	**Coordination Chemistry** **7 Hours**
Coordination Compounds: Nomenclature Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory crystal field theory of transition metal complexes. Application in Industries by Magnetic properties of transition metal complexes	
Unit-II	**Chemistry of Transition Metals:** **8 Hours**
Properties of d-block elements. Binary compounds (hydrides, carbides and oxides) of the elements of the first transition series and complexes with respect to relative stability of their oxidation states, coordination number and geometry. Chemistry of Elements of Second and Third Transition Series: General characteristics, comparative treatment of Zr/Hf, Nb/Ta, Mo/W in respect of ionic radii, oxidation states. Industrial application of transition metals	
Unit-III	**Inner Transition Elements: Actinides and Lanthanides** **6 Hours**
Definition of the f elements; position in the periodic table; Properties of the atoms and ions: ionization energies, electrode potentials, metallic and ionic radii; Colour and electronic spectroscopy; Magnetism; Solid state compounds: halides and oxides; Coordination chemistry of the lanthanides and actinides; Commercial applications;Rare earth Oxides used for Industries.	
Unit-IV	**Organometallic compounds** **7 Hours**
Organometallic compounds; Definition Nomenclature, Preparation properties and application and bonding of alkyl and Aryl compound. Electronic and Ionic Conduction , Metals, insulators and semiconductors, electronic structure of solids application in electronic and electrical industries. Bonding of ligands, Reactions of organometallic, Electron accountancy, Oxidative addition and reductive elimination, Insertion and α/β-elimination, Industrial organometallic catalysis, Olefin catalysis Organometallic compounds and application in electronic materials.	
Unit-V	**Recent Advances In Inorganic Chemistry** **8 Hours**
Borane, Silanes, Inorganic nanotechnology, Zeolite, Bio-inorganic chemistry (must emphasize the metal) Ceramics, Inorganic thin films, Intercalation compounds, Super acids , High-temperature superconductors, nanowire battery, Perovskites nonvolatile memory materials.	
Reference Books	1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P.L. Gaus. Wiley. 2. Concise Inorganic Chemistry, J.D. Lee ELBS. 3. Concepts of Models Inorganic Chemistry B.Douglas. D.McDaniel and J.Alexander, John Wiley. 4. Inorganic Chemistry. D.E. Shriver P.W. Atkins and C.H. Langford, Oxford. 5. Inorganic Chemistry, W.W. Porterfield Addison Wesley. 6. Inorganic Chemistry, A.G. Sharpe. ELBS. 7. Inorganic Chemistry, G.L. Miessler and D.A. Tarr, Prentice Hall. 8. Group Theory and Its Chemical Applications: P. K. Bhattacharya 9. Inorganic Chemistry: J. E. Huyee, Principles of Structure & Reactivity, 3rd Ed. 10. Selected Topics in Inorganic Chemistry: W. U. Malik, G. D. Tuli and R. Madan
Mode of Evaluation	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended by BOS on:	
Approved by Academic Council on :	

SC 346	Chemistry-VII (Physical &MiscChemistry-II) C (L, T, P) = 3 (3, 0, 0)
Version	**I**
Prerequisite	Chemistry of Sem I II, III and IV
Objectives:	This course deals with the application of structure and theory to the study of Solution colligative properties , Nuclear chemistry and heterogeneous system
Expected outcome:	Going green can save money while helping to relates with development of physical chemistry.
Unit-I	**Solution and Colligatives : 7 Hours**
Expression of Concentration of Solids in Liquids ,Solid Solutions ,Colligative Properties -Relative Lowering of Vapor Pressure ,Raoult's Law Elevation of Boiling Point ,Depression of Freezing Point ,Osmotic Pressure ,Determination of Molecular Masses using Colligative Properties 'Van't Hoff Factor and Calculations involving it ,	
Unit-II	**Nuclear Chemistry 8 Hours**
Nuclear chemistry; Fundamental particles of nucleus (nucleons); Concept of nuclides and its representation; Isotopes, isobars and isotones (with specific examples); Forces operating between nucleons (n-n, p-p, & n-p); Qualitative idea of stability of nucleus (n/p ratio). Radiochemistry: Natural and artificial radioactivity; Radioactive disintegration series, Radioactive displacement law, Radioactive decay rates, Half-life and average life, Nuclear binding energy, Mass defect and binding energy. Nuclear reactions; spallation, nuclear fission and fusion. Application radioactive waste management radioactivity.	
Unit-III	**Phase equilibrium 6 Hours**
Heterogeneous system, Phase diagram of one and two component system. Surface chemistry: Interface (chemistry) Surface modification of biomaterials with proteins, Surface finishing, Surface modification, Surface phenomenon, Tribology electrocardiography. Polarography theory, Ilkovic equation; half wave potential and its significance	
Unit-IV	**Soil and Environmental Biogeochemistry 7 Hours**
Soil Chemistry, Chemistry of Soils: interactions between soil solids, precipitates and solution phases including: mineralogy, ion exchange, adsorption, weathering and buffering, soil colloidal .Soil Humic Substances. **Soil Testing's and salinity**	
Unit-V	**Environmental and Green Chemistry 8 Hours**
Environmental Issues :Go Green ,Consumer Health & Food Safety Concerns , Environmental Disasters, Chemical reactions in environment, Impact of primary and secondary pollutants **Basics of Green Chemistry.** Definition of green chemistry, How green chemistry differs from cleaning up pollution, Green chemistry's 12 principles Green chemistry's roots in the Pollution Prevention Act of 1990 **.**Intellectual property Right	
Reference Books	1 Barrow, G. M. Physical Chemistry Tata McGraw-Hill (2007). 2. Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004). 3. Mahan, B. H. University Chemistry 3rd Ed. Narosa (1998).
Mode of Evaluation: (Percent Weightage)	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended by BOS on:	

Approved by Academic Council on :	

SC 348	**Chemistry-VIII (Organic Chemistry-II) C (L, T, P) = 3 (3, 0, 0)**
Version	**I**
Prerequisite	Organic chemistry is a growing subset of chemistry. To put it simply, it is the study of all carbon-based compounds; their structure, properties, and reactions and their use in synthesis.
Objectives:	It focuses on the methods used to identify the structure of organic molecules, advanced principles of organic stereochemistry, organic reaction mechanisms, and methods used for the synthesis of organic compounds. Additional special topics include illustrating the role of organic chemistry in biology, medicine, and industry.
Expected outcome:	Organic chemistry has expanded our world of knowledge and it is an essential part of the fields of biochemistry, biology, industry, nanotechnology, rocket science, and many more!
Unit-I	**Aldehyde and Ketone** **7 Hours**
Aldehyde synthesis by deportation or hydrolysis ,Aldehyde synthesis by oxidation of alcohols and rearrangements , 1,3-Dike tone synthesis by oxidation , Insole synthesis Ketone synthesis by oxidation of alcohols, Nucleophilic addition reactions.	
Unit-II	**Carboxylic Acids** **8 Hours**
Structure , Acidity, Synthesis , Carboxylic Acid Derivatives : Acryl Transfer Reactions : Background , Acid Chlorides/Anhydrides , Esters Amides , Chemistry of Nitriles : Formation Reactions. Acids, Tartaric acid Citric acid	
Unit-III	**Conjugated Systems** **6 Hours**
Molecular Orbital Theory: Conjugated Systems and frontier Molecular Orbital Theory Correlation diagrams, Pericyclic Reactions – Introduction to Electrocyclic– and Cycloadditionsreactions, 1,3 and 1,5 Sigmatropic Rearrangements.	
Unit-IV	**Polymers** **7 Hours**
Thermoplastcs and Thermosetts, polymerization classification, compounding of plastics, Elastomers natural and artificial rubber Industrial application of polymers biodegradable plastics.Industrial Process in polymers injection molding, foaming, reinforcing and fiber spinning.	
Unit-V	**Advanced Organics** **8 Hours**
Reaction intermediates and determination of reaction mechanism, concept of medicinal chemistry and drug design. Photochemistry, laws of photochemistry, Jablonski diagram, Norish-I & II reactions, Concept of Spectroscopy, IR, NMR, Mass, Raman and UV-visible spectroscopy for organic compounds, sample handling, instrumentation and applications	
Reference Books	1. Carey, F. A., and R. J. Sundberg. Advanced Organic Chemistry, Part A: Structure and Mechanisms. 4th Ed. New York, NY: Springer, 2000. 2. Joule, J. A., and K. Mills. Heterocyclic Chemistry. 4th ed. Malden, MA: Blackwell Science, 2000. 3. L. Finar: Organic Chemistry (Vol. I & II), E. L. B. S. 4. R. T. Morrison & R. N. Boyd: Organic Chemistry, Prentice Hall. 5. ArunBahl and B. S. Bahl: Advanced Organic Chemistry, S. Chand 6. Peter Sykes: A Guide Book to Mechanism in Organic Chemistry, Orient Longman. 7. S.M.Mukherjee and S.P.Singh ,Reaction Mechanism in Organic Chemistry,Mc Millan (2004). 8. Bhupinder Mehta and Manju Mehta, Organic Chemistry, PHI Learning (2009).
Mode of Evaluation: (Percent Weightage)	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended by BOS on:	

Approved by Academic Council on :	

SURESH GYAN VIHAR UNIVERSITY

Accredited by NAAC with 'A' Grade

SYLLABUS

B. Sc. Biotechnology

SCHOOL OF APPLIED SCIENCES

EDITION 2021-24

SURESH GYAN VIHAR UNIVERSITY
Accredited by NAAC with 'A' Grade

Teaching and Examination Scheme

To commence from the Academic year: 2021-24 Program

School of Applied Sciences **Program: B.Sc.Biotechnology: Semester: I**

S. No.	Course Code	Course Name	Type of Course Core/Elective	Credit	Contact Hrs/Wk.			Exam Hours ESE	Weightage (in%)	
					L	T	P		CIE	ESE
1.	EN 101	**English Language 1**	University Core	2	2	0	0	3	40	60
2.	PC 101	**Proficiency in co-curricular activities**	University Core	2	0	0	0	0	100	0
3.	CP 101	**Elementary Computer**	University Core	3	3	0	0	3	40	60
4.	FD102	**Foundation Course-I**	University Core	1	1	0	0	3	25	75
5.	ES 101	**Environmental Studies**	University Core	2	2	0	0	3	40	60
6.	SC101	**Cell Biology**	Program Core	3	3	0	0	3	40	60
7.	SC103	**General Microbiology**	Program Core	3	3	0	0	3	40	60
8.	SC105	**Biochemistry & Metabolism**	Program Core	3	3	0	0	3	40	60
9.	SC151	**Cell Biology Lab**	Program Core	2	0	0	3	3	60	40
10.	SC153	**General Microbiology Lab**	Program Core	2	0	0	3	3	60	40
11.	SC155	**Biochemistry & Metabolism lab**	Program Core	2	0	0	3	3	60	40
			Total:	25	17	00	09			

L – Lecture

T – Tutorial

P – Practical

CIE – Continuous Internal Evaluation

ESE – End Semester Examination

Signature of Concerned Teacher

Signature of Convener-BOS_____

Signature of Member Secretary

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Teaching and Examination Scheme

To commence from the Academic year: 2021-24 Program

School of Applied Sciences **Program: B. Sc.Biotechnology: Semester: II**

S. No.	Course Code	Course Name	Type of Course Core/Elective	Credit	Contact Hrs/Wk.			Exam Hours	Weightage (in%)	
					L	T	P	ESE	CIE	ESE
1.	EM 102	**Employability Skills**	University Core	1	0	0	2	3	60	40
2.	PC 102	**Proficiency in co-curricular activities**	University Core	2	0	0	0	0	100	00
3.	HUM102	**Human Values & Ethics**	University Core	1	1	0	0	3	60	40
4.	FD104	**Foundation Course-II**	University Core	1	1	0	0	3	25	75
5.	EN 104	**English language II**	University Core	3	3	0	0	3	40	60
6.	SC102	**Basics of Immunology**	Program Core	3	3	0	0	3	40	60
7.	SC104	**Biotechnology and Human Welfare**	Program Core	3	3	0	0	3	40	60
8.	SC106	**Genetics and Molecular Biology**	Program Core	3	3	0	0	3	40	60
9.	SC152	**Basic Immunology Lab**	Program Core	2	0	0	3	3	60	40
10.	SC154	**Genetics and Molecular Biology Lab**	Program Core	2	0	0	3	3	60	40
			Total:	21	18	00	09			

L – Lecture **CIE – Continuous Internal Evaluation**

T – Tutorial **ESE – End Semester Examination**

P – Practical

Signature of Concerned Teacher **Signature of Convener-BOS**_____

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Teaching and Examination Scheme

To commence from the Academic year: 2021-24 Program

School of Applied Sciences **Program: B. Sc. Biotechnology: Semester: III**

S. No.	Course Code	Course Name	Type of Course Core/Elective	Credit	Contact Hrs/Wk.			Exam Hours ESE	Weightage (in%)	
					L	T	P		CIE	ESE
1.	EM 203	**Employability Skills**	University Core	1	0	0	2	3	60	40
2.	PC 203	**Proficiency in co-curricular activities**	University Core	2	0	0	0	0	100	0
3.	SC201	**Bioanalytical Techniques**	Program Core	4	4	0	0	3	40	60
4.	SC203	**Environmental Biotechnology**	Program Core	4	4	0	0	3	40	60
5.	SC205	**Biosafety and Bioethics**	Program Core	4	4	0	0	3	40	60
6.	SC207	**Chemistry-I**	Program Core	4	4	0	0	3	40	60
7.	SC251	**Bioanalytical Techniques Lab**	Program Core	2	0	0	3	3	60	40
8.	SC253	**Environmental Biotechnology Lab**	Program Core	2	0	0	3	3	60	60
9.	SC255	**Chemistry I Lab**	Program Core	2	0	0	3	3	60	40
			Total:	25	116	00	11			

L – Lecture

T – Tutorial

P – Practical

CIE – Continuous Internal Evaluation

ESE – End Semester Examination

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Teaching and Examination Scheme

To commence from the Academic year: 2021-24 Program

School of Applied Sciences **Program: B. Sc. Biotechnology: Semester: IV**

S. No.	Course Code	Course Name	Type of Course Core/Elective	Credit	Contact Hrs/Wk.			Exam Hours ESE	Weightage (in%)	
					L	T	P		CIE	ESE
1.	EM 204	**Employability Skills**	University Core	1	0	0	2	3	60	40
2.	PC 204	**Proficiency in co-curricular activities**	University Core	2	0	0	0	0	100	0
3.	SC202	**Chemistry II**	Program Core	4	4	0	0	3	40	60
4.	SC204	**Genetic Engineering**	Program Core	4	4	0	0	3	40	60
5.	SC206	**Biostatistics**	Program Core	4	4	0	0	3	40	60
6.	SC218	**IPR, Bio-entrepreneurship and Bio-business Management**	Program Core	4	4	0	0	3	40	60
7.	SC252	**Chemistry II Lab**	Program Core	2	0	0	3	3	60	40
8.	SC254	**Genetic Engineering Lab**	Program Core	2	0	0	3	3	60	40
			Total:	23	16	00	11			

L – Lecture

T – Tutorial

P – Practical

CIE – Continuous Internal Evaluation

ESE – End Semester Examination

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Teaching and Examination Scheme

To commence from the Academic year: 2021-24 Program

School of Applied Sciences **Program: B. Sc. Biotechnology: Semester: V**

S. No.	Course Code	Course Name	Type of Course Core/Elective	Credit	Contact Hrs/Wk.			Exam Hours ESE	Weightage (in%)	
					L	T	P		CIE	ESE
1.	EM 301	**Employability Skills**	University Core	1	0	0	2	3	60	40
2.	PC 301	**Proficiency in co-curricular activities**	University Core	2	0	0	0	0	100	0
3.	SC301	**Bioprocess Engineering**	Program Core	4	4	0	0	3	40	60
4.	SC303	**Bioinformatics**	Program Core	4	4	0	0	3	40	60
5.	SC305	**Plant Biotechnology**	Program Core	4	4	0	0	3	40	60
6.		**Elective-I**	Program Core	4	4	0	0	3	40	60
7.	SC351	**Bioinformatics Lab**	Program Core	2	0	0	3	3	60	40
8.	SC353	**Bioprocess Engineering Lab**	Program Core	2	0	0	3	3	60	40
9.	SC355	**Plant Biotechnology Lab**	Program Core	2	0	0	3	3	60	40
			Total:	25	16	00	11			

L – Lecture

T – Tutorial

P – Practical

CIE – Continuous Internal Evaluation

ESE – End Semester Examination

Elective I

1. Molecular diagnostics (SC 345)
2. Biofertilizers and biopesticides (SC 321)

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Teaching and Examination Scheme

To commence from the Academic year: 2021-24 Program

School of Applied Sciences **Program: B. Sc. Biotechnology: Semester: VI**

S. No.	Course Code	Course Name	Type of Course Core/Elective	Credit	Contact Hrs/Wk.			Exam Hours ESE	Weightage (in%)	
					L	T	P		CIE	ESE
1.	SC302	**Animal Biotechnology**	Program Core	4	4	0	0	3	40	60
2.	SC304	**Medical Biotechnology**	Program Core	4	4	0	0	3	40	60
3.	SC306	**Genomics and Proteomics**	Program Core	4	4	0	0	3	40	60
4.		**Elective – II**	Program Core	4	4	0	0	3	40	60
5.	SC352	**Animal Biotechnology Lab**	Program Core	2	0	0	3	3	60	40
6.	SC354	**Medical Biotechnology Lab**	Program Core	2	0	0	3	3	60	40
7.	SC356	**Genomics and Proteomics Lab**	Program Core	2	0	0	3	3	60	40
			Total:	22	16	00	09			

L – Lecture

T – Tutorial

P – Practical

CIE – Continuous Internal Evaluation

ESE – End Semester Examination

Electives-II

1. **Basics of forensic science (SC 347)**
2. **Molecular modeling and drug designing (SC 324)**
3. **Nanobiotechnology (SC326)**
4. **Biophysics (SC328)**

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SC101	Cell Biology
Version	1.0
Prerequisite	All students are expected to have a general knowledge of Basic biology.
Learning objective	The learning objective of course are: To create an understanding regarding the cells and its organelles. To gain knowledge about cytoplasm and its components.
Course outcome	The student will be able to conceptualize basics of cell biology.
Unit-I	**Cell and Organelles** **8 hours**
	Cell: Introduction and classification of organisms by cell structure, cytosol, compartmentalization of eukaryotic cells, cell fractionation. Cell Membrane and Permeability: Chemical components of biological membranes, organization and Fluid Mosaic Model, membrane as a dynamic entity, cell recognition and membrane transport.
Unit-II	**Structure of Cell organelles** **7 hours**
	Membrane Vacuolar system, cytoskeleton and cell motility: Structure and function of microtubules, Microfilaments, Intermediate filaments. Endoplasmic reticulum: Structure, function including role in protein segregation. Golgi complex: Structure, biogenesis and functions including role in protein secretion.
Unit-III	**Functions of cell organelles** **7 hours**
	Lysosomes: Vacuoles and micro bodies: Structure and functions, Ribosomes: Structures and function including role in protein synthesis. Mitochondria: Structure and function, Genomes, biogenesis. Chloroplasts: Structure and function, genomes, biogenesis. Nucleus: Structure and function, chromosomes and their structure.
Unit-IV	**Extracellular Matrix and cancer** **7 hours**
	Extracellular Matrix: Composition, molecules that mediate cell adhesion, membrane receptors for extra cellular matrix, macromolecules, regulation of receptor expression and function. Signal transduction. Cancer: Carcinogenesis, agents promoting carcinogenesis, characteristics and molecular basis of cancer.
Unit-V	**Interactions between cell & environment** **7 hours**
	Interactions between cell & environment: - cell functions, cells adhesions, cell junction and extracellular matrix, cell signalling through G-protein linked receptors. Cellular regulation. cell cycle and its regulation. Mitosis and Meiosis. cell apoptosis.
Reference books	1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc. 2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition.Lippincott Williams and Wilkins, Philadelphia. 3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA. 4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

SC103	General Microbiology
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of microbiology.
Learning objective	The learning objective of course are: To create an understanding regarding the microbiology.
Course outcome	The student will be able to conceptualize basics to advance of microbiology.
Unit-I	**Fundamentals of microbiology** **8 hours**
	Fundamentals, History and Evolution of Microbiology. Classification of microorganisms: Microbial taxonomy, criteria used including molecular approaches, Microbial phylogeny and current classification of bacteria. Microbial Diversity: Distribution and characterization Prokaryotic and Eukaryotic cells, Morphology and cell structure of major groups of microorganisms *eg*. Bacteria, Algae, Fungi, Protozoa and Unique features of viruses. Viruses: SARS CoV2
Unit-II	**Cultivation and Maintenance of microorganisms** **7 hours**
	Cultivation and Maintenance of microorganisms: Nutritional categories of micro-organisms, methods of isolation, Purification and preservation.
Unit-III	**Microbial growth** **7 hours**
	Microbial growth: Growth curve, Generation time, synchronous batch and continuous culture, measurement of growth and factors affecting growth of bacteria. Microbial Metabolism: Metabolic pathways, amphi-catabolic and biosynthetic pathways. Bacterial Reproduction: Transformation, Transduction and Conjugation. Endospores and sporulation in bacteria.
Unit-IV	**Control of Microorganisms** **7 hours**
	Control of Microorganisms: By physical, chemical and chemotherapeutic Agents Water Microbiology: Bacterial pollutants of water, coliforms and non coliforms. Sewage composition and its disposal.
Unit-V	**Food Microbiology** **7 hours**
	Food Microbiology: Important microorganism in food Microbiology: Moulds, Yeasts, bacteria. Major food born infections and intoxications, Preservation of various types of foods. Fermented Foods.
Reference books	1. Alexopoulos CJ, Mims CW, and Blackwell M. (1996). Introductory Mycology. 4 th edition. John and Sons, Inc. 2. Jay JM, Loessner MJ and Golden DA. (2005). Modern Food Microbiology. 7thedition, CBS Publishers and Distributors, Delhi, India. 3. Kumar HD. (1990). Introductory Phycology. 2nd edition. Affiliated East Western Press. 4. Madigan MT, Martinko JM and Parker J. (2009). Brock Biology of Microorganisms. 12th edition. Pearson/Benjamin Cummings. 5. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company. 6. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5th edition. McMillan. 7. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9 th edition. Pearson Education. 8. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

SC105	Biochemistry & Metabolism
Version	1.0
Prerequisite	All students are expected to have a general knowledge of Basic biology.
Learning objective	The learning objective of course are: To create an understanding regarding the Biochemistry &Metabolism. To gain knowledge about Carbohydrates, Lipids, Protein, Nucleic acid.
Course outcome	The student will be able to conceptualize basics of biochemistry and metabolism.
Unit-I	**Amino acids, Proteins and Carbohydrates** **8 hours**
	Amino acids & Proteins: Structure and properties of Amino acids, Types of proteins and their classification, Protein Purification. Denaturation and renaturation of proteins. Fibrous and globular proteins. Urea cycle, Deamination and transamination. **Carbohydrates**: Structure, Function and properties of Monosaccharides, Disaccharides and Polysaccharides. Homo & Hetero Polysaccharides, Mucopolysaccharides, Glycoprotein's and their biological functions.
Unit-II	**Lipids and Nucleic acids** **7 hours**
	Lipids:Classification, nomenclature and properties of fatty acids, essential fatty acids. Phospholipids, sphingolipids, glycolipids, cerebrosides, gangliosides, Prostaglandins, Cholesterol. β-oxidation of fatty acids. **Nucleic acids**: Physical & chemical properties of Nucleic acids, Nucleosides & Nucleotides, purines & pyrimidines, Biologically important nucleotides, Double helical model of DNA.
Unit-III	**Enzymes** **7 hours**
	Enzymes: Nomenclature and classification of Enzymes, Holoenzyme, apoenzyme, Cofactors, coenzyme, prosthetic groups, metalloenzymes, monomeric & oligomeric enzymes, activation energy and transition state, enzyme activity, specific activity, common features of active sites,
Unit-IV	**Enzyme specificity and co-enzymes** **7 hours**
	Enzyme specificity: types & theories, Biocatalysts from extreme thermophilic and hyperthermophilic archaea and bacteria. Role of: NAD+, NADP+, FMN/FAD, coenzymes A, Thiamine pyrophosphate, Pyridoxal phosphate,lipoic-acid, Biotin vitamin B12, Tetrahydrofolate and metallic ions
Unit-V	**Carbohydrates Metabolism** **7 hours**
	Carbohydrates Metabolism: Reactions, energetics and regulation. Glycolysis: Fate of pyruvate under aerobic and anaerobic conditions. Pentose phosphate pathway and its significance, Gluconeogenesis, Glycogenolysis and glycogen synthesis. TCA cycle, Electron Transport Chain, Oxidative phosphorylation. ß-oxidation of fatty acids.
Bibliography	1. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman and Co. 2. Buchanan, B., Gruissem, W. and Jones, R. (2000) Biochemistry and Molecular Biology of Plants.American Society of Plant Biologists. 3. Nelson, D.L., Cox, M.M. (2004) Lehninger Principles of Biochemistry, 4th Edition, WH Freeman and Company, New York, USA. 4. Hopkins, W.G. and Huner, P.A. (2008) Introduction to Plant Physiology. John Wiley and Sons. 5. Salisbury, F.B. and Ross, C.W. (1991) Plant Physiology, Wadsworth Publishing Co. Ltd.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

SC102	Basics of Immunology
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of circulatory system.
Learning objective	The learning objective of course are: To create an understanding regarding the Immunology and Immunotechnology.
Course outcome	The student will be able to conceptualize basics to advance of Immunology and Immunotechnology.
Unit-I	**Immune Response** **7 hours**
	Immune Response - An overview, components of mammalian immune system, molecular structure of Immuno-globulins or Antibodies, Humoral & Cellular immune responses, Tlymphocytes& immune response (cytotoxic T-cell, helper T-cell, suppressor T-cells), T-cell receptors, T cell and B cell activation.
Unit-II	**Genetic Rearrangement** **7 hours**
	genome rearrangements during B-lymphocyte differentiation, Antibody affinity maturation class switching, assembly of T-cell receptor genes by somatic recombination. Adjuvants, cytokine and signaling, Complement system.
Unit-III	**Major Histocompatibility complexes** **7 hours**
	Major Histocompatibility complexes – class I & class II MHC antigens, antigen processing. Immunity to infection – immunity to different organisms, pathogen defense strategies, avoidance of recognition.
Unit-IV	**Regulation of Ig** **7 hours**
	Regulation of immunoglobulin gene expression – clonal selection theory, allotypes & idiotypes, allelic exclusion, immunologic memory, heavy chain gene transcription, genetic basis of antibody diversity, hypotheses (germ line & somatic mutation), antibody diversity.
Unit-V	**Immunotechniques and Autoimmune disease** **8 hours**
	Blood grouping, Antigen-Antibody reactions : agglutination, precipitation, immuno-electrophoresis, Coomb's test, ELISA, RIA. Vaccines & Vaccination Autoimmunity & auto-immune diseases, factors contributing development of auto-immune diseases, mechanism of development, breakdown of self-tolerance, rejection of transplants, molecular mimicry, nature of auto-antigens, immunodeficiency, AIDS
Reference books	1. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6 th edition Saunders Publication, Philadelphia. 2. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology. 11th edition Wiley-Blackwell Scientific Publication, Oxford. 3. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York. 4. Murphy K, Travers P, Walport M. (2008). Janeway's Immunobiology. 7th edition Garland Science Publishers, New York. 5. Peakman M, and Vergani D. (2009). Basic and Clinical Immunology. 2nd edition Churchill Livingstone Publishers, Edinberg. 6. Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

SC104	Biotechnology and human welfare
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of biotechnology
Learning objective	The learning objective of course are: To create an understanding regarding the Basics ofBiotechnology and human welfare
Course outcome	The student will be able to conceptualize basics to advance ofBasics of Biotechnology and human welfare.
Unit-I	**Industry** **8 hours**
	Industry: protein engineering; enzyme and polysaccharide synthesis, activity and secretion,alcohol and antibiotic formation.
Unit-II	**Agriculture** **7 hours**
	Agriculture: N2 fixation: transfer of pest resistance genes to plants; interaction between plantsand microbes; qualitative improvement of livestock.
Unit-III	**Environment** **7 hours**
	Environments: e.g. chlorinated and non-chlorinated organ pollutant degradation; degradation ofhydrocarbons and agricultural wastes, stress management, development of biodegradablepolymers such as PHB.
Unit-IV	**Forensic science** **7 hours**
	Forensic science: e.g. solving violent crimes such as murder and rape; solving claims of paternityand theft etc. using various methods of DNA finger printing.
Unit-V	**Health** **7 hours**
	Health: e.g. development of non-toxic therapeutic agents, recombinant live vaccines, genetherapy, diagnostics, monoclonal in E.coli, human genome project.
Reference books	1. Sateesh MK (2010) Bioethics and Biosafety, I. K. International Pvt Ltd. 2. Sree Krishna V (2007) Bioethics and Biosafety in Biotechnology, New age internationalpublishers
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

SC106	Genetics and Molecular Biology
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of Genetics
Learning objective	The learning objective of course are: To create an understanding regarding the Genetics and Molecular Biology.
Course outcome	The student will be able to conceptualize basics to advance of Genetics and Molecular Biology.
Unit-I	**Introduction and Mendelian genetics** **8 hours**
	Introduction: Historical developments in the field of genetics. Cell Cycle: Mitosis and Meiosis: Control points in cell-cycle progression in yeast. Mendelian genetics: Mendel's experimental design, monohybrid, di-hybrid and tri hybrid crosses, Law of segregation & Principle of independent assortment. Verification of segregates by test and back crosses, Chromosomal theory of inheritance, Allelic interactions: Concept of dominance, recessiveness, incomplete dominance, co-dominance, semi-dominance, pleiotropy, multiple allele, pseudo-allele, essential and lethal genes, penetrance and expressivity.
Unit-II	**Non allelic interactions** **7 hours**
	Non allelic interactions: Interaction producing new phenotype complementary genes, epistasis (dominant & recessive), duplicate genes and inhibitory genes. Chromosome and genomic organization: Eukaryotic nuclear genome nucleotide sequence composition –unique & repetitive DNA, satellite DNA. Centromere and telomere DNA sequences, middle repetitive sequences- VNTRs & dinucleotide repeats, repetitive transposed sequences - SINEs & LINEs, middle repetitive multiple copy genes, noncoding DNA.
Unit-III	**Genetic organization and mutation** **7 hours**
	Genetic organization of prokaryotic and viral genome. Structure and characteristics of bacterial and eukaryotic chromosome, chromosome morphology, concept of euchromatin and heterochromatin. packaging of DNA molecule into chromosomes, chromosome banding pattern, karyotype, giant chromosomes, one gene one polypeptide hypothesis, concept of cistron, exons, introns, genetic code, gene function. Chromosome and gene mutations: Definition and types of mutations, causes of mutations, Ames test for mutagenic agents, screening procedures for isolation of mutants and uses of mutants, variations in chromosomes structure - deletion, duplication, inversion and translocation (reciprocal and Robertsonian), position effects of gene expression, chromosomal aberrations in human beings, abonormalities– Aneuploidy and Euploidy.
Unit-IV	**Replication and DNA damage** **7 hours**
	Replication of DNA in prokaryotes and eukaryotes: Semiconservative nature of DNA replication, Bi-directional replication, DNA polymerases, The replication complex: Pre-primming proteins, primosome, replisome, Rolling circle replication, Unique aspects of eukaryotic chromosome replication, Fidelity of replication. DNA damage and repair: causes and types of DNA damage, mechanism of DNA repair, Homologous recombination.
Unit-V	**Transcription and translation** **7 hours**
	RNA structure and types of RNA, Transcription in prokaryotes, Transcription in eukaryotes, Regulation of gene expression in prokaryotes: Operon concept (inducible and repressible system), Genetic code and its characteristics, Prokaryotic and eukaryotic translation, Fidelity of translation, Inhibitors of translation. Posttranslational modifications of proteins.
Reference books	1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2006). Principles of Genetics. VIII Edition John Wiley & Sons. 2. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc. 3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. IX Edition. Benjamin Cummings. 4. Russell, P. J. (2009). Genetics- A Molecular Approach. III Edition. Benjamin Cummings. 5. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. IX Edition. Introduction to Genetic Analysis, W. H. Freeman & Co. 6. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons. Inc. 7. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended	

By BOS on:	
Approved by academic council on:	
SC201	**Bioanalytical Techniques**
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of Bioanalytical Technique.
Learning objective	The learning objective of course are: To create an understanding regarding the Bioanalytical Technique.
Course outcome	The student will be able to conceptualize basics to advance of Bioanalytical Technique.
Unit-I	**Analytical separation methods 8 hours**
	Chromatography - General principle and application Adsorption chromatography, Partition chromatography, Gas chromatography, liquid chromatography, Paper chromatography, Thin layer chromatography, Gel filtration chromatography, Ion exchange chromatography, Affinity chromatography, HPLC (High Performance/Pressure Liquid chromatography).
Unit-II	**Electrophoresis 7 hours**
	Electrophoresis - General principle and application, Paper electrophoresis, Gel electrophoresis (Native, Denaturing & Reducing), Disc Gel electrophoresis, Slab Gel electrophoresis, Isoelectrofocussing (IEF).
Unit-III	**Centrifugation 7 hours**
	Centrifugation: Basic principles. Common centrifuges used in laboratory (clinical, high speed &ultra centrifuges). Sedimentation rate, Sedimentation coefficient, Zonal centrifugation, Equilibrium density gradient centrifugation Types of rotors (fixed angle, swing bucket), Types of centrifugation: Preparative, differential & density gradient
Unit-IV	**Microscopy 7 hours**
	Basic knowledge of the principles and applications of Microscopy: Light, phase contrast, Fluorescence and Confocal microscopy, Scanning and Transmission Electron microscopy.
Unit-V	**Spectroscopy 7 hours**
	Spectroscopic methods: principle and applications of UV-visible, IR, NMR. Spectroscopy. Principle & application of X-ray crystallography.
Reference books	1. Sharma, V.K.: Techniques in Microscopy and Cell Biology Tata McGraw Hill, 1991. 2. Alberts et al.: Molecular Biology of the cell (2nd ed.), Garland, 1989. 3. Biochemical Technique: Theory & Practical J.F. Robyt& B.J. White $ 30.95. Waveland Press, Inc. 4. Wilson & Walker: Practical Biochemistry (4th ed) University of Hertfordshire Cambridge University Press 5. Jayraman: Laboratory Manual in Biochemistry 6. Arnold L. Demain& Julian E. Davies: Manual of Industrial Microbio. & Biotech. 2nd ed
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

SC203	Environmental Biotechnology
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of Environmental Sciences.
Learning objective	The learning objective of course are: To create an understanding regarding the Environmental Biotechnology.
Course outcome	The student will be able to conceptualize basics to advance of Environmental Biotechnology.
Unit-I	**Conventional fuels and their environmental impact** **8 hours**
	Conventional fuels and their environmental impact – Firewood, Plant, Animal, Water, Coal and Gas. Modern fuels and their environmental impact – Methanogenic bacteria, Biogas, Microbial hydrogen Production, Conversion of sugar to alcohol Gasohol
Unit-II	**Bioremediation** **7 hours**
	Bioremediation of soil & water contaminated with oil spills, heavy metals and detergents. Degradation of lignin and cellulose using microbes. Phyto-remediation. Degradation of pesticides and other toxic chemicals by micro-organisms- degradation aromatic and chlorinates hydrocarbons and petroleum products.
Unit-III	**Waste Treatment** **7 hours**
	Treatment of municipal waste and Industrial effluents. Bio-fertilizers Role of symbiotic and asymbiotic nitrogen fixing bacteria in the enrichment of soil. Algal and fungal biofertilizers (VAM)
Unit-IV	**Bioleaching** **7 hours**
	Bioleaching, Enrichment of ores by microorganisms (Gold, Copper and Uranium). Environmental significance of genetically modified microbes, plants and animals.
Unit-V	**Biodegradation** **7 hours**
	Overview of Biodegradation, Degradation of Basic Structures found in Hydrocarbons & Xenobiotics, Biodegradation of Xenobiotics, PCBs (Poly Chlorinated Biphenyls), DDT, Nitrobenzene, Biomagnifiction, Wastewater, Primary, Secondary, Tertiary treatment processes, Conventional Air Pollutants & Acid rain & Acid mine drainage, An overview of process of Bioremediation
Reference books	1. Environmental Science, S.C. Santra 2. Environmental Biotechnology, Pradipta Kumar Mohapatra 3. Environmental Biotechnology – Concepts and Applications, Hans-Joachim Jordening and Jesef Winter 4. Waste Water Engineering, Metcalf and Eddy, Tata McGraw hill 5. Agricultural Biotechnology, S.S. Purohit 6. Environmental Microbiology : Methods and Protocols, Alicia L. Ragout De Spencer, John F.T. Spencer 7. Introduction to Environmental Biotechnology, Milton Wainwright 8. Principles of Environmental Engineering, Gilbert Masters 9. Wastewater Engineering – Metcalf & Eddy
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

SC205	**Bioethics and Biosafety**
Version	1.0
Prerequisite	All students are expected to have a basic concept of general biology.
Learning objective	The learning objective of course are to introduce safety and ethical aspects of applied biology.
Expected Outcome	The student will be able to conceptualize about ● Govt guidelines of Biosafety. ● Relevance of Bioethics. ● Ethics in Health Care. ● Biosafety Management.
Unit-I	**Introduction** **7 hours**
Historical background, introduction to biological safety cabinets, primary containment for biohazards, biosafety levels of specific microorganisms, recommended biosafety levels for infectious agents and infected animals.Definition, historic evolution, codes and guidelines, universal principles.	
Unit-II	**Biosafety guidelines** **8 hours**
Government of India definition of genetic modified organism (GMOs) and living modified organisms (LMOs), roles of institutional biosafety committee, review committee on genetic manipulation (RCGM), genetic engineering approval committee (GEAC) for GMO applications in food and agriculture, environmental release of GMOs. The GM-food debate and biosafety assessment procedures for biotech foods and related products, including transgenic food crops, case studies of relevance. Biosafety assessment of pharmaceutical products such as drugs/vaccines etc.	
Unit-III	**Biosafety management** **7 hours**
Risk analysis, risk assessment, risk management and communication, overview of national regulations and relevant international agreements including Cartagena Protocol.Key to the environmentally responsible use of biotechnology, ethical implications of biotechnological products and techniques, social and ethical implications of biological weapons.	
Unit-IV	**Bioethics** **7 hours**
Define the term “Bioethics” in relation to profession, society, and biomedicine, learn about gradation of moral and ethical norms from simpler to higher levels for initiating right actions to „first do no harm“ and learn about prayers, oaths, covenants, declarations, guidelines and codes which have relevance to bioethics.	
Unit-V	**Health ethics** **7 hours**
Describe the sanctity of human life and the need to preserve human life, explain about issues related to prenatal screening, **Preclinical studies**, clinical trials (Phase I/II/III/IV) studies.Vulnerability of women with respect to health care, examination and screening of women for disease, social issues like domestic violence and female genital mutilation and abortion.identify ethical issues in clinical practice of HIV medicine and its prevention, research ethics related to HIV.	
Reference books	1. 1. Bioethics and Biosafety, 1st edition (2008), M. K Sateesh, I K International Pvt Ltd, ISBN-13: 978-8190675703. 2. 2. The Cambridge Textbook of Bioethics, 1st edition (2008), Peter A. Singer and A. M. Viens; Cambridge University Press, ISBN-13: 978-0511545566. 3. 3. Foundation of Bioethics, 2nd edition (1996), E. H Tristram; Oxford University Press, ISBN-13: 9780195057362. 4. 4. Social science: An introduction to the study of society, 14th edition (2010), Hunt, E. F.,and Colander, D. C. ; Peason/Allyn and Bacon, Boston, ISBN-13: 978-020570271. 5. 5. Principles of Biomedical Ethics, 6th edition (2011), Beauchamp Tl, Childress JF; Oxford University Press, 2001. ISBN-13: 978-0195143317. 6. 6. A Companion to Bioethics, 2nd edition (2012), Helga Kuhse, Peter Singer; John Wiley and Sons, ISBN-13: 978-1444350845.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOSon:	
Approved by academic councilon:	

SC207	Chemistry I
Version	1.0
Prerequisite	All students are expected to have a general knowledge of chemistry I.
Learning objective	The learning objective of course are: To create an understanding regarding the chemistry I.
Course outcome	The student will be able to conceptualize basics of chemistry I.
Unit-I	**Stereochemistry-I** **8 hours**
	Writing of Fischer projection, Newmann and Sawhorse projection and Wedge formulae. Interconversion of one type of structural representation into another type. Conformation: Restricted rotation about single bonds, Various conformations of ethane, butane and cyclohexane. Relative stability of different conformations in terms of energy difference is to be discussed for all these compounds.
Unit-II	**Stereochemistry-II** **7 hours**
	Geometrical Isomerism: Requirements for a molecule to show geometrical isomerism, Cis-Trans and E/ Z notation along with CIP rules for geometrical isomers. Optical Isomerism: Optical activity, specific and molar rotation, chirality, enantiomerism, diastereoisomerism, racemic mixtures and their resolution by salt formation method. Relative and absolute configuration: D / L nomenclature system for configuration of carbohydrates (difference between d/l and D/L notations). Threo and Erythro designation. R and Sconfiguration (upto two chiral centres).
Unit-III	**Alkene, Alkynes, Aldehyde and Ketones** **7 hours**
	Hydrogenation, addition of halogens, Hydrohalogenation (Markovnikov's and anti-Markovnikov's addition), hydration, hydroxylation (cis and trans), oxymercurationdemercuration, hydroboration-oxidation, ozonolysis. Reactivity of alkenes vs alkynes. **Aldehydes and ketones:** (formaldehyde, acetaldehyde, benzaldehyde, acetone) Addition of sodium bisulphite, hydrogen cyanide and alcohols. Addition- elimination reactions with ammonia and its derivatives Name reactions: Aldol, cross Aldol, Claisen, Knoevengel, Cannizzaro, cross Cannizzaro
Unit-IV	**Free radical substitution reactions** **7 hours**
	Free radical substitution reactions: Halogenation of alkanes, allylic compounds and alkylbenzenes. Nucleophilic substitution reactions: Alkyl, allyl and benzyl halides – substitution of halogen by some common nucleophiles. Mechanism of SN1 and SN2 reactions (stereochemistry, nature of substrate, nucleophile and leaving group) **Benzene diazonium chloride:** Replacement of diazo group Alcohols, amines and phenols: Substitution of active hydrogen, replacement of hydroxyl group in alcohols (using PCl5, SOCl2 and HI)
Unit-V	**Carboxylic acid derivatives** **7 hours**
	Carboxylic acid derivatives: Hydrolysis Ethers: Cleavage by HI Electrophilic Substitution Reactions (aromatic compounds): General mechanism of electrophilic substitution reactions (nitration, halogenation, sulphonation, Friedel Crafts alkylation and acylation), directive influence of substituents. **Elimination Reactions:** Alkyl halides (dehydrohalogenation, Saytzeff's rule), vicinal dihalides (dehalogenation), alcohols (dehydration), Quaternary ammonium salts (Hofmann's elimination). Mechanism of E1 and E2 reactions (nature of substrate and base), elimination vs substitution.
Reference books	1. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical OrganicChemistry, 5 th Ed., Pearson (2012). 2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Longman, London & New York. 3. Ahluwalia, V.K.; Dhingra, S. & Gulati, A. College Practical Chemistry, Universities Press. 4. I. L. Finar: Organic Chemistry (Vol. I & II), E. L. B. S. 5. R. T. Morrison & R. N. Boyd: Organic Chemistry, Pearson Education. 6. Arun Bahl and B. S. Bahl : Advanced Organic Chemistry, S. Chand 7. Peter Sykes: A Guide Book to Mechanism in Organic Chemistry, Orient Longman. 8. Eliel, E. L. & Wilen, S. H. Stereochemistry of Organic Compounds; Wiley: London, 1994. 9. T. W. Graham Solomon's Organic Chemistry, John Wiley and Sons. 10. P.S. Kalsi, Stereochemistry, Conformation and Mechanism, John Wiley and Sons. 11. D. Nasipuri, Stereochemistry of Organic Compounds, New Age International Publishers.
Mode of	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT

Examination	
Recommended By BOS on:	
Approved by academic council on:	

SC202	**Chemistry II**
Version	1.0
Prerequisite	All students are expected to have a general knowledge of Chemistry II.
Learning objective	1. To develop understanding of structure and reactivity of bio-molecules. 2. To understand action of enzymes and drug. 3. To understand the fundamental concepts of bioenergetics.
Course outcome	The student will be able to conceptualize basics of Chemistry II.
Unit-I	**Carbohydrates: 8 hours**
	Classification of carbohydrates, reducing and non-reducing sugars, General properties of Glucose and Fructose, their open chain structure. Epimers, mutarotation and anomers. Determination of configuration of glucose (Fischer proof). Cyclic structure of glucose. Haworth projections. Cyclic structure of fructose. Linkage between monosachharides, structure of isachharides (sucrose, maltose, lactose) and polysachharides (starch and cellulose) excluding their structure elucidation.
Unit-II	**Amino Acids, Peptides and Proteins 7 hours**
	Classification of Amino Acids, Zwitterion structure and Isoelectric point. Overview of Primary, Secondary, Tertiary and Quaternary structure of proteins. Determination of primary structure of peptides, determination of N-terminal amino acid (by DNFB and Edman method) and C–terminal amino acid (by thiohydantoin and with carboxypeptidase enzyme). Synthesis of simple peptides (upto dipeptides) by N-protection (t-butyloxycarbonyl and phthaloyl) & C-activating groups and Merrifield solid phase synthesis.
Unit-III	**Enzymes and correlation with drug action 7 hours**
	Mechanism of enzyme action, factors affecting enzyme action, Coenzymes and cofactors and their role in biological reactions, Specificity of enzyme action (including stereospecificity), Enzyme inhibitors and their importance, phenomenon of inhibition (competitive and noncompetitive inhibition including allosteric inhibition). Drug action – receptor theory. Structure - activity relationships of drug molecules, binding role of –OH group, -NH2 group, double bond and aromatic ring.
Unit-IV	**Concepts of Energy in Biosystems 7 hours**
	Calorific value of food. Standard caloric content of carbohydrates, proteins and fats. Oxidation of foodstuff (organic molecules) as a source of energy for cells: Introduction to metabolism (catabolism, anabolism), ATP: the universal currency of cellular energy, ATP hydrolysis and free energy change. Conversion of food into energy: Outline of catabolic pathways of Carbohydrates - Glycolysis, Fermentation, Krebs Cycle. Overview of catabolic pathways of fats and proteins. Interrelationships in the metabolic pathways of proteins, fats and carbohydrates.
Unit-V	**Nucleic Acid, Fats and Oils 7 hours**
	Components of Nucleic acids: Adenine, guanine, thymine and cytosine (structure only), other components of nucleic acids, Nucleosides and nucleotides (nomenclature), Structure of polynucleotides; Structure of DNA (Watson-Crick model) and RNA (types of RNA), Genetic code, Biological roles of DNA and RNA: Replication, Transcription and Translation. **Introduction to lipids, classification. Oils and fats:** Common fatty acids present in oils and fats, Omega fatty acids, Trans fats, Hydrogenation, Saponification value, Iodine number. Biological importance of triglycerides, phospholipids, glycolipids, and steroids (cholesterol).
Reference books	1. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). 2. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). 3. Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). 4. Nelson, D. L. & Cox, M. M. Lehninger's Principles of Biochemistry 7th Ed., W. H. Freeman. 5. Berg, J. M., Tymoczko, J. L. &Stryer, L. Biochemistry 7th Ed., W. H. Freeman. 6. Furniss, B.S.; Hannaford, A.J.; Rogers, V.; Smith, P.W.G.; Tatchell, A.R. Vogel's Textbook of Practical Organic Chemistry, ELBS.

	7. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry, Universities Press.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

SC204	**Genetic Engineering**
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of Molecular Biology.
Learning objective	The learning objective of course are: To create an understanding regarding the Genetic Engineering.
Course outcome	The student will be able to conceptualize basics to advance of Genetic Engineering.
Unit-I	**Molecular tools and applications 7 hours**
	Molecular tools and applications- restriction enzymes, ligases, polymerases, Alkaline phosphatase. Gene Recombination and Gene transfer: Transformation, Episomes, Plasmids and other cloning vectors (Bacteriophage-derived vectors, artificial chromosomes), Microinjection, Electroporation, Ultrasonication, Principle and applications of Polymerase chain reaction (PCR), primer-design, and RT- (Reverse transcription) PCR.
Unit-II	**Restriction and modification system 7 hours**
	Restriction and modification system, restriction mapping. Southern and Northern hybridization. Preparation and comparison of Genomic and cDNA library, screening of recombinants, reverse transcription,. Genome mapping, DNA fingerprinting, Applications of Genetic Engineering Genetic engineering in animals: Production and applications of transgenic mice, role of ES cells in gene targeting in mice, Therapeutic products produced by genetic engineering-blood proteins, human hormones, immune modulators and vaccines (one example each).
Unit-III	**Random and site-directed mutagenesis 7 hours**
	Random and site-directed mutagenesis: Primer extension and PCR based methods of site directed mutagenesis, Random mutagenesis, Gene shuffling, production of chimeric proteins, Protein engineering concepts and examples (any two).
Unit-IV	**Genetic engineering in plants 7 hours**
	Genetic engineering in plants: Use of Agrobacterium tumefaciens and A. rhizogenes, Tiplasmids, Strategies for gene transfer to plant cells, Direct DNA transfer to plants, Gene targeting in plants, Use of plant viruses as episomal expression vectors.
Unit-V	**RecombinantproteinTechnology 8 hours**
	Recombinant protein Technology: Design and use of expression vectors, selection of suitable promoter sequences, ribosome binding sites, transcription terminator, plasmid copy number. Processing of Recombinant proteins- Stabilization of proteins. Phage Display, Inclusion Bodies, solubilization of insoluble proteins. Codon optimization, Fusion ProteinsGene therapy, Gene silencing.
Reference books	1. Brown TA. (2006). Gene Cloning and DNA Analysis. 5th edition. Blackwell Publishing, Oxford, U.K. 2. Clark DP and Pazdernik NJ. (2009). Biotechnology-Applying the Genetic Revolution. Elsevier Academic Press, USA. 3. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington 4. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K. 5. Sambrook J, Fritsch EF and Maniatis T. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

SC206	Biostatistics
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of mathematics
Learning objective	The learning objective of course are: To create an understanding regarding the Biostatistics To apply statistical methods for analyzing biological data To analyze biological data and to draw inferences
Course outcome	The student will be able to conceptualize basics to advance ofBiostatistics
Unit-I	**Basics of Statistics** **8 hours**
	Statistics – Definition, functions and its limitations – Collection, Classification, Tabulation of data – Diagrammatic and Graphical representation of data.
Unit-II	**Measures of Central Tendency** **7 hours**
	Measures of Central Tendency – Mean, Median, Mode, Geometric mean, Harmonic mean – Merits and demerits of these measures - Measures of Dispersion – Range, Quartile deviation, Mean deviation, Standard deviation, Variance, Coefficient of Variation, Skewness – Kurtosis.
Unit-III	**Correlation** **7 hours**
	Correlation – Types, scatter diagram – Karl Pearson's coefficient of correlation, Spearman's Rank Correlation – Regression – Formation of Regression lines – Uses of Regression lines.
Unit-IV	**Basics of Probability Theory** **7 hours**
	Basics of Probability Theory – Addition & Multiplication Rule – Binomial, Poisson and Normal Distribution and their uses in biological sciences.
Unit-V	**Test for Mean** **7 hours**
	Test for Mean – Test for the difference between two means – Test for proportion – Test for the difference between two proportions – Small sample Tests: Student's t-test, F-test – Analysis of variance (one-way and two-way – Basic Ideas only).
Reference books	1. Le CT (2003) Introductory biostatistics. 1st edition, John Wiley, USA 2. Glaser AN (2001) High YieldTM Biostatistics. Lippincott Williams and Wilkins, USA 3. Edmondson A and Druce D (1996) Advanced Biology Statistics, Oxford University Press. 4. Danial W (2004) Biostatistics : A foundation for Analysis in Health Sciences, John Wiley and Sons Inc. 5. S.P.Gupta (2011), Statistical methods, Sultan Chand & Sons,4th Edition. 6. Jerold H.Zar (2009): Bio-statistical Analysis, 4th Edition, Pearson Education Inc., 7. Dorling Kindersley (India) Pvt. Ltd., New Delhi. 8. Antonisamy.B, Solomon Christopher and Prasanna Samuel.P, (2010): 9. Bio-Statistics Principles and Practice, 1st Reprint 2011, Tata McGraw Hill Education Pvt. Ltd., New Delhi.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

SC345	Molecular Diagnostics
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of Microbiology and Immunology
Learning objective	The learning objective of course are: To create an understanding regarding the Basics of Molecular Diagnostics
Course outcome	The student will be able to conceptualize basics to advance ofBasics of Molecular Diagnostics
Unit-I	**Enzyme Immunoassays 8 hours**
	Comparison of enzymes available for enzyme immunoassays, conjugation of enzymes. Solidphases used in enzyme immunoassays. Homogeneous and heterogeneous enzymeimmunoassays. Enzyme immunoassays after immuno blotting. Enzyme immuno histochemicaltechniques. Use of polyclonal or monoclonal antibodies in enzymes immuno assays.Applications of enzyme immunoassays in diagnostic microbiology
Unit-II	**Molecular methods in clinical microbiology 7 hours**
	Applications of PCR, RFLP, Nuclear hybridization methods, Single nucleotide polymorphismand plasmid finger printing in clinical microbiology
Unit-III	**Laboratory tests in chemotherapy7 hours**
	Susceptibility tests: Micro-dilution and macro-dilution broth procedures. Susceptibilitytests:Diffusion test procedures. Susceptibility tests: Tests for bactericidal activity. Automatedprocedures for antimicrobial susceptibility tests.
Unit-IV	**Automation in diagnostics 7 hours**
	Automation in microbial diagnosis, rapid diagnostic approach including technical purificationand standardization of antigen and specific antibodies.
Unit-V	**Idiotyping 7 hours**
	Concepts and methods in idiotypes. Antiidiotypes and molecular mimicry and receptors. Epitope design and applications.Immunodiagnostic tests. Immuno florescence. Radioimmunoassay.
Reference books	1. Practical Biochemistry, Principles and Techniques, Keith Wilson and John Walker 2. Bioinstrumentation, Webster 3. Advanced Instrumentation, Data Interpretation, and Control of Biotechnological Processes,J.F. Van Impe,Kluwer Academic 4. Ananthanarayan R and Paniker CKJ. (2005). Textbook of Microbiology. 7th edition (edited byPaniker CKJ). University Press Publication. 5. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg'sMedical Microbiology. 24th edition. McGraw Hill Publication. 6. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology.4thedition. Elsevier. 7. Joklik WK, Willett HP and Amos DB (1995). Zinsser Microbiology. 19th edition. Appleton-Centuary-Crofts publication. 8. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein'sMicrobiology. 7th edition. McGraw Hill Higher Education. 9. Microscopic Techniques in Biotechnology, Michael Hoppert
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

SC324	Molecular Modeling and Drug Designing
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of Bioinformatics and drugs
Learning objective	The learning objective of course are: To create an understanding regarding the Basics ofMolecular Modelling and Drug Designing
Course object	The student will be able to conceptualize basics to advance ofBasics ofMolecular Modelling and Drug Designing.
Unit-I	**Biotechnological products** **8 hours**
	Introduction, Stability profile, Barriers toproteins and peptide delivery, Delivery of protein & peptide drugs, Lymphatic transportation ofproteins, Site specific protein modification (protein engineering), Toxicology profilecharacterization.
Unit-II	**Basic principles of molecular dynamics** **7 hours**
	Drug targeting and drug delivery systems: Introduction, Historical perspectives, Drug targeting, Cellular levels events in targeting. Ligands as means of targeting, Blood cell receptors for endogenous compounds, Carrier system for targeting, Vesicular systems for ligand mediated drug targeting, Specialized liposomes for cellular drug targeting.
Unit-III	**Vaccines** **7 hours**
	Introduction, Multivalent subunit vaccines, Purified macromolecules, Synthetic peptide vaccines, Immuno-adhesions, Recombinant antigen vaccines, Vector vaccines, Anti-idiotype vaccines, Targeted immune stimulants, Miscellaneous approaches, New generation vaccines, Novel vaccine delivery systems.
Unit-IV	**Drug Design** **7 hours**
	Introduction to drug design cycle: Structure Activity Relationship (SAR), Rational Drug Design, Pharmacophoric patterns, Quantitative Structure-Activity Relationship. (Q SAR) &Hans equation
Unit-V	**Molecular Modelling** **7 hours**
	Introduction to molecular modeling: Quantum mechanical and molecular orbital methods, Introduction tosemiempirical, molecular mechanics and ab initio techniques. Potential energy surface, Docking andmodeling substrate – receptor interactions. Introduction to s/w tools for CADD.
Reference books	1. Andrew Leach, Molecular Modelling: Principles and Applications (2nd Edition),Addison Wesley Longman, Essex, England, 1996. 2. Alan Hinchliffe, Modelling Molecular Structures, 2nd Edition, John-Wiley, 2000. 3. Alan Hinchliffe, Molecular Modelling for Beginners, John-Wiley, 2003. 4. N. Cohen (Ed.), Guide Book on Molecular Modeling in Drug Design, AcademicPress, San Diego, 1996. 5. D. Frenkel and B. Smith, Understanding Molecular Simulations. FromAlgorithms to Applications, Academic Press, San Diego, California, 1996. 6. C. Rauter and K. Horn, X-ray crystallography and drug design, Elsevier, 1984. 7. M. Kalos and P. A. Whitlock, Monte Carlo Methods. John Wiley & Sons, NewYork, 1986. 8. J.A. McCammon and S.C. Harvey. Dynamics of Proteins and Nucleic Acids.Cambridge University Press, Cambridge, 1987. 9. D.C. Rapaport. The Art of Molecular Dynamics Simulation.Cambridge UniversityPress, Cambridge, England., 1995
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

SC321	**Biofertlizers and Biopesticides**
Version	1.0
Prerequisite	All students are expected to have a basic concept of general biology.
Learning objective	The learning objective of course are to introduce anatomy and physiology of various body systems.
Expected Outcome	The student will be able to conceptualize about ● Internal environment and homeostasis ● Identify and demonstrate functional anatomy of heart. ● Identify and demonstrate how to control Respiratory physiology. ● Demonstrate and evaluate Renal and Nerve physiology.
Unit-I	**Introduction** **7 hours**
History and concept of Insect pathogens and Bio Pesticides.Introduction, importance, scope and potential of Bio Pesticides. Definitions, concepts and classification of Bio Pesticides viz. pathogens, botanical pesticides,and bio rationals. Microbial Bio Pesticides viz. Viruses, Bacteria, Fungi etc. Virulence, pathogenicity and symptoms of entomopathogenic organisms.	
Unit-II	**Biopesticides** **8 hours**
Botanicals & other bio rational pesticides and their uses. Role of Bio Pesticides in Organic farming and ecofriendly agriculture.Mass production and scaling up of production of different categories of Bio Pesticides. Methods of applications of Bio Pesticides. Precautionary approaches in application and usage of Bio Pesticides. Methods of quality control and Techniques of Bio Pesticides. Constraints & possible solutions in production and use of Bio Pesticides	
Unit-III	**Biofertilizers** **7 hours**
Different Agriculturally important beneficial Microorganisms. Introduction and scope ofBiofertilizersTypes and classification of Biofertilizers. Total Biofertilizer production in India. Different Nitrogen Biofertilizers. Symbiotic & Non-Symbiotic Nitrogen fixation. Noduleformation, Competitiveness, Quantification of Nitrogen fixed. Associative and Free-livingNitrogen fixation. Cyanobacterial Biofertilizers.	
Unit-IV	**Plant Growth Promoting Biofertilizers** **7 hours**
Phosphate solubilizing Bacteria and Fungi. Mechanism and solubilization of Phosphorus.Phosphate mobilizing microorganisms. VAM in detail.Potassium and Zinc Biofertilizers. Plant Growth Promoting Biofertilizers (PGPR). Production technology; Strain selection, Sterilization, Growth and Fermentation. Mass scaleproduction of different carrier and liquid based biofertilizers.	
Unit-V	**Applications** **7 hours**
FCO specifications and quality control of biofertilizers. Microbes beneficial for recycling of Organic wastes & Composting. Bio remediators and its related Microbes. Application technology for seeds, seedlings, tubers, sets etc. Biofertilizers – Storage, shelf lifeand marketing. Factors influencing the efficacy of Biofertilizers.	
Reference books	7. Leo, M.L. Nollet, Hamirsingh Rathore. Bio Pesticide Handbook. CRC Press Tayler & Francisgroup, Newyork. 1-29 pp. 8. Md. Arshad Anwer. 2017. Bio Pesticides and Bio Agents e book CRC Press Taylor & Francisgroup Newyork. 1-365 pp. 9. Dwijendra Singh.2014. Advances in Plant Bio Pesticides. Publisher Springer 1-401 pp. 10. GhayurAlam. 2000. A Study of Bio Pesticides and Bio Fertilisers in Haryana, India. International Institute for Environment and Development 3 Endsleigh Street London 1-24 pp. 11. Vibrant Gujarath. 2017. Setting up a Bio-Fertilizers and Bio-Pesticides Unit Biotechnology Government of Gujarat. Gujarat State Biotechnology Mission. 1-23 pp. 199 12. Salma Mazid, Ratul Ch. Rajkhowa, Jogen Ch. Kalita (2011). A review on the use of Bio Pesticides in Insect Pest Management. International Journal of Science and Advanced Technology, Volume 1 No 7, 169-178 pp
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT

Recommended By BOSon:	
Approved by academic councilon:	

SC218	**IPR, Bio-entrepreneurship and Bio-business Management**
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of Environmental Sciences.
Learning objective	The learning objective of course are: To create an understanding regarding the Environmental Biotechnology.
Course outcome	The student will be able to conceptualize basics to advance of Environmental Biotechnology.
Unit-I	**Intellectual Property** **8 hours**
	Introduction to Intellectual Property:Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design,Traditional Knowledge, Geographical Indications, Protection of GMOsIP as a factor in R&D;
Unit-II	**Agreement and Treaties** **7 hours**
	IPs of relevance to Biotechnology and few. Introduction to Indian Patent Law. World Trade Organization and its related intellectual property provisions. History of GATT & TRIPS Agreement; Madrid Agreement; Hague Agreement;WIPO Treaties; Budapest Treaty; PCT; Indian Patent Act 1970 & recentAmendments. Intellectual/Industrial property and its legal protection in research, design and development. Patenting in Biotechnology, economic, ethical and depository considerations.
Unit-III	**Entrepreneurship** **7 hours**
	Meaning, Needs and Importance of Entrepreneurship, Entrepreneurs and Innovators, Promotion of entrepreneurship, Factorsinfluencing entrepreneurship, Features of a successful Entrepreneurship.Selection of a product, line, design and development processes, economics on material and energy requirement, stock the product and release the same for making etc.
Unit-IV	**Establishing and enterprise** **7 hours**
	Forms of Business Organization, Project Identification, Selection of the product, Project formulation,Assessment of project feasibility. Demand for a given product, feasibility of its production under given constraints of raw material, energy input, financial situations export potential etc.
Unit-V	**Bio-business Management** **7 hours**
	Worldwide market scenario of biotechnology based business,Biobusiness prospective in India. Management Process & organization,General analysis of Indian Biobusiness, Project formulation Business Plan, technological assessment, Cost estimation, feasibility andcommercial viability of project.
Reference books	1. Holt DH. Entrepreneurship: New Venture Creation. 2. Kaplan JM Patterns of Entrepreneurship. 3. Gupta CB, Khanka SS. Entrepreneurship and Small Business Management, Sultan Chand & Sons. 4. P. Narayan: Patent Law. 5. S. L Rao: Economic reforms and Indian markets.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

`SC301	**Bioprocess Engineering**
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of Fermentation Sciences.
Learning objective	The learning objective of course are: To create an understanding regarding the Bioprocess and Fermentation Technology.
Course outcome	The student will be able to conceptualize basics to advance of Bioprocess and Fermentation Technology.
Unit-I	**Introduction to bioprocess technology** **7 hours**
	Introduction to bioprocess technology. Range of bioprocess technology and its chronological development. Basic principle components of fermentation technology. Types of microbial culture and its growth kinetic parameters– Batch, Fedbatch and Continuous culture.
Unit-II	**Designing of Bioreactor** **8 hours**
	Significance of Impeller, Baffles, Sparger; Types of culture/production vessels- Airlift; Cyclone Column; Packed Tower and their application in production processes. Principles of upstream processing – Media preparation, Inocula development and sterilization.
Unit-III	**Downstream processing** **7 hours**
	Introduction to oxygen requirement in bioprocess; mass transfer coefficient; factors affecting KLa. Bioprocess measurement and control system with special reference to computer aided process control. Introduction to downstream processing, product recovery and purification. Effluent treatment. Microbial production of ethanol, amylase, lactic acid and Single Cell Proteins.
Unit-IV	**Production of industrial chemicals** **7 hours**
	Production of industrial chemicals, biochemicals and chemotherapeutic products. Propionic acid, butyric acid, 2-3 butanediol, gluconic acid, itaconic acid, Biofuels: Biogas, Ethanol, butanol, hydrogen, biodiesel, starch conversion processes; newer antibiotics, anti cancer agents, amino acids.
Unit-V	**Microbial products of pharmacological interest** **7 hours**
	Microbial products of pharmacological interest, steriod fermentations and transformations. Secondary metabolism – its significance and products. Metabolic engineering of secondary metabolism for highest productivity.Enzyme and cell immobilization techniques in industrial processing, enzymes in organic synthesis, proteolytic enzymes, hydrolytic enzymes, glucose isomerase, enzymes in food technology/organic synthesis.
Reference books	1. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited. 2. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi. 3. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited. 4. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2ndedition, Elsevier Science Ltd. 5. Salisbury, Whitaker and Hall. Principles of fermentation Technology,
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

SC303	**Bioinformatics**
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of Computer Sciences and Biotechnology.
Learning objective	The learning objective of course are: To create an understanding regarding the Bioinformatics and online web based tools for biotechnology analysis..
Course outcome	The student will be able to conceptualize basics to advances of Bioinformatics and its role in different biomes of Biotechnology.
Unit-I	**History of Bioinformatics** **7 hours**
	History of Bioinformatics. The notion of Homology. Sequence Information Sources, EMBL, GENBANK, DDBJ, Entrez, Unigene, Understanding the structure of each source and using it on the web.
Unit-II	**Protein Information Sources** **7 hours**
	Protein Information Sources, PDB, SWISSPROT, TREMBL, Understanding the structure of each source and using it on the web. Secondary Databases Introduction of Data Generating Techniques andBioinformatics problem posed by them- Restriction Digestion, Chromatograms, Blots, PCR, Microarrays, Mass Spectrometry.
Unit-III	**Sequence analysis** **7 hours**
	Introduction to Signaling Pathways andPathway Regulation (KEGG),Sequence analysis, Detecting Open Reading Frames, Outline of sequence Assembly, Mutation/Substitution Matrices, Pairwise Alignments, Introduction to BLAST, using it on the web, Interpreting results, Multiple Sequence Alignment,
Unit-IV	**Phylogenetic Analysis** **7 hours**
	Phylogenetic Analysis. Searching Databases: SRS, Entrez, Sequence Similarity Searches-BLAST, FASTA, Data Submission. Genome Annotation: Pattern and repeat finding, Gene identification tools. Phylogenetic tree building methods, ClustalW and MEGA6
Unit-V	**Web based Tools** **8 hours**
	Production of Protein Structure & Modeling Protein Primary & Secondary Structure, Prediction Methods – Introduction tovarious methods. Tertiary structure prediction (Homology & ThreadingMethods) Profiles.
Reference books	1. Ghosh Z. and Bibekanand M. (2008) Bioinformatics: Principles and Applications. Oxford University Press. 2. Pevsner J. (2009) Bioinformatics and Functional Genomics. II Edition. Wiley-Blackwell. 3. Campbell A. M., Heyer L. J. (2006) Discovering Genomics, Proteomics and Bioinformatics. II Edition. Benjamin Cummings.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

SC305	Plant Biotechnology
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of plant science
Learning objective	The learning objective of course are: To create an understanding regarding the plant tissue culture &biotechnology
Course object	The student will be able to conceptualize basics to advance ofplant tissue culture &biotechnology
Unit-I	**Plant tissue culture** **8 hours**
	Plant tissue culture – basis, plant hormones in PTC – micropropagation - callus induction, organogenesis, embryogenesis, somatic embryogenesis, somaclonal variation, artificial seeds and embryo rescue, plant cell suspension culture. Protoplast culture.
Unit-II	**Plant tissue culture** **7 hours**
	Introduction, Cryo and organogenic differentiation, Types of culture: Seed, Embryo, Callus,Organs, Cell and Protoplast culture. Micropopagation Axillary bud proliferation, Meristem andshoot tip culture, cud culture, organogenesis, embryogenesis, advantages and disadvantages ofmicropropagation.
Unit-III	**Polyploid plant production** **7 hours**
	In vitro haploid production Androgenic methods: Anther culture, Microspore cultureandogenesisSignificance and use of haploids, Ploidy level and chromosome doubling,diplodization, Gynogenic haploids, factors effecting gynogenesis, chromosome eliminationtechniques for production of haploids in cereals.
Unit-IV	**Protoplast and somaclonal production** **7 hours**
	Protoplast Isolation and fusion Methods of protoplast isolation, Protoplast development, Somatichybridization, identifiation and selection of hybrid cells, Cybrids, Potential of somatichybridization limitations.Somaclonal variationNomenclautre, methods, applications basis and disadvantages.
Unit-V	**PGPR** **7 hours**
	Plant Growth Promoting bacteria.Nitrogen fixation, Nitrogenase, Hydrogenase, Nodulation,Biocontrol of pathogens, Growth promotion by free-living bacteria.
Reference books	1. Bhojwani, S.S. and Razdan 2004 Plant Tissue Culture and Practice. 2. Brown, T. A. Gene cloning and DNA analysis: An Introduction. Blackwell Publication. 3. Gardner, E.J. Simmonns, M.J. Snustad, D.P. 2008 8th edition Principles of Genetics. Wiley India. 4. Raven, P.H., Johnson, GB., Losos, J.B. and Singer, S.R. 2005 Biology. Tata MC Graw Hill. 5. Reinert, J. and Bajaj, Y.P.S. 1997 Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture. Narosa Publishing House. 6. Russell, P.J. 2009 Genetics – A Molecular Approach. 3rdedition. Benjamin Co. 7. Sambrook & Russel. Molecular Cloning: A laboratory manual. (3rd edition) 8. Slater, A., Scott, N.W. & Fowler, M.R. 2008 Plant Biotechnology: The Genetic Manipulation of Plants, Oxford University Press.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

SC347	Basics of Forensic Science
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of Biology
Learning objective	The learning objective of course are: To create an understanding regarding the Basics of Forensic Science
Course outcome	The student will be able to conceptualize basics to advance ofBasics of Forensic Science
Unit-I	**Basics of Forensic Science** **8 hours**
	Introduction and principles of forensic science, forensic science laboratory and its organizationand service, tools and techniques in forensic science, branches of forensic science
Unit-II	**Crime Forensic** **7 hours**
	Causes ofcrime, role of modus operandi in criminal investigation. Classification of injuries and theirmedico-legal aspects, method of assessing various types of deaths.
Unit-III	**Fire Arm Forensic** **7 hours**
	Classification of fire arms and explosives, introduction to internal, external and terminal ballistics. Chemical evidence for explosives. General and individual characteristics of handwriting, examination and comparison of handwritings and analysis of ink various samples.
Unit-IV	**Toxicology Forensic** **7 hours**
	Role of the toxicologist, significance of toxicological findings, Fundamental principles of fingerprinting, classification of fingerprints, development of finger print as science for personal identification.
Unit-V	**Genetic Engineering Forensic** **7 hours**
	Principle of DNA fingerprinting, application of DNA profiling in forensic medicine,Investigation Tools, eDiscovery, Evidence Preservation, Search and Seizure of Computers,Introduction to Cyber security.
Reference books	1. Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press,Washington. 2. B.B. Nanda and R.K. Tiwari, Forensic Science in India: A Vision for the Twenty FirstCentury, Select Publishers, New Delhi (2001). 3. M.K. Bhasin and S. Nath, Role of Forensic Science in the New Millennium, Universityof Delhi, Delhi (2002). 4. S.H. James and J.J. Nordby, Forensic Science: An Introduction to Scientific andInvestigative Techniques, 2nd Edition, CRC Press, Boca Raton (2005). 5. W.G. Eckert and R.K. Wright in Introduction to Forensic Sciences, 2nd Edition, W.G.Eckert (ED.), CRC Press, Boca Raton (1997). 6. R. Saferstein, Criminalistics, 8th Edition, Prentice Hall, New Jersey (2004). 7. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's Techniques of Crime SceneInvestigation, CRC Press, Boca Raton (2013).
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

SC302	Animal Biotechnology
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of animal sciences.
Learning objective	The learning objective of course are: To create an understanding regarding the Animal Tissue Culture and Biotechnology.
Course outcome	The student will be able to conceptualize basics to advance of Animal Tissue Culture and Biotechnology.
Unit-I	**Gene transfer methods in Animals** **7 hours**
	Gene transfer methods in Animals – Microinjection, Embryonic Stem cell, gene transfer, Retrovirus & Gene transfer.
Unit-II	**Introduction to transgenesis** **7 hours**
	Introduction to transgenesis. Transgenic Animals – Mice, Cow, Pig, Sheep, Goat, Bird, Insect. Animal diseases need help of Biotechnology – Foot-and mouth disease, Coccidiosis, Trypanosomiasis, Theileriosis.
Unit-III	**Animal propagation** **7 hours**
	Animal propagation – Artificial insemination, Animal Clones. Conservation Biology – Embryo transfer techniques. Introduction to Stem Cell Technology and its applications.
Unit-IV	**Genetic modification in Medicine** **7 hours**
	Genetic modification in Medicine - gene therapy, types of gene therapy, vectors in gene therapy, molecular engineering, human genetic engineering, problems & ethics.
Unit-V	**Introduction of cloning** **8 hours**
	Cell cloning, micromanipulation and types of cloning. Cell transformation. Application of animal cellculture, limitations of animal cell cultures.Stem cell culture, embryonic stem cells and their applications. Organ and histotypic cultures. Three dimensional culture and tissue engineering
Reference books	1. Brown, T.A. (1998). Molecular biology Labfax II: Gene analysis. II Edition. Academic Press, California,USA. 2. Butler, M. (2004). Animal cell culture and technology: The basics. II Edition. Bios scientific publishers. 3. Glick, B.R. and Pasternak, J.J. (2009). Molecular biotechnology- Principles and applications of recombinant DNA. IV Edition. ASM press, Washington, USA. 4. Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009). An introduction to genetic analysis. IX Edition. Freeman & Co., N.Y., USA. 5. Watson, J.D., Myers, R.M., Caudy, A. and Witkowski, J.K. (2007). Recombinant DNAgenes and genomes- A short course. III Edition. Freeman and Co., N.Y., USA.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

SC304	Medical Biotechnology
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of basic biology
Learning objective	The learning objective of course are: To create an understanding regarding the medical biotechnology
Course outcome	The student will be able to conceptualize basics to advance of medical biotechnology
Unit-I	**Art and Acc** **8 hours**
	Assisted reproductive technology- Pregnancy diagnosis - Animal cell culture-media, maintenance and culture of primary, secondary and continuous cell lines- organ culture- applications- cancer cell lines- apoptosis.
Unit-II	**Diagnostics methods** **7 hours**
	Prenatal diagnosis - Invasive techniques and Non-invasive techniques – Diagnosis of pathogenic microbes: Classical and modern methods- Diagnosis using protein and enzyme markers, DNA/RNA based diagnosis - Molecular markers - Microarray technology - genomic and cDNA arrays.
Unit-III	**Gene therapy Models** **7 hours**
	Gene therapy Models – Liver diseases, Lung diseases, Hematopoietic diseases, Circulated gene products, Cancer & Auto-immune diseases. Vaccines – Vaccine vectors, nucleic acid vaccines, immuno-enhancing technology.
Unit-IV	**Synthetic therapy** **7 hours**
	Synthetic therapy – synthetic DNAs, therapeutic Ribozymes, synthetic drugs. Tissue Engineering – Skin, Liver, Pancreas. Xenotransplantation – terminology, technology behind it, organ donors, social & ethical issues.
Unit-V	**Gene therapy** **7 hours**
	Gene therapy – background, types of gene therapy (ex vivo & in vivo), choosing targets for gene therapy, vectors in gene therapy, retroviruses, adenoviruses, adeno-associated viruses, types of gene delivery, Weismann barrier (soma-to-germ line barrier), epigenetic inheritance, problems & ethics. Gene Delivery methods – Viral delivery (through Retroviral vectors, through Adenoviral vectors), Non-viral delivery, Antibody engineering. Cell Adhesion-based therapy – integrins, inflammation, cancer & metastasis. Drug delivery – conventional & new approaches to drug delivery.
Reference books	1. Jogdand, S. N.. Medical Biotechnology, Himalaya Publishing house, Mumbai, 2005. 2. Click, B. R. and Pasternak.. Molecular Biotechnology: Principle and applications of recombinant DNA. ASM Press, 2010. 3. Ramasamy, P.. “Trends in Biotechnology”, University of Madras, Pearl press, 2002. 4. Trevan.. “Biotechnology”. Tata McGraw-Hill, 2005.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

SC306	Genomics and Proteomics
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of Molecular Biology.
Learning objective	The learning objective of course are: To create an understanding regarding the Genomics and Proteomics.
Course outcome	The student will be able to conceptualize basics to advance of Genomics and Proteomics.
Unit-I	**Introduction to Genomics** **8 hours**
	Introduction to Genomics, DNA sequencing methods – manual & automated: Maxam & Gilbert and Sangers method. Pyrosequencing, Genome Sequencing: Shotgun & Hierarchical (clone contig) methods, Computer tools for sequencing projects: Genome sequence assembly software.
Unit-II	**Genome Data** **7 hours**
	Managing and Distributing Genome Data: Web based servers and softwares for genome analysis: ENSEMBL, VISTA, UCSC Genome Browser, NCBI genome. Selected Model Organisms' Genomes and Databases.
Unit-III	**Introduction to protein structure** **7 hours**
	Introduction to protein structure, Chemical properties of proteins. Physical interactions that determine the property of proteins. Short-range interactions, electrostatic forces, Vander Waal interactions, hydrogen bonds, Hydrophobic interactions.
Unit-IV	**Determination of sizes** **7 hours**
	Determination of sizes (Sedimentation analysis, gel filtration, SDS-PAGE); Native PAGE, Determination of covalent structures – Edman degradation.
Unit-V	**Introduction to Proteomics** **7 hours**
	Introduction to Proteomics, Analysis of proteomes. 2D-PAGE. Sample preparation, solubilization, reduction, resolution. Reproducibility of 2D-PAGE. Mass spectrometry based methods for protein identification. De novo sequencing using mass spectrometric data.
Reference books	1. Genes IX by Benjamin Lewin, Johns and Bartlett Publisher, 2006. 2. Modern Biotechnology, 2nd Edition, S.B. Primrose, Blackwell Publishing, 1987. 3. Molecular Biotechnology: Principles and Applications of Recombinant DNA, 4th Edition, B.R. Glick, J.J. Pasternak and C.L. Patten, 2010. 5. Molecular Cloning: A Laboratory Manual (3rd Edition) Sambrook and Russell Vol. I to III, 1989. 6. Principles of Gene Manipulation 6th Edition, S.B.Primrose, R.M.Twyman and R.W. Old. Blackwell Science, 2001. 7. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc. 3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. IX Edition. Benjamin Cummings. 4. Russell, P. J. (2009). iGenetics- A Molecular Approach. III Edition. Benjamin Cummings. 5. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington. 6. Pevsner, J. (2009). Bioinformatics and Functional Genomics. II Edition. John Wiley & Sons.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by	

academic council on:	

SC326	**Nanobiotechnology**
Version	1.0
Prerequisite	Basic principles of Biotechnology and its applications
Objectives:	This course deals with applications resulting from the combination of biotechnology and nanotechnology in the fields of medicine and environment
Expected Outcome	Helps in understanding the combination of biotechnology and nanotechnology and various technologies used for Nanotechnology research.
UNIT-I	**Introduction of nanobiotechnology** **8 hours**
Introduction, history and Timeline of Nanobiotechnology, Development ofnanobiotechnology – timelinesand progress, overview.	
UNIT-II	**Synthesis and Characterization of nanomaterials** **7 hours**
Nanomaterials for Biotechnological Applications, Carbon Nanotubes, Nanowires, synthesiszing nanoparticles, Green synthesis of nanoparticles, characterization of nanoparticles.	
UNIT –III	**Nanobiotechnology detection system** **7 hours**
Varioustypes of transducing elements and their applicationsin Bio-Nanotechnology, Electrochemical transducer, optical transducer, biosensors in nanotechnology, Quantum dots, gold nanoparticle as biosensors, DNA detection, small scale system for drug delivery.	
UNIT-IV	**Nanobiotechnology in chronic and infectious disease** **7 hours**
Application of Nanobiotechnology in the treatment of Infectious Diseases, Nanotechnology Applications in Cancer Diagnosis andTherapy	
UNIT-V	**Nanobiotechnology in environment and food sciences** **7 hours**
Nanobiotechnology in environment, detection of food contaminants, food industry, Food preservation, waste water treatment.	
Text Book	*Bionanotechnology*by David S. Goodsell, 2004, Wiley Publications
Reference Books	1. Rolf E. Hummel, *Electronic Properties of materials*, Narosa Publishing House 2. Raghavan.V., *Materials Science & Engineering – A First Course*, 5th edition, Prentice Hall of India 3. Khanna. O. P., *A Text Book of Material Science & Metallurgy*, Revised edition, Dhanpat Rai Publications
Mode of Evaluation: (Percent Weight-age)	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended by BOS on :	
Adopted by Faculty on:	
Approved by Academic Council on :	

SC328	Biophysics
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of basic physics and chemistry
Learning objective	The learning objective of course are: To create an understanding regarding the governing principle of physics in routine analysis of Biotechnology.
Course outcome	The student will be able to conceptualize basics to advance of different Biotechnology principles.
Unit-I	**Spectroscopy 8 hours**
	Spectroscopy: Definition. Electromagnetic wave. Electromagnetic spectrum. Applications of each region of electromagnetic spectrum for spectroscopy. Introduction to molecular energy levels. Excitation. Absorption. Emission. Rotational spectra. Energy levels of rigid diatomicmolecules. Electron spectroscopy. UV-visible spectroscopy. Principle, construction and working of colorimeter, Spectrophotometer, Flurometer. Application to biomolecules (proteins, DNA, Hb, chlorophyll).
Unit-II	**Radioactivity 7 hours**
	Radioactivity: Nucleus. Properties. Nuclear forces. Nuclear models (liquid drop and shell model). Radioactive nucleus. Revision of nuclear radiations and their properties - alpha, beta and gamma. Half life, physical and biological handling and standardization of alpha and beta emitting isotopes. Radioimunoassay. Radiopharmaceuticals and their uptake. Production of radionuclides. Measurement of radiation - Dosimetry and detectors. Principle, construction and working of – GM counter. Scintillation Counter (Solid and liquid).
Unit-III	**Thermoregulation and microscopy 7 hours**
	Thermoregulation: Thermometric properties and types of thermometers (clinical, thermocouple, bimetallic, platinum resistance, thermistor - thermometers). Microscopes: Concepts - Resolving power. Chromatic and achromatic aberrations. Construction and working principles of the following microscopes– Stereozoom (Dissecting), Compound , bright and Dark field, Inverted, Phase contrast, Fluorescence. Electron microscopes: TEM and SEM.
Unit-IV	**Bioinstrumentation 7 hours**
	Bioinstruments: Concepts- Analytical techniques, analyte, method, procedure and protocol. Principle construction, working and applications for analysis of biomolecules of following instruments. pH meter, weighing balance, ultrasonicator, Centrifuge (RCF, sedimentation concept), different types of centrifuges. Mass spectroscopy (Bainbridge mass spectrometer). Atomic absorption spectrometer (AAS), HPLC, GC-MS
Unit-V	**Bioenergy 7 hours**
	Forms of renewable bioenergy; Biomass conversion; Biocatalysts; Biochemical engineering; Algal biofuels; Bio-electricity; Microbial fuel cell; Bioenergy system and technology; Bioreactor design and engineering; Consolidated bioprocessing; Organic waste to fuels
Reference books	1. Biophysics, an introduction. 1st edition. (2002) Cotteril R. John Willey and Sons Ltd., USA 2. Biophysics. 1st edition (2002), Pattabhi V and Gautham N. Kluwer Academic Publisher, USA. 3. Textbook of optics and atomic physics, 8th edition (1989) P.P. Khandelwal, Himlaya Publishing House, India. 4. Instrumentation measurements and analysis – 2nd edition (2003). Nakra and Choudhari, Tata Mc Graw Hill, India. 5. Nuclear Physics: An Introduction. 2nd edition (2011). S. B. Patel. Anshan Publication, India
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

SURESH GYAN VIHAR UNIVERSITY

SURESH GYAN VIHAR UNIVERSITY

Accredited by NAAC with 'A' Grade

SCHOOL OF APPLIED SCIENCES

SYLLABUS I, II, III YEAR

B. Sc. Forensic Science

SEMESTER SYSTEM

(Session 2021-24)

Program Aims and Objectives:

The B.Sc. (Forensic Science) program of Suresh Gyan Vihar University, Jaipur designed keeping in view the latest trends in the field of Forensic Science. The students are given an overview of the various subjects of the disciplines during the tenure of their program. The various papers that are put to study during the program include study of Criminalistics and Criminal Justice System, Forensic Medicine & Toxicology, Forensic Physics and Ballistics, Forensic Chemistry & Explosives, Forensic Biology & Serology, Tools & Techniques in Forensic Science etc. in details. Therefore, after completion of the program, the students will well versed with the entire area of all these disciplines and their application in the current scenario.

Undergraduate Programs:

Undergraduates in Forensics will develop a broad base of general knowledge, focused primarily in the Legal sciences in context of Forensic examination, and capped with in-depth knowledge specific to their particular major program.

Forensic Science majors will also obtain broad knowledge in General Forensic Science and Crime Scene Management, Crime and Criminal Justice System, Various disciplines of Forensic Science etc. coupled with analytical, oral and compositional skills, to promote good citizenship and the capacity for life-long learning.

Our students expected to demonstrate a breadth of knowledge across the sub-disciplines that comprise Forensic Science. The curriculum Provide a platform for students and forensic scientist to exchange views, checkouts collaborative programs and work in holistic manner for the advancement of Forensic Science.

Learning Objectives:

The Universal Declaration of Human Rights directs the member nations to create such conditions under which the ideals of free human beings, enjoying civil and political freedom from fear and want, can be achieved. The Constitution of India, through its various articles, strives to ensure security and safety of citizens in accordance with the principles of Universal Declaration of Human Rights. However, crime is a violation of these principles. In a country like India, where majority of population is uneducated, social set up is heterogeneous, public-police relations are

not very cordial, poverty is rampant and unemployment widespread, it is not surprising that crime rate is increasing exponentially.

If we have to create conditions conducive to harmonious development, we must mitigate the crime rate. This can best be achieved by relying on the support of forensic science system. Unfortunately, in our country, forensic science is not viewed as a core investigative skill in crime detection. In fact, there is a lack of understanding of the forensic process itself. It is for this reason that less than 10% of the police cases are, at present, being referred for forensic examination. Less than 5% are solved by the application of forensic science. The rest are solved by third degree method – a practice which the human rights organizations will not allow in days to come.

In majority of serious crime cases, hi-tech measures are being adopted by perpetrators of crime. The counter measures have to be more sophisticated to surpass them. This calls for strengthening the foundations of forensic science at national level. It is with this aim that we wish to initiate a B.Sc. Course in Forensic Science.

The following are the **objectives** of this course:

1. To emphasize the importance of scientific methods in crime identification and detection
2. To disseminate information on the advancements in the field of Forensic Science.
3. To highlight the importance of Forensic Science for perseverance of the society.
4. To review the steps necessary for achieving highest excellence in Forensic Science.
5. To generate talented human resources, commiserating with latest requirements of Forensic Science.
6. To use technological advancements in the investigation of crimes and its occurrences

Understanding Crime Scene and it's Investigation along with Examination:

The study of Forensic Science, aims to increase understanding of Disciples of Forensic Science, involves the application of scientific knowledge to the investigation of crimes, allow you to consider the systems in relationship to the legal enforcement agencies and Courts. The goal is that in this discipline professional apply their knowledge of science to analyze the evidences found at a crime scene. An analysis could involve anything from an object at the crime scene, to soil, bloodStains, saliva, body fluids, bones, fingerprints, DNA profiling, recovering data from computers, researching new techniques / technology etc.

SURESH GYAN VIHAR UNIVERSITY
Accredited 'A' Grade by NAAC

Teaching and Examination Scheme
To commence from the Academic year: 2021-24

Department: School of Applied Sciences **Program: B.Sc. Forensic Science**

Semester: I

S.No.	Course Code	Course Name	Type of Course Core/Elective	Credit	Contact Hrs/Wk.			Exam Hours	Weightage (in%)	
					L	T	P		CIE	ESE
1.	PC 101	**Proficiency in co-curricular activities**	**University Core**	2	0	0	0	0	100	0
2.	CP 101	**Elementary Computer**	**University Core**	3	3	0	0	3	40	60
3.	FD102	**Foundation Course-I**	**University Core**	1	1	0	0	3	25	75
4.	EN 101	**English language I**	**University Core**	2	2	0	0	3	40	60
5.	ES 101	**Environmental Studies**	**University Core**	2	2	0	0	3	40	60
6.	SC107	**Introduction to Forensic Science**	**Program Core**	3	3	0	0	3	40	60
7.	SC109	**Instrumental methods (Biology)**	**Program Core**	3	3	0	0	3	40	60
8.	SC 113	**Chemistry-I (Fundamentals of Chemistry-I)**	**Program Core**	3	3	0	0	3	40	60
9.	SC157	**Forensic Science & Collection, packaging and labeling of biological evidences Lab**	**Program Core**	2	0	0	2	3	60	40
10.	SC 167	**Chemistry-I Lab**	**Program Core**	2	0	0	2	3	60	40
11.			**Total**	23	17	0	4			

L – Lecture
T – Tutorial
P – Practical

CIE – Continuous Internal Evaluation
ESE – End Semester Examination

Signature of Concerned Teacher **Signature of Convener-BOS**

Signature of Member Secretary

SURESH GYAN VIHAR UNIVERSITY
Accredited 'A' Grade by NAAC

Teaching and Examination Scheme
To commence from the Academic year: 2021-24
Department: School of Applied Sciences Program: B.Sc. Forensic Science

Semester: II

S.No.	Course Code	Course Name	Type of Course Core/Elective	Credit	Contact Hrs/Wk.			Exam Hours	Weightage (in%)	
					L	T	P		CIE	ESE
1.	EM102	**Employability Skills**	**University Core**	1	0	0	2	3	60	40
2.	PC 102	**Proficiency in co-curricular activities**	**University Core**	2	0	0	0	0	100	
3.	HUM102	**Human Values & Ethics**	**University Core**	1	1	0	0	3	40	60
4.	FD104	**Foundation Course-II**	**University Core**	1	1	0	0	3	25	75
5.	EN 104	**English language-II**	**University Core**	2	2	0	0	3	60	40
6.	SC110	**Criminalistics, Criminal law and Criminal Justice system**	**Program Core**	4	4	0	0	3	40	60
7.	SC112	**Instrumental methods (Physical)**	**Program Core**	3	3	0	0	3	40	60
8.	SC 114	**Chemistry-II (Fundamentals of chemistry-II)**	**Program Core**	3	3	0	0	3	40	60
9.	SC158	**Crime Scene Management Lab**	**Program Core**	2	0	0	2	3	60	40
10.	SC 168	**Chemistry-II Lab**	**Program Core**	2	0	0	2	3	60	40
11.			**Total**	21	16	0	6			

L – Lecture
T – Tutorial
P – Practical

CIE – Continuous Internal Evaluation
ESE – End Semester Examination

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SURESH GYAN VIHAR UNIVERSITY
Accredited 'A' Grade by NAAC

Teaching and Examination Scheme
To commence from the Academic year: 2021-24
Department: School of Applied Sciences Program: B.Sc. Forensic Science
Semester: III

S.No.	Course Code	Course Name	Type of Course Core/Elective	Credit	Contact Hrs/Wk.			Exam Hours	Weightage (in%)	
					L	T	P		CIE	ESE
1.	EM203	**Employability Skills**	**University Core**	1	0	0	2	3	60	40
2.	PC 203	**Proficiency in co-curricular activities**	**University Core**	2	0	0	0	0	100	
3.	SC213	**Forensic Documents Examination**	**Program Core**	3	3	0	0	3	40	60
4.	SC215	**Finger prints, Impressions & Biometrics**	**Program Core**	3	3	0	0	3	40	60
5.	SC217	**Cyber Security**	**Program Core**	3	3	0	0	3	40	60
6.	SC 219	**Chemistry-III (Organic chemistry)**	**Program Core**	3	3	0	0	3	40	60
7.	SC 265	**Chemistry-III Lab**	**Program Core**	2	0	0	2	3	60	40
8.	SC261	**Cyber Security Lab**	**Program Core**	2	0	0	2	3	60	40
9.	SC263	**Forensic documents & Fingerprints Lab**	**Program Core**	2	0	0	2	3	60	40
10.			**Total**	21	12	0	8			

L – Lecture CIE – Continuous Internal Evaluation

T – Tutorial
P – Practical

ESE – End Semester Examination

Signature of Concerned Teacher

Signature of Convener-BOS

Signature of Member Secretary

Teaching and Examination Scheme
To commence from the Academic year: 2021-22
Department: School of Applied Sciences Program: B.Sc. Forensic Science
Semester: IV

S.No.	Course Code	Course Name	Type of Course Core/Elective	Credit	Contact Hrs/Wk.			Exam Hours	Weightage (in%)	
					L	T	P		CIE	ESE
1.	EM204	**Employability Skills**	**University Core**	1	0	0	2	3	60	40
2.	PC204	**Proficiency in co-curricular activities**	**University Core**	2	0	0	0	0	100	0
3.	SC222	**Forensic Biology and Serology**	**Program Core**	3	3	0	0	3	40	60
4.	SC224	**Forensic Chemistry and Toxicology**	**Program Core**	3	3	0	0	3	40	60
5.	SC 250	**Chemistry-IV (Physical chemistry)**	**Program Core**	3	3	0	0	3	40	60
6.	SC 262	**Chemistry -IV Lab**	**Program Core**	2	0	0	2	3	60	40
7.	SC258	**Forensic Chemistry& Toxicology (Lab)**	**Program Core**	2	0	0	2	3	60	40
8.	SC260	**Forensic Biology & Serology (Lab)**	**Program Core**	2	0	0	2	3	60	40
9.		**Elective I**	**Program Core**	3	0	0	0	3	40	60
10.			Total	21	9	0	8			

L – Lecture
T – Tutorial
P – Practical

CIE – Continuous Internal Evaluation
ESE – End Semester Examination

Elective-I

1. **Instrumental methods (Chemical) (SC226)**
2. **DNA Profiling (SC228)**
3. **QD & Handwriting (SC230)**
4. **Forensic Neuroscience and Behavior (SC232)**

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SURESH GYAN VIHAR UNIVERSITY
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Teaching and Examination Scheme
To commence from the Academic year: 2021-24
Department: School of Applied Sciences **Program: B.Sc. Forensic Science**

Semester: V

S. No.	Course Code	Course Name	Type of Course Core/Elective	Credit	Contact Hrs/Wk.			Exam Hours	Weightage (in%)	
					L	T	P		CIE	ESE
1.	EM 301	**Employability Skills**	**University Core**	1	0	0	2	3	60	40
2.	PC 301	**Proficiency in co-curricular activities**	**University Core**	2	0	0	0	0	100	
3.	SC329	**Forensic Physics Photography, Forensic Ballistics and Explosives**	**Program Core**	3	3	0	0	3	40	60
4.	SC331	**DNA Forensics**	**Program Core**	3	3	0	0	3	40	60
5.	SC 333	**Chemistry-V (Inorganic Chemistry)**	**Program Core**	3	3	0	0	3	40	60
6.	SC359	**Forensic Physics and Ballistics (Lab)**	**Program Core**	2	0	0	2	3	60	40
7.	SC361	**DNA Forensics (Lab)**	**Program Core**	2	0	0	2	3	60	40
8.	SC363	**Instrumental methods (Physical, Chemical & Biological Lab)**	**Program Core**	2	0	0	2	3	60	40
9.		**Elective-II**	**Program Core**	3	0	0	0	3	40	60

10.			**Total**	21	9	0	8			

L – Lecture
T – Tutorial
P – Practical

CIE – Continuous Internal Evaluation
ESE – End Semester Examination

Electives-II

1. **Narcotics Drugs & Psychotropic Substances (SC335)**
2. **Computer Forensics and Cyber security (SC337)**
3. **Fingerprint & Speaker Identification (SC339)**
4. **Emerging trends in Forensic Science (SC 341)**

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SURESH GYAN VIHAR UNIVERSITY
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Teaching and Examination Scheme
To commence from the Academic year: 2021-22
Department: School of Applied Sciences Program: B.Sc. Forensic Science

Semester: VI

S. No.	CourseCode	CourseName	Type of Course Core/Elective	Credits	ContactHrs/Wk.			ExamHrs.	Weightage(in%)	
					L	T/S	P		CE	ESE
1	**SC 376**	**Minor Project**	**Program Core**	4			3	3	60	40
2		**Elective-III**	**Program Core**	3	2	0	0	3	40	60
3.	**SC330**	**Forensic Medicine & Anthropology and Odontology**	**Program Core**	4	4	0	0	3	40	60
4.	**SC332**	**Advancement in Forensic Science**	**Program Core**	4	3	0	0	3	40	60
5.	**SC362**	**Forensic Anthropology and Odontology (Lab)**	**Program Core**	2	0	0	2	3	60	40
6	**SC364**	**Criminology, crime and society**	**Program Core**	4	4	0	0			
			Total	21	13	0	2			

Elective-III

1. **Toxicants and Forensic Toxicology (SC334)**
2. **Forensic Pharmacology and Drugs of Abuse (SC336)**
3. **Firearms, Ammunitions and their Examinations (SC338)**
4. **Forensic Psychology (SC340)**

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SC107	**Introduction to Forensic Science**
Version	1.0
Prerequisite	All students are expected to have a general knowledge of Basic Forensic Science
Learning objective	*After studying this paper the students will know –* *a. The significance of forensic science to human society.* *b. The fundamental principles and functions of forensic science.* *c. The divisions in a forensic science laboratory.* *d. The working of the forensic establishments in India and abroad.*
Salient features	The student will be able to conceptualize basics of Forensic Science
Utility	A degree in Forensic Science allows students and their ability to apply knowledge and understanding of various scientific principles to solve crime cases. Possess high awareness of major issues and development of research areas in Forensic Science.
Unit-I	**Basics of Forensic Science**
	Forensic Science: Definition, History and Development of Forensic Science in abroad as well as in India, Specific contribution of scientists in the field of Forensic Science. Need and Function of Forensic Science, Scope of Forensic Science, Basic Laws/Principles of Forensic Science, Branches of Forensic Science. Ethics in Forensic Science. Frye case and Daubert standard.
Unit-II	**Tools and Techniques in Forensic Science**
	Domains in Forensic Science, Forensic Science international perspectives, including Set up of INTERPOL and FBI. Duties of Forensic Scientist. Code of conduct for Forensic scientists. Qualifications of Forensic Scientist. Data descriptions. Report writing.
Unit-III	**Organizational set up of Forensic Science Laboratories**
	Organizational setup of Forensic Science laboratory in India & Crime Detection Agencies - Hierarchical Setup of CFSL(Central Forensic Science Laboratories), SFSL (State Forensic Science Laboratories), GEQD (Government Examiners of Questioned Documents), FPB (Fingerprint Bureaus), , NCRB (National Crime Records Bureau), CDTS (Central Detective Training Schools), BPRD (Bureau of Police Research and Development), NPA, NICFS, CID, CBI, CPO, FBI, CIA, CSI, DAB, DEA, Bureau of Alcohol, Tobacco and Firearms, IB, Mobile Forensic Science Laboratory.
Unit-IV	**Services of Crime Laboratories**
	Understanding the role and duties of criminal investigators Directorate of Forensic Science and Mobile Crime Laboratories. Police Academies. Police Dogs. Services of Crime Laboratories. Basic Services and Optimal Services.
Unit-V	**Accreditation & certification**

	Accreditation & certification, NABL, ISO, IEC, BIS, ASCLD/LAB, ABC, IAI. Laboratory management procedures: - Lab information management system, validation of equipment's and safety protocols.
Reference books	1. .Saferstein: Criminalistics – An Introduction to Forensic Science, Prentice hall Inc. USA 91995) 2. James, S.H. and Nordby, J.J.; Forensic Science; an Introduction to Scientific and Investigative Techniques, CRC Press, USA (2003) 3. O' Hara &Osterberg: An Introduction to Criminalistics. 4. Sharma J D: ApradhonkaVigyanikAnveshan. 5. Sharma B R: Forensic Science in Criminal Investigation and trials.
Mode of Examination	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended By BOS on:	
Approved by academic council on:	

SC109	**Instrumental methods (Biology)**
Version	1.0
Prerequisite	All students are expected to have a general knowledge of Biological Instruments
Learning objective	*a. The general concepts of instrumentation.* *b. The significance of microscopy in visualizing trace evidence and comparing it with control samples.* *c. The importance of Centrifuge techniques in processing crime scene evidence.* *d. The utility of Electrophoresis and Immunochemical methods in identifying chemical and biological materials.*
Salient features	The student will be able to conceptualize basics of Biological Instruments
Utility	A degree in Forensic Science allows students and their ability to apply knowledge and understanding of various scientific principles to solve crime cases. Possess high awareness of major issues and development of research areas in Forensic Science.
Unit-I	**Forensic Microscopy**
	Introduction, definition & history of microscopy, types of microscopes, working principles and components of various types of microscopes i.e. simple, compound, comparison, stereo microscope etc. Forensic application microscopy
Unit-II	**Centrifuge**
	Basic principles of separation, introduction to centrifuge, and types of centrifuge i.e. density gradient centrifugation, prerogative centrifugation, refrigerated &ultra-centrifuge. Forensic application of centrifugation.
Unit-III	**Enzyme techniques**
	Introduction & definition of enzyme, classification of enzyme, nomenclature of enzyme, models of enzyme mechanism, enzyme kinetics, purification and protein estimation, enzyme assay techniques, UV-visible spectrophotometric methods, luminescence method, radioisotope methods, immuno-chemical method.
Unit-IV	**Electrophoretic techniques**
	Introduction, basic principles, classification of electrophoresis, factors affecti electrophoresis. Brief idea of low voltage electrophoresis, high voltage electrophoresis, g electrophoresis, capillary electrophoresis, isoelectric focusing etc. Forensic application electrophoresis.
Unit-V	**Immunochemical methods**
	Introduction, Basic principles, production of antibodies, precipitation reaction, gel immunodiffusion, immune-electrophoresis.

Reference books	1. Albert S., Bray B. Lewis D, Roberts K. & Watson J.D. (1989). Molecular Biology of Cell. New York: Garland Pub. 2. Ball S., (1991). Environmental Law – The Law and Policy relating to Protection of Environment. India: Universal Law Pub Co, Delhi. 3. Biology Methods Manual (1978). London: Metropolitan Police Forensic Science Laboratory. 4. Catts E.P. & Haskell N.H. (1990). Entomology and Death: A Procedural Guide. London: Joyce's Print Shop. 5. Clifford &B.J.(1971). The Examination and Typing of Bloodstains in the Crime Laboratory. USA: US Court Printing Press. 6. Edwin & Caney H. M. (1993). Human Genetics: The Molecular Revolution. London: Jones & Bartlett Pub. 7. Gardner E.J., Simmons M. I. &SnustadD.P.(1991). Principles of Genetics. New York: John Wiley. 8. Kimball & John W. (1974). Biology. New Delhi: Arvind Publishing Co.
Mode of Examination	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded ssignment (10%) Written examination (60%)
Recommended By BOS on:	
Approved by academic council on:	

SC 113	**Fundamentals of Chemistry-I**
Prerequisite	All students are expected to have a general knowledge of organic and inorganic chemistry principles.
Learning objective	The learning objectives of course are: To create an understanding regarding the atomic structure, To gain knowledge about electron displacement effects, To have understanding about chemical reaction mechanisms.
Salient features	The student will be able to conceptualize about hybridization, Able to analyse physical effect in organic chemistry.
Utility	A degree in Biology and chemistry allows health care workers to understand the living systems of the body and to apply the knowledge in direct ways to recover and maintain the physical health of both animal and human patients.
Unit-I	**Atomic Structure** **9hr**
Atomic Structure: Recapitulation of: Bohr's theory de-Broglie's relation, Heisenberg Uncertainty principle. Need of a new approach to Atomic structure. Time independent Schrodinger equation (H Ψ = EΨ). Significance of Ψ and Ψ 2, Schrodinger equation for hydrogen atom. Transformation of Cartesian coordinates (x,y,z) into polar coordinates (r,θ,φ). Radial and angular parts of the hydrogen wave functions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals. (Only graphical representation), Radial and angular nodes and their significance. Radial distribution functions (1s and 2s atomic orbitals). Significance of quantum numbers, orbital angular momentum and quantum numbers mr and ms. Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (ms). Electronic configurations of the atoms. Concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.	
Unit- II	**Chemical Bonding and Molecular Structure** **8hr**
Chemical Bonding and Molecular Structure, Ionic Bonding: Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Born-Lande equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, bond moment, dipole moment and percentage ionic character. Covalent bonding: VB Approach: Concept of hybridization and VSEPR theory. Resonance and resonance energy: study of some inorganic and organic compounds. Molecular Orbital Approach: LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combination of atomic orbitals, non- bonding combination of orbitals, MO treatment of homo-nuclear diatomic molecules of 1st and 2nd periods (including idea of s-p mixing) and hetero-nuclear diatomic molecules such as CO, NO and HF	
Unit-III	**Fundamentals of Organic Chemistry** **6hr**

Fundamentals of Organic Chemistry: Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions free radicals. Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Huckel's rule	
Unit-IV	**Stereochemistry** **6hr**
Stereochemistry: Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; cis-trans nomenclature; CIP Rules: R/S (for upto 2 chiral carbon atoms) and E/Z Nomenclature (for upto two C=C systems). Interconversion of Wedge Formula, Newman, Sawhorse and Fischer representations. Conformations w.r.t. ethane, butane and cyclohexane.	
Unit-V	**Aliphatic Hydrocarbons: Alkane and Alkene** **7hr**
Aliphatic Hydrocarbons-Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure. Alkanes: (Upto 5 Carbons) Preparation: Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. Reactions: Free radical Substitution: Halogenation. Alkenes: (Upto 5 Carbons) Preparation: Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). Hoffmann rule, Reactions: cis-addition (alk. $KMnO_4$) and trans-addition (bromine).	
Reference books	1. J. D. Lee: A new Concise Inorganic Chemistry, E L. B. S. 2. James E. Huheey, Ellen Keiter and Richard Keiter : Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Publication. 3. I. L. Finar : Organic Chemistry (Vol. I & II), E. L. B. S. 4. R. T. Morrison & R. N. Boyd : Organic Chemistry, Prentice Hall. 5. ArunBahl and B. S. Bahl : Advanced Organic Chemistry, S. Chand 6. Peter Sykes : A Guide Book to Mechanism in Organic Chemistry, Orient Longman.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

SC110	**Criminalistics, Criminal law and Criminal Justice system**
Version	1.0
Prerequisite	All students are expected to have a general knowledge of Criminalistics and Criminal Justice System
Learning objective	*a. The elements of criminal justice system.* *b. Acts and provisions of the Constitution of India related to Forensic science.* *c. Elements of IEA, CrPC and IPC related to Forensic science.* *d. Acts governing socio-economic crimes and environmental crimes.*
Salient features	The student will be able to conceptualize basics of Criminalistics and Criminal Justice System
Utility	A degree in Forensic Science allows students and their ability to apply knowledge and understanding of various scientific principles to solve crime cases. Possess high awareness of major issues and development of research areas in Forensic Science.
Unit-I	**Crime scene management**
Meaning of crime scene management, crime scene management- information management, technology management, logistic management, man power management, crime scene search methods. Classification of scene of crime, security of scene of crime, first responding officer at the scene of crime, duties of first responding officer, coordination between police personals and forensic scientists at crime scene, safety measures at crime scene, legal considerations at crime scenes.	
Unit-II	**Processing the crime scene**
Physical evidences and their significances in Forensic Science**.** various types of physical evidences found on the crime scene, searching, collection, packaging, and handling of the physical evidences found on the crime scene. Processing the crime scene- Plan of Action, Note Taking, Crime Scene Search, Crime Scene Photography, Types of Cameras, Admissibility of Photographs, Videotape, Sketching the Crime Scene Information Included in Crime Scene Sketches, Equipment, Types of Sketches, Locating Objects in the Sketch, Computer Programs, Admissibility of Sketches, Collection of Evidence	
Unit-III	**Elementary Police Science**
Police science: definition and scope, interview of witness, interrogation of suspect, Investigation: FIR, Case diary, Cognizable and non-cognizable offences and their investigation. Constitution of India – Preamble, Fundamental Rights Article 20, 21, 22. Criminal Justice System: Structure of Police, Prosecution & Judicial Organizations. Sections of the **Indian Penal Code**: Introduction, General exceptions and Rights of Private Defense (Sec.76-106 IPC) **(i) Offences Against Person:** Sections:299,300,302,304B,306,319,320,326,339,340,351,359,362,357 & 377.	

(ii) Offences Against Property: Sections: 378,383,390,405,415,441,463,471,499,503,511. (iii) Offences against the Public Tranquility- (Sec. 141-160). Public Safety, Decency and Morals (Sec –268 to 294A) (iv) Offences relating to documents and property marks (Sec 463-489E, IPC) Criminal intimidation & others (Sec.503-511), Defamation section- 499 **Criminal Procedure Code:** Introduction and general idea of sections: 291-93, 154,155, 156, 157, 158, 159, 160, 161, 162, 172, 173, 174, 175, And 176. **Indian Evidence Act:** Introduction and general idea of sections: 32, 45, 46, 47, 57,58, 60, 73, 135, 136, 137, And 159.	
Unit-IV	**Different Acts:**
Narcotic Drugs and Psychotropic Substances Act , Drugs and Cosmetics Acts , Explosive Substances Acts , Dowry Prohibition Act, Prevention of Food Adulteration Act, Prevention of Corruption Act, Arms Act, Wild Life Protection Act, I.T. Act(Information Technology Act)-2000, Motor Vehicle Act 1988 with recent proposed Amendments. Salient features of a) Prevention of children from sexual offences Act 2012, b) Child Labour Act 1986 c) Sexual harassment of women at work place (prevention, prohibition & redressal) Act 2014 d) Domestic Violence Act 2005 e) Prevention of Immoral Trafficking of (Women & Children) Act 1986	
Unit-V	**Criminal Justice System:**
Police organization at district, state & central level. Organization of courts in India, jurisdiction of courts in criminal cases, prosecution, F.I.R., case diary, roznamacha. **Report Writing and Evidence Evaluation:** Report formats of crime scene and Laboratory findings. **Court Testimony:** Admissibility of expert testimony, pro court preparation. Arrest, Search, Seizure and Bail.	
Reference books	1. Saferstein: Criminalistics – An Introduction to Forensic Science, Prentice hall Inc. USA 91995) 2. James, S.H. and Nordby, J.J.; Forensic Science; an Introduction to Scientific and Investigative Techniques, CRC Press, USA (2003) 3. O' Hara &Osterberg: An Introduction to Criminalistics. 4. Sharma J D: ApradhonkaVigyanikAnveshan. 5. Sharma B R: Forensic Science in Criminal Investigation and trials. 6. Bare Acts (IPC,IEA,Crpc)
Mode of Examination	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended By BOS on:	
Approved by academic council on:	
SC112	**Instrumental methods (Physical)**
Version	1.0
Prerequisite	All students are expected to have a general knowledge of Physical Instruments
Learning objective	*a. The general concepts of instrumentation.* *b. The significance of spectroscopy in visualizing trace evidence and comparing it with control samples.* *c. The importance of Radiochemical techniques in processing crime scene evidence.*
Salient features	The student will be able to conceptualize basics of Physical Instruments
Utility	A degree in Forensic Science allows students and their ability to apply knowledge and understanding of various scientific principles to solve crime cases. Possess high awareness of major issues and development of research areas in Forensic Science.
Unit-I	**Basic Concept of Spectroscopy:**
General idea on spectroscopy, electromagnetic Spectrum, various source of radiation their utility and limitation. Interaction of radiation with matter i.e., reflection, absorption, fluorescence etc. Detection of radiation i.e. photographic, photoelectric etc. Forensic application of spectroscopy.	
Unit-II	**Basic Concept of Atomic and Molecular Spectra:**
Atomic spectra – Energy level, Quantum number and designation of states, selection rule. Molecular Spectra – Quantitative discussion of molecular bindings, molecular orbital, Type of molecular energies, discussion of rotational, vibrational and electronic Spectra.	
Unit-III	**Ultraviolet-visible and Infrared Spectrophotometry:**
Basic principle, Instrumentation, qualitative and quantitative analysis, interpretation of spectra etc. Forensic application of UV-Vis. and IR spectrophotometry.	
Unit-IV	**Atomic Absorption/Emission and X-Ray Spectrometry:**
Basic principle, Instrumentation, qualitative and quantitative analysis, interpretation of spectra and its Forensic application.	
Unit-V	**Radiochemical Techniques:**

Basic principles and theory, introduction about nuclear Reactions and radiations, Neutron sources, Neutron Activation Analysis (NAA), Nuclear Magnetic Resonance Spectroscopy (NMR). Application of radiochemical techniques in forensic science.	
Reference books	1. Hobart H. Willard, Lynne L. Merrett Jr, John A Dean Frank A. Settle Jr; Instrumental Methods of Analysis, 7th Edn, CBS Pub. & Distributors (1986) 2. K.C. Thompson & R.J. Renolds; Atomic Absorption Fluorescence & Flame Emission Spectroscopy, A Practical Approach, 2nd Edn. Charles Griffin & Co. (178) 3. D.R. Khanna & H.R. Gulati; Fundamentals of Optics Geometrical Physical & Quantum, 20th Edn., R. Chand & Co. (2002) 4. R.S. Khandpur; handbook of Analytical Instruments, Tata McGraw Hill Pub. Co. New Delhi (2004) 5. John A. Dean; Analytical Chemistry Handbook, McGraw Hill Inc. (1995) 6. Sharma P K: Instrumental Methods of chemical Analysis. 7. Sharma P K: Instrumental Methods of chemical Analysis. 8. Chatwal and Anand: Instrumental Methods of chemical Analysis. 9. Kriggle: Instrumental methods.
Mode of Examination	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended By BOS on:	
Approved by academic council on:	

CY 112	**Chemistry - II**
Prerequisite	All students are expected to have a general knowledge of organic, inorganic and physical chemistry.
Learning objective	The learning objective of course are: To create an understanding regarding the thermodyanamics, To gain knowledge about chemical equilibrium, To have understanding about ionic equilibrium, Able to analyse reaction mechanisms.
Salient features	The student will be able to conceptualize about nucleophilic substitution reaction, Able to analyse hydrolysis of salt.
Utility	A degree in Biology allows health care workers to understand the living systems of the body and to apply the knowledge in direct ways to recover and maintain the physical health of both animal and human patients.
Unit-I	**Chemical Thermodynamics** **8hr**
Chemical Thermodynamics: What is thermodynamics? State of a system, state variables, intensive and extensive variables, concept of heat and work, thermodynamic equilibrium, thermodynamic properties, various types of systems and processes. First Law of thermodynamics. Calculation of work (w), heat (q), changes in internal energy (ΔU) and enthalpy (ΔH) for expansion or compression of ideal gases under isothermal and adiabatic conditions for both reversible and irreversible processes. Calculation of w, q, ΔU and ΔH for processes involving changes in physical states. Important principles and definitions of thermo-chemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermo-chemical data.	
Unit- II	**Chemical Equilibrium** **6hr**
Chemical Equilibrium: Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG and ΔG^{o}, Le Chatelier's principle. Relationships between Kp, Kc and Kx for reactions involving ideal gases.	
Unit-III	**Ionic Equilibria** **7hr**

Ionic Equilibria: Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect, Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.		
Unit-IV	**Aromatic hydrocarbons and, alkyl and aryl halides**	**8hr**
Aromatic hydrocarbons: Preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid. Reactions: (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel Craft's reaction (alkylation and acylation). (Upto 4 carbons on benzene). Side chain oxidation of alkyl benzenes (Upto 4 carbons on benzene). Alkyl and Aryl Halides Alkyl Halides (Upto 5 Carbons) Types of Nucleophilic Substitution (SN^2, SN^1 and SNi) reactions. Preparation: from alkenes and alcohols. Reactions: hydrolysis, nitrite & nitro formation, nitrile & iso-nitrile formation. Williamson's ether synthesis: Elimination vs substitution.		
Unit-V	**Alcohols, Phenols and Ethers**	**7hr**
Alcohols, Phenols and Ethers (Upto 5 Carbons) Alcohols: Preparation: Preparation of 1, 2 and 3 alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters. Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. $KMnO_4$, acid. dichromate, con. HNO_3). Oppeneauer oxidation Diols: (Upto 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement. Phenols: (Phenol case) Preparation: Cumene hydroperoxide method, from diazonium salts. Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer-Tiemann Reaction, Gattermann-Koch Reaction.		
Reference books	1 Barrow, G. M. Physical Chemistry Tata McGraw-Hill (2007). 2. Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004). 3. Mahan, B. H. University Chemistry 3rd Ed. Narosa (1998). 4. I. L. Finar : Organic Chemistry (Vol. I & II), E. L. B. S. 5. R. T. Morrison & R. N. Boyd : Organic Chemistry, Prentice Hall. 6. Arun Bahl and B. S. Bahl : Advanced Organic Chemistry, S. Chand 7. Peter Sykes : A Guide Book to Mechanism in Organic Chemistry, Orient Longman.	
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT	
Recommended By BOS on:		
Approved by academic council on:		

SC 213	**Forensic Documents Exam**

	inationC(L,T,P)=3(3,0,0)
Version	1.0
Prerequisite	Allstudentsareexpectedtoha

	v e a g e n e r a l k n o w l e d g e o f F o r e n s i c D o c u m e n t s
Objectives:	*a. T o u n d e r st a n d t h e h is t o r y a*

	n d d e v el o p m e n t o f Q u e st i o n e d D o c u m e n t E x a m i n a ti o n. b. T h e i m p o rt a n c e o f e x a m i n

	ingquestionedd documentsincrimecasess.b.Thetoolsrequiredforexaminationofq

	uestionedd ocuments .c. Theimportanceofdetectingfrauds andforgeriesbyanalyzi

	ngquestionneddocuments.
Salient features	Thestudentwillbeabletoconceptualizebasicso

	f Forensic Documents
Utility	A degree in Forensic Science allows students and the e

	irabilityto applyknowledgeandunderstandingofvariousscientific prin

	ciplestosolvecrimecases.Possesshighawarenessofmajorissuesan

	ddevelopmentofresearcharenasinForensicScience.
Unit-I	**Introductiont**

	oquestionneddocument
Introduction to questioned document- Terminology of documents- History of forensic document examination. Classification of documents-procurement of standard admitted/specimen writings-handling and marking of documents-preliminary examination of documents – Types of crimes related to documents – criminal investigation.	
Unit-II	**Handwritinganaly**

	sis
Handwriting analysis –Definition of Graphology- Basics of Handwriting Identification - Individuality of handwriting - General characteristics of handwriting- Analysis of hand writing- Tools for Forensic document examination- Simulation and Comparison of Handwriting- Collection of proper standards.	
Unit-III	**Identification of writer**
Disguised writing and anonymous letters-Identification of writer-Examination of signatures. Characteristics of forged and genuine signatures. Examination of alterations, erasures, over writings, additions and obliterations.	

Decipherment of secret writings indented and charred documents. Examination of seal impressions and mechanical impressions.	
Unit-IV	**Forgeries and their detection.**
Forgeries and their detection. Definition of Forgery, Types of forgeries. Examination of built up documents. Determination of sequence of strokes, physical matching of documents. Examination of black and white, colour Xerox copies, carbon copies and fax messages- Identification of type writer	

writings-identification of type writer, identification of printed matter, various types of printing of security documents, printing of currency notes. Examination of counterfeit currency notes, passports, visa, stamp papers, postal stamps etc.	
Unit-V	**Determination of age of documents**
Determination of age of documents by examination of signatures, paper, ink writing/signatures etc. Examination of computer printouts- dot matrix, ink jet and laser printers, electronic type	

writers, credit cards, E-documents, digital signatures. Opinion writing, Reasons for opinion and court testimony. Instrumentation and Principles of Video Spectral Comparator, Stereoscopic microscopes, TLC, HPLC, Spectroflourimetry and X-Ray flourimetry..	
Reference Books	1. B. B. Nanda and R. K. Tiwari, Forensic Science in

	India: A Vision for the Twenty First Century, Select Publishers, New Delh

	i (2001). 2. M. K. Bhasin and S. Nath, Role of Forensic Science in the New Mil

lennium, University of Delhi, Delhi (2002). 3. S. H. James and J. J. Nordby

	, Forensic Science: An Introduction to Scientific and Investigative Tec

	hniques, 2nd Edition, CRC Press, Boca Raton (2005). 4. W. G. Eckert and R. K

	. Wright in Introduction to Forensic Sciences, 2nd Edition, W. G. Eckert (

ED.), CRC Press, Boca Raton (1997). 5. R. Saferstein, Criminalistics, 8t

	hEdition, Prentice Hall, New Jersey (2004). 6. W. J. Tilstone, M. L. Hastr

	up and C. Hald, Fisher's Techniques of Crime Scene Investigation, CRC Pre

	s s , B o c a R a t o n (2 0 1 3) .
Mode of Evaluation	M i d - T e r m I (1 0 %) ; M i d - T e r m I I (1 0 %) ; W e e k l y t e

	st(10%);Gradedassignment(10%)Writtenexamination(60%)
Recommended by BOS on:	

Approved by Academic Council on :	

SC215	**Finger prints, Impressions & Biometrics C (L, T, P) = 3 (3, 0, 0)**
Version	**1.0**
Prerequisite	All students are expected to have a general knowledge of Finger prints, Impressions & Biometrics
Objectives:	*a) The fundamental principles on which the science of fingerprinting is based.* *b) The method of classifying criminal record by fingerprints.* *c) The physical and chemical techniques of developing fingerprints on crime scene evidence.* *d) The significance of foot, palm,tyreprint and lip print and Biometrics.*
Salient features	The student will be able to conceptualize basics of Finger prints, Impressions & Biometrics
Utility	A degree in Forensic Science allows students and their ability to apply knowledge and understanding of various scientific principles to solve crime cases. Possess high awareness of major issues and development of research areas in Forensic Science.
Unit-I	**Fingerprints**
Introduction of Fingerprints- Dactylography-– History and Importance of Fingerprints- Fundamentals of Fingerprints Patterns- Systematic method of classification – Types of Fingerprints- Visible, plastic, & Latent- Development of Latent Fingerprints Physical, Chemical methods & Modern methods- Recording & lifting of Fingerprints -Collection of Fingerprints at Scene of crime.	
Unit-II	**Poroscopy**
Skin outer surface impressions – Types of skin impressions– Evidence collection on victim and suspects – Preservation and lifting techniques - Identification and comparison of Fingerprints - Palm prints – AFIS - Digital imaging of FP- Fingerprint collection of cadavers	
Unit-III	**Foot prints**
Introduction of Foot prints– types of Foot prints – Surface & Sunken Footprint Recording & Casting of Foot prints– Comparison of Footprints- Examination of footprints- Footwear Impressions- Introduction, Recording of footwear impressions- Enhancement methods – Walking picture/ Gait pattern analysis- Gait pattern scan and its principles- Determination of personality by gait analysis.	
Unit-IV	**Tire impressions**
Introduction– Tire impression examination – Photography of tire impressions – Evidences Collection process. Skid marks- Calculation of vehicle speed at accident.	
Unit-V	**Biometrics**
Introduction- History – Definition – Types of Biometrics – Features and functions of biometrics — Iris detection & its principles– Lip prints- Ear prints- Bite marks- Judicial acceptance	
Reference Books	1. B.B. Nanda and R.K. Tiwari, Forensic Science in India: A Vision for the Twenty First Century, Select Publishers, New Delhi (2001). 2. M.K. Bhasin and S. Nath, Role of Forensic Science in the New Millennium, University of Delhi, Delhi (2002). 3. S.H. James and J.J. Nordby, Forensic Science: An Introduction to Scientific and Investigative Techniques, 2nd Edition, CRC Press, Boca Raton (2005). 4. W.G. Eckert and R.K. Wright in Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert (ED.), CRC Press, Boca Raton (1997). 5. R. Saferstein, Criminalistics, 8th Edition, Prentice Hall, New Jersey (2004). 6. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's Techniques of Crime Scene Investigation, CRC Press, Boca Raton (2013).
Mode of Evaluation	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)

Recommended by BOS on:	
Approved by Academic Council on :	

SC217	**Cyber Security**
Version	1.0
Prerequisite	All students are expected to have a general knowledge of Cybercrime in Forensics.
Learning objective	*The learning objective of course are:* *a. To create an understanding regarding the cybercrime and related investigations* *b. To gain knowledge about computer forensics investigation and its components.* *c. The cases which fall under the purview of digital crimes.* d. *The types of digital crime, the elements involved in investigation of digital crimes.*
Salient features	The student will be able to conceptualize basics of Cybercrime in Forensics.
Utility	A degree in Forensic Science allows students and their ability to apply knowledge and understanding of various scientific principles to solve crime cases. Possess high awareness of major issues and development of research areas in Forensic Science.
Unit-I	**Basics of Computer and internet**
Introduction, History and development of computers, hardware, software and other accessories, operating system, use of computer in criminal activities, world wide web, search engine, email, chat, methods of storing data.	
Unit-II	**Computer/ Cyber Crime & Cyber security**
Definition and types of computer crimes. Distinction between computer crimes and conventional crimes. Reasons for commission of computer crimes. Breaching security and operation of digital systems. Computer virus, and computer worm – Trojan horse, trap door, super zapping, logic bombs. Types of computer crimes – computer stalking, pornography, hacking, crimes related to intellectual property rights, computer terrorism, hate speech, private and national security in cyber space. An overview of hacking, spamming, phishing and stalking. Need of Cyber Security- Introduction to Cyber -The Cybersecurity World, Cybersecurity Criminals, Who Are the Cyber Criminals? Cyber Criminal Motives, Cybersecurity Specialists, Why Become a Cybersecurity Specialist?	
Unit-III	**Cyber Crime investigation**
Computer forensic experts and their role in cyber-crime investigation, challenges and limitations. Seizure of suspected computer. Preparation required prior to seizure. Protocol to be taken at the scene. Extraction of information from the hard disk. Treatment of exhibits. Creating bit stream of the original media. Collection and seizure of magnetic media. Legal and privacy issues. Examining forensically sterile media. Restoration of deleted files. Password cracking and E-mail tracking. Encryption and decryption methods. Tracking users.	
Unit-IV	**Computer networking and Incident response**
Introduction to network, LAN, WAN and MAN. Concept of network security and cybercrime investigation. Basic of security planning: Multi layered security, intrusion triangle, removing intrusion opportunities, importance of physical security, protecting server, work station and network devices, protection of removable storage disks. Introduction to Cyber forensics, Cyber forensic steps (Identification, Seizure, Acquisition, Authentication, and Presentation). Incident response process, Computer security incident, Goals of incident response, Involvement in incident response process, Incident response methodology, Formulate a response strategy, Investigation of incident, Preparing for incident response, Overview of pre-incident preparation, Identifying risk after detection of an incident.	
Unit-V	**Forensic Analysis, Recovery and Concealment Techniques**
Introduction to open source analysis tools like Slueth kit Autopsy, OS Forensic, SoloImage Master, Disk Locker, FRAT (Forensic Registry Analysis Tool). Working with commercial tools like Encase and Forensic Tool Kit (FTK). Data Recovery: Disk Geometry, Data Recovery Procedures, Recovery of Swap Files/Temporary Files/Cache Files, Recovery-Formatted Partition Recovery, Data Recovery Tools- open source and Commercial. Introduction to cryptography, Types of cryptographic algorithms(Secret key cryptography, Public key cryptography, Hash function),Electronic signature, Steganography, Reversing the steganographic process, Cloaking techniques(Data hide and seek), Renaming files, Manipulating file system, Data hiding on NTFS with alternate data stream. **Concept of Network Security and Cyber**-Crime Investigation, Relevant Section of Information Technology (IT) Act 2000.	
Reference books	1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc. 2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition.Lippincott Williams and Wilkins, Philadelphia. 3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.

	4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.
Mode of Examination	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended By BOS on:	
Approved by academic council on:	

SC222	**Forensic Biology and Serology**
Version	**1.0**
Prerequisite	All students are expected to have a general knowledge of Forensic Biological and Serology
Learning objective	*a. The significance of biological and serological evidence.* *b. The Forensic importance of hair evidence.* *c. Collection and Packaging of biological evidences.* *d. The importance of biological fluids – blood, saliva, semen – in crime investigations.* *e. How Forensic entomology assists in death investigations.* *f. How wildlife Forensics aid in conserving natural resources.*
Salient features	The student will be able to conceptualize basics of Forensic Biological and Serology
Utility	A degree in Forensic Science allows students and their ability to apply knowledge and understanding of various scientific principles to solve crime cases. Possess high awareness of major issues and development of research areas in Forensic Science.
Unit-I	**Forensic Biology and Forensic Botany**
Nature and importance of biological evidence. Collection and preservation of common biological evidences. Hair: Structure, development, anatomy, pigmentation, identification characters, Forensic examination of Hair. Fibers: Definition, classification, characters, difference between plant and animal fiber and forensic aspects of fiber examination – density, microscopy, hot stage microscopy, fluorescent, refractive index, birefringence, dye analysis and spectroscopic techniques. Pollens: Structure, anatomy, identification characters, Forensic examination of pollen grains, Importance of pollen grains, Wood and Diatoms: Structure, anatomy, identification characters, Forensic examination of diatoms and wood, Importance of wood and pollens in Forensic science.	
Unit-II	**Biological fluids and their examination**
Blood: Composition, histology, different blood grouping methods, examination of blood and its stains. Semen: Composition, structure of spermatozoa, methods of detection and identification of seminal stains Composition of saliva, urine and other biological fluids and their examination. Determination of origin of species, antigens and antibodies, antigen-antibody reaction, biochemical markers of individuality, basic concept of DNA profiling	
Unit-III	**Blood spatter Analysis**
Bloodstain characteristics. Impact bloodstain patterns. Cast-off bloodstain patterns. Projected bloodstain patterns. Contact bloodstain patterns. Blood trails. Bloodstain drying times. Documentation of bloodstain pattern evidence. Crime scene reconstruction with the aid of bloodstain pattern analysis	
Unit-IV	**Forensic Entomology:**
Definition Basics of Forensic entomology, forensically important species of insect, significance of entomology in forensic science. Collection of entomological evidence during death investigations.	
Unit-V	**Wildlife Forensics**
Significance of Wildlife Forensics. Organizations involved. IUCN Red List- Conservation Status- Extinct, Extinct in Wild, Critically Endangered, Endangered, Vulnerable, Near Threatened, Least Concern. List of protected species in India. Illegal trading of wildlife items. Identification of Physical evidences pertaining to wildlife crime	
Reference books	1. J. M. Butler, Advanced Topics in Forensic DNA Typing, Academic Press, (2014). 2. Alan Gunn, Essential Forensic Biology, 2nd Edition, Wiley (2009) 3. L. Stryer, Biochemistry, 3rd Edition, W.H. Freeman and Company, New York (1988). 4. R.K. Murray, D.K. Granner, P.A. Mayes and V.W. Rodwell, Harper's Biochemistry, APPLETON & Lange, Norwalk (1993). 5. S. Chowdhuri, Forensic Biology, BPRD, New Delhi (1971). 6. R. Saferstein, Forensic Science Handbook, Vol. III, Prentice Hall, New Jersey (1993). 7. G.T. Duncan and M.I. Tracey, Serology and DNA typing in, Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert (Ed.), CRC Press, Boca Raton (1997).

	8. W.G. Eckert and S.H. James, Interpretation of Bloodstain Evidence at Crime Scenes, CRC Press, Boca Raton (1989). 9. G.T. Duncan and M.I. Tracey in Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert (Ed.), CRC Press, Boca Raton (1997).
Mode of Examination	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended By BOS on:	
Approved by academic council on:	

SC224	**Forensic Chemistry and Toxicology**
Version	**1.0**
Prerequisite	All students are expected to have a general knowledge of Forensic Chemistry & Toxicology
Learning objective	After studying this paper the students will know The methods of analyzing trace amounts of petroleum products in crime scene evidence, contaminants in petroleum products, Beverage; The method of searching, collecting, preserving and analyzing arson evidence; The steps involved in processing the death scene; The importance of ascertaining whether the crime was staged to appear as suicide or accident. The stages of decomposition, the importance of autopsy. The significance of toxicological studies in Forensic science. The classification of poisons and their modes of actions, the absorption of poisons in body fluids.
Salient features	The student will be able to conceptualize basics of Forensic Chemistry & Toxicology
Utility	A degree in Forensic Science allows students and their ability to apply knowledge and understanding of various scientific principles to solve crime cases. Possess high awareness of major issues and development of research areas in Forensic Science.
Unit-I	**Forensic Chemistry and its Scope**
Analysis of beverages: Alcohol and Non- alcoholic, country made liquor, illicit liquor, Drugs of abuse: Introduction, Classification, Narcotic drugs & psychotropic Substances, drugs of abuse in sports.	
Unit-II	**Petroleum Products, Trap cases, Cement**
Examination of Petroleum Products: Distillation & Fractionation, various fraction and their commercial uses. Standard methods of analysis of petroleum products for adulteration, Trap cases: purpose, examination of chemicals used in trap case, Cement: Composition, types and Forensic analysis, Mortar & Concrete	
Unit-III	**Fires and Arson**
Fire: Nature and Chemistry of fire, Classification, Igniters of fires, Phases of fires, Main types of fires, Examination of scene of fires; Arson: Relevant IPC sections, Motives, Analysis of Accelerants, Brief Introduction to Drugs and cosmetic act, Excise Act, NDPS Act, Analysis of Gold and Other metals in cheating cases	
Unit-IV	**Forensic Toxicology**
Introduction, concept and Significance, Poisons: Definition, Classification of poisons, Types of poisoning sign and symptoms of poisoning, mode of action, factors modifying the action of poisons, Toxicological exhibits in fatal and survival cases, their preservation Treatment in cases of poisoning, Analysis report. Extraction, Isolation and Clean-up procedures: Non-volatile organic poison, Stas-otto, DovbrieyNickolls (Ammonium sulphate) method, acid digest and Valov (Tungstate) methods, Solid phase micro extraction techniques, Solvent extraction methods. Volatile Poisons: Industrial solvent acid and basic Distillation, Toxic Cations: Dry Ashing and Wet digestion process, Toxic Anions: Dialysis method total alcoholic extract	
Unit-V	**General Study and Analysis**
Barbiturates, methaqualone, Hydromorphine, Methadone, Meprobamate, Mescaline, Amphetamines, LDS, Heroin, Cannabinoids, Phinothiazines; Insecticides: Types, General methods for their analysis; Alkaloids: Definition, classification, Isolation and General characterization; Forensic Examination of Metallic Poisons: Arsenic, Mercury, Lead, Bismuth, Copper, Aluminium, Iron, Barium, Zinc; Analysis of Ethyl Alcohol in blood and urine, illicit liquor, Methanol, Acetone, Chloroform, Phenol; Snake venoms and Poisons, Irrespirable gases	
Reference books	1. Maudham Bassett etal; Vogel's Textbook of Quantitative Chemical Analysis, 6th Ed., Longman Essex (2004) 2. L. Finar; Organic Chemistry Vol. II Pearson Education (Singapore) 3. R.T. Morrison, R.N. Boyd; Organic Chemistry, 6th Ed., Prentice Hall, new Delhi (2003) 5. Brean S. Furniss etal; A.I Vogel Textbook of Practical Organic Chemistry, Addison Wesley Longman, Edinburg (1998)

	6. A. Burger; Medicinal Chemistry, Vol. II, Wiley Interscience, NY (1970) 7. D A Skoog, D.M. West, F.J. Holler; Analytical Chemistry – An Introduction, 7thEd., Saunders College Pub. Philadelphia, USA (2000) 8. Modi, Jaisingh P (2001); Textbook of Medical jurisprudence & Toxicology, M.M. Tripathi, Pub. 9. Dr. Reddy K.S. and Dr.Murty O.P. (2017) The essentials of Forensic Medicine and Toxicology, Jaypee-The Science Health Publishers.
Mode of Examination	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended By BOS on:	
Approved by academic council on:	

SC329	**Forensic Physics Photography, Forensic Ballistics and Explosives**
Version	**1.0**
Prerequisite	All students are expected to have a general knowledge of Forensic Physics and Ballistics
Learning objective	The classification of firearms and their firing mechanisms, The methods of identifying firearms, The characteristics of ammunition., The importance of firearm evidence, The nature of firearm injuries, The methods for characterization of gunshot residue. Analysis of other physical evidences
Salient features	The student will be able to conceptualize basics of Forensic Physics and Ballistics
Utility	A degree in Forensic Science allows students and their ability to apply knowledge and understanding of various scientific principles to solve crime cases. Possess high awareness of major issues and development of research areas in Forensic Science.
Unit-I	**Forensic Physics & Forensic Photography**
Density, Refractive Index, Birefringence and Other Optical Properties of Crystalline Material. Examination of Fiber, Soil, Dust, Paints, Glass and Glass Fracture, Tool Marks and Explosives. Restoration of Erased / Obliterated Marks, Examination of Wire/ Cables, Counterfeit Coins, Physical Matching of Severed / Broken Objects. Definition and basic principles, Camera and its Essential parts, Types of camera, Features of camera ,Working of SLR & DSLR Cameras, Optics and Lenses, Zoom and various types of Photography, Effect of aperture, Shutter speed and ISO on photograph, Manual mode & Auto mode. Introduction, Types of Forensic photography, Scope and significances of photography in various disciplines of forensic science- finger prints, foot prints, physics, chemistry, biology, ballistics, computer forensics etc. Crime scene photography.	
Unit-II	**Speaker Identification and Tape Authentication:**
Voice Production Theory-Vocal Anatomy, Speech Signal Processing & Pattern Recognition- Basic Factors of Sound in Speech, Acoustic Characteristics of Speech Signal, Fourier Analysis, Frequency & Time Domain Representation of Speech Signal, Analogue to Digital Signal and Conversion, Fast Fourier Transform, Quantization, Digitization and Speech Enhancement, Analysis of Audio-Video Signal for Authenticity	
Unit-III	**General Idea about Firearms**
History and Background of Firearms, Their Classification and Characteristics, Various Components of Firearms, Different Systems and Their Functions, Rifling - Purpose of Rifling, Types of Rifling, Trigger and Firing Mechanism, Cartridge-Firing Mechanism, Projectile Velocity Determination Identification of Origin, Improvised/Country-Made/Imitative Firearms and their Constructional Features	
Unit-IV	**Ammunition, Internal & External Ballistics**
Types of Ammunition, Classification and Constructional Features of Different Types of Cartridges, Types of Primers and Priming Composition, Propellants and their Compositions, Various Types of Bullets and Compositional Aspects, Smooth Bore Firearm Projectile, Identification of Origin, Improvised Ammunition and Safety Aspects for Handling Firearms. Definition, Ignition of Propellants, Shape and Size of Propellants, Manner of Burning, Various Factors Affecting the Internal Ballistics, Principal Problems of Exterior Ballistics, Vacuum Trajectory, Effect of Air Resistance on Trajectory, Base Drag, Yaw, Shape of Projectile and Stability, Ballistics Coefficient and Limiting Velocity, Measurements of Trajectory Parameters.	
Unit-V	**Explosives**
Classification, Comparison & characterization of explosives, Military & Commercial explosives, Detection of Explosophores (anions), Detection of Blackpowder, Nitrocellulose and Dynamite, Quantitative determination	
Reference books	1. Bengold&Moryson N. (1999). Speech and Audio Signal Processing. USA, John Wiley & Sons. 2. Heard B.J. (1997). Hand book of Firearms and Ballistics. London, John Willey. 3. Johari M. (1980) Identification of Firearms, Ammunition and Firearms Injuries. India, BPR&D. 4. Rose P. (2001). Forensic Speaker Identification; Forensic Science Series. London, Taylor and Francis. 5. Saferstein R. (1988). Forensic Science Handbook. NJ: Prentice Hall, Eglewood Cliffs. 6. John Freeman (2010), “Photography The New Complete Guide to Taking photographs”, Collins and Brown publisher, London.

	7. Helmut Gernsheim (1986), "A concise history of photography", Dove publications, New York, 3rd Edition. 8. Michael Langford (2015), "Basic Photography", Focal Press, Routledge publisher, 10th Edition. 9. Sharma B.R. (2003). Forensic Science in Criminal Investigation and Trials. India, Universal Law House. 10. Warlow T.A. (1996). Firearms-The Law and Forensic Ballistics. London, Taylor and Francis. 11. Working Procedures Manual: Ballistics. (2000) India, BPR & D Pub.
Mode of Examination	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended By BOS on:	
Approved by academic council on:	
SC331	**DNA Forensics**
Version	**1.0**
Prerequisite	All students are expected to have a general knowledge of DNA Forensics
Learning objective	*a. The basic principle of DNA analysis.* *b. The Forensic significance of DNA typing.* *c. The importance of Short Tandem Repeats and Restriction Fragment Length Polymorphism in DNA technique.* *d. Role of DNA typing in disputed paternity and maternity testing, child swapping, kidnapping, murder, rape cases and immigration cases.*
Salient features	The student will be able to conceptualize basics of DNA Forensics
Utility	A degree in Forensic Science allows students and their ability to apply knowledge and understanding of various scientific principles to solve crime cases. Possess high awareness of major issues and development of research areas in Forensic Science.
Unit-I	**Introduction to Inheritance and DNA**
	Principle of inheritance and diversity, Organization of genome in prokaryotes and eukaryotes, Chemical structure of DNA and RNA, Overview of Central Dogma
Unit-II	**Basic Principles DNA as biological blueprint of life.**
	Overview of Physical basis of hereditary, Alleles, Population genetics, human genetic variations, human chromosomes, Normal chromosome set, Chromosomal anomalies, Genetic markers and their Forensic Significance. (A, B, Z forms of DNA), Structure of chromatin, centromere, telomere, nucleosome, genome organization. Mutations: Definitions, Types, and causes and related disorders
Unit-III	**DNA extraction and Quantification methods**
	DNA extraction and Quantification methods: Organic (Phenol-chloroform) extraction, Chelex extraction, FTA paper, Solid phase DNA extraction methods: Qiagen extraction Chemistry and kits, DNA IQ (Identification & quantification), Prep Filer, Differential extraction. Introduction to electrophoresis techniques. DNA Amplification: Polymerase Chain Reaction (PCR)-Types, Instrumentation, working. DNA Quantification and DNA Sequencing: Overview.
Unit-IV	**DNA Typing**
	DNA Typing- History, Definition Development and Forensic Significance. STR- Discovery, Structure, Development, STR markers, STR Polymorphisms and related terminologies: Stutter peaks, split peaks, pull up, template DNA, overloaded profiles, low template DNA typing, peak balance, mixtures, degraded DNA, PCR inhibition. RFLP, Blotting techniques.
Unit-V	**Non-human DNA testing & Wildlife Conservation Techniques**
	Non-human DNA testing: Sources, domestic animal DNA Testing (cat DNA, dog DNA). Species identification: Wildlife DNA testing using genetic markers (mtDNA Cytochrome b gene, mtDNA 12S rRNA gene, mtDNA COI gene), geographic origin identification. Wildlife Conservation Techniques: Biosensors, use of remote sensing techniques for population study of endangered plants and animal species. DNA banks for endangered animals and DNA database (Types and limitations).
Reference books	1. Goodwin W, Wiley J & Sons Ltd. (2007), An Introduction to Forensic Genetics. 2. Richard Li, Forensic Biology. 3. Waldman A.S., Genetic Recombination. 4. Gunn A, Essential Forensic Biology.

	5. Giblett, Eloise R (1969), Genetic Markers in Human Blood, Blackwell Scientific Publications. 6. Boorman, DoddB, Lincoln PB, Blood grouping techniques.
Mode of Examination	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended By BOS on:	
Approved by academic council on:	

SC330	**Forensic Medicine & Anthropology and Odontology**
Version	**1.0**
Prerequisite	All students are expected to have a general knowledge of Forensic Medicine, Anthropology and odontology
Learning objective	After studying this paper the students will know – The importance of Forensic Medicine, The Human Anatomy and Physiology: Organizational Levels of human body, The Taphonomy: Introduction-Definition, types, modes and stages of death, The Definition, Nature and extent of wounds, Classification. Introduction to Forensic Anthropology, Determination of race, age, sex, stature, Introduction to anthropometric techniques, The Forensic Odontology: Introduction Structure and types of teeth, Teeth-marks and bite marks.
Salient features	The student will be able to conceptualize basics of Forensic Medicine, Anthropology and odontology
Utility	A degree in Forensic Science allows students and their ability to apply knowledge and understanding of various scientific principles to solve crime cases. Possess high awareness of major issues and development of research areas in Forensic Science.
Unit-I	**Basics of Forensic Medicine**
Introduction, definition and scope of forensic medicine, medico legal experts and their role in criminal investigation, Subpoena & oath of medical expert, types of medical evidence, kinds of witness and rules for giving evidence.	
Unit-II	**Personal Identification**
Introduction, definition and importance of personal identification, parameters contributing to personal identification, Race, Sex, Age, Complexion, Features & Photographs, Fingerprints, Footprints, tattoo marks, lip prints, ear prints, scars, occupational Marks, handwriting, personal belongings, Voice & Speech, DNA, superimposition techniques for skull, disputed paternity	
Unit-III	**Injury, Death and Post Mortem Examination**
Introduction and definition of injury, classification of injuries and their characteristics, difference between anti mortem and post mortem injuries, medico legal importance of injuries. Introduction, definition of Thanatology, modes of death (coma, syncope, asphyxia) and their characteristics, sign of death, time since death, post mortem changes, cause of death, suspended animation and medico legalimportance of death Post mortem examination, definition, classification, concepts and objectives, Precaution to be taken during Post Mortem Examination, exhumation and medicolegal importance of post mortem examination	
Unit-IV	**Forensic Anthropology**
Introduction and definition of forensic anthropology, historical background, nature and scope of forensic anthropology, somatometry, osteometery and craniometery their forensic importance recovery and identification of skeletal remains in accident cases and mass disasters, portrait parle, forensic odontology and bite marks examination, facial reconstruction, skull superimposition	
Unit-V	**Forensic Odontology**
Dentition pattern, types and structure of teeth, age determination- identity of person, role in mass disaster, disease of teeth and their significance in personal identification. Identification of burnt bones, recovery and identification of skeletal remains in accident cases and mass disasters. Facial reconstruction.	

Reference books	1. Aggrawal A. (2016). Textbook of Forensic Medicine and Toxicology. India: AvichalPublishing Company. 2. Parikh C.K. (1972). Forensic Medicine and Toxicology. India: Medical Publications. 3. Modi J.S. (2011). Medical Jurisprudence and Toxicology.India: Law Publishers. 4. Seth S. (2018). Review of Forensic Medicine. 6th edit. India: PeePee Publishers 5. Jason P. J. & Simpson K. (2014).Simpson's Forensic Medicine, NY: CRC Press. 6. Simpsen K. & Knight B. (1996). Forensic Medicine 11th edit. USA: Taylor & Francis. 7. Thompson T., Black S. (2006).Forensic Human Identification: An Introduction. NY: CRC Press. 8. Vij K. (2014). Textbook of Forensic Medicine & Toxicology: Principles & Practice. India: Elsevier Health Sciences. 9. Adams B. J. (2007). Forensic Anthropology. NY: Chelsea House Publishing. 10. Houck M. M. (2017). Forensic Anthropology. Academic press
Mode of Examination	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended By BOS on:	
Approved by academic council on:	

SC332	**Advancement in Forensic Science**
Version	**1.0**
Prerequisite	All students are expected to have a general knowledge of emerging trends in Forensic Science
Learning objective	To understand the Importance of Forensic Engineering, the importance of Forensic Archaeology, importance of Forensic Intelligence and Detection of Deception
Salient features	The student will be able to conceptualize basics of emerging trends in Forensic Science
Utility	A degree in Forensic Science allows students and their ability to apply knowledge and understanding of various scientific principles to solve crime cases. Possess high awareness of major issues and development of research areas in Forensic Science.
Unit-I	**Forensic Engineering**
Role of mechanical, electronics and computer engineers in Forensic Science. Accident investigations. Failure of signalling and control systems. Ergonomics. Applications of animations, simulations and digital imaging in solving crime cases. Episodes involving fire engineering	
Unit-II	**Forensic Archaeology**
Role of forensic archaeology. Searching the archaeological site. Methods of digging the burial site. Recovery of remains. Documenting the recovered material. Preservation of remains.	
Unit-III	**Forensic Intelligence**
Role of Forensic Intelligence in crime analysis. Methods of crime analysis. Databases in Forensic Intelligence. Management of serial crimes by application of Forensic intelligence	
Unit-IV	**Forensic Nursing and Forensic Pathology**
Forensic nursing development, definition, Role and responsibilities of Forensic Nurses, present and future trends, Forensic case management with the help of Forensic nursing. Forensic Pathology - Definition, Goals and unique aspects in Forensic pathology, objectives, Roles and responsibilities of Forensic pathologists, Significances of Forensic pathology.	
Unit-V	**Detection of Deception**
Tools for detection of deception – interviews, non-verbal detection, statement analysis, voice stress analyzer, hypnosis. Polygraphy – operational and question formulation techniques, ethical and legal aspects, the guilty knowledge test. BEOSP- brain electrical oscillation signatures Narco analysis and brain electrical oscillation signatures – principle and theory, ethical and legal issues.	
Reference books	1. A.A. Moenssens, J. Starrs, C.E. Henderson and F.E. Inbau, *Scientific Evidence in Civil and Criminal Cases*, 4th Edition, The Foundation Press, Inc., New York (1995). 2. R. Saferstein, *Criminalistics*, 8th Edition, Prentice Hall, New Jersey (2004). 3. J.C. DeLadurantey and D.R. Sullivan, *Criminal Investigation Standards*, Harper & Row, New York (1980). 4. J. Niehaus, *Investigative Forensic Hypnosis*, CRC Press, Boca Raton (1999).

	5. E. Elaad in *Encyclopedia of Forensic Science, Volume 2*, J.A. Siegel, P.J. Saukko and G.C. Knupfer (Eds.), Academic Press, London (2000). 6. Killam E.W (1990), The Detection of Human Remains, C.C. Thomas, Springfield. 7. RibauxO.and Margot P. (2000), Encyclopedia of Forensic Sciences, Volume 1. 8. Siegel J., ASaukko, P.J. and Knupfer G.C. (Ed.), Academic Press, London.
Mode of Examination	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended By BOS on:	
Approved by academic council on:	

SC364	**Criminology, crime and society**
Version	**1.0**
Prerequisite	All students are expected to have a general knowledge of Criminology
Learning objective	*After studying this paper the students will know –* *a. The importance of criminology.* *b. The causes of criminal behaviour.* *c. The significance of criminal profiling to mitigate crime.* *d. The consequences of crime in society.*
Salient features	The student will be able to conceptualize basics of Criminology
Utility	A degree in Forensic Science allows students and their ability to apply knowledge and understanding of various scientific principles to solve crime cases. Possess high awareness of major issues and development of research areas in Forensic Science.
Unit-I	**Basics of Criminology**
	Definition, brief history of criminology, aims and scope of criminology. Theories of criminal behavior – classical and neo-classical theory, Italian and body type, sociological, psychological theory. Criminal profiling, understanding modus operandi. Investigative strategy. Role of media and mass communication in crime.
Unit-II	**Crime**
	Elements, nature, causes and consequences of crime. Deviant behavior. Hate crimes, organized crimes and public disorder, domestic violence and workplace violence. White collar crimes. Victimology. Juvenile delinquency. Social change and crime. Psychological disorders and Criminality. Situational crime prevention.
Unit-III	**Types of Criminals**
	Violent criminals, property offenders, offenders of public morality, career and occupational criminals.
Unit-IV	**Etiology of Crime**
	Biological factors, Psychological factors, cultural areas as factors of crime, home and family factors, social institution, public agencies of communication.
Unit-V	Broad components of criminal justice system
	Policing styles and principles. Police's power of investigation. Filing of criminal charges. Community policing. Policing a heterogeneous society. Correctional measures and rehabilitation of offenders. Human rights and criminal justice system in India.

Reference books	1. Mordby, J Deed Reckoning – The Art of Forensic science Detection, CRC Press LLC, Boca Raton FL, CRC Press (2000) 2. Ram Ahuja : Criminology, Rewal Publ. jabalpur (2000) 3. S.H. James and J.J. Nordby, *Forensic Science: An Introduction to Scientific and Investigative Techniques*, 2nd Edition, CRC Press, Boca Raton (2005). 4. D.E. Zulawski and D.E. Wicklander, *Practical Aspects of Interview and Interrogation*, CRC Press, Boca Raton (2002). 5. R. Saferstein, *Criminalistics*, 8th Edition, Prentice Hall, New Jersey (2004). 6. J.L. Jackson and E. Barkley, *Offender Profiling: Theory, Research and Practice*, Wiley, Chichester (1997).
Mode of Examination	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended By BOS on:	
Approved by academic council on:	

SC 219	**Chemistry-III (Organic Chemistry)**
Prerequisite	All students are expected to have a general knowledge of basic chemistry principles.
Learning objective	The learning objective of course are: To create an understanding regarding principle of spectroscopy, To gain knowledge about heterocyclic compound, To have understanding about biomolecules, Able to understand polymer.
Salient features	The student will be able to conceptualize about NMR spectroscopy, Able to analyse structure of protein.
Utility	A degree in chemistry opens doors to job opportunities in science, industry and environmental management, chemist and biochemist.
Unit-I	**NMR Spectroscopy** **9hr**
Proton magnetic resonance spectroscopy (1H-NMR): Nuclear Shielding and Deshielding, Chemical shift and molecular, spin-spin splitting and coupling constants, Interpretation of NMR spectra, of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, ethyl acetate, toluene, and acetophenone.	
Unit- II	**Heterocyclic Compounds** **7hr**
Introduction, MO Picture, Aromatic Characteristics, Methods for preparation and chemical reactions of Pyrrole, furan, and thiophene, with particular emphasis on the mechanism of electrophilic substitution. Diels-Alder reaction of furan. Pyridine: synthesis and Mechanism of its Nucleophilic substitution reactions.	
Unit-III	**Organic Synthesis via Enolates** **6hr**
Organic Synthesis via Enolates: Acidity of alpha Hydrogen in reactive methylene compounds, Alkylation of diethyl Malonate and ethyl acetate. Synthetic applications of ethyl acetoacetate and malonic ester. Claisen condensation and keto-enol tautomerism.	
Unit-IV	**Biomolecules** **7hr**
Carbohydrates: Classification and Nomenclature and structure and synthesis of Glucose and fructose. Ribose and Deoxyribose, Interconversion of mannose, glucose and fructose. Classification of Amino Acids. Peptides, Proteins and Nucleic Acids: Structure and nomenclature of Peptides and Proteins, Constituents of Nucleic Acids.	
Unit-V	**Synthetic polymer and Synthetic Dyes** **7hr**

Synthetic Polymers: Addition and chain growth polymerization. Free radical and ionic polymerization. Condensation and step growth polymerization. Polyester, polyamides, Phenol-formaldehyde resins, urea formaldehyde resins. Natural and synthetic rubber. Ziegler-Natta Catalyst. Synthetic Dyes: Classification Color and constitution (electronic concept). Classification of dyes. Chemistry and synthesis of Methyl orange, Congo red and Malachite green, phenolphthalein, fluorescein, alizarin and indigo.	
Reference books	1. I. L. Finar : Organic Chemistry (Vol. I & II), E. L. B. S. 2. R. T. Morrison & R. N. Boyd : Organic Chemistry, Prentice Hall. 3. Arun Bahl and B. S. Bahl : Advanced Organic Chemistry, S. Chand 4. Peter Sykes: A Guide Book to Mechanism in Organic Chemistry, Orient Longman. 5. Jonathan Clayden, Nick Geeves, Stuart Warren, organic chemistry, Oxford University Press
Mode of Evaluation: (Percent Weightage)	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended by BOS on:	
Approved by Academic Council on :	

SC 250	**Chemistry- IV (Physical chemistry)** **C (L,T,P) = 3 (3,0,0)**
Prerquisites	Physical Chemistry I needs Chemistry I and II and Organic and Inorganic I Papers
Objectives	This course deals with the application of structure and theory to the study of physical aspects including reaction dynamics, isotope effects and molecular orbital theory applied. Electrochemistry for fuel systems of daily life
Salient features	The student will be able to conceptualize emulsion, kinetics of reactions,
Utility	A degree B.Sc. by knowing these topics can develop paint, varnish or coating material manufacturing companies.
Unit- I	**Colloidal States**:
Definition of colloids, classification of colloids; Solids in liquids (sols): properties – kinetic, optical and electrical; stability of colloids, protective action, Hardy-Schulze law, gold number. Liquids in liquids (emulsions): types of emulsions, preparation, Emulsifier, Liquids in solids (gels): classification, preparation and properties, inhibition, general application of colloids, colloidal electrolytes.	
Unit- II	**Chemical Kinetics I**
Chemical kinetics and its scope, rate of a reaction, factors influencing the rate of a reaction, concentration dependence of rates, mathematical characteristics of simple, chemical reactions – zero order, first order, second order, pseudo order, half life and mean life, Determination of the order of reaction – differential method, method of integration, method of half life period and isolation method. Radioactive decay as a first order phenomenon; Enzyme catalysis. Unimolecular reactions.	
Unit- III	**Chemical kinetics-II**:
Theories of chemical kinetics. Simple collision theory based on hard sphere model, transition state theory (equilibrium hypothesis), Expression for the rate constant based on equilibrium constant and thermodynamic aspects, Catalysis. Experimental methods of chemical kinetics: conductometric, potentiometric, optical methods, polarimetry and spectrophotometer.	
Unit- IV	**Electrochemistry**
Electrolyte Solutions, Electrical Conductivity, Electrified Interfaces, Equilibrium Electrochemistry, Dynamic Electrochemistry, Electrolysis, Biological Electrochemistry, photosynthesis, nerve excitation, blood coagulation, vision, smell, membrane transport.	

Unit- V	Thermodynamics – II
Statistical thermodynamics, Thermodynamic equilibrium, Quasi-static transfers between simple systems are nearly in thermodynamic equilibrium and are reversible, Non-equilibrium thermodynamics Account in terms of states of thermodynamic equilibrium, Thermodynamic processes between states of thermodynamic equilibrium, Dependent and independent variables for a process ,Scope of thermodynamics, Applied fields .	
References and Text Books:	1. R.G. Compton and G.H.W. Saunders ,Electrode Potentials Oxford Chemistry Primer 2. A.C. Fisher Electrode Dynamics Oxford Chemistry Primer 3 Barrow, G. M. Physical Chemistry Tata McGraw-Hill (2007). 4. Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004). 5. Mahan, B. H. University Chemistry 3rd Ed. Narosa (1998).
Mode of Examination	
Recommended By BOS on:	
Approved by academic council on:	

SC 333	Chemistry-V (Inorganic Chemistry) C (L, T, P) = 3 (3, 0, 0)
Version	**I**
Prerequisite	Chemistry study of earlier semester
Objectives:	1. To train qualified, adaptable, motivated, and responsible Mathematicians who will contribute to the scientific and technological development. 2.To impact knowledge by teaching 3.To advance knowledge by research
Expected outcome:	Better outcomes in chemistry specialization
Unit-I	**Coordination Chemistry 7 Hours**
Coordination Compounds: Nomenclature Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory crystal field theory of transition metal complexes. Application in Industries by Magnetic properties of transition metal complexes	
Unit-II	**Chemistry of Transition Metals: 8 Hours**
Properties of d-block elements. Binary compounds (hydrides, carbides and oxides) of the elements of the first transition series and complexes with respect to relative stability of their oxidation states, coordination number and geometry. Chemistry of Elements of Second and Third Transition Series: General characteristics, comparative treatment of Zr/Hf, Nb/Ta, Mo/W in respect of ionic radii, oxidation states. Industrial application of transition metals	
Unit-III	**Inner Transition Elements: Actinides and Lanthanides 6 Hours**
Definition of the f elements; position in the periodic table; Properties of the atoms and ions: ionization energies, electrode potentials, metallic and ionic radii; Colour and electronic spectroscopy; Magnetism; Solid state compounds: halides and oxides; Coordination chemistry of the lanthanides and actinides; Commercial applications;Rare earth Oxides used for Industries.	
Unit-IV	**Organometallic compounds 7 Hours**

Organometallic compounds; Definition Nomenclature, Preparation properties and application and bonding of alkyl and Aryl compound. Electronic and Ionic Conduction , Metals, insulators and semiconductors, electronic structure of solids application in electronic and electrical industries. Bonding of ligands, Reactions of organometallic, Electron accountancy, Oxidative addition and reductive elimination, Insertion and α/β-elimination, Industrial organometallic catalysis, Olefin catalysis Organometallic compounds and application in electronic materials.	
Unit-V	**Recent Advances In Inorganic Chemistry** **8 Hours**
Borane, Silanes, Inorganic nanotechnology, Zeolite, Bio-inorganic chemistry (must emphasize the metal) Ceramics, Inorganic thin films, Intercalation compounds, Super acids , High-temperature superconductors, nanowire battery, Perovskites nonvolatile memory materials.	
Reference Books	1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P.L. Gaus. Wiley. 2. Concise Inorganic Chemistry, J.D. Lee ELBS. 3. Concepts of Models Inorganic Chemistry B.Douglas. D.McDaniel and J.Alexander, John Wiley. 4. Inorganic Chemistry. D.E. Shriver P.W. Atkins and C.H. Langford, Oxford. 5. Inorganic Chemistry, W.W. Porterfield Addison Wesley. 6. Inorganic Chemistry, A.G. Sharpe. ELBS. 7. Inorganic Chemistry, G.L. Miessler and D.A. Tarr, Prentice Hall. 8. Group Theory and Its Chemical Applications: P. K. Bhattacharya 9. Inorganic Chemistry: J. E. Huyee, Principles of Structure & Reactivity, 3rd Ed. 10. Selected Topics in Inorganic Chemistry: W. U. Malik, G. D. Tuli and R. Madan
Mode of Evaluation	Mid-Term I (10%); Mid-Term II (10%); Weekly test (10%); Graded assignment (10%) Written examination (60%)
Recommended by BOS on:	
Approved by Academic Council on :	

SC226	**Instrumental Methods (Chemical)**
Version	**I**
Prerequisite	Students shall have a basic knowledge of instrumentation
Objectives:	• Infer the concepts of hyphenated technique in visualizing trace evidence and comparing it with control Samples • Articulate and execute theChromatographic techniques in processing crime scene evidence
Expected outcome:	• Interpret the utility of Colorimetry, and Neutron activation analysis in identifying chemical and biological materials • Integrate the Forensic applications on different instrumentations like: Sample Preparation Techniques
Unit-I	**Sample Preparation Techniques** **7 Hours**
Evaporation, Filtration, Crystallization, Decantation, Precipitation, Membrane Separation etc. General Idea and Principle of Centrifuge and its types, Distillation, Various Types of Distillation, Distribution Law and Solvent Extraction, Acid Dissolution & Digestion, Dry Ashing etc.	
Unit-II	**Chromatographic Techniques:** **8 Hours**
General Idea of Chromatography, theory and classification of chromatography: planar and column chromatography, adsorption and partition chromatography, ion exchange chromatography, exclusion chromatography, affinity chromatography.	
Unit-III	**Planer Chromatography** **6 Hours**
Introduction, basic principle, procedure and forensic application of Paper chromatography, thin layer chromatography, high performance thin layer chromatography.	
Unit-IV	**Column Chromatography** **7 Hours**

Introduction, basic principle, procedure and forensic application of High performance liquid chromatography and gas chromatography.	
Unit-V	**Basic Concept of Spectroscopy 8 Hours**
General Idea on Spectroscopy, Electromagnetic Spectrum, Various Source of Radiation Their Utility and Limitation. Interaction of Radiation with Matter i.e., Reflection, Absorption, Fluorescence, Phosphorescence, Diffraction, Refraction etc. Basic Principle, Instrumentation and Forensic Application of Ultraviolet-Visible and Infrared Spectroscopy, Atomic Absorption, Atomic Emission, X-Ray Spectrometry, NMR, NAA.	
Reference Books	1. Sharma B.K., (2000). Instrumental Methods of Chemical Analysis. India, Krishna Prakashan Media. 2. Skoog D.A., Holler F.J. &Stanley R.C. (2017). Principles of Instrumental Analysis, USA, Cengage Learning. 3. Willard H.H., Merrett L. L. Frank J.A.D. & Settle A. (1986). Instrumental Methods of Analysis. USA, CBS Pub. & Distributors. 4. Chatwal and Anand. (2016). Instrumental Methods of Chemical Analysis. India, Himalaya Publishing House Pvt. Ltd.
Mode of Evaluation	
Recommended by BOS on:	
Approved by Academic Council on :	

SC228	**DNA Profiling**
Version	**I**
Prerequisite	Students shall have a basic knowledge of instrumentation
Objectives:	● Role of DNA typing in parentage testing, maternity testing ● Forensic significance of DNA typing
Expected outcome:	● Importance of short tandem repeats and restriction fragment length polymorphism in DNA technique. ● Role of DNA typing in child swapping, kidnapping, murder, rape cases and immigration cases
Unit-I	**Introduction 7 Hours**
Introduction of nucleic acids, DNA as biological blueprint of life. History of DNA fingerprinting, basic structure and types of DNA, difference between DNA and RNA	
Unit-II	**Forensic DNA Typing I 8 Hours**
Collection, preservation, packaging, labelling and forwarding of specimens for DNA fingerprinting. Extraction of DNA for analysis. Quantitation of DNA – yield gel quantitation and slot blot quantitation. Mitochondrial DNA – sequence analysis.	
Unit-III	**Forensic DNA Typing II 6 Hours**
Polymerase chain reaction (PCR) – historical perspective, sequence polymorphisms, individualization of evidence. Short tandem repeats (STR) – role of fluorescent dyes, nature of STR loci. Restriction fragment length polymorphism (RFLP) – genetic markers used in RFLP, typing procedure and interpretation of results. Touch DNA.	
Unit-IV	**Parentage Testing 7 Hours**

Principles of heredity. Genetics of paternity. DNA testing in disputed paternity. Mandelian laws of parentage testing. Missing body cases. DNA databases.	
Unit-V	**Application and report writing** **8 Hours**
Report Writing: Role of DNA typing in identifying unrecognizable bodies. Allele frequency determination. Hardy-Weinberg law. Famous cases solved by DNA profiling	
Reference Books	1. J.M. Butler, Forensic DNA Typing, Elsevier, Burlington (2005). 2. K. Inman and N. Rudin, An Introduction to Forensic DNA Analysis, CRC Press, Boca Raton (1997). 3. H. Coleman and E. Swenson, DNA in the Courtroom: A Trial Watcher's Guide, GeneLex Corporation, Washington (1994). 4. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's, Techniques of Crime Scene Investigation, CRC Press, Boca Raton (2013)
Mode of Evaluation	
Recommended by BOS on:	
Approved by Academic Council on :	

SC230	**Questioned Documents & Handwriting**
Version	**I**
Prerequisite	All students are expected to have a general knowledge of questioned documents
Objectives:	● Important features in handwriting identification. ● Basis of handwriting characteristics.
Expected outcome:	● Tools required for examination of questioned documents ● Importance of examining questioned documents in crime cases.
Unit-I	**Nature and Scope of Questioned Documents** **7 Hours**
Definition of questioned documents. Types of questioned documents. Preliminary examination of documents. Basic tools needed for forensic documents' examination – ultraviolet, visible, infrared and fluorescence spectroscopy, photomicrography, microphotography, visible spectral comparator, electrostatic detection apparatus.	
Unit-II	**Comparison of Documents** **8 Hours**
Comparison of handwriting. Development of individuality in handwriting. Natural variations and fundamental divergences in handwritings. Class and individual characteristics. Merits and demerits of exemplar and non-exemplar samples during comparison of handwriting. Standards for comparison of handwriting.	
Unit-III	**Examination of Questioned Documents I** **6 Hours**
Comparison of paper, ink, printed documents, typed documents, Xeroxed documents. Determining the age and relative age of documents.	
Unit-IV	**Examination of Questioned Documents II** **7 Hours**

Alterations in documents, including erasures, additions, over-writings and obliterations. Indented and invisible writings. Charred documents.		
Unit-V	**Examination of Questioned Documents III**	**8 Hours**
Examination of counterfeit Indian currency notes, passports, visas and stamp papers. Disguised writing and anonymous letters. Examination of digital documents.		
Reference Books	1. O. Hilton, Scientific Examination of Questioned Documents, CRC Press, Boca Raton (1982). 2. A.A. Moenssens, J. Starrs, C.E. Henderson and F.E. Inbau, Scientific Evidence in Civil and Criminal Cases, 4th Edition, Foundation Press, New York (1995). 3. R.N. Morris, Forensic Handwriting Identification: Fundamental Concepts and Principles, Academic Press, London (2000). 4. E. David, The Scientific Examination of Documents – Methods and Techniques, 2nd Edition, Taylor & Francis, Hants (1997). 5. J.E. Cowger, Friction Ridge Skin, CRC Press, Boca Raton (1983). 6. 2. D.A. Ashbaugh, Quantitative-Qualitative Friction Ridge Analysis, CRC Press, Boca Raton (2000). 7. 3. C. Champod, C. Lennard, P. Margot an M. Stoilovic, Fingerprints and other Ridge Skin Impressions, CRC Press, Boca Raton (2004). 8. 4. Lee and Gaensleen's, Advances in Fingerprint Technology, 3rd Edition, R.S. Ramotowski (Ed.), CRC Press, Boca Raton (2013).	
Mode of Evaluation		
Recommended by BOS on:		
Approved by Academic Council on :		

SC232	**Forensic Neuroscience and Behavior**	
Version	**I**	
Prerequisite	All students are expected to have a general knowledge of neuroscience and behavior	
Objectives:	● Neuroscience in criminal investigation and Justice System ● Anatomy of nervous system, their examination in various psychopath cases	
Expected outcome:	● Evaluation of brain imaging and other neuroscience data in forensic and legal settings ● Utilization of MRI, PET in criminal profiling	
Unit-I	**Introduction to Forensic Neuroscience**	**7 Hours**
Neuroscience in Criminal Investigation and Justice System		
Unit-II	**Brain**	**8 Hours**
Introduction to the Structure and Function of the Vertebrate Nervous System. Anatomy of Nervous System, Neurons. Synapse and Neurotransmitter. Cellular Basis of Neuronal Activities, Physiological Bases of Motor Control, Sensory Systems, Motivated Behaviors and Higher Mental Processes.		
Unit-III	**Signal Transmission:**	**6 Hours**
. Action Potential Generation; Synaptic Transmission: Molecular and Physiological Studies of lon Channels) Second Messengers; Simple Neural Circuits; Synaptic Plasticity: Learning and Memory; and Neural Development		
Unit-IV	**Neurobiology of Behavior**	**7 Hours**

Neurobiology of Motivation, Violence, Empathy, Deception, Aggression, Depression and Suicidal Ideation. Neurobiology of Brain Disorders. Behavioral Analysis and Neuropsychiatric Disorders Including Depression Schizophrenia	
Unit-V	**Brain imaging** **8 Hours**
Principles of Brain Imaging and Rules of Scientific Evidence, Behavioural Neuroscience and Brain Imaging Techniques, Functional and Structural Magnetic Resonance Imaging (MRI) and Positron Emission Tomography (PET)	
Reference Books	1. Russel R. (2006).The Brain Book: Know Your Own Mind and How to Use it. USA:Routledge, 2. Scarabino T. &Salvolini U. (2003) Atlas of Morphology and Functional Anatomy ofthe Brain. NY: Springer. 3. Simpson J. R. (2012). Neuroimaging in Forensic Psychiatry: From the Clinic to the Courtroom. England: John Wiley & Sons. 4. Stone T. W. (1996). CNS Neurotransmitters and Neuromodulators. NY: CRC Press. 5. Vincent N. A.(2013).Neuroscience and Legal Responsibility. England: Oxford Press. 6. Welsh A. &Bolen J.D. (2012), The Neurobiology of Criminal Behavior: Gone Brain-Culture interaction USA: Routledge. 7. Walsh A (2012) Biology and Criminology. The Biosocial Synthesis. USA Routledge 8. Webster F (2001) Neurotransmiters, Drugs and Brain Function, England JohnWiey & Sona,
Mode of Evaluation	
Recommended by BOS on:	
Approved by Academic Council on :	

SC333	**Narcotics Drugs & Psychotropic Substances**
Version	I
Prerequisite	All students are expected to have a general knowledge of NDPS
Objectives:	• Classification and characteristics of the narcotics, drugs and psychotropic substances • Take part in collecting and examining various crime scene
Expected Outcome:	• Infer the ethics of Crime Reconstruction • Methods of identifying and purifying narcotics, drugs and psychotropic substances
Unit-I	**Introduction of NDPS**
Definition of narcotics, drugs and psychotropic substances. Broad classification – Narcotics, stimulants, depressants and hallucinogens. General characteristics and common example of each classification. Natural, synthetic and semi-synthetic narcotics, drugs and psychotropic substances.	
Unit-II	**Identification of Narcotics**
Designer drugs. Tolerance, addiction and withdrawal symptoms of narcotics, drugs and psychotropic substances Crime scene search for narcotics, drugs and psychotropic substances – searching a suspect, searching a dwelling, searching a vehicle. Clandestine drug laboratories. Collection and preservation of drug evidence. Testing of narcotics, drugs and psychotropic substances.	
Unit-III	**Isolation and Purification techniques for drugs**

Isolation techniques for purifying narcotics, drugs and psychotropic substances – thin layer chromatography, gas-liquid chromatography and high performance liquid chromatography. Presumptive and screening tests for narcotics, drugs and psychotropic substances. Microcrystalline testing of drugs of abuse.	
Unit-IV	**Analysis Methods I**
Analysis of narcotics, drugs and psychotropic substances in breast milk, saliva, urine, hair and antemortem blood. Drugs and driving. Dope tests.	
Unit-V	**Analysis Methods II**
Analysis of narcotics, drugs and psychotropic substances in postmortem blood. Postmortem changes affecting the analysis of narcotics, drugs and psychotropic substances.	
Reference Books	1. A. Poklis, Forensic toxicology in, Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert (Ed.), CRC Press, Boca Raton (1997). 2. A.W. Jones, Enforcement of drink-driving laws by use of per se legal alcohol limits: Blood and/or breath concentration as evidence of impairment, Alcohol, Drug and Driving, 4, 99 (1988). 3. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's, Techniques of Crime Scene Investigation, CRC Press, Boca Raton (2013).
Mode of Evaluation	
Recommended by BOS on:	
Approved by Academic Council on :	

SC335	**Computer Forensics and Cyber Security**
Version	I
Prerequisite	All students are expected to have a general knowledge of Computer Forensics and Cyber Security
Objectives:	● basics of digital forensics ● cases which fall under the purview of digital crimes
Expected Outcome:	● Types of digital crimes and helps to process of retrieving deleted data. ● Elements involved in investigation of digital crimes.
Unit-I	**Fundamentals and Concepts**
Fundamentals of computers Hardware and accessories, Memory and processor, Methods of storing data. Operating system. Software. Introduction to network, LAN, WAN and MAN.	
Unit-II	**Computer Crimes**
Definition and types of computer crimes. Distinction between computer crimes and conventional crimes. Reasons for commission of computer crimes. Breaching security and operation of digital systems. Computer virus, and computer worm – Trojan horse, trap door, super zapping, logic bombs.	
Unit-III	**Classification of Computer Crimes**

Types of computer crimes – computer stalking, pornography, hacking, and crimes related to intellectual property rights, computer terrorism, hate speech, private and national security in cyber space. An overview of hacking, spamming, phishing and stalking.	
Unit-IV	**Computer Forensics Investigations**
Seizure of suspected computer. Preparation required prior to seizure. Protocol to be taken at the scene. Extraction of information from the hard disk. Treatment of exhibits. Creating bit stream of the original media.	
Unit-V	**The Elements of Computer Crime Investigations**
Collection and seizure of magnetic media. Legal and privacy issues. Examining forensically sterile media. Restoration of deleted files. Password cracking and E-mail tracking. Encryption and decryption methods. Tracking users.	
Reference Books	1. R.K. Tiwari, P.K. Sastry and K.V. Ravikumar, Computer Crimes and Computer Forensics, Select Publishers, New Delhi (2003). 2. C.B. Leshin, Internet Investigations in Criminal Justice, Prentice Hall, New Jersey (1997)
Mode of Evaluation	
Recommended by BOS on:	
Approved by Academic Council on :	

SC337	**Fingerprint and Speaker Identification**
Version	I
Prerequisite	All students are expected to have a general knowledge of Fingerprint and Speaker Identification
Objectives:	• Fundamental principles on which the science of fingerprinting is based • Fingerprints are the most infallible means of identification
Expected Outcome:	• Physical and chemical techniques of developing fingerprints on crime scene evidence. • Method of classifying criminal record by fingerprints was worked out in India, and by Indians.
Unit-I	**Basics of Fingerprinting**
Introduction and history, with special reference to India. Biological basis of fingerprints. Formation of ridges. Fundamental principles of fingerprinting. Types of fingerprints. Fingerprint patterns. Fingerprint characters/minutiae. Plain and rolled fingerprints. Classification and cataloguing of fingerprint record. Automated Fingerprint Identification System. Significance of poroscopy and edgeoscopy.	
Unit-II	**Development of Fingerprints**
Latent prints. Constituents of sweat residue. Latent fingerprints' detection by physical and chemical techniques. Mechanism of detection of fingerprints by different developing reagents. Application of light sources in fingerprint detection. Preservation of developed fingerprints. Digital imaging for fingerprint enhancement. Fingerprinting the deceased. Developing fingerprints on gloves.	

Unit-III	Other Impressions
Importance of footprints. Casting of foot prints, Electrostatic lifting of latent foot prints. Palm prints. Lip prints - Nature, location, collection and examination of lip prints. Ear prints and their significance. Palm prints and their historical importance.	
Unit-IV	**Introduction and importance of speaker identification**
NATURE: Phonemes,Variations in Voice, Telephone Utterance, Wire Tapping, Controlled Voice, Transmission Channel VOICE TEXT COLLECTIONS: Mechanical Mode, Magnetic Mode, Digital Mode	
Unit-V	**EVALUATION**
Listening (SRL), Computer Analysis, Sound Spectrograph, Automatic Speaker Recognition (ASR)	
Reference Books	1. J.E. Cowger, Friction Ridge Skin, CRC Press, Boca Raton (1983). 2. D.A. Ashbaugh, Quantitative-Qualitative Friction Ridge Analysis, CRC Press, Boca Raton (2000). 3. C. Champod, C. Lennard, P. Margot an M. Stoilovic, Fingerprints and other Ridge Skin Impressions, CRC Press, Boca Raton (2004). 4. Lee and Gaensleen's, Advances in Fingerprint Technology, 3rd Edition, R.S. Ramotowski (Ed.), CRC Press, Boca Raton (2013)
Mode of Evaluation	
Recommended by BOS on:	
Approved by Academic Council on :	

SC339	Emerging Trends in Forensic Science
Version	I
Prerequisite	All students are expected to have a general knowledge of emerging Trends in Forensic Science
Objectives:	● Associate the importance of the various emerging trends in Forensic Science ● Categories the various forms of crimes & the identify the Forensics scenario in India
Expected Outcome:	● Interpret and implement the crime scene management strategies ● Explain and Correlate the various practical"s on physical evidences
Unit-I	**Polygraph and Narco-analysis**
Polygraph Analysis: Lie Detector with MRI; Narco Analysis: Basics of Narco Analysis and its Significance in Forensic Science; Brain Fingerprinting and its Use in the Criminal Identification	
Unit-II	**DNA Profiling**
Structure of DNA, Damage to DNA, Variation in DNA, DNA as Excellent Polymorphic Marker, Basis of DNA Typing and Techniques.	
Unit-III	**Voice Identification**

Voice Production, Theory-Vocal Anatomy, Speech Signal Processing & Pattern Recognition- Basic Factors of Sound in Speech, Acoustic Characteristics of Speech Signal.	
Unit-IV	**Wild Life Forensic**
Introduction and Importance of Wild Life, Protected and Endangered Species of Animals and Plants, Wild Life Species - Identification and Examination of Physical Evidence by Conventional and Modern Methods, Identification of Pug Marks of Various Animals.	
Unit-V	**Chromatographic Techniques**
Definition of Chromatography, Classification of Chromatography, Theory of Chromatography, Hyphenated Techniques like HPLC, HPTLC, GC-MS, and LC-MS.	
Reference Books	● James S. H. (2014). Forensic Science: An Introduction to Scientific and Investigative Techniques. New York, Taylor & Francis. ● Jorg T. & Epplen T. L. (1995). DNA Profiling and DNA Fingerprinting. Basel, Birkhauser Verlag. ● Lee H. C. & R. E. (1991). Ganesslen, Advances in Finger Print Technology. London,RC Press. ● Leshin & C.B. (1997). Internet Investigation in Criminalistics. New Jersey, Prentice Hall. Tessarolo A.A. and Marignani. (1996). Forensic Science and the Internet. Canada, The Canadian Society of Forensic Science Journal.
Mode of Evaluation	
Recommended by BOS on:	
Approved by Academic Council on :	

SC334	**Toxicants and Forensic Toxicology**
Version	I
Prerequisite	All students are expected to have a general knowledge of forensic toxicology
Objectives:	● Significance of toxicological studies in forensic science ● Classification of poisons and their modes of actions.
Expected Outcome:	● Physical examination of plant, animal poisons ● Identification of various poisons (Metallic, plant, animal poison, etc)
Unit-I	**Basics of Toxicology**
Significance of toxicological findings. Techniques used in toxicology. Toxicological analysis and chemical intoxication tests. Postmortem Toxicology. Human performance toxicology. Dose-response relationship. Lethal dose 50 and effective dose 50. Significance of toxicological findings. Techniques used in toxicology. Toxicological analysis and chemical intoxication tests. Postmortem Toxicology. Human performance toxicology. Dose-response relationship. Lethal dose 50 and effective dose 50.	
Unit-II	**Toxicants I**

. Classification of poisons. Physico-chemical characteristics and mode of action of poisons. Accidental, suicidal and homicidal poisonings. Signs and symptoms of common poisoning and their antidotes. Collection and preservation of viscera, blood and urine for various poison cases.	
Unit-III	**Toxicants II**
Identification of biocides and metal salts in body fluids. Metabolism and excretion of poisons. Application of immunoassays in forensic work. Animal poisons. Snake venom. Mode of action. Carbon monoxide poisoning. Vegetable poisons. Poisonous seeds, fruits, roots and mushrooms.	
Unit-IV	**Toxicants III**
Beverages. Alcoholic and non-alcoholic illicit liquors. Analysis and identification of ethyl alcohol. Estimation of ethyl alcohol in blood and urine. Proof spirit. Crime scene management in illicit liquor cases.	
Unit-V	**Narcotics, Drugs and Psychotropic Substances**
Definition of narcotics, drugs and psychotropic substances. Broad classification – Narcotics, stimulants, depressants and hallucinogens. General characteristics and common example of each classification. Natural, synthetic and semi-synthetic narcotics, drugs and psychotropic substances. Analysis of NDPS substances by physical and chemical methods of analysis. Designer drugs, Clandestine drug laboratories. Collection and preservation of drug evidence. Testing of narcotics, drugs and psychotropic substances.	
Reference Books	● R. Saferstein, Criminalistics, 8th Edition, Prentice Hall, New Jersey (2004). ● F.G. Hofmann, A Handbook on Drug and Alcohol Abuse, 2nd Edition, Oxford University Press, New York (1983). ● S.B. Karch, The Pathology of Drug Abuse, CRC Press, Boca Raton (1996).
Mode of Evaluation	
Recommended by BOS on:	
Approved by Academic Council on :	

SC336	**Forensic Pharmacology and Drugs of Abuse**
Version	I
Prerequisite	All students are expected to have a general knowledge of Forensic Pharmacology and Drugs of Abuse
Objectives:	• Pharmacological studies and pharmacodynamics of NDPS drugs • Absorption and distribution of drugs into Human bodies
Expected Outcome:	● Structural modification of drugs and their use in drug monitoring agenices ● Effects of drugs on brain and other body parts
Unit-I	**General considerations**
Definition of Drugs, difference between drugs and poisons, effect of dose, their behaviour and their effects on the body. Legal considerations: Drug nomenclature, Drug classes, Drug modalities, Routes of administration and elimination.	
Unit-II	**Pharmacokinetics I**

Absorption , Bioavailability, Distribution, Body compartments ,Volume of distribution, Phase 1 and 2 reactions, First-pass metabolism , Excretion, First- and zero-order kinetics Therapeutic window.	
Unit-III	**Pharmacodynamics**
Receptor and ligand binding, Dose response relationships, Individual variation, Pharmacogenetics Targets of Drug Action: Common drug mechanisms, Receptors, enzymes, ion channels, and transporters, New drug mechanisms, Protein-based, gene-based, and cell-based therapies	
Unit-IV	**Drug of abuse in sports**
Introduction, common prohibited substances, General Idea about NDPS Act, Drug and Cosmetics Acts, Sections 15-32, 37 Medicinal and synthetic medicinal chemistry of Drug of abuse, Understand the effects of drugs and alcohol on driving impairment.	
Unit-V	**Forensic Examination of drugs of abuse**
Seizer or sampling, collection, preservation, packaging labelling and forwarding of the drugs and other abusive substances, chain of custody, primary and confirmatory examination of drugs of abuse	
Reference Books	1. R. S. Satoskar, S. D. Bhandarkar &nirmala N. Rege. (2009). Pharmacology and Pharmacotherapeutics. Popular Prakashan 2. K. D.Tripathi. (2013).Essentials of Medical Pharmacology. Jaypee Brothers Medical Publishers 3. B.V. Subrahmanyam. (2017). Parikh' Textbook of Medical Jurisprudence Forensic Medicine and Toxicology, CBS publishers 4. Clark E.G.C. (1986). Isolation and Identification of Drugs, Vol. I and Vol. II. Britain: Academic Press. 5. R. Saferstein, Criminalistics, 8th Edition, Prentice Hall, New Jersey (2004).
Mode of Evaluation	
Recommended by BOS on:	
Approved by Academic Council on :	

SC338	**Firearms, Ammunitions and their Examinations**
Version	I
Prerequisite	All students are expected to have a general knowledge of Firearms, Ammunitions and their Examinations
Objectives:	● Nature of firearm injuries ● Importance of firearm evidence ● Characteristics of ammunition
Expected Outcome:	● Classification of firearms and their firing mechanisms ● Methods of identifying firearms
Unit-I	**Introduction**
Introduction and definition of forensic ballistics, history and development of firearms. Classification of firearms. Firing mechanisms of different firearms. Internal, external and terminal ballistics	

Unit-II	Ammunition
Types of ammunition. Constructional features and characteristics of different types of cartridges and bullets. Primers and priming compounds. Projectiles. Head-stamp markings on ammunitions. Different types of marks produced during firing process on cartridge – firing pin marks, breech face marks, chamber marks, extractor and ejector marks.	
Unit-III	**Firearm Evidence I**
Collection, preservation, packaging, labelling, sealing and forwarding of evidences in case of firing, chain of custody, photography of scene, blood stain patterns in shooting cases	
Unit-IV	**Firearm Evidence II**
Matching of bullets and cartridge cases in regular firearms. Identification of bullets, pellets and wads fired from improvised, country made firearms. Automated method of bullet and cartridge case comparison. Determination of range of fire and time of fire	
Unit-V	**GSR and its analysis**
Mechanisms of formation of gunshot residues. Methods of analysis of gunshot residues from shooting hands and targets, with special reference to clothing. Identification and nature of firearms injuries. Reconstruction with respect to accident, suicide, murder and self-defense.	
Reference Books	1. A.J. Schwoeble and D.L. Exline, Current Methods in Forensic Gunshot Residue Analysis, CRC Press, Boca Raton (2000). 2. E. Elaad in Encyclopedia of Forensic Science, Volume 2, J.A. Siegel, P.J. Saukko and G.C. Knupfer (Eds.), Academic Press, London (2000).
Mode of Evaluation	
Recommended by BOS on:	
Approved by Academic Council on :	

SC340	Forensic Psychology
Version	I
Prerequisite	All students are expected to have a general knowledge of forensic Psychology
Objectives:	● Basics of cognitive processes and various perspectives of Psychology ● Legal aspects of forensic psychology
Expected Outcome:	● Importance of psychological assessment in gauging criminal behavior ● Tools and techniques required for detection of deception
Unit-I	**Basics of Forensic Psychology**
Definition and fundamental concepts of forensic psychology and forensic psychiatry. Psychology and law. Ethical issues in forensic psychology.	

Assessment of mental competency. Mental disorders and forensic psychology. Psychology of evidence – eyewitness testimony, confession evidence. Criminal profiling. Psychology in the courtroom, with special reference to Section 84 IPC.	
Unit-II	**Psychology and Criminal Behaviour**
Psychopathology and personality disorder. Psychological assessment and its importance. Serial murderers. Psychology of terrorism. Biological factors and crime – social learning theories, psycho-social factors, abuse. Juvenile delinquency – theories of offending (social cognition, moral reasoning), Child abuse (physical, sexual, emotional), juvenile sex offenders, legal controversies.	
Unit-III	**Detection of Deception I**
Tools for detection of deception – interviews, non-verbal detection, statement analysis, voice stress analyzer, hypnosis.	
Unit-IV	**Detection of Deception I**
Polygraphy – operational and question formulation techniques, ethical and legal aspects, the guilty knowledge test.	
Unit-V	**Detection of Deception III**
Narco analysis and brain electrical oscillation signatures – principle and theory, ethical and legal issues.	
Reference Books	1. J.C. DeLadurantey and D.R. Sullivan, Criminal Investigation Standards, Harper & Row, New York (1980). 2. J. Niehaus, Investigative Forensic Hypnosis, CRC Press, Boca Raton (1999). 3. E. Elaad in Encyclopedia of Forensic Science, Volume 2, J.A. Siegel, P.J. Saukko and G.C. Knupfer (Eds.), Academic Press, London (2000).
Mode of Evaluation	
Recommended by BOS on:	
Approved by Academic Council on :	

SURESH GYAN VIHAR UNIVERSITY
Accredited 'A' Grade by NAAC

SYLLABUS

B.Sc. Virology & Immunology
SCHOOL OF APPLIED SCIENCES

EDITION 2021-24

SURESH GYAN VIHAR UNIVERSITY
Accredited 'A' Grade by NAAC

Teaching and Examination Scheme

To commence from the Academic year :2021-2024

School of Applied Sciences **Program: B.Sc. Virology & Immunology**

Semester:I

Sr. No.	Course Code	Course Name	Type of course Core/ elective	Credit	Contact hrs/week			Exam Hours	Weightage (%)	
					L	T	P		CIE	ESE
1.	EN101	English Language I	University Core	2	2	0	0	3	40	60
2.	PC101	Proficiency in Co-Curricular activities	University Core	2	2	0	0	0	100	0
3.	CP101	Elementary Computer	University Core	3	3	0	0	3	40	60
4.	FD102	Foundation Course I	University Core	1	1	0	0	3	25	75
5.	ES101	Environmental studies	University core	2	2	0	0	3	40	60
6.	SC101	Cell Biology	Program Core	3	3	0	0	3	40	60
8.	SC103	General Microbiology	Program Core	3	3	0	0	3	40	60
9.	SC105	Biochemistry & Metabolism	Program Core	3	3	0	0	3	40	60
10.	SC155	Biochemistry & Metabolism Lab	Program Core	2	0	0	3	3	60	40
11	SC151	Cell Biology Lab	Program Core	2	0	0	3	3	60	40
10.	SC153	General Microbiology Lab	Program Core	2	0	0	3	3	60	40
Total										

L- Lecture
T- Tutorial
P- Practical

CIE- Continuous Internal Examination
ESE- End Semester Examination

Signature of Concerned Teacher

Signature of Convenor BOS_____

Signature of Member Secretary

SURESH GYAN VIHAR UNIVERSITY
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Teaching and Examination Scheme
To commence from the Academic year :2021-2024
School of Applied Sciences **Program: B.Sc. Virology & Immunology**
Semester: II

Sr.No.	Course Code	Course Name	Type of course Core/ elective	Credit	Contact hrs/week			Exam Overs	Weightage (%)	
					L	T	P		CIE	ESE
1.	EM102	Employability skills	University Core	1	0	0	2	3	60	40
2.	PC102	Proficiency in co-curricular activities	University Core	2	0	0	0	0	100	00
3.	HUM102	Human Value and Ethics	University Core	1	1	0	0	3	40	60
4.	FD104	Foundation Course II	University Core	1	1	0	0	3	25	75
5.	EN104	English Language II	University Core	3	3	0	0	3	40	60
6.	SC108	Basic of Virology	Program core	3	3	0	0	3	40	60
7.	SC102	Basics of Immunology	Program Core	3	3	0	0	3	40	60
8.	SC106	Genetics and Molecular Biology	Program Core	3	3	0	0	3	40	60
9.	SC154	Genetics and Molecular Biology lab	Program Core	2	0	0	3	3	60	40
10.	SC156	Virology lab	Program Core	2	0	0	3	3	60	40
11.	SC152	Basic immunology lab	Program Core	2	0	0	3	3	60	40
			Total	**23**						

L-Lecture **CSE- Continuous Internal Evaluation**
T- Tutorial **ESE- End Term Examination**
P- Practical

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Signature of Member Secretary

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Teaching and Examination Scheme

To commence from Academic Year: 2021-2024

School of Applied Sciences **Program: B.Sc. Virology & Immunology**

Semester III

Sr.No.	Course Code	Course Name	Type of course core/elective	Credit	Contact Hrs/ Weeks			Exams Hours ESE	Weightage %	
					L	T	P		CIE	ESE
1.	EM203	Employability skills	University Core	1	0	0	2	3	60	40
2.	PC203	Proficiency in co-curricular activities	University Core	2	0	0	0	0	100	0
3.	SC201	Bioanalytical Techniques	Program Core	4	4	0	0	3	40	60
4.	SC205	Biosafety and Bioethics	Program Core	4	4	0	0	3	40	60
5.	SC209	Anatomy and Physiology	Program Core	4	4	0	0	3	40	60
6.	SC211	Clinical Microbiology	Program Core	4	4	0	0	3	40	60
7.	SC251	Bioanalytical Techniques Lab	Program Core	2	0	0	3	3	60	40
8.	SC257	Anatomy and Physiology Lab	Program Core	2	0	0	3	3	60	40
9.	SC259	Clinical Microbiology lab	Program Core	2	0	0	3	3	60	40
Total				**23**						

L- Lecture
T- Tutorial
P - Practical

CIE- Continuous Internal Examination
ESE- End Semester Examination

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SURESH GYAN VIHAR UNIVERSITY
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Teaching and Examination Scheme
To commence Academic year: 2021-2024

School of Applied Sciences **Program: B.Sc. Virology & Immunology**

Semester: IV

Sr. No.	Course Code	Course Name	Type of Course Core/ Elective	credits	Contact Hrs. /Weeks			Exam Over	Weightage %	
					L	T	P		CIE	ESE
1.	EM204	Employability Skills	University Core	1	0	0	2	3	60	40
2.	PC204	Proficiency in co-curricular activities	University Core	2	0	0	0	0	100	0
3.	SC206	Biostatistics	Program Core	4	4	0	0	3	40	60
4.	SC204	Genetic Engineering	Program Core	4	4	0	0	3	40	60
5.	SC208	Antivirals and Vaccines	Program Core	4	4	0	0	3	40	60
6.		Elective I	Program Elective	4	4	0	0	3	40	60
8.	SC254	Genetic Engineering Lab	Program Core	2	0	0	3	3	60	40
9.	SC256	Serological diagnostics Lab	Program Core	2	0	0	3	3	60	40
Total				23						

L- Lecture
T- Tutorial
P- Practical

CIE- Continuous Internal Examination
ESE- End Semester Examination

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Elective Course

1. **Animal Tissue Culture and Biotechnology (SC210)**
2. **Drug Designing and development (SC212)**
3. **IPR, Bio-entrepreneurship and Bio-business Management (SC218)**
4. **Microbial Physiology (SC220)**

Teaching and Examination Scheme
To commence from Academic Year:2021-2024

School of Applied Sciences **Program: B.Sc. Virology & Immunology**

Semester: V

Sr. No.	Course Code	Course Name	Type of Course core/ elective	Credits	Contact Hrs./weeks			Exam over	Weightage %	
					L	T	P		CIE	ESE
1.	EM301	Employability Skills	University Core	1	0	0	2	3	60	40
2.	PC301	Proficiency in co-curricular activities	University Core	2	0	0	0	0	100	0
3.	SC307	Viral Epidemiology	Program Core	4	4	0	0	3	40	60
4.	SC309	Clinical Virology	Program Core	4	4	0	0	3	40	60
5.	SC303	Bioinformatics	Program Core	4	4	0	0	3	40	60
6.		Elective II	Program Core	4	4	0	0	3	40	60
7.	SC353	Bioinformatics Lab	Program Core	2	0	0	3	3	60	40
8.	SC357	Clinical Virology Lab	Program Core	2	0	0	3	3	60	40
Total				**23**						

L- Lecture
T- Tutorial
P- Practical

CIE- Continuous Internal Evaluation
ESE- End Semester Examination

Signature of Concerned Teacher **Signature of Convenor BOS_____**

Signature of Member Secretary

Elective II

1. **Veterinary and Agricultural Viruses (SC343)**
2. **Molecular Diagnostics (SC345)**
3. **Basic of Forensic Sciences (SC347)**

Teaching and Examination Scheme
To Commence from Academic year :2021-2024

School of Applied Sciences **Program: B.Sc. Virology & Immunology**

Semester: VI

Sr. No.	Course Code	Course Name	Type of Course Core/ Elective	Credits	Contact Hrs/ weeks			Exams hours	Weightage %	
					L	T	P		CIE	ESE
1.	SC308	Advanced Immunology	Program Core	4	4	0	0	3	40	60
2.	SC310	Pharmacology	Program Core	4	4	0	0	3	40	60
3.	SC312	Elective III	Program Core	4	4	0	0	3	40	60
4.	SC314	Pathology	Program Core	4	4	0	0	3	40	60
5.	SC358	Advanced Immunology lab	Program Core	2	0	0	3	3	60	40
7.	SC360	Minor Project	Program Core	6	0	0	3	3	60	40
Total				**24**						

L- lecture
T- Tutorial
P- Practical

CIE- Continuous Internal Examination
ESE- End Semester Examination

Signature of Concerned Teacher

Signature of Convenor BOS_____

Signature of Member Secretary

Elective III

1. **Emerging Viral Infections (SC316)**
2. **Viral Disease and Interactions (SC318)**
3. **Viral Respiratory Diseases (SC320)**

I Semester

SC101	**Cell Biology**
Version	1.0
Prerequisite	All students are expected to have a general knowledge of Basic biology.
Learning	The learning objective of course are:

objective	To create an understanding regarding the cells and its organelles. To gain knowledge about cytoplasm and its components.
Salient features	The student will be able to conceptualize basics of cell biology.
Utility	A degree in Biotechnology allows students to understand the living systems of the body and to apply the knowledge in direct ways to recover and maintain the physical health of both animal and plants.
Unit-I	**Cell and organelles 8 hours**
	Cell: Introduction and classification of organisms by cell structure, cytosol, compartmentalization of eukaryotic cells, cell fractionation. Cell Membrane and Permeability: Chemical components of biological membranes, organization and Fluid Mosaic Model, membrane as a dynamic entity, cell recognition and membrane transport.
Unit-II	**Cell and organelles 7 hours**
	Membrane Vacuolar system, cytoskeleton and cell motility: Structure and function of microtubules, Microfilaments, Intermediate filaments. Endoplasmic reticulum: Structure, function including role in protein segregation. Golgi complex: Structure, biogenesis and functions including role in protein secretion.
Unit-III	**Organelles 7 hours**
	Lysosomes: Vacuoles and micro bodies: Structure and functions, Ribosomes: Structures and function including role in protein synthesis. Mitochondria: Structure and function, Genomes, biogenesis. Chloroplasts: Structure and function, genomes, biogenesis. Nucleus: Structure and function, chromosomes and their structure.
Unit-IV	**Extracellular Matrix and cancer 7 hours**
	Extracellular Matrix: Composition, molecules that mediate cell adhesion, membrane receptors for extra cellular matrix, macromolecules, regulation of receptor expression and function. Signal transduction. Cancer: Carcinogenesis, agents promoting carcinogenesis, characteristics and molecular basis of cancer.
Unit-V	**Interactions between cell & environment 7 hours**
	Interactions between cell & environment: - cell functions, cells adhesions, cell junction and extracellular matrix, cell signalling through G-protein linked receptors. Cellular regulation. cell cycle and its regulation. Mitosis and Meiosis. cell apoptosis.
Reference books	1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc. 2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition.Lippincott Williams and Wilkins, Philadelphia. 3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA. 4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

SC103	**General Microbiology**
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of microbiology.
Learning objective	The learning objective of course are: To create an understanding regarding the microbiology.

Salient features	The student will be able to conceptualize basics to advance of microbiology.
Utility	A degree in Biotechnology allows students to understand the living systems of the body and to apply the knowledge in direct ways to recover and maintain the physical health of both animal and plants.
Unit-I	**Fundamentals of microbiology** **8 hours**
	Fundamentals, History and Evolution of Microbiology. Classification of microorganisms: Microbial taxonomy, criteria used including molecular approaches, Microbial phylogeny and current classification of bacteria. Microbial Diversity: Distribution and characterization Prokaryotic and Eukaryotic cells, Morphology and cell structure of major groups of microorganisms *eg*. Bacteria, Algae, Fungi, Protozoa and Unique features of viruses.
Unit-II	**Cultivation and Maintenance of microorganisms** **7 hours**
	Cultivation and Maintenance of microorganisms: Nutritional categories of micro-organisms, methods of isolation, Purification and preservation.
Unit-III	**Microbial growth** **7 hours**
	Microbial growth: Growth curve, Generation time, synchronous batch and continuous culture, measurement of growth and factors affecting growth of bacteria. Microbial Metabolism: Metabolic pathways, amphi-catabolic and biosynthetic pathways. Bacterial Reproduction: Transformation, Transduction and Conjugation. Endospores and sporulation in bacteria.
Unit-IV	**Control of Microorganisms** **7 hours**
	Control of Microorganisms: By physical, chemical and chemotherapeutic Agents Water Microbiology: Bacterial pollutants of water, coliforms and non coliforms. Sewage composition and its disposal.
Unit-V	**Food Microbiology** **7 hours**
	Food Microbiology: Important microorganism in food Microbiology: Moulds, Yeasts, bacteria. Major food born infections and intoxications, Preservation of various types of foods. Fermented Foods.
Reference books	1. Alexopoulos CJ, Mims CW, and Blackwell M. (1996). Introductory Mycology. 4 th edition. John and Sons, Inc. 2. Jay JM, Loessner MJ and Golden DA. (2005). Modern Food Microbiology. 7thedition, CBS Publishers and Distributors, Delhi, India. 3. Kumar HD. (1990). Introductory Phycology. 2nd edition. Affiliated East Western Press. 4. Madigan MT, Martinko JM and Parker J. (2009). Brock Biology of Microorganisms. 12th edition. Pearson/Benjamin Cummings. 5. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company. 6. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5th edition. McMillan. 7. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9 th edition. Pearson Education. 8. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	
SC105	**Biochemistry & Metabolism**
Version	1.0
Prerequisite	All students are expected to have a general knowledge of Basic biology.
Learning	The learning objective of course are:

objective	To create an understanding regarding the Biochemistry & Metabolism. To gain knowledge about Carbohydrates, Lipids, Protein, Nucleic acid.
Salient features	The student will be able to conceptualize basics of biochemistry and metabolism.
Utility	A degree in Biotechnology allows students to understand the living systems of the body and to apply the knowledge in direct ways to recover and maintain the physical health of both animal and plants.
Unit-I	**Amino acids, Proteins and Carbohydrates** **8 hours**
	Amino acids & Proteins: Structure and properties of Amino acids, Types of proteins and their classification, Protein Purification. Denaturation and renaturation of proteins. Fibrous and globular proteins. Urea cycle, Deamination and transamination. **Carbohydrates**: Structure, Function and properties of Monosaccharides, Disaccharides and Polysaccharides. Homo & Hetero Polysaccharides, Mucopolysaccharides, Glycoprotein's and their biological functions.
Unit-II	**Lipids and Nucleic acids** **7 hours**
	Lipids: Classification, nomenclature and properties of fatty acids, essential fatty acids. Phospholipids, sphingolipids, glycolipids, cerebrosides, gangliosides, Prostaglandins, Cholesterol. β-oxidation of fatty acids. **Nucleic acids**: Physical & chemical properties of Nucleic acids, Nucleosides & Nucleotides, purines & pyrimidines, Biologically important nucleotides, Double helical model of DNA.
Unit-III	**Enzymes** **7 hours**
	Enzymes: Nomenclature and classification of Enzymes, Holoenzyme, apoenzyme, Cofactors, coenzyme, prosthetic groups, metalloenzymes, monomeric & oligomeric enzymes, activation energy and transition state, enzyme activity, specific activity, common features of active sites,
Unit-IV	**Enzyme specificity and co-enzymes** **7 hours**
	Enzyme specificity: types & theories, Biocatalysts from extreme thermophilic and hyperthermophilic archaea and bacteria. Role of: NAD+, NADP+, FMN/FAD, coenzymes A, Thiamine pyrophosphate, Pyridoxal phosphate,lipoic-acid, Biotin vitamin B12, Tetrahydrofolate and metallic ions
Unit-V	**Carbohydrates Metabolism** **7 hours**
	Carbohydrates Metabolism: Reactions, energetics and regulation. Glycolysis: Fate of pyruvate under aerobic and anaerobic conditions. Pentose phosphate pathway and its significance, Gluconeogenesis, Glycogenolysis and glycogen synthesis. TCA cycle, Electron Transport Chain, Oxidative phosphorylation. ß-oxidation of fatty acids.
Reference books	1. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman and Co. 2. Buchanan, B., Gruissem, W. and Jones, R. (2000) Biochemistry and Molecular Biology of Plants.American Society of Plant Biologists. 3. Nelson, D.L., Cox, M.M. (2004) Lehninger Principles of Biochemistry, 4th Edition, WH Freeman and Company, New York, USA. 4. Hopkins, W.G. and Huner, P.A. (2008) Introduction to Plant Physiology. John Wiley and Sons. 5. Salisbury, F.B. and Ross, C.W. (1991) Plant Physiology, Wadsworth Publishing Co. Ltd.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

II Semester

SC108	**Basic of Virology**

Version	1.0
Prerequisite	All students are expected to have a general knowledge of Basics of Virology.
Learning objective	The learning objective of course are: To create an understanding regarding the microorganism in relevance to environment. To gain knowledge about Viral Structure and Function.
Salient features	The student will be able to conceptualize basics of Virology and infections.
Utility	A degree in Virology allows students to understand the living systems of the body and viruses and to apply the knowledge in direct ways to recover and maintain the physical health of both animal and plants.
Unit-I	**Viral Structure and Function** **8 hours**
	Background/Discovery, General Concepts: Virus history, Diversity, shapes, sizes and components of genomes. Isolation and purification of viruses and components.
Unit-II	**Viral infections** **7 hours**
	Consequences of virus infection to animals and human.Viral infection: effect on host macromolecules.Viral infection: establishment of the antiviral state.Viruses counter attack mechanisms.
Unit-III	**Classification of viruses** **7 hours**
	Classification of viruses and nomenclatures. +strand RNA viruses- Picornaviruses. Flaviviruses- West Nile virus and Dengue virus. Coronaviruses- SARS pathogenesis.
Unit-IV	**Pathogenesis of Viral Diseases** **7 hours**
	Pathogenetic Steps in Human Infection, Immune Responses to Viral Infections, Mechanisms of Viral Persistence, Noncellular Infectious Agents •Prions
Unit-V	**Virus assembly** **7 hours**
	Structural basis of assembly, dynamics and function of viruses, Negative stranded RNA viruses Positive stranded RNA viruses Double stranded RNA viruses
Reference books	1. 1. Principles of Virology 2nd edition by S.J.Flint, L.W.Enquist, R.M.Krug,V.R. Racaniello, and A.M.Skalka. 2. Fields Virology 5th Edition by Bernard Fields, David Knipe and Peter Howley. 3. Medical Virology 4th edition by David O.White and Frank J. Fenner.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

SC102	**Basics of Immunology**
Version	1.0

Prerequisite	All students are expected to have a basic knowledge of circulatory system.
Learning objective	The learning objective of course are: To create an understanding regarding the Immunology and Immunotechnology.
Salient features	The student will be able to conceptualize basics to advance of Immunology and Immunotechnology.
Utility	A degree in Biotechnology allows students to understand the living systems of the body and to apply the knowledge in direct ways to recover and maintain the physical health of both animal and plants.
Unit-I	**Immune Response** **7 hours**
	Immune Response - An overview, components of mammalian immune system, molecular structure of Immuno-globulins or Antibodies, Humoral & Cellular immune responses, Tlymphocytes & immune response (cytotoxic T-cell, helper T-cell, suppressor T-cells), T-cell receptors, T cell and B cell activation.
Unit-II	**Genetic Rearrangement** **7 hours**
	genome rearrangements during B-lymphocyte differentiation, Antibody affinity maturation class switching, assembly of T-cell receptor genes by somatic recombination. Adjuvants, cytokine and signaling, Complement system.
Unit-III	**Major Histocompatibility complexes** **7 hours**
	Major Histocompatibility complexes – class I & class II MHC antigens, antigen processing. Immunity to infection – immunity to different organisms, pathogen defense strategies, avoidance of recognition.
Unit-IV	**Regulation of Ig** **7 hours**
	Regulation of immunoglobulin gene expression – clonal selection theory, allotypes & idiotypes, allelic exclusion, immunologic memory, heavy chain gene transcription, genetic basis of antibody diversity, hypotheses (germ line & somatic mutation), antibody diversity.
Unit-V	**Immunotechniques and Autoimmune disease** **8 hours**
	Blood grouping, Antigen-Antibody reactions : agglutination, precipitation, immuno-electrophoresis, Coomb's test, ELISA, RIA. Vaccines & Vaccination Autoimmunity & auto-immune diseases, factors contributing development of auto-immune diseases, mechanism of development, breakdown of self-tolerance, rejection of transplants, molecular mimicry, nature of auto-antigens, immunodeficiency, AIDS
Reference books	1. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6 th edition Saunders Publication, Philadelphia. 2. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology. 11th edition Wiley-Blackwell Scientific Publication, Oxford. 3. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York. 4. Murphy K, Travers P, Walport M. (2008). Janeway's Immunobiology. 7th edition Garland Science Publishers, New York. 5. Peakman M, and Vergani D. (2009). Basic and Clinical Immunology. 2nd edition Churchill Livingstone Publishers, Edinberg.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

SC106	**Genetics and Molecular Biology**
Version	1.0

Prerequisite	All students are expected to have a basic knowledge of Genetics
Learning objective	The learning objective of course are: To create an understanding regarding the Genetics and Molecular Biology.
Salient features	The student will be able to conceptualize basics to advance of Genetics and Molecular Biology.
Utility	A degree in Biotechnology allows students to understand the living systems of the body and to apply the knowledge in direct ways to recover and maintain the physical health of both animal and plants.
Unit-I	**Introduction and Mendelian genetics** **8 hours**
	Introduction: Historical developments in the field of genetics. Cell Cycle: Mitosis and Meiosis: Control points in cell-cycle progression in yeast. Mendelian genetics: Mendel's experimental design, monohybrid, di-hybrid and tri hybrid crosses, Law of segregation & Principle of independent assortment. Verification of segregates by test and back crosses, Chromosomal theory of inheritance, Allelic interactions: Concept of dominance, recessiveness, incomplete dominance, co-dominance, semi-dominance, pleiotropy, multiple allele, pseudo-allele, essential and lethal genes, penetrance and expressivity.
Unit-II	**Non allelic interactions** **7 hours**
	Non allelic interactions: Interaction producing new phenotype complementary genes, epistasis (dominant & recessive), duplicate genes and inhibitory genes. Chromosome and genomic organization: Eukaryotic nuclear genome nucleotide sequence composition –unique & repetitive DNA, satellite DNA. Centromere and telomere DNA sequences, middle repetitive sequences- VNTRs & dinucleotide repeats, repetitive transposed sequences - SINEs & LINEs, middle repetitive multiple copy genes, noncoding DNA.
Unit-III	**Genetic organization and mutation** **7 hours**
	Genetic organization of prokaryotic and viral genome. Structure and characteristics of bacterial and eukaryotic chromosome, chromosome morphology, concept of euchromatin and heterochromatin. packaging of DNA molecule into chromosomes, chromosome banding pattern, karyotype, giant chromosomes, one gene one polypeptide hypothesis, concept of cistron, exons, introns, genetic code, gene function. Chromosome and gene mutations: Definition and types of mutations, causes of mutations, Ames test for mutagenic agents, screening procedures for isolation of mutants and uses of mutants, variations in chromosomes structure - deletion, duplication, inversion and translocation (reciprocal and Robertsonian), position effects of gene expression, chromosomal aberrations in human beings, abnormalities– Aneuploidy and Euploidy.
Unit-IV	**Replication and DNA damage** **7 hours**
	Replication of DNA in prokaryotes and eukaryotes: Semiconservative nature of DNA replication, Bi-directional replication, DNA polymerases, The replication complex: Pre-primming proteins, primosome, replisome, Rolling circle replication, Unique aspects of eukaryotic chromosome replication, Fidelity of replication. DNA damage and repair: causes and types of DNA damage, mechanism of DNA repair, Homologous recombination.
Unit-V	**Transcription and translation** **7 hours**
	RNA structure and types of RNA, Transcription in prokaryotes, Transcription in eukaryotes, Regulation of gene expression in prokaryotes: Operon concept (inducible and repressible system), Genetic code and its characteristics, Prokaryotic and eukaryotic translation, Fidelity of translation, Inhibitors of translation. Posttranslational modifications of proteins.
Reference books	1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2006). Principles of Genetics. VIII Edition John Wiley & Sons. 2. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc. 3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. IX Edition. Benjamin Cummings. 4. Russell, P. J. (2009). Genetics- A Molecular Approach. III Edition. Benjamin Cummings. 5. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. IX Edition. Introduction to Genetic Analysis, W. H. Freeman & Co. 6. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons. Inc.

	7. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

III Semester

SC201	Bioanalytical Techniques
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of Bioanalytical Technique.
Learning objective	The learning objective of course are: To create an understanding regarding the Bioanalytical Technique.
Salient features	The student will be able to conceptualize basics to advance of Bioanalytical Technique.
Utility	A degree in Biotechnology allows students to understand the living systems of the body and to apply the knowledge in direct ways to recover and maintain the physical health of both animal and plants.
Unit-I	**Analytical separation methods** **8 hours**
	Chromatography - General principle and application Adsorption chromatography, Partition chromatography, Gas chromatography, liquid chromatography, Paper chromatography, Thin layer chromatography, Gel filtration chromatography, Ion exchange chromatography, Affinity chromatography, HPLC (High Performance/Pressure Liquid chromatography).
Unit-II	**Electrophoresis** **7 hours**
	Electrophoresis - General principle and application, Paper electrophoresis, Gel electrophoresis (Native, Denaturing & Reducing), Disc Gel electrophoresis, Slab Gel electrophoresis, Isoelectrofocussing (IEF).
Unit-III	**Centrifugation** **7 hours**
	Centrifugation: Basic principles. Common centrifuges used in laboratory (clinical, high speed & ultra centrifuges). Sedimentation rate, Sedimentation coefficient, Zonal centrifugation, Equilibrium density gradient centrifugation Types of rotors (fixed angle, swing bucket), Types of centrifugation: Preparative, differential & density gradient
Unit-IV	**Microscopy** **7 hours**
	Basic knowledge of the principles and applications of Microscopy: Light, phase contrast, Fluorescence and Confocal microscopy, Scanning and Transmission Electron microscopy.
Unit-V	**Spectroscopy** **7 hours**
	Spectroscopic methods: principle and applications of UV-visible, IR, NMR. Spectroscopy. Principle & application of X-ray crystallography.
Reference books	1. Sharma, V.K.: Techniques in Microscopy and Cell Biology Tata McGraw Hill, 1991. 2. Alberts et al.: Molecular Biology of the cell (2nd ed.), Garland, 1989. 3. Biochemical Technique: Theory & Practical J.F. Robyt & B.J. White $ 30.95. Waveland Press, Inc. 4. Wilson & Walker: Practical Biochemistry (4th ed) University of Hertfordshire Cambridge University Press 5. Jayraman: Laboratory Manual in Biochemistry 6. Arnold L. Demain & Julian E. Davies: Manual of Industrial Microbio. & Biotech. 2nd ed
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

SC205	Biosafety and Bioethics
Version	III

Prerequisite	All students are expected to have a basic concept of general biology.
Learning objective	This course helps to adhere to the ethical practices appropriate to the discipline at all times and to adopt safe working practices relevant to the bioindustries & field of research
Expected Outcome	1.Students will gain awareness about Intellectual Property Rights (IPRs) 2. They will be able to assists in technology upgradation and enhancing competitiveness. 3. They will acquire adequate knowledge in the use of genetically modified organisms and its effect on human health 4. They will gain more insights into the regulatory affairs.
Unit-I	**Introduction**
Historical background, introduction to biological safety cabinets, primary containment for biohazards, biosafety levels of specific microorganisms, recommended biosafety levels for infectious agents and infected animals. Definition, historic evolution, codes and guidelines, universal principles. IPR	
Unit- II	**Biosafety guidelines**
Government of India definition of genetic modified organism (GMOs) and living modified organisms (LMOs), roles of institutional biosafety committee, review committee on genetic manipulation (RCGM), genetic engineering approval committee (GEAC) for GMO applications in food and agriculture, environmental release of GMOs. The GM-food debate and biosafety assessment procedures for biotech foods and related products, including transgenic food crops, case studies of relevance. Biosafety assessment of pharmaceutical products such as drugs/vaccines etc.	
Unit-III	**Biosafety management**
Risk analysis, risk assessment, risk management and communication, overview of national regulations and relevant international agreements including Cartagena Protocol. Key to the environmentally responsible use of biotechnology, ethical implications of biotechnological products and techniques, social and ethical implications of biological weapons.	
Unit-IV	**Bioethics**
Define the term “Bioethics” in relation to profession, society, and biomedicine, learn about gradation of moral and ethical norms from simpler to higher levels for initiating right actions to „first do no harm“ and learn about prayers, oaths, covenants, declarations, guidelines and codes which have relevance to bioethics.	
Unit-V	**Health ethics**
Describe the sanctity of human life and the need to preserve human life, explain about issues related to prenatal screening, clinical trials (Phase I/II/III/IV) studies. Vulnerability of women with respect to health care, examination and screening of women for disease, social issues like domestic violence and female genital mutilation and abortion. identify ethical issues in clinical practice of HIV medicine and its prevention, research ethics related to HIV.	
Reference books	1. 1. Bioethics and Biosafety, 1st edition (2008), M. K Sateesh, I K International Pvt Ltd, ISBN-13: 978-8190675703. 2. 2. The Cambridge Textbook of Bioethics, 1st edition (2008), Peter A. Singer and A. M. Viens; Cambridge University Press, ISBN-13: 978-0511545566. 3. 4. Social science: An introduction to the study of society, 14th edition (2010), Hunt, E. F.,and Colander, D. C. ; Peason/Allyn and Bacon, Boston, ISBN-13: 978-020570271. 4. 5. Principles of Biomedical Ethics, 6th edition (2011), Beauchamp Tl, Childress JF; Oxford University Press, 2001. ISBN-13: 978-0195143317. 5. 6. A Companion to Bioethics, 2nd edition (2012), Helga Kuhse, Peter Singer; John Wiley and Sons, ISBN-13: 978-1444350845.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

SURESH GYAN VIHAR UNIVERSITY
Accredited 'A' Grade by NAAC

SC209	Anatomy and Physiology
Version	III
Prerequisite	All students are expected to have a basic concept of general biology.
Learning objective	The learning objective of course are to introduce anatomy and physiology of various body systems.
Expected Outcome	The student will be able to conceptualize about ● Internal environment and homeostasis ● Identify and demonstrate functional anatomy of heart. ● Identify and demonstrate how to control Respiratory physiology. ● Demonstrate and evaluate Renal and Nerve physiology.
Unit-I	**Introduction**
Internal environment and homeostasis- coordinated body functions. Digestion- digestive processes at various regions of digestive system, regulation of - gastric secretion and motility- intestinal secretion and motility-role of gastrointestinal hormones.	
Unit- II	**Cardio physiology**
functional anatomy of heart- genesis and spread of cardiac impulses- cardiac cycle- heart sound- cardiac output- cardiovascular regulatory mechanisms- basic E.C.G.	
Unit-III	**Respiratory physiology**
functional anatomy of air-passages and lung- respiratory muscles- mechanism of respiration- lung volumes and capacities- gas exchange in the lungs- regulation of respiration.	
Unit-IV	**Renal physiology**
structure of nephron- glomerular filtration- tubular reabsorption and secretion- formations of urine- regulation of water and mineral excretion counter current multiplier and exchanger- renal role in acid base balance.	
Unit-V	**Nerve physiology**
Structure of neuron and synapse- excitability- action potential conduction of never impulse-synaptic transmission-neurotransmitter systems. Muscle physiology- skeletal and smooth muscle- electrical properties and ionic properties- types of muscle contraction- Neuromuscular transmission.	
Reference books	6. Pal, G.K. Textbook of Medical Physiology, Ahuja Publishing House, Delhi, 2007 7. Hall. J.E. Guyton and Hall Textbook of Medical Physiology. 12th ed. Saunders, Elsevier Inc., 2011. 8. Barrett KE, Brooks HL, Boitano S and Barman SM, Ganong's Review of Medical Physiology, 23rd Ed., McGraw-Hill Medical, 2009. 9. Pelczar, M. J., Reid, R. D., & Chan, E. C. (2001). *Microbiology* (5^{th} ed.). New York: McGraw-Hill.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

SC211	Clinical Microbiology
Version	1.0
Prerequisite	All students are expected to have a general knowledge of basic Biology.
Learning objective	To create an understanding regarding the clinical microbiology.
Expected Outcomes	The student will be able to conceptualize basics of clinical microbiology
Unit-I	**Introduction to Clinical Bacteriology** **8 hours**
	Historical development in Bacteriology; Classification of Pathogenic bacteria; General methods of isolation and identification of pathogenic bacteria; Infections associated with following Gram-positive bacteria – *Bacillus anthracis;* Staphylococcal infections; Infections associated with following Gram-negative bacteria – *Salmonella*, *Pseudomonas*
Unit-II	**Clinical Bacteriology** **7 hours**
	Infections associated with *Mycoplasma, Mycobacterium tuberculosis, Leptospira, Rickettsiae* and *Chlamydiae,* Nosocomial infections and Zoonotic diseases; Sterilization, disinfection and antimicrobial agents
Unit-III	**Clinical Virology I** **7 hours**
	Classification of animal viruses; Isolation, Identification, Cultivation and Purification of animal viruses; Antiviral chemotherapy; Viral Zoonotic infection; Viral vaccines; Interferons.
Unit-IV	**Clinical virology II** **7 hours**
	Poxvirus, Herpes virus, Adeno virus, Hepatitis B virus, Retrovirus, Picorna virus, Reo virus, Herpes virus, Rhabdo virus, Toga virus, Paramyxo virus
Unit-V	**Clinical Parasitology & Mycology** **7 hours**
	Classification and Brief history of Protozoa and helminthic infections; Etiology, Pathogenesis, Clinical diagnosis of the protozoans – *Entamoeba histolytica;* Etiology, Pathogenesis, Clinical diagnosis of the Nematodes – *Wucheria bancrofti;* Etiology, Pathogenesis, Clinical diagnosis of the Cestodes – *Tinea;* Etiology, Pathogenesis, Clinical diagnosis of the Tremtodes – *Schistosoma;* Detailed study about etiology; Lab diagnosis; Pathogenesis and Treatment of Superficial *Trichophyton* Systemic (Candidiosis) diseases of human
Reference books	Moselio Schaechter, Cary Engleberg, N.Barry I. Eisenstein, Gerald medoff. Mechanisms of microbial disease, 3rd ed, Lippincott Williams & Wilkins, 1999. Ananthanarayan and Jayaram Paniker. Textbook of Microbiology, 4th ed. Orient Longman, 2000. Richman, Whitley, Hayden. Clinical virology. Churchill Livingstone, New York. 1997. David. M.Knipe & Peter M.Harley. Fundamental Virology, 4th Ed., Lippincott Williams & Wilkins, 2001. S.J. Flint Enguist, L.W. Krug RM, Racaniello V.R., A.M.Skalka. Principles of Virology, A.S.M. Press, Wasington, 2000. Moselio Schaechter, Cary Engleberg, N.Barry I. Eisenstein, Gerald medoff. Mechanisms of microbial disease, 3rd Ed, Lippincott Williams & Wilkins, 1999. Samuel Baron. Medical Microbiology, 2nd Ed, Addison – Wesley Publication & Co., New York. 1986.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT

Recommended By BOS on:	
Approved by academic council on:	

IV Semester

SC204	**Genetic Engineering**
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of Molecular Biology.
Learning objective	To create an understanding regarding the Genetic Engineering.
Salient features	The student will be able to conceptualize basics to advance of Genetic Engineering.
Utility	A degree in Biotechnology allows students to understand the living systems of the body and to apply the knowledge in direct ways to recover and mai ntain the physical health of both animal and plants.
Unit-I	**Molecular tools and applications** **7 hours**
	Molecular tools and applications- restriction enzymes, ligases, polymerases, Alkaline phosphatase. Gene Recombination and Gene transfer: Transformation, Episomes, Plasmids and other cloning vectors (Bacteriophage-derived vectors, artificial chromosomes), Microinjection, Electroporation, Ultrasonication, Principle and applications of Polymerase chain reaction (PCR), primer-design, and RT- (Reverse transcription) PCR.
Unit-II	**Restriction and modification system** **7 hours**
	Restriction and modification system, restriction mapping. Southern and Northern hybridization. Preparation and comparison of Genomic and cDNA library, screening of recombinants, reverse transcription, Genome mapping, DNA fingerprinting, Applications of Genetic Engineering Genetic engineering in animals: Production and applications of transgenic mice, role of ES cells in gene targeting in mice, Therapeutic products produced by genetic engineering-blood proteins, human hormones, immune modulators and vaccines (one example each).
Unit-III	**Random and site-directed mutagenesis** **7 hours**
	Random and site-directed mutagenesis: Primer extension and PCR based methods of site directed mutagenesis, Random mutagenesis, Gene shuffling, production of chimeric proteins, Protein engineering concepts and examples (any two).
Unit-IV	**Genetic Engineering in plants** **7 hours**
	Genetic engineering in plants: Use of Agrobacterium tumefaciens and A. rhizogenic, Ti plasmids, Strategies for gene transfer to plant cells, Direct DNA transfer to plants, Gene targeting in plants, Use of plant viruses as episomal expression vectors.
Unit-V	**Recombinant protein Technology** **8 hours**
	Recombinant protein Technology: Design and use of expression vectors, selection of suitable promoter sequences, ribosome binding sites, transcription terminator, plasmid copy number. Processing of Recombinant proteins- Stabilization of proteins. Phage Display, Inclusion Bodies, solubilization of insoluble proteins. Codon optimization, Fusion Proteins Gene therapy, Gene silencing.
Reference books	1. Brown TA. (2006). Gene Cloning and DNA Analysis. 5th edition. Blackwell Publishing, Oxford, U.K. 2. Clark DP and Pazdernik NJ. (2009). Biotechnology-Applying the Genetic Revolution. Elsevier Academic Press, USA. 3. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington 4. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K. 5. Sambrook J, Fritsch EF and Maniatis T. (2001). Molecular Cloning-A Laboratory Manual. 3rd

	edition. Cold Spring Harbor Laboratory Press.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

SC206	**Biostatistics**
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of Mathematics and Biology
Learning objective	The learning objective of course are: To create an understanding regarding the Biostatistics To apply statistical methods for analyzing biological data To analyze biological data and to draw inferences
Expected Outcomes	The student will be able to conceptualize basics to advance of Biostatistics
Unit-I	**Basics of Statistics** **8 hours**
	Statistics – Definition, functions and its limitations – Collection, Classification, Tabulation of data – Diagrammatic and Graphical representation of data.
Unit-II	**Measures of Central Tendency** **7 hours**
	Measures of Central Tendency – Mean, Median, Mode, Geometric mean, Harmonic mean – Merits and demerits of these measures - Measures of Dispersion – Range, Quartile deviation, Mean deviation, Standard deviation, Variance, Coefficient of Variation, Skewness – Kurtosis.
Unit-III	**Correlation** **7 hours**
	Correlation – Types, scatter diagram – Karl Pearson's coefficient of correlation, Spearman's Rank Correlation – Regression – Formation of Regression lines – Uses of Regression lines.
Unit-IV	**Basics of Probability Theory** **7 hours**
	Basics of Probability Theory – Addition & Multiplication Rule – Binomial, Poisson and Normal Distribution and their uses in biological sciences.
Unit-V	**Test for Mean** **7 hours**
	Test for Mean – Test for the difference between two means – Test for proportion – Test for the difference between two proportions – Small sample Tests: Student's t-test, F-test – Analysis of variance (one-way and two-way – Basic Ideas only).
Reference books	1. Le CT (2003) Introductory biostatistics. 1st edition, John Wiley, USA 2. Glaser AN (2001) High YieldTM Biostatistics. Lippincott Williams and Wilkins, USA 3. Edmondson A and Druce D (1996) Advanced Biology Statistics, Oxford University Press. 4. Danial W (2004) Biostatistics : A foundation for Analysis in Health Sciences, John Wiley and Sons Inc. 5. S.P.Gupta (2011), Statistical methods, Sultan Chand & Sons,4th Edition. 6. Jerold H.Zar (2009): Bio-statistical Analysis, 4th Edition, Pearson Education Inc., 7. Dorling Kindersley (India) Pvt. Ltd., New Delhi. 8. Antonisamy.B, Solomon Christopher and Prasanna Samuel.P, (2010): 9. Bio-Statistics Principles and Practice, 1st Reprint 2011, Tata McGraw Hill Education Pvt. Ltd., New Delhi.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic	

council on:	

SC208	Antivirals and Vaccines
Version	1.0
Prerequisite	All students are expected to have a general knowledge of basic microbiology.
Learning objective	The learning objective of course are: To create an understanding regarding the virology.
Expected Outcomes	The student will be able to conceptualize basics of virology
Unit-I	**Vaccines** **7 hours**
	Introduction, Multivalent subunit vaccines, Purified macromolecules, Synthetic peptide vaccines, Immuno-adhesions, Recombinant antigen vaccines, Vector vaccines, Anti-idiotype vaccines, Targeted immune stimulants, Miscellaneous approaches, New generation vaccines, Novel vaccine delivery systems.
Unit-II	**Conventional vaccines** **5 hours**
	Conventional vaccines -killed and attenuated, modern vaccines—recombinant proteins, subunits, DNA vaccines, peptides, immunomodulators (cytokines), vaccine delivery & adjuvants, large scale manufacturing-QA/QC issues.
Unit-III	**Immune markers** **5 hours**
	Vaccine induced immune response and immune markers of protection, Immunophenotyping, Immunotherapy, Antiviral state, Strategies for evading immune response. Different strategies of designing vaccines.
Unit-IV	**Designing and screening for antivirals** **5 hours**
	Interferons, designing and screening for antivirals, mechanisms of action, antiviral libraries, antiretrovirals-mechanism of action & drug resistance. Anti-sense RNA, siRNA, miRNA, ribozymes, in silico approaches for drug designing.
Unit-V	**Basic principles of molecular dynamics** **7 hours**
	Drug targeting and drug delivery systems: Introduction, Historical perspectives, Drug targeting, Cellular levels events in targeting. Ligands as means of targeting, Blood cell receptors for endogenous compounds, Carrier system for targeting, Vesicular systems for ligand mediated drug targeting, Specialized liposomes for cellular drug targeting.
Reference books	1. Antiviral Agents, Vaccines, and Immunotherapies. Stephen K. Tyring. Latest edition / Pub. Date: October 2004. Publisher: Marcel Dekker. 2. Antiviral Drug Discovery for Emerging Diseases and Bioterrorism Threats. Paul F. Torrence (Editor). Latest edition / Pub. Date: July 2005. Publisher: Wiley, John & Sons, Incorporated. 3. Chimeric Virus -like Particles as Vacc ines. Wolfram H. Gerlich (Editor), Detlev H. Krueger (Editor), Rainer Ulrich (Editor). Latest edition / Pub. Date: November 1996 Publisher: Karger, S. Inc. 4. Vaccines. Stanley A. Plotkin, Walter A. Orenstein. Latest edition / Pub. Date: September 2003. Publisher: Elsevier Health Sciences.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT

Recommended By BOS on:	
Approved by academic council on:	

SC210	**Animal Tissue culture and Biotechnology**
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of animal sciences.
Learning objective	To create an understanding regarding the Animal Tissue Culture and Biotechnology.
Expected Outcomes	The student will be able to conceptualize basics to advance of Animal Tissue Culture and Biotechnology.
Unit-I	**Gene transfer methods in Animals** **7 hours**
	Gene transfer methods in Animals – Microinjection, Embryonic Stem cell, gene transfer, Retrovirus & Gene transfer.
Unit-II	**Introduction to transgenesis** **7 hours**
	Introduction to transgenesis. Transgenic Animals – Mice, Cow, Pig, Sheep, Goat, Bird, Insect. Animal diseases need help of Biotechnology – Foot-and mouth disease, Coccidiosis, Trypanosomiasis, Theileriosis.
Unit-III	**Animal propagation** **7 hours**
	Animal propagation – Artificial insemination, Animal Clones. Conservation Biology – Embryo transfer techniques. Introduction to Stem Cell Technology and its applications.
Unit-IV	**Genetic modification in Medicine** **7 hours**
	Genetic modification in Medicine - gene therapy, types of gene therapy, vectors in gene therapy, molecular engineering, human genetic engineering, problems & ethics.
Unit-V	**Introduction of cloning** **8 hours**
	Cell cloning, micromanipulation and types of cloning. Cell transformation. Application of animal cell culture, limitations of animal cell cultures. Stem cell culture, embryonic stem cells and their applications. Organ and histotypic cultures. Three dimensional culture and tissue engineering
Reference books	1. Brown, T.A. (1998). Molecular biology Labfax II: Gene analysis. II Edition. Academic Press, California,USA. 2. Butler, M. (2004). Animal cell culture and technology: The basics. II Edition. Bios scientific publishers. 3. Glick, B.R. and Pasternak, J.J. (2009). Molecular biotechnology- Principles and applications of recombinant DNA. IV Edition. ASM press, Washington, USA. 4. Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009). An introduction to genetic analysis. IX Edition. Freeman & Co., N.Y., USA. 5. Watson, J.D., Myers, R.M., Caudy, A. and Witkowski, J.K. (2007). Recombinant DNAgenes and genomes- A short course. III Edition. Freeman and Co., N.Y., USA.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic	

council on:	

SC212	**Drug Designing and Development**
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of Bioinformatics and drugs
Learning objective	The learning objective of course are: To create an understanding regarding the Basics of Molecular Modelling and Drug Designing
Expected Outcomes	The student will be able to conceptualize basics to advance of Basics of Molecular Modelling and Drug Designing.
Unit-I	**Biotechnological products** **8 hours**
	Introduction, Stability profile, Barriers to proteins and peptide delivery, Delivery of protein & peptide drugs, Lymphatic transportation of proteins, Site specific protein modification (protein engineering), Toxicology profile characterization.
Unit-II	**Basic principles of molecular dynamics** **7 hours**
	Drug targeting and drug delivery systems: Introduction, Historical perspectives, Drug targeting, Cellular levels events in targeting. Ligands as means of targeting, Blood cell receptors for endogenous compounds, Carrier system for targeting, Vesicular systems for ligand mediated drug targeting, Specialized liposomes for cellular drug targeting.
Unit-III	**Vaccines** **7 hours**
	Introduction, Multivalent subunit vaccines, Purified macromolecules, Synthetic peptide vaccines, Immuno-adhesions, Recombinant antigen vaccines, Vector vaccines, Anti-idiotype vaccines, Targeted immune stimulants, Miscellaneous approaches, New generation vaccines, Novel vaccine delivery systems.
Unit-IV	**Drug Design** **7 hours**
	Introduction to drug design cycle: Structure Activity Relationship (SAR), Rational Drug Design, Pharmacophoric patterns, Quantitative Structure-Activity Relationship. (Q SAR) & Hans equation
Unit-V	**Molecular Modelling** **7 hours**
	Introduction to molecular modelling: Quantum mechanical and molecular orbital methods, Introduction to semiempirical, molecular mechanics and ab initio techniques. Potential energy surface, Docking and modelling substrate – receptor interactions. Introduction to s/w tools for CADD.
Reference books	1. Andrew Leach, Molecular Modelling: Principles and Applications (2nd Edition), Addison Wesley Longman, Essex, England, 1996. 2. Alan Hinchliffe, Modelling Molecular Structures, 2nd Edition, John-Wiley, 2000. 3. Alan Hinchliffe, Molecular Modelling for Beginners, John-Wiley, 2003. 4. N. Cohen (Ed.), Guide Book on Molecular Modeling in Drug Design, Academic Press, San Diego, 1996. 5. D. Frenkel and B. Smith, Understanding Molecular Simulations. From Algorithms to Applications, Academic Press, San Diego, California, 1996. 6. C. Rauter and K. Horn, X-ray crystallography and drug design, Elsevier, 1984. 7. M. Kalos and P. A. Whitlock, Monte Carlo Methods. John Wiley & Sons, New York, 1986. 8. J.A. McCammon and S.C. Harvey. Dynamics of Proteins and Nucleic Acids. Cambridge

	University Press, Cambridge, 1987. 9. D.C. Rapaport. The Art of Molecular Dynamics Simulation. Cambridge University Press, Cambridge, England., 1995
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

SC218	**IPR, Bio-entrepreneurship and Bio-business Management**
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of biology, law, and business.
Learning objective	The learning objective of course are: To create an understanding regarding the IPR, Bio-entrepreneurship and Bio-business Management
Expected Outcomes	The student will be able to conceptualize basics to advance of IPR, Bio-entrepreneurship and Bio-business Management
Unit-I	**Intellectual Property** **8 hours**
	Introduction to Intellectual Property: Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of GMOs IP as a factor in R&D;
Unit-II	**Agreement and Treaties** **7 hours**
	IPs of relevance to Biotechnology and few. Introduction to Indian Patent Law. World Trade Organization and its related intellectual property provisions. History of GATT & TRIPS Agreement; Madrid Agreement; Hague Agreement; WIPO Treaties; Budapest Treaty; PCT; Indian Patent Act 1970 & recent Amendments. Intellectual/Industrial property and its legal protection in research, design and development. Patenting in Biotechnology, economic, ethical and depository considerations.
Unit-III	**Entrepreneurship** **7 hours**
	Meaning, Needs and Importance of Entrepreneurship, Entrepreneurs and Innovators, Promotion of entrepreneurship, Factors influencing entrepreneurship, Features of a successful Entrepreneurship. Selection of a product, line, design and development processes, economics on material and energy requirement, stock the product and release the same for making etc.
Unit-IV	**Establishing and enterprise** **7 hours**
	Forms of Business Organization, Project Identification, Selection of the product, Project formulation, Assessment of project feasibility. Demand for a given product, feasibility of its production under given constraints of raw material, energy input, financial situations export potential etc.
Unit-V	**Bio-business Management** **7 hours**
	Worldwide market scenario of biotechnology based business, Bio business prospective in India. Management Process & organization, General analysis of Indian Bio business, Project formulation Business Plan, technological assessment, Cost estimation, feasibility and commercial viability of project.
Reference books	1. Holt DH. Entrepreneurship: New Venture Creation. 2. Kaplan JM Patterns of Entrepreneurship. 3. Gupta CB, Khanka SS. Entrepreneurship and Small Business Management, Sultan Chand & Sons.

	4. P. Narayan: Patent Law. 5. S. L Rao: Economic reforms and Indian markets.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

SC220	**Microbial Physiology**
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of Microbiology.
Learning objective	The learning objective of course are: To create an understanding regarding the Microbiology
Expected Outcomes	The student will be able to conceptualize basics to advance of Microbial Physiology.
Unit-I	**Nutritional Classification** **7 hours**
	Nutritional classification of microorganisms based on carbon, energy and electron sources, Metabolite Transport, Diffusion: Passive and facilitated, Primary active and secondary active transport, Group translocation (phosphotransferase system), symport, antiport and uniport, electrogenic and electro neutral transport, transport of Iron.
Unit-II	**Microbial Growth** **7 hours**
	Microbial Growth. Definition of growth, balanced and unbalanced growth, growth curve, the mathematics of growth-generation time, specific growth rate, batch and continuous culture, synchronous growth, diauxic growth curve. Measurement of microbial growth. Measurement of cell numbers, cell mass and metabolic activity.
Unit-III	**Effect of the environment on microbial growth** **7 hours**
	Temperature- temperature ranges for microbial growth, classification based on temperature ranges and adaptations, pH-classification based on pH ranges and adaptations, solutes and water activity, oxygen concentration, radiation and pressure. Chemo lithotrophic metabolism, Physiological groups of aerobic and anaerobic chemolithotrophs. Hydrogen oxidizing bacteria and methanogens.
Unit-IV	**Phototrophic Metabolism** **7 hours**
	Phototrophic metabolism. Historical account of photosynthesis, diversity of phototrophic bacteria, anoxygenic and oxygenic photosynthesis, photosynthetic pigments: action and absorption spectrum, type, structure and location,
Unit-V	**Bacterial Photosynthesis** **8 hours**
	physiology of bacterial photosynthesis: light reactions, cyclic and non-cyclic photophosphorylation. Carbon dioxide fixation, Calvin cycle and reductive TCA cycle.
Reference books	1. Gottschalk G. (1986). Bacterial Metabolism. 2nd edition. Springer Verlag 2. Madigan MT, Martinko JM and Parker J. (2003). Brock Biology of Microorganisms.10th edition. Pearson/ Benjamin Cummings. 3. Moat AG and Foster JW. (2002). Microbial Physiology. 4th edition. John Wiley & Sons. 4. Reddy SR and Reddy SM. (2005). Microbial Physiology. Scientific Publishers India. 5. Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. (1987). General Microbiology. 5th edition, McMillan Press. 6. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.

Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

Fifth Semester

SC307	**Viral Epidemiology**
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of Virology
Learning objective	The learning objective of course are: To create an understanding regarding the Viral Epidemiology
Expected Outcomes	The student will be able to conceptualize basics to advance of Viral Epidemiology.
Unit-I	**Introduction to Epidemiology** **7 hours**
	Introduction; Scope and applications of epidemiology in health care; Role, ethics and responsibilities of an epidemiologist; Relation between virulence and spread; Reservoirs of infection (Human, animal and non-living reservoirs); Types of carriers; Portals of entry and exit.
Unit-II	**Transmission of Viral Disease** **7 hours**
	Sources of infection; Modes of viral transmission; Disease cycle; Role of remote sensing and geographical information in recognition of an epidemic; Serological surveys; Influence of behavioral or spatial factors on transmission; Spatial, temporal and social distributions of communicable diseases; History of outbreaks: SARS, Chikungunya, Hantavirus infection, Swine flu, Haiti cholera.
Unit-III	**Mathematical Modelling** **7 hours**
	Transmission dynamics: Incidence, Prevalence, Morbidity, Mortality; Public health surveillance: Purpose and characteristics, identifying health problems for surveillance, Collection of data for surveillance, Analysis and interpretation of data, Disseminating data and interpretation, Evaluating and improving surveillance. Epidemiological studies: Collection of frequency data, Descriptive, analytical and experimental studies, Cross-sectional, case-control and cohort studies, Models for developing epidemiological theory
Unit-IV	**Control of Epidemics I** **7 hours**
	Cycle of epidemics; Emerging and re-emerging Viral infectious diseases and pathogens; Control of transmission: Isolation, Quarantine, Threat of bioterrorism, Global travel and health considerations;
Unit-V	**Control of Epidemics II** **8 hours**
	Community based control by vaccination, mass vaccination and herd immunity; Public health organizations for control: Centre of Disease Control (CDC), Guidelines issued by CDC and WHO, Health standards for international epidemics
Reference books	1. Gottschalk G. (1986). Bacterial Metabolism. 2nd edition. Springer Verlag 2. Madigan MT, Martinko JM and Parker J. (2003). Brock Biology of Microorganisms.10th edition. Pearson/ Benjamin Cummings. 3. Moat AG and Foster JW. (2002). Microbial Physiology. 4th edition. John Wiley & Sons. 4. Reddy SR and Reddy SM. (2005). Microbial Physiology. Scientific Publishers India. 5. Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. (1987). General Microbiology. 5th edition, McMillan Press. 6. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.

Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

SC309	**Clinical Virology**
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of Virology.
Learning objective	To create an understanding regarding the Clinical Virology.
Expected Outcomes	The student will be able to conceptualize basics to advance of Clinical Virology.
Unit-I	**Basics of clinical virology** **7 hours**
	Normal microbiota of human body; Role of resident flora and human host; Routes of transmission of pathogens; Nosocomial infections; Collection, transportation and processing of clinical samples; Isolation and identification of pathogenic organisms; Quality control in medical microbiology laboratory
Unit-II	**Viral respiratory diseases** **7 hours**
	Origin and evolution of viral respiratory diseases. History, clinical features, epidemiology, of influenza, RSV and other respiratory diseases. Biology of respiratory viruses. Biology and pathogenesis of SARS, Metapneumovirus, human rhino virus and Corona virus etc. Diagnostics Differential diagnosis of different respiratory diseases.
Unit-III	**Clinical Infections-Hemorrhagic Fever** **7 hours**
	Common clinical features of Viral Hemorrhagic Fevers, History and Disease burden, Risk factors and geographical distribution of viruses associated with hemorrhagic fevers and their impact on global health. Hemorrhagic manifestations caused by other viruses Virus replication strategy, Pathogenesis, Prevention and treatment of Yellow Fever, Chikungunya, Ebola, and Rickettsial fevers. KFD and Development of killed KFD vaccine.
Unit-IV	**Clinical Infections-II** **7 hours**
	Rubella, CRS, mumps and Poxviruses. Clinical features, disease burden of Rubella, CRS and mumps, case definition and risk factors. Preventive and therapeutic modalities. Pathogenesis of disease. .Clinical aspects of Parvovirus. Pox diseases Common features of viral pox diseases and case definitions. Para specific immunity due to pox vaccination, eradication and control programs.
Unit-V	**Clinical Infections III** **8 hours**
	Clinical presentation and epidemiology of viral hepatitis. Physiology of Jaundice, clinical features and differential diagnosis, presentations of hepatitis caused by different hepatitis viruses. Diagnostics. Serological and molecular diagnosis of different hepatitis viruses. Immunopathogenesis & animal models of different hepatitis viruses. Animal models and their uses. Vaccination as preventive measure in public health. Therapeutic possibilities of the present and future.
Reference books	1. Fields Virology, Volume 2, 4th edition:(2001). 2. Clinical Virology, Second Edition (Richmans Hayden). 3. Hepatitis Viruses (Japan medical research fourm).

	4. Viral Hepatitis and Liver disease, A.J. Zuckerman. 5. Viral Infection of Humans (S. Svans & A Kaslow). 6. Viral Hepatitis Molecular Biology Diagnosis and Control, By Isa Mushahwar. Elsevier
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	
SC303	**Bioinformatics**
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of Computer Sciences and Biotechnology.
Learning objective	To create an understanding regarding the Bioinformatics and Nanobiotechnology.
Expected Outcomes	The student will be able to conceptualize basics to advance of Bioinformatics and Nanobiotechnology.
Unit-I	**History of Bioinformatics** **7 hours**
	History of Bioinformatics. The notion of Homology. Sequence Information Sources, EMBL, GENBANK, DDBJ, Entrez, Unigene, Understanding the structure of each source and using it on the web.
Unit-II	**Protein Information Sources** **7 hours**
	Protein Information Sources, PDB, SWISSPROT, TREMBL, Understanding the structure of each source and using it on the web. Secondary Databases Introduction of Data Generating Techniques and Bioinformatics problem posed by them- Restriction Digestion, Chromatograms, Blots, PCR, Microarrays, Mass Spectrometry.
Unit-III	**Sequence Analysis** **7 hours**
	Introduction to Signaling Pathways and Pathway Regulation (KEGG), Sequence analysis, Detecting Open Reading Frames, Outline of sequence Assembly, Mutation/Substitution Matrices, Pairwise Alignments, Introduction to BLAST, using it on the web, Interpreting results, Multiple Sequence Alignment,
Unit-IV	**Phylogenetic Analysis** **7 hours**
	Phylogenetic Analysis. Searching Databases: SRS, Entrez, Sequence Similarity Searches-BLAST, FASTA, Data Submission. Genome Annotation: Pattern and repeat finding, Gene identification tools. Phylogenetic tree building methods, Crustal and MEGA6
Unit-V	**Web based Tools** **8 hours**
	Production of Protein Structure & Modeling Protein Primary & Secondary Structure, Prediction Methods – Introduction to various methods. Tertiary structure prediction (Homology & Threading Methods) Profiles.
Reference books	1. Ghosh Z. and Bibekanand M. (2008) Bioinformatics: Principles and Applications. Oxford University Press. 2. Pevsner J. (2009) Bioinformatics and Functional Genomics. II Edition. Wiley-Blackwell. 3. Campbell A. M., Heyer L. J. (2006) Discovering Genomics, Proteomics and Bioinformatics. II Edition. Benjamin Cummings.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by	

academic council on:	

SC345	**Molecular Diagnostics**
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of Microbiology and Immunology
Learning objective	The learning objective of course are: To create an understanding regarding the Basics of Molecular Diagnostics
Expected Outcomes	The student will be able to conceptualize basics to advance of Basics of Molecular Diagnostics
Unit-I	**Enzyme Immunoassays** **8 hours**
	Comparison of enzymes available for enzyme immunoassays, conjugation of enzymes. Solid phases used in enzyme immunoassays. Homogeneous and heterogeneous enzyme immunoassays. Enzyme immunoassays after immuno blotting. Enzyme immuno histochemical techniques. Use of polyclonal or monoclonal antibodies in enzymes immuno assays. Applications of enzyme immunoassays in diagnostic microbiology
Unit-II	**Molecular methods in clinical microbiology** **7 hours**
	Applications of PCR, RFLP, Nuclear hybridization methods, Single nucleotide polymorphism and plasmid finger printing in clinical microbiology
Unit-III	**Laboratory tests in chemotherapy** **7 hours**
	Susceptibility tests: Micro-dilution and macro-dilution broth procedures. Susceptibility tests: Diffusion test procedures. Susceptibility tests: Tests for bactericidal activity. Automated procedures for antimicrobial susceptibility tests.
Unit-IV	**Automation in diagnostics** **7 hours**
	Automation in microbial diagnosis, rapid diagnostic approach including technical purification and standardization of antigen and specific antibodies.
Unit-V	**Idiotyping** **7 hours**
	Concepts and methods in idiotypes. Ant idiotypes and molecular mimicry and receptors. Epitope design and applications. Immunodiagnostic tests. Immuno florescence. Radioimmunoassay.
Reference books	1. Practical Biochemistry, Principles and Techniques, Keith Wilson and John Walker 2. Bioinstrumentation, Webster 3. Advanced Instrumentation, Data Interpretation, and Control of Biotechnological Processes, J.F. Van Impe,Kluwer Academic 4. Ananthanarayan R and Paniker CKJ. (2005). Textbook of Microbiology. 7th edition (edited by Paniker CKJ). University Press Publication. 5. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's Medical Microbiology. 24th edition. McGraw Hill Publication. 6. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier. 7. Joklik WK, Willett HP and Amos DB (1995). Zinsser Microbiology. 19th edition. Appleton-Centuary-Crofts publication. 8. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's

	Microbiology. 7th edition. McGraw Hill Higher Education. 9. Microscopic Techniques in Biotechnology, Michael Hoppert
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

SC347	**Basics of Forensic Science**
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of Biology
Learning objective	The learning objective of course are: To create an understanding regarding the Basics of Forensic Science
Expected Outcomes	The student will be able to conceptualize basics to advance of Basics of Forensic Science
Unit-I	**Basics of Forensic Science** **8 hours**
	Introduction and principles of forensic science, forensic science laboratory and its organization and service, tools and techniques in forensic science, branches of forensic science
Unit-II	**Crime Forensic** **7 hours**
	Causes of crime, role of modus operandi in criminal investigation. Classification of injuries and their medico-legal aspects, method of assessing various types of deaths.
Unit-III	**Fire Arm Forensic** **7 hours**
	Classification of fire arms and explosives, introduction to internal, external and terminal ballistics. Chemical evidence for explosives. General and individual characteristics of handwriting, examination and comparison of handwritings and analysis of ink various samples.
Unit-IV	**Toxicology Forensic** **7 hours**
	Role of the toxicologist, significance of toxicological findings, Fundamental principles of fingerprinting, classification of fingerprints, development of finger print as science for personal identification.
Unit-V	**Genetic Engineering Forensic** **7 hours**
	Principle of DNA fingerprinting, application of DNA profiling in forensic medicine, Investigation Tools, eDiscovery, Evidence Preservation, Search and Seizure of Computers, Introduction to Cyber security.
Reference books	1. Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington. 2. B.B. Nanda and R.K. Tiwari, Forensic Science in India: A Vision for the Twenty First Century, Select Publishers, New Delhi (2001). 3. M.K. Bhasin and S. Nath, Role of Forensic Science in the New Millennium, University of Delhi, Delhi (2002). 4. S.H. James and J.J. Nordby, Forensic Science: An Introduction to Scientific and Investigative Techniques, 2nd Edition, CRC Press, Boca Raton (2005). 5. W.G. Eckert and R.K. Wright in Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert (ED.), CRC Press, Boca Raton (1997). 6. R. Saferstein, Criminalistics, 8th Edition, Prentice Hall, New Jersey (2004). 7. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's Techniques of Crime Scene Investigation,

	CRC Press, Boca Raton (2013).
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

VI Semester

SC308	**Advanced Immunology**
Version	1.0
Prerequisite	All students are expected to have a Immunology
Learning objective	To create an understanding regarding the Advanced Immunology
Expected Outcomes	The student will be able to conceptualize basics to advance of Advanced Immunology
Unit-I	**Ag Presentation and Molecular Immunology**
	Mucosal immunity, Peyer's patches, gut barriers oral immunization Oral tolerance Cytotoxic response, ADCC, NK cells, CTL, Th, T reg, Immunoregulation, anergy, tolerance, anti idiotype, Mechanisms of antiviral innate immune response Experimental models in immunopathogenesis
Unit-II	**Immunotechniques I** **8 hours**
	Precipitation, agglutination and complement mediated immune reactions; advanced immunological techniques: RIA, ELISA, Western blotting, ELISPOT assay, immunofluorescence microscopy.
Unit-III	**Immunotechniques II** **7 hours**
	flow cytometry and immunoelectron microscopy; surface plasmon resonance, biosensor assays for assessing ligand –receptor interaction; CMI techniques: lymphoproliferation assay, mixed lymphocyte reaction, cell cytotoxicity assays, apoptosis, microarrays, transgenic mice, gene knock outs.
Unit-IV	**Clinical Immunology** **7 hours**
	Transplantation: immunological basis of graft rejection; clinical transplantation and immunosuppressive therapy; tumor immunology: tumor antigens; immune response to tumors and tumor evasion of the immune system, cancer immunotherapy; immunodeficiency: primary immune deficiencies, acquired or secondary immune deficiencies, autoimmune disorder, anaphylactic shock, immune senescence, immune exhaustion in chronic viral infection, immune tolerance, NK cells in chronic viral infection and malignancy.
Unit-V	**Immunization** **7 hours**
	Active and passive immunization; live, killed, attenuated, subunit vaccines; vaccine technology: role and properties of adjuvants, recombinant DNA and protein based vaccines, plant-based vaccines, reverse vaccinology; peptide vaccines, conjugate vaccines; antibody genes and antibody engineering: chimeric, generation of monoclonal antibodies, hybrid monoclonal antibodies; catalytic antibodies and generation of immunoglobulin gene libraries, idiotypic vaccines and marker vaccines, dendritic cell based vaccines, vaccine against cancer, T cell based vaccine, edible vaccine and therapeutic vaccine.

Reference books	Immunology. David A. Goldsby, Janis Kuby, Thomas J. Kindt, Barbara A. Osborne Latest edition / Pub. Date: December 2002. Publisher: W. H. Freeman Company. 2 Cellular and Molecular Immunology. Abul K. K. Abbas, Andrew H. Lichtman .Latest edition / Pub. Date: February 2005. Publisher: Elsevier Health Sciences. 3 High Yield Immunology. Arthur G. Johnson . Latest edition / Pub. Date: August 2005. Publisher: Lippincott Williams & Wilkins.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

SC310	**Pharmacology**
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of drugs
Learning objective	The learning objective of course are: To create an understanding regarding the Basics of Pharmacology
Expected Outcomes	The student will be able to conceptualize basics to advance of Basics of Pharmacology
Unit-I	**General Pharmacology**
	Introduction, Definitions, Classification of drugs, Sources of drugs, Routes of drug administration, Distribution of drugs, Metabolism and Excretion of drugs Pharmacokinetics, Pharmacodynamics, Factors modifying drug response, Adverse effects.
Unit-II	**Autonomic Nervous system** **8 hours**
	General considerations – The Sympathetic and Parasympathetic Systems, Receptors, Somatic ,Nervous System Cholinergic and Anti-Cholinergic drugs, Adrenergic and Adrenergic blocking drugs, Peripheral muscle relaxants.
Unit-III	**Cardiovascular Pharmacology** **7 hours**
	Drugs Used in the Treatment of Heart Failure: Digitalis, Diuretics, Vasodilators, ACE inhibitors Antihypertensive Drugs: Diuretics, Beta Blockers, Calcium Channel Blockers. Drugs Used in the Tratment of Vascular Disease and Tissue Ischemia : Hemostasis Lipid-Lowering agents, Antithrombotics, Anticoagulants and Thrombolytics.
Unit-IV	**Inflammatory/Immune Diseases** **7 hours**
	Non-narcotic Analgesics and Nonsteroidal Anti-Inflammatory Drugs: Acetaminophen, NSAIDs, Aspirin, Nonaspirin NSAIDs, drug Interactins with NSAIDs. Glucocorticoids: Pharmacological Uses of Glucocorticoids, adverse effects, Physiologic Use of Glucocorticoids. Drugs Used in the Treatment of Neuromuscular Immune/Inflmmatory Diseases: Myasthena gravis, systemic lupus Erythmatosus, Scleroderma.
Unit-V	**Respiratory Pharmacology** **7 hours**
	Respiratory Pharmacology: Obstructive Airway Diseases, Drugs used in Treatment of Obstructive airway Diseases, Allergic Rhiniti.
Reference books	. Lippicott's Pharmacology. 2. Essential of Medical Phramacology by Tripathi 3. Text book of Medical Pharmacology by Padmaja uday kumar
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended	

By BOS on:	
Approved by academic council on:	

SC314	**Pathology**
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of diseases
Learning objective	The learning objective of course are: To create an understanding regarding the Basics of Pathology
Expected Outcomes	The student will be able to conceptualize basics to advance of Basics of Pathology
Unit-I	**Introduction to pathology** **7 hours**
	Etiology and Pathogenesis with a brief recall of important aspects of normal cell Structure. Reversible cell injury: Types, Sequential changes, Cellular swellings, vacuolation, Hyaline changes, Mucoid changes. Irreversible cell injury: Types of Necrosis & Gangrene, Autolysis. Pathologic calcification: Dystrophic and Metastatic. Intracellular Accumulations - Fatty changes, Protein accumulations, Glycogen accumulations, Pigments - Melanin / Hemosiderin. Extra cellular accumulations: Amyloidosis - Classification, Pathogenesis, Pathology including special stains.
Unit-II	**Inflammation** **8 hours**
	Acute inflammation: features, causes, vascular and cellular events. Inflammatory cells and Mediators. Chronic inflammation: Causes, Types, Classification nonspecific and granulomatous with examples. Repair, Wound healing by primary and secondary union, factors promoting and delaying the process. Healing in specific site including bone healing.
Unit-III	**Immunopathology** **7 hours**
	Immune system: General concepts. Hypersensitivity: type and examples, antibody and cell mediated tissue injury with examples. Secondary immunodeficiency including HIV infection. Auto-immune disorders: Basic concepts and classification, SLE. AIDS-Aetiology, Modes of transmission, Diagnostic procedures, handling of infected material and health education.
Unit-IV	**Infectious diseases** **7 hours**
	Viral diseases: Poliomyelitis, Herpes, Rabies, Measles, Rickttsia, Chlamydial infection, HIV infection. Mycobacterial diseases: Tuberculosis, Leprosy and Syphilis. Bacterial disease: Pyogenic, Diphtheria, Gram negative infection, Bacillary dysentery
Unit-V	**Hematology** **7 hours**
	Leukocytic disorders: Leukocytosis, Leukopenia, Leukemoid reaction. Leukemia: Classification, clinical manifestation, pathology and Diagnosis. Multiple myeloma and dysproteinemias. Blood transfusion; Grouping and cross matching, untoward reactions, transmissible infections including HIV & hepatitis, Blood-components & plasma-pheresis.
Reference books	1. Text book of pathology: Harshmohan 2. General systemic pathology: Churchill Livingstone

	3. Text book of Pathology: Robbins
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

SC318	**Viral disease and Interaction**
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of Virology
Learning objective	The learning objective of course are: To create an understanding regarding the Basics of Viral disease and Interaction
Expected Outcomes	The student will be able to conceptualize basics to advance of Basics of Viral disease and Interaction
Unit-I	**Viral Encephalitis**
	Epidemiological scenario with respect to Viral Encephalitis at National and International level. Viral Encephalitis, encephalopathy and meningitis, clinical symptoms and causative agents, treatment modalities, transmission, spread of an outbreak in relation to causative agent. Laboratory diagnosis of viral encephalitic agents, basic principles, preferred methods and problems. Japanese encephalitis and West Nile viral infection, endemic areas, disease burden, seasonality, role of non human hosts, genotypes, vaccines.
Unit-II	**Chandipura encephalitis**
	Chandipura encephalitis, endemic areas, disease burden, seasonality, role of non human hosts, genotypes, other rhabdoviral neurotropic agents. Encephalitis/ encephalopathy caused by measles virus, Enteroviral encephalitis and meningitis, causative agents, spread of the disease, seasonality, differential diagnosis, Mumps encephalitis, Encephalitis caused by alpha viruses, Encephalitis caused by Nipah and Hendra virus, Herpes virus encephalitis, diagnosis in sporadic cases, association with immunosuppression, reactivation vs. primary infections, treatment. Routes and modalities of infections of the nervous tissue, blood brain barrier, factors affecting the neurovirulence
Unit-III	**Epidemiological scenario**
	Epidemiological scenario with respect to Viral Hemorrhagic Fevers at National and International level. Common clinical features of Viral Hemorrhagic Fevers, History and Disease burden, Risk factors and geographical distribution of viruses associated with hemorrhagic fevers and their impact on global health. Clinical samples required, choice of laboratory diagnostic tests and their interpretation for differential diagnosis.
Unit-IV	**Virus replication strategy**
	Virus replication strategy, Pathogenesis, Prevention and treatment of Dengue. Role of humoral and cell mediated immunity and viral factors in development of DHF, differential diagnosis of DF and DHF on the basis of clinical symptoms. Virus replication strategy, Pathogenesis, Prevention and treatment of Yellow Fever, Kyasanur forest disease, Chikungunya, Rift Valley Fever, Crimean Congo hemorrhagic fever, Hanta, Marburg and Ebola, and Rickettsial fevers.
Unit-V	**viral receptors**
	Definition, structure and methods of discovery of viral receptors (polio, herpes, VSV, HIV).

	Kinetics of receptor binding. Cellular interactions—clathrin coated pits, lipid rafts, caveolae, endocytosis and virus uncoating mechanisms. Nuclear localization signals and nuclear pore transit, virus –cytoskeletal interactions, chaperons. Replication sites and their characterization, IRES, replicons, transport of viral proteins. Host cell 'shut off', apoptosis, necrosis, stress response, alteration of signaling pathways, cellular basis of transformation, types of cenotaphic effects, ultrastructural cytopathology. Cellular injury associated markers, mechanism of viral persistence and latency—in vivo and in vitro models (JE, measles, LCM and HIV).
Reference books	1. Principles of Virology: Molecular Biology, Pathogenesis, and Control of Animal Viruses. S. J. Flint, V. R. Racaniello, L. W. Enquist, V. R. Rancaniello, A. M. Skalka Latest edition / Pub. Date: December 2003 Publisher: American Society Microbiology. 2. Virus Dynamics: Mathematical Principles of Immunology and Virology. Martin A. Nowak, Robert May.Latest edition / Pub. Date: January 2000. Publisher: Oxford University Press. 3. Molecular Aspects of Host-Pathogen Interactions. Malcolm A. McCrae (Editor), J. R. Saunders (Editor), C. J. Smyth (Editor), N. D. Stow (Editor) Latest edition / Pub. Date: September 1997. Publisher: Cambridge University Press. 4. Cell Biology of Virus Entry, Replication, and Pathogenesis. Richard W. Compans, Ari Helenius (Editor), Michael B. Oldstone (Editor). Latest edition / Pub. Date: December 1988. Publisher: Wiley, John & Sons, Incorporated.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

SC316	Emerging Viral Infections
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of Virology
Learning objective	The learning objective of course are: To create an understanding regarding the Emerging Viral Infections
Expected Outcomes	The student will be able to conceptualize basics to advance of Emerging Viral Infections
Unit-I	**Epidemiology of viral infection I**
	Introduction to viruses, viral diseases, Outbreaks, epidemics and pandemics. History of Viral outbreaks. Viral disease like, Ebola in West Africa, Zika Viral disease, Kyasanur forest disease (KFD).
Unit-II	**Epidemiology of viral infection II**
	Nipah viral disease, Influenza (H1N1, Avian Flu). Severe Acute Respiratory Syndromes (SARS), Middle East Respiratory Syndrome (MERS) and Novel corona viral disease (Covid-19).
Unit-III	**Methods for studying emerging infections I** **7 hours**
	Viral sampling, isolation, culture, precautions and bio safety. Principle and application of techniques involved in diagnosis like genetic material based: RT PCR , microscopic methods:
Unit-IV	**Methods for studying emerging infections II** **7 hours**
	Immunofluorescence and electron microscope, Antibody based method: ELISA and Rapid detection strips, Hemagglutination assay.
Unit-V	**Disease Mapping** **7 hours**
	Mapping of viral disease in the world. Viral Infection, prevention and control (IPC). Categorization of Epidemic, Endemic and Pandemic. Population studies, WHO standards.
Reference books	1. Text book of pathology: Harshmohan 2. General systemic pathology: Churchill Livingstone 3. Text book of Pathology: Robbins
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

SC320	Viral Respiratory diseases
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of viral pathology
Learning objective	The learning objective of course are: To create an understanding regarding the Viral Respiratory diseases
Salient features	The student will be able to conceptualize basics to advance of the Viral Respiratory diseases
Unit-I	**Epidemiological scenario**
	Epidemiological scenario with respect to respiratory diseases at National and International level
Unit-II	**History**
	History, clinical features, epidemiology, of influenza, RSV and other respiratory diseases.
Unit-III	**Biology and pathogenesis**
	Biology and pathogenesis of SARS, Metapneumovirus, human rhino virus and Corona virus etc.
Unit-IV	**Differential diagnosis**
	Differential diagnosis of different respiratory diseases.
Unit-V	**Vaccines**
	Vaccines against different viral respiratory diseases.
Reference books	1. Principles of Virology: Molecular Biology, Pathogenesis, and Control of Animal Viruses. S. J. Flint, V. R. Racaniello, L. W. Enquist, V. R. Rancaniello, A. M. Skalka Latest edition / Pub. Date: December 2003 Publisher: American Society Microbiology. 2. Virus Dynamics: Mathematical Principles of Immunology and Virology. Martin A. Nowak, Robert May.Latest edition / Pub. Date: January 2000. Publisher: Oxford University Press. 3. Molecular Aspects of Host-Pathogen Interactions. Malcolm A. McCrae (Editor), J. R. Saunders (Editor), C. J. Smyth (Editor), N. D. Stow (Editor) Latest edition / Pub. Date: September 1997. Publisher: Cambridge University Press. 4. Cell Biology of Virus Entry, Replication, and Pathogenesis. Richard W. Compans, Ari Helenius (Editor), Michael B. Oldstone (Editor). Latest edition / Pub. Date: December 1988. Publisher: Wiley, John & Sons, Incorporated.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	