

COURSE OUTCOME
M.Sc. BIOTECHNOLOGY

Course code	Course name	Course Outcome
BTH 101	Cell biology	CO1: Comprehend on structural and functional study of prokaryotic and eukaryotic system CO2: Describe the Cell movement, extracellular matrix, cell interaction and cell regulation CO3: Specify the effects of free radical on macromolecules and mechanism involved in aging
BTH 102	Molecular Genetics	CO1: Illustrate the concepts involved in Mendelism and organization of chromosomes and their significance CO2: Acquire the essential aspects involved in mutation and study on important disorders CO3: Summarise the importance of molecular basis of evolution studies
BTH 103	General Microbiology	CO1: Describe the general classification, morphological and molecular basis classification of microbes/bacteria CO2: Differentiate the properties, structure and reproduction of Microorganism CO3: Expound the microbial growth, control process and cultivation of microbes from various sources
BTH 104	Biochemistry	CO1: Illustrate the aspects of bioenergetics and metabolic pathway by which cell use enzymes to oxidize nutrients CO2: Describe the classification, structure, properties and metabolism of biomolecules link with its applications CO3: Expound the structure, properties and metabolism of macromolecules
BTS 105	Biostatistics	CO1: Analyse and interpret the measurement of variability and population studies CO2: Investigate and interpret the probability distributions and test with various hypothesis of biological samples using biostatistics conceptions

BTP106	Cell Biology and Molecular Genetics	CO1: Perform and explore the skills involved in molecular cell biology and other significant studies CO2: Perform molecular genetics and its significances
BTP107	General Microbiology and Biochemistry	CO1: Perform hands on techniques to identify the microorganism by morphological and biochemical test CO2: Estimate the presence of biomolecules by quantitative methods
BTH 201	Enzymology and biochemical techniques	CO1: Illustrate the concepts of physical, chromatographic and electrophoretic techniques and its applications CO2: Expound the classification, properties and mechanism involved in the substrate reactions CO3: Discuss the enzymes and its reaction to proceed towards various concepts in biotechnology and theoretical, practical aspects of kinetics towards research
BTH202	Molecular Biology	CO1: Explore and co-relate the biological system and properties of macromolecules CO2: Expound the mechanism involved in the central dogma of the cell of prokaryotic and eukaryotic system CO3: Illustrate the mechanism involved in the molecular interaction between the cells
BTH 203	Immunology and Immunotechnology	CO1: Explain and co-relate the concepts in immune system and its cellular response CO2: Illustrate and explore the biological response and autoimmunity CO3: Discuss the mechanism underlying protective immune responses and the recent advances and emerging themes in immunology research
BTH204	Environmental Biotechnology	CO1: Expound and co-relate the concepts in energy resources and monitoring environment CO2: Expound the techniques and treatment for the industrial effluent CO3: Discuss the methods to improve global environmental issues by incorporating research
BTS205	Bioinformatics	CO1: Expound and explore different types of operating system and application CO2: Apply computational based solutions for biological perspectives

		CO3: Pursue higher education in the field
BTP206	Enzymology and Immunology	CO1: Perform and interpret the estimated amount of enzymes from natural resource CO2: Perform and interpret the complement response technique towards research
BTP 207	Molecular Biology and Environmental biotechnology	CO1: Perform the isolation technique for DNA, the computational applications related to macromolecules CO2: Perform water quality parameters and analysis the sample
BTH301	Plant and agricultural Biotechnology	CO1: Expound the importance of tissue culture techniques and production of biodegradable products CO2: Expound the importance of biofertilizers, biopesticides, vermicomposting and plant growth regulators CO3: Illustrate the techniques involved in crop improvement which can assimilated in the research activity
BTH302	Animal Biotechnology	CO1: Explicate the methods involved in animal cell tissue and tissue engineering CO2: Illustrate the importance and applications of transgenic animals CO3: Expound and explore guidelines and social awareness of biosafety responsible related to biotechnology
BTH303	Genetic Engineering	CO1: Illustrate and co-relate the aspects involved of cloning and screening techniques CO2: Elaborate the significance of transformation and screening techniques CO3: Expound and co-relate the concepts towards research
BTP305	Plant, Agricultural and Animal Biotechnology	CO1: Perform various hands on explant culturing techniques CO2: Perform and explore in depth knowledge in tissue culture technique
BTP306	Genetic engineering and Bioinformatics	CO1: Perform and analysis recombinant DNA technology techniques and put forward towards research CO2: Apply and interpret the results by accessing the major sequence database and use different computational tools

BTH 401	Bioprocess Engineering	CO1: Explain the various aspects and significance of fermentation process CO2: Illustrate the problems associated with biomolecules and their environmental condition CO3: Analyse and identify factors involved in bioprocess and solution to address biological and engineering problems
BTH402	Medical Biotechnology	CO1: Explicate the symptoms, mode of infection and organ function in detail CO2: Explain the cellular changes and its response in tumour cells associated with molecular therapies CO3: Expound the clinical research aspects towards research
BTH403	Genomics and Proteomics Discuss the techniques used in functional genomics such as microarrays, NGS Interpret data obtained through high throughput expression studies	CO1: Discuss the key technological developments that enabled modern genomic and proteomic studies CO2: Apply bioinformatics techniques to query samples of genomics and proteomic databases to analyses biology system CO3: Describe the different types of genome variation and relation with human disease and help to develop towards research
BTP404	Bioprocess Engineering and Medical Biotechnology	CO1: Perform the isolation process and analysis and estimate the industrial important products CO2: Perform and estimate the biochemical parameters using biological samples and to interpret the pathological conditions

COURSE OUTCOME
M.Sc. MICROBIOLOGY

Course code	Course name	Course Outcome
MBH101	Bacteriology & Virology	<p>CO1: To study the various systems of classification of microorganisms, like Three kingdom, Five kingdom and other criteria followed according to Bergey's Manual. Taxonomical methods as per the recent trends and about the phylogenetic trees To be acquainted with basic morphology of microorganisms, cell organelles, inclusion bodies. The knowledge about cyanobacteria and ultrastructure and their habitat.</p> <p>CO2: To gain knowledge of the various microorganisms like Spirochetes, difficult to grow microorganisms like (Chlamydiae, Mycoplasma, Rickettsia), Actinomycetes and also Archaeobacteria</p> <p>To understand the nutritional requirement of the microorganisms (micro & macro) elements for growth, various media, growth factors, types of growth and the mechanism involved in cell cycle and fission.</p> <p>CO3: To perceive the various systems involved in classification and nomenclature of viruses, its morphology and ultrastructure To study the different cultivation methods of viruses.</p>
MBH 102	Eukaryotic Microbiology	<p>CO1: Elucidate the structure & significance of important protozoan species and describe the structure, reproduction, measurement of growth and physiological features of fungi.</p> <p>CO2: Comprehend the ecological niche, morphology, characteristic features, type study, isolation, large scale culture techniques of algae and distinguish the economic importance of algae as primary</p>

		<p>producers, commercial products and in formation of algal blooms</p> <p>CO3: Appreciate the evolutionary tendencies and features of important fungi of each class, fungal economic importance, various substrate groups and interactions of fungi.</p>
MBH 103	Microbial Physiology & Biochemistry	<p>CO1 To understand microbial adaptation/response to various environmental stresses like starvation, osmotic, thermal and oxidative stress and how nutrients are transported across the membrane by various transport systems like passive, active and facilitated diffusion. To perceive the significance and mechanism of enzyme action, their properties and enzyme kinetics</p> <p>CO2 To be aware of structures and properties of carbohydrates their various fermentation pathways like HMP, ED, EMP, PP, TCA and the associated bioenergetics/ energy production aspects like ETC and phosphorylation. To know the structure and classification and significance of various lipids, their biosynthesis and oxidation process.</p> <p>CO3 To apprehend the structure of bases, nucleotides, their biosynthetic pathways and metabolism. To discern the properties of amino acids and proteins, their classification, metabolism, structural organization and metabolism</p>
MBH 104	Microbial and Biochemical Techniques	<p>CO1: To comprehend the various isolation techniques for microorganisms, their maintenance, preservation of pure cultures, National and International culture collections.</p> <p>To familiarize with the working principles of microscopy, staining techniques and image processing methods.</p> <p>To apprehend microbial growth by various techniques.</p> <p>CO2: To analyze the metagenomes of culture independent microbes, phospholipid analysis, and hybridization methods.</p> <p>To understand the principles of spectrophotometry and spectroscopic methods.</p>

		CO3: To apprehend the principles and applications of various chromatographic techniques, Electrophoretic types, Radio isotopic and labelling techniques.
MBS105	Biostatistics	CO1: Introduction, basic concepts including measures of central tendencies and deviation data types, properties and its applications related to population and sample studies CO2: To understand the rules and types of probability and its distributions with worked out problems CO3: To understand the basic concepts and its hypothesis testing by performing few problems and understanding of SPSS statistical software
MBP106	Bacteriology, Virology and Eukaryotic Microbiology	CO1: To develop skills of how to perform basic techniques in Bacteriology like pure culture techniques, media preparation, staining techniques CO2: To comprehend biochemical characterization of microorganisms based on a series of tests, bacterial growth measurements, bacteriophage isolation and certain other sources. CO 3: To perceive essential skills for eukaryotic microbiology, isolation of fungi by different methods, growth measurements, identification of algae, protozoa and certain antibiotic producers.
MBP107	Microbial Physiology, Biochemistry & Microbial Techniques	CO1: To equip oneself with techniques involved in biochemistry for the estimation of sugars, proteins and nucleic acids CO2: To understand the microbial physiology in isolating lipolytic microorganisms, determining the activity of enzymes. CO3: Fractionation of lipids and performing SDS PAGE for the determination of molecular weight of proteins and enzymes.
MBH201	Microbial Genetics	CO1 To understand the bacterial chromosomal structure and organization, various models proposed to explain the structure and type study. To perceive the genome organization in Eukaryotes, to have

		<p>the knowledge of histones, chromosomal remodelling, types and banding patterns.</p> <p>CO2 To be aware of how different types of mutations occurs in genetic material, the cause for mutation, its role in evolution and the way they are tested. To know the flexibility of genetic material in terms of genetic recombination process occurring in prokaryotes like bacteria and bacterial viruses with emphasis on mechanism</p> <p>CO3 To apprehend the techniques involved in genetic analysis of <i>Neurospora crassa</i> and <i>Saccharomyces</i> sp. by mutation experiments and study of mutants and to get practical skills in other methods of recombination like protoplast fusion techniques.</p>
MBH202	Molecular Biology	<p>CO1: To understand the concepts of molecular biology, like structure of DNA, its damage, repair, DNA replication in prokaryotes and viruses.</p> <p>CO2: To comprehend Transcription process, its factors, activators and repressors. Translation, genetic codes, steps of translation, control of translation.</p> <p>CO3: Regulation of gene expression, operon concept, inducible enzymes, repressible enzymes, negative regulation, Lac operon concept. Control of gene expression.</p>
MBH203	Environmental Microbiology	<p>CO1: To perceive the various atmospheric layers and to assess the air quality in different locations based on certain general principles, and also to be familiar with the causes and detection tests for various allergies.</p> <p>To understand the concept of fresh water and marine ecosystem, its zonation, food chain in aquatic systems, familiarizing role of methanotrophs in the ecosystem, assessment of water quality of potable water, causes for the contamination of ground water, waste water treatment methods.</p> <p>CO2: To comprehend the biotic and abiotic interactions in nature and various ecological concepts, management & conservation of biodiversity, and significance of microorganisms in solid waste treatment and their role in biogeochemical cycles.</p>

		<p>To understand the methanogenic bacteria in reduction of certain organic compounds, the mechanisms involved and their transformations.</p> <p>CO3: To possess an in-depth knowledge of the extremophilic microorganisms, their habitat, adaptations, membrane variations and applications of the enzymes thereof.</p> <p>To develop an understanding of role of microbes in the degradation of hydrocarbons, xenobiotics, heavy metals and plastics.</p> <p>Exploitation of microorganisms for bioremediation and extraction of metals from their native ores.</p>
MBH204	Food Microbiology	<p>CO1: To understand the chronological development of food microbiology, how food can be a substrate for microorganisms, various factors involved in the growth of microorganisms in food from different sources.</p> <p>To understand sources of contamination and spoilage of cereals, sugars, vegetables, fruits, milk & its products, meat & its products, poultry, sea foods. Assessing the spoilage of canned foods for their spoilage and methodologies involved in their characterization & detection.</p> <p>CO2: Understanding of the food borne infection and intoxication from different microbial sources, toxins produced from microorganisms and their detection methods.</p> <p>To be familiar with the physical food preservation methods and the application of chemical methods for preservation and to explore the biological methods of food preservation and the various aspects of food packaging.</p> <p>CO3: To be acquainted with the fermented foods for their nutritional and therapeutic properties from different sources, single cell proteins, single cell oils, and microbial pigments for their applications food in industries.</p> <p>Importance of Food sanitation, various practices involved, food protection agencies, good manufacturing practices, good</p>

		manufacturing practices, safe disposal of waste and quality control. Knowledge of the development of food technology is to be highlighted.
MBP206	Microbial Genetics & Molecular Biology	<p>CO1: To develop skills of how to perform basic techniques in genetics like isolation of DNA from bacteria, fungi and algae, electrophoresis followed by southern and western blotting. To learn skills in performing mutation based experiments of selective fungal and bacterial species by UV treatment and replica plating techniques.</p> <p>CO2: To equip oneself with techniques involved in gene transfer mechanisms like bacterial conjugation, bacterial transformation and transduction experiments and to know the significance and trouble shooting aspects.</p> <p>CO3: To apprehend the techniques involved in genetic analysis of <i>Neurospora crassa</i> and <i>Saccharomyces</i> sp. by mutation experiments and study of mutants and to get practical skills in other methods of recombination like protoplast fusion techniques.</p>
MBP207	Environmental Microbiology & Food Microbiology	<p>CO1: To apprehend the techniques involved in quantification of microorganisms in air, quantification of air borne endotoxins.</p> <p>CO2: To selectively isolate methanogenic bacteria, carry out potability tests for water, physical assessment of water, testing the heavy metal tolerance of microorganisms, screening & characterization of recalcitrant compounds.</p> <p>CO3: Isolating Bacteriocin producers, isolation and identification food borne pathogens, aflatoxin producers, production and estimation of single cell proteins, role of yeast in bread making, study of probiotic microorganisms.</p>
MBH301	Medical Microbiology	<p>CO1: To perceive the significance of normal flora of the human body, microorganisms affecting certain tissues and emerging and reemerging diseases from viral, bacterial and protozoan and fungal diseases.</p> <p>To understand the various portals of entry of pathogens, their virulence factors, their role in</p>

		<p>breaching host defences, evading host defences, signalling mechanisms, factors influencing quorum sensing and hospital acquired infections.</p> <p>CO2: To understand the various bacterial diseases their pathogenecity, laboratory diagnosis, epidemiology and control measures.</p> <p>To grasp the causative agents of various fungal diseases their symptoms, epidemiology and treatment. Study of certain of subcutaneous mycoses and systemic mycoses.</p> <p>CO3: To understand the causative agents of various viral diseases their clinical symptoms, epidemiology and treatment.</p> <p>To perceive antimicrobial agents, their classification, mechanism of drug action, methods of testing drug sensitivity, multiple drug resistance causes, probiotics as therapeutic agents, passive prophylactic measures.</p>
MBH 302	Immunology	<p>CO1:Acquire Knowledge on types of immunity, the cells , organs of the immune system, their products and interaction with antigen</p> <p>CO2:Expertize the various mode of antigenic elimination-CMI,HI,Complement and nonspecific immune reactions</p> <p>CO3: Learn the immune associated clinical complications, laboratory diagnosis and treatment of Hypersensitivity, tumor, autoimmunity etc and immuno -prophylaxis</p>
MBH 303	Recombinant DNA Technology	<p>CO1To understand the scope of recombinant DNA technology, steps involved in cloning, the role of various enzymes in gene manipulation and cloning vectors ranging from simple to super vectors of bacteria, plants and animals. To perceive the significance of strategizing cloning with emphasis on cloning in bacteria and yeast and relative importance of library construction, various transformation and selection techniques.</p> <p>CO2 To be aware of techniques involved in cloning like blotting, electrophoresis, microarray and the role of various markers</p>

		<p>like RAPD, RFLP in genomics. To know how to sequence the genome using various sequencing techniques like classical and recent automated techniques and their applications.</p> <p>CO3 To apprehend the techniques involved in chemical synthesis of DNA and their applications like whole gene synthesis. To discern the role of RDT in agriculture wherein revolution could be done by creating transgenic plants resistant to insecticides, herbicides, environmental stresses and infections. Also the role of RDT in animal husbandry by creating transgenic animals for better milk and meat production and other applications of RDT like gene therapy.</p>
MBP305	Medical Microbiology & Immunology	<p>CO1: To develop skills in isolation and identification of microbes from clinical samples, skin on selective, differential and enrichment media.</p> <p>CO2: To carry out various staining techniques for microbes, inclusion bodies, testing of drug susceptibility by various protocols.</p> <p>CO3: To equip with skills for the purification of antigens, antibodies, test antigen-antibody reactions, allergens.</p>
MBP306	Recombinant DNA Technology & Bioinformatics	<p>CO1:To develop skill of how to perform basic techniques in RDT like nucleic acid isolation, Agarose gel electrophoresis and various blotting techniques like southern and western blotting. To learn skills in basic steps of cloning like how to cut DNA into fragments using restriction enzymes and how to stick DNA fragments using ligase enzymes and other trouble shooting aspects.</p> <p>CO2:To equip oneself with techniques involved in cloning by performing cloning experiment on <i>Escherichia coli</i>, which will give exposure to transformation and selection techniques by using markers employed in cloning vectors. To know how to do DNA amplification by Polymerase Chain Reaction and Rapid amplification of Polymorphic DNA and be aware of their applications.</p>

		<p>CO3:To apprehend the techniques involved in handling of Sequenced data of DNA and protein data by bioinformatics methods. To be experienced in bioinformatics tools like BLAST, FASTA etc.</p>
MBH401	Agricultural Microbiology	<p>CO1: To understand the role of microorganisms in decomposition of organic matter thereby in enriching soil fertility, and to study the effect of pesticides on soil microflora.</p> <p>To analyze the Biological nitrogen fixation processes in various microorganisms, genes, enzymes involved and the molecular mechanisms involved.</p> <p>CO2: To comprehend the plant microbe interactions, methods involved, presence of microorganisms on the different plant parts, plant growth promoting rhizobacteria, iron chelators, VAM.</p> <p>To understand the production and quality control of bioinoculants, its type, carrier based inoculants, its applications. To gain knowledge of biopesticides, its production, types and applications.</p> <p>CO3: To get in-depth knowledge of the various aspects of molecular plant pathology like host cell behaviour by pathogen, mechanism of disease establishment, phytoxins, enzymes, r and R genes, and transgenic approaches for crop protection.</p> <p>To perceive the various diseases affecting crops wherein a clear understanding of fungal, bacterial, viral, protozoan diseases, post harvest diseases and its control measures, integrated pest management.</p>
MBH402	Industrial Microbiology	<p>CO1: To perceive the scope of industrial microbiology, fermentation technology and to study the industrially important microorganisms and its preservation, strategies for strain improvement, and control of recombinant organisms.</p> <p>To analyze the effect of different fermentation processes involving physical and chemical sources, growth measurement and certain viscosity studies.</p>

		<p>CO2: To study the construction and the various aspects of fermentors, sterilization and scaling up of processes and its associated problems. Fermentation media, its formulation, role of various components. Understanding different bioreactors. To familiarize the concept of sterility, comparison of solid state fermentation and submerged fermentation, factors influencing each type, design of a koji fermentor, commercial exploitation of knowledge of SSF for biomolecules.</p> <p>CO3: To conceive the idea of Down stream processing, its objectives, criteria and certain other aspects involved in product recovery, quality control of the product, process economics involved. To perceive the Intellectual property rights, patents, procedure of patents, laws involved, patentable & non-patentable materials, various treaties and organizations implicated in the field. Understanding the concept of entrepreneurship, theories involved and entrepreneurship in Indian perspective, regulations of the government, and valuation in business concerns.</p>
MBH403	Microbial Technology	<p>CO1: To know the principle, economics and milestones of microbial technology. To be familiar with the industrial production of various organic acids, amino acids, solvents, antibiotics and certain microbial polysaccharides, hormones, anticholesteremic agents, vaccines. Production aspects of certain microbial insecticides, secondary metabolites from microorganisms.</p> <p>CO2: To understand the industrial production of enzymes with wide application across industries, for diagnostic applications and recombinant enzymes. To perceive the microbial transformation of sterols, glutathione from GMO's, vitamin C production, nitrile hydratase and optically pure drugs.</p> <p>CO3: Understanding nanotechnology, application of various tools of nanotechnology, production of nanomaterials</p>

		<p>from microorganisms, and nanoparticles from microorganisms.</p> <p>To understand the Human genome project with the associated ethical, legal and social implications, biosafety guidelines on GMOs, labelling of GM products. Testing of drugs on human volunteers.</p>
MBP404	Agricultural and Industrial Microbiology & Microbial Biotechnology	<p>CO1: To equip oneself with techniques involved in isolation of microorganisms capable of degrading agro industrial wastes, isolation of nitrogen fixing microbes, PSBs.</p> <p>CO2: Cultivation of single cell proteins like Mushrooms, estimation of phenolics from diseased plants.</p> <p>CO3: To develop skills for immobilization of microorganisms, production of alcoholic beverages, antibiotics, isolation of pigment producers and its quantification, carrying out assays of amino acids.</p>

COURSE OUTCOMES

M.Sc. BIOCHEMISTRY

Semester -I

Course code	Course name	Course Outcome
BCT-101	Biophysical and Bio – organic chemistry	<p>CO-I: Students should be able to understand the role of water in the biological system, colligative properties, buffers, laws of thermodynamics and red-ox reactions in the biological system.</p> <p>CO -II : Students should gain knowledge of the confirmation of the atoms and structure of the molecules and should understand the mechanism of the Bio-oraganic, inorganic reaction, and role of the free radicals in the chemical reactions.</p> <p>CO-III: Students should able to the importance of the Heterocyclic compounds and the role of the Co-ordination compounds and their stability.</p>
BCT 102	Biomolecules	<p>CO-I: Students should be able to learn structure , types, function and significance of carbohydrates, Lipids, proteins and nucleic acids.</p> <p>CO-II: Students should able to gain knowledge in protein folding , Kinetics, synthesis and sequencing of protein, Functions of cheperons, diseases related to protein folding.</p> <p>CO-III : Students will gain knowledge in Nucleic acids, their types, structural organizations and the synthesis and sequencing of nucleic acids.</p>
BCT 103	Analytical Biochemistry – I	<p>CO-I: Students will able to learn the strategies in the biochemical investigation, use of different organisms, various methods of extraction, also the operations and principles used in different microscopes.</p>

		<p>CO-II: Students will be able to understand the principle of centrifugations, types, and biocalorimetry and manometry.</p> <p>CO-III: Students will gain knowledge in radioisotopes and different methods of measuring the radioactivity, they will get information in types of errors in experiments and SOPs , ANOVA, and different other bio statistical methods.</p>
BCT 104	General physiology	<p>CO-I: Students will able to learn the organization, types and functions of tissues and to understand the organization of the cytoskeleton, microfillaments, locomotary structures of the cell.</p> <p>CO-II: : Students will be able to understand the regulation of the body physiology and the nervous system, structure and mechanism of the muscles.</p> <p>CO III: Students will be able to gain knowledge of the digestion, respiratory and excretion, endocrine system.</p>
BCSCT – 105	Nutrition	<p>CO-I: Students will able to understand the importance of essential and non-essential amino acids, various lipids in growth and development and concepts of energy in nutrition.</p> <p>CO-II: Students will be able to learn the various macro/micro- minerals and trace minarals and different types of vitamins and their functions.</p> <p>CO-III : Students will be able to understand the causes of mal nutrition and different disorders and the role of free radicals -their effect, role of anti oxidants and the importance in the biological system.</p>
BCP-106	Gen. Biochemistry – I	<p>CO-I :Students will be able to prepare buffers, and can perform determination of saponification number, and acid value, iodine number and peroxide value of oils and fats.</p>

		<p>CO-II : Students will be able to determine pka of weak acids and amino acids by pH metric titration and calculation of pI,</p> <p>CO-III : Students will be able to determine starch/ glycogen in a given sample also can estimate Vitamine C, Phytic acid in a given sample.</p>
BCP-107	Gen. Biochemistry – I	<p>CO-I : Students will be able to perform determination of absorption spectra of proteins and nucleic acids and determination of molar extinction coefficient.</p> <p>CO-II : Students will be able to perform colorimetric estimation of sugar, inorganic phosphate, different amino acids and nucleic acids</p>
BCT- 201	Enzymology	<p>CO-I : Students will be able to learn the nomenclature, classification, localization, purity, immobilization of enzymes and also the investigation of active site structure of enzyme.</p> <p>CO-II ; Students will be able to gain in depth knowledge in enzyme catalysis reaction, effect of coenzymes and kinetics of enzyme catalyzed reactions, Kinetics of bi- substrate reactions.</p> <p>CO-III : Students will be able to understand enzyme inhibition and allosteric mechanism of action of enzyme.</p>
BCT- 202	Analytical Biochemistry -II	<p>CO-I : Students will be able to know the basics of chromatographic technique- modes of chromatography, advance techniques – HPLC, FPLC, reverse, Gas chromatography and different methods of electrophoresis .</p> <p>CO-II : Students will gain knowledge in Spectroscopic technique, function construction, and applications in biological system</p>

		CO-III : Students will learn proteomics and bioinformatics with biological applications
BCT-203	Metabolism I	<p>CO-I : Students will learn in details of carbohydrate metabolism-glycogen/starch metabolism and disorders related to this .</p> <p>Co-II : Students will gain knowledge in lipid metabolism- catabolism and anabolism .</p> <p>CO-III : Students will learn about process, types and mechanism of Photosynthesis.</p>
BCT-204	Membrane Biochemistry	<p>CO-I : Students will able to understand structure , components, FMM, organelle membrane, lipid bi layer, asymmetry, non bilayer, cholesterol, organization , concept of liposomes.</p> <p>CO-II: Students will gain information of different membrane proteins- their composition, structure, functions, techniques to determine and will gain concept of membrane transport methods experimental proof and details mechanism of intracellular compartment and protein trafficking.</p> <p>CO- III : Students will learn topology of membrane and biogenesis of lipid bilayers.</p>
BCSCT-205	Microbiology	<p>CO-I : Students will be able to gain knowledge in bacteriology, food microbiology, eukaryotic microorganisms, medical microbiology and virology.</p> <p>CO-II : students will be able to understand pure culture technique, staining technique and control of microbial growth.</p>
BCP- 206	Biochemical and Immunochemical Techniques	<p>Co-I : Students will be able to gain hands on training in different chromatographic techniques and electrophoretic techniques.</p> <p>CO-II : Students will learn the method of separation and molecular mass determination process : western blotting, antibody purification and pI determination of given protein sample.</p> <p>CO-III : Students will learn different method of antigen – antibody interaction methods-</p>

		ELISA, Immuno-electrophoresis, agglutination techniques .
BCP-206	Enzymology	<p>CO- I : Students will be able to determine K_m and V_{max} of different enzyme samples.</p> <p>CO-II : Students will be able to impart knowledge on the effect of temperature, pH, time , substrate concentration of an enzyme substrate reaction.</p> <p>CO-III : Students will have hands on training in mechanism of enzyme catalyzed reactions, Henri-Michaelis-Menten and Briggs Haldane hypothesis, Lineweaver-Burk plot. Enzyme inhibition: reversible (Competitive, Non-competitive and Un-competitive) and irreversible inhibition. K_i, Substrate and product inhibition.</p>
BCT-301	Molecular Biology- I	<p>CO- I: Students will be able to understand central dogma of molecular biology. experiments confirming DNA/ RNA as genetic material. Prokaryotic and eukaryotic replication mechanisms, experimental methods.</p> <p>CO-II : Students will be able to gain knowledge in replication of different DNA/ RNA viruses, mechanisms and experimental proof of different types of DNA repair systems both in prokaryotes and eukaryotes.</p> <p>CO-III : Students will be able to understand different mechanisms and experimental methods of prokaryotic and eukaryotic transcriptions and post transcription modifications and their experimental proofs.</p>
BCT-302	Molecular Physiology	<p>CO- I : Students will be able to understand different mechanisms of nerve signaling, regulations, endocrine system and signal transduction pathways- primary messenger, cell surface/ nuclear receptor, transducers, effectors, with or without secondary messenger pathway, role of inhibitors, - cell</p>

		<p>growth, proliferation and survival and signaling in insects.</p> <p>CO-II : Students will be able to impart knowledge in Mammalian Cell cycle – Function regulation and effect of inhibitors, Importance and applications of Stem Cells.</p> <p>CO-III : Students will be able to understand the signs, symptoms, causes, molecular mechanisms of cancer biology/ etiology and also its prevention and management and the concept of apoptosis, mechanisms of intrinsic and extrinsic pathways , necrosis and hyperactive apoptosis and treatment.</p>
BCT-303	Metabolism - II	<p>Co-I : Students will be able to understand the concept and function of bioenergetics, biological oxidation mechanisms- ETC- Oxidative phosphorylation –mechanisms of proton motive force- ATP synthase.</p> <p>CO- II: Students will be able to impart knowledge in individual amino acid biosynthesis and degradation- amino acid metabolism.</p> <p>CO-III: Students will be able to learn Nitrogen cycle, Heme metabolism, and biosynthesis and degradation, regulation of purine and pyrimidine nucleotides.</p>
BCP-305	Clinical Biochemistry	<p>CO-I: Students will gain hands on experience in blood glucose, cholesterol, hemoglobin, calcium and urea measurement.</p> <p>CO-II: Students will be able to perform quantitative analysis of urine and estimation of creatinine, creatine, urea, acidity, bilirubin, uric acid, chloride.</p>
BCP-306	Molecular Biology	<p>CO-I: Students will be able to isolate nucleic acid from animal and plant sources and can quantify and characterize them by spectrophotometry and electrophoretic methods respectively.</p> <p>CO-II: students will be able to perform amplification of desirable gene by polymerase</p>

		<p>chain reaction, rapid amplification of polymorphic DNA and RT-PCR.</p> <p>CO-III: Students will get hands on experience in nucleic acid blotting techniques, quantification of virus, determination of T_m of calf thymus DNA.</p>
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BCT-401	Molecular Biology II	<p>CO I :Students should be able to understand the regulation of gene expression in Prokaryotes and eukaryotes and also the knowledge about structure and organization of chromatin, regulation of eukaryotic gene expression</p> <p>CO II : They should be able to appreciate the importance of differential developmental pattern of drosophila embryo and ribosome subunits, assembly and dissociation.</p> <p>CO III: Students will be able to gain knowledge of prokaryotic and eukaryotic translation mechanisms with an overview of genetic code.</p>
BCT 402	Biochemical genetics	<p>CO I : Students should be able to understand historical account of genetic material along with mutations in them and different types of inheritances using classical genetics approach as well mechanism of sex determination.</p> <p>CO II : They should be able to gain knowledge of quantitative genetics, biochemical events of cell divisions, transposition in humans and human genome project.</p> <p>CO III: Students will learn comprehensive knowledge about mechanisms of recombination, transposition, transformation and conjugation events in bacterial chromosome in addition to T-phages life cycle</p>
BCT 403	Biotechnology	<p>CO I : Students should be able to understand the basic cloning process with the help of restriction endonucleases and DNA modifying enzymes and the construction and</p>

		<p>applications of different commercial prokaryotic and eukaryotic vectors along with transformation and screening methods used in cloning.</p> <p>CO II :Students will be able to learn the construction and screening of genomic and cDNA libraries and characterization of plasmid clones and also will acquire comprehensive knowledge about the principle, procedure, variant types and applications of PCR in addition to DNA sequencing and analysis of sequenced data.</p> <p>CO III: Students will be able to gain information regarding the overview of cloning strategies in animals using animal vectors and transfection. They get information of culturing of callus, transformation and functioning of Agro bacterium based vectors in plants and usage of different plant expression vectors.</p>
BCT 404	Immunology and Toxicology	<p>CO I : Students will be able to understand basic concepts of infection, first line of defense against pathogens in addition to compliment system and its regulation and will be able to Gain the knowledge of immunity, immunization practices, vaccines and also understand structure, functions, types of antibodies and production of monoclonal antibodies</p> <p>CO II : Students will able to learn comprehensively about recognition of self and non self, MHC and cell mediated immunity. They will get information regarding the principles of formation of antibodies and genetics of antibody diversity.</p> <p>CO III: Students will be able to understand hypersensitivity, autoimmunity and immunodeficiency diseases with emphasis on tissue transplantation and tumor immunology.</p> <p>CO IV: Students will be enriched with the knowledge of techniques immuno</p>

		precipitation, agglutination, complement fixation, RIA and ELISA. They will also learn about the toxicological chemistry, factors influencing toxicity, diagnosis of different types of toxicity and detoxification mechanisms
BCP- 405	Genetic Engineering and Protein Chemistry	<p>CO- I : Students will get hands on experience in genetic engineering- bacterial transformation, different types of PCR, cDNA synthesis, expression in host, isolation, purification of recombinant protein, blotting technique and characterization of the clones.</p> <p>CO-II: Students will get hands on experience in protein chemistry- extraction and isolation of different enzymes, fraction and fold purification by conventional techniques, ammonium sulfate , acetone and pH precipitation , kinetic characterization and different chromatographic techniques.</p>
BCP- 406	Project Work	<p>CO- I: Students will undertake research project and will get an exposure in research which will enhance their scientific aptitude.</p> <p>CO-II : Students will be able to analyze their research result, present the results to peer committee where they demonstrate skill in relevant literature analysis, experimental design, actual use of experimental techniques, teamwork, statistical analysis and oral and written communication of conclusions and their defense.</p>

COURSE OUTCOMES

M.Sc. CHEMISTRY

Course code	Course name	Course Outcome
C-101	Inorganic Chemistry-I	<p>Upon successful completion of course C-101(Inorganic chemistry-I), students are expected to be able to:</p> <p>CO I: Understand the basic concepts of inorganic chemistry which includes Chemical Bonding, Chemistry of main group elements, HSAB concept, Stereoisomerism, Metal carbonyl clusters.</p> <p>CO II: Learn the concept of bonding in boranes, carboranes, metalloboranes, phosphazenes and S-N compounds.</p> <p>CO III: Get an overview of silicates, zeolites and molecular sieves. Do a detailed study of nuclear chemistry.</p>
C-102	Organic Chemistry-I	<p>Upon successful completion of course C-102(Organic Chemistry-I), students are expected to be able to:</p> <p>CO I: Understand the basic concepts of organic chemistry like nature of bonding in organic molecules, reaction mechanism and stereochemistry.</p> <p>CO II: Emphasize on generation, structure, stability and reactivity of reactive intermediates.</p> <p>CO III: Get an overview of carbohydrates, vitamins and heterocyclic compounds. Give understanding of subject by writing assignments and class tests.</p>
C-103	Physical Chemistry-I	<p>Upon successful completion of course C-103(Physical Chemistry-I), students are expected to be able to:</p> <p>CO I: Have detailed knowledge of quantum chemistry.</p>

		<p>CO II: To get an overview of theories of reaction rate, Concept of steady state kinetics, Chain reactions, Kinetics of fast reactions, Flash photolysis.</p> <p>CO III: To learn basic concept of kinetics of homogeneous catalysis and get an overview of surface chemistry.</p>
C-104	Biophysical, Bioorganic and Medicinal Chemistry	<p>Upon successful completion of course C-104(Biophysical, Bioorganic and Medicinal Chemistry), students are expected to be able to:</p> <p>CO I: Know the basic concepts of biophysical and bioinorganic chemistry which includes bioenergetics, properties of water, biopolymer interactions, biosensors.</p> <p>CO II: Do a detailed study of biosensors, synthetic molecular receptors, fatty acid metabolism.</p> <p>CO III: Get an overview of basic concepts medicinal chemistry (nomenclature, classification, drug discovery, prodrugs).</p>
C-105	Green Synthesis	<p>Upon successful completion of course C-105(Green Synthesis), students are expected to be able to:</p> <p>CO I: Understand and appreciate the green chemistry principles. Get an idea about use of ultrasound and microwaves in organic synthesis and polymer supported reagent in organic synthesis.</p> <p>CO II: Get an overview of multi-component reaction in organic synthesis. Do a detailed study of crown ethers and its synthetic applications.</p> <p>CO III: Learn importance of photochemistry, laws, Quantum mechanical formulation of Franck Condon, Classification of photochemical reactions, some current topics in photochemistry.</p>
C-106	Inorganic Chemistry Practical-I	<p>Upon successful completion of course Inorganic Chemistry Practical-I, students are expected to be able to:</p> <p>CO I: Know the concept of semi micro qualitative analysis.</p> <p>CO II: Carry out semi micro qualitative analysis of mixtures containing two anions,</p>

		<p>two common cations and one less familiar element (W, Mo, Ce, Th, Zr, V, U and Li).</p> <p>CO III: Perform mock test on detection of different ions in given mixture.</p>
C-107	Inorganic Chemistry Practical-II	<p>Upon successful completion of course Inorganic Chemistry Practical-II, students are expected to be able to:</p> <p>CO I: Prepare inorganic complexes (Cis- and trans- potassium dioxalatodiaquachromium (III) complex, Hexamminecobalt (III) chloride, Mercurytetraethiocyanatocobaltate and pentamminechloro cobalt (III) chloride).</p> <p>CO II: Carry out quantitative analysis of different ions in prepared complexes.</p> <p>CO III: Execute mock test of coordination complexes synthesized.</p>
C-108	Physical Chemistry Practical-I	<p>Upon successful completion of course Physical Chemistry Practical-I, students are expected to be able to:</p> <p>CO I: Have idea of basics in physical chemistry like acid hydrolysis, saponification, Beer Lambert's law, phase diagrams, Freundlich and Langmuir isotherm and colorimetry.</p> <p>CO II: Estimate concentration of Fe^{2+} ions using titration of FAS versus KMnO_4 and EDTA through colorimetric method. Verify Freundlich and Langmuir isotherm for adsorption of oxalic/acetic acid on activated charcoal.</p> <p>CO III: Carry out acid hydrolysis of methyl acetate at lab temperature; calculate velocity constant for the saponification of ethyl acetate, verification of Beer's Law for Cu^{2+} ions and Fe^{2+} ions.</p>
C-109	Physical Chemistry Practical-II	<p>Upon successful completion of course Physical Chemistry Practical-II, students are expected to be able to:</p> <p>CO I: Understand the concept of conductometric and potentiometric titrations. Perform different conductometric titrations like lithium sulphate versus BaCl_2, weak acid versus weak base, strong acid versus strong base.</p> <p>CO II: Calculate dissociation constant of weak acid (CH_3COOH) and equivalent</p>

		<p>conductance of a given strong electrolyte by conductometric method. Determination of single electrode potential of Cu^{2+}/Cu and Zn^{2+}/Zn and estimate unknown concentration potentiometrically.</p> <p>CO III: Perform titration of AgNO_3 versus KCl and weak acid against a strong base potentiometrically.</p>
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C-201	Inorganic Chemistry-II	<p>Upon successful completion of course Inorganic Chemistry-II, students are expected to be able to:</p> <p>CO I: Understand the basic concepts of Inorganic chemistry which includes metal ligand equilibria in solution, metal- ligand bonding, electronic spectra of coordination compounds, magnetic properties of coordination compounds.</p> <p>CO II: Learn the concept of stereoisomerism, Crystal field theory, Ligand Field Theory, MO theory.</p> <p>CO III: Get an overview of magnetic properties of coordination compounds: Types of magnetic behaviour, magnetic susceptibility and its determination by different methods. Do a detailed study of photochemical reactions of transition metals complexes.</p>
C-202	Organic Chemistry-II	<p>Upon successful completion of course organic Chemistry-II, students are expected to be able to:</p> <p>CO I: Understand the basic concepts of organic chemistry like aromatic substitution reaction, addition reaction, elimination reactions and rearrangements. Learn the concept of electrophilic substitution reactions and Nucleophilic substitution reactions.</p> <p>CO II: Get an idea about addition to carbon-carbon multiple bonds and addition to carbon-heteroatom multiple bonds, Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acids, esters and nitriles. Emphasize on different</p>

		<p>rearrangements (with mechanism) in organic chemistry.</p> <p>CO III: Get an overview of amino acids and peptides. Give understanding of subject by writing assignments and class tests.</p>
C-203	Physical Chemistry-II	<p>Upon successful completion of course Physical Chemistry-II, students are expected to be able to:</p> <p>CO I: Understand concepts of thermodynamics like partial molar properties, Gibbs-Duhem equation, Gibbs-Duhem-Margulus equation, fugacity, activity and activity coefficient, thermodynamics of non-ideal system, phase rule, statistical thermodynamics.</p> <p>CO II: Detailed analysis of thermodynamic criteria for non-equilibrium states, Coupled and Non-coupled reactions, Entropy production and entropy flow and to learn basic concept of electrochemistry of solutions.</p> <p>CO III: To get an overview of structure of electrified interface, Overpotential, Electrocatalysis, Polarography, Semiconductors.</p>
C-204	Spectroscopy-I	<p>Upon successful completion of course Spectroscopy-I, students are expected to be able to:</p> <p>CO I: Know the basic concepts of group theory like symmetry elements and symmetry operations, point groups, Schönflies notations, representations of groups by matrices, reducible and irreducible representations, characters of representations, Great Orthogonality Theorem, character tables.</p> <p>CO II: Perform elaborated study of physical spectroscopy like microwave, infrared and Raman spectroscopy.</p> <p>CO III: Get an overview of electronic spectroscopy, Born-Oppenheimer approximation, Franck-Condon principle, Fortrat diagram, Electronic structure of diatomic molecules and polyatomic molecules.</p>

C-205	Soft Core: Mathematics For Chemists	<p>Upon successful completion of course C-205: Soft core: Mathematics for chemists, students are expected to be able to:</p> <p>CO I: Know the basic concepts of mathematics like vectors, matrix algebra, calculus, integration, differentiation, probability.</p> <p>CO II: Get an idea about vectors, dot and cross products, scalar and vector triple products and their applications, Tensors and their applications.</p> <p>CO III: Understand different types of matrices, matrix addition and multiplication; determinant of a square matrix, transpose, adjoint and inverse of a square matrix, Solution to system of linear equation (a) by matrix method and (b) by Cramer's Rule.</p>
C-206	Inorganic Chemistry Practical-III (Gravimetric Analysis)	<p>Upon successful completion of course Inorganic Chemistry Practical-III, students are expected to be able to:</p> <p>CO I: Understand the concept of gravimetric analysis.</p> <p>CO II: Perform gravimetric determination of: Fe in iron ore as Fe_2O_3, Ni in Cu and Ni solution, Fe in Fe and Cr solution, Cu in Cu and Fe solution and Cu in Cu and Zn solution.</p> <p>COIII: Perform mock test on gravimetric estimation.</p>
C-207	Inorganic Chemistry Practical-IV (Volumetric Analysis)	<p>Upon successful completion of course Inorganic Chemistry Practical-IV, students are expected to be able to:</p> <p>CO I: Understand the concept of volumetric analysis.</p> <p>CO II: Perform volumetric estimation of: Ca and Mg in Dolomite solution, Cu in Cu and Ni (German Silver), Fe in Cu and Fe solution, Zn in Cu and Zn solution and Ni in Ni and Zn solution.</p> <p>CO III: Execute mock test on volumetric analysis.</p>
C-208	Physical Chemistry Practical-III	<p>Upon successful completion of course Physical Chemistry Practical-III, students are expected to be able to:</p> <p>CO I: Study the hydrolysis of methyl acetate at different concentrations of HCl and different temperature. Determine pH of acetic</p>

		<p>acid with sodium acetate buffer and formic acid with sodium formate buffer by pH metry method.</p> <p>CO II: Analyze binary mixture of two miscible liquids and determine the composition of the unknown mixture. Study kinetics of autocatalytic reaction between KMnO_4 versus oxalic acid.</p> <p>CO III: Determine degree of hydrolysis of aniline hydrochloride at room temperature and calculate dissociation constant of the base by pH metry.</p>
C-209	Physical Chemistry Practical-IV	<p>Upon successful completion of course Physical Chemistry Practical-IV, students are expected to be able to:</p> <p>CO I: Perform different conductometric titrations like acid mixture versus NaOH, weak acid with salt versus NaOH, strong acid with salt versus NaOH.</p> <p>CO II: Use pH metry to determine strength of HCl, CH_3COOH and CuSO_4 versus NaOH and determine isoelectronic point of amino acid. Perform potentiometric titration of: $\text{K}_2\text{Cr}_2\text{O}_7$ versus FAS, acid mixture versus NaOH, KMnO_4 versus FAS.</p> <p>CO III: Determine dissociation constant of H_3PO_4 using potentiometric method. Determine pKa value of phosphoric acid by pH meter.</p>

C-301 OC	Organic Reaction Mechanisms	<p>Upon successful completion of course C-301(Organic Reaction Mechanisms), students are expected to be able to:</p> <p>CO I: Understand different reaction mechanisms like Nucleophilic and electrophilic substitution on different substrates.</p> <p>CO II: Get an overview of photochemical and pericyclic reaction mechanisms. Also understand advantages of photochemical reactions over thermal reactions. Photochemical reactions in different functional groups. Orbital interaction mechanisms (woodward Hoffmann correlation diagrams, FMO and PMO). Understand stereochemistry in pericyclic reactions, Biochemical mechanistic role of various biomolecules in living systems.</p> <p>CO III: Able to write mechanism and predict the products with their proper stereochemistry. Arrive at writing mechanisms of different types of reactions given. Application of various reaction mechanisms for the synthesis of industrially important compounds.</p>
C-302 OC	Chemistry of Natural Products	<p>Upon successful completion of course C-302 (Chemistry of Natural Products), students are expected to be able to:</p> <p>CO I: Understand Structural details of terpenoids, carotenoids, porphyrins like haemoglobin and chlorophyll. Their occurrence and isolation. Structural elucidation, chemical and biochemical synthesis methods.</p> <p>CO II: Get an overview about nucleic acids (DNA/RNA) chemical composition, structural elucidation and solid phase synthesis. Prostaglandins importance, classification, Importance of insect pheromones and their application in pest control. Stereoselective synthesis of few pheromones.</p> <p>CO III: Emphasize structural elucidation methods for different functional groups. Able to elucidate the structures of any given bio molecule by chemical methods. Sketch their synthesis.</p>
C-303 OC	Organic Spectroscopy	<p>Upon successful completion of course C-303 (Organic Spectroscopy), students are expected to be able to:</p> <p>CO I: Get an overview of UV visible spectroscopy and its application in</p>

		<p>determination of structures and other related analysis. IR spectroscopy and its application in determination of functional groups. Understand basics on proton NMR spectroscopy and their application in structural prediction of unknown organic compounds. Interpretation of spectra.</p> <p>CO II: Get an overview of other NMR spectroscopic methods like carbon-13, 15N, 19F, 29Si and 31P. Understanding combined data to be used in determination of structures of unknown organic compounds. Understanding of Mass spectroscopy, instrumentation and basic principle involved. Application in determining exact molecular formulae of the compounds.</p> <p>CO III: Elucidate the structure of unknown organic compounds using all the above spectroscopic methods (UV, IR, Mass, H1-NMR, C13-NMR)</p>
C-304	Open Elective (Non Chemistry Paper)	<p>C-304 is an open elective paper where students opt for different soft core paper of their interest like English, NSS, media and society etc.</p>
C-305 OC	Organic Chemistry Practicals-I One step organic preparations	<p>Upon successful completion of course C-305 (One step organic preparations), students are expected to be able to:</p> <p>CO I: Get an idea of single step chemical synthesis in laboratory. Methods involved in organic synthesis. Planning, reaction set-up and Stoichiometry.</p> <p>CO II: Understand work up, purification methods. Calculation of theoretical yield, practical yield and percentage yield.</p> <p>CO III: Perform mock test on single step organic synthesis of given compound.</p>
C-306 OC	Organic Chemistry Practicals-II Qualitative organic analysis	<p>Upon successful completion of course C-306:Qualitative organic analysis, students are expected to be able to:</p> <p>CO I: Get an overview of systematic organic qualitative analysis of bifunctional organic compounds.</p> <p>CO II: Understand preparation of derivatives, melting point/boiling point of compounds.</p>

		CO III: Perform mock test on analysis of unknown organic bifunctional group by systematic qualitative analysis method.
C-307 OC	Organic Chemistry Practicals-III Two step organic preparations	<p>Upon successful completion of course C-307:Two step organic preparations, students are expected to be able to:</p> <p>CO I: Get an idea of Two-step chemical synthesis in laboratory. Methods involved in organic synthesis. Reaction set-up, monitoring reaction and Stoichiometry. Understand separation of first step product and using the same for second step. Their stoichiometrical calculations.</p> <p>CO II: Understand work up, purification methods. Calculation of theoretical yield, practical yield and percentage yield.</p> <p>CO III: Perform mock test on Two step organic synthesis of given compound.</p>
C-308 OC	Organic Chemistry Practicals-IV Quantitative estimations	<p>Upon successful completion of courseC-308:Quantitative estimations, students are expected to be able to:</p> <p>CO I: Understand about Quantitative estimations (volumetric estimations of organic compounds like amino acids, glucose).</p> <p>CO II: Determine Saponification value, iodine value of oil. Estimate the number of –OH groups, methyl groups in methyl ketone.</p> <p>CO III: Perform mock test on one of the quantitative estimations</p>

Course Code	Course name	Course Outcome
C-401 OC	Organometallic and Heterocyclic Chemistry	<p>Upon successful completion of course C-401:Organometallic and Heterocyclic Chemistry, students are expected to be able to:</p> <p>CO I: Explain and rationalize the chemistry of organotransition metal complexes. Understand synthesis, structure, bonding, properties and reactivity of organometallic compounds. Get an overview of industrially important catalytic processes through the application of organometallic principle. Namely application of organosilicon, organotin, organomercurials, organomagnesium (Grignard), organocopper (Gilman), organozinc etc in organic synthesis.</p> <p>CO II: Understand structural details and synthesis of small ring heterocycles, benzofused heterocycles and 6 membered heterocycles with 2 hetero atoms. Understand structural details and synthesis of Seven and large membered heterocycles, heterocycles containing P, As, Sb and Bi and mesoionic compounds like sydnone.</p> <p>CO III: Explain and rationalize the uses of organometallic compounds in much important industrially viable synthesis. Able to give mechanistic approach for the organometallic catalysis. Study synthesis of structural details of heterocycles, which are the basic structural units of many natural products, drug molecules in pharmaceutical industry.</p>
C-402 OC	Stereochemistry & Retrosynthetic Analysis	<p>CO I: Understand stereochemistry and optical activity in the absence of chiral atoms, optical activity due to presence of hetero atoms. Understand importance of trans annular reactions. Understand the determination of absolute and relative configurations of the compounds. Get an overview of retrosynthetic analysis by disconnection approach.</p> <p>CO II: Get an overview of protecting groups of important reactive functional groups (alcohols, amines, carbonyls). Also understand Carbon-carbon disconnections.</p>

		<p>Understand small ring synthesis and synthesis of complex biomolecules by disconnection approach (like vitamin D, cortisone, aromadendrene).</p> <p>CO III: Understanding stereochemistry of given compounds which will help students in designing stereoselective synthesis of drug molecules of one particular stereoisomer in enantiomeric excess. Assignments given on disconnection and retrosynthetic methods. The outcome of this will be strategic synthesis planning of complex molecules in greener method.</p>
C-403 OC	Organic Synthesis	<p>CO I: Get an overview of organic synthetic reagents used for C-C and C-N bond formations. Few named reaction examples involving C-C and C-N bond formation. Understand about different reagents used in organic synthesis for functional group transformations like DDQ, NBS, LDA etc.</p> <p>CO II: Get an overview of various oxidizing agents and reducing agents for the functional group transformations. Also understand about selective oxidations and reductions. Understand about asymmetric synthesis and its significance. Understand methodology of stereoselective synthesis, enantioselective synthesis, diastereoselective synthesis. Polymer bound chiral catalysis.</p> <p>CO III: Understand about various synthetic reagents, their uses in selective organic synthesis. Solve Problems on selected reagent for the given synthesis which helps in strategic planning of synthesis of industrially viable components.</p>
C-404 OC	Medicinal Organic Chemistry	<p>CO I: Understand terminologies like Pharmacokinetics, Pharmacodynamics. Theories of drug activity and computer aided drug design. Also they understand synthesis and structural elucidation of important steroidal molecules (important class of drug molecules). Get an overview of antibiotics structure and the methods of synthesizing antibiotics.</p> <p>CO II: Understand mechanism of drug action and synthesis of important class of drugs like</p>

		<p>antipyretics, analgesics, antidiabetics, antihistamines, antivirals, antineoplastic agents and cardiovascular drugs. Get an overview about local anti infective agents and study about chemotherapy of mind (antipsychotic drugs).</p> <p>CO III: Understand basic principles of chemotherapy and their synthetic methodologies and mechanism of action. With the knowledge of various types of drugs and their chemical components and mechanism of action of drug, one can design potent drug molecule with synthetic methodology.</p>
C-405 OC	Organic Chemistry Practicals-V Organic preparations	<p>CO I: Understand organic preparations of industrially important compounds and purification.</p> <p>CO II: Get an overview about reaction set-up, monitoring, work up procedures and purification. Also understand calculation of theoretical yield, practical yield and percentage yield.</p> <p>CO III: Perform mock test on one of the organic preparations.</p>
C-406 OC	Organic Chemistry Practicals-VI Extractions, Isolations and separations	<p>CO I: Understand about organic extraction procedures of natural products like caffeine, piperine, limonene etc.</p> <p>CO II: Get an overview about separation of organic compounds by using chromatographic techniques (paper chromatography, Thin layer chromatography, column chromatography).</p> <p>CO III: Perform mock test on extraction of one of the natural product.</p>
C-407 OC	Organic Chemistry Practicals-VII Instrumental methods in organic analysis and quantitative analysis	<p>CO I: Understand instrumental methods of organic analysis. Interpretation of spectra, structural elucidation of organic compounds with the spectra provided, which is problem based learning.</p> <p>CO II: Estimate quantitatively the given organic functional groups.</p> <p>CO III: Perform mock test of either quantitative estimation or solving the spectra given by examiner.</p>

C-408 OC	Organic Chemistry Practicals-VIII Qualitative analysis	<p>CO I: Understand about the separation of binary mixtures of organic compounds by solubility method.</p> <p>CO II: Identify the separated compounds by systematic qualitative organic analysis method.</p> <p>CO III: Perform mock test on separation and analysis of given organic mixture.</p>
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COURSE OUTCOMES
M.Sc. APPLIED GENETICS

Course Code	Course name	Course Outcome
HCT 101	Cell Biology	<p>The students will be able to</p> <p>CO1 understand the ultrastructure, function, chemical composition of the cell and communication of cells</p> <p>CO2 Conceptualize the molecular events of gene expression</p> <p>CO3 Elucidate the role of genetic engineering in improvement of the cells</p>
HCT 102	Basic Genetics	<p>After successful completion of the course the students will be able to</p> <p>CO1 Gain Knowledge about model organisms life history, Mendelian principles, extension of Mendelism , various genetic analysis techniques along with applications and different allelic interactions.</p> <p>CO2 Understand about chromosomal basis of inheritance by focusing on molecular mechanism of sex determination, sex linked inheritance and traits which are limited and influenced by sex chromosomes they will also learn about linkage, crossing over, construction of genetic map and analysis of genetic and linkage maps of various organisms.</p> <p>CO3 Gain idea and interpret about Non Mendelian inheritance, maternal inheritance, various extra nuclear inheritance by focusing on its examples in different organisms and</p>

		about different somatic cell hybridization techniques and its applications and to make them aware about transposable genetic elements, mechanisms with examples.
HCT 103	Essentials Of Cytogenetics	<p>After learning this course students will be able to</p> <p>CO1 Gain a basic detailed concept of nucleus and chromosomes in both prokaryotes and eukaryotes.</p> <p>CO2 Learn about the cell division process. They will also learn about various specialized types of chromosomes.</p> <p>CO3 Acquire knowledge regarding the changes or aberrations in chromosome number or structure</p>
HCT 104	Biological Chemistry	<p>Biochemistry provide students with an appreciation and an understanding of key metabolic biochemistry and molecular biology concepts such as</p> <p>CO1 Understand fundamental biochemical principles such as structure and function of biomolecules (Protein, carbohydrates and nucleic acids) ,metabolic pathways and the regulation of biochemical processes</p> <p>CO2 Provide an insight on classification, mechanism of action ,kinetics of enzyme catalyzed reaction, enzyme inhibitions and regulatory processes.</p> <p>CO3Insight on coupled reactions and their role in metabolism and chemiosmotic hypothesis of ATP synthesis.</p>
SCT-105	Cell Physiology	<p>The course is designed to provide the students with an insight into the physiology of cell at both micro and macro levels. At the completion of the course student will be able to:</p> <p>CO1 Define the physical and chemical nature of water and to point out its importance in living system. In addition to that the students are expected to understand the buffering mechanism and the effect of physiological stress in living system.</p>

		<p>CO2 Demonstrate theoretical and practical understanding of the role of plasma membrane in maintaining cell environment and electrolyte balance in relation to membrane permeability/transport across the membrane, in addition to having a clear idea about the effect of various factors on the permeability of membrane.</p> <p>CO3 Understand what membrane potential is, how it is generated and propagated, why it matters, and how to record it and use mathematical operations to calculate it.</p> <p>CO4 Develop an understanding about how impulses travel along the neurons and across the synapse for transmission of nerve signals and the role played by excitable membrane in the process and to Gain an insight into the physiology of contraction in muscle and non-muscle cells.</p>
HCT- 201	Molecular Biology	<p>The course is designed to provide the students with basic knowledge of molecular biology whereby they will be able to</p> <p>CO1 Understand the concepts of molecular biology, the central dogma, replication mechanism in prokaryotes and eukaryotes with an overview of common inhibitors of DNA replication.</p> <p>CO2 Gain an insight into the copying of information from DNA to RNA through the process of transcription in both prokaryotes and eukaryotes and inhibitors of transcription.</p> <p>CO3 Insight into genetic code, gene expression regulation at transcriptional and post transcriptional level which can be useful for research.</p> <p>CO4 Understand the processes of co and posttranslational modifications of proteins, gene silencing and RNAi pathways.</p>
HCT 202	Genetics Of Development	<p>The course is designed for the students to-</p> <p>CO1 Understand the concepts of developmental biology. They will be able to comprehend the reproduction processes gametogenesis, fertilization and process of development and differentiation.</p>

		<p>CO2 Gain an insight into the early embryonic developmental processes including morphogenetic and cell movement.</p> <p>CO3 Demonstrate the knowledge regarding pattern formation during development and process of metamorphosis.</p> <p>CO4 Gain in depth knowledge about stem cells-types and applications, cell ageing and cell death.</p>
HCT 203	Mutation And Cancer Biology	<p>The student upon completion of the course will be able to</p> <p>CO1 Gain an in depth concept on gene mutation, mutagenic agents, its types and its role in mutagenesis. Role of clastogens in chromosomal aberration.</p> <p>CO2 Understand the mechanism of DNA Repair Mechanism, Repair defect and Disease related to error in DNA repair.</p> <p>CO3 .Demonstrate an in depth concept on Cancer, its types, Molecular, cellular and genetic Characteristics of Cancer cells. Genetic mutation and mechanism responsible for cancer</p> <p>CO4 Understand and appreciate diagnostic tools and methods for cancer. Therapies for treating cancer.</p>
HCT- 204	Evolutionary Genetics	<p>The course introduces the principles of population, evolutionary Genetics. Upon completion of the course the students are able to</p> <p>CO1 Gain an insight to different evolutionary theories and different mechanisms that drive evolutionary processes in a population, including fitness, selection, migration and random drift of evolutionary change, application of Hardy-Weinberg equilibrium (principle) to evaluate gene and genotype frequency.</p> <p>CO2 Understand modern concept of evolution like Neo-Darwinism, the <i>neutral theory of molecular evolution</i> and molecular clock to understand the evolutionary scale to study evolution over the course of millions of years.</p>

		<p>CO3 Analyse the origins of species- methods of speciation. Insight on reproductive isolation mechanisms important to speciation</p> <p>CO4 Comprehend molecular phylogenetics, evolutionary relationship of hominids and their ancestors and impact of gene polymorphism on gene function and phenotype</p>
HCT 301	Genetic Engineering	<p>The course is designed to give an insight to students about the versatile tools and techniques used in genetic engineering. The students after learning this course would be able to</p> <p>CO1 Gain an insight to the Role of Restriction enzymes and various vectors in gene cloning.</p> <p>CO2 Understand and interpret Transformation, Plating and screening and preservation of recombinants.</p> <p>CO3 Understand Electrophoresis, Blotting, use of probes in hybridization and immunoblotting and also a brief understanding on the gene expression study using microarray.</p>
HCT- 302	Microbial And Plant Genetics	<p>The course aims to provide an integrated view of microbial and plant genetics/sciences The students will be able to</p> <p>CO1 Gain knowledge of the benefits and limitations of model organisms (microbial and plant) in research (basic/applied), construction of genetic map of genomes by use of recombination data and role of microbes and plant in combating environmental pollution and as biofertilizers.</p> <p>CO2 Insight on biosensors and industrial/fermentation technology like bioreactors fermentative production of biomolecules like vitamin, antibiotics and alcoholic beverages.</p> <p>CO3 Basics of the physiological and molecular processes that occur during plant growth and development- genes involved in regulation of flower and leaf development (dorsal and ventral, compound leaf).</p>

		<p>Mechanism of nitrogen fixation (nodular gene) and self-incompatibility in plants.</p> <p>CO4 Introduce students to the plant pathogen interaction: genetic basis of disease resistance and susceptibility in plants and molecular basis of host pathogen interaction. Emphasis is laid on molecular and genetic basis of crown gall disease development, mechanism of <i>Agrobacterium</i> T-DNA transfer and their utility in production of transgenic plants. Knowledge and practical skill on isolation, maintenance and viability tests for protoplast.</p>
HCT 303	Human Genetics	<p>CO1 Gain an in depth concept on gene mutation, mutagenic agents, its types and its role in mutagenesis. Role of clastrogens in chromosomal aberration.</p> <p>CO2 Understand the mechanism of DNA Repair Mechanism, Repair defect and Disease related to error in DNA repair.</p> <p>CO3 Demonstrate an in depth concept on Cancer, its types, Molecular, cellular and genetic Characteristics of Cancer cells. Genetic mutation and mechanism responsible for cancer</p> <p>CO4 Understand and appreciate diagnostic tools and methods for cancer. Therapies for treating cancer.</p>
HCP304	Cellular Physiology	<p>The students would gain practical skill to</p> <p>CO1 Demonstrate an in-depth knowledge of the techniques used in physiology like chromatography, nucleic acid estimation.</p> <p>CO2 Understand the ATPase activity in various tissues and estimation of ascorbic acid in different tissues.</p> <p>CO3 Have a practical understanding of cell electrolyte balance in relation to membrane permeability/transport across the membrane.</p>
HCT 401	Genomics and Proteomics	<p>CO1 Be able to understand genome organization.</p> <p>CO2 Learn to analyze mapping genomes through various techniques</p>

		<p>CO3 Understand about genomics including various genome projects and structural and functional genomics</p> <p>CO4 Gain an insight into pattern of genome evolution.</p>
HCT402	Immunology & Haematology	<p>This course describes the molecular and cellular basis of development and function of immune system and the role of Hematopoietic networking and the diseases associated with it.</p> <p>CO1 Conceptualize how the innate and adaptive immune responses coordinate to fight invading pathogens.</p> <p>CO2 Determine what immune modulatory strategies can be used to enhance immune responses or to suppress unwanted immune responses such as hypersensitivity reactions and autoimmune diseases.</p> <p>CO3 Explore strategies to improve existing vaccines and antibodies in diagnosis</p> <p>CO4 By the end of this course, the students should be able to: Understand the principles of haematology, both blood physiology, functions, and disorders. Master the pathobiology of haematological disorders. Interpret diagnostic test results and erroneous test results and able to fix them.</p>
HCT403	Biomedical Genetics	<p>Upon completion of the course, the students should be able to:</p> <p>CO1 Gain information about the genetically inherited diseases and the diseases transmitted by an array of viruses, bacteria, fungi and Protozoa. Also they will learn about the evaluation of various organ Function tests.</p> <p>CO2 Understand the principles of pharmacodynamics and pharmacokinetics with respect to Drug receptor interactions, efficacy, toxicity, potency and fate of drugs in the body and approaches to drug discovery.</p> <p>CO3 Demonstrate an in-depth knowledge of developments in technologies for molecular therapeutics, specifically in the areas of drug delivery, cell therapy and gene therapy. In addition they should have a clear idea about</p>

		<p>the use of recent advances in the field of nanobiotechnology.</p> <p>CO4 Gain knowledge about the Human Genome project, population screening for genetic diseases, ethical and social issues related to genetics.</p>
HCT-404	Plant And Animal Biotechnology	<p>The course is designed to provide students with an insight of industry applications of biotechnology related to plant and animal system</p> <p>CO1 Develop an understanding on various components of plant tissue culture and its applications</p> <p>CO2 Acquaint with general principles and methods of generating transgenic plants. It includes vector mediated methods, chemical and direct methods</p> <p>CO3 Understanding the principles of animal cell culture and its application. They would come across methods for initiation of primary cell lines, maintenance and preservation of animal cell lines, cryo-preservation.</p> <p>CO4 Key aspects of downstream processing and commercial applications of animal cell cultures in production of vaccines, pharmaceuticals etc.</p>
PR 405	Project	<p>The students would be able to</p> <p>CO1 Construct scientific hypothesis and devise appropriate experiments to test and evaluate the hypothesis</p> <p>CO2 Acquire knowledge to record and analyze data and to communicate it through poster ,oral and visual presentation.</p>