छत्रपति शाहू जी महाराज विश्वविद्यालय, कानपुर

CHHATRAPATI SHAHU JI MAHRAJ UNIVERSITY, KANPUR

(पूर्ववर्ती कानपुर विश्वविद्यालय कानपुर)

Formerly Kanpur University, Kanpur – 208024

A Documentary Support

For

Metric No. – 1.1.1

Programme Outcomes & Course Outcomes

Under the

Criteria - I

(Curriculum Design and Development)

Key Indicator - 1.1

In

Metric No. – 1.1.1

M.Sc. Bio Chemistry

Co-ordinator
Internal Quality Assurance Cell
CSJM University, Kanpur

(Registrar)
C.S.J.M.University
Kanpur

REGISTRAR
C.S.J.M. UNIVERSITY
KANPUR

ANNEXURE - 123

Institute of Bioscience & Biotechnology
Department of Biochemistry

NEW SYLLABUS

SEMESTER	Paper code	Title	Marks
FIRST	BCH 101	General Biochemistry	100
	BCH 102	Cell Biology And Membrane Biochemistry	100
	BCH 103	Biophysical Chemistry, Techniques & application	100
	BCH 104	General Microbiology	100
	Practical		100
SECOND	BCH 201	Bioenergetics and intermediary metabol ism	100
	BCH 202	Enzymolo!!v	100
	BCH 203	Plant Biochemi stry	100
	BCH 204	Biostatistics, computer application and IPR	100
	Practical		100
THIRD	BCH 301	Physiology and clinical Biochemistry	100
	BCH 302	Molecular Biology	100
	BCH 303	lmmunolo Qv	100
	BCH 304	Advanced Biotechnology	100
	Practical		100
FOURTH	BCH 401	Environmental Biochemistry	100
	BCH 402	Bioinformatics	100
		Elect anv one (A or B or C)	100
	BCH 403 A	Industrial Biochemistry	
	BCH 403 B	Human Genetics	
	BCH 403 C	Biochemical Engineering and Fermentation Technology	
	BCH-404	Project/ Dissertation	200
	BCH-405	MOOCs	Grade

Programme Specific Outcome

At the end of the programme, the student will be able to

PSO1: Acquire deep scientific knowledge in subjects like cell biology, enzymology, biotechnology, Metabolism, endocrinology, immunology, genetics, genetic engineering and clinical biochemistry.

PSO2: Describe the biochemical basis of diseases, regulation of metabolic pathways and gene expression regulation.

PSO3: Undertake biochemical / scientific experiments using classical and modern instruments of biochemistry and molecular biology, record and interpret the results, draw the conclusions.

PSO4: Learn and develop work collaboratively as a team in classroom and scientific laboratory.

PSO5: Communicate biochemical concepts through effective written, dissertation and oral presentation.

Program Outcomes (POs)

PO1: To develop analytical and technical skills: Students will acquire ability to handle/use appropriate tools/techniques/equipment with an understanding of the standard operating procedures, safety aspects/limitations.

PO2: Resource Utilisation: The program will help in learning the resources including library, e-learning resources, ICT and novel tools to enhance knowledge base and stay learn recent developments.

PO3: Critical thinking and Problem solving: Identify and critically analyse relevant problems in biochemistry and scientific discipline using appropriate tools and techniques as well as explore and work on approaches to address conclusions/solutions.

PO4: Domain knowledge: Demonstrate knowledge of basic concepts, principles and applications of the science-specific discipline.

PO5: Project Management: To develop the zeal and ability to work safely and effectively in a laboratory. Acquire knowledge in technical and scientific areas to identify research problems, design experiments, use appropriate methodologies, analyse and infer the data and explore the solutions. The program will also enhance the ability of organizational skills and management of time and resources.

PO6: Individual and team work: The program will enhance the skills to effectively accomplish tasks independently and as a team member in multidisciplinary areas of research and development.

PO7: Effective Communication: M. Sc. Biochemistry program will educate and develop the ability to write dissertations, reports, make effective presentations and documentation. In addition to that the program will educate and build the ability to effective communication with scientific community as well as society at large.

PO8: Environment and Society: To analyse the impact of scientific and technological advances on the environment and society and the need for sustainable development.

PO9 Life-long learning: Ability to engage in life-long learning in the context of the rapid developments in the discipline.

PO10 Ethics: Program has a very important part to learn and develop professional ethics and responsibility and serve the society.

SEMESTER - I

PAPER-I (BCH 101) **MAX .MARKS: 100**

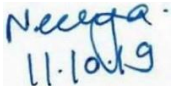
GENERAL BIOCHEMISTRY

Course Outcomes

BCH101: General Biochemistry

- Understanding fundamental properties of elements, their role in formation of biomolecules and in chemical reactions within living organisms.
- Exposure with the nature of various biomolecules present in living cells.
- To know about the unique property of water as a universal solvent and its importance in biological system
- Understanding of concepts of acids, bases, indicators, pKa values, etc.
- To understand the properties of carbohydrates, proteins, lipids, DNA, RNA, and their importance in biological systems

UNIT-I	Introduction of Biochemistry, Structure of water and interaction with ions, nature significance of week acids and bases. Henderson-Hasselbalach equation. pH and buffers.
UNIT-II	Structure of Monosaccharides Stereoisomerisms and optical isomerism of sugar, Ring structure and anomeric forms, mutarotation. Important biological importance of monosaccharaides, oligosaccharides and polysaccharides.
UNIT-III	Classification of lipids, Fatty acids: introduction classification, nomenclature and properties of saturated and unsaturated fatty acids. Essential fatty acids prostaglandins. Triacylglycerols: nomenclature, physical properties, chemical properties and characterization of fats-hydrolysis saponification, rancidity of fats. Sphingolipids, Glycolipids, Properties and function of phospholipids, isoprenoid and sterols.
UNIT IV	Introduction, Classification and function of proteins. Amino acids: Common structural feature, stereoisomerism and RS system of designating optical isomers, classification, physical and chemical properties, titration of amino acids. Essential amino acids. Peptides, Structure of peptides bond, chemical synthesis of peptides. Ramachandran Plot, primary, secondary, tertiary and quaternary structure of protein, protein folding.
UNIT-V	Nature of genetic materials; evidence that DNA genetic material. Structure, chemistry and biological properties of purine and pyrimidine, nucleosides and nucleotides, DNA and RNA structure, physico-chemical properties and their various functions.



BCH102: Cell Biology and Membrane biochemistry

- Students will understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles
- Students will understand how these cellular components are used to generate and utilize energy in cells
- Students will understand the cellular components underlying mitotic cell division.
- Students will apply their knowledge of cell biology to selected examples of changes in cell function.

PAPER-II (BCH 102) **MAX MARKS: 100**

CELL BIOLOGY AND MEMBRANE BIOCHEMISTRY

UNIT-I Cell classification, cell variability (size, shape, complexity, function), Structural organization of prokaryotic and eukaryotic cells, cell types, differences in plant and animals.

UNIT-II Detailed descriptions of eukaryotic cell structure. The ultra-structure of nucleus. Mitochondria, Chloroplast, Endoplasmic reticulum, Golgi apparatus, Lysosomes, peroxisomes and their function.

UNIT-III The cytoskeleton-microtubules, microfilaments and intermediary filaments. Cellular interaction, cell cycle and cell division. Cell differentiation-organogenesis, morphological, functional and biochemical maturation of tissue. Culture techniques to cell division. Use of microscopy in the study of cells, cell organelles and macromolecules.

UNIT-IV Chemical composition of biomembrane. Gap and tight junctions. Physical and biochemical methods to study membrane structure and properties. Different models of cell membrane-historical perspective. Function of biomembraneS with examples Energy transduction-mitochondria and chloroplast, signal recognition.

UNIT-V Transport across bio membrane,, Simple diffusion, Fick's law, porins, facilitated diffusion, porter molecules, kinetics of facilitated transport, symport, antiport, uniport. Red cell-membrane proteins, anion porter and glucose porter. Active transport, proton and Na+-K+ pumps- examples and metabolic significance, Donan's membrane equilibrium.




BCH 103: Biophysical chemistry techniques and application

- The objective of this course is to familiarize students with the basic concepts and applications of modern techniques used in Biochemistry, Biophysics, Cell and Molecular Biology.
- To learn the application of different techniques and tools in different areas of scientific research.
- The students will be able to understand the principle and working of different chromatography techniques.
- The students will be able to understand the principle and working of different centrifugation techniques.
- The students will be able to understand the principle and working of different Electrophoretic and molecular biology techniques.

PAPER-III (BCH 103) **MAX MARKS : 100**

BIOPHYSICAL? HEMISTRY, TECHNIQUES & APPLICATION

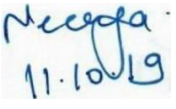
UNIT-I Imaging techniques, pH metry, centrifugation techniques and their application: Differential, zonal, density gradient and ultra-centrifugation.

UNIT-II Chromatography – Theory and general techniques of absorption, part1t1on, ion exchange, gel filtration, TLC, chromatofocussing, covalent, affinity, Gas chromatology. HPLC and reverse phase HPLC.

UNIT-III Electrophoresis basic principle of agarose electrophoresis, PAGE and SOS-PAGE and their applications. Two dimensional electrophoresis and its importance Isoelectricfocussing, immunoelectrophoresis.

UNIT-IV Spectroscopic Techniques – Theory, instrumentation and techniques of absorption (UV, Visible and IR), EMISSION flourmetry, NMR, E.S.R. and mass spectroscopy, X ray crystallography, CD and ORD.

UNIT-V Tracer techniques- Detection measurement of isotopes and application of isotopes in biochem istry, RIA, IRMA, and ELISA. Units of radioactivity, biological hazards of radiation and safety measures in handling radioisotopes.



BCH 104: General Microbiology

- To illustrate the characteristic features of microorganisms and the disease they cause.
- To explore mechanism by which microorganisms cause disease.
- To show how the human immune system counteracts infection by specific and non-specific mechanisms.
- To explore the routes of transmission of infection in hospital, communities and populations and the methods used to control the spread of infection.
- To demonstrates the principles of vaccine preparation and the use of vaccine in immunization.
- To shows the methods for sterilization of equipments.
- To shows the antimicrobial activity of disinfectants.
- To demonstrates the contribution of the microbiologists and the microbiology laboratory to the diagnosis of infection including specimen collection and the role of nurse in carrying this out.
- Enable students to acquire expertise in the field of microbiology.

PAPER-IV (BCH 104) **MAX.MARKS:100**

GENERALMICROBIOLOGY

UNIT-I General characteristics of main groups of microorganisms. Criteria used in the classification of microorganisms, physiology, nutrients and growth of microbes.

UNIT-II Special feature of bacterial metabolism, EDP and modified EDP pathway, role of microorganisms in food spoilage, Biosynthesis of bacterial cell wall and biochemistry of bacterial sporulation.

UNIT-III Microbial genetics differentiation-adaptation and mutation, transformation conjugation, sex types, transduction, transfection, protoplast fusion, genetic recombination.

UNIT-IV Morphology and replication of viruses -definition, virus structure, viral protein, virus classification enphasizing importance of bacteriophage and virus as tool in modem biological research. Replication of RNA viruses negative strand (VSV) positive strand (polio), retroviruses (Infection cycle) replication of DNA (adnoviruses or SV40).

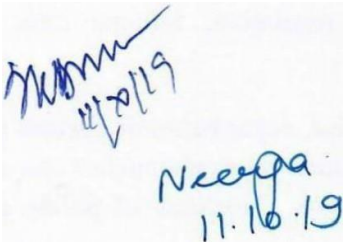
UNIT-V Virus-host infection- Acute virus infection – influenza, persistent virus infection herpes/hepatitis A and B and AIDS; Transformation and cancer RNA & DNA Tumor viruses, vaccines in prevention of viral infection- Smallpox, Polio, and AIDS.

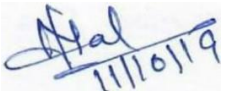


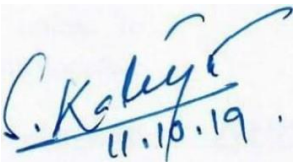

LABORATRY COURSE – I **MAX.MARKS - 100**

LIST OF EXPERIMENTS

1. Biochemical estimation of carbohydrates
2. Biochemical tests for amino acids and proteins.
3. Isolation of proteins.
4. Fractionation of cellular organelles through centrifugation.
5. Separation and estimation of lipids by using TLC.
6. Estimation of protein by Lawry's and Bradford methods.
7. Estimation of DNA by DPA method.
8. Estimation of RNA by orcinol.
9. Preparation of various culture media for growing microorganism.
10. Gram staining of Bacteria.







BCH 201: Bioenergetics and Intermediary Metabolism

- Explain the role of catabolic and anabolic pathways in cellular metabolism.
- Distinguish between kinetic and potential energy.
- Distinguish between exergonic and endergonic reactions in terms of available energy change.
- Describe the structure of ATP and identify the major class of macromolecules to which ATP belongs.

SEMESTER-TI

PAPER-I (BCH 201) **MAX.MARKS - 100**

BIOENERGETICS AND INTERMEDIARY METABOLISM

UNIT – I Bioenergetics- Energy transduction, Law of thermodynamics, Biological Oxidation. Gibbs energy, energy changes and redox potential, electrochemical and membrane potential, High energy compounds and low energy compounds, ATP cycle.

UNIT-II The mitochondrial respiratory chain, order and organization of carriers, proton gradient, cytochromes and their characterization. Respiratory control and oxidative phosphorylation. Fractionation and reconstitution of respiratory chain complex, oxidative phosphorylation and theories.

UNIT-III Methods and Techniques in the study of Intermediary metabolism. Multienzyme complex. Metabolism of carbohydrates and its regulation, Biosynthesis of glycogen and starch. Fatty acids biosynthesis & oxidation; lipid biosynthesis; biosynthesis of triglycerols, phasphoglycerides and sphingolipids. Biosynthesis of steroids, ketone bodies formation and utilization.

UNIT-IV Biosynthesis and degradiation of amino acids and their regulation, Specific aspects of amino acid metabolism. Urea cycle and its regulation, Inborne error of metabolism.

UNIT-V Biosynthesis and regulation of purines and pyrimidines, degradation of purines and pyrimidines,, structure and regulation of ribonucleotides deoxyribonucleotides and polynucleotides. Inhibitors of nucleic acid biosynthesis. Disorders of purine and pyrimidine metabolism.

BCH202: Enzymology

- To learn about general properties of enzymes like activation energy, active site, etc.; definition of enzyme activity and its various units; classes of enzymes and international nomenclature, the types of enzyme assays; and the various kinds of techniques employed for purification
- To know about the concepts of enzyme kinetics
- To study about Mechanism of enzyme action
- To understand the concept of Enzyme Regulation
- To know about Multienzyme complexes and isozymes

PAPER-II (BCH 202) **MAX.MARKS-100**

ENZYMOLOGY

UNIT-I Isolation and purification of enzymes, purity of enzymes, enzyme activity and specific activity, native, inactive and denature state of enzymes. Nomenclature and classification of enzymes, general structure and properties of enzymes, enzyme assay, factors affecting enzyme activity.

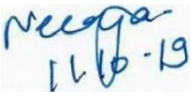
UNIT-II Kinetics of enzyme action -Concept of ES complex, active site, specificity, derivation of Michael is-Menten equation for uni- substrate reactions. Different plots for the determination of Km & Vmax and their physiological significances. Importance of Keat/Km. Kinetics of zero & first order reactions. Classification of multi substrate reactions with examples. Derivation of the rate of expression for Ping Pong, random & ordered BiBi mechanisms. Use of initial velocity, inhibition and exchange studies to differentiate between multi substrate reaction mechanism. Reversible and irreversible inhibition. Competitive, non- competitive, uncompet1t1ve, linear-mixed type inhibitions and their kinetics, determination of Ki and numericals. Suicide inhibitor.

UNIT-Ill Mechanism of Enzyme Action – Acid-base catalysis, covalent catalysis. proximity, orientation effect. Strain & distortion theory. Chemical modification of active site groups. Site directed mutagenesis of enzymes. Mechanism of action of chymotrypsin, lysozyme, aldolase, carboxypeptidase and alcohol dehydrogenase.

UNIT-IV Enzyme Regulation - General mechanisms of enzyme regulation, product inhibition. Reversible (glutamine synthase & phosphorylase) and irreversible (proteases) covalent modifications of enzymes. Mono cyclic and multicyclic cascade systems with specific examples. Feed back inhibition and feed forward stimulation. Allosteric enzymes, qualitative description of "concerted" & "sequential" models for allosteric enzymes. Half site reactivity, Flipflop mechanism, positive and negative co-operativity with special reference to aspartate transcarbamoylase & phosphofructokinase. Protein-ligand binding measurement, analysis of binding isotherms, Hill and Scatchard plots.

UNIT-V Multienzyme system – Occurrence, isolation & their properties: Mechanism of action and regulation of pyruvate dehydrogenase & fatty acid synthase complexes. Enzyme-enzyme interaction, isoenzymes with special reference to lactate dehydrogenase and

phaspho creatine kinase.

BCH203: Plant Biochemistry

- The course is designed to know the structure and function of plant cell and role of different organelles.
- Students will be able to learn the general process of photosynthesis in the plants and energy transfer.
- To know the general metabolism in plants such as respiration, lipid biosynthesis and other key process such as nitrogen metabolism
- Students will also gather information on metabolites and hormones, important in the development of plants.

PAPER-III (BCH 203) **MAX.MARKS - 100**

PLANT BIOCHEMISTRY

UNIT-I Structure and function of plant cell (including cell-wall, plasmodesmata, meristmetic cells, vacuoles, secretory system root quiescent zone), Isolation of cell organelles, absorption, transport of water & ions in plants, Evapotranspiration.

UNIT-II Photosynthesis, Photosystem I & II their location, Mechanism of quantum capture & energy transfer between photo system. hi ll reaction, photophosphorylation, & reduction of C02, C3, C4, and CAM metabolism, light and dark reaction. Light activation of enzymes, Regulation of photosynthesis, Photorespiration.

UNIT-III Biological nitrogen fixation and ammonia assimilation, nitrate and sulphate reduction and their incorporation into amino acids translocation of inorganic and organic substances. Role of microbes in nitrogen, sulphur, carbon and phosphorous cycles.

UNIT-IV Special features of secondary plant metabolism, formation of phenolic acids, tannins, lignins, lignans, pigments, terpenes, terpenoids, plant, phenolic, alkaloids and surface waxes -their biosynthesis and function.

UNIT-V Plant hormones – growth regulating substances and their mode of action. Biological and Molecular aspects of auxins, Gibberllins, abscisic acid, cytokinins and ethylene. Biochemistry of seed development and fruit ripening. Defense system in plants.

BCH204: Biostatistics, computer application and IPR

- Develop learning and experience on computers, and biostatistics in students for their future personal and professional development.
- Construct knowledge about the various applications of softwares and statistics to the students.
- Solve mathematical and statistical problems with fellow class mates as well as individually.
- To recognize the importance of IP and to educate the people on basic concepts of Intellectual Property Rights.
- To learn the procedure of obtaining Patents, Copyrights, Trade Marks and industrial design
- To enable the students to keep their IP rights alive

PAPER-IV (BCH 204) **MAX.MARKS-100**

BIOSTATISTICS, COMPUTER APPLICATION AND IPR

UNIT-I Aim scope and elementary idea of stat1st1cs in Biology, Tabulation and diagrammatic representation of statistical data. Concepts of statistical population and sample, elementary account of sampling methods, frequency distributions. Measures of central location and dispersion, measures of skewness and Kurtosis.

UNIT-II Probability – definition simple theorems on probability, conditional probability Discrete and continuous variables, Standard distributions- Bionominal, poisson normal. Correlation and regression – Least square method of fitting linear and quadratic regression, standard errors of estimate, correlation coefficient.

UNIT-III Basic ideas of sampling distribution Statistical estimation and Test of significance, confidence limit. Some commonly used tests of significance. Normal tests students't' test, x^2 and F tests. Analysis of variance.

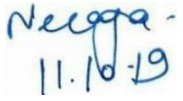
UNIT-IV Intellectual Property Rights: Types of IP, patents, trademarks, copy rights and related rights, industrial design, traditional knowledge, geographical indication, IPs of relevant to Biochemistry.

UNIT-V History and development of computer, computer peripherals and hardware description, operating system, office application, logic development, basic knowledge of computer softwares and scienctific application packages.

LABORATORY COURSE -II **MAX. MARKS -100**

LIST OF EXPERIMENTS

1. Isolation of enzymes from different sourses.
2. Assay of enzyme activity (acid phosphatase, peroxidase).
3. Isolation and chemical characterization of cell wall.
4. Purification of protein by column chromatography.
5. Separation of proteins by SOS-PAGE.
6. Separation of proteins by 20-PAGE.
7. ELISA.

BCH301: Physiology and Clinical biochemistry

- Understand and explain the acid-base and water-electrolyte balance in the body.
- Understand the difference between plasma, serum, normal and abnormal constituents in various body fluids. blood clotting mechanism and anticoagulants.
- Explain the nature and function of various enzymes, normal levels and elevated levels in various diseases. Also, learning on various systems of the body.
- Comprehend that blood is a universal fluid for carrying different minerals, nutrients, proteins etc to and from various tissues.
- Learn that many diseases result from imbalance in certain biomolecules and helps in diagnosis of liver, cardiac, gastrointestinal, kidney diseases.
- The course will also aid to learn about kidney diseases like uremia and glomerulonephritis; liver diseases like jaundice, hepatitis, neurological diseases like epilepsy, Parkinson and Alzheimer's disease.

SEMESTER-III

PAPER-I (BCH 301) **MAX.MARKS-100**

PHYSIOLOGY AND CLINICAL BIOCHEMISTRY

UNIT-I Nutrition and balanced diet vitamins and minerals. Digestion and Absorption of food (Carbohydrates, Lipid and protein), Chemistry of respiration homeostasis, regulation of acid base balance. factor affecting acid base balance.

UNIT-II Body fluids – Composition and functions, Blood groups, Rh factor, Plasma protein, coagulation, clotting formation, Anemia, Urine - Composition & function, formation in health and disease.

UNIT-III A brief outIine of various endocrine glands. Classification, Structure, and function of Hormones. Feedback regulation of hormone secretion. Mechanism of extracellular and intracellular hormone action. Metabolic and physiologic role of hormones secreted by pituitary, thyroids, parathyroid, adrenals, pancreas and gonad, disorders due to over and under secretion.

UNIT-IV Biochemical basis of drugs action. Biotransformation and detoxification mechanism, Role of glutathione in drug resistance.

UNIT-V Clinical and Bio-chemical aspects of disease- cancer, AIDS, jaundice, cushing, syndrome, diabetes mellitus, atherosclerosis, protein calorie malnutrition.

BCH302: Molecular Biology

- The course has been devised to familiarize students with molecular biology which mainly deals with interactions among various systems of the cell, including those between DNA, RNA and proteins and learning how these are regulated.
- To gain an understanding of biochemical and molecular processes that occurs in and between cells.
- To gain insight into the most significant molecular and cell-based methods used today to expand our understanding of biology.
- Will be able to design and implement experimental procedures using relevant techniques.
- To learn and acquire knowledge on tools and techniques related to molecular biology.

PAPER-II (BCH 302) **MAX.MARKS - 100**

MOLECULAR BIOLOGY

UNIT – I Nucleic acid as genetic information carriers experimental evidence, current version of central dogma, DNA topology, unique and repetitive DNA, Satellite DNA, function of satellite DNA, reassociation kinetics, C-value paradox, cot values.

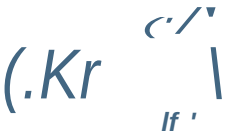
UNIT – II Organization of genetic material of viruses, Prokaryotes and eukaryotes. Concept of gene, fine structure of gene. Split gene, transmission of genetic materials, sexual and parasexual system

UNIT- III Genetic code, Evidence for triplet codon, properties of code, nonsense code, mutatagenic agents, biochemical and molecular basis of mutation. DNA replication in prokaryotes and in eukaryotes and its regulation. Genetic repair mechanism.

UNIT – IV Transcription of RNA: RNA polymerase, promoter's initiation, elongation and termination of RNA synthesis, inhibitors of transcription, Reverse transcriptase. post transcriptional modification.

UNIT -V Protein biosynthesis and its regulation, mechanisms in prokaryotes and eukaryotes. Effect of hormones and antibiotics on protein biosynthesis, post-translational modifications, operon concept.



BCH303: Immunology

- The students will be able to identify the cellular and molecular basis of immune responsiveness.
- The students will be able to describe the roles of the immune system in both maintaining health and contributing to disease.
- The students will be able to describe immunological response and how it is triggered and regulated.
- The students will be able to transfer knowledge of immunology into clinical decision- making through case studies presented in class.

PAPER- III (BCH 303) **MAX.MARKS - 100**

IMMUNOLOGY

UNIT-I The biochemical basis of immunology- Innate immunity, Specific acquired immunity, Immunoglobulin Classification, structure and biochemical basis of function, variable domain bind antigen, MHC, T-cells, B-cells, receptors. Antigens haptens, recognition of antigen -primary interaction its detection and application.

UNIT -II Major Histocompatibility Complex (MHC) Genes and product- Polymorphism of MHC genes, Role of MHC antigens in immune Reponses, MHC antigens in transplantation.

UNIT- III Measurement of antigen-antibody interactions – Production of polyclonal and monoclonal antibodies: Principles techniques and applications. Agglutination and precipitation techniques, RIA, ELISA, IRMA, immunofluorescence assays. Measurement of T cell activation.

UNIT-IV Acquired immune response: consequences of antigens recognition, product effectors and its control development, adversial strategies, and immunodeficiency. Elementary knowledge of hypersensitivity.

UNIT- V Disorders of immune responses - Autoimmunity, congenital immunodeficiencies, acquired immunodeficiencies, Immune responses to infectious diseases, role of vaccines in the prevention of diseases.

BCH304: Advanced Biotechnology

- To understand various techniques of Cell and Tissue Culture, their types and applications,
- To learn about the basic techniques used in recombinant DN A technology (RDT) and to know about vectors and their applications for cloning, recognize the extraordinary power of restriction and other enzymes in molecular cloning and genetic manipulations
- To know about the isolation of genes, their sequencing and synthesis
- To learn about Strategies for transferring genes as well as transgenic animal s, and plants.
- To understand about the various applications of biotechnology in various fields of biology especially industrial.

PAPER-IV (BCH 304) **MAX.MARKS-100**

ADVANCED BIOTECHNOLOGY

UNIT-I Cell and tissue culture techniques, concept of totipotency, introduction to different types of culture, cell induction and maintenance, clonal multiplication, protoplast fusion, Biochemistry of organogenesis and embryogenesis.

UNIT-JI Basic elements and experimental techniques of the Biotechnology. Restriction enzymes and analysis. Cosmid, plasmid (Vectors), gene cloning, gene library, basic principles of nucleic acid probe.

UNIT-III Isolation of genes (genes with Tissue specific expression; mutant complementation transposon tagging): sequencing of genes (Maxam-Gilbert's method): synthesis of genes (Organochemical Synthesis of tRNA gene and interferon).

UNIT-IV Gene transfer methods of animals and plants: Agro- bacterium mediated Gene transfer. Electroporation and particle gun. Transgenic animals (Mouse and rabbit): Transgenic plants (Herbicide insect and virus resistance).

UNIT-V Biological and medical application of Biotechnology - microbiology and industrial Biotechnology. Food Biotechnology, protein engineering, Bioreactors, concept design and control. Downstream processing, biofertilizers, Biopesticides.

LABORATORY COURSE- Ill **MAX.MARKS - 100**

LIST OF EXPERIMENTS

I. Isolation of total DNA by rapid method.

2. Isolation of total RNA by GTC or CTAB method.

3. Separation of DNA and RNA by Agarose Gel Electrophoresis.

4. Microbial cultures, competent cell preparation and cloning.

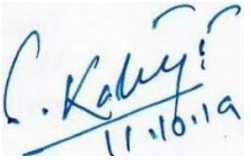
5. Southern and Northern Bloting.

6. Screening through probes.

7. Sequencing of DNA and RNA on polyacrylamide gels.

8. Preparation of culture media.

9. Establishment and maintenance of callus.



BCH401: Environmental Biochemistry

- Development of understanding on ecology and environmental biology
- Appreciate the inter-relationship between organism in population and communities.
- Understand principles of toxicology and the harmful effects of toxic metals on humans and environment.
- It will also enable the learners to acquire awareness and sensitivity to the total environment and its allied problems.
- The course will acquaint the students with the various environmental hazards like environmental pollution, greenhouse effect and ozone layer depletion.

SEMESTER IV

PAPER-I (BCH 401) **MAX.MARKS-100**

ENVIRONMENTAL BIOCHEMISTRY

UNIT-I Introduction of ecology, Environmental factors. Biosphere, food web, trophic level and their pyramids. Ecosystem – types, development and evolution, habitat and niche. Concept of productivity and standing crops. Biome ecological indicators, ecology efficiency, edge effect, Biogeochemical cycles.

UNIT-II Population ecology – definition and characters. Regulation of population size by density dependent and independent factors. Quantative analysis of plant community. Biotic community – characteristics of community. Ecological succession.- causes sera climax community. Primary and secondary succession, Evolutionary ecology.

UNIT-III Pollution – air, water, lignin, detergent, dyes, heavy metal, drugs, Industrial waste effluents (pulp, sugar, and paper mills), and pollution control device impact analysis of some common pollutants. Harmful effects of rays – UV, gamma, ozone layer, ozone holes, greenhouse effect. Degradation: environmental biodegradable pollutants, non-degradable pollutants Treatment of waste water and industrial effluent.

UNIT-IV Metabolism and Toxicity of agro and industrial chemical to plants and animals. Toxicology of free radicals and its scavengers. Xenobiotics, Bioremediation, Vermiculture Biochemical aspects environmental Monitoring and ecosystem analysis.

UNIT-V Detection of Toxic exposure: acute Toxicity, chronic and sub acute exposure and their tests. Testing agents for carcinogenic, mutagenic and teratogenic action. The basis of antidotal procedures.

BCH402: Bioinformatics

- Students will be able to understand the basics of computer
- To understand the alignment between two sequences
- To gain knowledge about the functioning of NCBIand EMBL
- To demonstrate the role of computer in genomics and proteomics

PAPER-II (BCH 402) **MAX.MARKS-100**

BIOINFORMATICS

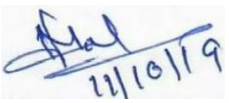
UNIT-I Computer basics -course introduction MS Window, basics UNIX, PC X, window (PCXWARE), file management, E-MAIL,(PINE, EUDOURA, NETSCAPE, MAIL), file transfer (ftp, WSftp)

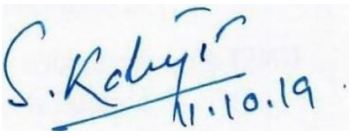
UNIT-II Review of key molecular genetic internet sites searching for sequence & multiple sequence alignment, - Internet World Wide Web resources similarly searching BLAST/FASTA, Retrieving and installing a programme (tree tool), Multiple sequence alignment (CLUSTAL W).

UNIT-III Construction of virtual library - Literature and journal search from MEDLINE and PUBMED, search engine of NCBI, extraction of citation index and current content from lSI data base

UNIT-IV Higher- order sequence analysis searching for simple repeat sequences restriction site analysis – MAR finder, identifying repetitive elements, identifying transfactor binding site, candidates using tools of basic Sequence alignment and multiple sequence alignment to predict genes .

UNIT-V Proteomics, GCG sequence analysis or other comparable site, introduction of GCG: sequence analysis seqlab:the X interface to GCG: Sewed: the web interface to GCG:





BCH403 A: Industrial Biochemistry

- The course will enhance learning and understanding of the fundamentals of microbiology like important characteristics and biology of bacteria, fungi, mycoplasma, viruses etc.
- This course will help students to acquire basic knowledge of fermentation process and industrial application of microbes for the production various useful products.
- Learn different immobilization techniques and Industrial and clinical scope of enzymes.
- Develop understanding of state-of-the-art technique/instruments used in various reputed research institutions. and industries

Elect any one of following

PAPER-III (BCH 403- A) **MAX.MARKS-100**

INDUSTRIAL BIOCHEMISTRY

UNIT-I: Basics of biochemical engineering; material and energy balances, heat transfer, mass transfer, mass transfer correlations with oxygen transfer, fluid flow, Non-newtonian fluids, Bernoulli's principle, viscosity, hydraulic conductivity, capillary flow, control and applications of industrial processes, Flux and metabolic control analysis, stoichiometric analysis, strategies for manipulating carbon fluxes in intermediary metabolism. Fermentors, general design of bioreactor, fermentation processes; type of culture- Batch, Plug-Flow, Chemostat and Fed batch, Growth kinetics of batch and continuous culture.

UNIT-II: Over production of metabolites, downstream processing, gene dosage and its applications in industrial processes, Large scale production of enzymes from traditional sources and genetically engineered organisms, proteases, amylases, cellulases, lipases, industrial scale production of lactic acid, alcohol, amino acids, antibiotics and secondary metabolites. Production of biopesticides, biofertilisers, biopreservatives (Nisin), cheese, biopolymers, (xanthan gum, PHB etc) and dyes

UNIT-III: Intrinsic and extrinsic parameters affecting quality of Foods, food preservation, characteristics of radiations of interest in food preservation, principles underlying the destruction of microorganisms by irradiation, physical and chemical methods of food preservation, legal status of food preservation, alterations during food processing, maillard reaction, non-enzymatic browning reaction and nutritional effects, fatty acids hydrogenation, lipid peroxidation and protein degradation.

UNIT-IV Pesticides and biopesticides in integrated pest management, physical, chemical and biological treatment of waste water, bioremediation of contaminated soils and waste lands,

UNIT-V Development of new drug/molecules and elucidation of their mechanisms of actions; pharmacokinetics and pharmacodynamics, Factors affecting- drug efficacy, drug resistance and biotransformation.

BCH403 B: Human Genetics

- The student will learn and understand the genome organization, cytogenetics, genetic control of development.
- The student will learn and understand the principles of Mendelian inheritance, linkage and genetic mapping; extrachromosomal inheritance, sex-linked inheritance and genetic disorders, somatic cell genetics, population genetics.
- The course will aid to learn about physical and chemical mutagens, drug metabolism and detoxification; DNA damage, DNA repair mechanisms, oncogenes, proto-oncogenes, and tumour suppressor genes from humans.
- The student will learn and understand the Human Genome Project, gene therapy, genetic testing, and genetic counselling.

PAPER-III (BCH 403- B) MAX.MARKS-100

HUMAN GENETICS

UNIT -I Introduction to Human Genetics: History ; Early perception , development and documentation; Genome organization; Chromosome structure, function and implications for disease. Study tools in Human Genetics: Pedigree analysis- Mendelian inheritance and exceptions; Chromosomal analysis (in vitro, in vivo), Biochemical analysis; Somatic cell genetics (somatic cell hybrids, monochromosome hybrid panels, gene mapping); Molecular genetic analysis.

UNIT -II Human genome mapping methods: Physical mapping: Introduction to physical map markersChromosomal, G/Q- banding, radiation hybrid , Fluorescence in situ hybridization, comparative genome hybridization, long range restriction mapping, high resolution mappingSTS/EST/MS/SNP/sequencing; Genetic mapping: Linkage analysis (RFLP/MS/SNP); Applications of mapping in normal and disease genome analysis; Gene identification using positional and functional cloning approach.

UNIT -III Human genome analysis: Conception, mapping, cloning and sequencing, Outcome-Generation of 'OMICS' era, significant leads. Genetic variation in health and disease: Human genetic diversity- Methods of study – Biochemical/molecular genetic markers· some examples. Tracing human migrations with autosomal, Y-chromosomal and mitochondrial markers.

UNIT-IV Diseases and disorders: Chromosomal disorders: Structural and numerical; Autosomal/sex chromosomal/sex reversal; Mechanisms – mitotic/meiotic non-disjunction/ chromosomal rearrangements; Some examples (Syndromes/Cancer/Infertility); Single gene and disease: Inborn errors of metabolism, Haemoglobinopathies; Multifactorial disorders: Introduction; Methods of study (Epidemiological, Twin/ adoption and Family studies); Etiology - genetic and non-genetic determinants; Common examples.

UNIT-V Epigenetics and disease: Mechanisms (Imprinting/methylation; chromatin remodeling);

Current understanding; examples. Mitochondrial myopathies. Ethical, legal and social issues in Human genetics: Prenatal/adult (individual/family/population) screening of mutation/risk factor for genetic diseases; Confidential ity/privacy, Discrimination, Ethical dilemma, Human rights, Surrogate mothers; Human cloning and eugenics; Organ banking and transplantation ; Research ethics; Medical ethics in India.

BCH403 C: Biochemical Engineering and Fermentation Technology

- Learn about Genetic engineering and prospects of improving crop productivity, resistance, resistance to disease and environmental stresses, methods for production of transgenic animals.
- Students will learn sterilization of air and medium; sterilization of fermenters, thermal death kinetics of microorganisms.
- The course will develop knowledge on enzyme kinetics with one or two substrates, modulation and regulation of enzyme activity, enzyme reactions in heterogeneous systems, immobilized enzyme technology, and industrial application of enzymes.
- This course will help students to acquire basic knowledge of microbial fermentation kinetics, bioreactors bioprocess system and commercial production of bioproducts.

PAPER-III (BCH 403- C) MAX.MARKS- 100

BIOCHEMICAL ENGINEERING AND FERMENTATION TECHNOLOGY

UNIT-I Biochemical engineering principals, range of fermentation process : microbial biomass, microbial enzyme, microbial metabolites recombinant products transformation process. Chronological development of fermentation industry, component part of the fermentation process.

UNIT-II Microbial fermentation kinetics : growth cycle, phase for batch cultivation , kinetics of garden type I and II fermentation system, determination of kinetics parameter using batch reactor with and without inhibition. thermal death kinetics.

UNIT-III Transport phenomena in bioprocess: Mixing and agitation, mechanical and non-mechanical agitation and oxygen – substrate mass transfer equipment, heat transfer energy balanced and transfer correlation, sterilization centrifugation filtration and drying .

UNIT-IV Introduction of bio reactors : Batch, CSTR and plug flow bioreactors performance equation, fermenter design, elementary treatment of non-ideal bioreactors – TD function and their application .

UNIT-V Dynamic modeling of batch and CSTR type bioreactors dimensional analysis and scale up fermentation economics .

BCH 404- Project/ Dissertation MAX.MARKS-200

BCH 405- MOOCs Grade (A/B/51