

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 metabolism	100
	BCH 202	Enzymology	100
	BCH 203	Plant Biochemistry	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	Immunology	100
	BCH 304	Advanced Biotechnology	100
	Practical		100
FOURTH	BCH 401	Environmental Biochemistry	100
	BCH 402	Bioinformatics	100
		Elect any 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

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SEMESTER – I

PAPER-I (BCH 101)

MAX .MARKS: 100

GENERAL BIOCHEMISTRY

- UNIT-I** Introduction of Biochemistry, Structure of water and interaction with ions, nature significance of weak acids and bases. Henderson-Hasselbalch 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 monosaccharides, 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.

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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 $\text{Na}^+\text{-K}^+$ pumps- examples and metabolic significance, Donan's membrane equilibrium.

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PAPER-III (BCH 103)

MAX MARKS : 100

BIOPHYSICALS CHEMISTRY, 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, partition, 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 SDS-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 biochemistry, RIA, IRMA, and ELISA. Units of radioactivity, biological hazards of radiation and safety measures in handling radioisotopes.

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PAPER-IV (BCH 104)

MAX.MARKS:100

GENERAL MICROBIOLOGY

- 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 emphasizing importance of bacteriophage and virus as tool in modern 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.

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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 Lowry'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.

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SEMESTER-II

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, phosphoglycerides and sphingolipids. Biosynthesis of steroids, ketone bodies formation and utilization.
- UNIT-IV** Biosynthesis and degradation of amino acids and their regulation, Specific aspects of amino acid metabolism. Urea cycle and its regulation, Inborn 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.

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ENZYMOLGY

- 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 Michaelis-Menten equation for uni- substrate reactions. Different plots for the determination of K_m & V_{max} and their physiological significances. Importance of K_{cat}/K_m . 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, uncompetitive, linear-mixed type inhibitions and their kinetics, determination of K_i and numericals. Suicide inhibitor.
- UNIT-III 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.

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PLANT BIOCHEMISTRY

- UNIT-I Structure and function of plant cell (including cell-wall, plasmodesmata, meristematic 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. Hill reaction, photophosphorylation, & reduction of CO₂, 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, Gibberellins, abscisic acid, cytokinins and ethylene. Biochemistry of seed development and fruit ripening. Defense system in plants.

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BIostatistics, Computer Application and IPR

- UNIT-I Aim scope and elementary idea of statistics 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- Binominal, 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, χ^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 scientific application packages.

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LABORATORY COURSE – II

MAX. MARKS -100

LIST OF EXPERIMENTS

1. Isolation of enzymes from different sources.
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 SDS-PAGE.
6. Separation of proteins by 2D-PAGE.
7. ELISA.

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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 outline 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.

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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, mutagenic 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.

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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 Responses, 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.

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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-II 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.

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LIST OF EXPERIMENTS

1. 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 Blotting.
6. Screening through probes.
7. Sequencing of DNA and RNA on polyacrylamide gels.
8. Preparation of culture media.
9. Establishment and maintenance of callus.

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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.

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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 ISI 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:

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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.

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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 markers Chromosomal, G/Q- banding, radiation hybrid, Fluorescence in situ hybridization, comparative genome hybridization, long range restriction mapping, high resolution mapping STS/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; Confidentiality/privacy, Discrimination, Ethical dilemma, Human rights, Surrogate mothers; Human cloning and eugenics; Organ banking and transplantation; **Research ethics; Medical ethics in India.**

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PAPER-III (BCH 403- C)

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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/C)

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