M.Sc.Biochemistry

Outcomes:

1. After completion of M.Sc. Biochemistry the student will have complete knowledge on the chemistry of bio-molecules, their role in structure and functions of living cells.
2. They will be able to understand the structural and functional organisation of various physiological systems in human body.
3. The student will know the various nutrients,their role in maintainance of human health.
4. The student will learn the various biochemical techniques to analyse biological samples at molecular level.

Programme specific outcomes:

1.After completion of the programmey, the student will have thorough knowledge on the bio-chemical aspects of life, such as structural and functional role played by bio-molecules in living organisms.

2. The student will have clear understanding of metabolic pathways, the role of enzymes in metabolisms and the metabolic disorders in humans.

3. The student gets expertise to analyze various biological samples to know their biochemical composition and structural and functional characteiztion of the biomolecules.

4. The student will be capable of identifying the causative factors of various diseases and developing therapeutic remedies for them.

5. With the technical expertise they can get employment in food industries, pharmaceutical industries,biotech industries, medical laboratories and research institutions.

M.Sc. BIOCHEMISTRY, SEMESTER-I

Course Code	Course Title	No of Hours Per week	No of Credits
BCH-101	Biochemical and biophysical methods	04	4
Sessional Marks: 20		End Semester Exam Marks: 80	

Objectives:

1) To impart knowledge about the various analytical and biophysical techniques.
2) To make the student to be able to carry out purification and characterization of various biomolecules.
3) To educate the student to characterize the separated biomolecules by electrophoresis and spectroscopic techniques.

Unit I

Biological relevance of pH, measurement of pH, pKa of functional groups in biopolymers such as proteins and nucleic acids. Importance of buffers in biological systems, ion selective electrodes, and oxygen electrode. Donnan membrane equilibrium. Significance of osmotic pressure in biological systems, viscosity and determination of molecular weight using viscometers.

Microscopy: Basic principles of light microscopy, phase contrast microscopy, electron microscopy, and fluorescence microscopy.

Sedimentation methods: Basic principles of centrifugation, preparative, differential and density gradient centrifugations, analytical, ultra-centrifugation, applications in the determination of molecular weight, purity of biomolecules and detection of conformational changes of biomolecules. Flow cytometry.

Unit II

Radioactivity: Half-life, decay constant, average life, units of radioactivity, Radioactivity measuring techniques, and correction factors. Statistics of counting operations, Radiation dose units, Roentgen, REP, REM maximum permissible dose, dosimetry and dosimeters; radiation monitoring hazards, biological effects of radiation, Isotope dilution technique and its application in biochemical investigations. Radioisotopes in biochemistry and medicine. RIA.

Unit III

Theoretical principles, methodology and biochemical applications of separation methods: Counter current distribution, Paper, Thin layer, Reverse phase, absorption, ion exchange, and gas chromatography, affinity chromatography, Gel filtration, HPLC, Electrophoresis: Paper, agar, immune-electrophoresis, high voltage electrophoresis, SDS-PAGE and isoelectric focusing, Capillary electrophoresis, iso-tachophoresis, Northern blot, Southern blot, Western blot Analyses and development of blots. 2D electrophoresis, Pulse- field gel electrophoresis.

Unit IV

Spectroscopy: Electromagnetic radiations, Beer-Lamberts law principles and applications of colorimetry, spectrophotometry. Concept and biological application of UV, fluorimetry, flame photometry, AAS, AES, Infrared, ESR, NMR spectroscopy, Polarimetry, CD & ORD. Principles and applications of X-ray Diffraction. MALDI- LCMS, Biosensors.

Text Books:

1. Techniques in Molecular Biology. Walker and GastraEdt, 1983
2. Principles and Techniques of practical biochemistry. Wilson and Walker, 1980
3. Analytical Biochemistry, Holmes and Hazelpeck, Edt, 1983

Course outcomes:

1) After studying the mentioned topics in the paper, the student will know the various steps involved in the purification of biomolecules.
2) In additional he will be knowing the applications of radioisotopes in biology and selection of buffers for particular experiment.

Course Code	Course Title	No of Hours Per week	No of Credits
BCH-102	Molecular Physiology & Community Nutrition	04	4
Sessional Marks: 20		End Semester Exam Marks: 80	

Objectives:

1. To impart knowledge on the various physiological systems in human body
2. To make the students know the chemical composition of human body, energy requirements and expenditure.
3. To enable the students to know the nutritional requirements of different age groups of humans.

Course Content:

Unit I

Circulatory system: Formation and composition of blood. Total and differential counts in blood. Development of erythrocytes, and leukocytes. Platelets. Plasma proteins Blood clotting mechanism. Erythrocyte Sedimentation Rate.

Circulation of blood: Cardiac cycle, Capillary and venous blood flow. Blood pressure Electrocardiogram Blood gas transport and gaseous exchange in tissues. Acid-base balance in lungs. The value of blood pH, PO2, PCO2, Measurements.

Excretory system: Structure and function of Nephrons. Urine formation; GFR, reabsorption and secretion. Composition. Normal Inorganic and organic constituents' abnormal constituents of urine. Acid-base balance equilibrium maintained by the Kidney.

Unit II

Muscular system: Types of Muscular tissue; structure of striated muscle fiber molecular organization of contractile systems, mechanism of muscle contraction, Regulation and energetics of contraction. Role of calcium.

Nervous system: Outlines of organization of nervous system; blood-brain barrier; Nerve growth factor. Origin of membrane potential. Mechanisms of propagation of nerve impulse of synaptic transmission. Myelin sheath – composition and function; biogenic amines amino acids and Peptides; Neurotransmitters. Transmission at cholinergic adrenergic nerve endings. Electrophysiological methods: PET, MRI, CAT, Sense organs andthermoregulators.

Unit III

Body weight and the body composition: Determination of body fat and body water. Body composition during growth and energy requirements. Measurement of energy expenditure, direct and indirect calorimetry, Respiratory quotient and BMR.Protein nutrition. Essential and non-essential amino acids.

Nitrogen balance: Methods of calculation of biological value of proteins protein calorie deficiency. Kwashiorkor and Marasmus. Fats as component of diet, Energy value of fats. Essential fatty acids and phospholipids in nutrition.

Unit IV

Requirement of fat-soluble and water-soluble vitamins and their deficiency symptoms, sources of the vitamins. Macro and trace elements in nutrition as regards to dietary sources. Deficiency symptoms and recommended dietary allowances. Special aspects of Nutrition for

the infants, children, pregnant and lactating woman and in old age, Importance of Nutrition under stress conditions.

Community Nutrition and Health: Assessment of Nutritional status of community. Anthropometric measurements, clinical examination. Radiological, Biophysical and Biochemical techniques.

Text Books:

1. Harper's Biochemistry
2. Trace elements by Underwood
3. Nutrition by M.S.Swaminathan.
4. The book of Human Nutrition (1996) MS. Bamji, N.Prahlad Rao and V. Reddy.
5. Molecular Biology of the cells by Alberts *et al* (1994).

Course Outcomes: After learning the topics in the above course

1. The student will know the human body chemical composition and the various physiological systems in the body that carryout different physiological functions such as respiration, nerve impulse transmission, muscle contraction, excretion etc.
2. The student gets the knowledge and importance of nutritional requirements for the growth, development and maintenance of health of human body.

CourseCode	Semester-I, Course Title	No of Hours Per week	No of Credits
BCH-103P	Practical's related to Biochemical preparations and Analysis	06	04
End Semester Examination Marks: 100			

Objectives:

1. To impart knowledge and procedures of different biochemical tests and conduct practicals to know the presence or absence of carbohydrates/sugars, lipids/cholesterol, proteins/aminoacids in the given sample and also perform quantitative estimations Using colorometric and spectrophotometric methods.

Course Content

1.General reactions of carbohydrates. Specific reactions of different sugars: arabinose, xylose, fructose, galactose, sucrose, maltose and lactose.
2. General reactions of proteins and amino acids. Precipitation reactions of albumins and globulins.
3. General reactions of lipids and cholesterol.
4. Isolation and estimation of cholesterol from brain.
5. Isolation and estimation of glycogen/starch.
6. Preparation of Casein from milk.
7. Crystallization of albumin.
8. Estimation of proteins in biological samples:

a. Biuret method.
b. Folin-Lowry method.
c. UV method.
d. Bradfords dye binding method.

9. Titration curve of amino acid and calculation of PK and PI value.
10. Estimation of amino acids by formal titration.
11. Estimation of amino acid by Ninhydrin method.
12. Estimation of tyrosine by Million's –reaction.
13. Identification of N-terminal group of proteins by Sanger's method.

Estimation of fructose in Fruit-juice.

Recommended Books:
1. Hawk's physiological chemistry
2. Practical Biochemistry by T Plumer
3. Practical Biochemistry by J.Jayaraman
4. Varley's Practical chemistry.
5. A manual of laboratory techniques, NIN manual

Course Outcomes: At the end of the course the students will be able to
1. Learn Qualitative and quantitative procedures and methods of biochemical assays to identify and estimate carbohydrates-sugars, proteins-aminoacids, lipids etc in the given sample and in future useful for clinical, diagnostic and research purposes.

Course Code	Course Title	No of Hours Per week	No of Credits
BCH-104P	Practical related to Analytical Methods	04	4
End Semester Exam Marks: 100			

Objectives:
1. To impart knowledge about various equipment's employed in Biochemical investigation like, pH meter, Centrifuges, Colorimeters, and Spectrophotometry.
2. To create awareness about various types of Electrophoreticequipment's and their functioning

Syllabus:
1. Effect of solvent system on the Rf value of two solutes using TLC.
2. Separation of purines and pyrimidines by Paper Chromatography.
3. Separation of amino acids by Paper Chromatography.
4. Separation of sugars by TLC.
5. Isolation & Characterization of Brain Lipids by Solid phase extraction and TLC.
6. Separation of amino acids by Paper Electrophoresis (Demonstration).
7. Separation of amino acids by Ion-exchange Chromatography (Demonstration).
8. Separation of Serum proteins by Paper Electrophoresis.
9. Measurement of pH of a biological fluid using pH meter.
10. Absorption spectra of phenol red, amino acids and nucleic acid.
11. Verification of Beer's law and determination of molar extinction coefficient using p-nitro phenol.
12. Isolation and spectrophotometric characterization of plant pigments.
13. Isolation of Mitochondria from Rat liver by density gradient centrifugation (Demonstration).
14. Viscosity measurement of Bovine serum albumin.
15. Measurement of inversion of sucrose by Polarimetry.
16. Measurement of refractive index of Biological sample.
17. Dialysis.

Recommended Books:
1. Hawk's Physiological chemistry
2. Practical Biochemistry by T Plummer
3. Practical Biochemistry by J Jayaraman

Outcomes:
After performing the practical's the candidate will be knowing the construction, functioning, and applications of various instruments.

CourseCode	Semester-I, Course Title	No of Hours Per week	No of Credits
BCH-105	Human Values and Professional Ethics-I	06	04
Sessional Marks: 20End Semester Examination Marks: 80			

Objectives

1. To impart knowledge of ethics and to make students learn and follow ethics, values good behaviours in different domains of human life.
2. To enlighten students to follows yamas viz..ahimsa, satya, Brahmacharyam, Asteya and Aparigraha.
3. To explain the essence of Bhagavad Gita, concepts of Buddism, Jainism, Gandhian philosophy and Religious tolerance.
4. To make students understand crime and theories of punishment and Views of Manu and Yagnavalkya.

Course content

Unit I

Definition and Nature of Ethics-Its relation to Religion, Politics, Business, Law, Medicine and Environment. Need and Importance of Professional Ethics- Goals- Ethical Values in various Professions.

Unit II

Nature of Values – Good and Bad, Ends and Means, Actual and potential Values, Objective and Subjective Values, Analysis of basic moral concepts- right, ought, duty, obligation, justice, responsibity and freedom, Good behavior and respect for elders, Character and Conduct.

Unit III

Individual and Society: Ahimsa (Non- Violence), Satya (Truth), Brahmacharya (Celibacy), Asteya (Non possession) and Aparigraha (Non- stealing). Purusharthas (Cardinal virtues) – Dharma (Righteousness), Artha (Wealth), Kama (Fulfillment Bodily Desires), Moksha (Liberation).

Unit IV

Bhagavad Gita- (a) Niskama Karma (b) Buddhism- The Four Noble Truths- Arya astanga marga,(c) Jainism- mahavratas and anuvratas. Values Embeded in various Religions, Religious Tolerance, Gandhian Ethics.

Unit V

Crime and Theories of punishment (a) Reformative, Retributive and Deterrent. (b) Views on manu and Yajnavalkya.

Text Books:

1. John S Mackenjie: A manual of Ethics
2. Ethics in management by S.A.Sherlekar, Himalayan publishing House
3. Harold H.Titus: Ethics for today
4. Ethics:Theory and Contemporary Issues, Barbara Mackinnon Wadsworth/Thomson
5. An Introduction to Applied ethics (Ed.) John H.Piet and Ayodhya Prasad, Cosmo Publications. Learning, 2001.

Course Outcomes:

After Completion of the course the student will be able to

1. To impart knowledge about the basics and concepts of ethics, morals, values, conduct, character and yamas to be followed in life.

2. To understand the values embedded in Buddism, Jainisms and other religions and to follow religious tolerance.
3. Realize punishment theories and be away from crimes and to live as responsible citizens

Course Code	Semester-I, Course Title	No of Hours Per week	No of Credits
BCH-106	Cell and Biomolecules– Theory	06	04
Sessional Marks: 20End Semester Examination Marks : 80			

Objectives:

1. To impart the basic structure and function of different cell organelles in the living system.
2. To impart knowledge about different classes of Bio-molecules like carbohydrates, proteins-amino acids, lipids, Nucleic acids and their classification, their structural and functional aspects in living cells.

Course Content

Unit I

Prokaryotic and Eukaryotic cells:
Structure, Composition and functions of nucleus, mitochondria plastids, endoplasmic reticulum, Golgi, lysosomes, vacuole, micro bodies, ribosomes, cytoskeleton.

Origin of basic Biomolecules. Amino acids & Proteins:
Classification of amino acids, acid-base properties of amino acids, chemical reactions of amino acids, non-protein amino acids, Peptide bond – Structure and conformation. Naturally occurring peptides.

Classification of proteins – purification and isolation of proteins, criteria of purity of proteins, physico-chemical properties, structural organization of proteins, Elucidation of primary structure, secondary structure, , Tertiary structure Quaternary structure, Denaturation & renaturation of proteins. Outlines of Proteomics.

Unit II

Carbohydrates: Definition and classification of carbohydrates, nomenclature, Reaction of Monosaccharides, Acid derivatives of Monosaccharides amino-sugars, Oligo saccharides, structure, properties and importance of Homo & Hetero polysaccharides.

Lipids: Classification, Physical and chemical properties of fatty acids. Characterization of natural fats & oils, structure and biological role of triaceyl glycerol, phospolipids, sphingolipids, Gangliolipids, Prosta-glandins, Thromboxanes, Leukotrienes and steroids. Killer fat (Staphylococcus killer)

Unit III

Isolation, fractionation, characterization of nucleic acids, properties of nucleic acids in solution. Structure of nucleic acids – primary – purine and pyramidine bases, nucleosides, nucleotides, polynucleotides; secondary & Tertiary structure of DNA.

Structure of RNAs – Secondary and Tertiary structure; Analysis of stability to nucleic acid structures. DNA denaturation and renaturation kinetics, Nucleic acid sequencing –Higher orders of DNA & RNA Structure, chromatin structure; Gene analysis – southern blot technique and its variance. Proteomics and genomics.

Unit IV

Structure of porphyrins; Protoporphyrin, porphobilinogen properties Identification of Porphyrins. Structure of metalloporphyrins – Heme, cytochromes and chlorophylls. Chemistry and functions of water- and fat-soluble vitamins. Circadian clock.

Text Books

1. Biochemistry-Lubert Stryer

2. Lehninger Principles of Biochemistry- David L.Nelson, Michael M Cox
3. Biochemistry-Zubay
4. Fundamentals of Biochemistry-Donald Voet
5. Biochemistry of Nucleic acids-Adams et al
6. Biochemistry, Lehninger A.H.
7.Textbook of Biochemistry West, E.S., Todd, Mason &Vanbruggen,Macmillian&Co.

Course Outcomes: After Completion of the course the student will be able to

1. Learn the fundamentals, classification, structural and functional aspects of major classes of biomolecules and porphyrins in living systems.
2. Will have knowledge about complex and derived lipids and Nucleic acids and their properties.

M.Sc. BIOCHEMISTRY, SEMESTER-II

Course Code	Course Title	No of Hours Per week	No of Credits
BCH-**201**	Energy Metabolism	04	4
Sessional Marks: 20		End Semester Exam Marks: 80	

Objectives:

1) To educate the students about various metabolic techniques used in pathway identification of carbohydrates and lipids.
2) In addition to impart the student with basic concepts of bioenergetics of mitochondrial and chloroplast organelles.

Course Contents:

Unit I

Broad outlines of Intermediary metabolism, methods of investigation, Intermediary metabolism in vivo studies such as analysis of excretion, Respiratory exchange, Removal of organs and perfusion studies, in vitro studies such as tissue slice techniques; Homogenates and purified enzyme systems; isotope tracer studies, use of inhibitors and antimetabolites.

Metabolism of carbohydrates: Glycolysis, Fermentation, Feeder path ways (of fructose, galactose and mannose), TCA cycle, HMP shunt, Regulation of glycolysis, pyruvate dehyraogenage complex, and TCA cycle.

Unit II

Bioenergetics: Thermodynamic principles – Chemical equilibria; free energy, enthalpy (H), entropy (S). Free energy change in biological transformations in living systems; High energy compounds. Energy, change, oxidation-reduction reactions. Organization of electron carriers and enzymes in mitochondria. Classes of electron-transferring enzymes, inhibiters of electron transport. Oxidative phosphorylation. Uncouplers and inhibitors of oxidative phosphorylation. Mechanism of oxidative phosphorylation. Miotrochondrial transport system. Microsomal electron transport; Photorespiration, cyclic and non-cyclic reactions; photochemical events associated with pigment system – II and I. Utilization of oxygen by oxygenases, Superoxide dismutase and catalase.

Unit III

Uronic acid pathway, metabolism of amino sugars, metabolism of glycogen, starch, sucrose, lactose, glycoproteins. Gluconeogenesis, glyoxylate cycle. Regulation of glycogen metabolism and gluconeogenesis. Futile cycles in carbohydrate metabolism. Disorders of carbohydrate metabolism – Glycogen, lactose, Fructose.

Unit IV

Biosynthesis and degradation of fatty acids (Saturated and unsaturated) regulation, metabolism of TAG, Glycerol and sphingolipids, cholesterol, prostaglandins. Biosynthesis

and degradation of cholesterol and its regulation. Metabolism of lipoproteins and Ketone bodies.

Text Books:

1) Biochemistry text book by Albert Lehninger
2) Text book of Biochemistry by West and Todd.
3) Biochemistry II edition by Zubay, G

Course Outcomes:

1) After studying the topic mentioned in the objectives the student will know the types and mechanism of electron transport and phosphorylation. In addition, they will be knowing the diffective enzymes of carbohydrate and lipid metabolism.

Course Code	Course Title	No of Hours Per week	No of Credits
BCH-202	Metabolism of Nitrogen based Molecules	04	4
Sessional Marks: 20		End Semester Exam Marks: 80	

Objectives:

1) To impart knowledge on N_2 metabolism and N_2 containing compounds (Proteins, Nucleic acids etc.) metabolism in human system.

Course Content:

Unit I

Nitrogen cycle

Non-biological and biological nitrogen fixation, Nitrogenase system. Utilization of nitrate ion, Ammonia incorporation into organic compounds. Synthesis of glutamine and regulatory mechanism of glutamine synthase.

Unit II

Metabolism of proteins and amino acids:

Introduction, General metabolic reactions of amino acids. Degradation and biosynthesis of individual amino acids in animal, plant, and microbial systems. End products of amino acid metabolism - Krebs Haslett urea cycle. Regulation of amino acid biosynthesis.

Unit III

Amino acids as biosynthetic precursors- Formation of creatine, Seratonine, histamine, polyamines, melatonine, GABA, melanine, catecholamines. Biosynthesis and degradation of porphyrines (Heme), porhyrias. Non-ribosomal peptide synthesis-glutathione, cyclic antibiotics (gramicidin).

Unit IV

Metabolism of Nucleic Acids: Synthesis and Degradation of Purines and Pyrimidines, Synthesis of Nucleotides and its regulation.

Text Books:

2) Principles of Biochemistry, White. A, Handler, P and Smith.
3) Biochemistry, Lehninger A.L.
4) Biochemistry, David E. Metzler.
5) Biochemistry, LubertStryer.
6) Review of physiological chemistry, Harold A. Harper.

Course Outcomes: After studying the paper, the students will know the importance of N_2 containing compounds (Proteins, Nucleic acids, porphyrins etc.) and their metabolic pathways and disorders associated with them resulting in metabolic diseases in humans.

Course Code	Course Title	No of Hours Per week	No of Credits
BCH-203P	Practical related to Enzymology	04	4
End Semester Exam Marks: 100			

Objectives:

1. To impart knowledge about various enzymes used in Biochemical investigations.
2. To create awareness about various types of Enzyme assays and the determination of Vmax, Km and Ki.

Syllabus:

1. Amylase from Saliva.
2. Urease from Horse-gram.
3. Acid phosphatase from Potato.
4. Alkaline phosphatase from Serum.
5. Cholinesterase from Blood.
6. SDH from Liver.
7. Invertase from yeast.
8. Trypsin
9. LDH from Serum (Isoenzymes).
10. Enzyme purification and enzyme kinetics (Determination of Vmax, Km and Ki).
11. Effect of pH, Temperature, Activators, Inhibitors.
12. Immobilization of enzymes (demonstration only).

Recommended Books:

1. Hawk's Physiological chemistry
2. Practical Biochemistry by T Plummer
3. Practical Biochemistry by J Jayaraman
4. Klemir and others: practical Biological chemistry.
5. Practical Biochemistry – Koch and Hank Dunn and Drell
6. Practical Biochemistry-Sawhney (2000)
7. Varley's Practical clinical Biochemistry – Ed. Alan W.Gowenlock (Heinemann, London)

Outcomes

After performing the practical's, the candidate will be knowing the Enzyme assays and the determination of Vmax, Km and Ki.

Coursecode	Semester-II, Course Title	No of Hours Per week	No of Credits
BCH-204P	Practicalsrelated to molecular biology	06	04
End Semester Examination Marks: 100			

Objectives:

1.To impart the procedures/protocols for isolation of DNA and RNA from plant, bacterial, plasmid, yeast and animal tissues.
2.To know DNA kinetics and estimation of DNA and RNA by colorimetric, spectrophtometric, gel electrophoretic methods.

Course Content

1. Isolation of DNA from bacterial, plant and animal cells.
2. Estimation of DNA by Diphenylamine method.
3. Isolation RNA from yeast cells.
4. Estimation of RNA BY Orcinol method.
5. Estimation of DNA and purity determination by UV absorption method.
6. Determination of melting temperature (Tm).
7. Isolation of plasmid DNA from E.coli.
8. Detection and differentiation of open circular, linear and closed covalent circular plasmid DNA bysubmarine gel electrophoresis.
9. Transformation of E.coli with ampicillin resistant plasmid.
10. Trasfection of M13 DNA into E. coli JM103.
11. Isolation of phage M13.
12. Isolation of single and double standard M13 DNA.
13. Conjugation: Use of broad host range plasmid RP in demonstrating conjugation transfer of plasmidbacteria.
14. Catabolite repression: Evidence of B-Galactosidase induction in presence of lactose in E .coli lacstrains.

Recommended Books:

1. Hawk's Physiological chemistry
2. Practical Biochemistry by T Plummer
3. Practical Biochemistry by J Jayaraman
4. Klemir and others: practical Biological chemistry.
5. Practical Biochemistry – Koch and Hank Dunn and Drell
6. Practical Biochemistry-Sawhney (2000)
7. Varley's Practical clinical Biochemistry – Ed. Alan W.Gowenlock (Heinemann Medical Books,London)

Course Outcomes: At the end of the course the students will be able to

1. Acquaint themselves with DNA/RNA isolation procedures from different sources and their kinetics which will be useful for them for further clinical and research studies.

CourseCode	Semester-II, Course Title	No of Hours Per week	No of Credits
BCH-205	Human Values and Professional Ethics-II	06	04
Sessional Marks: 20End Semester Examination Marks: 80			

Objectives:

1. To educate about the strengths of value education, to promote self-esteem, understand human values, adjustment, family structure and family values
2. To explain the status of women and the need for caring the elderly andneedy
3. To make students learn about ethics in medical and business fields, social ethics, human rights and Environmental ethics.

Course Content

Unit I

Value Education- Definition- relevance to present day- Concept of Human Values- self introspection-Self-esteem- Family Values – Components, Structure and responsibilities of family- Neutralization of anger- Adjustability- Treats of family life – Status Of women in family and society- Caring for needy and elderly – Time allotment for sharing ideas and concerns.

Unit II

Medical ethics- Views of Charaka, Sushruta and Hippocratus on moral responsibility of medical
practitioners. Code of ethics for medical and Health care professionals. Euthanasia, Ethical obligation to animals, Ethics issues in relation to health care professionals and patients. Social justice in health care, Human cloning, Problems of abortion. Ethical issues in genetic engineering and Ethical issues raised by new biological technology or knowledge.

Unit III

Business ethics- Ethical standards of business- Immoral and illegal practices and their solutions.
Characteristics of ethical problems in management, ethical theories, causes of unethical behavior, ethical abuses and work ethics.

Unit IV

Environment ethics- Ethical theory, man and nature- Ecological crisis, Pest control, Pollution and waste, Climate change, Energy and population, Justie and Environmental health.

Unit V

Social ethics- Organ trade, Human trafficking, Human rights violation and social disparities, Feminist
ethics, Surrogacy/ pregnancy. Ethics of media- Impact of Newspaper, Television, Movies and Internet.

Text Books:

1. A manual of Ethics-Sinha
2. Introduction to Ethics-William Lilly
3. A manual of Ethics-John S Mackenjie
4. Ethics in management" by S.A.Sherlekar, Himalaya Publishing House.
5. The Ethics of Management" by Larue Tone Hosmer, Richard.D. Irwin Inc.
6. Manu: Manu Dharma Sastra or the Institute of Manu: Comprising the Indian System of Duties: Religious and Civil (ed.) G.C. Haughton.
7. Caraka Samhita: Tr. Dr. Ram Karan Sarma and Vaidya Bhagavan Dash, Chowkambha Sanskrit Series Office, Varanasi Vol 100, 16-20,21-32 and 74-77 only.

Course Outcomes: After Completion of the course the student will be able to

1. Realize the need and power of value education, to promote self-esteem, understand human values, increase adjustment attitude, uphold family structure and family values, respect women and promote no gender bias towards a better society.
2. Understand the responsibility to take care of the elderly and to help the needy and to adhere to human rights and to follow medical, business and social ethics and to protect the environment.

CourseCode	Course Title	No of Hours Per week	No of Credits
BCH 206	ENZYMOLOGY	04	04
Sessional Marks: 20		End Semester Examination Marks: 80	

Objectives:

- To understand the classification, structure and functions of various enzymes.
- To know the various type of enzymes and their imbalances.
- To identify the co-ordinated working pattern of enzymes.

Course Content:

Unit I

Nomenclature and classification of enzymes according to I.U.B. Convention, specificity and active site. Fundamentals of enzyme assay – enzyme units, coupled kinetic assay. Enzyme localization, Isolation, purification and criteria of purity. Profile of enzyme purification by different separation techniques.

Elements of kinetics – Reaction rates transition state theories free energy change. Methods used in the investigation of kinetics of enzyme-catalyzed reactions – Initial velocity studies and rapid reaction techniques (Continuous flow and Stopped flow). Enzyme kinetics of single substrate reactions, study state assumption, Michales-Menten (Briggs-Haldane), Lineweavar Burk, Eadie Hofstee, Hanes plots. Pre-steady state kinetics. Effect of pH and temperature.

Unit II

Enzyme inhibition: Types of reversible inhibitors – competitive, non-competitive, un-competitive mixed inhibition and partial inhibition. Substrate inhibition, Feedback inhibition and allostearic inhibition.

Irreversible inhibition. Bisubstrate reactions, Sequential mechanism compulsory order and random order mechanism, non-sequential mechanism, Ping-pong mechanism. Chemical nature of enzyme catalysis: General acid – base catalysis, electrostatic catalysis, covalent catalysis, intermolecular-catalysis, metal ion catalysis, and proximity and orientation.

Unit III

Mechanism of reactions catalyzed by the following enzymes – Chymotrypsin, Trypsin, Carboxypeptidase, Ribonuclease and Lysozyme.

Co-enzymes – the mechanistic role of the following co-enzymes in enzyme catalyzed reactions – Nicotinamide nucleotides, Flavin nucleotides, Co-enzymes A, Lipoic acid, Thiamine pyrophosphate, Biotin, Tetrahydrofolate and Co-enzyme B12. Modern concepts of evaluation of catalysis-catalytic RNA (Ribozyme), abzymes (catalytic antibodies), Synzymes (Synthetic enzymes), Site-directed mutagenesis.

Unit IV

Monomeric enzymes – the Serine proteases, Zymogen activation, Oligomeric enzymes – Isoenzymes (LDH) and multienzyme complexes (pyruvate dehydrogenase complex). Covalent modification (Glycogen phosphorylase, Glutaminesynthase, Chymotrypsin).

Allosteary of enzyme action; Binding of ligands to proteins Co-operativity, the Hill Plot for Myoglobin and Hemoglobin, Sigmoidal kinetics: The MWC and KNF models. Significance sigmoidal behaviour. Study of ATCase a typical allostearic enzyme.

Recommended Books:

1) Understanding enzymes: Palmer T., Ellis Harwood ltd., 2001.
2) Enzyme structure and mechanism. Alan Fersht, Freeman & Co. 1997
3) Principles of enzymology for food sciences: Whitaker Marc Dekker 1972.
4) Methods in enzymology Ed. Colowick and Kaplan, Academic Pr (Continuing series)
5) Text book of Biochemistry with clinical correlations (4^{th} edition)-Thomas M.Devlin.
6) Biological chemistry; H.R. Mehler & E.H Cordes Harper & Rev.
7) Enzyme kinetics Siegel interscience – Wiley 1976.

Course Outcomes: After Completion of the course the student able to

- ✓ Know the classification, structure and functions of various enzymes.
- ✓ Understandson various type of enzymes and their imbalances.
- ✓ Finally, they can get the knowledge on co-ordinated working pattern of enzymes.

M.Sc. BIOCHEMISTRY, SEMESTER -III

CourseCode	Semester-III, Course Title	No of Hours Per week	No of Credits
BCH-301	Microbial Biochemistry and Genetics	06	04
Sessional Marks: 20		**End Semester Examination Marks: 80**	

Objectives:

1. To educate students about fundamentals, historical developments of microbiology, the importance of microbes, bacterial classification, modes of nutrition, their culturing, maintenance and control, basics of viruses, their classification, life cycles and microbiology of food, water and sewage.
2. To impart knowledge about experimental evidences for genetic material, chromosomes structure, organization and abnormalities, gene arrangements and regulation in prokaryotes and eukaryotes and aspects of bacterial genetics.

Course Content

Unit I

Microorganisms and their place in the living World; Historical developments of microbiology (Spontaneous generation, Germ theory of disease and Koch's postulates). Nomenclature and broad classification of bacteria as per Bergey's manual of systematic bacteriology; General characteristics of Actinomycetes, Rickettsiae, Mycoplasms, Spirochetes. Difference between prokaryotic and eukaryotic cells. Ultra-structure of bacterium and endospore. Nucleic acid and 16s RNA based classification.

Nutritional requirements in microorganisms: Modes of nutrition – phototrophy, chemotrophy, methylotrophy, organotrophy, mixotrophy, saprophytic, symbiotic and parastitic modes of nutrition. Isolation of microorganisms – Direct and indirect Methods of maintenance of culture. Growth and kinetics of bacterial cells; Normal and biphasic growth curve, batch and continuous cultures, chemostats. Preservation of cultures (glycerol stocks, freeze drying), Culture collection centers in India.

Unit II

Control of microorganisms: Fundamentals of control, control by physical and chemical agents. Antibiotics and other chemotherapeutic agents. Microbiology of Food, Water, Sewage and Biogas. Water and Sewage treatment. Food and water-borne infections, Bacteriological and Viral standards of water. Estimation of BOD and COD and their importance. Outlines of the Ames Test.

Introduction to Virology: Classification, Morphology, size, ultra-structure and life cycle of some representative viruses (ØX 174, T4, SV40, λ-Phase, M13 and HIV). Methods of culturing of viruses, Isolation, purification and characterization. Biology of subviral agents – Viroids, Prions, Satellite viruses.

Unit III

Genetic material – Direct and Indirect evidences of DNA as genetic material, experimental proof. Evidences of RNA as genetic material – eg. Virus.

Chromosome - Chromosome and genes, chromosomal replication, genetic mapping of chromosomes, structure of chromatin - nucleosomes and higher orders of organization, chromosome banding, transposition in human chromosome and chromosomal abnormalities.

Gene – arrangements in prokaryotes and eukaryotes. Gene structure in eukaryotic organisms, introns, exons, pseudogenes, and gene clusters, spacers, repetitive sequences. Single and multiple copy genes in eukaryotes, eg – Histones, Alu, copia, satellite. Mapping of human genes – techniques used, assignment of important genes. Gene regulatory mechanisms and cell memory. Mechanism of recombination, extra nuclear inheritance. Non-coding explosion,

cell fate determination and reprogramming. Genetic technique for Archea. New gene evolution,Tiniest genome of proteobacteria and bacteriodates.

Unit IV

Bacterial genetics – Bacterial chromosomes, plasmids – fertility, resistance, colicinogenic and other, PBR 322 and other synthetic plasmids - isolation and uses. Transposable genetic elements, transformation, transduction, and conjugation in bacteria.

Linkage map of bacterial chromosome. Recombination in bacteria. Structure of Bacteriophages and their use in the study of molecular genetics – lytic cycle- replication of T-phages, Lysogeny and its regulation. Transduction – specialized, generalized and abortive. Transfection and cosmids. Fine structure analysis of T- phages, Benzers work and concept of cistrons. Bacterial defence (CRISPR- Gene turning on).

Mutation – Types of mutations, mutagens, mechanism of mutation, Mutagenesis, induction and isolation of mutants. Haploid genetic tools. Radiation effects on human heredity. Phylogenetic inheritance. Heretability and its measurements and mapping.Gene duplication and self-incompatibility.

Text Books:

1. Microbiology – Pelzar, Chan and Krieg
2. A text book of Microbiology-R.C.Dubey and D.K. Maheswari, S.Chand Co.
3. An introduction to Viruses-S.B.Biswas, Vikas publishing house
4. Molecular Genetics-D.Friefelder
5. Genetics-Gardner
6. Cell molecular Biology-Bruce Alberts
7. Microbiology 4th edition, Prescott, Harley, Klein (Mc grew Hill)

Course Outcomes: After completion of the course, the students will be able to

1. Learn fundamentals of microbiology, biology and classification of bacteria and viruses, their culturing, maintenance and regulation.
2. Concepts of bacterial genetics, structural aspects of chromosomes and genes, their organization, regulation in living organisms and abnormalities.

CourseCode	Semester-IIICourse Title	No of Hours Per week	No of Credits
BCH-302	Molecular Biology	06	04
Sessional Marks: 20End Semester Examination Marks: 80			

Objectives:

1. To impart knowledge about the synthesis of DNA and repair mechanisms, RNA processing, protein synthesis and regulation in living organisms.
2. To explain in detail about Genetic code and ribosomolgy aspects.

Course Content

Unit I

DNA synthesis and repair - Topology of DNA, conservative, semi conservative and discontinuous synthesis of DNA, DNA primer for DNA synthesis. DNA polymerases I, II, III – their role in DNA synthesis. DNA ligase - mechanism of its action and its role in DNA synthesis. Inhibition of DNA synthesis, fidelity of replication. Alternate lengthening of telomere.Nearest neighbor frequency analysis. Mechanism of replication of E. coli DNA. Role of DNA binding proteins – Histones in Eukaryotes, SSB in prokaryotes. Replication of lambda phage DNA, phage T-7 and single stranded DNA, the rolling circle model of replication of DNA. Mitochondrial replication, transcriptional switch.

Unit II

RNA synthesis and processing: RNA polymerases in prokaryotes and eukaryotes. Molecular composition of prokaryote RNA polymerase. Mechanism of transcription. Role of various compounds on RNA polymerases. Inhibitors of RNA synthesis. Biosynthesis of prokaryotic and Eukaryotic m RNA, r RNA, and t RNA. Processing of RNA- post transcriptional modifications, capping, adenylation and splicing. Role of the hn RNA, sn RNA and sn RNP in processing of RNA. Functions and information content of DNA methylation, Transcriptional transcript RNA, template DNA, recombination and silencing repair in yeast, sRNA and gene regulation.

Unit III

Genetic code: General features of the code, Deciphering of the genetic code – Nirenberg and Khorana's work. Central dogma in the molecular biology and its verification. Colinerarity of gene and protein. Wobble hypothesis and deviation from wobble hypothesis. Mitochondrial genetic code and evolution of genetic code. RNA editing and evolution.

Unit IV

Ribosomology: Prokaryotic and Eukaryotic molecular components of ribosomes. Assembly and dissociation of subunits. Polysomes and organelles ribosomes. Ribosomal switch.

Biosynthesis of proteins: Different stages and components of protein synthesis, ribosomes, m RNA and t RNA. Amino acid activation, protein chain initiation, elongation, and termination. Mechanism of protein synthesis in relation to gene action.

Some aspects of eukaryotic translation. Inhibitors of prokaryotic translation. Post – translational modification of proteins. Synthesis of secretory and membrane proteins – signal sequence hypothesis. Mechanism of translation control. Proteins local synthesis and disposal.

Text Books:

1. Molecular biology of the gene-Watson
2. Molecular biology of the cell-Bruce Alberts
3. Genetics-Zubay
4.Molecular Genetics-D.Friefelder
5. Genes VII-Benzemin Lewin
6. Cell and Molecular Biology 2nd Edit. (2002) By P.K.Gupta, Rastogi Publ.
7. Cell molecular Biology by Baltimore

Course Outcomes: After Completion of the course the students will be able to

1. Understand DNA replication methods, enzymes involved and its repair mechanisms in living cells and viruses.
2. Learn importance of Genetic code, structures of different RNAs, their synthesis, processing, Ribosomal biology, protein synthesis, modifications and regulation.

Course Code	Course Title	No of Hours Per week	No of Credits
BCH-303P	Practicals related to Microbiology	04	4
End Semester Exam Marks: 100			

Objectives:

1. To impart knowledge about various types of Microscopes, Microbial Media, Cultivation and identification Methods related to microorganisms.
2. To create awareness about BOD, COD and Antibiotic sensitivity test.

Syllabus:

1. Handling of Microscopes: Calibration of Microscopes.

2. Sterilization techniques: Autoclaving (Moistened-heat), Oven sterilization (dry-heat), Filtration,
UV irradiation and Chemical.Preparation of media: For Bacteria and Fungi.
3. Isolation and cultivation of pure cultures: Serial dilution, Pour plate method, Spread plate method
and streak plate method.
4. Methods for the estimation of Growth (Growth rate and generation time in bacteria).
5. Staining techniques for bacteria and yeast: Gram Staining and Spore staining for bacteria; Methylene blue staining for Yeast.
6. Antibiotic sensitivity test.
7. Starch hydrolysis assay for the identification amylase-producing microorganisms.
8. Gelatin hydrolysis assay for the identification protease-producing microorganisms.
9. Preparation of wine from Grapes.
10. Production of Alcohol from molasses and its estimation by specific gravity method.
11. Production of Citric acid and its estimation by Marrier and Boulet method.
12. Production of Lactic acid and its estimation by Barker and Summerson method.
13. Induction of mutation in bacteria using physical and chemical mutagens.
14. Isolation of nucleic acids (DNA and RNA) from bacteria and yeast.
15. Water analysis for bacteria and determination of BOD and COD of water.
16. Observation of *Rizobium* from root nodules of groundnut plant.
17. Isolation of phages from sewage and quantification by plaque assay.

Recommended Books:
1. Microbiology laboratory Manual 4th Edit. By Cappuccino
2. Microbiology laboratory Manual (2001) by Aneja, K.M
3. Laboratory Manual in Microbiology by P.Gunasekaran (1996), New Age Publ.

Outcomes: After performing the practical's, the candidate will be knowing cultivation, identification of various microorganisms. Antibiotic sensitivity test will be useful for diagnosing the bacterial infection and its treatments.

Course Code	Course Title	No of Hours Per week	No of Credits
BCH-304-P	Practical related to Clinical and Biochemical Analysis	04	4
		End Semester Exam Marks: 100	

Objectives: To impart knowledge about various clinical and biochemical tests like, estimation of blood glucose, Urea, Creatinine, Serum total protein and albumin etc. and also using of various diagnostic kits.

Syllabus:
1. Estimation of blood glucose.
2. Estimation of blood urea.
3. Determination of creatinine clearance.
4. Estimation of creatine in serum.
5. Estimation of uric acid in serum.
6. Estimation of serum total protein.
7. Estimation of Serum albumin.
8. Agar gel electrophoresis of serum proteins.
9. Agar gel electrophoresis of serum lipoproteins.
10. Estimation of Serum cholesterol.
11. Determination of SGOT.

12.Determination of SGPT.
13.Estimation of serum calcium.
14.Estimation of serum phosphate.
15.Estimation of serum bilirubin.
16.Determination of urine ascorbic acid.
17.Tests for abnormal constituents in urine.
18.Use of diagnostic kits.

Recommended Books:

1. Practical Biochemistry by T Plummer
2. Practical Biochemistry by J Jayaraman
3. Klemir and others: practical Biological chemistry.
4. Practical Biochemistry – Koch and Hank Dunn and Drell
5. Microbiology laboratory Manual 4th Edit. By Cappuccino

Outcomes:

1. The student will be able to perform the analysis of blood and urine samples for estimation of glucose, cholesterol, urea, creatinine, bilurubin Uric acid total protein levels which are required for diagnosis of various diseases such as Diabetes,Jaundice,kidney diseases etc.

Course Code	Course Title	No of Hours Per week	No of Credits
BCH-305-a	Molecular Endocrinology (Elective)	04	4
Sessional Marks: 20		End Semester Exam Marks: 80	

Objectives:

1) To impart knowledge on the different endocrine glands and their hormones, their biomedical importance in human system.

Course contents:

Unit 1

History and Introduction to Endocrinology:Classification, chemistry, biosynthesis, secretion, regulation, transport and general mechanisms of actions of Hormones, bio-assay, chemical, RIA, ELISA. Hormones of the pituitary, hypothalamus and pineal body: Growth hormone. Adrenocorticotropic hormone, Thyroid stimulating hormone, luteinizing hormone, Follicular stimulating hormone, prolactin, oxytocin, antidiuretic hormone. Their structure, storage, regulation of secretion, mechanism of action and their actions. Structure secretion and actions of hypothalamic releasing hormones and inhibitory hormones. Pineal hormones: Melatonin and serotonin.

Unit II

Hormones of the Thyroid and parathyroid gland: Iodine metabolism, Biosynthesis of thyroid hormones, regulation of secretion. Possible mechanism of action and general functions. Metabolism at target cells and excretion. Calcitonin and parathyroid hormone. Role of calcitonin in calcium and phosphate homeostasis in blood. Disorders of thyroid and parathyroid.

Unit III

Hormones of Pancreas and Gastro intestinal hormones: Chemistry, biosynthesis andsecretion of insulin and glucagon. Actions of insulin and glucagon on Carbohydrate, lipid and protein metabolism. Gastrin, secretin, pancreozymin Cholecystokinin etc. Adrenal hormones, Structure, biosynthesis metabolism, excretion and actions of adrenaline and noradrenaline.

Corticosteroids: Biosynthesis, secretion, actions, metabolism and excretion of cortisone Cortisol, corticosterone, deoxy corticosterone and aldosterone. Disorders of pancreas and adrenal glands.

Unit IV

Sex hormones (Hormones of Reproduction): Testosterone and inhibin. Estrogens, Progesterone and relaxin Human chorionic gonadotropin; Human placental lactogen, Hormonal regulation of menstrual cycle, contraceptions. Disorders associated with Gonadal hormones. Miscellaneous hormones: Thymosin – synthesis and actions.

Insect molting hormones – (ecdysone) Plant hormones – Auxins, gibberellins, ethylene, and abscissic acid, Pheromones.

Text Books:

2) Text book of biochemistry and human biology. Talwar G.P.Prentice Hall India,
3) Human physiology and mechanism of distance–Guyton 3rdedn. Igkushoen / Seunders
4) Clinical Biochemistry Vols. 1 and 2: Williams et al Heinemann Medical 1978
5) Lynchs Medical Laboratory Technology Raphael, S.S., 4thedn. Igkushoe / Saunders
6) Text book of Endocrinology – William.

Course Outcomes: After studying the topics in the above course, the student will know the different endocrine glands, the hormones produced by them, their function and associated disorders with them.

Course Code	Course Title	No of Hours Per week	No of Credits
BCH-305-b	Clinical Biochemistry (ELECTIVE)	04	4
Sessional Marks: 20		End Semester Exam Marks: 80	

Objectives: To impart knowledge on analysis of biomedical parameters for the diagnosis of various human metabolic disorders.

Course Contents:

Unit I

Introduction to Clinical Biochemistry: Introduction and maintenance of clinical biochemistry laboratory; hazards in clinical biochemistry laboratory; units; 'normal range', reference values. Factors affecting reference values quality control in laboratory – use of external and internal standards; use of WHO standards. Selection of analytical methods. Automation in clinical laboratory. Collection and preservation of specimens.

Disorders of Carbohydrate Metabolism: Importance of extra cellular glucose; blood glucose homeostasis– role of tissues and hormones; hyperglycemia and hypoglycemia. Diabetes mellitus – classification, etiology, clinical and laboratory features. Diagnosis of diabetes mellitus – glucose tolerance test, random fasting and post- prondial glucose levels, glycosuria, ketone bodies, glycosylated hemoglobin, plasma insulin. Metabolic complications – diabetic hyperglycemic coma and nonketotic coma; lactic acidosis; atherosclerosis, neuropathy.

Hypolycemia – fasting and provoked; diagnosis – stimulation tests (I.V. glucagon and leucine test); extended G.T.T; hypoglycemia in children – neonatal and early infancy. Investigation of glycogen storage diseases, galactosemia, hereditary fructosuria, lactose intolerance.

Unit II

Inborn errors of amino acid metabolism: Phenylketonuria, alkaptonuria, Hartnup's maple-syrup urine disease, Plasma proteins in health and changes in diseases; paraproteinaemias; proteinuria.

Lipid metabolism: Plasma lipids and lipoproteins and their functions. Hyperlipo-prolteincmias; Classification – primary and secondary. Investigation of lipoproteinaemias and lipidemias.

Renal function: Glomerular and tubular functions. Tests for evaluation – concentration, dilution, excretion, clearance tests, nephrotic syndrome.

Unit III

Clinical Enzymology: Plasma enzyme in diagnosis and prognosis – aminotransferases, creatine kinase, LDH, alpha amylase, phosphatases, choline esterase, glucose 6-phosphate dehydrogenase, gama glutamyl transferase. Isozymes of LDH alkaline phosphatase. Clinical application of plasma enzyme assays in myocardialinfraction, liver disease, and muscle disease.

Disorders of Gastrointestinal Tract: Gastric function. Stimulation of gastric secretion. Composition of gastric secretion. Test for gastric function – fractional test meal. Pentagastrin test, insulin stimulation tests; hyperchlorohydria, achlorohydria, achylia gastrica.

Pancreatic exocrine secretion–composition. Duodenal contents – collection, examination following stimulation of pancreas; analysis; malabsorption syndrome due to intestinal disease and pancreatic dysfunction, differential diagnosis. Disaccharide's deficiency.

Unit IV

Biochemical aspects of Liver disease: Bile acid metabolism and bile formation. Bilirubin metabolism – biosynthesis, transport, hepatic uptake and transport, conjugation and excretion, enterohepatic circulation. Liver function tests related to protein, carbohydrate, lipid, pigment metabolism, detoxification and excretion.Serum enzymes in liver disease. Jaundice – classification and differential diagnosis. Kermicterus.

Hydrogen ion homeostasis: Blood buffers, bicarbonate-buffering system. Role of Kidney. Red cells, lungs, acidosis and alkalosis.

Recommended Books:

1. Essentials of Food and Nutrition, Vol. I & II, M.S. Swaminathan.
2. Text Book of Biochemistry with clinical correlations. Thomas M. Devlin (John Wily).
3. Harper's Review of Biochemistry, Murray et al (Longman).
4. Biochemical aspects of human disease – R.S. Elkeles and A.S. Tavil. (Blackwell Scientific Publications).
5. Clinical chemistry in diagnosis and treatment–Joan F.Zilva and P.R.Pannall (Lloyd-Luke Medical Books, 1988).

Course Outcomes:

1) After studying the above course, the student will have knowledge on various metabolic disordes, their pathogenesis and will be able to carryout various medical laboratory tests for the diagnosis of various human diseases.

Course Code	Course Title	No of Hours Per week	No of Credits
BCH 305	GEc: CELL AND DEVELOPMENTAL BIOLOGY	04	04
Sessional Marks: 20		End Semester Examination Marks: 80	

Objectives:

- To understand the origin of cells and unicellular evolution.
- To impart theconcepts of development biology of plant and animals.
- To inculcate the aspects of Membrane structure and Transport.

Course Contents:

Unit I

Origin of cells and unicellular evolution. Prokaryotic and Eukaryotic cells: Structure, Composition and functions of nucleus, mitochondria plastids, endoplasmic reticulum, golgi, lysomes, vacuole, micro bodies, ribosomes, cytoskeleton.
Cell division, cell cycle and its regulation, cell signaling, stress response, cell communication, cell adhesion, Apoptosis, Senescence, extracellular matrix, integrins.

Unit II

Basic concepts of development**:** Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development.
Gametogenesis, fertilization and early development**:** Production of gametes, cell surface molecules in sperm-egg recognition in animals; embryo sac development and double fertilization in plants; zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; embryogenesis, establishment of symmetry in plants; seed formation and germination.

Unit III

Morphogenesis and organogenesis in animals**:** Cell aggregation and differentiation *Drosophila*, amphibia and chick; organogenesis limb development and regeneration in vertebrates; differentiation of neurons, post embryonic development-larval formation, metamorphosis; environmental regulation of normal development; sex determination.
Morphogenesis and organogenesis in plants**:** Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy; transition to flowering, floral meristems and floral development in *Arabidopsis* and *Antirrhinum.*

Unit IV

Biomembranes: Chemical composition of Membranes, Composition of plasma and organelle membranes of animal and plant cells. Lipids, proteins and Carbohydrates of membranes Distribution of membrane lipids. Assembly of membrane components. Molecular structure of membranes: Miscelle, and liposomes, biological membrane; Symmetry of the membrane; Membrane fluidity; fluid mosaic model of biological membranes. Nanomaterilas and their applications.
Membrane Transport: Donnan membrane equilibrium, Diffusion across cellular membranes Mediated transport; Energetics of transport systems; Passive transport anion exchange proteins; Active transport; Active transport of Na+ K+ (Sodium potassium ATPase) Ca_2+ (Ca_2+-ATPase). Active transport of sugars coupled to Phosphorylation; group translocation (Y-Glutamyl cycle). Proton motive force in bacterial transport processes. Ionophores Gap junctions; Endocytosis, Exocytosis. Nature of receptors.

Recommended Books:

1. Molecular Biology of the cells by Alberts *et al* (1994).
2. Cell and Molecular Biology (2001) by EDP de Robertis and EMF de Robertis.
3. Text Book OF medical physiology by A.C.Guyton (2001).
4. Cell and Molecular Biology 2nd Edit. (2002) By P.K.Gupta, Rastogi Publ.

Course Outcomes:

After Completion of the course the student able to

- ✓ Knowledge about the origin of cells and unicellular evolution.
- ✓ Gains the concepts in development biology of plant and animals.
- ✓ Finally, helps to develop the concepts on Membrane structure and Transport.

M.Sc. BIOCHEMISTRY SEMESTER -IV

Course Code	Semester-IV, Course Title	No of Hours Per week	No of Credits
BCH-401	Genetic Engineering	06	04
Sessional Marks : 20End Semester Examination Marks : 80			

Objectives:

1. Learn basics of genetic engineering, Isolation of genes, their sequencing, genetic maps, cloning procedures, vectors and applications of rDNA technology.
2. Genetically modified organisms, their prospects and consequences and market potential

Course Content

Unit I

Cloning and amplification of DNA: Introduction, choice of the organism, use of restriction endonucleases for the production of DNA fragments. Vehicles for cloning - plasmids, phage vectors and cosmids. RNA isolation, preparation and use of cDNAs. Screening and determination of nucleotide sequences. Application of recombinant DNA technology. Oncogenes and their mode of action.

Unit II

Isolation, sequencing and synthesis of genes: Isolation of genes, sequencing of genes, synthesis of genes, Cloning of specific eukaryotic genes and their expression in bacteria.
Operon model: Isolation and chemical nature of repressor. Catabolite repression and role of cAMP and cAMP receptor protein (CRP) in the expression of glucose – sensitive operons. Lac operon, His operon, Trp operon of E. coli. Stringent and relaxed control. Regulation of gene expression in prokaryotes and eukaryotes: Transcriptional control, enzyme induction and repression. Constitutive synthesis of enzymes. Genes involved in regulation, regulatory gene, promoter gene, operator gene and structural genes. Genome imprint.

Unit III

Gene transfer methods and transgenic organisms: Gene transfer methods for animals and plants, Agro bacterium mediated gene transfer, electroporation and particle gun. Trasgenic animals, and transgenic plants.
Restriction maps and molecular genetic maps: Restriction mapping, restriction fragment length polymorphisms (RFLP) Linkage and recombination between molecular and phenotypic markers, Random amplified polymorphic DNA (RAPDs) using PCR, Chromosome walking. Organic genome engineering and cell molecular memory/ Biosensors

Unit IV

Applications of genetic engineering in biotechnology: Genome imprint, Dynamic genome engineering and cell molecular memory.
Biosensors: Genetically Modified Organism - Market potential, Diet, Leash, Potato, Rice BT.

Text Books:

1. Principles of Biotechnology-P.K.Gupta, Rastogi publications
2. Introduction to Biology and Biotechnologt-K.Vaidyanath et al, B.S.Publications
3. Molecular cloning by Maniatis and Co Vol I, II, III
4. Books already mentioned above for Molecular Biology paper.

Course Outcomes: After Completion of the course the students will be able to

1. Gained knowledge on genetic engineering methods and procedures like isolation of genes, their transfer to vectors and desired organisms and their expression.
2. Acquainted the knowledge of genetic maps and production of G.M organisms, their success and consequences.

Course Code	Course Title	No of Hours Per week	No of Credits
BCH-402	Technical writing biostatics and bioinformatics	04	4
Sessional Marks: 20		End Semester Exam Marks: 80	

Objectives: To enlighten the students with basic knowledge of project preparation, funding agencies and human genome project. In addition, role of statistics and various bioinformatic tools in biochemical investigation will be also studied.

Course Contents:

Unit I

Technical writing: Sentence writing, paragraph writing, story writing, review writing, various types of letters writing, critical comments writing.

Project proposal preparation: Preparation of informal proposal, modified proposal and formal proposal. Experimental design and Collection of results, submission of progress report (year wise) and submission of technical report (Format: Title page, Introduction, Aims of the proposal/research, methodology, results, references, acknowledgments, budgetary preparation). Submission of final technical Report. Patenting and intellectual property rights.

Introduction of computation: Computer's components, storage devices, graphic devises, concepts of hardware and software, methods and types of networks. Basics of operating systems and types python, cython.

Unit II

Bio-Statistics:Data - Data types, collection of data, classification and tabulation. Measures of central tendencies. Mean, median and mode. Measures of variation - Range, quartile deviation, mean deviation and standard deviation. Coefficient of variation. Probability. Addition and multiplication theories, conditional probability and probability distributors. Binomial, poission and normal distribution. Correlation and linear regression. Regression: Regression coefficients and properties. Small sample tests-t, F and chi square tests. ANOVA - one way and two-way classifications.

Unit III

Bio-Informatics–I: Origin of bioinformatics biological data (genome projects), Disciplines of bioinformatics, transcriptomics, functional genomics, structural genomics, metabolomics, pharmaco-genomics, structure prediction, drug design and Microarrays.

Genome projects - General introduction to genome projects (rice and Mycobacterium tuberculosis genome project). Special emphasis on Human Genome Project (HGP). Science behind HGP, benefits of HGP, ELSI of HGP in use of genetic information, genetic testing standard, quality and commercialization.

Biological database:Introduction of database (DB), need, organization, search of DB. An over view of biological databases - NCBI, EMBL, DDBJ, SWISS-PROT, PDB, KEGG. Decoding of the genome (Nathan blow study), Ribosomal bar codes, Molecular signatures.

Unit IV

Bio-Informatics–II: Database querying with NCBI using key words, sequences (proteins and genes), finding similarities, identifying genes and proteins from different organisms.

Sequence alignment - Introduction, significance of sequence alignments and use of dot matices. Pair wise and multiple sequence alignment (MSA) using Clustal programs.
Sequence analysis - concepts of sequence analysis and their importance. BLAST. blastn, blastp, blastx, tblastx, output analysis matrix BLOSSUM, PAM, e-value.
Proteomics - Introduction, principle, technique, 2-D data base. Gel analysis, post gel analysis, MALDI-TOF. Significance and applications of proteomics in modern biology.

Text Books:

1. Statistical methods. S.P. Gupta
2. Fundamentals of mathematical statistics. S.C Gupta & Kapoor
3. Statistical methods in biological and Health Science. J. S. Milton & J.O. Tsokan.
4. Primrose SB. Principles of Genome Analysis: a guide to mapping and sequencing DNA from different organisms. 2nd Ed. 1998. Blackwell Science: Oxford. ISBN 0-632-04983-9.

Course Outcomes: After studying the mentioned topics, the candidate can prepare a research project and use biostatistics and bioinformatics as tools for structural elucidation of biomolecules.

Course Code	Course Title	No of Hours Per week	No of Credits
BCH-403-P	Practical related toimmunology and hematology	04	4
End Semester Exam Marks: 100			

Objectives:

1. To impart knowledge on various hematological tests like, RBC count, ESR, estimation of Hemoglobin, and some immunological methods like Immunodiffusion, Rocket immunoelectrophoroesis and agglutination tests etc.

Syllabus:

1. RBC count.
2. Total WBC count.
3. WBC Differential count.
4. Erythrocyte Sedimentation Rate (ESR).
5. Packed Cell Volume (PCV).
6. Estimation of Haemoglobin (Hb).
7. Mean Cell Haemoglobin and Mean Cell RBC volume.
8. Colour Index and Volume Index of RBC.
9. Osmotic fragility of RBC.
10. Raising of antibodies to soluble antigen in rabbits.
11. Immunodiffusion.
12. Single Radial Immunodiffusion.
13. Rocket immuno-electrophoroesis.
14. Cross over Immuno-electrophoresis.
15. Graber and Williams Immuno-electrophoresis.
16. Detection of HCG by latex agglutination inhibition test.
17. Haemeagglutination tests for identification of human blood groups.
18. Detection by viral fever by slide agglutination tests.

Recommended Books:

1. Hawk's Physiological chemistry.
2. Practical Biochemistry by T Plummer.
3. Practical Biochemistry by J Jayaraman.

4. Klemir and others: Practical Biological chemistry.
5. Practical Biochemistry – Koch and Hank Dunn and Drell.
6. Practical Biochemistry-Sawhney (2000)
7. Varley's Practical clinical Biochemistry – Ed. Alan W. Gowenlock (Heinemann, 1988).

Outcomes

1.The student will be able to perform the hematological and immunological diagnostic tests related to various diseases Which are required for transplantations, immunodeficiency disorders, and Cancer etc.

Course Code	Course Title	No of Hours Per week	No of Credits
BCH 405	**IMMUNOLOGY (General Elective)**	04	04
Sessional Marks: 20		End Semester Exam Marks: 80	

Objectives:

- To impart knowledge on the immunity, Hypersensitivity and Transplantation.
- To educate the student on Immune Deficiencies, MHC and Immunological techniques.

Course Contents:

Unit I

Introduction: Scope of Immunology, Historical background of Immunology, Biological aspects of Immunology, Self and non-self-recognition, specificity, memory of immune system.

Antigens: Essential features of Ag, haptens, Carrier molecule, Immunological valence, Antigenic determinants. Adjuvants: Freund's complete and incomplete.

Antibodies: Nature, Primary structure of immunoglobulins, light chain, heavy chain, variable region, constant region, Hinge region; Enzymatic fragmentation of Ig. Domain structure of Ig and significance; Classification of Immunoglobulins: Types –IgG (G1, G2, G3 & G4), IgM, IgA, IgD and IgE (Origin, structural functions). Theories of Ab formation-Instructive, selective, clonal selection theories and evidences; Immunological memory.

Antibody diversity: Mini gene theory, Mutation theory, Germ line theory, Somatic recombination, V (D) J recombination, Combinatorial diversity, Junctional diversity.

Unit II

Immunity: Types: Active and passive immunity. Cell mediated immunity, humoral immunity, immune response; primary and secondary response. Phagocytosis, mechanism of phagocytosis. Interferon: Types of Interferons. Null cells: Natural Killer cells. Complement system: Nature, components of compliment.

Pathways: Classical and alternative pathways. Compliment fixation tests.

Unit III

Hypersensitivity (HS): Type I: Allergies and anaphylaxis – IgE, Mast cell degranulation, biologically active agents released in reactions, Clinical manifestations.

Type II: Antibody mediated HS reactions; Mechanism, pathogenicity and cases of type II reactions; Haemolytic-disease of new born (HDN).

Type III: Immune complex mediated HS reactions: Mechanism &pathogenicity of type III reactions. Soluble immune complexes and insoluble immune complex mediated reactions. Arthus reaction, Serum sickness.

Type IV: Delayed type (or) cell-mediated HS reactions; Mechanisms and pathogenicity, Tuberculin reaction.

Type V: Stimulatory HS reactions. Mechanism and pathogenicity, Grave's disease.

Blood groups: AB, Rh system, Lewis-Luthern systems, significance, practical application of immuno methodology in blood transfusions, Erythroblastosisfetalis.
Auto immunity: Introduction, Auto recognition, classes of auto immuno diseases. (Hashimoto disease, thyrotoxicosis, Systemic lupus erythematosus, Autoimmune haemolytic anaemia, Rheumatoid arthritis).
Transplantation: Terminology, Auto graft, Isograft, Allograft, Xenograft, Immunological basis of transplantation reactions, GVH reaction, Immuno suppression, General mechanisms of Immune suppression, Immune suppression, drugs (azothioprine, methotrexate, cyclophosphamide, cyclosporin-A, Steroids).

Unit IV

Immune Deficiencies: Introduction, primary and secondary deficiencies. T-cell, B-cell and combined immunedeficiencies, Compliment system deficiency. Acquired immuno deficiency syndrome. SCID.
Major Histocompatibility Complex: MHC in mice and HLA in man-fine structure and functions only.
Immunological techniques: Precipitin curve, Immuno diffusion, one and two dimensional, single radial immuno diffusion, Ouchterlony immuno diffusion.
Immuno-electrophoresis: Rocket immuno-electrophoresis; CIE, Graber and William technique.
Agglutination: Direct and Indirect, Widal test, VDRL test.
Radioimmunoassay: ELISA – Principle, Methodology and applications.
Immuno-fluorescence: Direct, indirect and Sandwich, *in situ* localization by techniques such as FISH and GISH.

Recommended Books:

1. Essential immunology- Ivan M. Roitt.
2. Introduction to Immunology – John W.Kinball.
3. Immunology – D.M. Weir.
4. Immunology – Janis Kuby.

Course Outcomes:

- ✓ The student will gain knowledge on the immunity, Hypersensitivity and Transplantation.
- ✓ Gains the concepts in Immune Deficiencies, MHC and Immunological techniques.

Course Code	Course Title	No of Hours Per week	No of Credits
BCH 405b	GE**:**Applied Biochemistry	04	04
Sessional Marks: 20		End Semester Examination Marks: 80	

Objectives:

1) To inculcate the applied concepts of Fermentation Technology and Enzyme Technology.
2) To educate the student with basic aspects of Immuno-technology, Plant and animal cell culture.

Course Contents:

Unit I

Fermentation Technology: Batch, continuous culture techniques, principle types of fermenters.
Industrial production of chemicals- alcohol, acids (citric, lactic and acetic acids), solvents (acetone and butanol), antibiotics (penicillin and streptomycin), Vitamins (Riboflavin and Vitamin B12), amino acids (lysine and glutamic acid), Single Cell Protein (SCP) and Biopesticides (Toxins of *Bacillus thuringenesis* and its mode of action).

Unit II

Enzyme Technology: Immobilization of enzymes and cells, different methods.
Industrial applications (Production of glucose from starch, Use of glucose isomerase in confectionary industry, Use of lactase in Dairy Industry, Production of invert sugar from sucrose, Use of protease in food, detergent and leather Industries, Medical applications of enzymes). Low calorie sweeteners.

Unit III

Immunotechnology: Hybridoma technique, monoclonal antibodies production, myeloma cell lines, fusion of myeloma cells, selection of hybridomas, protoplast fusion and HAT medium. Screening, purification and application (biochemical research, clinical diagnosis and treatment) of monoclonal antibodies.
Subunit vaccines-against Herpes Simplex virus. Foot and Mouth disease, Live recombinant vaccines-attenuated (Cholera, Salmonella), Vector vaccines directed against viruses and bacteria.

Unit IV

Plant and animal cell culture: Micro propagation, Somatic cell culture, Soma clonal variations, Somatic cell hybridization, Protoplast fusion, genetic transformation, methods of gene transfer (vector and vector less methods).
Production of transgenic plants, animals and their applications. Plant tissue culture clonal propagation and transgenic plants as bioreactors. Outlines of Bioremediation and its importance. Development of mapping population in plants.

Recommended Books:

1. Fermentation Technology (2^{nd} ed.) Standury (Pergman press)
2. Biotechnology: Textbook of Industrial microbiology 2^{nd} Edit. By Crueger and Crueger.
3. Principles of Gene manipulation: An Introduction to genetic Engineering (5^{th}). R.V.Old and S.B.Primrose (Blackwell Scientific Publications).
4. Principles of Biotechnology (1985) Alen Weisman (Surrey University Press).
5. Concepts in Biotechnology (1996) Ed., D. Balasubramaian, K. Dharmalingam, J. Green and K. Jayaraman (University Press).
6. Industrial Microbiology, Miller and Litsky, Mc Graw- Hill, 1976.
7. Industrial Microbiology, L.E.Casida, JR. New Age International (1995).
8. Industrial Microbiology (Prescott & Dunn), Ed by G. Reed, CBS Publishers.
9. Immobilized enzymes (1978) by Ichiro Chibata, Halsted Press Book.

Course Outcomes:

After Completion of the course the student able to

- ✓ Know the classification, structure and functions of various enzymes.
- ✓ Understands on various type of enzymes and their imbalances.
- ✓ Finally, they can get the knowledge on co-ordinated working pattern of enzymes.

Course Code	Course Title	No of Hours Per week	No of Credits
BCH-405-c	Plant Biochemistry	04	4
Sessional Marks: 20		End Semester Exam Marks: 80	

Objectives:

1) To impart knowledge about secondary metabolites, production and transport of ions across the membrane. In addition, concepts will be discussed related to population genetics and gene frequency.

Course Contents:

Unit I

Biosynthesis, Storage, breakdown and transport; physiological effects and mechanisms of action. Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; stomatal movement; photoperiodism and biological clocks.
Uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photoassimilates.
Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles.
Structure and biochemical aspects of specialized plant cell organelles, cell plates, primary and secondary cell walls, plasmodesmata importance of vacuolar, characteristic of meristematic cells.

Unit: II

Role of water absorption, adsorption, conduction, transpiration, guttation water balance and stress. Role of different minerals absorption and translocation of inorganic and organic substances Special features of secondary plant metabolism, formation and functions of phenolic acids, tannins, lignin, flavonoid pigments, surface walls, cutin and suberin plant protective walls, Terpenes, Embryogentics growth and development, Defence system in plants, Photosynthesis in microbes, bacteria, fungi, algae and yeast

Unit III

Lamarck; Darwin–concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; Spontaneity of mutations; The evolutionary synthesis.
Origin of basic biological molecules; Abiotic synthesis of organic monomers and polymers; Concept of Oparin and Haldane; Experiement of Miller (1953); The first cell; Evolution of prokaryotes; Origin of eukaryotic cells; Evolution of unicellular eukaryotes; Anaerobic metabolism, photosynthesis and aerobic metabolism.
The evolutionary time scale; Eras, periods and epoch; Major events in the evolutionary time scale; Origins of unicellular and multi cellular organisms; Major groups of plants and animals; Stages in primate evolution including Homo.

Unit IV

Concepts of neutral evolution, molecular divergence and molecular clocks; Molecular tools in phylogeny, classification and identification; Protein and nucleotide sequence analysis; origin of new genes and proteins; Gene duplication and divergence.
Population genetics – Populations, Gene pool, Gene frequency; Hardy-Weinberg Law; concepts and rate of change in gene frequency through natural selection, migration and random genetic drift; Adaptive radiation; Isolating mechanisms; Speciation; Allopatricity and Sympatricity; Convergent evolution; Sexual selection; Co-evolution.

Text Books:

1) Evolution by Carl- Zimmer
2) Origin of Species: by C. Darwin,
3) Plant Biochemistry by Arun Kumar et al (2010)

Course outcomes:

1) The candidate will be well worsed with the mechanisms of transport of ions across the membranes and role of secondary metabolites in plant defence.

Course Code	**Semester-IV,Course Title**	**No of Hours Per week**	**No of Credits**
BCH-406-c	Nutritional Biochemistry	06	04
Sessional Marks: 20		End Semester Examination Marks: 80	

Objectives:

1. To impart knowledge about body composition parameters, their measurement methods, energy requirements, the role and requirement of carbohydrates, fats and proteins to our body.

2. To educate the students about the importance of macro and micronutrients, trace elements and vitamins, their sources and daily requirements for children, adults, pregnant and lactating women and to assess community nutritionstatus and ultimately to improve nutritional status of community.

Course Content

Unit I

Technical writing: Sentence writing, paragraph writing, story writing, review writing, various types of letters writing, critical comments writing.

Unit II

Project proposal preparation: Preparation of informal proposal, modified proposal and formal proposal. Experimental design and Collection of results, submission of progress report (year wise) and submission of technical report (Format: Title page, Introduction, Aims of the proposal/research, methodology, results, references, acknowledgments, budgetary preparation). Submission of final technical Report. Patenting and intellectual property rights.

Unit III

Introduction of computation: Computers components, storage devices, graphic devises, concepts of hardware and software, methods and types of networks. Basics of operating systems and types python, cython.

Unit IV

Bio-Statistics: Data - Data types, collection of data, classification and tabulation. Measures of central tendencies. Mean, median and mode. Measures of variation - Range, quartile deviation, mean deviation and standard deviation. Coefficient of variation. Probability. Addition and multiplication theories, conditional probability and probability distributors. Binomial, poission and normal distribution. Correlation and linear regression. Regression: Regression coefficients and properties. Small sample testst, F and chi square tests. ANOVA - one way and two way classifications.

Text Books:

1. Essentials of Food and Nutrition-Vol-I & II-M.S.Swaminathan
2. The text book of Human Nutrition-M.S.Bamji et al.
3. Trace elements by Underwood
4. Nutrient requirement for Indians-by NIN, Hyderabad-ICMR

Course Outcomes: After Completion of the course the student able to

1. Students gain knowledge about the energy requirements for children, adults and women, the importance of balanced diet, the rich sources of vitamins, minerals and micronutrients.
2. Will improve the understanding about nutritional aspects to be followed at individual level and implemented at community level to build a healthy society.