SRI VENKATESWARA UNIVERSITY:: TIRUPATI

DEPARTMENT OF BIOCHEMISTRY

Minutes of meeting of BOS with internal members held on 20th June 2018 at 11 AM in the Department of Biochemistry.

The members have discussed the existing syllabus of **M.Sc. Biochemistry** and unanimously resolved to make minor changes in the syllabus of **BCH 306b Environmental Biochemistry** and **BCH 406c Nutritional Biochemistry** Papers with effective from 2018-19.

BCH 306b	**Environmental Biochemistry** ***Unit 4:*Environment and stress factors** Definition of stress, types, reasons and effect on biological functions in plants, animals and microbes. Analysis of possible defence mechanism adapted by living organism to overcome stress
BCH 406c	**Nutritional Biochemistry:** ***Unit 4:*** Food adulteries. Detection methods. Food additives, composition and toxic effects

Signatures:

1. Chairman : Prof. O.V.S. Reddy O Vrey
2. Members :

Programme Code	Programme name	Year of Introduction	Status of implementation of CBCS / Elective Course System (ECS)	Year of implementation of CBCS/ ECS	Year of revision (if any)	If revision has been carried out in the syllabus during last 5 years, % of content added or replaced	Link to the relevant documents
204	**M.Sc BCH**	**1978**	CBCS: Yes	CBCS: 2018-19	CBCS: 2018-19	25%	CBCS:

SRI VENKATESWARA UNIVERSITY TIRUPATI

S.V.U. COLLEGE OF SCIENCES

DEPARTMENT OF BIOCHEMISTRY

RESTRUCTURED CURRICULUM FOR M.Sc. BIOCHEMISTRY PROGRAMME

TO BE IMPLEMENTED WITH EFFECT FROM THE ACADEMIC YEAR 2018-2019

SYLLABUS Choice Based Credit System (CBCS)

M.Sc. BIOCHEMISTRY programme CBCS pattern (with effect from 2018-2019)

Vision: To develop scientific tempo in understanding the importance of Biochemistry in the field of Life sciences, especially in Medicine, Agriculture and Environment for well being of humans.

Mission: By providing required training to the students of Biochemistry with latest tools, techniques and teaching methods. So as to enable them to do advanced research for finding solution to various problems encountered with respect to Human health, Agriculture and Environment.

Programme Objectives:

The main objective of M.Sc. Biochemistry is to impart knowledge to the students in the advanced fields of life sciences such as Biochemistry, Molecular Biology, Immunology, Biotechnology and Bioinformatics so as to enable the student to get the expertise and skills to carry out research in the fields of Medicine, Agriculture and other allied life sciences and make the learner fit to be employed in the Government sector and private sector and organizations such as research institutions, pharma and Biotech industries. The programme enables the students to procure entrepreneurship capabilities to establish research institutions and industries in the fields of Biotechnology, Medicine and other advanced fields of life sciences.

Programme Outcomes

S.No	Program Outcomes
PO1	Students acquire knowledge in the chemistry of different biomolecules, which constitute living organisms including humans. Students also will have knowledge on the different physiological systems and their functions and disorders.
PO2	Students will get the ability and expertise to analyse the different biological, molecules, compounds at cellular and molecular level to understand their functions.
PO3	After completion of this program students will able to investigate the causative factors of various diseases and disorders, pollutants, etc
PO4	The student will enable to design innovative protocols and devices which will have applicability in various fields of life sciences.
PO5	Students acquire knowledge in latest techniques and tools that are used for investigating different types of problems related to plant, animal and humans.
PO6	The students will have the skills, knowledge and enthusiasm for solving different issues arising in the society scientifically.
PO7	Students will enable to understand the importance of environment and necessary to maintain pollution free environment.
PO8	To understand ethical principles, professional ethics and responsibilities and apply them to solve societal problems.
PO9	Students will have the efficiency to carry out the projects individually, as a team leader and as a team member.
PO10	Students will acquire communications skills to dissipate the scientific knowledge to the society
PO11	Students will acquire knowledge to carry out project and maintain financial requirements as per the guidelines of funding agency.
PO12	The students being lifelong learners will be enthusiastic to update their knowledge for improving the human life.

S.V.U. COLLEGE OF SCIENCES; DEPARTMENT OF BIO-CHEMISTRY

(Syllabus common for SV University College and affiliated by SVU Area

Academic Years (2016-2017); M.Sc. Biochemistry

SCHEME OF INSTRUCTION AND EXAMINATION

Semester	Code	Title of the course	Credit Hrs/ week	No. of Credits	Core/ Elective	Uni. Exams (Hours	IA	Semester end exam	Total Marks
FIRST	BCH101	Biochemical and Biophysical methods	**6**	**4**	**Core**	**3**	**20**	**80**	**100**
	BCH 102	Molecular Physiology and community nutrition	**6**	**4**	**Core**	**3**	**20**	**80**	**100**
	BCH 103P	Practical related to Biochemical Preparations and Analysis	**6**	**4**	**--**	**4**			**100**
	BCH 104P	Practical related to Analytical methods	**6**	**4**	**--**	**4**			**100**
	BCH 105	Human values and Professional ethics-I	**6**	**4**	**Compul. Founda**	**3**	**20**	**80**	**100**
	BCH 106	Cell and Biomolecules	**6**	**4**	**Elective foundati**	**3**	**20**	**80**	**100**
		TOTAL	**36**	**24**					**600**
SECOND	BCH 201	Energy metabolism	**6**	**4**	**Core**	**3**	**20**	**80**	**100**
	BCH 202	Metabolism of Nitrogen based molecules	**6**	**4**	**Core**	**3**	**20**	**80**	**100**
	BCH 203P	Practical related to Enzymology	**6**	**4**	**--**	**4**			
	BCH 204P	Practical related to Molecular Biology	**6**	**4**	**--**	**4**			
	BCH 205	Human values and Professional ethics-II	**6**	**4**	**Compu Founda**	**3**	**20**	**80**	**100**
	BCH 206	Enzymology	**6**	**4**	**Elective foundat**	**3**	**20**	**80**	**100**
		TOTAL	**36**	**24**					**600**

Semester	Code	Title of the course	Hrs/ week	No. of Credits	Core/ Elective	Uni Exams (Hours	IA	Semester end exam	Total Marks
THIRD	BCH 301	Microbial Biochemistry and Genetics	**6**	**4**	**Core**	**3**	**20**	**80**	**100**
	BCH 302	Molecular Biology	**6**	**4**	**Core**	**3**	**20**	**80**	**100**
	BCH 303P	Practical related to Microbiology	**6**	**4**	**--**	**--**			**100**
	BCH 304P	Practical related to Clinical Biochemical Analysis	**6**	**4**	**--**	**--**			**100**
	BCH 305 **Generic Elective (Two papers out of three)**	a) Molecular Endocrinology b) Clinical Biochemistry c) Cell and Developmental Biology	**6** **6**	**4** **4**	**elective**	**3** **3**	**20** **20**	**80** **80**	**100** **100**
	BCH 306 Open Elective to others	a) General Biochemistry b) Environmental Biochemistry c) Experimental aspects related to analytical methods	**6** **6**	**4** **4**	**Elective Other dept**	**3** **3**	**20** **20**	**80** **80**	**100** **100**
		TOTAL	**36**	**32**					**800**
FOURTH	BCH 401	Genetic Engineering	6	4	Core	3	20	80	100
	BCH 402	Technical Writing, Biostatistics and Bioinformatics	6	4	Core	3	20	80	100
	BCH 403P	Practical related to Immunology and Hematology	6	4	--	--			100
	BCH 404P	Practical/Project work	6	4	--	--			100
	BCH 405 Generic Elective	a) Immunology b) Applied Biochemistry c) Plant Biochemistry	6 6	4 4	elective	3 3	20 20	80 80	100 100
	BCH 406 Open Elective to others (For other department students)	a) Research Methodology b) Biochemistry of diseases c) Nutritional Biochemistry	6 6	4 4	elective	3 3	20 20	80 80	100 100
		TOTAL	36	32					800

M.Sc. BIOCHEMISTRY

SEMESTER-I

Course Code	Semester-I, Course Title	No of Hours Per week	No of Credits
BCH-101	Biochemical and biophysical methods	06	4
Sessional Marks: 20		End Semester Exam Marks: 80	

Course Objectives:

1. To study about the biological relevance of P^H, importance of buffers in biological system and basic principle, instrumentation and applications of microscopy and centrifugation techniques.
2. Knowledge about radioactivity measuring method and their applications in biochemical investigations.
3. To explore the theoretical principles, methodology and biochemical applications of chromatography and electrophoresis techniques.
4. To Understand the importance and applications of spectroscopy techniques in research field.

Course Content:

Unit I

Biological relevance of pH, measurement of pH, pKaof functional groups inbiopolymers 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.

Recommended Books

1. Principles and Techniques of practical Biochemistry. Eds. Williams and Wilson.
2. Techniques in Molecular biology Ed. Walker &Gastra, Croom Helm, 1983.
3. Principles of instrumental analysis, 2nd Ed, Holt-Sanders, 1980.
4. An introduction to spectroscopy for Biochemistry. Ed. Brown S.N., Academic press.
5. Analytical Biochemistry, Holmes and Hazel peck, Longman, 1983.
6. An introduction to practical biochemistry. David T. Plummer, Tata MacGrew-Hill.
7. Biophysical chemistry, Edshall& Wyman, Academic press Vol II & I.
8. A textbook of quantitative inorganic analysis including elementary instrumental analysis, Vogel ELBS.
9. Biochemical calculations Seigel, IH, 2nd Edit, John Wiley &sons Inc., 1983.
10. Analytical Biochemistry by Friefelder David.

Course outcomes: After the completion of this course, the student will be able to

1. Understand the principle, Instrumentation of different types of Light microscopy, electron microscopy, and techniques of Centrifugation and its applications in various fields of research.
2. Learn about basic Radioactivity principles, measurement method and its biological applications.
3. Acquire knowledge about the basics and latest developments in the instrumentation techniques of Electrophoresis (IEF, 2D PAGE) and Chromatography and their applications in various research fields.
4. Demonstrate skill to explain about principle, Bioinstrumentation and applications of spectroscopy techniques.

	PO_1	**PO_2**	**PO_3**	**PO_4**	**PO_5**	**PO_6**	**PO_7**	**PO_8**	**PO_9**	**PO_{10}**	**PO_{11}**	**PO_{12}**
CO_1	3	3	3	3	3	3	3	-	2	2	3	3
CO_2	3	3	3	3	3	3	3	-	2	2	3	3
CO_3	3	3	3	3	3	3	3	-	2	2	3	3
CO_4	3	3	3	3	3	3	3	-	2	2	3	3

Course Code	Semester-I, Course Title	No of Hours Per week	No of Credits
BCH-102	Molecular Physiology & Community Nutrition	06	4
Sessional Marks: 20		End Semester Exam Marks: 80	

Course Objectives:

1. To study the physiological aspects of circulatory and excretory system.
2. To describe the structure, function and mechanism of muscular system and nervous system.
3. To describe the importance of proteins, lipids in the maintenance of health and gives information about various methods of calculations of protein quality and their deficiency.
4. To explore the knowledge about Nutritional importance in different ages of human health.

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 and thermoregulators.

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, measurement of energy value of fats. Essential fatty acids and phospholipids in nutrition.

Unit IV

Vitamins and Minerals: Sources of the vitamins, Requirement of fat-soluble and water-soluble vitamins and their deficiency symptoms. Macro and trace elements in nutrition.

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, Biophysical and Biochemical techniques.

Recommended Books

1. Harper'sBiochemistry.
2. Trace elements by Underwood.
3. Nutrition byM.S.Swaminathan.
4. The book of Human Nutrition (1996) MS. Bamji, N.PrahladRao and V.Reddy.
5. Text Book OF Medical physiology by A.C.Guyton (2001).

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

1. Gain the knowledge about circulatory and excretory systems.
2. Know the importance of muscular and nervous system.
3. Health benefits and malnutrition of proteins and fats.
4. Know the importance of nutrition in maintenance of health and diseases.

	PO_1	**PO_2**	**PO_3**	**PO_4**	**PO_5**	**PO_6**	**PO_7**	**PO_8**	**PO_9**	**PO_{10}**	**PO_{11}**	**PO_{12}**
CO_1	3	1	2	2	1	3	2	1	2	2	2	3
CO_2	3	1	2	2	1	3	2	1	2	2	2	3
CO_3	3	1	2	2	1	3	3	1	2	3	3	3
CO_4	3	1	2	2	1	3	3	1	2	3	3	3

Course Code	**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			

Course Objectives:

1. Exposure to basic reactions of biomolecules.
2. To analyse the presence of biomolecules like carbohydrates, proteins, lipids, etc. in known and unknown samples qualitatively.
3. To estimate the proteins, present in biological samples.
4. Isolation studies of biological samples.

Course Content:

PRACTICALS

BCH 103P: BIOCHEMICAL PREPARATIONS AND ANALYSIS-PRACTICALS

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 frombrain.
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. Bradford's 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.
14. Estimation of fructose in Fruit-juice.

Recommended Books

1. Practical Biochemistry by T Plummer
2. Practical Biochemistry by J Jayaraman
3. Klemir and others: practical biological chemistry.
4. A manual of laboratory techniques by NIN, Hyderabad.

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

1. Learn safety and precautionary measures for working in a laboratory.
2. Develop skill and proficiency in preparation of laboratory reagentsand Use of handling of glass wares, minor equipment for conducting experiments
3. Acquire practical training for qualitative and quantitative analysis of biological materials/molecules and their estimation using multiple methods.
4. Gain the knowledge about isolation studies of biological samples.

	PO_1	**PO_2**	**PO_3**	**PO_4**	**PO_5**	**PO_6**	**PO_7**	**PO_8**	**PO_9**	**PO_{10}**	**PO_{11}**	**PO_{12}**
CO_1	3	3	3	3	3	3	3	1	2	2	2	3
CO_2	3	3	3	3	3	3	3	1	2	2	2	3
CO_3	3	3	3	3	3	3	3	1	2	2	2	3
CO_4	3	3	3	3	3	3	3	1	2	2	2	3

Course Code	Semester-I, Course Title	No of Hours Per week	No of Credits
BCH-104P	Practical related to Analytical Methods	06	04
End Semester Exam Marks: 100			

Course Objectives:

1. To understand the concepts of preparation of buffers.
2. The students will obtain hands-on training in basic separation techniques in biochemistry like electrophoresis, chromatography, etc.
3. To Develop competence in handing various centrifugation techniques and apply them in isolating and characterizing different biological molecules.
4. Understanding the applications of centrifugation and chromatography in biological investigations in order to create scientific interest.
5. Gain expertise in the isolation of various biomolecules and organelles.

Course Content:

PRACTICALS

BCH 104P: BIOCHEMICAL & BIOPHYSICAL METHODS

1. Effect of solvent system on the Rf value of two solutes usingTLC.
2. Separation of purines and pyrimidines by Paper Chromatography.
3. Separation of amino acids by Paper Chromatography.
4. Separation of sugars byTLC.
5. Isolation & Characterization of Brain Lipids by Solid phase extraction andTLC.
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 PaperElectrophoresis.
9. Measurement of pH of a biological fluid using pH meter.
10. Absorption spectra of phenol red, amino acids and nucleicacid.
11. Verification of Beer's law and determination of molar extinction coefficient using p-nitro phenol.
12. Isolation and spectrophotometric characterization of plantpigments.
13. Isolation of Mitochondria from Rat liver by density gradient centrifugation (Demonstration).
14. Viscosity measurement of Bovine serumalbumin.
15. Measurement of inversion of sucrose by Polarimetry.
16. Measurement of refractive index of biologicalsample.
17. Dialysis.

Recommended Books:

1. Hawk's Physiological chemistry
2. Practical Biochemistry by T Plummer
3. Practical Biochemistry by J Jayaraman
4. Klemir and others: practical Biologicalchemistry.
5. Practical Biochemistry – Koch and Hank Dunn and Drell.

6. Practical Biochemistry-Sawhney (2000)
7. Varley's Practical clinical Biochemistry–Ed.AlanW. Gowenlock (Heinemann Medical Books).

Course Outcomes:

1. Learn how to standardize various biomolecules.
2. Separate biomolecules by paper chromatography and thin layer chromatography
3. Demonstrate separation of protein by electrophoresis.
4. Isolation and spectrophotometric characterization of plant pigments.

	PO_1	**PO_2**	**PO_3**	**PO_4**	**PO_5**	**PO_6**	**PO_7**	**PO_8**	**PO_9**	**PO_{10}**	**PO_{11}**	**PO_{12}**
CO_1	3	3	3	3	3	3	1	3	3	3	3	3
CO_2	3	3	3	3	3	3	1	3	3	3	3	3
CO_3	3	3	3	3	3	3	1	3	3	3	3	3
CO_4	3	3	3	3	3	3	1	3	3	3	3	3

CourseCode	**Semester-I, Course Title**	**No of Hours Per week**	**No of Credits**
BCH 105	Human values and professional ethics	06	04
Sessional Marks: 20		End Semester Examination Marks: 80	

Course objectives:

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, ReligiousTolerance, Gandhian Ethics.

Unit V

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

BOOKS FOR STUDY

1. John S Mackenjie: A manual of ethics.
2. The Ethics of Management" by Larue Tone Hosmer, Richard .D. Irwin Inc.
3. Management Ethics-integrity at work" by Joseph A. Petrick and John F. Quinn, Response Books:New Delhi.
4. Ethics in management" by S.A.Sherlekar, Himalaya Publishing House. Harold H. Titus:Ethics for Today.
5. Maitra,S.K: Hindu Ethics.
6. William Lilly : Introduction to Ethics.
7. Sinha : A Manual of Ethics
8. Manu : Manu Dharma Sastra or the Institute of Manu : Comprising the Indian System of Duties: Religious and Civil (ed.) G.C. Haughton.
9. Susruta Samhita : Tr. Kaviraj Kunjalal ,Kunjalal Brishagratha, Chowkamba Sanskrit series, Vol I,II and III, Varanasi, Vol 1 OO, 16-20, 21-32 and 74- 77 only.
10. 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.
11. Ethics:Theory and Contemporary Issues, Barbara Mackinnon Wadsworth/Thomson Learning ,2001.
12. Analysing Moral Issues, Judith A. Boss, Mayfield Publishing Company ,1999.
13. An Introduction to Applied ethics (Ed.) John H.Piet and Ayodhya Prasad, Cosmo Publications. Text Book for Intermediate logic, Ethics and Human Values .Telugu Academic Hyderabad.
14. I.C.Sharma Ethical Philosophy of India, Nagin & Co Julundhar.

Course Outcomes:

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	1	2	2	2	1	1	1	1	2	2	1	1
CO_2	1	2	2	2	1	1	1	1	2	2	1	1
CO_3	1	2	2	2	1	1	1	1	2	2	1	1

CO_4	1	2	2	2	1	1	1	1	2	2	1	1

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

Course Objectives:

1. To study the cell organelles in prokaryotic and eukaryotic cells.
2. Gives information about classification, physico-chemical properties of amino acids and structural organization of proteins.
3. To understand the structure, properties and biological importance of carbohydrates and lipids.
4. Explore the composition and structure of nucleic acids.

Course Content:

Unit I

Prokaryotic and Eukaryotic cells: Cell organelles Structure, Composition and functions of nucleus, mitochondria plastids, endoplasmic reticulum, Golgi, lysomes, vacuole, micro bodies, ribosomes, cytoskeleton. Biomembranes, structure and mechanisms of transport.
Cell division, cell cycle and its regulation, cell signaling, stress response, cell communication, cell adhesion, Apoptosis, Senesence, extracellular matrix, integrins.

Unit II

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 III

Carbohydrates: Definition and classification of carbohydrates, nomenclature, Reaction of Mono- saccharides, 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 (*Staphylococcu*s killer).

Unit IV

Nucleic acids: Purine and pyramidine bases, nucleosides, nucleotides, polynucleotides, Structure of nucleic acids primary secondary & Tertiary structure of DNA. DNA denaturation and renaturation kinetics
Structure of RNAs – Secondary and Tertiary structure; Analysis of stability to nucleic acid structures, Nucleic acid sequencing –Higher orders of DNA & RNA Structure, chromatin

structure; Gene analysis – southern blot technique and its variance. Porphyrins; Types, chemistry and structure of porphyrins. Vitamins, structures and chemistry.

Recommended Books:

1. The biochemistry of Nucleic acids; Adams et al., Chapman and Hall, 1986.
2. Proteins: A guide to study by physical & chemical methods, Haschemeyer and Haschemeyer,
3. Proteins: Structure, function and evolution. Dickerson & Geis, 2nd Edn, Benjamin/Cummings.
4. Biochemistry - Zubay C, Addison – Wesley, 1986.
5. Biochemistry, A problem Approach, 2nd Edn. Wood, W.B. Addison Wesley1981.
6. Biochemistry, Lehninger A. H.
7. Textbook of Biochemistry West, E.S., Todd, Mason &Vanbruggen, Macmillian& Co.
8. Principles of Biochemistry White-A, Handler, PandSmith E.L. Mc Grew Hill.
9. Organic chemistry, I.L. Finar, ELBS. (1985).
10. Organic Chemistry by Morrison and Boyd (2000) PrenticeHall.
11. Fundamentals of Biochemistry by Donald Voet (1999).

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

1. Easily understand the difference between prokaryotic and eukaryotic cells, and the concept of cell division.
2. Understand the classification, structure and biochemical reactions of aminoacidsand proteins.
3. Describe the classification, structure and biochemical reactions of carbohydrates and lipids.
4. Understand the concept of structural organization of nucleic acids.

	PO_1	**PO_2**	**PO_3**	**PO_4**	**PO_5**	**PO_6**	**PO_7**	**PO_8**	**PO_9**	**PO_{10}**	**PO_{11}**	**PO_{12}**
CO_1	3	3	3	2	1	3	3	1	2	2	3	3
CO_2	3	3	3	2	1	3	3	1	2	2	3	3
CO_3	3	3	3	2	1	3	3	1	2	2	3	3
CO_4	3	3	3	2	1	3	3	1	2	2	3	3

M.Sc. BIOCHEMISTRY

SEMESTER-II

Course Code	Semester-II, Course Title	No of Hours Per week	No of Credits

BCH-**201**	Energy Metabolism	06	4
Sessional Marks: 20		End Semester Exam Marks: 80	

Course Objectives:

1. To acquire knowledge related to the intermediary metabolism and the role of TCA cycle in central carbon metabolism.
2. To learn basic concepts of Bioenergetics, the importance of high energy compounds, electron transport chain, synthesis of ATP, mechanisms of oxidative phosphorylation and photophosphorylation.
3. To understand the fundamentals of cellular metabolism of carbohydrates their association with variousmetabolic diseases.
4. To learn biosynthesis and degradation of Lipids, fattyacids and cholesterol, Metabolism of lipoproteins and Ketone bodies.

Course Content:

Unit I

Broad outlines of Intermediary metabolism, methods of investigation, 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 dehydrogenase 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.

Recommended Books:

1. Principles of Biochemistry, White. A, Handler, P and Smith.
2. Biochemistry, Lehninger A. L.
3. Biochemistry, David E. Metzler.
4. Biochemistry, LubertStryer.
5. Review of physiological chemistry, Harold A.Harper.
6. Text of Biochemistry, West andTodd.
7. Outlines of Biochemistry, Conn and Stummf.
8. Metabolic pathways –Greenberg.
9. Mitochondria, Munn.
10. Biochemistry, 2nd Edition, G. Zubay.

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

1. Explain the broad outlines of intermediary metabolism and importance of carbohydrate metabolism in life.
2. Describe the importance of Electron transport and ATP production mechanism.
3. Gain in knowledge in Carbohydrate metabolism and their associated disorders.
4. Describe the details of lipid metabolism.

	PO_1	**PO_2**	**PO_3**	**PO_4**	**PO_5**	**PO_6**	**PO_7**	**PO_8**	**PO_9**	**PO_{10}**	**PO_{11}**	**PO_{12}**
CO_1	3	3	3	3	2	3	2	1	3	2	2	3
CO_2	3	3	3	3	2	3	2	1	2	2	2	3
CO_3	3	3	3	3	2	3	2	1	3	2	2	3
CO_4	3	3	3	3	2	3	2	1	2	2	2	3

Course Code	**Semester-II, Course Title**	**No of Hours Per week**	**No of Credits**
BCH-202	Nitrogen Metabolism	06	04
Sessional Marks: 20		End Semester Exam Marks: 80	

Course Objectives:

1. To study the metabolism of proteins and aminoacids.
2. To learn about aminoacids as biosynthetic precursors.
3. To learn about biosynthesis and degradation of nucleic acids.
4. To understand the effect of toxic chemicals in the environment and concept of carcinogenicity.

Course Content:

Unit I

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.
Biosynthesis and Regulation of amino acids and disorders related to amino acid metabolism. Nitrogen cycle, Non-biological and biological nitrogen fixation, Nitrogenase system, Nif genes.

Unit II
Amino acids as biosynthetic precursors-Formation of creatine, seratonine, histamine, polyamines, melatonine, GABA, melanine, catecholamines. Non-ribosomal peptide synthesis-glutathione, cyclic antibiotics (gramicidin).

Unit III
Metabolism of Nucleic Acids: Biosynthesis and degradation of Purines and regulation of path ways. Biosynthesis and degradation of Pyrimidines and regulation of pathways. Interconversion of nucleotides, Metabolic disorders related to nucleic acid metabolism.

Unit IV
Toxic chemicals in the environment, Mode of entry of toxic substance, Insecticides, MIC effects, Pesticides, biotransformation of xenobiotics, detoxification. Carcinogens in air, chemical carcinogenicity, mechanism of carcinogenicity, Environmental carcinogenicity testing.

Recommended Books:

1. Principles of Biochemistry, White. A, Handler, P andSmith.
2. Biochemistry, Lehninger A. L.
3. Biochemistry, David E.Metzler.
4. Biochemistry, LubertStryer.
5. Review of physiological chemistry, Harold A.Harper.
6. Outlines of Biochemistry, Conn and Stumpf.
7. Metabolic pathways –Greenberg.
8. Mitochondria, Munn.
9. Biochemistry, 2nd Edition, G. Zubay.
10. Environmental hazards & human health R.B. Philip
11. Toxicology – Principles & applications –Niesink& Jon devries.

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

1. Understand the anabolic and catabolic reactions of proteins and aminoacids.
2. Gain knowledge in the importance of aminoacids as biosynthetic precursors.
3. Know the biosynthesis and degradation of purine and pyramidined and their associated disorders.
4. How toxic chemicals metabolised by the body through detoxification and the mechanism of carcinogenicity.

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}

CO_1	3	3	3	2	2	3	2	1	2	2	2	3
CO_2	3	3	3	2	2	3	2	1	2	2	2	3
CO_3	3	3	3	2	2	3	2	1	2	2	2	3
CO_4	3	3	3	2	2	3	2	1	2	2	2	3

Course Code	Semester-II, Course Title	No of Hours Per week	No of Credits
BCH-203P	Practical related to Enzymology	06	04
End Semester Exam Marks: 100			

Course Objectives:

1. The lab is designed to train the students in basic techniques of Analytical Biochemistry likeestimation of enzymes from various sources, Enzyme purification and enzyme kinetics.
2. It also deals with the assay of clinically important enzymes and determinationof factor affecting enzyme activity.
3. To demonstrate the Immobilization of enzymes.

Course Content:

BCH 203P: ENZYMOLOGY PRACTICAL

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)

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

1. Learnabout estimation of various enzymes in biological sample.
2. Learn to perform assay of clinically importantenzyme: serum acid and alkaline phosphatase, serum LDH.
3. Learn aboutthe factors affecting enzymeactivity and determination of Km.
4. Demonstrate the Immobilization of enzymes.

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	3	3	3	3	3	3	2	1	3	2	3	3
CO_2	3	3	3	3	3	3	2	1	3	2	3	3
CO_3	3	3	3	3	3	3	2	1	3	2	3	3
CO_4	3	3	3	3	3	3	2	1	3	2	3	3

Course Code	**Semester-II, Course Title**	**No of Hours Per week**	**No of Credits**
BCH-204P	Molecular biology Practicals	06	04
End Semester Examination Marks: 100			

Course Objectives:

The lab is designed to train the students in basic methods of molecularbiology.

1. To isolate DNA and RNA from bacterial, plant and animal cells.
2. To estimate the DNA and RNA by suitable methods.
3. Transfection studies.
4. Purity determination of DNA by UV absorption method.
5. Detection and differentiation of open circular, linear and closed covalent circular plasmid DNA by submarine gel electrophoresis.
6. Determination of melting temperature (Tm).

Course Contents:

204P: MOLECULAR BIOLOGY PRACTICALS

7. Isolation of DNA from bacterial, plant and animal cells.
8. Estimation of DNA by Diphenylamine method.
9. Isolation RNA from yeast cells.
10. Estimation of RNA BY Orcinol method.
11. Estimation of DNA and purity determination by UV absorption method.
12. Determination of melting temperature (Tm).
13. Isolation of plasmid DNA from E. coli.
14. Detection and differentiation of open circular, linear and closed covalent circular plasmid DNA by submarine gel electrophoresis.
15. Transformation of E. coli with ampicillin resistant plasmid.

16. Trasfection of M13 DNA into E. coliJM103.
17. Isolation of phageM13.
18. Isolation of single and double standard M13DNA.
19. Conjugation: Use of broad host range plasmid RP in demonstrating conjugation transfer of plasmid bacteria.
20. Catabolite repression: Evidence of B-Galactosidase induction in presence of lactose in E .coli lac strains.

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: The student will be able to

1. Isolate nucleic acids from various sources.
2. Estimate the nucleic acids quantitatively.
3. Determine the melting temperature.
4. Determine the purity of DNA by UV method.

	PO_1	**PO_2**	**PO_3**	**PO_4**	**PO_5**	**PO_6**	**PO_7**	**PO_8**	**PO_9**	**PO_{10}**	**PO_{11}**	**PO_{12}**
CO_1	3	3	3	3	3	3	3	1	3	3	3	3
CO_2	3	3	3	3	3	3	3	1	3	3	3	3
CO_3	3	3	3	3	3	3	3	1	3	3	3	3
CO_4	3	3	3	3	3	3	3	1	3	3	3	3

CourseCode	**Semester-I, Course Title**	**No of Hours Per week**	**No of Credits**
BCH 205	Human values and professional ethics-II	06	04
Sessional Marks: 20		End Semester Examination Marks: 80	

Course Objectives:

Course Contents:

Unit I

Value Educattion- Defination- 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 famiy 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.

Recommended Books:

1. John S Mackenjie: A manual of ethics.
2. The Ethics of Management" by Larue Tone Hosmer, Richard .D. Irwin Inc.
3. Management Ethics-integrity at work" by Joseph A. Petrick and John F. Quinn, Response Books: NewDelhi.
4. Ethics in management" by S.A.Sherlekar, Himalaya Publishing House.
5. Harold H. Titus: Ethics for Today.
6. Maitra, S.K: Hindu Ethics.
7. William Lilly: Introduction to Ethics
8. Sinha: A Manual of Ethics
9. Manu: Manu Dharma Sastra or the Institute of Manu : Comprising the Indian System of Duties:Religious and Civil (ed.) G.C. Haughton.
10. Susruta Samhita: Tr. Kaviraj Kunjalal ,Kunjalal Brishagratha, Chowkamba Sanskrit series, Vol I,II andIII, Varanasi, Vol 1 OO, 16-20, 21-32 and 74- 77 only.
11. Caraka Samhita: Tr. Dr. Ram Karan Sarma and Vaidya Bhagavan Dash, Chowkambha Sanskrit SeriesOffice , Varanasi Vol 100, 16-20,21-32 and 74-77 only.
12. Ethics: Theory and Contemporary Issues., Barbara Mackinnon Wadsworth/ Thomson Learning ,2001.
13. Analysing Moral Issues, Judith A. Boss, Mayfield Publishing Company ,1999.
14. An Introduction to Applied ethics (Ed.) John H.Piet and Ayodhya Prasad, Cosmo Publications.
15. Text Book for Intermediate logic, Ethics and Human Values , board of intermediate Education &Telugu Academic Hyderabad.

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}

CO_1	1	2	2	2	1	1	1	1	2	2	1	1
CO_2	1	2	2	2	1	1	1	1	2	2	1	1
CO_3	1	2	2	2	1	1	1	1	2	2	1	1
CO_4	1	2	2	2	1	1	1	1	2	2	1	1

CourseCode	**Semester-II, Course Title**	**No of Hours Per week**	**No of Credits**
BCH 206	ENZYMOLOGY	06	04
Sessional Marks: 20		End Semester Examination Marks: 80	

Course Objectives:

1. To study the basic concept of enzymes and their kinetics.
2. Knowledge about different types of enzyme inhibition and Chemical nature of enzyme catalysis.
3. To describe the importance of coenzymes in living organism.
4. To study the allosteric regulation 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, and 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, Glutamine synthase, 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 of sigmoidal behavior. Study of ATCase a typical allostearic enzyme.

Recommended Books:

1. Enzyme structure and mechanism. Alan Fersht, Freeman & Co.1997
2. Principles of enzymology for food sciences: Whitaker Marc Dekker1972.
3. Methods in enzymology Ed. Colowick and Kaplan, Academic Pr (Continuing series)
4. Text book of Biochemistry with clinical correlations (4^{th} edition)-Thomas M. Devlin.
5. Biological chemistry; H.R. Mehler& E.H CordesHarper&Rev.
6. Enzyme kinetics Siegel interscience – Wiley1976.
7. Biochemistry chemical reactions of living cells (2001) David E. Matzler. Vol. I.

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

1. Distinguish the fundamentals of enzyme properties, nomenclatures, characteristics and mechanisms.
2. Describe the concepts of enzyme inhibition and mechanism of enzyme catalysis.
3. Students will acquaint with mechanism of enzyme action and various coenzymes involved in the biochemical reactions taking place in living systems.
4. Describe the concepts of co-operative behavior and allosteric regulation.

	PO_1	**PO_2**	**PO_3**	**PO_4**	**PO_5**	**PO_6**	**PO_7**	**PO_8**	**PO_9**	**PO_{10}**	**PO_{11}**	**PO_{12}**
CO_1	3	3	2	2	2	3	1	1	2	1	1	2
CO_2	3	3	2	2	2	3	1	1	2	1	1	2
CO_3	3	3	2	2	2	3	1	1	2	1	1	2
CO_4	3	3	2	2	2	3	1	1	2	1	1	2

M.Sc. BIOCHEMISTRY

SEMESTER-III

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

Course Objectives:

1. The objective of the course is learning and understanding the fundamentals of Microbiology like important characteristics and biology of bacteria, fungi, mycoplasma, viruses etc. and to learn basic knowledge about control methods of microorganisms and industrial application of microbes for water and sewage treatment.
2. Designed to learn nutritional requirements in microorganisms and virus classification, morphology and Methods of culturing of viruses, Isolation, purification and characterization.
3. The objectives of the course are to learn and understand the fundamentals of genetics like DNA as genetic material, chromosome and gene and understand the gene arrangement in prokaryotes and eukaryotes.
4. To learn and understand the concept of bacterial genetics and detailed information about Mutation

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.

Recommended Books:

1. Microbiology by Pelczar, Chan and Krieg 5th edn. 1995 Mc Grew- Hill.
2. General Microbiology: Boyd, R.F., Times Mirror/ Mosby College, 1984.
3. A Textbook of Microbiology, R.C.Dubey and D.K.Maheswari, S.Chand Co (2001).
4. Pharmaceutical Microbiology, By Hugo and Russell, Blackwell Scientific (1987).

5. An Introduction to Viruses by S.B.Biswas, Vikas Publishing house.
6. Microbiology 4th edition, Prescott, Harley, Klein (Mc grew Hill)
7. Fundamentals of Microbiology – M. Frebisher.
8. Text book of Microbiology – William Burrows.
9. Biology of Microorganisms – Sandes T. Lyles
10. Microbial Ecology – Atlas (2001).
11. Molecular Genetics by D Friefelder
12. Cell molecular biology, Albert Bruce
13. Gene VII by Lewin
14. Molecular cloning by Maniatis and Co Vol I, II, III
15. Genetics by Gardner

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

1. Understand the basics of microbiology like nomenclature and classification of microorganisms, understand the various biological and non-biological method to control microorganisms
2. The student will learn about different mode of nutrition in microorganisms and about viruses - Isolation, purification and characterization.
3. Understand the basics of genetics and the gene arrangement in prokaryotes and eukaryotes.
4. Gain knowledge in bacterial genetics includes the different types plasmids, recombination in bacteria, bacteriophages and bacterial defense mechanism(CRISPR) and Describe the various types of mutations and its effect.

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	3	3	3	3	2	2	3	1	2	2	2	3
CO_2	3	3	3	3	2	3	3	1	2	2	3	3
CO_3	3	3	3	3	2	2	3	1	2	2	3	3
CO_4	3	3	3	3	2	2	3	1	2	2	3	3

Course Code	**Semester-III, Course Title**	**No of Hours Per week**	**No of Credits**
BCH-302	Molecular Biology	06	04
Sessional Marks: 20		**End Semester Examination Marks: 80**	

Course Objectives:

1. The objective of the course is learning and understanding the fundamentals of DNA replication and its mechanism.
2. Complete information about RNA synthesis in prokaryotes and eukaryotes.
3. To understand the genetic code.
4. Detailed accounts on the biosynthesis and mechanism of protein synthesis.

Course Content:

Unit I

Isolation, fractionation, characterization of nucleic acids, properties of nucleic acids in solution. 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

Biosynthesis and mechanism of protein synthesis: Different stages and components of protein synthesis, m RNA and t RNA. Amino acid activation, protein chain initiation, elongation, and termination. Ribosomes and types, molecular components of ribosomes. Assembly and dissociation of subunits

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.

Recommended Books:

1. Molecular Biology of the gene by Watson.
2. Genetics by G Zubay.
3. Molecular Biology of the Cell by Albert Bruce.
4. Cell molecular Biology by Baltimore.
5. Molecular Biology by D Friefelder.
6. Molecular Genetics by D Friefelder.
7. Genes VII Benjamin Lewin (2000). Oxford Univ. Press. London.
8. Cell and Molecular Biology 2nd Edit. (2002) By P. K. Gupta, Rastogi Publ.

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

1. The students will learn about the Possible modes of replication, and roles of helicase, primase, gyrase, topoisomerase, DNA Polymerase, DNA

ligase, and Regulation of replication.
2. Learnabout the mechanism and regulation of transcription in prokaryotes and eukaryotes.
3. Learnabout genetic code and their evolution.
4. Gain knowledge in Different stages and components of protein synthesis.

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	3	3	3	3	3	3	2	1	3	2	2	3
CO_2	3	3	3	3	3	3	2	1	3	2	2	3
CO_3	3	3	3	3	3	3	2	1	3	2	2	3
CO_4	3	3	3	3	3	3	2	1	3	2	2	3

Course Code	**Semester-III, Course Title**	**No of Hours Per week**	**No of Credits**
BCH-303P	Practical related to Microbiology	06	04
End Semester Examination Marks: 100			

Course Objectives:

1. The lab is designed to train the students in handling of microscope.
2. It also deals with microbial techniques of isolation, purification and maintenance of microbial cultures.
3. To learn Staining techniques for bacteria and yeast.
4. To Prepare wine from Grapes.
5. Production and estimation of alcohols, citric acid, lactic acid etc..

Course Content:

BCH 303P: MICROBIOLOGY PRACTICALS

1. Handling of Microscopes: Calibration of Microscopes.
2. Sterilization techniques: Autoclaving (Moistened-heat), Oven sterilization (dry-heat), Filtration,
3. UV irradiation and Chemical.
4. Preparation of media: For Bacteria and Fungi.
5. Isolation and cultivation of pure cultures: Serial dilution, Pour plate method, Spread plate method and streak plate method.
6. Methods for the estimation of Growth (Growth rate and generation time in bacteria).
7. Staining techniques for bacteria and yeast: Gram Staining and Spore staining for bacteria; Methylene blue staining for Yeast.Antibiotic sensitivity test.

8. Starch hydrolysis assay for the identification amylase-producing microorganisms.
9. Gelatin hydrolysis assay for the identification protease-producing microorganisms.
10. Preparation of wine from Grapes.
11. Production of Alcohol from molasses and its estimation by specific gravity method.
12. Production of Citric acid and its estimation by Marrier and Boulet method.
13. Production of Lactic acid and its estimation by Barker and Summerson method.
14. Induction of mutation in bacteria using physical and chemical mutagens.
15. Water analysis for bacteria and determination of BOD and COD of water.
16. Observation of Rizobium from root nodules of ground nut plant.
17. Isolation of phages from sewage and quantification by plaque assay.

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)

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

1. Handle the microscope.
2. Learn Methods of sterilization and preparation of various culture media, Purification techniques.
3. Identification of isolated bacteria, and Growth curve of microorganism.
4. Learn Staining techniques for bacteria and yeast.
5. Gain knowledge in the Preparation of wine from Grapes.
6. Production and estimation of alcohols, citric acid, lactic acid etc.

	PO_1	**PO_2**	**PO_3**	**PO_4**	**PO_5**	**PO_6**	**PO_7**	**PO_8**	**PO_9**	**PO_{10}**	**PO_{11}**	**PO_{12}**
CO_1	3	3	3	3	3	3	3	1	2	2	3	3
CO_2	3	3	3	3	3	3	3	1	2	2	3	3
CO_3	3	3	3	3	3	3	3	1	2	2	3	3
CO_4	3	3	3	3	3	3	3	1	2	2	3	3

Course Code	Semester-III, Course Title	No of Hours Per week	No of Credits
BCH-304P	Clinical biochemistry practicals	06	04
			End Semester Exam Marks: 100

Course Objectives: The lab is designed to train the students

1. To collect and maintain the biological samples for clinical assays.
2. Estimation of clinical enzymes.
3. To analyze urine sample qualitatively to identify the abnormalities.
4. Demonstration of diagnostic kits.

Course Contents:

BCH 304P: CLINICAL BIOCHEMISTRY PRACTICALS

1. Estimation of blood glucose.
2. Estimation of blood urea.
3. Estimation of creatine in serum.
4. Estimation of uric acid in serum.
5. Estimation of serum total protein.
6. Estimation of Serum albumin.
7. Estimation of Serum cholesterol.
8. Determination of SGOT.
9. Determination of SGPT.
10. Estimation of serum calcium.
11. Estimation of serum phosphate.
12. Estimation of serum bilirubin.
13. Determination of urine ascorbic acid.
14. Tests for abnormal constituents in urine.
15. 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 (2001) by Aneja, K.M
6. Laboratory Manual in Microbiology by P. Gunasekaran (1996), New Age Publ.
7. Microbiology laboratory Manual (2001) by Aneja, K.M

Course Outcomes: The student will be able to

1. Collect and maintain the biological samples for clinical assay.
2. Estimate the blood and serum enzymes for diagnosis of diseases.
3. Qualitatively analyse the abnormal constituents in urine.
4. Work with diagnostic kits.

	PO_1	**PO_2**	**PO_3**	**PO_4**	**PO_5**	**PO_6**	**PO_7**	**PO_8**	**PO_9**	**PO_{10}**	**PO_{11}**	**PO_{12}**
CO_1	3	3	3	3	3	3	3	1	3	3	3	3
CO_2	3	3	3	3	3	3	3	1	3	3	3	3
CO_3	3	3	3	3	3	3	3	1	3	3	3	3
CO_4	3	3	3	3	3	3	3	1	3	3	3	3

Course Code	**Semester-III, Course Title**	**No of Hours Per week**	**No of Credits**
BCH-305a	Endocrinology (Generic Elective)	06	4
Sessional Marks: 20		End Semester Exam Marks: 80	

Course Objectives:

1. To impart knowledge on structure and hormones secreted by hypothalamus, pituitary and pineal glands.
2. To familiarize the concepts of biosynthesis and regulation of secretion of thyroid, parathyroid and calcitonin hormones.
3. To make them understand the chemistry, biosynthesis, secretion, regulation of Hormones of Pancreas and Gastro intestinal hormones.
4. To impart knowledge of Sex hormones, hcg, Miscellaneous hormones and Insect molting hormones.

Course Contents:

Unit I

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, leutinizing 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 and secretion 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, deoxycorticosterone 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.

Recommended Books:

1. Text book of biochemistry and human biology. Talwar G. P. Prentice Hall India.
2. Human physiology and mechanism of distance–Guyton 3rdedn. Igkushoen /Seunders.
3. Clinical Biochemistry Vols. 1 and 2: Williams et al Heinemann Medical 1978.
4. Lynchs Medical Laboratory Technology Raphael, S.S., 4thedn. Igkushoe /Saunders.
5. Text book of Endocrinology – William.
6. General endocrinology –Turner.
7. Biochemical endocrinology of the vertebrates by E. Fruden and H.Lines.
8. Foundation of modern Biochemical series, prentice Hall Inc.1971.
9. Metabolic and endocrine physiology: By Jay Teppermann.
10. Metabolic pathways –Greenberg.
11. Intermediary metabolism and its regulation –Larner.
12. Principles of Biochemistry, White, A, Handler, P and Smith.
13. Receptors and hormone action 1977.
14. Receptors and recognition series.

Course Outcomes: The student will be able to

1. Know about the mechanism of action of different hormones secreted by hypothalamus, pituitary and pineal glands.
2. Familiar with Iodine, Calcium metabolisms and disorders related to thyroid and parathyroid glands.
3. Know about the mechanism of action of insulin, glucagon and many gastro intestinal hormones.
4. Acquire knowledge on Hormonal regulation of menstrual cycle and disorders associated with Gonadal hormones.

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	3	3	3	3	3	3	2	1	3	2	3	3
CO_2	3	3	3	3	3	3	2	1	3	2	3	3
CO_3	3	3	3	3	3	3	2	1	3	2	3	3
CO_4	3	3	3	3	3	3	2	1	3	2	3	3

Course Code	**Semester-III, Course Title**	**No of Hours Per week**	**No of Credits**
BCH-305b	Clinical Biochemistry	06	04
Sessional Marks: 20		End Semester Exam Marks: 80	

Course Objectives:

1. The main objective of this skill oriented course is to learn and understand the fundamentals of clinical biochemistry, Collection and preservation of specimens and Assays of Carbohydrate Metabolism associated clinical conditions/diseases.
2. To impart knowledge of Inborn errors of amino acid metabolism, investigation of lipid metabolism and functioning of renal system.
3. To understand Clinical application of plasma enzyme assays and Disorders of Gastrointestinal Tract.
4. To acquire knowledge of biochemical aspects of Liver diseases.

Course Contents:

Unit I

Introduction to Clinical Biochemistry: Introduction and maintenance of clinical biochemistry laboratory; azards 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-proteincmias; Classification – primary and secondary. Investigation of lipoproteinemias and lipidemias.
Renal function: Glomerular and tubular functions. Tests for evaluation – concentration, dilution, excretion, clearance tests, nephritic 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 myocardial infraction, 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, achyliagastrica. Pancreatic exocrine secretion – composition.Duodenal contents – collection, examination following stimulation of pancreas; analysis; malabsorption syndrome due to intestinal disease and pancreatic dysfunction, differential diagnosis.Disaccharides 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 (JohnWily).
3. Harper's Review of Biochemistry, Murray et al. (Longman).
4. Biochemical aspects of human disease – R.S. Elkeles and A.S. Tavil. (Blackwell ScientificPublications).
5. Clinical chemistry in diagnosis and treatment–JoanF.Zilva and P.R.Pannall (Lloyd-Luke Medical Books.
6. Varley's Practical clinical Biochemistry – Ed. Alan W. Gowenlock (Heinemann Medical Books, London, 1988).
7. Clinical diagnosis and management by Lab methods (John Bernard Henry, W.B. Salunders Company, 1984).
8. Clinical Biochemistry – S. Ramakrishnan and Rajiswami.
9. Chemical Biochemistry (Metabolic and clinical aspects) by W. J. Marshall & S. K. Bangert.
10. Text book of clinical Biochemistry by Tietz et al.

Course Outcomes: The student will be able to

1. Maintain clinical biochemistry laboratory, biological specimen collection for clinical assay and investigation of disorders associated with carbohydrates.
2. Learn and understand the Inborn errors of amino acid metabolism, Lipid metabolism and Renal function system.

3. Gain knowledge in clinical enzymology and Disorders of Gastrointestinal Tract.
4. Investigate the serum enzymes in liver diseases.

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	3	3	3	3	3	3	3	1	3	3	3	3
CO_2	3	3	3	3	3	3	3	1	3	3	3	3
CO_3	3	3	3	3	3	3	3	1	3	3	3	3
CO_4	3	3	3	3	3	3	3	1	3	3	3	3

Course Code	Semester-III, Course Title	No of Hours Per week	No of Credits
BCH-305c	Cell and Developmental Biology	06	04
Sessional Marks: 20		End Semester Exam Marks: 80	

Course Objectives:

1. To explore the knowledge and awareness of the basic principles and concepts of Developmental Biology.
2. To familiarize with the concepts Gametogenesis, fertilization and early development.
3. To impart knowledge about Morphogenesis and organogenesis in animals and in plants.
4. To understand the concept of biomembranes and membrane 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, Senesence, 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: The student will be able to

1. Acquire knowledge on basic concepts of Developmental Biology.
2. Gain the proficient knowledge about zygote formation, blastula formation, gastrulation and many events in early development.
3. Understand Organogenesis, limb development and regeneration in vertebrates, and post embryonic development in animals and Plant tissue culture, Protoplast fusion and Production of transgenic plants.
4. Acquire knowledge about biomembrane concept and various membrane transport systems.

	PO_1	**PO_2**	**PO_3**	**PO_4**	**PO_5**	**PO_6**	**PO_7**	**PO_8**	**PO_9**	**PO_{10}**	**PO_{11}**	**PO_{12}**
CO_1	3	3	3	3	3	3	2	2	3	2	3	3
CO_2	3	3	3	3	3	3	2	2	3	2	3	3
CO_3	3	3	3	3	3	3	2	2	3	2	3	3
CO_4	3	3	3	3	3	3	2	2	3	2	3	3

Course Code	Semester-III, Course Title	No of Hours Per week	No of Credits
BCH-306a (Open elective)	General biochemistry	06	04
Sessional Marks: 20		End Semester Exam Marks: 80	

Course Objectives:

1. Gives information about classification, physico-chemical properties of amino acids and structural organization of proteins.
2. To understand the structure, properties and biological importance of carbohydrates and lipids.
3. Explore the composition and structure of nucleic acids.
4. Structure of porphyrins, Chemistry and functions of water and fat soluble vitamins.

Course Content:

Unit I

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 Mono- saccharides, 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.

Recommended Books:

1. Glycoproteins by Hughes R.C., Chapman & Holl, 1983.
2. Biochemistry – Mechanisms of metabolism Cunningham, E.B., Mc Grew – Hill, 1978.
3. Nucleic acid – Chargaff & Davidson Vol. II.
4. The biochemistry of Nucleic acids; Adams et al., Chapman and Hall, 1986.
5. Proteins: A guide to study by physical & chemical methods, Haschemeyer and Haschemeyer, Wiley, New York, 1973.
6. Proteins: Structure, function and evolution. Dickerson & Geis, 2nd Edn, Benjamin / Cummings, Menlo Park, California 1983.
7. The proteins: Neurath and Hill, 3rd Edn. Academic New York, 1977.
8. Biochemistry - Zubay C, Addison – Wesley, 1986.
9. Biochemistry, A problem Approach, 2nd Edn. Wood, W.B. Addison Wesley1981.
10. Biochemistry of Lipids and Membranes - Vance D, Addison-Wesley, 1985.

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

1. Understand the classification, structure and biochemical reactions of aminoacidsand proteins.
2. Describe the classification, structure and biochemical reactions of carbohydrates and lipids.
3. Understand the concept of structural organization of nucleic acids.
4. Describe the Structure of porphyrins, Chemistry and functions of water and fat soluble vitamins.

	PO_1	**PO_2**	**PO_3**	**PO_4**	**PO_5**	**PO_6**	**PO_7**	**PO_8**	**PO_9**	**PO_{10}**	**PO_{11}**	**PO_{12}**
CO_1	3	3	3	2	1	3	3	1	2	2	3	3
CO_2	3	3	3	2	1	3	3	1	2	2	3	3
CO_3	3	3	3	2	1	3	3	1	2	2	3	3
CO_4	3	3	3	2	1	3	3	1	2	2	3	3

Course Code	**Semester-III, Course Title**	**No of Hours Per week**	**No of Credits**
BCH-306b (Open elective)	Environmental biochemistry	06	04
Sessional Marks: 20		End Semester Exam Marks: 80	

Course Objectives:

1. To differentiate between renewable and non-renewable resources and conservation of natural resources.
2. To Describe the different types of ecosystems.

3. Explore the details about various types of environmental pollution.
4. Importance of environment in human population.

Course Contents:

Unit I

Renewable and non-renewable resources. Definition, scope and importance, need for public awareness Forest resources: Use and over-exploitation, deforestation, case studies.
Water resources, Mineral resources, Food resources, Food resources, Energy resources, Role of an individual in conservation of natural resources.

Unit II

Ecosystems, Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids.
Introduction, types, characteristic features, structure and function of the following ecosystems: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems and Biodiversity and its conservation

Unit III

Environmental Pollution Definition, Cause, effects and control measures of: Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards.
Solid waste Management: Causes, effects and control measures of urban and industrial wastes, Role of an individual in prevention of pollution, Pollution case studies, Disaster management: floods, earthquake, cyclone and landslides.

Unit IV

Human Population and the Environment, Population growth, variation among nations, Population explosion –Family Welfare Programme.
Environment and human health, Human Rights, Value Education HIV/AIDS, Women and Child Welfare, Role of Information Technology in Environment and human health, Case Studies.

Reference books

1. Environmental Biochemistry - NeelimaRajvaidya, Dilip Kumar Markandey(2005).
2. EnvironmentalandEcologicalBiochemistry- P.W.HochachkaT.P.Mommsen
3. Environmental Biochemistry Hardcover – 2005 by D. K. Markandey, N.Rajvaida

Course outcomes: After the completion of this course, the student will be able to

1. Students will be able to know how to conserve natural resources for future.
2. Students will be able to describe differing types of ecosystems and their characteristic features.
3. Gain the knowledge about different types of pollution in the environment.

4. Know the Relation between human population and environment.

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	3	3	3	2	2	3	3	2	3	2	2	3
CO_2	3	3	3	2	2	3	3	2	3	2	2	3
CO_3	3	3	3	2	2	3	3	2	3	2	2	3
CO_4	3	3	3	2	2	3	3	2	3	2	2	3

Course Code	Semester-III, Course Title	No of Hours Per week	No of Credits
BCH-306c (Open elective)	Experimental aspects related to analytical methods	06	04
Sessional Marks: 20		End Semester Exam Marks: 80	

Course Objectives:

1. To study about the biological relevance of P^H, importance of buffers in biological system and basic principle, instrumentation and applications of microscopy and centrifugation techniques.
2. Knowledge about radioactivity measuring method and their applications in biochemical investigations.
3. To explore the theoretical principles, methodology and biochemical applications of chromatography and electrophoresis techniques.
4. To Understand the importance and applications of spectroscopy techniques in research field.

Course Contents:

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, isotachophoresis, 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.

Recommended Books

1. Principles and Techniques of practical Biochemistry. Eds. Williams and Wilson.
2. Techniques in Molecular biology Ed. Walker &Gastra, Croom Helm, 1983.
3. Principles of instrumental analysis, 2nd Ed, Holt-Sanders, 1980.
4. An introduction to spectroscopy for Biochemistry. Ed. Brown S.N., Academic press
5. Analytical Biochemistry, Holmes and Hazel peck, Longman, 1983.
6. An introduction to practical biochemistry. David T. Plummer, Tata Mac Grew-Hill.
7. Biophysical chemistry, Edshall& Wyman, Academic press Vol II & I.
8. A textbook of quantitative inorganic analysis including elementary instrumental analysis, Vogel ELBS.
9. Biochemical calculations Seigel, IH, 2nd Edit, John Wiley & sons Inc., 1983.
10. Analytical Biochemistry by Friefelder David

Course outcomes: After the completion of this course, the student will be able to

1. Understand the principle, Instrumentation of different types of Light microscopy, electron microscopy, and techniques of Centrifugation and its applications in various fields of research.
2. Learn about basic Radioactivity principles, measurement method and its biological applications.
3. Acquire knowledge about the basics and latest developments in the instrumentation techniques of Electrophoresis (IEF, 2D PAGE) and Chromatography and their applications in various research fields.
4. Demonstrate skill to explain about principle, Bioinstrumentation and applications of spectroscopy techniques.

	PO_1	**PO_2**	**PO_3**	**PO_4**	**PO_5**	**PO_6**	**PO_7**	**PO_8**	**PO_9**	**PO_{10}**	**PO_{11}**	**PO_{12}**
CO_1	3	3	3	3	3	3	3	-	2	2	3	3

CO_2	3	3	3	3	3	3	3	-	2	2	3	3
CO_3	3	3	3	3	3	3	3	-	2	2	3	3
CO_4	3	3	3	3	3	3	3	-	2	2	3	3

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 : 20		**End Semester Examination Marks : 80**	

Course Objectives:

1. To impart knowledge about major events in the development of rDNA technology and to acquire skills on techniques of construction of recombinant DNA - Cloning vectors and isolation of gene of interest.
2. To familiarize with the concepts different operons and regulation of gene expressions in prokaryotes and eukaryotes.
3. To acquaint them with the different gene transfer methods and mappings.
4. To explain the applications of genetic engineering in biotechnology.

Course Contents:

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 ofnucleotide sequences. Application of recombinant DNA technology. Oncogenes andtheir 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. Plant, animal cell and Tissue culture methods.
Biosensors: Genetically Modified Organism - Market potential, Diet, Leash, Potato, Rice BT.

Recommended Books

1. Genes and Probes, A Practical Approach Series (1995) by Hames and SJ Higgins; Oxford Univ. Press.
2. Gel Electrophoresis of Nucleic Acids, A practical Approach (1990) by D Rickwood and BD Hames.
3. Oxford Univ. Press.

Course Outcomes: The student will be able to

1. Familiar with the tools and techniques for isolation and purification of genes, vector construction.
2. Understand the mechanisms of regulation of gene expression in different operons.
3. Know the techniques for transfer and expression of cloned gene and
4. Apply the knowledge of genetic engineering in biological research.

	PO_1	**PO_2**	**PO_3**	**PO_4**	**PO_5**	**PO_6**	**PO_7**	**PO_8**	**PO_9**	**PO_{10}**	**PO_{11}**	**PO_{12}**
CO_1	3	3	3	3	3	3	3	2	3	2	3	3
CO_2	3	3	3	3	3	3	3	2	3	2	3	3
CO_3	3	3	3	3	3	3	3	2	3	2	3	3
CO_4	3	3	3	3	3	3	3	2	3	2	3	3

Course Code	**Semester-IV,Course Title**	**No of Hours Per week**	**No of Credits**
BCH-402	Research methodology and bioinformatics	06	04
Sessional Marks: 20		End Semester Exam Marks: 80	

Course Objectives:

1. To choose the appropriate research design and develop appropriate research hypothesis for a research project
2. To describe the appropriate statistical methods required for a particular research design.
3. To get introduced to the basic concepts of Bioinformatics and its significance in Biological data analysis.

4. To provide knowledge about the basics of sequence alignment and analysis.

Course Contents:

Unit I

Research Methodology: Meaning and scope, steps of Research, Article and thesis writing. Funding agencies, Project proposal preparation, Preparation of proposal, Experimental design and implementation of project, submission of progress report (year wise), statement of expenditure (SE), Utilization certificate (UC). Research ethics, Plagiarism.

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, Information and Communication Technology (ICT), online methods of teaching (MOOCS).

Unit II

Bio-Statistics: Data - Data types, collection of data, classification, tabulation and interpretation. 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 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 and FASTA. Proteomics- Introduction, principle, technique, 2-D data base. Gel analysis, post gel analysis, MALDI- TOF. Significance and applications of proteomics in modern biology.

Recommended 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. ISBN0-632-04983-9.
5. Genome Mapping: A practical approach. Dear P (Editor). 1st Ed. 2000. Oxford University Press.
6. Developing Bioinformatics Skills. Alfonso Valencia and Blaschke. L (2005) Oreilles Publication.
7. Bioinformatics sequence, structure and data banks ed. By Des Higgins Willie Taylor (2006).
8. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins" (Andreas D. Baxevanis, B. F. Ouellette), Paperback, 2nd ed., 470 pp., ISBN: 0471383910, Publisher: Wiley, John & Sons, Inc.,Pub.
9. David W. Mount, Bioinformatics: Sequence and Genome Analysis, 2nd edition, Cold SpringHarbor Laboratory, 2004, ISBN0-87969-687-7.
10. Introduction to Bioinformatics by T.K.Altwood and D.J Parry-Smith (Pearson Education Asia1999).

Course Outcomes: The student will be able to

1. Discuss the various steps involved in conducting research.
2. Learn to apply hypothesis testing via some of the statistical distributions.
3. Develop understanding about biological data and database search tools.
4. Acquire hands on training on various computational tools and techniques employed in biological sequence analysis.

	PO_1	**PO_2**	**PO_3**	**PO_4**	**PO_5**	**PO_6**	**PO_7**	**PO_8**	**PO_9**	**PO_{10}**	**PO_{11}**	**PO_{12}**
CO_1	3	3	3	3	3	2	1	1	3	3	3	3
CO_2	3	3	3	3	3	2	2	1	3	3	3	3
CO_3	3	3	3	3	3	2	1	1	3	3	3	3
CO_4	3	3	3	3	3	2	1	1	3	3	3	3

Course Code	**Semester-IV, Course Title**	**No of Hours Per week**	**No of Credits**
BCH-403-P	Practical related to immunology and hematology	06	04
End Semester Exam Marks: 100			

Course Objectives:

1. The lab is designed to train the students in basic techniques of immunology and electrophoresis.
2. Gain knowledge in collection of biological sample and handling of microscope.
3. To determine the blood samples like RBC and WBC count.
4. To determine the Human Blood grouping.

5. To determine the Ag and Ab reactions by immunodiffusion and immunoelectrophoresis techniques.

Course Contents:

BCH 403P: IMMUNOLOGY AND HAEMATOLOGY PRACTICALS

1. RBCcount.
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 immune electrophoroesis.
14. Cross over Immunoelectrophoresis.
15. Graber and WilliamsImmunoelectrophoresis.
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 agglutinationtests.

Recommended Books:

1. Hawk's Physiological chemistry.
2. Practical Biochemistry by TPlummer.
3. Practical Biochemistry by JJayaraman.
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, 1988).

Course Outcomes: The student will be able to

1. Collect the blood samples and handle the microscope.
2. Analyze the blood samples.
3. Expert in immunodiffusion and immunoelectrophoresis techniques.

	PO_1	**PO_2**	**PO_3**	**PO_4**	**PO_5**	**PO_6**	**PO_7**	**PO_8**	**PO_9**	**PO_{10}**	**PO_{11}**	**PO_{12}**
CO_1	3	3	3	3	3	3	3	1	3	3	3	3
CO_2	3	3	3	3	3	3	3	1	3	3	3	3
CO_3	3	3	3	3	3	3	3	1	3	3	3	3
CO_4	3	3	3	3	3	3	3	1	3	3	3	3

BCH 404P: PROJECT WORK (100 MARKS)

Marks allotted to thesis preparation-80 (40 marks for the progress performed by the student in laboratory will be awarded by project research supervisor and another 40 marks for content of the thesis). Marks allotted to viva presentation-20

Course Code	Semester-IV, Course Title	No of Hours Per week	No of Credits
BCH 405a	Immunology	06	04
Sessional Marks: 20		End Semester Examination Marks: 80	

Course Objectives:

1. To provide knowledge on essential features of antigens and antibodies and their types and different theories of Antibody formation.
2. To acquire knowledge on types of immunity, phagocytosis, interferons and complement system.
3. To explain the concept of hypersensitivity, auto immunity and transplantation.
4. To provide knowledge on immune deficiencies and several 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 haemolyticanaemia, 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, Ouchterlonyimmuno 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 be able to

1. Gain knowledge on different types of antigens, antibodies and how different types of antibodies are produced.
2. Out line, compare and contrast the key mechanism of innate and adaptive immunity.
3. Gain knowledge on undesirable immunological reactions and their complication in health management.
4. Apply knowledge in disease diagnosis through serological tests.

	PO_1	**PO_2**	**PO_3**	**PO_4**	**PO_5**	**PO_6**	**PO_7**	**PO_8**	**PO_9**	**PO_{10}**	**PO_{11}**	**PO_{12}**

CO_1	3	3	3	3	3	3	2	1	2	2	3	3
CO_2	3	3	3	3	3	3	2	1	2	2	3	3
CO_3	3	3	3	3	3	3	2	1	2	2	3	3
CO_4	3	3	3	3	3	3	2	1	2	2	3	3

Course Code	**Semester-IV,Course Title**	**No of Hours Per week**	**No of Credits**
BCH 405b	Generic Elective**:** Applied Biochemistry	06	04
Sessional Marks: 20		End Semester Examination Marks: 80	

Course Objectives: This course is designed to

1. Introduce Fermentation Technology and industrial production of chemicals.
2. Importance of Enzyme Technology in industries.
3. Gain knowledge in Applications of hybridoma technology.
4. To understand the Applications of genetic engineering in biotechnology and Genetically Modified Organisms.

Course Contents:

Unit I

Fermentation Technology: Batch, continuous culture techniques, principle types of fermentors. 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

Applications of genetic engineering in biotechnology: Genome imprint, Dynamic genome engineering and cell molecular memory. Biosensors:

Genetically Modified Organisms - Market potential, Diet, Leash, Potato, Rice BT. Intellectual property rights (IPRs).

Recommended Books:

1. Fermentation Technology (2nded.) Standury (Pergmanpress)
2. Biotechnology: Textbook of Industrial microbiology 2nd Edit. By Crueger and Crueger (2000).
3. Principles of Gene manipulation: An Introduction to genetic Engineering (5th). R.V.Old and S. B. Primrose (Blackwell Scientific Publications).
4. Principles of Biotechnology (1985) Alen Weisman (Surrey UniversityPress).
5. Concepts in Biotechnology (1996) Ed., D.Balasubramaian, K.Dharmalingam, J.Green and K.Jayaraman.
6. Industrial Microbiology, Miller and Litsky, McGraw- 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 PressBook.

Course Outcomes: The student will be able to

1. Gain knowledge in Fermentation Technology and industrial production of chemicals.
2. Learn Industrial application of Enzyme Technology.
3. Gain knowledge in Applications of hybridoma technology.
4. Understand the applications of genetic engineering in biotechnology and Genetically Modified Organisms.

	PO_1	**PO_2**	**PO_3**	**PO_4**	**PO_5**	**PO_6**	**PO_7**	**PO_8**	**PO_9**	**PO_{10}**	**PO_{11}**	**PO_{12}**
CO_1	3	3	3	3	3	3	3	1	3	3	3	3
CO_2	3	3	3	3	3	3	3	1	3	3	3	3
CO_3	3	3	3	3	3	3	3	1	3	3	3	3
CO_4	3	3	3	3	3	3	3	1	3	3	3	3

Course Code	**Semester-IV, Course Title**	**No of Hours Per week**	**No of Credits**
BCH-405c	Plant Biochemistry	06	04
Sessional Marks: 20		End Semester Exam Marks: 80	

Course Objectives: The main objective of this course is

1. To impart students an understanding of plant biochemistry includes Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins;
2. The course includes special features of secondary plant metabolism.
3. Gain knowledge in evolutionary studies Origin of basic biological molecules.
4. To understand the Concepts of natural evolution and population genetics.

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; Experiment 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 natural 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; HardyWeinberg 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.

Reference books:

1. Plant Biochemistry (Fourth Edition): Hans-Walter Heldt and Birgit Piechulla
2. Plant Biochemistry - by Dr. V.Arunkumar, Dr.K.Siva Kumar, Dr. N. Senthil Kumar (2010).
3. Origin of Species – Charles Darwin
4. Evolution: The Triumph of an Idea by Carl Zimmer

Course outcomes: The student will be able to

1. Understand the Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins;
2. Gain knowledge in special features of secondary plant metabolism.
3. Know the evolutionary studies Origin of basic biological molecules.
4. Understand the Concepts of natural evolution and population genetics.

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	3	3	2	2	2	2	2	1	2	2	2	2
CO_2	3	3	2	2	2	2	2	1	2	2	2	2
CO_3	3	3	2	2	2	2	2	1	2	2	2	2
CO_4	3	3	2	2	2	2	2	1	2	2	2	2

Course Code	**Semester-IV,Course Title**	**No of Hours Per week**	**No of Credits**
BCH 406a	Research Methodology-Open elective	06	04
Sessional Marks: 20		End Semester Examination Marks: 80	

Course Objectives:

1. To choose the appropriate research design and develop appropriate research hypothesis for a research project
2. To describe the appropriate statistical methods required for a particular research design.
3. To get introduced to the basic concepts of Bioinformatics and its significance in Biological data analysis.
4. To provide knowledge about the basics of sequence alignment and analysis.

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.

Unit II

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, Information and communication technology (ICT).

Unit III

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 IV

Research Aptitude: Meaning and scope of research, steps of Research, Article and thesis writing. Funding agencies.

Project proposal preparation, Preparation of proposal, Experimental design and implementation of project, submission of progress report (year wise), statement of expenditure (SE), Utilization certificate (UC).Research ethics, Plagiarism.

Recommended 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.

Course Outcomes: The student will be able to

1. Discuss the various steps involved in conducting research.
2. Learn to apply hypothesis testing via some of the statistical distributions.
3. Develop understanding about Biological data and database search tools.
4. Acquire hands on training on various computational tools and techniques employed in Biological sequence analysis.

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	3	3	3	3	3	2	1	1	3	3	3	3
CO_2	3	3	3	3	3	2	2	1	3	3	3	3
CO_3	3	3	3	3	3	2	1	1	3	3	3	3
CO_4	3	3	3	3	3	2	1	1	3	3	3	3

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

Course Objectives:

1. The main objective of this skill oriented course is to learn and understand the fundamentals of clinical biochemistry, Collection and preservation of specimens and Assays of Carbohydrate Metabolism associated clinical conditions/diseases.
2. To impart knowledge of Inborn errors of amino acid metabolism, investigation of lipid metabolism and functioning of renal system.
3. To understand Clinical application of plasma enzyme assays and Disorders of Gastrointestinal Tract.
4. To acquire knowledge of biochemical aspects of Liver diseases.

Course Contents:

Unit I

Introduction to Clinical Biochemistry: Introduction and maintenance of clinical biochemistry laboratory; azards 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-proteincmias; Classification – primary and secondary. Investigation of lipoproteinemias and lipidemias.

Renal function: Glomerular and tubular functions. Tests for evaluation – concentration, dilution, excretion, clearance tests, nephritic 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 myocardial infraction, 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, achyliagastrica. Pancreatic exocrine secretion – composition.Duodenal contents – collection, examination following stimulation of pancreas; analysis; malabsorption syndrome due to intestinal disease and pancreatic dysfunction, differential diagnosis.Disaccharides 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:

11. Essentials of Food and Nutrition, Vol. I & II, M. S. Swaminathan.
12. Text Book of Biochemistry with clinical correlations. Thomas M. Devlin (JohnWily).
13. Harper's Review of Biochemistry, Murray et al. (Longman).
14. Biochemical aspects of human disease – R.S. Elkeles and A.S. Tavil. (Blackwell ScientificPublications).
15. Clinical chemistry in diagnosis and treatment–JoanF.Zilva and P.R.Pannall (Lloyd-Luke Medical Books.
16. Varley's Practical clinical Biochemistry – Ed. Alan W. Gowenlock (Heinemann Medical Books, London, 1988).
17. Clinical diagnosis and management by Lab methods (John Bernard Henry, W.B. Salunders Company, 1984).
18. Clinical Biochemistry – S. Ramakrishnan and Rajiswami.
19. Chemical Biochemistry (Metabolic and clinical aspects) by W. J. Marshall & S. K. Bangert.
20. Text book of clinical Biochemistry by Tietz et al.

Course Outcomes: The student will be able to

5. Maintain clinical biochemistry laboratory, biological specimen collection for clinical assay and investigation of disorders associated with carbohydrates.
6. Learn and understand the Inborn errors of amino acid metabolism, Lipid metabolism and Renal function system.
7. Gain knowledge in clinical enzymology and Disorders of Gastrointestinal Tract.
8. Investigate the serum enzymes in liver diseases.

	PO_1	**PO_2**	**PO_3**	**PO_4**	**PO_5**	**PO_6**	**PO_7**	**PO_8**	**PO_9**	**PO_{10}**	**PO_{11}**	**PO_{12}**
CO_1	3	3	3	3	3	3	3	1	3	3	3	3
CO_2	3	3	3	3	3	3	3	1	3	3	3	3

CO_3	3	3	3	3	3	3	3	1	3	3	3	3
CO_4	3	3	3	3	3	3	3	1	3	3	3	3

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

Course Objectives: The objective of this course is

1. To learn and understand the basic concepts of nutritional biochemistry which comprises the determination of body composition and body weight and Measurement of energy expenditure by direct and indirect calorimetry.
2. To know the importance of proteins and fats in the diet to maintain health and also their malnutrition.
3. To learn nutritional significance of vitamins and minerals.
4. This course is also focus on the Special aspects of Nutrition for the infants, children, pregnant and lactating woman and in old age and community nutrition.

Course Contents:

Unit-I

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.

Unit-II

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-III

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.

Unit-IV

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.

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

1. Determine the body composition and body weight by using various methods.
2. To describe the importance of protein and fats.
3. Gain knowledge on vitamins and minerals to maintain health.
4. Aquire knowledge on nutritional importance in different ages in the life

	PO_1	**PO_2**	**PO_3**	**PO_4**	**PO_5**	**PO_6**	**PO_7**	**PO_8**	**PO_9**	**PO_{10}**	**PO_{11}**	**PO_{12}**
CO_1	3	3	3	2	2	2	3	1	2	2	3	3
CO_2	3	3	3	2	2	2	3	1	2	2	3	3
CO_3	3	3	3	2	2	2	3	1	2	2	3	3
CO_4	3	3	3	2	2	2	3	1	2	2	3	3

MOOCS (UGC) to be approved by DDC.

Note:

1. Open elective will be selected by our students from other department course syllabus depending on their interest.
2. Open electives offered by Biochemistry Department will be for students of life sciences other than Biochemistry.

MSc Biochemistry :: Model Question paper

Semester I/II/III/IV Title of the Paper

Time3HrsMax marks: 80

Attempt any **FOUR** from part A (5 x 4=20 marks) and all from part B (4 x 15=60 marks)

SECTION A (5 x 4=20 marks)

1. Unit 1

2. Unit 1

3. Unit 2

1. Unit 2

2. Unit 3

3. Unit 3

4. Unit 4

5. Unit 4

SECTION-B (4X 15= 60 MARKS)

6. Unit 1 a or b

10. Unit 2 a or b

11. Unit 3 a or b

12. Unit 4 a or b