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 (Immunology)** and unanimously resolved to make minor changes in the syllabus of **Open elective a (IV semester) - Research Methodology** Paper with effective from 2018-19.

Open elective a (IV semester)	**RESEARCH METHODOLOGY** **Unit-II:** 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.

Signatures:

1. Chairman :
2. Members :

SRI VENKATESWARA UNIVERSITY TIRUPATI
S.V.U. COLLEGE OF SCIENCES
DEPARTMENT OF BIOCHEMISTRY

RESTRUCTURED CURRICULUM FOR M.Sc. Immunology PROGRAMME
TO BE IMPLEMENTED WITH EFFECT FROM THE ACADEMIC YEAR 2018-2019
SYLLABUS Choice Based Credit System (CBCS)

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

Vision: To develop scientific tempo in understanding the importance of Immunology 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 Immunology 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. Immunology is to impart knowledge to the students in the advanced fields of life sciences such as Immunology, Biochemistry, Molecular Biology, 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.

SRI VENKATESWARA UNIVERSITY, Tirupati-517502

M.Sc. programme in Immunotechnology CBCS pattern (with effect from 2018-19)

SEMESTER-I

S. No	Components of Study	Title of the Paper	Instruction hours per week	Credits	Internal Assessment Marks	End Semester Exam Marks	Total
1	**Core 1**	Biochemical and Biophysical methods	6	4	20	80	100
2	**Core 2**	Molecular Physiology and community nutrition	6	4	20	80	100
3	**Core 3**	Practical related to Biochemical Preparations and Analysis	6	4	-	-	100
4	**Core 4**	Practical related to Analytical methods	6	4	-	-	100
5	**Compulsory Foundation**	Cell and Biomolecules	6	4	20	80	100
6	**Elective foundation**	Human values and Professional ethics-I	6	4	20	80	100
	Total		36	24	-	-	600

SEMESTER-II

S. No	Components of Study	Title of the Paper	Instruction hours per week	Credits	Internal Assessment Marks	End Semester Exam Marks	Total
1	**Core 1**	Energy metabolism	6	4	20	80	100
2	**Core 2**	Metabolism of Nitrogen based molecules	6	4	20	80	100
3	**Core 3**	Practical related to Enzymology	6	4	-	-	100
4	**Core 4**	Practical related to Molecular Biology	6	4	-	-	100
4	**Compulsory Foundation**	Enzymology	6	4	20	80	100
5	**Elective foundation**	Human values and Professional ethics-II	6	4	20	80	100
	Total		36	24	-	-	600

Semester-III

S. No	Components of Study	Title of the Paper	Instruction hours per week	Credits	Internal Assessment Marks	End Semester Exam Marks	Total
1	**Core 1**	Microbial Biochemistry and Genetics	6	4	20	80	100
2	**Core 2**	Immunology	6	4	20	80	100
3	**Core 3**	Practical related to Microbiology	6	4	-	-	100
4	**Core 4**	Practical related to Immunology	6	4	-	-	100
4	**Generic Elective (Two papers out of three)**	a) Molecular Biology b)Molecular Endocrinology c) Cell and Developmental Biology	6 6	4 4	20 20	80 80	100 100
5	**Open Elective to others (For other department students)**	a) Basics of Immunology b) Immunotechniques	6	4	20	80	100
	Total		36	24	-	-	600

Semester-IV

S. No	Components of Study	Title of the Paper	Instruction hours per week	Credits	Internal Assessment Marks	End Semester Exam Marks	Total
1	**Core 1**	Genetic Engineering	6	4	20	80	100
2	**Core 2**	Technical Writing, Biostatistics and Bioinformatics	6	4	20	80	100
3	**Core 3**	Practical related to Clinical Immunology, biostatistics and bioinformatics	6	4	-	-	100
4	**Core 4**	Project work	6	4	-	-	100
4	**Generic Elective (Two papers out of three)**	a) Clinical Immunology b) Applied and molecular immunology c) Immuno pharmacology	6 6	4 4	20 20	80 80	100 100
5	**Open Elective to others(For other department students)**	a) Research Methodology b) Immunological diseases and therapeutics	6	4	20	80	100
	Total		36	24	-	-	600

SEMESTER-I

Course Code	Course Title	No of Hours Per week	No of Credits
Core I	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, pKa of functional groups in biopolymers such as proteins and nucleic acids. Importance of buffers in biological systems, ion selective electrodes, and oxygen electrode. Donnan membrane equilibrium. Significance of osmotic pressure in biological systems, viscosity and determination of molecular weight using viscometers.

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

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

Unit II

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

Unit III

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

Unit IV

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

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

Course Code	**Course Title**	**No of Hours Per week**	**No of Credits**
Core 2	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, Energy value of fats. Essential fatty acids and phospholipids in nutrition.

Unit IV

Requirement of fat-soluble and water-soluble vitamins and their deficiency symptoms, sources of the vitamins. Macro and trace elements in nutrition as regards to dietary sources. Deficiency symptoms and recommended dietary allowances. Special aspects of Nutrition for the infants, children, pregnant and lactating woman and in old age, Importance of Nutrition under stress conditions.

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

Recommended Books:

1. Harper's Biochemistry
2. Trace elements by Underwood
3. Nutrition by M.S.Swaminathan.
4. The book of Human Nutrition (1996) MS. Bamji, N.Prahlad Rao and V. Reddy.
5. Molecular Biology of the cells by Alberts *et al* (1994).
6. Cell and Molecular Biology (2001) by EDP de Robertis and EMF de Robertis.
7. Text Book OF medical physiology by A.C.Guyton (2001).
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. 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**
Core 3P	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

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

a. Biuret method.

b. Folin-Lowry method.
c. UV method.
d. Bradfords dye binding method.
9. Titration curve of amino acid and calculation of PK and PI value.
10. Estimation of amino acids by formal titration.
11. Estimation of amino acid by Ninhydrin method.
12. Estimation of tyrosine by Million's –reaction.
13. Identification of N-terminal group of proteins by Sanger's method.
14. Estimation of fructose in Fruit-juice.

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 reagents and 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	**Course Title**	**No of Hours Per week**	**No of Credits**
Core 4P	Practical related to Analytical Methods	06	4

PRACTICALS

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:

1. Effect of solvent system on the Rf value of two solutes using TLC.
2. Separation of purines and pyrimidines by Paper Chromatography.
3. Separation of amino acids by Paper Chromatography.

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

Recommended Books:

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

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

Course Code	**Semester-I, Course Title**	**No of Hours Per week**	**No of Credits**
Compulsory Foundation	Cell and Biomolecules	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: Structure, Composition and functions of nucleus, mitochondria plastids, endoplasmic reticulum, golgi, lysomes, vacuole, micro bodies, ribosomes, cytoskeleton.
Origin of basic Biomolecules. Amino acids & Proteins: Classification of amino acids, acid-base properties of amino acids, chemical reactions of amino acids, non-protein amino acids, Peptide bond –Structure and conformation. Naturally occurring peptides.
Classification of proteins – purification and isolation of proteins, criteria of purity of proteins, physico-chemical properties, structural organization of proteins, Elucidation of primary structure, secondary structure, , Tertiary structure Quaternary structure, Denaturation & renaturation of proteins. Outlines of Proteomics.

Unit II

Carbohydrates: Definition and classification of carbohydrates, nomenclature, Reaction of 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, Prostaglandins, Thromboxanes, Leukotrienes and steroids. Killer fat (*Staphylococcu*s 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. 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 Wesley 1981.
6. Biochemistry, Lehninger A.H.
7. Textbook of Biochemistry West, E.S., Todd, Mason & Vanbruggen, Macmillian&Co.
8. Principles of Biochemistry White-A, Handler, Pand Smith E.L. Mc Grew Hill.
9. Organic chemistry, I.L. Finar, ELBS. (1985).
10. Organic Chemistry by Morrison and Boyd (2000) Prentice Hall.
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 aminoacids and 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

Course Code	**Semester-I, Course Title**	**No of Hours Per week**	**No of Credits**
Elective Foundation 5	Human Values And Professional Ethics-I	06	04
Sessional Marks: 20		**End Semester Examination Marks : 80**	

Course Objectives:

1. To study the Ethics and its relation with Religion, Politics, Business, Law, Medicine and Environment.
2. Gives information about Good and Bad, Ends and Means, Actual and potential Values, Objective and Subjective Values.
3. To understand the structure Ahimsa, Satya, Brahmacharya, Asteya and Aparigraha etc.
4. Explore the Bhagavad Gita.
5. To know about Crime and Theories of punishment.

Course Content:

Unit I

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

Unit II

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

Unit III

Individual and Society:

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

Unit IV

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

Unit V

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

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.
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 and III, 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 Series Office , 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 .Telugu Academic Hyderabad.
16. I.C.Sharma Ethical Philosophy of India, Nagin & Co Julundhar.

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

1. Easily understand the Need and Importance of Professional Ethics- Goals- Ethical Values in various Professions.
2. Analyse the basic moral concepts- right , ought, duty, obligation, justice, responsibity and freedom.
3. Know about Purusharthas, Dharma, Artha, Kama, Moksha.
4. Understand the Four Noble Truths- Arya astanga marga, Jainism- mahavratas and anuvratas.
5. Gain the knowledge about views on Manu and Yajnavalkya.

	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	1	1	1	1	1	2	3	2	1	1	2
CO_2	1	1	1	1	1	1	2	3	2	1	1	2
CO_3	1	1	1	1	1	1	2	3	2	1	1	2
CO_4	1	1	1	1	1	1	2	3	2	1	1	2
CO_5	1	1	1	1	1	1	2	3	2	1	1	2

SEMESTER-II

Course Code	Course Title	No of Hours Per week	No of Credits
Core 1	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 various metabolic 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, Intermediary metabolism in vivo studies such as analysis of excretion, Respiratory exchange, Removal of organs and perfusion studies, in vitro studies such as tissue slice techniques; Homogenates and purified enzyme systems; isotope tracer studies, use of inhibitors and antimetabolites.

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

Unit II

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

Unit III

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

Unit IV

Biosynthesis and degradation of fatty acids (Saturated and unsaturated) regulation, metabolism of TAG, Glycerol and sphingolipids, cholesterol, prostaglandins. Biosynthesis and degradation of cholesterol and its regulation. Metabolism of lipoproteins and Ketone bodies.

Recommended Books:

1. Principles of Biochemistry, White. A, Handler, P and Smith.
2. Biochemistry, Lehninger A.L.
3. Biochemistry, David E. Metzler.
4. Biochemistry, Lubert Stryer.
5. Review of physiological chemistry, Harold A. Harper.
6. Text of Biochemistry, West and Todd.
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	**Course Title**	**No of Hours Per week**	**No of Credits**
Core 2	Nitrogen Metabolism of Nitrogen based Molecules	06	4
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

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

Unit II

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

Unit III

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

Unit IV

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

Recommended Books:

1. Principles of Biochemistry, White. A, Handler, P and Smith.
2. Biochemistry, Lehninger A.L.
3. Biochemistry, David E. Metzler.
4. Biochemistry, Lubert Stryer.
5. Review of physiological chemistry, Harold A. Harper.
6. Text of Biochemistry, West and Todd.
7. Outlines of Biochemistry, Conn and Stumpf.
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. 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	Course Title	No of Hours Per week	No of Credits
Core 3P	Practicals related to Enzymology	06	4
End Semester Exam Marks: 100			

Course Objectives:

1. The lab is designed to train the students in basic techniques of Analytical Biochemistry like estimation of enzymes from various sources.
2. To demonstrate enzyme purification and enzyme kinetics.
3. It also deals with the assay of clinically important enzymes and determination of factors affecting enzyme activity.
4. To demonstrate the Immobilization of enzymes.

Course Content:

PRACTICALS

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).

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

1. Learn about estimation of various enzymes in biological sample.
2. Learn to perform assay of clinically important enzyme: serum acid and alkaline phosphatase, serum LDH.
3. Learn about the factors affecting enzyme activity 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	Course Title	No of Hours Per week	No of Credits
Core 4P	Molecular Biology Practicals	06	4
End Semester Exam Marks: 100			

Course Objectives:

1. To isolate DNA and RNA from different sources.
2. To estimate concentrations of DNA and RNA using different methods.
3. To demonstrate transformation and transfection experiments.
4. To perform Conjugation and Catabolite repression experiments.

Course Content:

PRACTICALS

1. Isolation of DNA from bacterial, plant and animal cells.
2. Estimation of DNA by Diphenylamine method.
3. Isolation RNA from yeast cells.
4. Estimation of RNA BY Orcinol method.
5. Estimation of DNA and purity determination by UV absorption method.
6. Determination of melting temperature (Tm).
7. Isolation of plasmid DNA from *E.coli*.
8. Detection and differentiation of open circular, linear and closed covalent circular plasmid DNA by submarine gel electrophoresis.
9. Transformation of *E.coli* with ampicillin resistant plasmid.
10. Trasfection of M13 DNA into *E. coli* JM103.
11. Isolation of phage M13.
12. Isolation of single and double standard M13 DNA.
13. Conjugation: Use of broad host range plasmid RP in demonstrating conjugation transfer of plasmid bacteria.
14. 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 DNA from bacterial, plant and animal cells and RNA from yeast cells.
2. Estimate concentrations of DNA and RNA by conventional methods and UV absorption methods.
3. Determine the melting temperature(Tm) of DNA.

4. Learn procedures for isolation of phage M_{13} and single and double standard M_{13}DNA.

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

CourseCode	**Course Title**	**No of Hours Per week**	**No of Credits**
Compulsory Foundation	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, Hanes plots. Pre-steady state kinetics. Effect of pH and temperature.

Unit II

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

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

Unit III

Mechanism of reactions catalyzed by the following enzymes – Chymotrypsin, Trypsin,

Carboxypeptidase, Ribonuclease and Lysozyme.

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

Unit IV

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

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

Recommended Books:

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

Course Code	**Semester-I, Course Title**	**No of Hours Per week**	**No of Credits**
Elective Foundation	Human Values And Professional Ethics-II	06	04
Sessional Marks: 20		**End Semester Examination Marks : 80**	

Course Objectives:

1. To study about Concept of Human Values like self introspection, self esteem, Family Values etc.
2. Gives information about Medical ethics and moral responsibility of medical practitioners.
3. To understand the Business ethics - Immoral and illegal practices and their solutions.
4. Explore the Environment ethics and Environmental health.
5. To know Ethics of media- Impact of Newspaper, Television, Movies and Internet.

Course Content:

Unit I

Value Education- Definition- relevance to present day- Concept of Human Values- self introspection-Self esteem- Family Values – Components, Structure and responsibilities of family- Neutralization of anger- Adjustability- Treats of 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: New Delhi.
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 and III, 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 Series Office , 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.

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

1. Easily understand the Components, Structure and responsibilities of family and status of women in family and society.
2. To get an idea on Ethical issues in relation to health care professionals and patients and genetic engineering, Social justice in health care, Human cloning.
3. To know about Characteristics of ethical problems in management, ethical theories, causes of unethical behavior, ethical abuses and work ethics.
4. Understand the Ethical theory, Ecological crisis, Pest control, Pollution and waste, Climate change, Energy and population.
5. Gain the knowledge about Organ trade, Human trafficking, Human rights violation and social disparities, Feminist ethics, Surrogacy/ pregnancy.

	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	2	2	2	1	1	2	2	3	2	2	2	2
CO_2	2	2	2	1	1	2	2	3	2	2	2	2
CO_3	2	2	2	1	1	2	2	3	2	2	2	2
CO_4	2	2	2	1	1	2	2	3	2	2	2	2
CO_5	2	2	2	1	1	2	2	3	2	2	2	2

SEMESTER-III

Course Code	**Semester-II, Course Title**	**No of Hours Per week**	**No of Credits**
Core 1	Microbial Biochemistry and Genetics	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 nutritional requirements in microorganisms.
2. Designed to learn about control methods of microorganisms and industrial application of microbes for water and sewage treatment and virus classification, morphology and Methods of culturing of viruses, isolation, purification and characterization.
3. Designed to learn the fundamentals of genetics like DNA as genetic material, chromosome and gene arrangement in prokaryotes and eukaryotes.
4. Designed to learn and understand the concept of bacterial genetics and Mutations in detail.

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 and different modes of nutrition in microorganisms.
2.Learn and understand the various biological and non-biological methods to control microorganisms and Biology of subviral agents – Viroids, Prions, Satellite viruses.
3. Understand the basics of genetics and the gene arrangement in prokaryotes and eukaryotes.
4. Gain knowledge in bacterial genetics like different types plasmids, recombination in bacteria, bacteriophages and bacterial defense mechanism (CRISPR) and various types of mutations and their effects.

	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	**Course Title**	**No of Hours Per week**	**No of Credits**
Core 2	Immunology	06	4
Sessional Marks: 20		End Semester Exam 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 Content:

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, pathogencity and cases of type II reactions; Hemolytic-disease of new born (HDN).

Type III: Immune complex mediated HS reactions: Mechanism & pathogenecity 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 pathogenecity, Tuberculin reaction.

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

Blood groups: AB, Rh system, Lewis-Luthern systems, significance, practical application of immuno methodology in blood transfusions, Erythoblastosis faetalis.

Auto immunity: Introduction, Auto recognition, classes of auto immuno diseases. (Hashimoto disease, thyrotoxicosis, Systemic lupus erythomatosis, Autoimmune haemolytic anaemia, Rheumatoid arthritis).

Transplantation: Terminology, Auto graft, Isograft, Allograft, Xenograft, Immunological basis of transplantation reactions, GVH reaction, Immuno suppression, General mechanisms of Immune suppression, Immune suppression, drugs (azothioprine, methotrexate, cyclophosphamide, cycosporin-A, Steroids).

Unit IV

Immune Deficiencies: Introduction, primary and secondary deficiencies. T-cell, B-cell and combined immune deficiencies, Compliment system deficiency. Acquired immuno deficiency syndrome. SCID. Major Histocompatability Complex: MHC in mice and HLA in man-fine structure and functions only.

Immunological techniques: Precipitin curve, Immuno diffusion, one and two dimensional, single radial immuno diffusion, Ouchterlony immuno diffusion.

Immuno-electrophoresis: Rocket immuno-electrophoresis; CIE, Graber and William technique. Agglutination: Direct and Indirect, Widal test, VDRL test.

Radioimmunoassay: ELISA – Principle, Methodology and applications.

Immuno-fluorescence: Direct, indirect and Sandwich, *in situ* localization by techniques such as FISH and GISH.

Recommended Books:

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

Course Outcomes: The student will 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 complications 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	**Course Title**	**No of Hours Per week**	**No of Credits**
Core 3P	Practicals related to Microbiology	06	4
End Semester Exam 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:

PRACTICALS

Handling of Microscopes: Calibration of Microscopes.

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

Recommended Books:

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

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	Course Title	No of Hours Per week	No of Credits
Core 4P	Practical related to Immunology And Haematology	06	4
Sessional Marks: 20		End Semester Exam Marks: 80	

Course Objectives:

1. To perform RBC, WBC counts.
2. To estimate Hb, ESR, PCV, Mean Cell Haemoglobin, Osmotic fragility of RBC.
3. To perform different types of Immunodiffusions.
4. To demonstrate different types of Immunoelectrophoreses

Course Content:

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

Recommended Books:

1. Hawk's Physiological chemistry.
2. Practical Biochemistry by T Plummer.
3. Practical Biochemistry by J Jayaraman.
4. Klemir and others: practical Biological chemistry.
5. Practical Biochemistry – Koch and Hank Dunn and Drell.
6. Practical Biochemistry-Sawhney (2000)
7. Varley's Practical clinical Biochemistry – Ed. Alan W. Gowenlock (Heinemann, London, 1988).

Course Outcomes: The student will be able to

1. Perform RBC, WBC count and differential count.
2. Do all haematological tests that will be done in clinical labs.
3. Have an idea on Rocket immunoelectrophoroesis, Cross over Immunoelectrophoresis etc.
4. Do Heme agglutination tests for identification of different antigens.

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

Course Code	**Course Title**	**No of Hours Per week**	**No of Credits**
Generic Elective:(a)	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

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

Unit II

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

Unit III

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

Unit IV

Ribosomology: Prokaryotic and Eukaryotic molecular components of ribosomes. Assembly and dissociation of subunits. Polysomes and organelles ribosomes. Ribosomal switch.
Biosynthesis of proteins: Different stages and components of protein synthesis, ribosomes, m

RNA and t RNA. Amino acid activation, protein chain initiation, elongation, and termination. Mechanism of protein synthesis in relation to gene action.
Some aspects of eukaryotic translation. Inhibitors of prokaryotic translation. Post – translational modification of proteins. Synthesis of secretory and membrane proteins – signal sequence hypothesis. Mechanism of translation control. Proteins local synthesis and disposal.

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
6. Genes VII Benjamin Lewin (2000). Oxford Univ.Press. London.
7. 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. Learn about the mechanism and regulation of transcription in prokaryotes and eukaryotes.
3. Learn about 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	**Course Title**	**No of Hours Per week**	**No of Credits**
Generic Elective:(b)	Molecular Endocrinology	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 Content:

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, deoxy corticosterone and aldosterone. Disorders of pancreas and adrenal glands.

Unit IV

Sex hormones (Hormones of Reproduction): Testosterone and inhibin. Estrogens, Progesterone and relaxin Human chorionic gonadotropin; Human placental lactogen, Hormonal regulation of menstrual cycle, contraceptions. Disorders associated with Gonadal hormones.
Miscellaneous hormones: Thymosin – synthesis and actions.
Insect molting hormones – (ecdysone) Plant hormones – Auxins, gibberellins, ethylene, and abscissic acid, Pheromones.

Recommended Books:

1. Text book of biochemistry and human biology. Talwar G.P.Prentice Hall India,
2. Human physiology and mechanism of distance–Guyton 3rd edn. Igkushoen / Seunders
3. Clinical Biochemistry Vols. 1 and 2: Williams et al Heinemann Medical 1978
4. Lynchs Medical Laboratory Technology Raphael, S.S., 4th edn. 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	Course Title	No of Hours Per week	No of Credits
Generic Elective:(c)	Cell and Developmental Biology	06	4
Sessional Marks: 20		End Semester Exam Marks: 80	

Course Objectives:
1. To explore the knowledge and awareness of the origin of cell, cell division, cell cycle and its regulation.
2. To familiarize with the concepts basic principles and concepts of Developmental Biology, Gametogenesis, fertilization and early development.
3. To impart knowledge about Morphogenesis and organogenesis in animals and plants.
4. To learn about chemical composition of biomembranes and distribution of membrane lipids and membrane transport.

Course Content:

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. Nanomaterials 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 all cell organelles in prokaryotes and eukaryotes, cell signaling, cell communication, cell adhesion, Apoptosis, Senesence, integrins .
2. Gain the proficient knowledge about basic concepts of Developmental Biology, 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. Gain knowledge about Miscelle, and liposomes, Membrane fluidity, Active transport, Ionophores Gap junctions, Endocytosis and Exocytosis.

	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	**Course Title**	**No of Hours Per week**	**No of Credits**
Open Elective (a)	Basics of Immunology	06	4

Sessional Marks: 20	End Semester Exam Marks: 80

Course Objectives:

1. To provide knowledge on essential features of antigens and antibodies and their types.
2. To acquire knowledge on types of immunity, phagocytosis, interferons and complement system.
3. To explain the concept of different types of hypersensitivity, and transplantation.
4. To provide knowledge on immune deficiencies and several immunological techniques.

Course Content:

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 Ig: Types – IgG (G1, G2, G3 & G4), IgM, IgA, IgD and IgE (Origin, structural functions).

Theories of Ab formation: Instructive, selective, clonal selection theories.

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 pathway. 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 Type I reactions, Clinical manifestations.

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

Type III: Immune complex mediated HS reactions: Mechanism & pathogenecity 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 pathogenecity, Tuberculin reaction.

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

Blood groups: AB, Rh system, Lewis-Luthern systems, significance, practical application of immuno methodology in blood transfusions, Erythoblastosis faetalis.

Auto immunity: Introduction, Auto recognition, classes of auto immuno diseases. (Hashimoto disease, thyrotoxicosis, Systemic lupus erythomatosis, Autoimmune haemolytic anaemia, Rheumatoid arthritis).

Major Histocompatability Complex (MHC)

MHC in mice and HLA in man-fine structure and functions only.

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:

Immunological techniques: Precipitin curve: Immuno diffusion: One and two dimensional, single radial immuno diffusion, Ouchterlony immno diffusion.

Immuno electrophoresis: rocket immunoelectrophoresis; 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.Recommended Books:

1. Essential immunology- Ivan M. Roitt.
2. Immunology – a short course Elibezamini and Sidney Leskowitz, Alan R. Lisi Inc. New York, 1988.
3. Immunology III. Joseph A. Bellanti igaku – Shein Saunders International Edn.1985
4. Immunology at a glance J.H.L.Playfeir 4th edn. Blackwell scientific publication 1987.
5. Aids to Immunology D.M. Weir Churchill, Livingtons 1986.
6. Fundamentals of Immunology, Myrvik and Weiser, 1984.
7. Fundamentals of Immunology, Bier et al, Springer 1986.
8. Textbook of Biochemistry and Human biology, Talwar G.P. Prentice Hall, 1980.
9. Basic and clinical immunology – Stites et al., 4th edn. Lange 1982.
10. The immunosystem, Mc Connell et al., Blackwell scientific 1981.

Course Outcomes:

1. Gain knowledge on essential features of different types of antigens, antibodies.
2. Out line, compare and contrast the key mechanism of innate and adaptive immunity.
3. Gain knowledge on undesirable immunological reactions and their complications in health management and transplantation.
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	Course Title	No of Hours Per week	No of Credits
Open Elective (b)	Immunotechniques and their Applications	06	4
Sessional Marks: 20		End Semester Exam Marks: 80	

Course Objectives:

1. To acquire knowledge on antigens and antibody preparation.
2. To gain insights in Techniques used in immunology.
3. To use antisera in detection of diseases.
4. To impart knowledge on antibody immunotherapy.

Course Content:

Unit I:

Methods used in immunology: Preparation of antigens and antibodies, purification of antibodies, analysis of antibodies and antigens, preparation and uses of various types of vaccines.

Unit II:

Techniques used in immunology: Types of immunodiffusion methods, Elisa, RIA, Western blot analysis, Electrophoresis and Hybridization techniques, immunohistochemistry, Immunoflowcytometry.Immunofluoroscence.

Unit III:

Applications of antisera in the detection of various diseases. Examples: syphilis and lyme, typhoid, streptococci infections, HIV, various types of Hepatitis

Unit IV:

Antibody engineering, Catalytic antibodies, antibody immunotherapy, productions of drugs to allergies. Vaccines and Subunit vaccines-against Herpes Simplex virus, Foot and Mouth disease, live recombinant vaccines-attenuated (Cholera, Salmonella), Vector vaccines directed against viruses and bacteria. Purified vaccines. DNA vaccines. Antifertility vaccines.

Recommended Books:

1. Harper's Biochemistry (Latest edition)
2. Immunology by Carpenter (Latest edition)
3. Kubay's Immunology (Latest edition)
4. Biotechnology by RC Dubay (2001) S Chand and Company, New Delhi.

Course Outcomes: The student will be able to

1. To purify and analyse the antigens and antibodies.
2. To apply different Hybridization techniques and ELISA, RIA.
3. To detect various diseases by application of antiisera.
4. To engineer antibodies and catalytic antibodies and produce drugs to allergies.

	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

SEMESTER-IV

Course Code	Course Title	No of Hours Per week	No of Credits
Core 1	Genetic Engineering	06	4
Sessional Marks: 20		End Semester Exam 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 Content:

Unit I

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

Unit II

Isolation, sequencing and synthesis of genes: Isolation of genes, sequencing of genes, synthesis of genes, Cloning of specific eukaryotic genes and their expression in bacteria.

Operon model: Isolation and chemical nature of repressor. Catabolite repression and role of cAMP and cAMP receptor protein (CRP) in the expression of glucose – sensitive operons. Lac operon, His operon, Trp operon of *E. coli*. Stringent and relaxed control.

Regulation of gene expression in prokaryotes and eukaryotes: Transcriptional control, enzyme induction and repression. Constitutive synthesis of enzymes. Genes involved in regulation, regulatory gene, promoter gene, operator gene and structural genes. Genome imprint.

Unit III

Gene transfer methods and transgenic organisms: Gene transfer methods for animals and plants, Agro bacterium mediated gene transfer, electroporation and particle gun. Trasgenic animals, and transgenic plants.

Restriction maps and molecular genetic maps: Restriction mapping, restriction fragment length polymorphisms (RFLP) Linkage and recombination between molecular and phenotypic markers, Random amplified polymorphic DNA (RAPDs) using PCR, Chromosome walking. Organic genome engineering and cell molecular memory/ Biosensors

Unit IV

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

Biosensors: Genetically Modified Organism - Market potential, Diet, Leash, Potato, Rice BT.

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. Oxford Univ. Press.

Refer the books already mentioned for other Molecular Biology courses.

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	**Course Title**	**No of Hours Per week**	**No of Credits**
Core 2	Technical Writing, Biostatistics and Bioinformatics	06	4
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 Content:

Unit I

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

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

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

Unit II

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

Unit III

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

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

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

Unit IV

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

Sequence alignment - Introduction, significance of sequence alignments and use of dot matices. Pair wise and multiple sequence alignment (MSA) using Clustal programs.

Sequence analysis - concepts of sequence analysis and their importance. BLAST. blastn, blastp, blastx, tblastx, output analysis matrix BLOSSUM, PAM, e-value.

Proteomics - Introduction, principle, technique, 2-D data base. Gel analysis, post gel analysis, MALDI-TOF. Significance and applications of proteomics in modern biology.

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. ISBN 0-632-04983-9.
5. Genome Mapping: A practical approach. Dear P (Editor). 1st Ed. 2000. Oxford University Press: Oxford.
6. Developing Bioinformatics Skills. Alfonso Valencia and Blaschke. L (2005) Oreille.s 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 Spring Harbor Laboratory, 2004, ISBN 0-87969-687-7.
10. Introduction to Bioinformatics by T.K.Altwood and D.J Parry-Smith (Pearson Education Asia 1999).

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-III, Course Title**	**No of Hours Per week**	**No of Credits**
Core 3 P	Practical related to Clinical Immunology, Biostatistics and Bioinformatics	06	04
			End Semester Exam Marks: 100

Course Objectives: The lab is designed to train the students

1. To demonstrate the usage of diagnostic kits.
2. To learn how to raise antibodies to soluble antigen in Rabbits.
3. To perform different types of Immunodiffusions.
4. To demonstrate different types of Immunoelectrophoreses.
5. To perform different types of slide agglutination tests.

Course Contents:

1. Use of diagnostic kits.

2. Preparation of animal to raise antibodies.

3. Inoculation of antigen to animal to raise antibodies

4. Collection of serum from animal and separation of antiserum from blood.

5. Analysis of titer of antiserum.

6. Demonstration of antigen-antibody interaction: Ouchterlony method

7. Direct agglutination reaction: Determination of human blood group antigens.

8. Demonstration of immunofluorescence technique

9. Purification of IgG from bovine serum

10. Rocket immunoelectrophoresis.

11. Enzyme linked immunosorbant assay: Antibody capture assay

12. Polyacrylamide gel electrophoresis

13. Western blot analysis.

14. Determination of antibody content by Lowry method.

15. Demonstration of Immunoelectrophoresis

Course Outcomes: The student will be able to

1. Use diagnostic kits to test different types of auto immune diseases.
2. Prepare Rabbit for performance of immunological studies.
3. Perform Single Radial Immunodiffusion.
4. Have an idea on Rocket immunoelectrophoroesis, Cross over Immunoelectrophoresis etc.
5. Do Heme agglutination tests for identification of different antigens.

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

Course Code	**Course Title**	**No of Hours Per week**	**No of Credits**
Core 4	Project Work	06	4
End Semester Exam Marks: 100			

Course Objectives:

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

Course Content:

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 Outcomes: The student will be able to

1. Understand the microbial techniques for isolation, cultivation and maintenance of pure cultures
2. Learn structure, function of gene and its transfer methods

3. Develop understanding on cause, spread and control of diseases caused by different microorganisms
4. Get knowledge on collection of data, thesis writing.

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

Course Code	Course Title	No of Hours Per week	No of Credits
Generic Elective (a)	Clinical Immunology	06	4
Sessional Marks: 20		End Semester Exam Marks: 80	

Course Objectives:

1. To impart knowledge about maintenance of clinical Immunology/biochemistry laboratory.
2. To gain knowledge on Primary and Secondary immunodeficiencies.
3. To make them understand the concept of transplantation and types of grafts.
4. To impart knowledge on origin of cancer and its malignancy.

Course Content:

Unit I

Introduction to Clinical Immunology: Introduction and maintenance of clinical Immunology/biochemistry laboratory; hazards in clinical 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. Natural Immunity, a. First Line of Defense innate / nonspecific immunity

b. Adaptive / specific immunity, c. Factors associated with immunologic disease, Components of the Immune System. Immune response to various infectious diseases

Unit II

Primary immunodeficiencies, AIDS and other acquired or Secondary immunodeficiencies, Auto immune diseases, Animal model for autoimmune diseases. Proposed mechanism for induction of autoimmunity. Treatment of autoimmune diseases.

Unit III

Transplantation, Types of grafts, Graft acceptance and rejection, Clinical manifestation of graft rejection, general immunosuppressive therapy, immune tolerance to allografts, clinical transplantation.

Unit IV

Cancer origin and terminology, malignant transformation of cells, oncogenes and cancer induction, tumors of the immune systems, tumor antigens, tumor evasion of the immune system and cancer immunotherapy. Psychoimmunology: Psychoneuroimmunology, Immunomediators, Immunesystem neuroanatomy, Neuroimmunomodulation.

References:

1. Turgons "Immunology and serology" by Mosby Latest Edition

2007 Immunology by Irwin Roitt Latest edition
2. Immunology by Kubay.
3. Varley's Practical clinical Biochemistry – Ed. Alan W. Gowenlock (Heinemann medical Books, London, 1988).
4. Clinical diagnosis and management by Laboratory methods (John Bernard Henry, W.B. Salunders Company, 1984).
5. Hand Book of Human stress and immunity by Glaser R and Glaser K (1994) Psychoimmunology by Schedlowski M (2000).

Course Outcomes: The student will be able to

1. Understand different types of immunity and components of the Immune System.
2. Gain knowledge on auto immune diseases, Animal models used to study them and the treatment foe them.
3. Familiar with Clinical manifestation of graft rejection, general immunosuppressive therapy and immune tolerance to allografts.
4. Acquire the knowledge on oncogenes, Psychoimmunology and neuroimmunomodulation.

	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	**Course Title**	**No of Hours Per week**	**No of Credits**
Generic Elective (b)	Applied And Molecular Immunology	06	4
Sessional Marks: 20		End Semester Exam Marks: 80	

Course Objectives:

1. To acquaint them with the hybridoma technique and its clinical applications
2. To impart knowledge on Immobilization of enzymes.
3. To make them understand the concept of Vaccines and Subunit vaccines.
4. To impart knowledge about intellectual property rights.

Course Content:

Unit I

Immunodiagnostics and preparation of tools: Hybridoma technique, monoclonal antibodies production, myeloma cell lines, fusion of myeloma cells, selection of hybridomas, Screening, purification and application (biochemical research, clinical diagnosis nd treatment) of monoclonal antibodies

Unit II

Immobilization of enzymes, Examples and their industrial and clinical applications. Production of DNA antigens.

Unit III

Vaccines and Subunit vaccines-against Herpes Simplex virus, Foot and Mouth disease, live recombinant vaccines-attenuated (Cholera, Salmonella), Vector vaccines directed against viruses and bacteria. Purified vaccines. DNA vaccines. Antifertility vaccines.

Unit IV

Transgenic organisms and their uses, Patenting, General Agreement on Trade and Tariff {GATT} and Intellectual Property Rights.

Recommended Books:

1. Harper's Review of Biochemistry.
2. Leninger's principles of Biochemistry
3. Biochemistry – Lubert Stryer.
4. Fermentation Technology (2^{nd} ed.) Standury (Pergman press)
5. Biotechnology: Textbook of Industrial microbiology 2^{nd} Edit. By Wulf Crueger and Anneliese Crueger (2000).
6. Molecular biotechnology: Principles and Applications of Recombination DNA. (1996) Bernard R. Glick and Jack. J. Pasternak (Panima Publishing Corporation)
7. Principles of Gene manipulation: An Introduction to genetic Engineering (5^{th}) R.V.Old and S.B.Primrose (Blackwell Scientific Publications).
8. Principles of Biotechnology (1985) Alen Weisman (Surrey University Press).
9. Concepts in Biotechnology (1996) Ed., D.Balasubramaian, K.Dharmalingam, J.Green and K.Jayaraman (University Press).
10. Industrial Microbiology, Miller and Litsowky, Mc Graw- Hill, 1976.
11. Industrial Microbiology, L.E.Casida, JR. New Age International., (1995).
12. Industrial Microbiology (Prescott & Dunn), Ed by G.Reed, CBS Publishers.
13. Immobilized enzymes (1978) by Ichiro Chibata, Halsted Press Book.

Course Outcomes: The student will be able to

1. Develop skill in production of monoclonal antibodies.
2. How better enzyme immobilization enhances its activity and their industrial and clinical applications.
3. Familiar with different types of vaccines and how they help in prevention of diseases.
4. Acquire the knowledge on IPR and procedures for patent filing.

	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	Course Title	No of Hours Per week	No of Credits
General Elective (C)	Immunopharmacology	06	4
Sessional Marks: 20		End Semester Exam Marks: 80	

Course Objectives:

1. To impart knowledge about drugs, their receptors and kinetics.
2. To develop understanding about vasoactive amines and immunosuppressive drugs.
3. To extend comprehensive knowledge on Eicosanoid related compounds and NSAIDS.
4. To make them understand about drugs used in asthma.

Course Content:

Unit I: Drugs, Drug receptors, pharmacodynamics, pharmacokinetics, drug biotransformation, development and regulation of drug, Cholino and adrenoreceptor drugs.

Unit II: Histamines, Serotonins, vasoactive peptides and ergot alkaloids, Immunomodulation therapy, infiltration of cells and their diseases, Immunosuppressive drugs and antibodies, glucocorticoid drugs, malignancy therapy, role of TNFa, Immunoglobulin genes.

Unit III: The Eicosanoids, Prostaglandins, thromboxanes, leukotrienes and related compounds, and inhibitors of these molecules formation.

Unit IV. Nitric oxide and its immunological effects, Drugs used in asthma.

Reference Book:

Basic and Clinical pharmacology by BT Katzung, 10th Edn, McGraw Hill Edn, Oxford, 2008

Course Outcomes: The student will be able to

1. Understand about drug receptors, pharmacodynamics, pharmacokinetics, drug biotransformation.
2. Acquire knowledge on Immunomodulation therapy, malignancy therapy.
3. Gain knowledge on Prostaglandins, thromboxanes, leukotrienes and inhibitors of these molecules formation.
4. Familiar with Nitric oxide and its immunological effects.

	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	Course Title	No of Hours Per week	No of Credits
Open Elective a	Research Methodology	06	4
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 provide basic knowledge on computer software, hardware and few operating systems.

3. To describe the appropriate statistical methods required for a particular research design.
4. To impart knowledge on Research ethics, Plagiarism.

Course Content:

Unit I

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

Unit II

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

Unit III

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

Unit IV

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

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:

1. Discuss the various steps involved in conducting research.
2. Acquire hands on training on various computational tools and techniques.
3. Learn to apply hypothesis testing via some of the statistical distributions.
4. To acquire knowledge on research proposals and motivate students towards 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	2	2	2	2	3	3	3
CO_2	3	3	3	3	3	2	2	2	2	3	3	3
CO_3	3	3	3	3	3	2	2	2	2	3	3	3
CO_4	3	3	3	3	3	2	2	2	2	3	3	3

Course Code	Course Title	No of Hours Per	No of Credits

		week	
Open Elective (b)	Immunological Diseases and Therapeutics	06	4
Sessional Marks: 20		End Semester Exam Marks: 80	

Course Objectives:

1. To inculcate the etiquette to be maintained in Clinical Immunology lab.
2. To provide knowledge on the types of immunity and the immune organs.
3. To impart knowledge about different types of immunodeficiencies and autoimmune diseases.
4. To equip with the knowledge on transplantation and immunosuppression and tumors of the immune systems.

Course Content:

Unit I

Introduction to Clinical Immunology: Introduction and maintenance of clinical Immunology laboratory; hazards in clinical laboratory; units; 'normal range', reference values. Factors affecting reference values quality control in laboratory – use of external and internal standards; use of WHO standards. Collection and preservation of biological samples.

Unit II

Natural Immunity (a)First Line of Defense innate / nonspecific immunity (b) Adaptive / specific immunity, (c)Factors associated with immunologic disease, Components of the Immune System. Immune response to various infectious diseases. Complement system: Nature, components of compliment. Pathways: Classical and alternative pathways. Compliment fixation tests.

Unit III

Primary immunodeficiencies, AIDS and other acquired or Secondary immunodeficiencies, Auto immune diseases, Animal model for autoimmune diseases. Proposed mechanism for induction of autoimmunity. Rheumatoid Arthritis, Scleroderma, Vitiligo, Systemic Lupus Erythematosus, Graves' disease, Myasthenia gravis, Multiple sclerosis, Diabetes (type 1) Psoriasis, Treatment of autoimmune diseases.

Unit IV

Transplantation, Types of grafts, Graft acceptance and rejection, Clinical manifestation of graft rejection, general immunosuppressive therapy, immune tolerance to allografts, clinical transplantation. tumors of the immune systems, tumor antigens, tumor evasion of the immune system and cancer immunotherapy.

Recommended Books:

Varley's Practical clinical Biochemistry – Ed. Alan W. Gowenlock (Heinemann Medical Books, London, 1988).

Clinical diagnosis and management by Lab methods (John Bernard Henry, W.B. Salunders Company, 1984).

Clinical Biochemistry – S.Ramakrishnan and Rajiswami.

Chemical Biochemistry (Metabolic and clinical aspects) by W.J.Marshall & S.K.Bangert. Text book of clinical Biochemistry by Tietz et al.

Turgons "Immunology and serology" by Mosby Latest Edition 2007

Immunology by Irwin Roitt Latest edition

Immunology by Kubay.

Hand Book of Human stress and immunity by Glaser R and Glaser K (1994)

Course Outcomes: The student will be able to

1. Maintain the Clinical Immunology lab with all required standards.
2. Out line, compare and contrast the key mechanism of innate and adaptive immunity.
3. Gain knowledge on different types of immunodeficiencies, their treatment and about autoimmune disorders.
4. Familiar with Clinical manifestation in graft acceptance or rejection and how immunosuppressive therapy is useful. And about cancer immunotherapy.

	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

MSc Biochemistry :: Model Question paper

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

Time 3 Hrs **Max marks 80**

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

PART A (5 x 4=20 marks)

1. Unit 1
2. Unit 1
3. Unit 2
4. Unit 2
5. Unit 3
6. Unit 3
7. Unit 4
8. Unit 4

9. Unit 1 a or b
10. Unit 2 a or b
11. Unit 3 a or b
12. Unit 4 a or b