BHARATHIAR UNIVERSITY: COIMBATORE– 641 046

M.Sc., BIOCHEMISTRY (CBCS PATTERN)

(For the students admitted during the academic year 2018–2019 batch and onwards)

Duration of the course: 2 Years Eligibility Condition

B.Sc., Biochemistry	B.Sc., Genetics
B.Sc., Biotechnology	B.Sc., Animal Sciences
B.Sc., Microbiology/Environmental Sciences	B.Sc., Bioinformatics
B.Sc., Zoology	B.Sc., Applied Chemistry
B.Sc., Food Science and Nutrition	B.Sc., Chemistry
B.Sc., Botany	B.Sc., Clinical Lab Technology
B.Sc., Medical Lab Technology	All Branches in Life Sciences

M.Sc., Biochemistry– Semester Wise Syllabus and Scheme

Semester	Core	Subject Code	Title of the Paper	Hours/ Week	Internal	External	Total Marks	Total Credits
I	CORE – I	13A	Biomolecules and Bioenergetics	4	25	75	100	4
	CORE – II	13B	Cell and Molecular Biology	4	25	75	100	4
	CORE – III	13C	Analytical Biochemistry	4	25	75	100	4
	CORE – IV	13D	Genetics and Developmental Biology	4	25	75	100	4
	CORE PRACTICAL– I	13P	Biochemistry, cell biology and microbiology	6	25	75	100	4
	ELECTIVE – I	1EA/B	Microbiology / Nutrition	4	25	75	100	4
	SUPPORTIVE – I	GS108	Tools and Techniques in Bioscience	2	12	38	50	2
II	CORE – V	23A	Enzymology	4	25	75	100	4
	CORE – VI	23B	Intermediary metabolism	4	25	75	100	4
	CORE – VII	23C	Human Physiology	4	25	75	100	4
	CORE – VIII	23D	Immunology	4	25	75	100	4
	CORE PRACTICAL– II	23P	Enzymology and Immunology Lab	6	25	75	100	4
	ELECTIVE – II	2EB	Molecular Physiology	4	25	75	100	4
		2EC	Nano science and Technology					
	SUPPORTIVE – II	GS102	Medical Lab Technology	2	12	38	50	2
			Summer Training*					
III	CORE – IX	33A	Clinical Biochemistry	4	25	75	100	4
	CORE – X	33B	Recombinant DNA Technology	4	25	75	100	4
	CORE – XI	33C	Pharmacology and Toxicology	4	25	75	100	4
	CORE – XII	33D	Biostatistics and Research Methodology	4	25	75	100	4
	CORE PRACTICAL– III	33P	Clinical Biochemistry & Molecular Biology Lab	6	25	75	100	4
	ELECTIVE – III	3EC	Bio-Informatics	4	25	75	100	4
		3ED	Biology of Cancer and Stem cell					
	SUPPORTIVE – III	GS109	Clinical Diagnosis in Health and Diseases	2	12	38	50	2
			Summer Training*		50		50	2
			Online Course for a period of 4 weeks duration**		50		50	2
IV			Industrial Visit***					
	CORE – XIII	43A	Plant Biochemistry and Environmental Biotechnology	4	25	75	100	4
	PROJECT AND VIVA	–	Project Work****	–	25	125	150	6
			Total				**2250 +50**	**90 + 2**

***Summer Training:** All the students have to undergo summer training for period of minimum 30 days. Final reports have to be submitted which will be evaluated.
****Allthe students should berequired to complete online courses offered by **SWAYAM, MOOCs or NPTEL** by the end of 3rd semester. Online courses have an extra credit (other than 90 credits)

*****Industrial Visit:** Students have to undertake an industrial /institutional visit and have to submit report for evaluation.

******Project Work:** The report is the bonafied work carried out by the candidate under the guidance of a faculty authenticated and countersigned by the HOD. This project work must be presented and defended by the candidate in the department attended by all faculties and reviewed by external examiner.

Candidate who has presented the work as "Not qualified as per CBCS" must resubmit the project again in the ensuing academic year.

SUPPORTIVE PAPERS OFFERED FOR OTHER DEPARTMENT STUDENTS

Paper I : Tools and techniques in bioscience
Paper II : Medical lab technology
Paper III : Clinical diagnosis in health and disease

PRACTICAL COMPONENTS:

The M.Sc., Biochemistry Core Practical Examination having the following Marks:

INTERNAL MARKS: 25

Major Practical		10 Marks
Minor Practical		5 Marks
Spotters (A, B, C , D and E)	5x2 =	10Marks
	Total =	25 Marks

EXTERNAL MARKS: 75

Major Practical	30	Marks
Minor Practical	20	Marks
Spotters (A, B, C,D and E)	5x2 =10	Marks
Record and Viva	10+5 = 15	Marks
	Total = 75	Marks

THEORY COMPONENTS:

The M.Sc.,Biochemistry Core and Elective theory Examination having the following Marks.

CORE AND ELECTIVE PAPERS: MAXIMUM MARKS– 100

INTERNALMARKS: 25

Test – 15Marks
Assignment– 5 Marks
Seminar – 5 Marks

EXTERNAL MARKS: 75

SECTION – A:10x1=10 Marks (Question No. 1 to 10)
Choose the best Answer type. Answer all questions. All questions carry equal marks.

SECTION – B: 5x5=25 Marks (Either or type– Question No. 11 to 15)
Answer all questions. All question carry equal marks. Each answer should not exceed 2 pages.

SECTION – C: 5x8=40 Marks (Either or type– Question No. 16 to 20)
Answer all questions. All Question carry equal marks. Each answer should not exceed 4 pages.

SUPPORTIVE PAPERS: **MAXIMUM MARKS– 50**

INTERNAL MARKS: 12
Test –6 Marks
Assignment –3 Marks
Seminar – 3 Marks

EXTERNAL MARKS: 38

SECTION – A: 5x1=5 Marks (Question No. 1 to 5)
Choose the best Answer type. Answer all questions. All questions carry equal marks.

SECTION – B: 3x3=9 Marks (Either or type– Question No. 6 to 8)
Answer all questions. All Question carry equal marks. Each answer should not exceed 1 page.

SECTION – C: 4x6=24 Marks (Either or type– Question No. 9 to 12)
Answer all questions. All Question carry equal marks. Each answer should not exceed 2 pages.

Vision

To make biochemistry the most preferred, lucrative career. To provide high quality education and biochemist, developing competent.

Mission

1. To educate of inspire the young minds from the basics to the latest innovations in science.
2. To inculcate the traditional culture of ethics.
3. To captivate unexplored sectors in research.

Program Educational Outcomes (PEO)

Post graduates of M.sc program will be

PEO 1 : Laboratory Skills : Upon completion of a M.Sc Biochemistry students will have critical thinking and scientific inquiry in the performance, design, interpretation and documentation of laboratory experiments, at a level suitable to succeed at an entry – level position in biochemical industries.

PEO 2 : Communicate the concepts and results of their laboratory experiments through effective writing and/or oral communication using the discipline standards for reporting and citation.

PEO 3 : The summer training, IV & Project work help the students to known the practical aspects about the subject.

Programme Outcomes (PO) of M.Sc

On completion of M.Scprogramme, the students are expected to

PO1 : Students would be to recognize demonstrate and understand of structure, chemical properties and reactions of the biomolecules and their biopolymer structure to predict chemical properties and reactivity.

PO2 : To obtain the knowledge about the qualitative and quantitative analysis of different molecules using different types of microscopes, chromatographic techniques, spectroscopic techniques, radio isotopes and electrophoresis.

PO3: Expect to diagnose the pathogenic microbes in the laboratory by applying the knowledge of microbial culture techniques.

PO4 : By applying the knowledge of metabolism the students will be able to detect various disorders and identify the defect in the metabolic pathways and evaluate solutions for metabolic disorders.

PO5 : Students will get expertise on cell and molecular biology as well as on cell signaling that would help them to plan and carryout research programmes in relevant aspects.

PO6: Design, synthesis and characterize nanoparticles for biomedical applications.

Title of the subject: Biomolecules and Bioenergetics **No. of Credits:** 4

Code No: 13A **No. of Teaching Hours: 4 hrs /week**

Course objectives:

- This course emphasizes on various bio-molecules and its significance.
- To enable the students to learn the basic functions, structures and biological importance of lifeless chemical compounds.
- On successful completion of the course the students should have understood the significance of the complex bio-molecules, polysaccharides, lipids, proteins, nucleic acids, vitamins and minerals.

Unit- I: Water and Carbohydrates

Water - Unique properties, weak interactions in aqueous systems, ionization of water, buffers. Classification, chemical properties of carbohydrates, Chemistry and biological roles of homo and heteropolysaccharides. Structural elucidation of polysaccharides; Oligosaccharides – lectin interaction in biochemical processes. Structure and role of proteoglycans, glycoproteins and glycolipids (gangliosides and lipopolysaccharides).

Unit-II: Lipids

Classification of Lipids, Biological significance of lipids, Fatty acids andtheir physiochemical properties. Structure and properties of Prostaglandins. Storage lipids - triacyl glycerol and waxes. Structural lipids in membranes – glycerophospholipids, galactolipids and sulpholipids, sphingolipids and sterols, structure, distribution and role of membrane lipids. Lipids as signals, cofactors and pigments.

Unit-III: Amino acids and Proteins

Amino acids–classification, structure and physiochemical properties,chemical synthesis of peptides – solid phase peptide synthesis. Proteins – classification, purification, and criteria of homogeneity. Structural organization, sequence determination and characterization of proteins. Conformation of proteins – Ramachandran plots. Denaturation of proteins.

Unit-IV: Nucleotides

Nucleotides- structure and properties, physicochemical properties of nucleicacids, cleavage of nucleic acids by enzymatic methods, non – enzymatic transformation of nucleotides and nucleic acids, methylation, Sequencing, chemical synthesis of DNA. Three dimensional structure of DNA. Different forms of DNA – circular DNA and Supercoiling. Types of RNA. Structure of t-RNA. Nucleotides as source of energy, component of coenzymes, second messengers. Porphyrins – Structure and properties of porphyrins – heme, Chlorophyll and Cytochromes.

Unit–V: Thermodynamics

Principles of thermodynamics, free energy, enthalpy and entropy, Freeenergy changes in biological transformations in living systems. Redox potential, phosphate group transfer potential and ATP, High-energy compounds, oxidation and reduction reactions. Mitochondrial electron transport system – organization of components and importance. Substrate level

phosphorylation, oxidative phosphorylation, Respiratory control, Mechanism and theories of oxidative phosphorylation. Respiratory chain inhibitors and uncouplers of oxidative phosphorylation.

Reference Books:

- Lehningers Principles of Biochemistry, Nelson, David L and Cox, M. M, Macmillan/Worth, NY.
- Fundamentals of Biochemistry (1999) by Donald Voet, Judith G Voet and Charlotte W Pratt, John Wiley & sons, NY.
- Biochemistry III edition (1994) by LubertStryer, WH Freeman and CO., San Francisco.
- Outlines of Biochemistry (1987) by Eric E Conn, P K Stumpf, G Bruening and Ray H DOI, John Wiley & Sons NY.

Course Outcome:

CO 1 – Helps to understand about the polysaccharides and its types.
CO 2 – Gives a clear understanding about the lipids and its role.
CO 3 – A Clear Knowledge regarding amino acids and protein characterization.
CO 4 – Provides the structure and properties of Nucleic acids.
CO 5 – Gives an idea about energy level and its synthesis.

Course Prepared by: Dr. S. Suja

Course verified by: Dr. S. Suja, Associate Professor and Head

Title of the subject: Cell and Molecular Biology **No. of Credits:** 4

Code No: 13B **No. of Teaching Hours: 4 hrs /week**

Paper-II

Course objectives

- To study the structure and function of cells and to know about extracellular Matrix and cell communication.
- Understanding the function of intracellular organelles and cell cycle mechanism. Also, thorough understanding the replication process as well as DNA damage and repair mechanisms.
- Upon completion of the course, students might also be thorough about transcription mechanism and its regulations as well as on translation and post translational modification of proteins.

Unit-I: Structure and function of cells

Structure and function of cells–prokaryotes and eukaryotes, difference**,** Structure and organization of membrane – structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active & passive transport, ion pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes. Extracellular matrix, cell-cell communication.

Unit–II: Mechanism of cell components

Plasma membrane, nucleus, mitochondria, Golgi bodies, lysosomes,endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility and Mechanism of cell division: Mitosis; meiosis and genetic recombination; regulation of cell cycle; factors and genes regulating cell cycle.

Unit-III: Cell replication

Unit of replication, enzymes involved, replication origin and replicationfork, fidelity of replication, extra chromosomal replicons, and DNA damage and repair mechanisms.

Unit-IV: Transcription and translation

RNA polymerases, Regulatory sequences in protein-coding genes, Transcription factors and machinery, formation of initiation complex,transcription activators and repressors, regulation of transcription factor activity, capping, elongation and termination, Processing of Pre-mRNA, splicing, polyadenylation; RNA transport, Cytoplasmic mechanisms of Post-transcriptional control, Processing of rRNA and tRNA. Gene regulation –lac and trp operon.

Unit-V: Translational modifications

Ribosome, formation of initiation complex, initiation factors and theirregulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, translational proof-reading, translational inhibitors, post-translational modification of proteins.

Reference Books:

- Molecular and Cell Biology – Baltimore
- Molecular Cell Biology – Darnell et al.
- Biochemistry – Lehninger, Cox, Nelson
- Biochemistry – Cohn and Stum.

Course Outcome:

CO 1 - The course material will provide clear understanding of structure and functions of cells.
CO 2 -Students will advance their knowledge in cell cycle events and regulation of cell cycle at molecular level.
CO 3 -The course will provide detailed understanding of replication process.
CO 4 -Students will learn their mechanism of transcription and its regulation in detail.
CO 5 - Course material provides detailed understanding of translation process, including proofreading and post translational modification of proteins.

Course prepared by: Dr. S. Selvakumar

Course verified by: Dr. S. Suja, Associate Professor and Head

Title of the subject: Analytical Biochemistry **No. of Credits: 4**

Code No: 13C **No. of Teaching Hours: 4 hrs /week**

Paper-III

Course objectives:

- The main objective of the course is qualitative and quantitative analysis of different molecules taking place in a biochemical reaction.
- It includes the development of different tools and methods for identification, analysis and examination of physical properties of different biochemical compositions to provide better chemical information.
- It helps the biochemistry students in understanding the basic science in a variety of applications.

Unit-I:Types of microscope and electrochemical techniques

Light microscope, Fluorescence microscope, Phase contrast microscope, Electron microscope, Confocal microscopy. Centrifugation: Small bench top centrifuges, large capacity refrigerated centrifuges, High speed refrigerated centrifuges, preparative and analytical ultra-centrifuge. Electrochemical techniques: Principles of electrochemical techniques, redox reactions, the pH electrode, ionsensitive and gas-sensitive electrodes, The clark oxygen electrode, Biosensors. Spectrophotometry: visible and UV spectrophotometry.

Unit-II:Chromatography

Principles of chromatography, size exclusion, Ion-exchange and affinity chromatographies. High performance liquid chromatography (HPLC), Gas liquid chromatography (GLC), Thin layer chromatography (TLC), Paper chromatography, GC-MS, LC-MS, MaldiTof, ICPMS and Surface Plasma Resonance methods.

Unit-III: Spectroscopic techniques

Spectroscopic techniques: Properties of electromagnetic radiation, interaction with matter. Gamma ray spectroscopy, X-ray spectroscopy, UV and Visible spectroscopy, Infrared and Raman spectroscopy, Electron spin resonance spectroscopy, Nuclear magnetic resonance spectroscopy, Circular dichorism spectroscopy, Atomic absorption spectroscopy. Lasers, Spectrofluorimetry, turbidometry and nephelometry.

Unit-IV:Radio isotope techniques

Radio isotope techniques: The nature of radioactivity, detection and measurement of radioactivity: detection based on gas ionization- Geiger Muller counter- principles and applications. Detection based on excitation- Liquid Scintillation counter-principle and applications. Supply, storage and purity of radiolabelled compounds, specific activity, inherent advantages and restrictions of radiotracer experiments, safety aspects, applications of radio isotopes in biological sciences. Flowcytometry, ELISA, immunoblotting.

Unit-V:Electrophoresis

Electrophoresis: General principles, Electrophoresis of proteins: SDS-PAGE, Native gels, Gradient gel, Isoelectric focusing, 2-D gel electrphoresis (2-D PAGE), cellulose acetate elecrophoresis, continuous flow electrophoresis; Detection, estimation and recovery of proteins. Electrophoresis of nucleic acids: agarose gel electrophoresis of DNA, Pulse field gel electrophoresis, electrophoresis of RNA, Capillary electrophoresis. DNA sequencing - NGS

References:

- Keith Wilson and John Walker. Practical Biochemistry- principles and techniques; Cambridge University press, London, UK.
- David T Plummer, Tata McGraw- Hill publishing company limited; McGrqw Office, New Delhi.
- C.R. Kothari, 2 Edition, 2004. Research methodology- methods and techniques. New Age International (P) limited publishers, New Delhi.
- Instrumental methods of chemical analysis – P.K. Sharma.
- Biophysical chemistry – Upadhyay., Upadhyay and Nath.
- A Biologists guide to principle and techniques of practical biochemistry – Brigan L. Williams.
- Handbook of Biomedical Instrumentation – R.S. Khandpur, Tata McGraw Hill.

Course outcome:

CO 1 – To obtain the knowledge about the microscope handling and the basic difference between the ordinary microscope and electron microscope.
CO 2 – To learn the chromatographic techniques for the separation of the individual compound from the mixture of compound.
CO 3 – To study the interaction between matter and electromagnetic radiation and visible light dispersed according to its wavelength, by a prism.
CO 4 – To understand the characterization of surfaces using radioisotopes generally involves observing the manner in which the radioactive species interact with the surface.
CO 5 – To obtain knowledge about the separation and analysis of macromolecules and their fragments, based on their size and charge.

Course prepared by: Dr. K.M. Saradhadevi

Course verified by: Dr. S. Suja, Associate Professor and Head

Title of the subject: Genetics and Developmental Biology No. of Credits: 4

Code No: 13D No. of Teaching Hours: 4 hrs /week

Paper-IV

Course objectives:

- The main objective of this course is to introduce about concepts in Genetics and Developmental Biology. This course emphasizes to learn about principles involved in mendelian genetics and Non-mendelian inheritance and techniques used to diagnose prenatal genetic diseases.

- The course aims to give exposure to learn the concepts involved in developmental biology such as spermatogenesis, gametogenesis, fertilization and development and differentiation of organs (eye, ears, limbs, heart, brain, kidney, immune system).

- This course also provides knowledge about Rudimental organs, genes involved in development, Nuclear transplantation and chemical agents that cause abnormal growth (Teratogenesis).

Unit-I: Mendelian inheritance

Principles of Mendelian inheritance; Mendel‟s experiments-monohybrid,dihybrid trihybrid and multihybrid crosses. Interaction of genes: incomplete dominance, codominance, epistasis, complementary genes, duplicate genes, polymeric genes, modifying genes; lethal genes. Environment and gene expression: penetrance and expressivity; temperature, light, phenocopies. Environmental effects and twin studies; human intelligence. Quantitative or polygenic inheritance: QTL mapping, Inheritance of kernel color in wheat; corolla length in tobacco skin color inheritance in man, transgressive and regressive variation. Multiple alleles; Sex determination; Extra chromosomal inheritance.

Unit-II: Genetic diseases

Prenatal diagnosis of genetic diseases- amniocentesis, karyotyping,DNA/RNA probes. DNA probes in the diagnosis of infectious diseases; Tuberculosis, Malaria, Chagas disease, AIDS, HPV, Lymph disease and periodontal diseases. DNA probes in diagnosis of genetic diseases: Cystic fibrosis, Sickle cell anemia, Cancer (breast cancer, Leukaemia, Burkets lymphoma).

Unit-III: Gametogenesis

Gametogenesis–Origin of germ cells–Significance of gametogenesisOogenesis – Types of eggs–growth, development and maturation of oocyte, Egg envelopes, Polarity and symmetry, Spermatogenesis–Sperm Structure, Types of sperm, Fertilization – Approach of spermatozoon–Reaction of egg, essence of activation – Changes in egg cytoplasm caused by fertilization.

Unit-IV: Cell division

Cell division in cleavage–Chemical changes–Patterns of embryoniccleavage – Morula and Blastula – Role of egg cortex – Morphogenetic gradients – Fate map – Gastrulation – Primary organ, Rudimental organs, Organizer – Morphogenetic movements.

Unit-V: Organogenesis

Organogenesis: Induction and differentiation of Brain, eye, ear, limb, Heart,kidney, Development of Immune system, Chemical basis of differentiation – selective action of genes– gene action in development – Nuclear transplantation–cell death in development– aging– Teratogenesis.

Reference Books:

- Developmental Biology, Berrill N.J., 1974, TMH Edition.
- Animal Regeneration, Diwan A.P., Dhakad N.K., 1996, Anmol Publications Ltd.
- Developmental Biology, Browder L.W., Erickson C.A., And Jeffery W.R, 1991 Saunder college Publishing House, Philadelphia.
- Genetics, 3rd edition, 2002, Strickberger, Prentice Hall of India.
- Genes VII, Benjamin Lewin, 2000, Oxford University Press.
- Genetics, Sarin C, 1990, Tata McGraw–Hill Publishing Co., Ltd., New Delhi.
- Genetics, Gupta PK., 1996, Rastogi Publications, Meerut, India.

Course Outcome:

CO 1 – Describe Mendelian genetics, history, Monohybrid, Dihybrid and Trihybrid cross, Mendelian ratio of segregation, interaction of genes, alleles, Extrachromosomal inheritance, sex determination and how the environment affects the gene expression.

CO 2 – Describe the techniques involved in Prenatal diagnosis of genetic diseases, DNA/RNA probes in the diagnosis of infectious diseases (Tuberculosis, Malaria, Chagas disease, AIDS, HPV, Lymph disease and periodontal diseases.) and diagnosis of genetic diseases (Cystic fibrosis, Sickle cell anemia, Cancer).

CO 3 – Describe the process involved in spermatogenesis, gametogenesis and fertilization.

CO 4 – Describe the cell division in cleavage, patterns in embryonic cleavage after fertilization. To know about the development of primary organs and Rudimental organs.

CO 5 – Describe development and differentiation of Brain, eye, liver, limb, heart, kidney and immune system. To know about nuclear transplantation and chemical agents that cause abnormal growth (Teratogenesis).

Course prepared by: Dr. M. Rajesh

Course verified by: Dr. S. Suja, Associate Professor and Head

Title of the subject: Microbiology **No. of Credits: 4**

Code No: 1EA **No. of Teaching Hours: 4 hrs /week**
Course objectives:

• To provide knowledge about microbial culture techniques.
• To learn the concepts of different energy sources.
• To understand the basic concept, principles and methods of diagnosis of infectious diseases.
• To understand the concepts for isolation of microbes from textiles and to identify the organisms responsible for HAI (Hospital acquired infection).

Unit-I: Microbiological techniques

Culture techniques: Isolation of microbes from various sources, serial dilution techniques, pure culture techniques, anaerobic culture methods – chemical and physical methods. Culture preservation techniques. Nutritional requirements: - different kinds of media, composition of media-carbon sources, nitrogen sources, vitamin and growth factors, mineral, inducers, precursors and inhibitors. Sterilization methods. Anaerobic fermentation Alcoholic fermentation, propionic acid fermentation, formic acid fermentation.

Unit-II: Sources of energy

Energy from inorganic compounds - ET in chemolithotrophs, production of reducing power in chemolithotrophs; Energy from visible radiation – photosynthesis in eukaryotes, blue-green algae, bacteria. Energy from aromatic compounds – two carbon compounds, one carbon compounds, endogenous reserve polymers). Energy from hydrocarbons – alkanes, alkenes, acyclic aromatic hydrocarbons.

Unit-III: Food poisoning

Food borne diseases- Bacterial and Non- Bacterial. Microbial quality and safety – Determining microorganisms in food culture, Microscopy and sampling methods – Chemical and immunological methods, Textile microbiology.

Unit-IV: Medical microbiology

Infectious Diseases process – Diagnosis – Process of sample collection, transport and examinations of the specimens. Antibiogram. Bacteriology: Morphology, cultural characteristics, pathogenicity and laboratory diagnosis of Gram positive organisms - Staphylococcus aureus, Mycoplasma; Gram negative organisms: E. coli.
Infections, antimicrobial agents for textiles, international standards for the assessment of antimicrobial activity of textiles.

Unit-V: Pathogenicity and laboratory diagnosis
Virology - Basic concepts of virology - General properties of Human viruses, Approaches to viral diagnosis.
Serological and Molecular techniques of viral infections - Hepatitis, Polio, Ebola, SARS.
Mycology: General properties and approaches to laboratory diagnosis. Mycosis – Superficial, Subcutaneous and Systemic infections –Candida allbicans.
Parasitology: Pathogenicity and laboratory diagnosis of Entamoeba histolytica, Plasmodium vivax.

Reference Books:

- Microbiology by Pelczar M.J., Ried, RD and Chan, ECS.
- Principles of Fermentation Technology – By Standby and Wittaker, second Edition.
- Chemical microbiology – An introduction to microbial physiology – AH Rose, Butterworth, London.
- Microbial Physiology – S. Meenakumari.
- Brock Biology of Microorganisms – 10th edition – MT Madigan, JM Martinko& Jack Parker, Pearson and Education Inc., New Jersey.
- Medical Microbiology, Vol. 1: Microbial Infection, Vol. 2: Practical Medical Microbiology, - Mackie and McCartney.
- Food Microbiology by Frazier.
- Basic food microsbiologoy (Abridged edition) by George J. Banwart.
- Text Book of Microbiology by Ananthanarayanan and Jayaram Paniker.
- Yuan Gao and Robin Cranston. Recent Advances in Antimicrobial Treatments of Textiles, Textile Research Journal, 2008 78: 60. SAGE publications.
- Rajendran, R. Biotechnological Application in Textile Industry-Antimicrobial Textiles. Maheswari, Industrial Exploitation of Microorganisms, Google ebooks.

Course outcomes:

CO 1 - Use culture techniques for isolation of microbes from various sources and preserve the isolates.

CO 2 -Obtain knowledge about different energy sources such as inorganic compounds, organic compounds and visible radiation for organisms.

CO 3 - Obtain knowledge for the concepts to diagnose the microbes from food using chemical and Immunological methods.

CO 4 - Obtain knowledge for isolation of microbes from textiles and also to identify the organisms responsible for HAI (Hospital acquired infection)

CO 5 - Know the concepts of laboratory diagnosis of infectious disease, sample collections and examinations of the specimens.

Course prepared by: Dr. R. Kavitha

Course verified by: Dr. S. Suja, Associate Professor and Head

Title of the subject: Nutrition **No. of Credits: 4**

Code No: 1EB **No. of Teaching Hours: 4 hrs /week**

Course objectives:

- The main objective of this course is to introduce about Dietary sources and energy content in foods needed for human body. This course emphasizes to learn about the dietary requirements of Proteins, lipids carbohydrates and vitamins.

- The course aims to give exposure to learn about malnutrition, starvation, protein metabolism in prolonged fasting and diseases that occur due to malnutrition.

- This course also provides knowledge about Nutritional requirement during pregnancy and inherited metabolic disorders such as Phenylketonuria, Maple syrup diseases, Hemocystinuria, Galactosemia, Gout, Diabetes Insipidus and Diabetes Mellitus. This course teaches about naturally borne food toxicants and allergy causing foods.

Elective-1

Unit-I: Bioenergetics and nutrients

Composition of human body. Energy content of foods. Measurement of energyexpenditure: direct and indirect colorimetry. Definition of BMR and SDA and factors affecting these. Carbohydrates – Dietary requirements and sources of available and unavailable carbohydrates. Physico - chemical properties and physiological actions of unavailable carbohydrates (dietary fibre). Lipids – Major classes of dietary lipids. Properties and composition of plasma lipoproteins. Dietary needs of lipids. Essential fatty acids and their physiological functions.

Unit-II: Protein metabolism

Protein reserves of human body. Nitrogen balance studies and factorsinfluencing nitrogen balance. Essential aminoacids for men and concept of protein quality. Cereals proteins and their limiting aminoacids. Protein requirements at different stages of requirement. Protein energy malnutrition, clinical features, metabolic disorders and management of marasmus and Kwashiorkar diseases: starvation – Techniques for the study of starvation. Protein metabolism in prolonged fasting. Proteins baring treatments during fasting. Basic concepts of high protein and low calorific weight reduction diets.

Unit-III: Dietary sources

Dietary sources, biochemical functions and specific deficiency diseasesassociated with fat and water soluble vitamins. Hyper vitaminosis, Symptoms of fat-soluble vitamins. Nutrition requirements during pregnancy, lactation and of infants and children. Nutritional significance of dietary calcium, phosphorus, magnesium, iron, iodine, zinc and copper.

Unit-IV: Diet related diseases

Role of diet and nutrition in the prevention and treatment of diseases: Dentalcarries, Fluorosis, Renal failure, Hyperlipidemia, Atherosclerosis & Rheumatic disorders, Inherited metabolic disorders: Phenylketonuria, Maple syrup diseases, Hemocystinuria, Galactosemia, Gout, Diabetes Insipidus and Diabetes Mellitus.

Unit-V: Allergy and toxins

Types of diagnosis and management of allergy. Naturally occurring foodborne toxicants: protease inhibitors, haemoagglutinins, Hepatotoxins, Allergens, Oxalates, Toxins from mushrooms, animal food stuffs and sea foods.

References Books:

- Nutrition: An integrated approach (3rd edition 1984) R.L. Pike and M.L. Brown, Wiley & Sons Inc., NY.
- Text Book of Biochemistry and Human Biology G.P. Talwar Prentice Hall.
- Mechanism and Theory in Food chemistry (1996) DWS Wong, CBS, New Delhi.
- Text Book of Human nutrition (1996) M.S. Bamji N. Pralhad Rao and V. Reddy, Oxford & IBH publishers.
- Nutritional Biochemistry and metabolism. Maria C. Linder.
- Principles of Food Science – I (Food Chemistry) Fennemona D.R.
- Human Nutrition and Dietetics (8 Ed. 1982) by Davidson and Passmore.
- Modern Nutrition in Health and Diseases (7Ed. 1988) by Maurice E Skills and V. R. Young K.M. Varghese Co. Bombay.
- Nutritional Biochemistry. S. Ramakrishnan and S. Venkat Rao, T.R. Publications, 1995.
- Antinutrients and natural toxicants in foods. Robert L. Ory, Food & Nutrition Press, 1981.

Course Outcome:

CO 1 -Describe energy content in foods. Techniques involved in the measurement of energy expenditure, Dietary requirements of carbohydrates and dietary fibre, to know about major classes of dietary lipids and health benefits of essential fatty acid.

CO 2 - Describe essential and non-essential aminoacids, protein reserves in human body, Protein malnutrition, protein metabolism in prolonged fasting, techniques for the study of starvation, concepts for weight reduction diets.

CO 3 -Describe nutritional requirement of vitamins, Nutritional requirement during pregnancy, lactation, infants and childs, Nutritional significance of dietary calcium, phosphorus, magnesium, iron, iodine, zinc and copper.

CO 4 - Describe the role of diet and nutrition in the prevention and treatment of diseases, learn about inherited metabolic disorders.

CO 5 - Describe naturally occurring food borne toxicants, Allergy causing foods and management.

Course prepared by: Dr. M. Rajesh

Course verified by: Dr. S. Suja, Associate Professor and Head

Title of the subject: Bio-Chemistry, Cell Biology& Microbiology No. of Credits: 4

Code No: 13P No. of Teaching Hours: 6hrs/week

Practical - I

Bio-chemistry

1. Estimation of Glucose by GOD/POD end point.
2. Estimation of Total Cholesterol by ZAK's method.
3. Separation of amino acids using paper chromatography.
4. Separation of amino acids and lipids using thin layer chromatography (TLC).
5. Separation of two proteins using column chromatography.
6. Estimation of proteins using Bradford and Lowry‟s methods.
7. Estimation of DNA using DPA.
8. Estimation of RNA using Orcinol reagent.
9. Estimation of sugar by Anthrone method.
10. Estimation of Methionine

Cell biology

1. Subcellular fractionation of organelles from liver cells and identification by the use of marker enzymes.
2. Squash preparation of onion root tip and anther lobes.
3. Preparation of buccal smear.
4. Determination of apoptosis by staining method.

Microbiology

1. Preparation of culture media- Nutrient Broth, Nutrient Agar, Blood Agar, Macconkey Agar, Potato Dextrose Agar.
2. Isolation of bacteria from soil and air.
3. Staining techniques – simple, differential and special staining, streaking method.
4. Plotting of bacterial growth curve.
5. IMVIC test.
6. Motility of bacteria by hanging drop method.
7. Assay of antibiotics by disc diffusion method.
8. Bacteriological examination of water / Industrial effluents.
9. Isolation of Phage from sewage water and plaque forming Unit.

Reference Books:

- Experimental Biochemistry: A Student companion- Sashidhar Rao, B and Deshpande, V. IK International (P) Ltd.
- Experiments and Techniques in Biochemistry: by Sheel Sharma, Galgotia publications.
- Industrial Microbiology by Casida, LE Industrial Microbiology by Patel.
- AH Industrial Microbiology by Miller.
- BM and Litsky Industrial Microbiology by Prescot.
  Dunn Microbial Technology by Peppler, JH and Perlman, D

Title of the subject: Enzymology **No. of Credits: 4**

Code No: 23A **No. of Teaching Hours: 4 hrs /week**
Paper-V

Course objectives:

- To understand the classification of enzymes and fundamentals of enzyme assay. Also, understanding of kinetics of enzyme catalyzed reactions and derivation of Michaelis Menten equation.
- To advance the knowledge on mechanism of enzyme action as well as regulation of enzyme action with relevant examples.
- To study about the techniques of immobilization and application in enzymes in food and pharmaceutical industries.

Unit-I: Enzymes

Introduction to Enzymes- Concept of convergent and divergent evolution of enzymes. Nomenclature and classification of enzymes.Specificity and active site. Fundamentals of enzyme assay – enzyme Units, coupled kinetic assay, immobilized enzymes. Enzyme localization. Criteria of purity of enzymes. Monomeric and oligomeric enzymes- Monomeric enzymes; serine proteases, zymogen activation, multifunctional enzymes, oligomeric enzymes and multi- enzyme complexes.

Unit-II: Enzymatic reactions

Kinetics of enzyme-catalyzed reactions- Methods used in the investigation of thekinetics of enzyme-catalyzed reactions, initial velocity studies, rapid reaction techniques and relaxation technique. Enzyme kinetics of single substrate reactions – Michaelis Menten and Briggs and Haldane theory (rapid equilibrium and steady state theory). Kinetic data evaluation-linear transformation of Michaelis-Menten equation. Pre-steady state kinetics. Integrated velocity equation. Haldane equation. King-Altman procedure for deriving the rate equation. Effect of pH & temperature on enzymatic reactions, Arrhenius plot, determination of activation energy.

Unit-III: Mechanism of Enzyme activity

Mechanism of Enzyme Action – Acid-base catalysis, covalent catalysis,proximity, orientation effect. Strain & distortion theory. Chemical modification of active site groups. Site directed mutagenesis of enzymes. Mechanism of action of chymotrypsin, lysozyme, glyceraldehyde 3-phosphate dehydrogenase, aldolase, carboxypeptidase, triose phosphate isomerase and alcohol dehydrogenase.

Unit-IV: Enzyme Regulation

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

Unit-V: Applications of enzymes

Application of enzymes in food, Pharmaceutical, pulp, textile and otherindustries; diagnostic & therapeutic applications. Immobilized enzymes-Techniques of enzyme immobilization; applications of immobilized enzymes.

References Books:

- Fundamentals of Ezymology; 3rd Edn. Nicholas C. Price and Lewis Stevens, Oxford University Press (2012).
- Enzymes; Trevor Palmer, East – West Press Pvt. Ltd., Delhi (2004).
- Enzymes: A Practical Introduction to Structure, Mechanism, and Data Analysis; Robert A. Copeland, Wiley-VCH Publishers (2000).
- Enzyme Kinetics and Mechanism; Paul F. Cook, W. W. Cleland, Garland Science (2007).
- Biochemical Calculations, Irwin H. Segel (1976) 2nd Ed. John Wiley and Sons.
- Methods in Enzymology; Colowick S.P. et al., Vol. 152, Academic Press, (1987).
- Methods of Enzymatic Analysis; Berg Meyer Vol. 1-X, (1974).
- Basic Biochemical Laboratory Procedures and Computing, R. Cecil Jack (1995) Oxford University.
- Enzyme Kinetics; Roberts, D.V. (1977), Cambridge University Press.
- The Enzymes; Boyer, Academic Press, (1982).
- Enzyme Kinetics; Irwin H. Segel (1976) Interscience-Wiley.
- Enzyme Kinetics; the Steady state approach; Engel, P.C. (1981) 2nd Edn. Champman and Hall.
- Nature of Enzymology; Foster, (1980), Croom Helm.
- Principles of Enzymology for Food Sciences; Whitaker, Marcel Dekker (1972) Academic Press.
- Enzymes: Biochemistry, Biotechnology and Clinical Chemistry; Trevor Palmer (Edn) Horwood Chemical Science Series.
- Introduction to Enzyme and Co-enzyme Chemistry. Ed. T. Bugg, (2000), Blackwell Science.
- An Introduction to Enzyme and Coenzyme Chemistry; Timothy B. Bugg, (1997) Jones

Course Outcome:

CO 1 – Course material will help in understanding of nomenclature and classificationof enzymes and also the fundamentals of enzyme assay.
CO 2 – Students will thoroughly understand the Kinetics of enzyme essay and derivationof velocity equations.
CO 3 – Course will advance the knowledge of students on mechanism of enzyme action.
CO 4 – Understanding of detailed mechanism in enzyme regulation withrelevant examples.
CO 5 – Students will gain knowledge in various immobilization techniques and industrial application of enzymes

Course prepared by: Dr. S. Selvakumar

Course verified by: Dr. S. Suja, Associate Professor and Head

Title of the subject: Intermediary metabolism **No. of Credits: 4**

Code No: 23B **No. of Teaching Hours: 4 hrs /week**

Course objectives:

- To understand the metabolism of carbohydrates, lipids, proteins and nucleic acids.
- To give exposure to study the concepts of regulation of metabolism and metabolic disorders.
- To give adequate exposure in the antioxidants and role of free radicals in diseases.

Paper – VI

Unit-I: Metabolism of Carbohydrates

Intermediary metabolism of carbohydrates - Reactions, energetics andregulation of glycolysis; Feeder pathways for glycolysis; Fate of pyruvate under aerobic and anaerobic conditions; Pyruvate dehydrogenase complex and its regulation; Reactions, regulation and amphibolic nature of TCA cycle; Anaplerotic reactions; Glyoxalate cycle; Poylol pathways; Pentose phosphate pathway; Gluconeogenesis; Cori cycle; Biosynthesis of lactose, sucrose and starch; Glycogenesis and Glycogenolysis; Control of glycogen metabolism;

Unit-II: Metabolism of Lipid

Fatty acid oxidation - Franz Knoop's experiment; βoxidation of saturated, unsaturated and odd carbon fatty acids; Peroxisomal βoxidation; α- and ω- oxidations of fatty acids; Ketone bodies – Formation and utilization; Biosynthesis of saturated fatty acids; Elongation and desaturation of fatty acids; Triacylglycerols – Biosynthesis, and mobilization from adipose tissue; Regulation of fatty acid metabolism; Cholesterol biosynthesis and its regulation; Biosynthesis of phosphoglycerides and sphingolipids.

Unit-III: Protein and nucleotides metabolism

Protein, amino acid and nucleotides metabolism - Degradation of aminoacids oxidative and nonoxidative deamination, transamination, decarbooxydation, detoxication of ammonia, catabolism of carbon skeletons of amino acids - ketogenic and glucogenic amino acids -nitrogen balance conversion of amino acids to specialised products. Biosynthesis of purines and pyrimidines- De novo and salvage pathways and their regulation. Catabolism of purines and pyrimidines. Structure and regulation of ribonucleotide reductase. Biosynthesis of ribonucleotides and deoxyribonucleotides. Overview of metabolism of Porphyrins, Biosynthesis and degradation of heme.

Unit-IV:Free Radicals

Formation of free radicals, autoxidation initiated by oxygen radicals, Influence of free radicals in metal toxicity. Free radical hepatotoxins - CCl_4 model. Free radicals and cancer. Oxidative process in tissue injury. Detection of free radicals and radical ions. Role of free radicals in diseases.

Unit V: Antioxidants

Antioxidants: Source, chemistry, toxicity, biochemical functions, bioavailability and bioassays.
Types – Enzymic antioxidants – chemistry, mechanism of SOD, catalase, Glutathione peroxidase.
Non enzymic antioxidants – Vit A, Vit C, Vit E, Glutathione and selenium.
Trace elements – introduction, sources, and biochemical functions of zinc, copper, magnesium & iron.

Reference Books:

- Principles of Biochemistry - L. Stryer (W.H. Freeman & Co.).
- Principles of Biochemistry - A.L.Lehninger, D.W.Nelson&M.M.Cox (Macmillan).
- Biochemistry - D. Voet&J.G.Voet (John Willey) SCAA Dated: 03.07.2017.
- 4 Harpers Illustrated Biochemistry - R.K.Murray et al. (McGraw Hill).
- Biochemistry oxygen toxicity, Annual review of Biochemistry Enrique cadinar, Vol 58, 1989.pp 78-110.
- Free radicals in biology by William a. Pryor, Academic press 1980. pp 96-150.
- Selenium dependent enzymes-glutathione peroxidase. Annual review of Biochemistry by Thresser, stadman, Vol 49.1980 pp 103-108.
- Superoxide radicals & SOD by Irwin Fridowich Annual review of Biochemistry, Vol 64.1995 pp 97-106.
- Vitamins –Annual research review by Horrobin, Eden Press Pub., and Vol.3. 1980. pp 59-82, 91-105, 218-291.

Course outcomes:

CO 1 - Understand how the glycolytic pathway is used to convert glucose to pyruvate and understand conservation of chemical potential energy in the form of ATP and NADH.
CO 2 - Understand the fate of pyruvate under aerobic and anaerobic conditions and the amphibolic nature of TCA cycle.
CO 3 - Understand the concepts of metabolism of carbohydrates.
CO 4- Understand the concepts of metabolism of lipids.
CO 5-Understand the concepts of metabolism of protein, amino acid, nucleic acid and also the antioxidants.

Course prepared by: Dr. R. Kavitha

Course verified by: Dr. S. Suja, Associate Professor and Head

Title of the subject: Human physiology **No. of Credits: 4**

Code No: 23C **No. of Teaching Hours: 4 hrs /week**

Course objectives:

- This course presents an Introduction and provides a comprehensive, balanced introduction to this exciting, evolving and multi-disciplinary field.
- To enable the students to learn or to know the biological, physiological activities along with the mechanism of action of various organs.

Unit-I: Blood and its components

Composition and functions of blood and plasma. Blood volume, bloodvolume regulation, immUnity, haemostasis, blood groups. Haemopoiesis. Blood coagulation - mechanism, fibrinolysis, anticoagulants. Hemoglobin - structure, abnormal types, anemia, Blood corpuscles.

Unit-II: Anatomy of heart and functions of sense organs

Comparative anatomy of heart structure, myogenic heart, specialized tissue,ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation of all above. Sense organs – Vision, hearing and tactile response.

Unit-III: Digestive system

Digestive secretions - composition, functions and regulation of saliva,gastric, pancreatic, intestinal and bile secretions. Digestions and absorption of carbohydrates, lipids, proteins and nucleic acids. Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, electrolyte balance, acid-base balance.

Unit-IV: Respiratory and nervous system

Comparison of respiration in different species, anatomical considerations,transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration. Neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture. Muscle physiology.

Unit-V: Exocrine and Endocrine glands

Exo and Endocrine glands, basic mechanism of hormone action, hormonesand diseases; reproductive processes, neuroendocrine regulation.

Reference Books:

- Review of Medical Physiology by William. F. Ganong. McGraw-Hill Medical; 22 editions (2005).
- Human Physiology and Mechanisms of Disease by Guyton. Saunders Publications; 6th edition (1996).
- Human physiology by C.C. Chatterjee. 11th edition (1985).

Course Outcomes:

CO 1 – Obtain a deep knowledge regarding blood.
CO 2 – Gives an idea about heart and its regulation.
CO 3 – Provides Knowledge about digestive secretion and urine formation.
CO 4 – Obtain an insight about respiration and Neurons.
CO 5 – Provides knowledge about Hormone and its regulation.

Course prepared by: Dr. S. Suja

Course verified by: Dr. S. Suja, Associate Professor and Head

Title of the subject: Immunology **No. of Credits: 4**

Code No: 23D **No. of Teaching Hours: 4 hrs /week**

Paper-VIII

Course objectives:

- The study of immunology helps the students in understanding the immune system in all organism especially the physiological functioning of the immune system in states of both health and disease.
- To understand the malfunctions of the immune system in immunological disorders such as autoimmune disease, hypersensitives, immune deficiency and transplant rejection.
- To understand the physical, chemical and physiological characteristics of the components of immune system in in vitro, in situ and in vivo.

Unit-I: Cells of the immune System

Cells of the immune System - Macrophages, B and T lymphocytes, Dendritic cells, Natural killer and Lymphokine activated killer cells, Eosinophils, Neutrophils and Mast cells. Organs of the immune system: Thymus, Bone marrow, Spleen, lymph nodes, MALT, GALT. Haemopoiesis and differentiation, lymphocyte trafficking. Antigen- biology, structure and functions of different classes of Immunoglobulin. Biology of Superantigens.

Unit-II: Antigen-antibody reactions

Antigen antibody reactions, Applications of Immunological techniques, genetic control of immune response, effector mechanisms, MHC, antigen recognition and presentation, activation of B and T lymphocytes.

Unit-III: Humoral and cell mediated immUnity

Humoral and cell mediated immUnity. Cell mediated Cytotoxicity: Mechanism of T cell and NK Cell mediated lysis, Antibody dependent cell mediated Cytotoxicity and macrophage mediated Cytotoxicity. Cytokines and their role in immune regulation, Biology of Complement system, Complement fixation test and assessment of immune complexes in tissues. Immune suppression and immune tolerance.

Unit-IV: ImmUnity versus diseases

Hyper sensitivity reactions, Autoimmune disorders, Transplantation immunology- MLR, HLA Typing, Bone marrow transplantation, Organ transplants. ImmUnity to Infectious agents - Bacteria, Viruses, Malaria, and Helminthes. Tumor immunology, Tumor antigens, immune response to tumors, cancer immunotherapy, Vaccines. AIDS and other immunodeficiencies, Structure of HIV, envelope glycoproteins, destruction of T cells: immunologic symptoms of AIDS, AIDS vaccine.

Unit-V: Applications of antibodies

Vaccine technology and recombinant vaccines, Identification of B and T epitopes for vaccine development. In situ characterization of cells from tissues, Immunoscreening of Recombinant library, Hybridoma – Monoclonal Antibody production and applications; MAbs in diagnosis and therapy.

References Books:

- J. Kuby, 2003, Immunology 5th edition, W.H. Freeman and Company, Newyork.
- C.V. Rao. 2002, An Introduction to Immunology, Narosa Publishing House, Chennai.
- K.M. Pavri. 1996, Challenge of AIDS, National Book Trust, India.
- I.R. Tizard, 1995, Immunology: An Introduction, 4 editions, Saunders College Publishers, New York.
- Roitt, 1994, Essential Immunology, Blackwell Science, Singapore.
- Bul and K. Abbas, 1994, Cellular and Molecular immunology.

Course outcome:

CO 1 – To obtain the knowledge about the immune system, as a host defense system comprising many biological structures and processes within an organism that protects against disease.

CO 2 – To concentrate on the antigen and antibody reactions and immunological techniques.

CO 3 – Understanding about the two branches of immune system such as humoral immUnityand cellular immUnity, cytokines and complement system.

CO 4 – Clear about the hypersensitivity reaction or intolerance with undesirable reactions produced by the normal immune system, including allergies and autoimmUnity.

CO 5 – To obtain the knowledge about the hybridoma technology is to produce large numbers of identical antibodies (monoclonal antibodies) and a recombinant DNA technology that involves inserting the DNA encoding an antigen that stimulates an immune response.

Course prepared by: Dr. Saradhadevi

Course verified by: Dr. S. Suja, Associate Professor and Head

Title of the subject: Molecular physiology No. of Credits: 4

Code No: 2EB No. of Teaching Hours: 4 hrs /week

Elective-2
Course objectives:

- To understand the signaling components and receptor mediated signaling process.
- To advance the knowledge on nuclear receptor mediated signaling as well as on G-protein signaling mechanism and its regulation.
- To learn about the various signaling Pathways that control the gene activity. Also, to enhance the understanding of integration of Signals and gene control.

Unit-I: Signaling Components

Signaling Components: Endocrine, Paracrine and Autocrine signaling;Signaling molecules - Hormones (agonists and antagonists) NO; Receptor Classification: Receptor linked to Trimeric G proteins (G proteins linked Receptors), Receptors with intrinsic or associated enzymic activity (TGF-□, cytokine, Receptor Tyrosine kinase, Receptor guanylyl cyclase, Receptor Phosphotyrosine phosphatase ,T-Cell Receptor), Ion Channels as receptors, receptors involving proteolysis (Wnt, Hedgehog Hh, Notch/ Delta, NF –k□), intracellular receptor (NO. Pathway, Nuclear receptor). Membrane anchoring process - myristoylation, palmitoylation, Farnesylation, Geranylation, GPI anchor.

Unit-II: Nuclear Receptors

Nuclear Receptors:Principle of signaling with nuclear receptors,classification and structures; Transcriptional regulation by nuclear receptorscoactivators, co-repressors; Regulation and variability of signaling; Signaling path ways via steroids hormones receptors, Nuclease localized (retinoid, vit D3 and T3 hormones).

Unit-III: Signal transmission and its regulations

G Protein Coupled Signal Transmission:GPCR Structure and classification,ligand binding domain; Signaling path ways via cAMP, ion Channel regulation, Phospholipase C; Trimeric and monomeric G proteins and their effectors; Regulation – GTPase super family and GTP hydrolysis; Regulation of GPCR signaling – GDPGTP cycling, GTPase activity, phosphodiesterase activity, feedback inhibition, heterologous desensitization, phosphorylation of receptors, β-arrestin in regulation of GPCR.

Unit-IV: Signaling Pathway

Signaling Pathway That Control Gene Activity**:** TGF□Receptors and Smadactivation; cytokine receptors and JAK –STAT path way; RTK and Ras activation; MAP Kinase pathways; phosphoinositides as signal transducers; Signal induced protein cleavage (NF-kB, Notch /Delta, Wnt, Hedgehog).

Unit-V:Integration and control of signals

Integration of Signals and Gene Controls:Responses of cells toenvironmental influences control of cell fates by graded amounts of regulators, boundary creation by different combination of transcription factors; Boundary creation by extra cellular signals; Reciprocal induction and lateral inhibition; Integrating and controlling signals; Down modulation of receptor signaling.

Reference Books:

- Biochemistry of signal transduction and regulation. Gerhard krauss, III edition WileyVCH GmbH &co, (2003).
- Molecular Cell Biology – Lodish et al. 2004. W.H Freeman & Co., New York

Course outcome:

CO 1 – Course will advance the understanding of various signaling components and their functions.
CO 2 –Students will understand the nuclear receptor mediated signaling mechanism and its regulation.
CO 3 –Advancement in knowledge in the field of G protein coupled signal transmission and its regulation.
CO 4 – Thorough understanding of signaling Pathways that controls gene activity.
CO 5 – Understanding in signal integration and gene controls.

Course prepared by: Dr. S. Selvakumar

Course verified by: Dr. S. Suja, Associate Professor and Head

Title of the subject: Nanoscience and technology **No. of Credits: 4**

Code No: 2EC **No. of Teaching Hours: 4 hrs /week**

Course objectives:

- This course is offered as elective paper in the Department of Biochemistry. The main objective of this course is to introduce about concepts in Nanoscience and technology.

- This course emphasizes to learn about nanoparticles and its types, synthesis, characterization of nanoparticles using electron and atomic force microscopy techniques and application of nanoparticle in various fields.

- Based on this, the course aims to give adequate exposure to the approaches involved in Nanoparticle synthesis and its application in various fields. Nanocarriers and drug delivery system in nanomedicine provides the learner to know about the treatment of diseases using nanoparticles. These topics provides knowledge in nanoscience and technology.

Elective-2

Unit-I: Nanoscience and nanotechnology

Introduction to Nanoscience and Nanotechnology; Milestones inNanotechnology; Overview of Nanobiotechnology and Nanoscale processes; Physicochemical properties of materials in Nanoscales. Polymers in nano material synthesis- natural and synthetic polymers.

Unit-II: Nanomaterials

Types of Nanomaterials (Quantum dots, Nanoparticles, Nanocrystals,Dendrimers, Buckyballs, Nanotubes); Gas, liquid, and solid phase synthesis of nanomaterials; Lithography techniques (Photolithography, Dip-pen and Electron beam lithography); Thin film deposition; Electrospinning. Bio-synthesis of nanomaterials.

Unit-III: Characterization techniques

Characterization of Nano material**;** Absorption, Fluorescence, andResonance; Microscopy measurements: SEM, TEM, AFM and STM. Confocal and TIRF imaging.

Unit-IV:Biomolecules and bio mimics

Reactive groups on biomolecules (DNA & Proteins); Surface modificationand conjugation to nanomaterials.
Fabrication and application of DNA nanowires;Nanofluidics to solve biological problems. Bio mimics.

Unit-V: Nanocarriers

Properties of nanocarriers; drug delivery systems used in nanomedicine;Enhanced Permeability and Retention effect; Blood-brain barrier; Active and passive targeting of diseased cells; Health and environmental impacts of nanotechnology.

Reference Books:

- Nanobiotechnology: Concepts, Applications and Perspectives, Christof M. Niemeyer (Editor), Chad A. Mirkin (Editor), Wiley-VCH; 1 edition, 2004.
- Nanobiotechnology: Bioinspired Devices and Materials of the Future by Oded Shoseyov and Ilan Levy, Humana Press; 1 edition 2007.
- Nanobiotechnology Protocols (Methods in Molecular Biology) by Sandra J Rosenthal and David W. Wright, Humana Press; 1 edition, 2005.
- Bio-nanotechnology Concepts and applications. Madhuri Sharon, Maheshwar Sharon, Sunil Pandey and Goldie Oza, Ane Books Pvt Ltd, 1 edition 2012.
- Microscopy Techniques for Material Science. A. R. Clarke and C. N. Eberhardt (Editors) CRC Press. 1st Edition, 2002.

Course Outcome:

CO 1 – Describe what is Nano? History of nanotechnology, Properties of nanoparticles and polymers in nanomaterial synthesis.
CO 2 –Describe the types of nanoparticles and synthesis of nanoparticles using physical, chemical and biological method.
CO 3 – Describe the characterization of nanoparticles using Microscopy techniques such as SEM, TEM, AFM, and STM.
CO 4 – Design, carry out surface modification of biomolecules and conjugation to nanomaterials and apply nature's nano in biology (Biomimics).
CO 5 – Apply theoretical knowledge to solve the problems in treatment of diseases using nanoparticles in nanomedicine.

Course prepared by: Dr. M. Rajesh

Course verified by: Dr. S. Suja, Associate Professor and Head

Title of the subject: Immunology and Enzymology Lab **No. of Credits: 4**

Code No: 23P **No. of Teaching Hours: 6hrs /week**

Practical-II

Immunology

1. Immunodiffusion – single radial and double diffusion
2. Immunoelectrophoresis
3. Rocket immunoelectrophoresis
4. Haemagglutination and passive hemagglutination
5. Identifying blood group and Rh typing
6. ELISA-Direct and Indirect
7. Isolation and purification of IgG from serum
8. Dissection and identification of Thymus, Spleen, Lymph node from rat.

Enzymology

1. Isolation and Purification of Salivary Amylase enzyme.
2. Determination of total and specific activity of salivary amylase.
3. Effect of pH on enzyme activity (Acid phosphatase/Alkaline phosphatase).
4. Effect of temperature on enzyme activity (ACP/ALP) and determination ofactivation energy.
5. Effect of substrate concentration on enzyme activity (Salivary Amylase) and determination of Km value.
6. Effect of inhibitor on activity of Salivary Amylase.
7. Assay of lactate dehydrogenase (LDH).
8. Isoenzyme analysis (LDH) from serum sample- Native PAGE.

Reference Books:

- Experimental Biochemistry- R.W. Switzer & L.F. Garrity (W.H.Freeman& Co.)
- Modern Experimental Biochemistry - R. Boyer (Pearson Education)
- Practical Biochemistry - K. Wilson & J. Walker (Cambridge Univ. Press)
- Laboratory Manual in Biochemistry - J. Jayaraman (Narosa Publishing House)
- Practical Biochemistry - D.T. Plummer (TATA McGraw-Hill)
- Practical Biochemistry - R.C.Gupta& S. Bhargava
- Experimental Physiology and Biochemistry - P.V.Chadha
- Experiments in Microbiology - Gilstrap-Kleyn-Nester
- Experimental Biochemistry – A Student Companion - B.S. Rao & V. Deshpande, I.K. International Pvt. Ltd. (N. Delhi, Mumbai, Bangalore) 2005.
- K. Wilson and J. Walker (ed.), Practical Biochemistry, Principles and Techniques,
- Cambridge University Press, 1995.
- R. Boyer, Modern Experimental Biochemistry, 3rd., Pearson Education
- (Singapore) Pvt. Ltd., 2001.
- R. L. Switzer and L. F. Garrity, Experimental Biochemistry, 3rd., W. H. Freeman, 1999.

Course prepared by: Dr. S. Selvakumar
Course verified by: Dr. S. Suja, Associate Professor and Head

Title of the subject: Tools and Techniques in Bioscience **No. of Credits: 2**

Code No: GS108 **No. of Teaching Hours: 2hrs /week**

Supportive papers for other department students

Course objectives:

- Methods and tools in biosciences represents a new standard of comprehensive paper for all students in various fields of biology and medicine.
- The series emphasizes important developments in methodology and research tools and their potential for application to human and other biologic systems.

Supportive-1

Unit-I: Fractionation techniques

Cell fractionation techniques: Cell lysis, homogenization, extraction, saltingin, salting out, dialysis and ultra-filtration. Radioisotopes in Biology: Concept of half-life, decay constant, detection and quantitation - GM counter and solid and liquid scintillation counter. Specific activity, autoradiography and Applications of radioactivity.

Unit-II: Centrifugation and types of microscope

Centrifugation: Svedberg's constant, sedimentation velocity andsedimentation equilibrium. Differential and density gradient centrifugation, centrifugal elutriation, construction of preparative and analytical ultra-centrifuge. Microscopy: Principles and application of light phase contrast, fluorescence, scanning and transmission electron microscopy.

Unit-III: Chromatographic techniques

Chromatographic techniques: Principles and applications of paper, TLC,adsorption, ion exchange, gel filtration, affinity, GLC, chromatofocusing, HPLC and FPLC.

Unit-IV: Electrophoretic techniques

Electrophoretic techniques: Polyacrylamide gel electrophoresis, SDS PAGE, 2D electrophoresis, agarose gel electrophoresis, isoelectric focusing, and pulse field electrophoresis.

Unit-V: Spectroscopic techniques

Spectroscopic techniques: Principles of colorimeter, spectrophotometer,fluorimeter. BeerLambert's Law and its limitations. Extinction coefficient, Atomic absorption spectroscopy UV-Visible, Spectrofluorimetry, Flame Photometry.

Reference Books:

- Wilson, K. and Walker, J. 2005. Principles and Techniques of Practical Biochemistry, 6th Edition, Cambridge University Press.
- Upadhyay, A. Upadhyay, K. and Nath, N. 2009. Biophysical Chemistry: Principles and Techniques, Third Edition, Himalaya Publishing. 11th Edition
- Sharma, B.K. 1981.Instrumental Methods of Chemical analysis, 5th Edition Goel Publications.
- Homie, D.J. and Peck, H. Analytical Biochemistry, Third Edition, Longman group, 1998.

Course outcome:

CO 1 - To obtain the knowledge on the cell fractionation techniques to separate cellular components and to demonstrate the cellular location of various biochemical processes. Understood about radionuclide as an unstable atom and are used in biology and nuclear medicine.

CO 2 -Understood about the centrifugation technique to separate particles from a solution according to their size, shape, density, viscosity of the medium and rotor speed.

CO 3 - To learn the chromatographic techniques for the separation of the individual compound from the mixture of compound and measuring the relative proportions of analytes in a mixture.

CO 4 - To obtain knowledge about the separation and analysis of macromolecules and their fragments, based on their size and charge.

CO 5 - To study the interaction between matter and electromagnetic radiation and visible light dispersed according to its wavelength, by a prism.

Course prepared by: Dr. M. Rajesh and Dr. R. Kavitha

Course verified by: Dr. S. Suja, Associate Professor and Head

Title of the subject: Medical Lab Technology **No. of Credits: 2**

Code No: GS102 **No. of Teaching Hours: 2hrs /week**

Course objectives:

- This course is offered as a supportive paper in the Department of Biochemistry. The main objective of this course is to introduce basic concepts in Medical laboratories. This course emphasizes to understand about the functioning of medical laboratories and laboratory personnel.

- Based on this, the course aims to give adequate exposure to the concepts involved in medical laboratories. Basic laboratory principles, medical laboratory professionalism, Good clinical practices give adequate knowledge about the common principles involved medical laboratories.

- Automation in clinical biochemistry provides the learner to know about the instrumental concept and quality control. solution preparation provides exposure to prepare normality, molarity and percent solutions. These topics provides knowledge in basic concepts in Medical Lab technology.

Supportive-2

Unit-I: laboratory principles

Basic laboratory principles - Code of conduct of medical laboratory personnel - Organization of clinical laboratory - Role of medical laboratory technician - Safety measures - Medical laboratory professional and professionalism in laboratory workers - communication between physician and lab technician - hospital and clinic borne infection and personnel hygiene.

Unit-II: laboratory professionalism

Common glass wares in clinical laboratory - care and maintenance - Calibration of pipettes and volumetric apparatus - Cleaning and sterilization methods - antiseptics and disinfectants - staining techniques – vital stains.

Unit-III: laboratory techniques and set up

Automation in Clinical Biochemistry- Instrumental concept, Selection of Instrument, Quality assurance, Control of pre-analytical and analytical variables, External and internal quality control measurements. Good Clinical Practices. Clinical laboratory records- Modern laboratory set up - Quality control: Accuracy, Precision, and Reference values.

Unit-IV: Specimen collection

Clinical samples and specimens - Specimen collection, transport, storage and disposal – common laboratory infections - Anticoagulants: EDTA, Di-potassium salts of EDTA, double oxalate, single oxalate, sodium citrate and sodium fluoride.

Unit-V: Buffer and solution preparation

Acid - Base balance – Electrolytes - Buffer and pH- Preparation of solution: Normal, per cent and Molar solution - normal saline -Methods of measuring liquids.

Course Outcome:

CO 1 – Learn basic laboratory concepts and principles, know about the role of medical laboratory personnel, safety measures in laboratory, know about clinical born infections and personnel hygiene.
CO 2 – Acquire knowledge on sterilization methods and staining techniques.
CO 3 – Know about Quality control, Quality assurance and Instrumentation.
CO 4 – Get wide knowledge on Clinical samples, common laboratory infections and anticoagulants.
CO 5 – Calculate Normality, Molar and percent solutions. know about pH and methods to measure liquids.

Course prepared by: Dr. M. Rajesh

Course verified by: Dr. S. Suja, Associate Professor and Head

Title of the subject: Clinical Biochemistry **No of credits: 4**

Code No: 33A **No of teaching hours: 4hrs/week**

Course Objective:

- To provide knowledge about carbohydrate , lipid and nucleic acid metabolic disorders
- To offer knowledge about hemoglobin metabolism and associated diseases
- To give knowledge about functional tests of organs and clinical diagnosis of diseases by enzymatic assays
- To give basic knowledge about free radicals and antioxidants
- To provide awareness about Laboratory safety and regulations

Paper-IX

Unit- I: Clinical investigation of sugar levels in blood and urine; factors influencing blood glucose level, Glycosylated hemoglobin; carbohydrate tolerance tests-procedures and interpretation. Biochemical basis of Diabetes, glycogen storage diseases; carbohydrate metabolic disorders. Disorders associated with lipid metabolism and its therapeutic intervention, ketone bodies and ketosis; Fatty liver, Atherosclerosis, biochemical basis of Jaundice.

Unit II: Heme metabolism associated diseases- porphyrias, porphyrinurias, sickle cell anemia, thalassemia. Disorders of nitrogen metabolism - Assimilation and excretion of nitrogen with reference to ammonia, urea, uric acid, creatine, creatinine - excretion of nitrogenous waste products - abnormalities of nitrogen metabolism including uremia, aminoaciduria-phenylketonuria, Alkaptonuria, Albinism.

Unit-III: Disorders of Nucleotide metabolism – Gout, Xanthinuria, orotic aciduria. Lesch-Nyhan syndrome. Biochemistry of cancer, carcinogens; oncogenes, proto-oncogenes and tumor suppressor genes; metastasis and cancer stem cells; Hemorrhagic disorders, disseminated intravascular coagulation, acquired prothrombin complex disorders. Trace elements and their deficiency. Free radicals - reactive oxygen species and reactive nitrogen species. Formation of free radicals- Oxidative stress- Free radical and diseases. Detection of free radicals. Antioxidants- Chemistry, mechanism, antioxidant effect of SOD, catalase, Glulathione Peroxidase. Antioxidant effects of Vit A, Vit C, Vit E, glutathione and selenium

Unit-IV: Functional tests of liver, kidney, thyroid, gastrointestinal and pancreas, biochemical diagnosis of diseases by enzymatic assays-ALP, SGOT, SGPT, creatinine, cholinesterase, creatine kinase and LDH. Metabolism of iron, calcium and phosphorus, disorders of acid base balance.

Unit-V: Laboratory safety and regulations:- Safety awareness for clinical laboratory personnel, Safety equipments, Biologic safety, Chemical safety, Radiation safety, Fire safety, Control of other hazards, Disposal of hazardous materials, Accident documentation and Investigation.

Reference Books

- Chatterjee and Shindae (2007). Text book of medical biochemistry, 7th edition.
- Devlin, T.M (2002). Text Book of Biochemistry with clinical correlations, 5th edition. NewYork.
- Gans, G and Murphy, J.M. (2008). Clinical Biochemistry, fourth edition, Churchill Livingstone, Elsevier.

- Gowenlock, A.H. and Donald, J (2002). Varley's practical clinical Biochemistry, sixth edition, CBS publications and Distributors, New Delhi.
- Sembulingam, K and Sembulingam, P (2010). Essentials of Medical Physiology, fifth edition. Jaypae Brothers (p) ltd, New Delhi.
- Burtis and Ashwood (2007) Tietz Fundamentals of Clinical chemistry, 6th edition, WB Saunders Company, Oxford Science Publications USA.

Course outcomes:

CO 1 - Students will acquire insight into disorders of carbohydrates, lipids and nucleic acid.
CO 2 -Students will learn about functional tests and enzymatic assays to diagnose the function of liver, kidney, thyroid, gastrointestinal and pancreas.
CO 3 .Students will gain knowledge about various disorders of nitrogen metabolism
CO 4- Students will learn about the disorders of hemoglobin metabolism
CO 5- Students will learn about the Clinical laboratory safety and regulations

Course prepared by: Dr. R.Kavitha

Course verified by: Dr. S. Suja, Professor and Head

Title of the subject: Recombinant DNA technology **No. of Credits:** 4

Code No: 33B **No. of Teaching Hours: 4 hrs /week**
Paper-X

Course objectives

- To study about the DNA modifying enzymes and Vectors used in recombinant DNA technology
- Understanding the cloning strategies and preparation of probes. In addition, acquiring thorough knowledge about confirmation of rDNA expression by various techniques, including blotting and immunological screening.
- Upon completion of the course, students might also be thorough about various types of sequencing techniques as well as on biotechnological applications of rDNA technology.

Unit-I: DNA modifying enzymes and their uses in Molecular Biology a) Restriction enzymes b) DNA Polymerase i) Klenow ii) DNA polymerase I iii) T4/T7 DNA Polymerase c) Reverse Transcriptase d) Terminal Transferases e) T4 Polynucleotide kinases & Alkaline phosphatase f) DNA dependent RNA polymerases. g) DNA ligases h) Nucleases: - Bal 31, S1 nucleases, DNase I, Mungbean nucleases, Ribonucleases, EXO III. Thermostable DNA polymerases used in PCR.

Unit-II: Host cells and Vectors- Host Cell Types (Prokaryotic and eukaryotic). Plasmid vectors for use in *E. coli* and Gram positive bacteria. Bacteriophage - Lambda and M13 vectors c) Cosmids d) Phagemids. Artificial chromosomes (YACs, PACs, BACs, MACs and HACs). Specialized vectors & their uses a) Expression vectors for Prokaryotes & Eukaryotes - Inducible vectors; vectors with tags (Histidine tags, signalling peptides for exportation), b) Gene fusion vectors.

Unit-III: Cloning strategies: DNA cloning a) Sticky ends b) Blunt ends c) Homopolymeric tailing d) Use of adapters & linkers. Methods of gene transfer into plant and animal cells: chemical, biological and mechanical methods. Construction of genomic DNA libraries (shotgun cloning) and cDNA libraries. Screening of recombinants - Antibiotic resistance, lacZ complementation (Blue-white selection), fluorescent markers (e.g. GFP). Preparation of radiolabelled/non-radiolabelled DNA & RNA probes. Southern/Northern/Western blot, dot blot and Zoo blot. Screening of genomic libraries with oligo-probe. Immunological screening for expressed genes.

Unit-IV: PCR – basic process, types and applications. DNA sequencing- Principle of chemical and enzymatic methods. Automated DNA sequencing, high throughput Pyrosequencing, next generation sequencing - Lynx Therapeutics' Massively Parallel Signature Sequencing (MPSS), Polony sequencing, Ligation based sequencing (SOLiD sequencing), Ion semiconductor sequencing, DNA nanoball sequencing, sequencing based on reversible dye-terminators (Illumina or Solexa sequencing), Real-Time DNA sequencing, Optical sequencing, Microchip based Sanger Sequencing of DNA, Deep sequencing. DNA footprinting, chromosome jumping, chromosome walking.

Unit-V: Biotechnological applications of rDNA technology: CRISPR-Cas9 gene editing, Synthesis and purification of proteins from cloned genes- Native and fusion proteins. Yeast expression system. Production of enzymes. Therapeutic products for use in human health care- insulin, growth hormones, TPA, alpha interferon, Hepatitis B vaccine and Factor VIII. Medical and forensic applications of rDNA technology- DNA Profiling, Multiplex PCR, Diagnosis of inherited disorders and infectious diseases, diagnosis and management of cancer. Treatment using rDNA technology- gene therapy. Gene therapy for ADA and cystic fibrosis.

Reference Books:

- Principles of Gene Manipulation and Genomics – 2013 by Sandy B. Primrose, Richard Twyman; Publisher: Wiley-Blackwell; 7 edition.
- Molecular Cloning: A Laboratory Manual (3 Volume Set): 4th Edition – 2013 by Michael R Green, Joseph Sambrook; Publisher: Viva Books Private Limited
- Gene Cloning and DNA Analysis: An Introduction – 2016 by T. A. Brown; Publisher: Wiley-Blackwell; 7th edition
- Gene cloning and DNA analysis: an introduction (Dr. Hansie peterson) – 2015 by Dr. Hansie Peterson; Publisher: Koros
- Gene Cloning -2006 by Julia Lodge, Peter Lund, Steve Minchin; Publisher: Taylor & Francis; 1 edition
- An Introduction to Genetic Engineering – 2008 by Desmond S. T. Nicholl; Publisher: Cambridge University Press; 3 edition.
- Next-Generation Genome Sequencing: Towards Personalized Medicine 1st Edition-2011 by Michal Janitz; Publisher: Wiley-Blackwell.
- Recombinant DNA: Genes and Genomes – 2007 by James D. Watson, Amy A. Caudy, Richard M. Myers and Jan A. Witkowski; Publisher: WH Freeman; 3rd ed.

Course Outcome:

CO 1 - The course material will provide clear understanding about DNA modifying enzymes and their uses in rDNA technology
CO 2 - Students will advance their knowledge on host cells and vectors that are highly suitable for rDNA based expression of desirable genes.
CO 3 - The course will provide detailed understanding of cloning strategies and various methods adapted for confirmation of rDNA expression.
CO 4 - Students will learn about advances in sequencing techniques and their advantages.
CO 5 - Course material provides detailed understanding of Biotechnological applications of rDNA technology.

Course prepared by: Dr. S. Selvakumar

Course verified by: Dr. S. Suja, Professor and Head

Title of the subject: Pharmacology and Toxicology **No of credits: 4**

Code No: 33C **No of teaching hours 4 hours/week**

Paper-XI

Course Objectives:

- To study about the basic principles about pharmacokinetics, routes of drug administration
- Understanding the mechanism of drug action, drug receptor interactions, factors affecting the drug receptor interaction
- This course also provides knowledge about drug discovery process, ethical issues and preclinical toxicological studies

UNIT-I: General Principles: Basic principles of drug action-Pharmacokinetics:Absorption, distribution and elimination of drugs, routes of drug administration. Pharmacogenetics. origin of drug from plants and animals.

UNIT-II: Drug metabolism – general pathways of drug metabolism (different types of reaction in phase I and phase II with examples), metabolism and excretion of drugs. Mechanism of drug action, combined effect of drugs. Factors modifying drug action, tolerance and dependence.

UNIT-III: Pharmacodynamics - receptor concepts, theory, drug receptor interaction (DRI), Factors affecting DRI, Cholinergic and anticholinergic drugs, Adrenergic and adrenergic blockers, General anesthetics, Local anesthetics. Adverse reactions to drugs and common drug receptor interactions.

UNIT-IV: Principles of therapeutics: Chemotherapy of microbial diseases, Chemotherapy of fungal infections, Chemotherapy of parasitic infections, rational use of antibiotics. Application for New Drug Discovery (NDD) according to Indian Control Authority and USFDA guidelines. Ethical considerations in utilizing human subjects for drug discovery process. Helsinki‟s declaration.

UNIT-V: Toxicology: Principles of toxicology and treatment of poisoning. Heavy metals and antagonists. Non metallic environmental toxicants. Methods involved in the development of new drugs. Preclinical toxicological studies: Calculation of LD50 and ED50.Acute, subacute and chronic toxicity studies; Irwin profile test, Pre-clinical pharmacokinetic and dynamic studies.Lipinski‟s rule for drug like molecule, High throughput screening (in-vitro and in-vivo) for pre-clinical pharmacokinetic and pharmacodynamic studies.

Reference Books:

- Satoskar, R.S and Bhandarkar, S.D. (2000) Pharmacology and Pharmacotherapeutics, 13th edition, Vol. I and II, Popular Prakeshan PVT Ltd, Mumbai.
- Tripathi, K.D. (2013) Essentials of Medical Pharmacology, 7th edition, Jaypee brothers medical publishers, New Delhi.
- Rang, H.P., Dale, M.M., Ritter, J. and Flower, R.J. (2007) Pharmacology, 6th edition, Churchill Living Stone Elsevier.
- Barar, F.S.K. (2013) Text Book of Pharmacology, 1st edition, S.Chand and Company Pvt. Ltd.
- Brenner, G.M. and Stevens, C.W. (2010) Pharmacology, Reed Elsevier India Pvt. Ltd.
- Sharma, P.D. (2003) Toxicology, 2nd edition, Rastogi Publications, Meerut.
- Shargel,L. et al., 2012. Applied Biopharmaceutics and Pharmacokinetics, 6th Edition, McGraw-Hill Medical,
- Foreman,J.C. and Johansen,T.J. 1996. Text Book of Receptor Pharmacology,2nd Edition, CRC Press.

CO 1 – Students will understand about basic principles involved in pharmacokinetics and routes of drug administration
CO 2 – Students will gain knowledge on metabolism and excretion of drugs
CO 3 –. Students will understand mechanism of drug action, drug receptor interactions, Factors affecting the drug receptor interaction
CO 4 – Course will advance the knowledge of students on drug discovery process and ethical issues in drug discovery process
CO 5 – Students will gain knowledge in preclinical toxicological studies

Course prepared by: Dr. M.Rajesh and Dr. R. Kavitha

Course verified by: Dr. S. Suja, Professor and Head

Title of the subject: Biostatistics and Research Methodology No. ofCredits:4

Paper-XII Code No:33D No. of Teaching Hours: 4 hrs /week

Course objectives:

- To understand the statistical tools commonly used in biological research
- To assimilate the concepts of hypothesis testing and its importance in research
- To know the aspects fundamental to research and to understand the methods of research
- To know the nuances of technical writing of scientific documents like thesis and journal articles

UNIT I: Organising a statistical survey - Planning and executing the survey. Source of data - Primary and secondary data, Collection - observation; interview; enquiry forms, questionnaire schedule and check list. Classification and tabulation of data. Diagrammatic & graphic presentation of data.

UNIT II: Measures of central tendency; arithmetic mean, median, mode, quartiles, deciles and percentiles. Measures of variation: range, quartile, deviation, mean deviation, standard deviation. Correlation analysis: Scatter diagram, Karl Peason's coefficient of correlation and Spearman's rank method. Regression analysis.

UNIT III: Probability - definition, concepts, theorems (proof of the theorems not necessary) and calculations of probability. Theoretical, distributions. Binomial - Poisonn and normal distribution. Normal -importance, properties, conditions and constants of the distribution (proof not necessary). Simple problems.

UNIT IV: Sampling distribution and test of significance: Testing of hypothesis errors in hypothesis testing, standard error and sampling distribution. sampling of variables (large samples and small samples). Student's 't' distribution and its applications. Chi - square test & goodness of fit. Analysis of variance one-way and two-way classification, Duncans Multiple Range Test. Design of experiment - completely randomized block design.

UNIT V: Thesis writing, Publication in a scientific journal, Preparation of Abstract and manuscript. Contents-Preamble, the problem, objectives, hypothesis to be tested, study,design, setup, measurement procedures, analysis of data, organization of report; Displaying data tables, graphs and charts – preparation of project proposal: Thrust area – funding agencies (National and International) – kinds of research program in India and abroad – career development in laboratory research – principle and method of patenting.

References Books:

1. Statistical Methods, S.P.Gupta 45th Edition; Sultan Chand & Sons, 2018
2. Biostatistics – A foundation for analysis in health science Danien. 10th Edition, Wiley, 2013.
3. Biostatistical analysis - Jerrold H.Zar. Pearson Education, 5th Edition Pearson Education, 2010
4. An Introduction to Bio-Statistics - Sundar Rao, Jesudian Richard, PHI Learning, 2012
5. Bio-statistics Alvin E. Lewis, (Illustrated edition) McGraw-Hill, 2013
6. Fundamentals of Statistics - S.P.Gupta, (7th Edition edition) Himalaya Publishing House, 2016

7. MS office; Sexena S, 1st Edition, Vikas Publishing, 2007
8. Statistical methods; Snedecor GW and Cohran WG, Oxford and IBH publishing CO Pvt. Ltd.
9. Biometry; Sokal RR and Rohlf FJ, Freeman WH publishing House, 2012
10. Biostatistical analysis; Zar JH, Prentice Education Limited, 2013

Course Outcome:

CO 1 – Helps to collect data and organize the data
CO 2 – Gives a clear understandingabout thebasic statistical analysis
CO 3 – A Clear Knowledgeon probability and its application
CO 4 – Provides the sampling distribution techniques and its analysis
CO 5 – Gives an ideaabout thesis writing,funding agencies and patenting

Course Prepared by: Dr. S. Suja

Course verified by: Dr.S.Suja,Professor and Head

Title of the subject:BIOINFORMATICS **No. of Credits:** 4

Code No : 3EC **No. of Teaching Hours: 4 hrs /week**

Paper-Elective-3

Course objectives

- The basic objective is to give students an introduction to the basic practical techniques of bioinformatics.
- Emphasis will be given to the application of bioinformatics and biological databases to problem solving in real research problems.

Unit-I: History and development of computers, mainframe, mini and super computer systems. Principles of computing: Operating systems, Basic word processing and database management soft wares: LOTUS, DBASE, Wordstar, and other scientific application packages. Data acquisition and management**:** Types of data-DNA, RNA and protein sequences, protein structure data, gene and protein expression data

Unit-II: Programming in PERL - introduction, variables and data types, Basic operators and control structures, scalars, arrays, lists, hashes, file manipulation, regular expression, patterns, input and output, HTML: basic codes for a web-page. Systems biology: Introduction - Integrating networks. Methods for prediction of tertiary structure of proteins-knowledge based structure prediction, fold recognition Suggested.

Unit-III: Databases: Biological databases (Eg. Genbank, SWISSPROT, PDB, etc) - searching and retrieving data form databases- FASTA – BLAST: parameters and its types. Sequence analysis with acquired data: Sequence comparison with pair wise and multiple sequence alignment. Deducing phylogenetic relationships from multiple sequence alignment. phylogenetic analysis. Genome sequencing projects.

Unit-IV: Bioinformatics in structure analysis: Format of a protein structure data - Primary, secondary (alpha helix and Beta sheet), Tertiary, quarternary structure of protein molecules molecular visualization tools: rasmol, SWISS PDB viewer. Predicting protein structure: comparative modelling. Profiles and motifs. Phi, psi angles. Ramachandran plot. Bioinformatics and drug discovery.

Unit-V: Basic knowledge of compuer systems software and programming languages. Application and advantages of Unix/Linux in bioinformatics.Programming in C: Basic algorithms – flowcharts - Arithmetic Examples.

Reference Books:

1. Bioinformatics-A beginner‟s guide by Jean – Michel Claverie and Cedric Notredame, Wiley-Dream Tech India Pvt. Ltd.
2. Developing bioinformatics computer skills by Cynthia Gibas and Per Jambeck, O‟ Reilly publications.
3. Introduction to bioinformatics by T.K. Attwood and D.J. Parry –smith, Pearson Education Asia.
4. Bioinformatics by David.W.Mount, CBS publishers and distributers.
5. Instant notes in bioinformatics by D.R. Westhead, J.H.Parish and R.M.Twyman

Course Outcome:
A student completing a major in Bioinformatics shall be able to apply:

CO 1 - knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics
CO 2 - existing software effectively to extract information from large databases and to use this information in computer modeling
CO 3 - problem-solving skills, including the ability to develop new algorithms and analysis methods
CO 4 - an understanding of the intersection of life and information sciences, the core of shared concepts, language and skills the ability to speak the language of structure-function relationships, information theory, gene expression, and database queries

Title of the subject: Biology of Cancer and Stem cell **No. of Credits:** 4

Code No : 3ED **No. of Teaching Hours: 4 hrs /week**

Paper-Elective-3

Course objectives

- To update knowledge on types of cancer, causes of cancer as well as on molecular mechanism of carcinogenesis.
- To be familiar with various methods used for cancer diagnosis and on therapeutic strategies used to control tumor cell proliferation.
- To become updated on types of stem cell, its characterization, pluripotency and niche specification.

Unit-I: Introduction to Cancer: Definition; Cancer incidence and mortality; Origin of neoplastic cells; Cancer as cellular disease; Types of Cancer: Benign Tumors Vs. Malignant Tumors, Common Symptoms, Causes of Cancer: Carcinogenesis-Chemical and Irradiation; Oxygen Free Radicals, Aging and Cancer; Genetic Susceptibility and Cancer; Viral Carcinogenesis.

Unit-II: Molecular Mechanism of cancer: protooncogenes, oncogene, tumour suppressor genes involved in cancer, errors in cell cycle (Cyclins and CDKs). Apoptosis in cancer – mechanism of apoptosis, intrinsic and extrinsic pathways. Principles and methods of cancer diagnosis-Biochemical, genetic, cytotoxic, cell growth and viability tests, cancer biomarkers.

Unit-III: Cancer, Diagnosis & Therapy: Tumor Markers; Gene Expression Microarrays; Proteomic Methods; Circulating Epithelial Cells; Circulating Endothelial Cells and Endothelial Progenitor Cells; Molecular Imaging; Haplotype Mapping. Cancer therapy: Surgery, Radiotherapy, Chemotherapy, Hormone therapy, Immune, Prodrug and Targeted therapies.

Unit-IV: Introduction to Stem Cell: Definition, Types of Stem cell, characterization, pluripotency, niche specification – Drosophila germ line stem cells, self-renewal and

differentiation, tooth primordia, gut specifications. Occurrence of stem cell in mammals: In Mesenchymal cells - Hemangioblasts, skeletal muscle cells, adipose cells, bladder cells; In Epidermal cells – skin, mammary gland, dental and neural cells; In Endodermal cells – liver, GI tract, pancreatic cells

Unit-V: Embryonic Stem Cells: Blastocyst and inner cell mass cells, Organogenesis, Adult versus embryonic stem cells, post genomic adult stem cells, stemness, characteristics, hierarchy, stem cell niche; Adult stem cell from amniotic fluid and cord blood; induced pluripotency stem cells (ips cells).-Stem cell characterization techniques and cryopreservation

References:

- Principles of Cancer Biology – 2016 by Kleinsmith; Publisher: Pearson Education India; First edition
- Molecular biology of cancer, 3rd edition – 2014 by Pecorino; Publisher: Oxford University Press
- The Biology of Cancer – 2013 by Robert Weinberg; Publisher: W. W. Norton & Company; 2nd edition
- The Molecular Basis of Human Cancer – 2018 by William B. Coleman (Editor), Gregory J. Tsongalis; ublisher: Humana Press Inc.; Softcover reprint of the original 2nd ed. 2017 edition.

- Molecular Biology of Cancer: Mechanisms, Targets, and Therapeutics– 2012 by Pecorino; Oxford University Press; 3rd edition.
- Stem Cells: Current Challenges and New Directions (Stem Cell Biology and Regenerative Medicine) – 2013 by Kursad Turksen; Publisher: Humana Press; 2013 edition.
- Stem Cells: Research and Development – 2016 by Rex Turner; Publisher: Hayle Medical.
- Adult Stem Cells: Biology and Methods of Analysis (Stem Cell Biology and Regenerative Medicine) – 2014 by Donald G. Phinney; Publisher: Humana Press.
- Human Embryonic Stem Cells – 2010 by Arlene Chiu (Editor), Mahendra S. Rao; Publisher: Humana Press

Course Outcome:

CO 1 - Students will become updated on types of cancer, causes of cancer as well as on molecular mechanism of carcinogenesis.
CO 2 - The course will help in detailed understanding of cancer, its diagnosis & therapy.
CO 3 - Course material provides understanding on types of stem cell, its characterization, pluripotency and niche specification.

Course prepared by: Dr. S. Selvakumar

Course verified by: Dr.S. Suja, Professor and Head

Title of the subject: Clinical Diagnosis in Health and Diseases No. of Credits: 2

Code No: GS109 No. of Teaching Hours: 2hrs /week

Course objectives:

- The main objective of this course is to introduce basic concepts in Clinical diagnosis in health and diseases.
- This course emphasizes to understand about analysis of body fluids and detection of body metabolites. Based on this, the course aims to give adequate exposure to know about liver, heart, brain, lung and kidney function test.
- Bacterial viral fungal infections provide the learner to know about the pathogens which cause diseases. The course teaches about non-communicable diseases. These topics provides knowledge in clinical diagnosis in health and diseases.

Supportive-3

Unit-I: General health analysis

Introduction: General health, syndrome and common diseases – communicable and noncommunicable diseases. Samples for analysis: Blood, urine, pleural fluid, synovial fluid, cerebro spinal fluid and tissues and histology. General checkup: Blood group, Hb, height and weight, waist to hip ratio, electro cardio gram, X-ray, abdomen scan and appearance of scars, urine analysis – routine analysis (protein, sugar, pigments and cells).

Unit-II: **Clinical Assays**

Detection of metabolites and its importance. Tests for liver function: Enzyme assay (SGOT, SGPT, Alkaline phosphatase, GGT), Total protein, albumin /globulin ratio and their significance. Test for kidney function: Urea and creatinine estimation and their significance.

Unit-III: Clinical diagnosis

Test for heart function: Blood pressure (cystolic and diastolic), lipid profile (cholesterol, triglycerides, HDL, LDL estimation) and their importance. Test for lung function: Chest X-ray, Spirometry. Test for Brain function: EEG, MRI, CT. Test for Surgery: Bleeding time, clotting time. Special test: X-ray, CT, MRI, Doppler, TMT, angioplasty.

Unit-IV: Clinical infections

Infection: Bacterial, viral, fungal and protozoans. Blood: Total cell count, differential count, erythrocyte sedimentation rate. Infectious diseases: Tuberculosis, Leprosy, Malaria, Hepatitis, Cholera, Dengue, HIV, Chikungunya and H1N1. TORCH – Panel (infertility profile), Infection in pregnancy, Koch postulations – Microscopic examination of body fluids, ELISA and PCR tests.

Unit-V: Non-communicable diseases and cancer markers

Non communicable diseases: Diabetes: Blood sugar, urine sugar, glucose tolerance test, HbA1c. Hyper tension: Lipid profile, electrolyte (sodium, potassium, chloride and biocarbonate) investigation. Cancer markers: ELISA and DNA Probs.

Reference Books

- Chatterjee and Shindae (2007). Text book of medical biochemistry, 7th edition.
- Devlin, T.M (2002). Text Book of Biochemistry with clinical correlations, 5th edition. NewYork.
- Gans, G and Murphy, J.M. (2008). Clinical Biochemistry, fourth edition, Churchill Livingstone, Elsevier.
- Gowenlock, A.H. and Donald, J (2002). Varley's practical clinical Biochemistry, sixth edition, CBS publications and Distributors, New Delhi.
- Sembulingam, K and Sembulingam, P (2010). Essentials of Medical Physiology, fifth edition. Jaypae Brothers (p) ltd, New Delhi.
- Burtis and Ashwood (2007) Tietz Fundamentals of Clinical chemistry, 6th edition, WB Saunders Company, Oxford Science Publications USA

Course Outcome:

CO 1 – Learn about general health and common diseases, to learn how to analyse the samples (Blood, urine, pleural fluid, synovial fluid, cerebro spinal fluid and tissues and histology)
CO 2 – Acquire knowledge on detection of body metabolites and its importance, liver function and kidney function.
CO 3 – Know about heart function, lung function test.
CO 4 – Get wide knowledge on Bacterial viral and fungal infections.
CO 5 – Know about Non communicable diseases and cancer markers.

Course prepared by: Dr. M. Rajesh

Course verified by: Dr. S. Suja, Professor and Head

Title of the subject: Clinical Biochemistry and Molecular Biology No of credits: 4

Code No: 33P No. of Teaching Hours: 6hrs /week

Practical-III

Clinical Biochemistry

1. Differential, cell count
2. Blood sugar determination by glucose oxidase method
3. Estimation of bilirubin
4. Estimation of blood urea
5. Estimation of serum enzymes - Creatine phosphokinase (CPK), ALP, AST , SGPT and SGOT
6.Normal and abnormal constituents of urine
7. Determination of Lipid Profile
8. Estimation of glycosylated haemoglobin
9. Estimation of total protein and albumin from serum

Molecular Biology Lab

1. Subcellular fractionation of organelle
2. Bacterial Transformation
3. Isolation of DNA from E. coli/ liver/ plant
4. Agarose gel electrophoresis of DNA
5. Restriction digests of DNA.
6. Isolation of plasmid
7. Separation of serum protein by SDS -PAGE
8. Western blotting

Reference books:

1. Experiments in Molecular Biology-R. J. Slater, Humana Press, 1986.
2. Molecular cloning -Sambrook and Russell, Cold Spring Harbor Laboratory Press, 2001
3. Practical Biochemistry- Keith Wilson and John Walker, Cambridge University Press, 1997.
4. Practical Biochemistry- David T Plummer, Tata McGraw-Hill, 1988.
5. Experimental Biochemistry- B. S. Rao and V. Deshpande, I.K. International Pvt. Ltd.
6. Practical Biochemistry- David T Plummer, Tata McGraw-Hill, 1988

Title of the subject: Plant Biochemistry and Environmental Biotechnology

No of credits: 4

Code No: 43A **No. of Teaching Hours: 4hrs /week**

Objective

- This course emphasizes to learn about principles involved in photosynthesis process and types
- The course aims to give exposure to learn the concepts involved in plant tissue culture, secondary metabolite production and genetic transformation techniques for the generation of transgenic plants
- This course provides basic concepts about environmental pollution
- This course also provides knowledge about Disaster management

Unit-I: Photosynthesis –organization of thylakoid; role of photosynthetic pigments; light absorption and energy conservation.Light absorption by pigment molecules; the reaction centre complex. The photo systems I and II; cyclic and noncyclic photophosphorylation.Carbon reactions in C3, C4 and CAM plants - Calvin cycle; Hatch-Slack pathway. pathways of glucose oxidation in plants; starch biosynthesis and degradation; .Photorespiration: role of photorespiration in plants.

Unit-II: Nitrogen fixation – symbiotic and non-symbiotic. Symbiotic nitrogen fixation in legumes by Rhizobia– enzymology of nitrogen fixation; regulation of nif and nod genes of nitrogen fixation. Interaction between nitrate assimilation and carbon metabolism. Sulphur chemistry and functions; reductive sulfate assimilation pathway. Synthesis and function of glutathione and its derivatives. Metabolic transport between organelles.

Unit-III: Plant cell and tissue culture. Tissue culture media-composition and preparation. Micropropagation; somoclonal variation. callus. Protoplast culture-isolation and purification of protoplast. Alkaloids, Flavanoids, terpenoids, phenol- Nature, distribution and functions. Production of secondary metabolites in plants, elicitation, Gene transfer to plant; *Agrobacterium* mediated transformation-Ti plasmids, Ri plasmids, Direct DNA transfer to plants- Protoplast transformation, Plant viruses as vectors- CAMV, Gemini viruses, RNA viruses (TMV, Potato virus X) as vectors. Advantages and uses of transgenic plants.

Unit-IV: Concept of Ecology and Ecosystem: Environmental pollution-water, soil, air, noise and thermal. Global environmental problems – Greenhouse effect, reforestration through micropropagation, biodiversity, species conservation. Treatment of Waste water from distillery, dairy and tannery industries –parameters – BOD, COD, TSS, TDS - physical, chemical and biological wastewater treatment - primary, secondary and tertiary treatment - Solid waste management.

Unit-V: Disaster management: Types of environmental hazards and Disasters; Natural - volcanic eruption, earthquakes, landslides, cyclones, lightning, hailstorms; Man Induced Hazards - Soil erosion, chemical hazards, sedimentation problems, biological hazards. Disaster management - pre-disaster stage (preparedness), emergency stage, post disaster stage (rehabilitation); Integrated approach- role of Institutions and Media.

Reference books

- Buchanan, B.B., Gruissem,W. and Jones, R.L., (2002); Biochemistry and Molecular Biology of Plants; ISBN: 978-0-943088-39-6; American Society of Plant Physiologists, 2 nd Indian Reprint (2007), I.K. International Pvt. Ltd. N. Delhi.
- Russell Jones, Helen Ougham, Howard Thomas, Susan Waaland, (2012), The Molecular life of Plants, ISBN 978-0-470-87011-2; Wiley-Blackwell Publishers
- Heldt Hans-Walter and Birgit Piechulla, (2011); Plant Biochemistry, 4th Edition, Elsevier Academic Press Publication, USA.
- Srivastava, H.S. (2006), Plant Physiology, Biochemistry and Biotechnology,Rastogi Publications, Meerut.
- Chawla,H.S. (2004) Introduction to plant Biotechnology, Science Publishers, Plymouth,U.K.
- Razdan, M.K. (2007), Introduction to Plant Tissue culture, II edition, Oxford and IBA Publications Co Pvt Ltd.
- Ghosh, G.K.(2007), Disaster Management, 1st edition, Delhi
- Wang, L.K. (2010), Environmental Biotechnology, 1st edition, A Product of Humana Press.
- Dubey,R.C. (2010) A textbook of Biotechnology, S.Chand and Company Ltd, New Delhi
- Saikia,R., Bezbarrah,R.L.,Bora,T., (2008) Microbial Biotechnology, New India Publishing agency, New Delhi

Course Outcome:

On successful completion of the course, students can able to

Co 1: Students will able to know photosynthesis process and types

Co 2: Students will learn about nitrogen fixation in plants and enzymology of nitrogen fixation.

Co 3:Students know about plant tissue culture, plant secondary metabolites, elicitation and methods involved in gene transfer of plants

Co 4:Students will learn about types of environmental pollution

Co 5:Students will learn about Disaster management

Course prepared by: Dr.M.Rajesh

Course verified by: Dr. S. Suja, Professor and Head