

THIRUVALLUVAR UNIVERSITY

BACHELOR OF SCIENCE

B.Sc. BIOCHEMISTRY

UNDER CBCS

(With effect from 2021 - 2022)

The Course of Study and the Scheme of Examinations

S. No.	Part	Study Components		Ins. Hrs / week	Credit	Title of the Paper	Maximum Marks		
		Course Title					CIA	Uni. Exam	Total
SEMESTER I									
1.	I	Language	Paper-1	6	4	Tamil/Other Languages	25	75	100
2.	II	English (CE)	Paper-1	6	4	Communicative English I	25	75	100
3.	III	Core Theory	Paper-1	6	4	Cell biology	25	75	100
	III	Core Practical	Practical-1	4	0	Titrimetric and Qualitative analysis	0	0	0
4.	III	Allied -1	Paper-1	4	3	Chemistry I	25	75	100
	III	Allied- 1	Practical-1	2	0	Chemistry I & II	0	0	0
5.	III	PE	Paper 1	6	3	Professional English I	25	75	100
6.	IV	Environmental Studies		2	2	Environmental studies	25	75	100
		Sem. Total		36	20		150	450	600
SEMESTER II									
7.	I	Language	Paper-2	6	4	Tamil/Other Languages	25	75	100
8.	II	English (CE)	Paper-2	6	4	Communicative English II	25	75	100
9.	III	Core Theory	Paper-2	5	4	Biomolecules	25	75	100
10.	III	Core Practical	Practical-1	3	2	Titrimetric and Qualitative analysis	25	75	100
11.	III	Allied-1	Paper-2	4	3	Chemistry II	25	75	100
12.	III	Allied Practical - 1	Practical-1	2	2	Chemistry I & II	25	75	100
13.	III	PE	Paper 1	6	3	Professional English II	25	75	100
14.	IV	Value Education		2	2	Value Education	25	75	100
15.	IV	Soft Skill		2	1	Soft Skill	25	75	100
		Sem. Total		36	25		225	675	900

S.NO	Part	Study Components		Ins. hrs /week	Credit	Title of the Paper	Maximum Marks		
		Course Title					CIA	Uni. Exam	Total
SEMESTER III									
16.	I	Language	Paper-3	6	4	Tamil/Other Languages	25	75	100
17.	II	English	Paper-3	6	4	English	25	75	100
18.	III	Core Theory	Paper-3	4	5	Analytical Biochemistry	25	75	100
	III	Core Practical	Practical-2	3	0	1. Colorimetry 2. Biochemical Preparation 3. Chromatographic Separation 4. Electrophoretic Technique	0	0	0
19.	III	ALLIED-2	Paper-3	4	3	(To choose 1 out of 2) 1. Microbiology I 2. Zoology I	25	75	100
	III	Allied Practical	Practical-2	3	0		0	0	0
20.	IV	Skill based Subject	Paper-1	3	2	First Aid	25	75	100
21.	IV	Non-major elective	Paper-1	2	2	Food & Nutrition	25	75	100
				30	20		150	450	600
SEMESTER IV									
22.	I	Language	Paper-4	6	4	Tamil/Other Languages	25	75	100
23.	II	English	Paper-4	6	4	English	25	75	100
24.	III	Core Theory	Paper-4	4	4	Plant Biochemistry	25	75	100
25.	III	Core Practical	Practical-2	3	3	1. Colorimetry 2. Biochemical Preparation 3. Chromatographic Separation 4. Electrophoretic Technique	25	75	100
26.	III	ALLIED-2	Paper-4	4	3	(To choose 1 out of 2) 1. Microbiology II 2. Zoology II	25	75	100
27.	III	Allied Practical-2	Practical-2	3	2		25	75	100
28.	IV	Skill based Subject	Paper-2	2	2	Biostatistics	25	75	100
29.	IV	Non-major elective	Paper-2	2	2	Life style diseases and prevention	25	75	100
				30	24		200	600	800
SEMESTER V									
30.	III	Core Theory	Paper-5	6	6	Enzymes and Intermediary Metabolism	25	75	100
31.	III	Core Theory	Paper-6	6	5	Molecular Biology	25	75	100

S.NO	Part	Study Components		Ins. hrs /week	Credit	Title of the Paper	Maximum Marks		
		Course Title							
32.	III	Core Theory	Paper-7	6	5	Physiology and Nutrition	25	75	100
	III	Core Practical	Practical-3	3	0	1. Colorimetric Estimations 2. Enzyme Assay	0	0	0
	III	Core Practical	Practical-4	3	0	1. Hematology 2. Microbiology 3. Urine Analysis	0	0	0
33.	III	Internal Elective	Paper-1	3	3	Molecular Endocrinology	25	75	100
34.	IV	Skill based Subject	Paper-3	2	2	Medical Lab technology	25	75	100
				30	21		125	375	500
SEMESTER VI							CIA	Uni. Exam	Total
35.	III	Core Theory	Paper-8	5	5	Clinical Biochemistry	25	75	100
36.	III	Core Theory	Paper-9	5	5	Biotechnology	25	75	100
37.	III	Core Practical	Practical-3	3	3	3. Colorimetric Estimations 4. Enzyme Assay	25	75	100
38.	III	Core Practical	Practical-4	3	3	1. Hematology 2. Microbiology 3. Urine Analysis	25	75	100
39.	III	Core Project		5	5	(Individual / Group Project)	25	75	100
40.	III	Internal Elective	Paper-2	3	3	Immunology	25	75	100
41.	III	Internal Elective	Paper-3	3	3	Pharmaceutical Biochemistry	25	75	100
42.	IV	Skill based Subject	Paper-4	3	2	Research Methodology	25	75	100
43.	V	Extension Activities		-	1		100	0	100
				30	30		300	600	900
					140				4300

Part	Subject	Papers	Credit	Total Credits	Marks	Total Marks
Part I	Languages	4	4	16	100	400
Part II	Communicative English & English	4	4	16	100	400
Part III	Allied (Odd Semester)	2	3	6	100	200
	Allied (Even Semester)	2	5	10	100	200

	Allied Practical	2	2		100	200
	Electives	3	3	9	100	300
	Core	9	(3-5)	43	100	900
	Core practical	4	(2-3)	11	100	400
	Professional English	2	3	6	100	200
	Compulsory Project (Group/Individual Project)	1	5	5	100	100
Part IV	Environmental Science	1	2	2	100	100
	Soft skill	1	1	1	100	100
	Value Education	1	2	2	100	100
	Lang. & Others /NME	2	2	4	100	200
	Skill Based	4	2	8	100	400
Part V	Extension Activities	1	1	1	100	100
	Total	43		140		4300

THIRUVALLUVAR UNIVERSITY
B.Sc. BIOCHEMISTRY

SYLLABUS
UNDER CBCS
(With effect from 2020-2021)

SEMESTER I

PAPER - 1

CELL BIOLOGY

At the end of the course, the student will be able to

CO NUMBER	CO Statement
CO1	Explain the structures and functions of basic components of prokaryotic and eukaryotic cells
CO2	Describe the structure, function and composition of cell membrane and communicate the types and mechanism of membrane transport
CO3	Discuss the structure and functions of cellular organelles
CO4	Understand the types of microfilaments and mitochondria
CO5	Describe nucleus and nucleolus ,Illustrate the phases of cell cycle; in particular mitosis and describe the significance of meiosis in genetic diversity
	Relate the structure and biological role of extra cellular matrix and cell -cell junction with physiological processes

UNIT - I

15 hrs

An overall view of cells - origin and evolution of cells. Cell theory. Classifications of cell - Prokaryotic and Eukaryotic cells. Differences between prokaryotic and eukaryotic cells. Scope of cell biology

UNIT - II

15 hrs

Cell membrane- Evolution, Fluid Mosaic Model of membrane structure. Membrane proteins and their properties. Membrane carbohydrates and their role. Transport mechanism –Uniport, Symport and Antiport. Simple, facilitated diffusion, active and passive transport.

UNIT – III

15 hrs

Endoplasmic reticulum - types, structure and functions. Golgi apparatus- structures and functions. Ribosomes - types, structure and functions. Lysosomes- structure and functions.

UNIT - IV

15 hrs

Cytoskeleton: Types of filaments and their functions. Microfilaments and Microtubules: Chemistry and function (esp. cilia and flagella). Actin and Myosin. Mitochondria: Structure and function

UNIT – V

15 hrs

Nucleus and nucleolus- structure and functions .Chromosome-chromatin structure, the cell cycle - phases of cell cycle. Meiotic and mitotic cell divisions, cell- cell communications, cell recognition, cell adhesion and cell functions.

REFERENCES

1. Rastogi . S.C. Cell Biology. Newage Publishers, (2008).
2. Devasena.T, Cell Biology, Oxford University Press India First edition (2012).
3. Cooper, G.M. and Hausman, R.E. The Cell: A Molecular Approach Sinauer Associates, Inc 6th edition (February 1, 2013)
4. Verma.P.S and Agarwal.V.K. Cell biology, Genetics, Molecular biology, Evolution and Ecology, S.Chand & Co Ltd, 2004

SEMESTER I

CORE PRACTICAL-1 PRACTICAL-1

Course Outcomes: At the end of the Course, the Student will be able to:

CO NUMBER	CO STATEMENT
CO1	Qualitatively analyze the carbohydrates and amino acids and report the type of carbohydrate based on specific tests
CO2	Differentiate the carbohydrates based microscopic examination of the crystal structure.
CO3	Quantify glucose by benedicts method
CO4	Quantify ascorbic acid in lemon by Dichlorophenol indo phenol dye method
CO5	Quantify glycine by Sorenson's formol titration method
CO6	Determine lipid properties of unsaturation and fatty acid content by SAP number and iodine number

I. QUALITATIVE ANALYSIS

A) Qualitative analysis of Carbohydrates

1. Qualitative analysis of Glucose,
2. Qualitative analysis of Fructose,
3. Qualitative analysis of Arabinose/Xylose,
4. Qualitative analysis of Maltose,
5. Qualitative analysis of Sucrose
6. Qualitative analysis of Starch
7. Qualitative analysis of unknown sugar.

B) Qualitative analysis of Amino acids

1. Qualitative analysis of Arginine,
2. Qualitative analysis of Cysteine,
3. Qualitative analysis of Tryptophan
4. Qualitative analysis of Tyrosine
5. Qualitative analysis of unknown amino acids.

II. QUANTITATIVE ANALYSIS:

1. Estimation of ascorbic acid using 2, 6 – dichlorophenol indophenol as link solution, present in unknown solution

2. Estimation of Glycine by Sorenson formal titration.
3. Determination of glucose by Benedict's method.

DEMONSTRATION EXPERIMENTS

1. Determination of SAP number.
2. Determination of Acid number.

TEXT BOOKS/ REFERENCE BOOKS

1. J. Jayaraman, Laboratory Manual in Biochemistry, New Age International Pvt Ltd Publishers, 2011.
2. S. K. Sawhney Randhir Singh, Introductory Practical Biochemistry, Alpha Science International, Ltd 2 edition, 2005.
3. Irwin H.Saegal, Biochemical calculations, Liss, Newyork, 1991

ALLIED - 1
PAPER - 1

CHEMISTRY I

OBJECTIVE:

- Basic knowledge on Metallurgy, Cycloalkanes, Polarising Effects, Stereochemistry, Chemical Kinetics, Catalysis, Photochemistry, VSEPR Theory, Fuels, Osmosis, Nuclear Chemistry, Petroleum Chemistry, Chemistry of Naphthalene, Conductors and Applications wherever necessary are to be taught for I- Semester.

UNIT – I

1.1 General Metallurgy - Extraction of Metals - Minerals and Ores- Difference between Minerals and Ores – Minerals of Iron, Aluminum and Copper - Ore Dressing or Concentration of Ores - Types of Ore Dressing- Froth Floatation process, Gravity separation and Magnetic separation.

1.2 Calcination, Smelting, Roasting, Flux, Slag - Definition - Reduction methods - Goldschmidt Aluminothermic process and Carbon Reduction method - Refining of Metals - Electrolytic, Van Arkel and Zone Refining.

1.3 Ores of Titanium and Cobalt - Extraction of Titanium and Cobalt.

UNIT – II

1. Cycloalkanes - Preparation – Wurtz reaction and Dieckmann's condensation - Properties of Cycloalkanes – Substitution and Ring opening reactions.

2.2 Polarisation - Inductive effect, Mesomeric effect and Steric effect (Acid and Base Strength).

2.3 Stereoisomerism – Types - Cause of Optical Activity – Enantiomers - Diastereomers - Meso form - Optical Activity of Lactic acid and Tartaric acid - Racemisation and Resolution – Definition and Methods - Geometrical isomerism – Definition and example - Maleic and Fumaric acid – Differences.

UNIT – III

3.1 Chemical Kinetics – Rate of a reaction – Definition of Order and Molecularity – Distinction between Order and Molecularity - Derivation of First order rate equation - Half Life Period of first order reaction.

3.2 Catalysis - Catalyst - Autocatalyst - Enzyme catalyst - Promoters - Catalytic poisons –

Active Centre - Differences between Homogeneous and Heterogeneous Catalysis - Industrial Applications of Catalysts.

3.3 Photochemistry – Grothus-Draper's law – Stark-Einstein's law - Quantum yield – Photosynthesis - Phosphorescence – Fluorescence.

UNIT – IV

4.1 VSEPR Theory – Hybridisation and Shapes of simple molecules BF_3 , PCl_5 , SF_6 and XeF_6 .

4.2 Fuels – Classification of Fuels - Calorific value of Fuels – Water gas, Carbureted Water gas and Producer gas – Composition and Uses - Non-Conventional fuels - Need of Solar Energy - Applications - Biofuels – Oil gas, Natural gas and LPG – Uses.

4.3 Osmosis - Osmotic pressure - Reverse osmosis – Definition - Desalination of Sea water.

UNIT – V

5.1 Nuclear Chemistry – Atomic number, Mass number - Isotopes, Isobars and Isotones – Definition and Examples - Definition of Half life period - Nuclear Binding Energy, Mass Defect and N/P ratio - Nuclear Fission and Nuclear Fusion (Elementary idea) - Applications of Radioisotopes in Medicine, Agriculture and Industries – Carbon Dating.

5.2 Crude Oil - Petroleum - Petroleum Refining - Cracking - Applications of Cracking –
Naphthalene – Preparation – Haworth's method – Properties – Oxidation, Reduction and Uses of Naphthalene - Structure of Naphthalene (Structural elucidation not necessary).

5.3 Conductors, Insulators, Semiconductors, N- and P- Type Semiconductors – Definitions and Examples.

SEMESTER II

CORE THEORY PAPER – 2

BIOMOLECULES

OBJECTIVE

To understand the importance, structure, properties and functions of various biomolecules.

COURSE OUTCOMES

CO NUMBER

CO STATEMENT

- | | |
|-----|--|
| CO1 | To gain the knowledge about the classification, structure, properties and functions of carbohydrates. |
| CO2 | Able to understand the classification, structure, properties and importance of amino acids. |
| CO3 | To understand and gain knowledge about the classification of proteins, levels of structural organization of proteins and its properties. |
| CO4 | To gain insights about the types, structure and properties of nucleic acids. |
| CO5 | To acquire knowledge about the classification, structure and properties of different types of lipids. |

UNIT I: CHEMISTRY OF CARBOHYDRATES

15 hrs

Introduction -Definition of carbohydrates, classification – monosaccharide, oligosaccharides and polysaccharides; occurrence, structure and functions of monosaccharide (glucose and fructose).General properties with reference to glucose, anomer, epimer, enantiomer and mutarotation. Structure, occurrence, properties and biological importance of disaccharides (sucrose, lactose, maltose) and Polysaccharides-Storage polysaccharides (starch, glycogen), Structural polysaccharides (cellulose, chitin), Heteropolysaccharides (hyaluronic acid, heparin).

UNIT II: CHEMISTRY OF AMINOACIDS

15 hrs

Amino acids- structure and classification based on structure. Standard and non standard amino acids, Essential and non essential amino acid. Physical properties: isoelectric points and zwitter ion. General reactions of amino acids – Edman's reaction, Sanger's reaction, reaction with Dansyl chloride and Ninhydrin reaction.

UNIT III: CHEMISTRY OF PROTEINS

15 hrs

Definition, classification of proteins based on size, solubility, chemical composition functions, structure of proteins- peptide bond, primary, secondary, tertiary and quaternary structure of proteins, forces that determine folding and conformation and structural organization, Physical properties: salting in and salting out and denaturation.

UNIT IV: CHEMISTRY OF NUCLEIC ACIDS

15 hrs

Nucleic acids – Definition, bases, Nucleotides and Nucleosides, phosphodiester linkage; Nucleic acid types –DNA and RNA; structure- double helical structure of DNA; Properties of DNA – Denaturation, Renaturation, T_m and hyperchromicity, structure of RNA and its major types -tRNA, mRNA and rRNA.

UNIT V: CHEMISTRY OF LIPIDS

15 hrs

Introduction, definition and classification of lipids- simple, compound (phospholipids) and derived lipids (cholesterol). Classification of fatty acids – saturated fatty acids, unsaturated fatty acids. Physical property-emulsification. Chemical properties- saponification number, Rancidity, acid number, Iodine number and Reichert – Meissl number.

REFERENCES

1. Ambika shunmugam, “Fundamentals of Biochemistry(8th Edition)2016, Wolters Kluwer India Pvt Ltd
2. Dr.A.C.Deb, “Fundamentals of Biochemistry” (8th edition), Kolkata, New Central Book Agency
3. Nelson, D. L. & Cox, M. M. Lehninger Principles of Biochemistry. Freeman, 5th edn, 2008.
4. Harper’s Illustrated Biochemistry.30th edition -McGraw Hill
5. U.Sathayanarayana,(2006). Biochemistry. 3rd Edition by Books and Allied (P) Ltd., India.
6. Donald Voet and Judith Voet,”Biochemistry”,2nd edition,John Wiley & Sons,Inc,NY

**ALLIED - 1
PAPER - 2**

CHEMISTRY II

OBJECTIVE:

- Basic knowledge on Coordination Chemistry, Industrial Chemistry, Carbohydrates, Aminoacids, Proteins, Electrochemistry, Paints and Pigments, dyes, Vitamins, Medicinal Chemistry, Corrosion and Applications wherever necessary are to be taught for II- semester.

UNIT – I

1.1 Coordination Chemistry - Nomenclature of Coordination Compounds - Ligands, Central Metal Ion and Complex Ion – Definition and Examples – Coordination Number - Werner’s Theory of Coordination Compounds - Chelates - Functions and Structure of Haemoglobin and Chlorophyll.

1.2 Industrial Chemistry - Fertilisers and Manures – Biofertilisers - Organic Manures and their importance - Role of NPK in plants - Preparation and Uses of Urea, Ammonium Nitrate, Potassium Nitrite and Super Phosphate of Lime.

1.3 Contents in Match Sticks and Match Box - Industrial making of Safety Matches – Preparation and Uses of Chloroform, DDT, Gammexane and Freons.

UNIT – II

2.1 Carbohydrates - Definition and Examples - Classification – Oxidation and Reduction Reactions of Glucose - Structure of Glucose (Structural elucidation not necessary) - Uses of Starch - Uses of Cellulose Nitrate and Cellulose Acetate.

2.2 Amino Acids – Definition and Examples - Classification of Amino Acids - Preparation - Gabriel Phthalimide Synthesis – Properties – zwitterion and Isoelectric point - Structure of Glycine.

2.3 Proteins – Definition - Classification of Proteins based on Physical properties and Biological functions - Primary and Secondary Structure of Proteins (Elementary Treatment only) – Composition of RNA and DNA and their Biological role - Tanning of Leather - Alum (Aluminum chloride tanning) - Vegetable tanning – Chrome Tanning.

UNIT – III

3.1 Electrochemistry - Electrolytes – Definition and Examples – Classification - Specific and Equivalent Conductance - their determination – Variation of Specific and Equivalent conductance with Dilution – Ostwald’s Dilution Law and its Limitations.

3.2 Kohlrausch's Law - Determination of Dissociation Constant of weak Electrolytes using Conductance measurement - Conductometric titrations.

3.3 pH – Definition and pH determination by indicator method - Buffer solutions - Buffer action - Importance of buffers in the living systems.

UNIT – IV

4.1 Paints - Components of Paint – Requisites of a Good Paint - Pigments – Classification of Pigments on the basis of Colour – Examples - Dyes – Definition – Chromophores and Auxochromes – Examples - Colour and Dyes - Classification based on Constitution and Application – Examples.

4.2 Vitamins – Definition – Classification – Water Soluble and Fat Soluble – Occurrence - Biological Activities and Deficiency Diseases caused by Vitamin A, B, C, D, E and K - Hormones – Definition and Examples – Biological Functions of Insulin and Adrenaline.

4.3 Chromatography - Principles and Applications of Column and Paper chromatography- R_f value.

UNIT – V

5.1 Drugs - Sulpha Drugs – Preparation and Uses of Sulphapyridine and Sulphadiazine - Mode of Action of Sulpha Drugs - Antibiotics - Uses of Penicillin, Chloramphenicol and Streptomycin - Drug Abuse and Their Implication - Alcohol – LSD.

5.2 Anaesthetics - General and Local Anaesthetics - Antiseptics - Examples and their Applications - Definition and One Example each for Analgesics, Antipyretics, Tranquilizers, Sedatives - Causes, Symptoms and Treatment of Diabetes, Cancer and AIDS.

5.3 Electrochemical Corrosion and its Prevention – Electroplating – Applications.

ALLIED PRACTICAL

CHEMISTRY

VOLUMETRIC ANALYSIS

1. Estimation of HCl – Standard sulphuric acid.
2. Estimation of Borax - Standard Sodium Carbonate.
3. Estimation of NaOH – Standard Oxalic Acid.
4. Estimation of FeSO₄ – Standard FAS.
5. Estimation of Oxalic acid – Standard FeSO₄.
6. Estimation of FAS – Standard Oxalic Acid.
7. Estimation of Oxalic acid – Standard Oxalic Acid.
8. Estimation of Fe²⁺ using Diphenylamine / N- Phenyl Anthranilic acid as indicator.

ORGANIC ANALYSIS

Systematic Analysis of Organic Compounds containing One Functional Group and Characterisation by Confirmatory Tests.

Reactions of Aromatic Aldehyde, Carbohydrates, Mono and Dicarboxylic acids,
Phenol, Aromatic Primary Amine, Amide and Diamide.

REFERENCE BOOKS

- ❖ Inorganic Chemistry - P. L. Soni - Sultan Chand (2006).
- ❖ Inorganic Chemistry - B. R. Puri, L. R. Sharma and K. C. Kallia – Milestone Publications (2013).
- ❖ Selected Topics in Inorganic Chemistry - W. U. Malik, G. D. Tuli and R. D. Madan - S. Chand Publications (2008).
- ❖ Text Book of Inorganic Chemistry – R. Gopalan, Universities Press – 2012.
- ❖ Text Book of Organic Chemistry - P. L. Soni - Sultan Chand & Sons - 2007.
- ❖ Advanced Organic Chemistry - Bahl and Arun Bahl - Sultan Chand and Co. Ltd – 2012.
- ❖ Organic Reaction Mechanisms - Gurdeep Chatwal- Himalaya Publishing House.
- ❖ A Text Book of Organic Chemistry K. S. Tewari, N. K. Vishol, S. N. Mehrotra-Vikas Publishing House – 2011.
- ❖ Principles of Physical Chemistry - B. R. Puri, Sharma and Madan S. Pathania, Vishal Publishing Company – 2013.
- ❖ Text Book of Physical Chemistry - P. L. Soni, O. P. Dharmarha and U. N. Dash - Sultan Chand & Co – 2006.
- ❖ Understanding Chemistry – C. N. R. Rao, Universities Press – 2011.

SEMESTER III

CORE PAPER - 3

ANALYTICAL BIOCHEMISTRY

OBJECTIVE:

To obtain analytical skills and practical knowledge on various techniques involved in biochemistry

Course Outcomes: At the end of the Course, the Student will be able to:

CO NUMBER	CO STATEMENT
CO1	<ul style="list-style-type: none">• A practical knowledge on the preparation of solutions• Separate biological sample by centrifugation• Separation of subcellular organelles by differential centrifugation
CO2	<ul style="list-style-type: none">• Obtaining analytical skills to separate samples (amino acids) using paper chromatography.
CO3	<ul style="list-style-type: none">• Advanced knowledge about the interactions of electromagnetic radiation and matter and their applications in spectroscopy
CO4	<ul style="list-style-type: none">• Assay of biomolecules using UV spectroscopy and spectrofluorimetry• Demonstrate the methodology involved in separation of proteins, Nucleic acid by various electrophoretic techniques.
CO5	<ul style="list-style-type: none">• Acquire knowledge on atomic structure.• Radiation, types of radioactive decay,• Detection and measurement of radioactivity using GM counter and Scintillation counter.• Biological hazards of radiation and safety measures in handling radio isotopes.

UNIT - I

CENTRIFUGATION

(15 Hrs)

Definition - pH, pOH. Molarity, Molality and Normality. Examples for preparing solutions (1N, 1 M solutions etc.,). Buffers-Definition. Basic principles of centrifugation, RCF, sedimentation coefficient / Svedberg unit, differential centrifugation, density gradient centrifugation, Analytical ultracentrifuge-Components and its application in separation of macromolecules

UNIT - II

CHROMATOGRAPHY

(15 Hrs)

Principles of chromatography, Partition coefficient- Rf value. Principle, operation procedure and applications of Paper chromatography, Thin layer chromatography, Ion exchange, Gel permeation chromatography and affinity chromatography and its applications in separation of macromolecules.

UNIT - III

SPECTROSCOPY (15 Hrs)

Electromagnetic spectrum-Regions. Definitions for wavelength, wavenumber and frequency, Stoke's shift. Absorption and emission spectra. Beer- Lambert law. Absorbance and transmittance. UV and Visible spectrophotometry, Principle Instrumentation, and applications on coupled enzyme assays. Spectrofluorimetry and Atomic absorption and Flame emission spectroscopy-Principle Instrumentation, and applications

UNIT - IV

ELECTROPHORETIC TECHNIQUES (15 Hrs)

Principles of electrophoresis, electrophoretic mobility. Factors affecting electrophoretic mobility - sample, electric field, supporting medium, composition of buffer. Sodium dodecyl sulphate polyacryl amide gel electrophoresis (SDS- PAGE), methodology and its application. Determination of molecular weight of proteins by SDS PAGE.

UNIT - V

RADIOACTIVITY (15 Hrs)

Atomic structure, radiation, types of radioactive decay, half life, units of radio activity. Detection and measurement of radioactivity - methods based upon ionization (GM counter), methods based upon excitation (Scintillation counter). Autoradiography. Applications of radioisotopes in the elucidation of metabolic pathways. Biological hazards of radiation and safety measures in handling radio isotopes.

TEXT BOOKS/ REFERENCE BOOKS:

- 1.Chatwal Anand, Instrumental methods of Analysis, Himalaya Publishing house 2014
- 2.Wilson Walker, Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press. 2018
- 3.Dr. AvinashUpadhyay, Dr. Kakoli Upadhyay, Dr. NirmalenduNath Biophysical Chemistry Himalaya Publishing house, 2016

ALLIED -2
PAPER - 3
(to choose one out of 2)
MICROBIOLOGY I

Course outcomes

1. To gain knowledge on history of microbiology and various types of microscopes
2. To learn about cell structure and staining methods
3. To understand Microbial Classification and genome organization
4. To gain knowledge on culturing microorganisms and microbial growth
5. To learn about antimicrobials and various groups of microorganisms

UNIT - I

Definition and scope of Microbiology, History and Recent Developments, Spontaneous generation, Biogenesis, Contribution of Louis Pasteur, Anton van Leeuwenhoek, Lazzaro Spallanzani, John Tyndall, Joseph Lister, Robert Koch; Microscopy - Simple, Compound, Light Microscopy, Dark ground, Phase contrast, Fluorescence and Electron Microscopy.

UNIT - II

Anatomy of Prokaryotic and Eukaryotic cells - ultra structure and function of cell wall and cell organelles. Microbial morphology - wet mount, Hanging drop technique; staining methods - Dyes, Simple, Differential and Special staining techniques - Acid fast staining, spore stain, Capsule stain, staining for metachromatic granules.

UNIT - III

Microbial Classification, Five Kingdom concept, Binomial Nomenclature of microbes, species concept, classical approach with examples; Classical techniques of Microbial identification - Morphological, Physiological and Biochemical properties; Bacterial genome and its organization, Plasmids and their significance.

UNIT - IV

Media preparation, Aerobic and Anaerobic culture techniques, pure culture techniques, Preservation of cultures; Measurement of microbial growth, Batch and continuous culture, Growth Determination - Growth curve; Sterilization – physical and chemical methods.

UNIT - V

Antimicrobial chemotherapy - Antibiotics - source, classification, mode of action - Antimicrobial resistance - Tests for Sensitivity to Antimicrobial agents and its Quality control; General characteristics and classification of Algae - *Chlorella*, Fungi – *Mucor*, Protozoa – *Entamoeba*, Viruses – Rabies virus and Bacteriophages – T4.

Text Book:

- Prescott's Microbiology. 10th Edition, 2016. Willey J., Sherwood L., Woolverton C.J. McGraw Hill Education, New York.

Reference Books:

- Principles of Microbiology. 2nd Edition, 1997. Atlas R.M. William C Brown Publishers, New York.
- Microbiology. 5th Edition, 2006. Pelczar T.R., Chan E.C.S. and Krieg N.R. Tata McGraw-Hill, New Delhi.
- Foundations in Microbiology. 8th Edition, 2001. Talaro K.P. and Chess B. McGraw Hill Companies, New York.
- Microbiology: Principles and Explorations. 8th Edition, 2012. Black J.G. 2012. John Wiley & Sons, Inc., Hoboken, New Jersey.
- Microbiology: An Introduction. 10th Edition, 2010. Tortora G.J., Funk B.R. and Case C.L. Benjamin Cummings, San Francisco.

ALLIED -2
PAPER - 3
ZOOLOGY I

Objective;

To acquire knowledge about different kinds of animals species.

To study the systematic and functional morphology of invertebrates and chordates.

UNIT-I

Type study includes life history.

Protozoa – entamoeba, Porifera- Sycon. Coelenterata – Obelia geniculata.
Platyhelminthes - Teania solium.

Unit II

Annelida – earthworm , Arthropoda – Prawn, Mollusca – Freshwater Mussel, Echinodermata – Sea Star.

UNIT-III

Type study includes morphology, digestive system, respiratory system, circulatory system and urinogenital system of Chordate. Chordate – general characters, Prochordata; morphology of Amphioxus. Vertebrates; Pisces – Shark.

UNIT-IV

Amphibia; Frog, Reptiles; Calotes.

UNIT-V

Aves; Pigeon, Mammalia; Rabbit.

References;

1. Ayyar, E.K. and T.N. Ananthkrishnan. 1992. Manual of Zoology. Volume I & II, S. Viswanathan (printers and publishers) Pvt. Ltd., Madras, 891 p.
2. Kotpal series, 1998 – 1992. Rastogi publications, Meerut.
3. Jordan E.L. and P.S. Verma. 1993. Invertebrate Zoology 12th edition, S. Chand & Co., Ltd., New Delhi.
4. Jordan, E.L. and P.S. Verma. 1995. Chordate Zoology and Elements of Animal physiology , S. Chand & Co., Ltd., New Delhi.

Outcomes;

1. The students will be able to understand the life – cycle to and adaptations of protozoa, porifera coelenterata and platy helminthes.
2. The student will be able to understand the functional morphology of Annelids, Arthropods , Molluscs and Echinoderms.
3. The student will be able acquire knowledge about the functional morphology of chordata, prochordatas and pisces.
4. The student will be able have a thorough knowledge about Frog and Calotes.
5. The student will be able to understand the functional morphology of Aves and Mammals.

SKILL BASED SUBJECT

PAPER - 1

FIRST AID

OBJECTIVE:

To understand the importance of first aid treatment and to prevent secondary complications.

Course Outcomes: At the end of the Course, the Student will be able to:

CO NUMBER	CO STATEMENT
CO1	Summarize the importance of first aid
CO2	Analyze the symptoms and treatment for various medical emergencies
CO3	Illustrate the causes and effects of poisoning and its treatment
CO4	Identify the causes and treatment for various aches in the body
CO6	Identify the treatment for various wounds

UNIT - I

BASIC PRINCIPLES AND TECHNIQUES OF FIRST AID

Definition, objects and principles of First Aid. Important rules of first aid. Content of first aid kit First Aid Techniques: Dressings, Bandages and Transport techniques.

UNIT - II

MEDICAL EMERGENCIES

Diabetic emergencies - Hyperglycemia, Hypoglycemia - symptoms, signs and treatment. Liver emergency, Kidney emergency, Hemorrhage and its types. Chocking - symptoms, signs and treatment, Asphyxia - causes, symptoms, signs and treatment, Drowning effects - symptoms, signs and treatment, Suffocation by poisonous gases,

UNIT - III

INJURIES AND ANAPHYLACTIC SHOCK

Insect bites, Snake bites, Dog bites - symptoms and treatment. Injuries - Head injuries, burns and scalds, Chemical burns, Electric burns, Radiation burns and cold burns - signs, symptoms and treatment. Poisoning-Routes of poisoning, Effects poisoning, treatment and measures. Stroke, Heart attack, Coronary obstruction and Cardiac arrest - signs, symptoms and treatment.

UNIT - IV

COMMON AILMENTS

Blood Pressure, Constipation - travel sickness - signs, symptoms and treatment. Head ache, Tooth ache, Ear ache, - causes and treatment, Common Cold, Cough, Diarrhoea and Dysentery - causes, symptoms, signs and treatment.

UNIT - V

WOUNDS AND SAFETY MEASURES IN EMERGENCY

Emergencies in Rural area, Auto safety, Disasters and multiple casualty accidents. Wounds - Types- Open and Closed wounds. Emergency care for general wounds. Wound with foreign body, Special wound, Wounds to the palm of hand, abdominal wounds.

REFERENCES

1. Manual of First aid - L.C.Gupta Abhitab -2004, jaypee brothers, medical publishers (p)ltd, new delhi, India.
2. Sathya Narayanan U, 1999, "Biochemistry", (2nd Edition), Kolkata, Allied publishers.
3. First aid and Safety Hand book by American Red Cross and Kathleen A .Handal .M.D Foreword by Elizabeth Dole, Little brown and company Boston, New York, London.

**NON-MAJOR ELECTIVE
PAPER - 1**

FOOD AND NUTRITION

OBJECTIVE:

To understand about various biological macro and micro molecules and its function

Course Outcomes: At the end of the Course, the Student will be able to:

CO NUMBER	CO STATEMENT
CO1	Realizing the fact that “Food as medicine”, Classify carbohydrates and analyze their sources and functions in the body
CO2	Classify fats and analyze their sources and functions in the body
CO3	Identify and explain proteins in foods and the specific functions in maintaining health.
CO4	Identify the types of vitamins and their biomedical significance of vitamins present in food
CO5	Analyzing the biological importance of major and minor trace elements (Minerals) in the food

UNIT - I

Food -Definition. Balanced diet and its composition. Nutrition and nutrients. Macro and micronutrients. Carbohydrates - Sources, classification, RDA and nutritional significance in the body. Glucose as a chief source of energy. Dietary fibre and its importance

UNIT - II

Lipids, Classification. Sources of dietary lipids. Essential fatty acids and their importance. Saturated and unsaturated fatty acids. Mono unsaturated and Poly unsaturated fatty acids and their importance.

UNIT - III

Proteins as a body building food. Classification of proteins. Major functions of proteins in the body. Rich sources of Protein in diet. RDA for protein. Protein deficiency disorders- Kwashiorkor and marasmus

UNIT - IV

Vitamins- Fat soluble - Vitamin A, D, E and K. - Sources, RDA and functions. Water soluble vitamins- Thiamine, riboflavin, folic acid, cobalamine and pantothenic acid- Sources, RDA and function. Ascorbic acid as a free radical scavenger- Sources and RDA.

UNIT -V

Minerals - Macro and micro minerals. Sources, RDA and biological functions of Iron, Calcium, Iodine, magnesium, Sodium, potassium and chlorine.

REFERENCES

1. R.K. Murray, D.K. Granner, P.A. Mayes, D.W. Rodwell (2006), Harper's Biochemistry, twenty fifth edition, Prentice Hall, New Jersey.
2. D.L.Nelson, and M.M. Cox (2008) Lehninger Principles of Biochemistry, 5th Ed, W.H. Freeman and Company, New York.
3. Sathyanarayanan. U (2002), Essentials of Biochemistry Books and allied (p) Ltd.
4. D. Voet, and G.Voet (2006), Biochemistry, John Wiley and Sons, New York.
5. G.L Zubay (1999) Biochemistry, 4th Ed, WCB, McGraw-Hill, New York.

SEMESTER IV

CORE PAPER - 4

PLANT BIOCHEMISTRY

OBJECTIVE:

To gain knowledge on the plant physiology, photosynthesis and identify the functions of growth hormones, responses of plants to the stress

Course Outcomes: At the end of the Course, the Student will be able to:

CO NUMBER	CO Statement
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CO1	Summarize the events in Photosynthesis
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CO2	Classify Plant Hormones And Explain Their Functions. Discuss Secondary Metabolites In Plants
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CO3	Illustrate Nitrogen Fixation By Symbiosis Biochemistry Of Nitrogen Fixation
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CO4	Distinguish Between Types of Stress Tolerance in plants
-----	---

CO6	Evaluate The Anti Oxidant Defense In Plants
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UNIT - I

PLANTS (15 Hrs)

Various plants of a plant and its uses. Photosynthesis - Chlorophyll -Structure and functions. Light reactions, Photosystem I and II, Z scheme. Dark reaction- Calvin cycle, Rubisco-Importance. Proton gradient and ATP synthesis of chloroplast. Regulation of photosynthesis and photorespiration.

UNIT - II

HORMONES (15 Hrs)

Definition. Plant hormones, their types and functions. Structure, action, transport, distribution and physiological functions of Auxin, Gibberillin, Cytokinins, Abiscic acid and Ethylene. Plant secondary metabolites/PPhytochemicals-Definition. Types of phytochemicals - Flavonoids, alkaloids, tannins, terpenoids and anthocyanins- their functions

UNIT - III

(15

Hrs)

Nitrogen fixation in plants. Nitrogen cycle. Nitrate assimilation, Nitrate reductase and nitrite reductase, incorporation of ammonia into organic compounds, regulation of nitrate assimilation. Nitrogen fixation - nodule formation - regulatory factors involved in modulation - Role of nif genes.

UNIT - IV

(15

Hrs)

Stress in plants - Environmental stresses, salinity, water stress. Stress due to heavy metals. Impact of stress on plant growth and metabolism, criteria of stress tolerance. Toxins of plant origin - mycotoxins, phytohemagglutinins, nitriles, protease inhibitors, protein toxins.

UNIT - V

(15

Hrs)

Antioxidant mechanism in plants - Reactive oxygen species and sources of ROS generation in plants. Formation of triplet chlorophyll. Oxidative stress. Enzymatic and non-enzymatic antioxidant system. Role of superoxide dismutase, catalase, glutathione peroxidase. Antioxidant vitamins - Role of Vitamin C (Ascorbic acid) and vitamin E.

TEXT BOOKS/ REFERENCE BOOKS:

1. Verma, Plant Physiology, Athena Academic Publishers, 2015
2. Lincoln Taiz, Angus Murphy, Fundamentals of Plant Physiology, Oxford University Press, 2018
3. S. K. Verma and Mohit Verma, Plant Physiology, Biochemistry and biotech S Chand Publishers, 2018
4. Dr. V. K. Jain Fundamentals of Plant physiology, S Chand Publishers 2016

CORE PRACTICAL-II

Course Outcomes: At the end of the Course, the Student will be able to:

- CO1 **Understand good laboratory practices in a biochemistry laboratory**
- CO2 Use analytical balance and weigh
- CO3 Calculate and prepare normal, molar and percentage solutions
- CO4 Learn the working of colorimeter device
- CO5 Explain the concept of stock solution and working standard solution
- CO6 Estimate phosphorus and protein using colorimetric method
- CO7 Exhibit the knowledge of isolation of biomolecules like starch, casein and albumin from biological samples
- CO8 Obtain hands on training in basic separation technique like paper chromatography, thin layer chromatography and column chromatography and gain expertise
- CO9 Assess the suitability of chromatography technique for solving specific analytical problem and critically apply the knowledge for biomolecule separation
- CO10 Demonstrate the principle and working of SDS PAGE and its applications

1. COLORIMETRY

1. Estimation of inorganic phosphorus by Fiske and Subbarow method.
2. Estimation of protein by Biuret method.

2. BIOCHEMICAL PREPARATION

1. Preparation of starch from potatoes.
2. Preparation of Caesin from milk.
3. Preparation of albumin from eggs.

3. CHROMATOGRAPHIC SEPARATION

1. Paper chromatography separation and detection of amino acids and simple sugars (group experiment).
2. Chromatographic separation of chlorophyll, carotenes of flower pigments and protein using column Chromatography (Demo).

4. ELECTROPHORETIC TECHNIQUE

1. Separation of protein by SDS-PAGE (Demo)

TEXT BOOKS/ REFERENCE BOOKS:

1. J. Jayaraman Laboratory Manual in Biochemistry, New Age International Pvt Ltd Publishers, 2011
2. S. Sadasivam A. Manickam , Biochemical Methods, New age publishers, 2009
3. Keith Wilson and John Walker, Principles and techniques of Practical Biochemistry Cambridge University Press. 2010, Seventh edition
4. S. K. Sawhney Randhir Singh, Introductory Practical Biochemistry, Alpha Science International, Ltd, 2 edition, 2005.

ALLIED - 2 PAPER - 4

MICROBIOLOGY – II

Course outcomes

1. To gain knowledge about the importance of microorganisms in soil and agriculture
2. To understand the role of microorganisms in air and water
3. To learn about foodborne microorganisms
4. To gain knowledge on microbial production of industrially important compounds
5. To learn about various microorganisms causing diseases in humans

UNIT - I

Soil Microbiology – Microbes in soil formation, Microorganisms found in soil and their importance; Plant growth promoting bacteria – Nitrogen fixation, Phosphate solubilization, Biofertilizers, Biopesticides; Microorganisms and plant diseases, transmission and control.

UNIT - II

Microorganisms in air, Distribution and Source of Airborne Organisms; Aquatic Microbiology, Sewage Treatment - Physical and Biological methods; Drinking water treatment, Waterborne diseases, role of microorganisms in biogeochemical cycles.

UNIT - III

Food Microbiology - Microbial Spoilage of food, food preservation techniques, Microbes in Milk, microbial product of milk fermentation – Cheese, butter, curd; Pasteurization techniques; Foodborne infections caused by bacteria, fungi and viruses.

UNIT - IV

Microbial Fermentations, Fermentors, Microbial production of Organic acids – Citric acid, Antibiotics – Penicillin, Vitamins – Cyanocobalamin, Amino acid production - glutamic acid, alcohol - Ethanol and beverages - wine; SCP production, Bioremediation, Biodeterioration.

UNIT - V

Morphology, Cultural Characteristics, Pathogenecity, Laboratory diagnosis and prevention of Infections caused by the following organisms *Mycobacterium tuberculosis*, *Vibrio cholerae*, *Salmonella* sp., dermatophytes, *Candida albicans*, *Entamoeba histolytica*, *Plasmodium falciparum*, Rabies virus, Hepatitis B Virus and HIV.

Textbook

- Prescott's Microbiology. 10th Edition, 2016. Willey J., Sherwood L., Woolverton C.J. McGraw Hill Education, New York.

Reference Books

- Modern food microbiology. 7th Edition, 2005. James M. Jay, Martin J. Loessner, David A. Golden. Springer Science & Business.
- Environmental Aspects of Microbiology. 1996. Joseph C. Daniel. Brightsun Publications, Chennai.
- Biotechnology. 2nd Edition, 2000. Crueger W. and A Crueger. Panima Publishing Corporation, New Delhi.
- Text Book of Microbiology. 9th Edition, 2013. Ananthanarayanan, R and C.K.J. Panicker. Orient Longman Private Ltd., Chennai.
- Soil Microbiology - Soil microorganisms and Plant growth. 4th Edition, 2017. Subba Rao, N.S. Oxford & IBH publishing Co. Pvt. Ltd.

ALLIED - 2
PAPER - 4
ZOOLOGY II

Objective;

- To study the principles of Cell biology and Genetics.
- To study the principles of Developmental Biology and Physiology.
- To have a complete knowledge about circulatory systems and excretory system.
- To create awareness towards recent changes in the environment and preventive measures.
- To understand the concepts of origin of life.

UNIT-I

Cell Biology – structure of animal cell, Genetic; molecular structure of gene – gene function, sex linked inheritance. Genetic engineering and its application.

UNIT-II

Embryology – cleavage and gastrulation of Amphioxus.

Human Physiology; Digestion, circulation – blood components, structure of heart, heart function.

UNIT-III

Disease of Circulatory system – blood pressure, heart disease – Ischemia, Myocardial infarction, Rheumatic heart disease, stroke.

Excretion – structure of kidney and mechanisms of urine formation.

UNIT-IV

Environmental Biology – Biotic factors and Abiotic factors, food chain and food web. Pollution – Environmental Degradation, (Air, Water and Land) – Green house effect – Bioremediation, - Global warming – acid rain.

UNIT-V

Evolution; Theories of Lamarkism & Darwinism.

Reference;

1. Ekambaranatha Ayyar, and Ananthkrishnan, T.N. 1993. Outlines of Zoology, Vol I & II, Viswanathan and Co, Madras.
2. Sambasiviah, I, Kamalakara Rao, A.P., Augustine Chellappa, S. 1983. Text book of Animal Physiology, S. Chand & Co., New Delhi.

3. Verma and Agarwal. 1983. Text book of animal Ecology, S. Chand & Co., New Delhi.
4. Verma and Agarwal and Tyagi. 1991. Chordate Embryology, S. Chand & Co., New Delhi.
5. Rastogi and Jayaraj. 2000. Text book of genetics. Rastogi publications, Meerut.
6. Verma and Agarwal. 2000. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, S. Chand & Co., New Delhi.

Outcomes;

1. The student will acquire knowledge about cell structure, gene function and Genetic engineering.
2. The student will be able to understand the cleavage pattern and gastrulation in Amphioxus.
3. The students will have a thorough knowledge about the diseases of circulatory systems and urine formation.
4. The student will be have an awareness about the environment.
5. The student will understand the basic concepts of evolution.

ALLIED PRACTICAL II

ALLIED MICROBIOLOGY PRACTICAL

Course outcomes

1. To gain knowledge about laboratory procedures in Microbiology
2. To use microscopes in the study of microorganisms
3. To learn about media preparation
4. To observe and isolate microorganisms from samples
5. To learn about enumeration of microorganisms

List of Experiments

1. Cleaning of glasswares, sterilization techniques
2. Gram staining
3. Motility (Hanging drop)
4. Lactophenol cotton blue mounting of fungi – *Mucor*, *Rhizopus*, *Penicillium*, *Aspergillus*
5. Observation of wet mount for algae
6. Serial dilution techniques
7. Pour plate and spread plate techniques
8. Preparation of culture media, Slant preparation
9. Streak plate and pour plate techniques
10. Assessment of milk quality by MBRT test
11. Microscopic observation of curd
12. Cross sectioning of Root nodules for *Rhizobium*
13. Assessment of air quality by open plate method

Manuals for Reference

1. Experimental Procedures in Life Sciences. Rajan. S and Selvi Christy. 2015. Anjanaa Book House Publishers, Chennai.
2. Microbiology: A Laboratory Manual. Cappuccino and Sherman. 7th edition, 2004. Benjamin Cummings Publications, US.

ALLIED PRACTICAL

ZOOLOGY

I MAJOR PRACTICAL

DISSECTIONS

Cockroach; Digestive and nervous system

Prawn; nervous system

II MINOR PRACTICAL

MOUNTING

1. Mouth parts of Mosquito and Honey bee
2. Earthworm – Body setae
3. Placoid scales of Shark

III SPOTTERS

Entamoeba, Sycan, Obelia, Taenia solium (entire, scolex) earthworm (entire, Pineal setae) Prawn (entire), Fresh water mussel, Sea star, Amphioxus – Entire, Amphioxus – T.S. through pharynx, Shark, Frog, Calotes, Pigeon, feathers of pigeon and Rabbit.

Sphygnomanometer, Stethoscope, Rain gauge.

References;

- 1.verma. P.S. 2011. A manual of practical Zoology – INVERTEBRATES. Chand & Co., Ltd., Ram Nagar, New Delhi.
2. Verma. P.S. 2011. A manual of practical Zoology – CHORDATES. Chand & Co., Ltd., Ram Nagar, New Delhi.

**SKILL BASED SUBJECT
PAPER - 2**

BIOSTATISTICS

Course Outcomes: At the end of the Course, the Student will be able to:

CO NUMBER CO STATEMENT

CO1	Understand the definition of biostatistics and its scope. Ascertain the methods and importance of data collection and presentation
CO2	Examine the usage of statistical tools like measure of central tendency and measure of dispersion
CO3	Apply hypothesis testing via t, f, z and chi square statistical distribution & Basic Definition of Probability
CO4	deduce the results of correlation and regression
CO5	Deduce ANOVA and make statistical decision

UNIT - I

DATA ANALYSIS

(15

hrs)

Nature and scope of statistical methods and their limitations. Collection, classification, tabulation of statistical data. Organization of data - Individual series, discrete series, continuous series / class interval. Diagrammatic and graphical representation of statistical data (bar diagram, line diagram, pictogram, histogram & horizontal and vertical bar diagram).

UNIT - II

MEASURE OF CENTRAL TENDENCY & DISPERSION

(15hrs)

Mean, Median, Mode..Measure of Dispersion- Introduction. Range - Introduction & definition. Standard deviation, Variance, Coefficient of Variation.

UNIT - III

PROBABILITY & DISTRIBUTIONS

(15hrs)

Probability - Introduction & Definition. Testing of Hypothesis - null hypothesis, alternative hypothesis, standard error. Introduction to Theoretical Distribution, Binomial distribution, Poisson distribution and Normal distribution. Skewness and Kurtosis Chi- Square test-

introduction & application, t-test- introduction & application.

UNIT - IV

CORRELATION AND REGRESSION

(15

hrs)

Correlation Analysis - introduction, definition, uses. Types of correlation - Positive and negative, linear and nonlinear, simple and multiple, partial and total correlation. Regression Analysis - introduction, definition, application, types of regression.

UNIT - V

ANALYSIS OF VARIANCE (ANOVA)

(15

hrs)

Analysis of Variance (ANOVA) - introduction, one way and two way classification.

REFERENCES:

1. Introduction to Biostatistics and Research Methods by P. S. S. Sundar Rao, J. Richard 5th edition PHI learning Pvt Ltd. 2012.
2. Biostatistics: A Foundation for Analysis in the Health Sciences, 10th Edition Wayne W. Daniel, Chad L. Cross Wiley Global Education, 2012.
3. Statistical methods - S.P.Gupta. Sultan chand & sons. 2012.
4. Biostatistical analysis - Jerrold H. Zar 5th edition Prentice Hall of India 2010.
5. Statistical Methods, S.P.Gupta 28th edition Sultan Chand & Sons 2009.
6. Statistical methods - G.W.Snedecor and W.Cocharan- 8th edition. Oxford and IBH, New Delhi.1989.

**NON MAJOR ELECTIVE
PAPER - 2**

LIFESTYLE DISEASES & PREVENTION

OBJECTIVES:

- Understand the basics of lifestyle diseases.
- Describe the risks of developing a lifestyle disease.
- Choose healthy life style to cope up with modern life.

Course Outcomes: At the end of the Course, the Student will be able to:

CO NUMBER

CO STATEMENT

CO1	Define a Balanced Diet. Understand the importance of vitamins and minerals
CO2	Identify Lifestyle Prone Disorders
CO3	Manage physiological and psychological disorders
CO4	Categorize Communicable And Non-Communicable Disease
CO5	Maintain good health

UNIT - I

Balanced diet- composition and functions. Nutrients and their role. Types of nutrients- Macronutrients- carbohydrates, proteins, fats. Micronutrients, Vitamins and minerals Importance of water. Dietary Fibre and its major role in the body.

UNIT - II

Life style disorders: Lack of Physical activity, Incompatible food, irregular food habits, fast foods. Alcohol intake, cigarette smoking- Consequences. Technology in health deterioration- Computer vision syndrome, mobile vision syndrome.

UNIT - III

Physiological disorders: Food poisoning-Signs and symptoms, Vomiting, diarrhea, head ache, stomach ache, hormonal imbalance, premenstrual syndrome, Renal Calculi and gall stones.

Psychological disorder- Stress, Memory dysfunction. Depression, mood swings, Lack of motivation Suicides-causes. Self-medications.

UNIT - IV

Communicable diseases and Non-communicable diseases - Definition and examples Communicable diseases - AIDS, Tuberculosis, Cholera, typhoid- Causes and treatment. Non-

communicable diseases- Type 2 diabetes, Cancer, Coronary Heart diseases, Stroke, Obesity- Definition, causes and treatment.

UNIT - V

Good health- Improved life style, Improved Food habits, Proper deep sleep, Exercise in good health maintenance -Yoga, Swimming, Walking, Outdoor games, Stress management- Meditation.

REFERENCES

1. B. Srilakshmi, Dietetics - Multi Colour Edition, New age inter Pbs 2019
2. B. Srilakshmi, Food Science (Multi Colour Edition) , New age inter Pbs 2017
3. DC SHARMA and DEVANSHI SHARMA Nutritional Biochemistry, CBS Publisher and Distributers, 2017
4. B. Kumar, Meenal Kumar, Guide to prevention of lifestyle diseases b. kumar, Deep and Deep Publications, 2004

SEMESTER V

CORE PAPER - 5

ENZYMES AND INTERMEDIARY METABOLISM

OBJECTIVE:

To understand the role of enzymes in biochemical reactions and its applications and also to promote and understand chemical reactions, central metabolic pathways and kinetics of energy and homeostasis of metabolism

Course Outcomes: At the end of the Course, the Student will be able to:

CO NUMBER	CO STATEMENT
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CO1	Acquire Fundamental knowledge in relevant principles of enzyme, mechanism of enzyme kinetics, enzyme catalysis emphasizes on capability of the students to work in a group and gather the information.
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CO2	Illustrate the reactions of carbohydrate metabolism. Summarize the steps involved in ATP formation
-----	--

CO3	Identify the steps involved in oxidation of fatty acids
-----	---

CO4	Obtain knowledge on the metabolism of amino acids and formation of urea
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CO5	Summarize the steps involved in purine and pyrimidine synthesis
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UNIT - I

ENZYMES

(15 Hrs)

Definition, units, various classifications, nomenclature, specificity, isoenzymes, factors affecting enzyme activity - pH, temperature, enzyme concentration and substrate concentration. Active site, Mechanism - Lock and key mechanism and Induced Fit theory. Michaelis Menten equation, Line weaver Burk plot. Enzyme inhibition - Competitive, Non competitive and Uncompetitive (Concepts with example) inhibition and Irreversible inhibition.

UNIT - II

CARBOHYDRATES METABOLISM

(15

Hrs)

Definition - Metabolic pathways (Anabolic and catabolic) and Amphibolic pathways. Glycolysis, Glycogenesis and glycogenolysis, PDH complex, Citric acid cycle, HMP shunt. High energy compounds, Electron transport chain, Oxidative phosphorylation, ATP synthase and Uncouplers.

UNIT - III

LIPID METABOLISM

(15

Hrs)

Oxidation of fatty acids - Beta oxidation of palmitic acid, Role of carnitine in beta oxidation. Alpha oxidation and omega oxidation (Only definition). Oxidation of fatty acids with odd number of carbon atoms. Ketogenesis- Formation of ketone bodies. Biosynthesis of saturated fatty acids. Biosynthesis of triacyl glycerol and phospholipids. Biosynthesis of cholesterol with regulation.

UNIT - IV

PROTEIN METABOLISM

(15

Hrs)

Amino acid pool, Transamination- Role of transaminases-SGPT and SGOT, PLP as a coenzyme in transamination, Degradation of proteins - Oxidative, Non-oxidative deamination. Role of Glutamate dehydrogenase in amino acid metabolism. Decarboxylation of amino acids- Formation of serotonin, GABA, Histamine, Epinephrine and nor epinephrine. Urea Cycle, Relationship between urea and TCA cycle. Biosynthesis of creatinine

UNIT - V

NUCLEIC ACID METABOLISM

Purine and Pyrimidine - Sources of nitrogen and carbon atoms in Purine and Pyrimidine. Denovo synthesis of purine and degradation. Pyrimidine nucleotides- biosynthesis and degradation Regulation of purine and pyrimidine biosynthesis.

TEXT BOOKS:

2. J.M. Bery, J.L. Tymoczko and L. Stryer (2008) Biochemistry, 6th Ed, W.H. Freeman and Company, New York.
3. J.L Jain S. (2005), Fundamentals of Biochemistry, Chand Publishing, New Delhi.

REFERENCES:

1. D.L.Nelson, and M.M. Cox (2008) Lehninger Principles of Biochemistry, 5th Ed, W.H. Freeman and Company, New York
2. D. Voet, and G.Voet (2006), Biochemistry, John Wiley and Sons, New York.
3. R.K. Murray, D.K. Granner, P.A. Mayes, D.W. Rodwell (2006), Harper's Biochemistry, twenty fifth edition, Prentice Hall, New Jersey.
4. A.C. Deb (2001), Fundamentals of Biochemistry, New Central Book Agency Pvt., Ltd., Calcutta.
5. S.M. Bhatt (2011), Enzymology and Enzyme Technology. (2011), S. Chand Publishing, New Delhi.
6. U. Sathya Narayanan and U. Chakrapani. (2007), Text book of Biochemistry - 3rd edition, Pvt Ltd.

MOLECULAR BIOLOGY

OBJECTIVES

1. To understand the major experimental approaches and mechanisms in cell and molecular biology.
2. To acquire knowledge of gene & to know how genes are expressed
3. To be aware of the regulation of cellular processes, signaling and proliferation in prokaryotic cells.

Course Outcomes: At the end of the Course, the Student will be able to:

CO NUMBER CO Statement

CO1	Infer the central dogma of molecular biology, Show how DNA acts as vehicle of inheritance through experimental evidences Outline the steps involved in replication and explain the events, enzymology, fidelity and inhibitors of replication in prokaryotes
CO2	Summarize the process of prokaryotic transcription
CO3	Define genetic code and show how it can be deciphered Relate genetic code to translation process and explain protein biosynthesis
CO4	Illustrate the regulation of gene expression in prokaryotes using <i>lac</i> and <i>trp</i> operon
CO5	Gain knowledge on gene mutation and DNA Repair mechanisms

UNIT - I

REPLICATION

(15 Hrs)

DNA as a Genetic material - Experimental evidence -Bacterial Transformation, Transduction and Conjugation. DNA Replication-types, evidence to show DNA replication is semi conservative; Messelson and Stahl experiment.DNA Replication mechanism in Prokaryotes and Inhibitors.

UNIT - II

TRANSCRIPTION

(15 Hrs)

Transcription in Prokaryotes: Central Dogma, DNA dependent RNA polymerases, Transcription Mechanism and Inhibition. Post transcriptional modification-mRNA, rRNA and tRNA processing. Reverse transcription and Retro virus.

UNIT - III

TRANSLATION

(15

Hrs)

Genetic Code-Definition, deciphering of the genetic code, codon dictionary and salient features, Mechanism of Translation in Prokaryotes-initiation, elongation, translocation, termination and Inhibition. Protein targeting.

UNIT - IV

GENE REGULATION AND AMPLIFICATION (15

Hrs)

Operon model - Lac operon (positive and negative control), Trp Operon (repression and attenuation), recombination and Gene amplification.

UNIT - V

MUTATION AND REPAIR (15

Hrs)

Gene mutation-Base pair substitution, frame shift mutation, missense mutation, nonsense mutation, mutation in termination codons, silent mutation. Molecular mutation- spontaneous and induced mutation. Chromosome mutation - Changes in the number of chromosomes and changes in the structure of chromosomes. DNA Repair-Definition and mechanism.

REFERENCE BOOKS

1. James D Watson, Molecular Biology of the gene 7th edition, Pearson, 2017.
2. David. L. Nelson, Michael. M. Coil Lehninger. Principles of Biochemistry Freeman. W. H. and Company , 2019.
3. Donald Voet, Judith Voet, Charlotte Wiratt. Fundamentals of Biochemistry: life at molecular level. 5th edition John Wiley & Sons 2016
4. Bruce Albert, Molecular Biology of the cell, W.W. Norton and company, 2014.

CORE PAPER - 7

PHYSIOLOGY AND NUTRITION

OBJECTIVE

To learn the structure and functions of the different organs and the importance of nutrients in body

COURSE OUTCOME

At the end of the course students will be able to

CO NUMBER

CO Statement

CO1	Gain knowledge about the various types of RBC and WBC cells, different types of blood groups and basic structure and functions of heart.
CO2	Illustrate the Mechanism of digestion and absorption of macromolecules.
CO3	To acquire the knowledge about the structure and functions of kidney, nephron and mechanism of urine formation.
CO4	Realizing the fact that “Food as medicine”, describe the significance of carbohydrates, lipids and proteins and analyze their sources and functions in the body
CO5	Identify the types of vitamins and their biomedical significance of vitamins present in food Analyze the biological importance of major and minor trace elements (Minerals) in the food

UNIT - I

CIRCULATORY SYSTEM

(15

Hrs)

Composition of Blood -types of blood cells and function, Blood groups -ABO group and Rh group. Composition of Lymph, Circulatory system, Cardiac system - physiologic anatomy of heart- genesis and spread of cardiac impulses-cardiac cycle, heart sound, cardiac output, ECG.

UNIT - II

DIGESTION

(15

Hrs)

Definition, Digestive system of man, Physical and Chemical process of digestion. structure and function of microvillus, Salivary digestion, gastric digestion-mechanism of HCL formation, intestinal digestion-liver, pancreas, intestinal juice, Role of bile salt in Digestion, Digestion and absorption of carbohydrates, proteins, and lipids.

UNIT - III

RESPIRATORY AND EXCRETORY SYSTEM (15

Hrs)

Respiratory system -Types of respiration, Transport of O₂ and CO₂, Role of Hemoglobin in of O₂ and CO₂ transport. Oxygen Dissociation curve, Bohr Effect, Chloride shift. Oxygen toxicity & therapy, Artificial respiration. Structure and function of kidney and nephron, Mechanism of urine formation

UNIT - IV

MACRONUTRIENTS (15 Hrs)

Food- Definition. Balanced diet and its composition. Nutrition and nutrients. Macro and micronutrients. Carbohydrates - Sources, classification, RDA and nutritional significance in the body. Lipids-Sources, RDA and functions Essential fatty acids and their importance. Poly unsaturated fatty acids and their importance. Proteins as a body building food. Major functions of proteins in the body. Rich sources of Protein in diet. RDA for protein. Protein deficiency disorders-Kwashiorkor and marasmus

UNIT - V

MICRONUTRIENTS (15

Hrs)

Vitamins- Fat soluble - Vitamin A, D, E and K.- Sources, RDA and functions. Water soluble vitamins- Thiamine riboflavin, folic acid and cobalamine - Sources, RDA and function. Minerals - Macro and micro minerals. Sources, RDA and biological functions of Iron, Calcium, Iodine, magnesium, Sodium, potassium and chlorine.

REFERENCES:

1. Textbook of Medical Physiology 10th Ed by Arthur C. Guyton and John E. Hall, Harcourt Asia Pvt. Ltd, 2016.
2. Principles of Anatomy and Physiology 10th Edition by Gerard J. Tortora and Sandra Grabowski. Publisher: John Wiley and Sons.
3. Animal Physiology and biochemistry -RA Agarval, Anil. K,Srivastav, Kaushal Kumar, S .Chand & CO.,
4. Sathyanarayanan. U (2002), Essentials of Biochemistry Books and allied (p) Ltd.
5. Dr. M. Swaminathan, "Food and Nutrition Vol I&II ", Second edition, Bangalore, Bappco Publishers.

6. B. Srilakshmi Dietetics - Multi Colour Edition, New Age International Publishers ,
2019
7. B. Srilakshmi Food Science (Multi Colour Edition) New Age International Publishers
2017

**INTERNAL ELECTIVE
PAPER - 1**

MOLECULAR ENDOCRINOLOGY

OBJECTIVE:

To understand the role of hormones in the body

CO NUMBER	CO STATEMENT
CO1	Understand the structure of hormones and receptors. Classify hormones based on nature, mechanism of action.
CO2	Explain the structure, biological action and regulation of hypothalamic and pituitary hormones.
CO3	Illustrate the structure, biological action and regulation of thyroid and pancreatic hormones.
CO4	Understand about the actions of adrenal hormones
CO5	Compare the structure and metabolic effects of adrenal hormones

UNIT - I **(15 Hrs)**

Hormones: Definition, Chemical nature and classification. General mechanism of action of Group I and Group II hormones, secondary messengers, G Protein cycle, Signal transduction and Hormonal receptors.

UNIT - II **(15 Hrs)**

Hypothalamus and hypothalamic releasing factor. Pituitary hormones- Chemistry, Secretion, Functions and Regulation of Anterior Pituitary hormones - GH, Pituitary tropic hormones (LH, FSH and ACTH) and Posterior Pituitary hormones - Vasopressin and Oxytocin.

UNIT - III **(15 Hrs)**

Thyroid and Parathyroid Hormones-Chemistry, Synthesis, Secretion, Functions and Regulations and disorders. Pancreatic Hormones - Chemistry, Secretion, Functions and Regulations of Pancreatic hormones (Insulin and Glucagon)

UNIT - IV **(15 Hrs)**

Adrenal gland hormones - Chemistry, Secretion, Functions Regulations and disorders of Adrenal Cortex hormones (glucocorticoids and mineralocorticoids) and Adrenal Medullary hormones (Epinephrine and Nor-Epinephrine).

UNIT - V

(15

Hrs)

An introduction to Male and Female Reproductive system. Functions of Gonadal hormones - Testosterone, Estrogen and Progesterone. Ovarian cycle and its regulation.

TEXT BOOKS:

1. R.K. Murray, D.K. Granner, P.A. Mayes, D.W. Rodwell (2006), Harper's Biochemistry, twenty fifth edition, Prentice Hall, New Jersey.
2. Guyton (1996) Human Physiology and Mechanisms of Disease. Saunders Publications; 6th edition.

REFERENCES:

1. Williams Textbook of Endocrinology. (2011), Shilomo Melmed., Elsevier, New Delhi.
2. N.Chatterjee and Rana Shinde (2012) Textbook of Medical Biochemistry - eighth edition, Jaypee publication, New Delhi.
3. D.L.Nelson, and M.M. Cox (2008) Lehninger Principles of Biochemistry, 5th Ed, W.H. Freeman and Company, New York
4. D. Voet, and G.Voet (2006), Biochemistry, John Wiley and Sons, New York.
5. G.L Zubay (1999) Biochemistry, 4th Ed, WCB, McGraw-Hill, New York.

**SKILLED BASED SUBJECT
PAPER - 3**

MEDICAL LABORATORY TECHNOLOGY

OBJECTIVE:

To obtain [practical skills to analyze biological samples

Course Outcomes: At the end of the Course, the Student will be able to:

CO NUMBER CO STATEMENT

- | | |
|------------|---|
| CO1 | <ul style="list-style-type: none">• Follow good laboratory practices• Prepare reagents for experiments |
| CO2 | <ul style="list-style-type: none">• Examine urine and stool sample for normal and abnormal constituents |
| CO3 | <ul style="list-style-type: none">• Estimate Hemoglobin and other hematological parameters |
| CO4 | <ul style="list-style-type: none">• Perform blood grouping |
| CO5 | <ul style="list-style-type: none">• Acquire knowledge on culturing microorganisms. |

UNIT - I

LABORATORY CARE AND INSTRUMENTATION (15 Hrs)

Good laboratory practices, Code of conduct for laboratory personnel - safety measures in the laboratory-chemical and reagents, labeling, storage and usage. First aid in laboratory accidents - precautions and first aid equipment. Reporting laboratory tests and keeping records- documentation. General approach to quality control, quality control of quantitative data.

UNIT - II

URINE ANALYSIS AND STOOL EXAMINATION (15 Hrs)

Composition, collection, preservation, gross examination, interfering factors, chemical examination. Significance of sugar, protein, ketone bodies, bile pigments, blood, uric acid in urine. Specimen collection- inspection of faeces- odour, pH, Interfering substance. Test for occult blood, faecal fat.

UNIT - III

CLINICAL HEMATOLOGY

(15

Hrs)

Anticoagulant, preservation, Estimation of Hb, PCV, WBC, RBC, Platelets, ESR. Clotting time, bleeding time - normal value, clinical interpretation.

UNIT - IV

BODY FLUIDS AND BLOOD BANKING

(15 Hrs)

Cerebrospinal fluid and amniotic fluid, semen analysis, sputum examination - Interpretation. Blood grouping- ABO system, Rh typing, Blood transfusion, cross matching, blood transfusion and its complications.

UNIT - V

MEDICAL MICROBIOLOGY

(15 Hrs)

Culturing of organisms from various specimens. Culture media and antibiotic sensitivity test (pus, urine, Stool, sputum, throat swab, gram staining, Zielh -Neilson staining (TB, Lapra bacilli). Safety procedure in microbiological techniques.

REFERENCES:

1. Medical Laboratory Technology - Kanai L. Mukherjee, 10th reprint, Tata McGraw Hill Publication and Co. Ltd., Vol, I, II, III. 2002.
2. Medical Laboratory Science- J. Ochei & A. Kolhatkar, Tata McGraw Hill Publication and Co. Ltd., 2002.
3. Practical Clinical Biochemistry - Harold Varley, 5th edition, William Heinemann Medical Books Ltd., London. 1980.
4. Medical lab technology - Ramnik Sood, Jaypee Brothers, Medical Publishers (P) Ltd, New Delhi.
5. Clinical Chemistry- M.N. Chatterjee & R. Chawla, 2nd edition, Jaypee Brothers Medical Publishers (P) Ltd., 2010.

SEMESTER VI

CORE PAPER - 8

CLINICAL BIOCHEMISTRY

OBJECTIVES:

This course would make the students to understand the significance of diagnostic biochemistry.

Course Outcomes: At the end of the Course, the Student will be able to:

CO NUMBER CO Statement

- | | |
|-----|--|
| CO1 | <ul style="list-style-type: none">• Understand the blood glucose regulation.• Describe the pathophysiology and molecular basis of Diabetes mellitus.• Acquire knowledge on the clinical features on Glycosuria, Ketosis, Fructosuria & Galactosemia. |
| CO2 | <ul style="list-style-type: none">• Analyze the genetic diseases like phenyl ketonuria, cystinuria, albinism, hypo and hyperuricemias, obesity and fatty liver |
| CO3 | <ul style="list-style-type: none">• Explain the physiopathological and biochemical markers of the liver function tests. |
| CO4 | <ul style="list-style-type: none">• Assess the diagnostic performance of renal function tests. |
| CO5 | <ul style="list-style-type: none">• Examine the gastric contents. Practical knowledge on FTM analysis• Categorize the use of enzymes and Isozymes in assessment of liver damage, bone disorders and myocardial infarction. |

UNIT - I

(15 Hrs)

Blood glucose homeostasis, renal threshold value, regulation of blood glucose - hormonal action. WHO criteria Definitions for hypo & hyperglycemia,. Diabetes Mellitus and its metabolic complications. Oral GTT in normal and diabetic condition, renal glycosuria, Fructosuria & Galactosemia.

UNIT - II

(15 Hrs)

Disease related to amino acid metabolism- Clinical manifestation of Phenylketonuria, Cystinuria, Albinism, Fanconi syndrome, Tyrosinemia and alkaptonuria. Types of Lipoproteins - Dyslipoproteinemias, atherosclerosis, obesity & Fatty liver.

UNIT - III

(15 Hrs)

Liver function tests: Metabolism of bilirubin - Jaundice, types, causes and differential diagnosis. Liver function test -Icteric index, Vandenberg test, plasma protein changes, Prothrombin Time. Liver disorders - Acute and Chronic Hepatitis, Cirrhosis.

UNIT - IV

(15 Hrs)

Renal function tests: Clearance test - urea, creatinine, inulin, PAH test, concentration and dilution test. Renal disorders - glomerulonephritis, Diabetes Insipidus, Nephrotic syndrome, renal failure and UTI.

UNIT - V

(15 Hrs)

Gastric function test- collection of gastric contents, examination of gastric residue, FTM stimulation test, tubeless gastric analysis. Gastric disorders.Enzyme patterns in acute pancreatitis, Myocardial infarction and bone disorder.

REFERENCES:

1. N.Chatterjee and Rana Shinde (2012) Textbook of Medical Biochemistry - eighth edition, Jaypee publication, New Delhi.
2. T.M. Devlin (2002), Textbook of Biochemistry with Clinical correlations, 5th edition, John Wiley & Sons Inc, Publications.
3. P.D. Mayne, Clinical chemistry in Diagnosis and Treatment, ELBS / Arnold, New Delhi.
4. W.J. Marshall and S.K. Bangert, Clinical Chemistry [1995]
5. K.V. Krishnadas, Textbooks of Medicine [1996], Jaypee publication, New Delhi.
6. Harrison's principles of internal medicine - Vol-I &II., (2015), 19 edition. McGraw Hill Education Publishers.
7. Fundamentals of Biochemistry - 10th Edition - A C DEB, New Central Agency (p) Ltd, Kolkata.

CORE PAPER - 9

BIOTECHNOLOGY

OBJECTIVE:

To acquire knowledge on the recombinant DNA, vectors and applications of rDNA in biotechnology

Course Outcomes: At the end of the Course, the Student will be able to:

CO NUMBER	CO Statement
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CO1	To discuss the basic requirements and tools employed in genetic engineering process
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CO2	Demonstrate the basic and recent techniques applied in the field of Recombinant DNA technology
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CO3	Apply the basic rDNA technique to produce transgenic animal, discuss gene transfer methods, their application in pharmaceutical industry, cloning and its importance
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CO4	To Design plants based on rDNA techniques
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CO5	To Describe the methods employed for DNA amplification, gene therapy and antisense RNA therapy. To Discuss the basic requirements and tools employed in genetic engineering process
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UNIT - I

(15 Hrs)

Biotechnology -Definition, Recombinant technology- Restriction endonuclease- Type I, Type II. DNA ligase- DNA joining enzyme, alkaline phosphatase, DNA modifying enzymes. Linkers, adapters, homopolymers, enzymes used in genetic engineering. Applications of Recombinant DNA. Vectors-Plasmids- pBR322, cosmids, Yeast artificial chromosome

UNIT - II

(15 Hrs)

Preparation of r-DNA, insertion of r-DNA into vector, methods of transfer, selection of recombinants and screening- genetic methods, immuno chemical methods, South- Western screening, Nucleic acid hybridization methods, radio-active and non-radioactive labelling of probes.

UNIT - III

(15 Hrs)

Animal biotechnology: Animal cell culture, tissue culture - gene transfer methods in animals - transfection, microinjection, electroporation, gene gun, use of polycation, transgenic mice - knock out and knock in technology. Embryo transfer and invitro fertilization - applications.

UNIT - IV

(15 Hrs)

Plant biotechnology: Plant tissue culture -role of Auxins, Cytokinins, Giberellic acid. Somaclonal variations -microprojectiles, transgenic plant technology -for pest resistance, herbicide tolerance, delay of fruit ripening and use of plants to produce commercially important proteins -growth promoting bacteria in plants -antisense RNA technology.gene transfer.

UNIT - V

(15 Hrs)

Basic techniques: Maxam and Gilbert method of DNA sequencing. Chemical synthesis of oligonucleotides. Isolation, purification and sequencing of DNA -hybridization methods - southern, northern and western blotting. Amplification of DNA -PCR,- quantitative and qualitative. PCR - types and applications.

TEXT BOOKS / REFERENCE BOOKS

1. U.Sathyanarayana, U Chakrapani, Biotechnology, 12thedition, 2018
2. Brown T.A.Gene cloning and DNA analysis, Wiley Blackwell publishers, 2016.
3. Old and primrose. Principles of gene manipulation. Business service publishers,2003.
4. RC. Dubey, A Textbook of Biotechnology, S. Chand publishers, 2014.

**INTERNAL ELECTIVE
PAPER - 2**

IMMUNOLOGY

OBJECTIVE:

To study the mechanism of action of Ag-Ab interaction and immunological techniques

Course Outcomes: At the end of the Course, the Student will be able to:

CO NUMBER	CO Statement
CO1	A wide knowledge on the immunity, cells and organs of immune system
CO2	Illustrate the structure and classification of antibodies
CO3	Enlightenment of antigen and antibody interaction during infection
CO4	Exposure to mechanisms involved during allergic reactions.
CO5	Acquire knowledge on the principles, methodology involved in immunological techniques.

UNIT - I

(15 Hrs)

History of Immunology - Edward Jenner and Louis Pastuer. Immunity - Innate & Acquired immunity. Immune Response - Antibody & Cell Mediated response. Primary and secondary lymphoid organs. Structure of T, B and NK cell, Structure and functions of Neutrophils, Eosinophils and Basophils, Macrophages - Phagocytosis and inflammation.

UNIT - II

(15 Hrs)

Antigen - Properties, Specificity, Cross reactivity, Immunogenicity, antigen determinants, Haptens, Adjuvants, Self antigen (MHC). Antibodies - Properties and Structure of classes and subclasses of Immunoglobulin, Monoclonal Antibody production.

UNIT - III

(15 Hrs)

Antigen - Antibody interaction - Precipitation and Agglutination - Definition and mechanism of formation. Complement pathways, Cytokines and their functions.

UNIT - IV

(15 Hrs)

Immunity to infection: Hypersensitivity - type I, II, III and IV and their clinical manifestations. Transplantation - types, Mechanism of Allograft rejection, Graft Vs Host reaction, mechanism and prevention of graft rejection,(skin),Immuno suppressive drugs. Basic concepts of plastic surgery.

UNIT - V

(15 Hrs)

Precipitation in gel. Ouchterlony procedure, Radial immunodiffusion, Immuno electrophoresis, Electroimmunodiffusion. Principle and applications of RIA and, ELISA .Immunization - Passive and Active, Vaccines - Recombinant vaccines, DNA vaccines, Benefits and adverse effects of vaccination.

REFERENCES

1. Annadurai. B (2008), A textbook of Immunology and Immunotechnology, 1st Edition. S.Chand & Co, Ltd,New York.
2. J. Kuby, R.A.Goldsby, T.J. Kindt and B.A. Osborne, B.A. (2007), Immunology, 4th edition, W.H.Freeman and Company, New York, USA.
3. J. Kuby (2002), Immunology, 5th edition, W.H.Freeman and Company, New York.
4. Ian R. Tizard (2000), Immunology: An Introduction., 4th edition, W.B.Saunders Co.,Philadelphia.
5. Murphy Kenneth (2008), Janeway's Immunobiology, Garland Science Publishers, New York..
6. Peter J.Delves, Ivan Maurice Roitt,, Seamu J. Martin and Deninis Burton (2006), Roitt's Essential Immunology, 11th edition, Blackwell Scientific Publications, London.
7. I. Roitt, J. Brostoff and DMale (2002), Essential Immunology, 8th edition, English Language Book Society, London..
8. Rajasekaran Pandian (2007), Immunology and Immunotechnology, Panima Publishers, Chennai.

**INTERNAL ELECTIVE
PAPER - 3**

PHARMACEUTICAL BIOCHEMISTRY

OBJECTIVE:

To identify the mechanism and action of drugs used for various diseases

Course Outcomes: At the end of the Course, the Student will be able to:

CO NUMBER	CO STATEMENT
CO1	Define a drug and identify the chemistry of drug molecules. Illustrate the mechanism of drug absorption, distribution and metabolism
CO2	Explain the routes of drug administration. Appraise on the novel drug delivery systems compared to the conventional routes.
CO3	Justify the use of synthetic drugs for different disease systems.
CO4	Highlight the uses of Plants in traditional medicine
CO5	Highlight the importance of organic phytochemicals in pharmaceuticals

UNIT - I

(15 Hrs)

Drug -Definition- Structural feature- prodrug concept. Mechanism of Absorption -first -pass effect. Distribution and metabolism of drug. Mechanism of Phase I and Phase II reactions, Action of cytochrome p450. Drug receptor- localization, type and subtypes, models and their drug - receptor interaction, agonist & antagonist. Examples

UNIT - II

(15 Hrs)

Definition for IC 50 and LD50 of a drug - Drug tolerance and intolerance, Idio syneracy (pharmacogenesis), drug allergy- allergic responses to sulphadugs. Drug abuse. Novel drug delivery systems- role of liposomes and nanoparticles in drug delivery - non conventional routes of administration.

UNIT - III

(15 Hrs)

GI tract disorders. Drugs for GI tract disorders. Mechanism of action of drugs used in therapy of GI tract disorder - Ulcer, Irritable bowel syndrome and constipation. Statins as a drug for hyperlipidemia. Antibiotics - sulfonamides,, cotrimoxazole and penicillin. Role of insulin in the treatment of diabetes mellitus. Oral hypoglycemic drugs - sulphonyl ureas (Gliclazide,glimipride, glibenclamide biguanides (Metformin).

UNIT - IV

(15 Hrs)

Plants and bioactive compounds used in traditional medicine Ayurveda , Siddha and Unani - tulsi, turmeric, neem, ashwagandha, amla, coriander, ginger, Aloe barbadensis. Nila vembu kashayam preparation.

UNIT - V

Bioactive components of plant origin: flavonoids, alkaloids, terpenoids, glycosides, saponins, Medicinal plants for the treatment of Diabetes mellitus and Cancer. Chemotherapy - Cytotoxic drug. Biological analysis of active compounds using HPLC, GC- MS(Basic principles only).

TEXT BOOKS/ REFERENCE BOOKS:

1. R.S. Satoskar, S.D. Bhandhakar, Pharmacology and pharmacotherapy Elsevier, 2017.
2. Bertram. G. Katzung, Basic and clinical Pharmacology, Tata Mc Qrahill publishers, 2015
3. David G. smith, Oxford textbook of clinical pharmacology and drug therapy, Oxford press, 2008, 3rd edition.
4. Ajay Kumar Meena , Parveen Bansal, Sanjiv Kumar Plants-herbal wealth as a potential source of ayurvedic drugs, Asian Journal of Traditional Medicines, 2009

SKILL BASED SUBJECT

PAPER - 4

RESEARCH METHODOLOGY

OBJECTIVE:

To learn the fundamentals of research, research design, principles of scientific research, data collection and analysis of data.

Course Outcomes: At the end of the Course, the Student will be able to:

CO NUMBER CO Statement

CO1	Gain wide knowledge on the fundamentals of research
CO2	Identify the research problem and research design
CO3	Enlighten Importance of Hypothesis, Characteristics of a Good Hypothesis
CO4	Exposure to write thesis
CO5	Acquire knowledge on journals and paper writing
	Acquire a knowledge on finding scientific articles using PubMed

UNIT - I

(15 Hrs)

Definition of research - Objectives of research, general characteristics of research, qualities of researcher, criteria for good research, Types of Research, approaches and significance of Research. Problems encountered in research, Motivation in Research.

UNIT - II

(15 Hrs)

Scientific thinking, identification of research problem, defining the problem, evaluation of a Problem. Research design- contents and types of research design, factors affecting research design.

UNIT - III

(15 Hrs)

Meaning of Hypothesis, Definitions of Hypothesis, Importance of Hypothesis, Characteristics of a Good Hypothesis, Variables in a Hypothesis, formulating a Hypothesis, Testing the Hypothesis

UNIT - IV

(15 Hrs)

Thesis- Components of a thesis -format for writing thesis (Abstract, introduction, review of literature, materials and methods and discussion), reference styles. Useful search engines. E-resources (e-books/e-journals).

UNIT - V

(15 Hrs)

Journals: Standard of research journals - International and national journals, Scopus indexed journals-explanation. Impact factor - citation index and H index-Definition.Preparation of research manuscript - report writing - format of journals - proof reading - sources of information; journals, reviews, books, and monographs-bibliography. Plagiarism.Search engines - google, pubmed - national informatics center network services. Online data base library.

REFERENCES:

1. Research methodology, Methods and techniques. C.R.Kothari & Gurav Garg. New age publishers, New Delhi.4th edition.2019.
2. Research methodology. P.Saravanavel - Kitlab mahal, 6th edition. 2018.
3. Research methodology: The beginners' manual. 1st edition. Graham Myers. 2017.
4. Research Methodology: Methods and Techniques. Kothari, C.R.New Age International Publishers, New Delhi.2004.
5. Bioinformatics: sequence and genome analysis, by David Mount, second edition.Cold spring harbor lab press. 2004.
6. Bioinformatics: Sequence and Genome Analysis David W Mount, CBS Publishers, Ian Korf, Mark Yandell& Joseph Bedell. 2003.
7. Introduction to Bioinformatics by T.K Atwood and D.J Parry, Smith Publisher: Pearson Education Pvt Ltd. 2002.
8. Robert A. Day. How To Write & Publish a Scientific Paper. Oryx Press; 5 edition.1998.

CORE PRACTICAL-III

ENZYMOLGY AND BIOMOLECULES

Course Outcomes: At the end of the Course, the Student will be able to:

CO NUMBER	CO Statement
CO1	Demonstrate the collection of blood sample List the conditions essential for collection of urine and other clinical samples
CO2	Show the effect of pH, temperature and substrate concentration on the activity of salivary amylase Assay the activity of salivary amylase
CO3	Estimate creatinine by Jaffe's method, urea by DAM-TSC method, DNA by diphenylamine method and RNA by orcinol method
CO4	Identify and enumerate the total count of erythrocytes and leukocytes Differentiate leukocytes and calculate their total count
CO5	Define and determine the erythrocyte sedimentation rate, packed cell volume and mean corpuscular volume and relate their clinical implications Utilize sphygmomanometer to determine the blood pressure

I. COLORIMETRIC ESTIMATION

- Estimation of creatinine by Jaffe's method (in serum & urine)
- Estimation of urea by diacetyl monoxime method (in serum & urine)
- Estimation of glucose by O-Toluidine method
- Estimation of Protein by Lowry's method

II. CLINICALLY IMPORTANT ENZYMES:

- Assay of Serum alkaline phosphatase
- Determination of optimum pH of salivary amylase.
- Determination of optimum temperature of salivary amylase.
- Effect of substrate concentration on the activity of salivary amylase.
- Assay of activity of salivary amylase.

REFERENCE BOOKS/TEXT BOOKS

- J. Jayaraman Laboratory Manual in Biochemistry, New Age International Pvt Ltd Publishers, 2011

2. S. K. Sawhney Randhir Singh, Introductory Practical Biochemistry, Alpha Science International, Ltd 2 edition, 2005.
3. Alan H Gowenlock Varley's Practical Clinical Biochemistry, CBS Publishers and distributors, India Sixth Edition, 1988.

CORE PRACTICAL - IV

HEMATOLOGY, MICROBIOLOGY AND URINALYSIS

At the end of course students will be able to

CO NUMBER	CO Statement
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- CO1 Demonstrate the collection of blood sample
List the conditions essential for collection of urine and other clinical samples
- CO2 Hands on training to sterilization and gram staining
- CO4 Identify and enumerate the total count of erythrocytes and leukocytes
Differentiate leukocytes and calculate their total count
- CO5 Define and determine the erythrocyte sedimentation rate, packed cell volume and mean corpuscular volume and relate their clinical implications
Utilize sphygmomanometer to determine the blood pressure
- CO5 Qualitatively analyze the normal and abnormal constituents of urine sample

1. HAEMATOLOGY

Hematology - Haemoglobin by Sahli's method, RBC count, PCV, ESR, Total and differential WBC count, Platelet count, Blood grouping, ABO system, Rh System, clotting time, bleeding time.

2. MICROBIOLOGY

Sterilization and disinfection, culture, gram staining, media preparation, antibiotic sensitivity testing

3. URINE ANALYSIS

1. Collection of urine samples
2. Qualitative analysis of urine for normal and pathological conditions.

DEMO EXPERIMENTS.

- Detection of Heart sounds using Stethoscope
- Measurement of Blood pressure using Sphygmomanometer.

REFERENCE BOOKS/TEXT BOOKS

1. J. Jayaraman Laboratory Manual in Biochemistry, New Age International Pvt Ltd Publishers, 2011
2. S. K. Sawhney Randhir Singh, Introductory Practical Biochemistry, Alpha Science International, Ltd 2 edition, 2005.
3. Alan H Gowenlock Varley's Practical Clinical Biochemistry, CBS Publishers and distributors, India Sixth Edition, 1988.
