B. Sc. Biochemistry

Syllabus

AFFILIATED COLLEGES

Program Code: 22H

2023 – 2024 onwards

BHARATHIAR UNIVERSITY

(A State University, Accredited with "A" Grade by NAAC,
Ranked 13th among Indian Universities by MHRD-NIRF,
World Ranking: Times -801-1000,Shanghai -901-1000, URAP - 982)

Coimbatore - 641 046, Tamil Nadu, India

Program Educational Objectives (PEOs)	
The **B.Sc Biochemistry** program describe accomplishments that graduates are expected to attain within five to seven years after graduation	
PEO1	An ability to apply fundamental knowledge related to sciences in an interdisciplinary manner for providing innovative solutions to need based problems for global impact
PEO2	An ability to critically analyze scientific data, draw objective conclusions and apply this knowledge for human welfare. Students should be able to demonstrate expertise and ethical perspective on areas related to Biochemistry
PEO3	An ability to gain domain knowledge and know-how for successful career in academia, industry and research. Promoting lifelong learning to meet the ever evolving professional demands by developing ethical, inter personal and team skills.

Program Specific Outcomes (PSOs)	
After the successful completion of Bsc.Biochemistry program, the students are expected to	
PSO1	Ability to understand the technical aspects of existing technologies that help in addressing the biological and medical challenges faced by humankind.
PSO2	Ability to contribute effectively in the development of the ethical practices, societal contributions, and leading to responsible and competent professionals
PSO3	Acquiring the ability of leadership skills to manage projects in multidisciplinary environments

Program Outcomes (POs)	
On successful completion of the B.Sc program, the graduates will be able to acquire :	
PO1	Broad knowledge in biochemistry
PO2	Meaningful applications for better healthcare and economic development
PO3	Constant updation of application oriented skills
PO4	Technical skills in diagnosing Covid-19 related issues
PO5	Sole responsibility in contributing the public to lead better life through extension activities
PO6	Critical thinking and problem-solving skills
PO7	Provision for an inspiring, exciting and collaborative scientific environment
PO8	Values of professionalism and dedication
PO9	intelligent strategies and biochemical approaches in problem solving methods
PO10	Global competence with confidence in all the sectors of life science

First Semester

Course code	13A	Core Paper I – Biomolecules	L	T	P	C
Core/Elective/Supportive		Core	3	1	-	4
Pre-requisite		Basic knowledge in Biomolecules	Syllabus Version		2021-2022	

Course Objectives:

The main objectives of this course are to:

1. Learn the elements present in Biomolecules
2. For each group of biomolecule, learn the name of its generic monomer (simple unit), polymer (complex structure) and their function.
3. Learn the importance of Vitamins and Minerals

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	A thorough knowledge about the structure, chemistry and function of carbohydrates	K1
2	In depth knowledge about the significance of the complex lipids	K2
3	An understanding about the importance of proteins and peptides	K2
4	A knowledge about the salient features of nucleic acids	K2
5	A knowledge about the importance of vitamins and minerals.	K1

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Carbohydrates	10 hours

Carbohydrates: Definition, classification, Haworth projections.
Monosaccharides- Structure, chemistry and functions. Action of acids and alkalies on sugars-Aldose (Glucose) and Ketose (Fructose).
Disaccharides- Structure, chemistry and function – Sucrose, Lactose, Maltose and Cellobiose.
Trisaccharides-Structure of Raffinose.
Polysaccharides- Chemistry and functions
Homopolysaccharides-starch, glycogen and cellulose.
Heteropolysaccharides-hyaluronic acid, chondroitin sulfate and heparin.
Blood group substances.

Unit:2	Lipids	9 hours

Lipids; Definition, classification of lipids, simple, compound and derived.
Simple lipids-Physical and chemical properties of fats.
Characterisation of fat – Saponification number, acid number, Iodine number and RM number.
Compound lipids-Structure and function of phospholipids, glycolipids and lipoproteins.
Derived lipids - Fatty acids-saturated and unsaturated.
Essential fatty acids. Steroids-Structure of cholesterol.

Unit:3	Amino acids and peptides	08 hours

Amino acids and peptides. Definition, amino acids as Ampholytes.
Structure and classification of amino acids based on chemical nature, chemical reaction of amino acids due to carbonyl and amino groups. Essential amino acids.
Peptides; Structure and properties. Determination of primary structure of peptides-Glutathione, Oxytocin and Vasopressin.

Unit:4	**Nucleic acids**	**08 hours**
Nucleic acids; Structure of Purines and Pyrimidines; Nucleotides and Nucleosides. DNA: double helix: A, B and Z forms; DNA denaturation and renaturation. RNA: types, unusual bases. DNA as genetic material		
Unit:5	**Vitamins and Minerals**	**08 hours**
Vitamins: Definition, Classification. Fat soluble vitamins- sources, structure and physiological functions; Water soluble vitamins-sources, structure and physiological functions. Minerals: Mineral requirement, essential macro minerals and essential micro minerals, sources and functions.		
	Contemporary Issues	**2 hours**
Expert lectures, online seminars – webinars (self study)		
	Total Lecture hours	**45 hours**

Text Book(s)	
1	Deb, A.C., Fundamentals of Biochemistry, New Central Agency, Calcutta, 2016.
2	Jain J.L, Fundamentals of biochemistry, S.Chand Publication 6th Edition, 2005
3	Ambika Shanmugam, Fundamentals of Biochemistry for Medical Students, Seventh Edition, Lippincott Williams and Wilkins Publications
4	Satyanarayana.U., Fundamentals of Biochemistry, Allied & Books Pvt Ltd, Calcutta, 2019

Reference Books	
1	Lehninger, A.L., Nelson, D.L., Cox, M.M., Principles of Biochemistry, W H Freeman Publishers, 7th Edition, 2017
2	Lubert stryer, Biochemistry, Freeman and company, 9th Edition, 2019

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	onlinecourses.swayam2.ac.in/cec20_bt12
2	onlinecourses.swayam2.ac.in/cec20_bt19
3	onlinecourses.swayam2.ac.in/cec20_ag10

Course Designed By: Dr S.Vennila

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	L	S	M	M	M	M	M	M	S
CO2	S	L	S	M	M	M	M	M	M	S
CO3	S	L	S	M	M	M	M	M	M	S
CO4	S	L	S	M	M	M	M	M	M	S
CO5	S	L	S	M	M	M	M	M	M	S

*S-Strong; M-Medium; L-Low

Course code	13B	Core Paper II - Cell Biology	L	T	P	C
Core/Elective/Supportive		Core	3	1	-	4
Pre-requisite		Basic knowledge in structure of cells	Syllabus Version		2021-2022	

Course Objectives:

The main objectives of this course are to:

1. Understand the structure and purpose of basic components of Prokaryotic and Eukaryotic cells.
2. Enable the students to get themselves aware on how different tissue types are combined to form organs and how the organs function which follows from the structure and function of the constituent tissue.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	The overview of cells and cell cycle	K2
2	The structure and transport of molecules across biological membranes	K1,K2
3	The various cell organelles with their functions and actions	K2
4	The relationship between cellular and genetic organization and biological functions	K2,K4
5	The application of cell biology in cancer research..	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	An Overview of cells	09 hours

An Overview of cells – Origin and evolution of cells. Cell theory, Classification of cells – Prokaryotic cells and Eukaryotic cells. Comparison of prokaryotic and eukaryotic cells. Molecular composition of cells: - Water, Carbohydrates, lipids nucleic acids and proteins. Cell Cycle: Phases, Meiotic and Mitotic division.

Unit:2	Cell Membrane	09 hours

Cell Membrane – Fluid mosaic model of membrane structure. Membrane proteins and their properties. Membrane carbohydrates and their role. Transport across membranes – Diffusion - active and passive diffusion.

Unit:3	Endoplasmic reticulum	09 hours

Endoplasmic reticulum – Types, structure and function. Golgi apparatus – Structure and function. Lysosome – Structure and functions. Morphology and functions of peroxisomes and glyoxisomes. Ribosomes – Types structure and function.

Unit:4	Nucleus	08 hours

Nucleus: Structure and function. Chromosomes, chromatin structure. Mitochondria – Structure and functions. Cytoskeleton: Types of filaments and their functions. Microtubules – Chemistry and functions – Cilia and flagella.

Unit:5	Oncogenesis	08 hours

Oncogenesis: Development and causes of cancer, Types of cancer, Properties, early detection, Treatment. Oncogenes: Retro viral, proto, tumor suppressor gene

	Contemporary Issues	**2 hours**
Expert lectures, online seminars – webinars(self study)		
	Total Lecture hours	**45 hours**

Text Book(s)	
1	Cooper M 2000. The cell molecular approach, ASM Press, 2nd Edition
2	Cell Biology. Organelle structure and function, David E Sadava, Jones Bartlett Publishers.
3	Principle of cell and molecular biology 2nd edition – Lewis J Kleinsmith, Valerie M Kish.
4	Ajoy Paul, TB of Cell & Molecular Biology 4th edn, Allied &Books pvt ltd, Calcutta, 2018
Reference Books	
1	DeRobertis, EDP, E.M.F Robertis, 8th edition 2017. Cell and molecular biology, Saunders Company
2	Harvey Lodish, Baltimore. Arnold Berk et al 2000. 4rd edition. Molecular cell biology.
3	Lewin' s Genes XII, 2017, Jocelyn E Krebs, Elliott S.Goldstein, and Stephen T.Kilpatrick Jones, Bartlett Publishers, 12th revised edition
4	Cell Biology, 2013, Gerald Karp, wiley 7th edition
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	onlinecourses.swayam2.ac.in/cec20_ma14
2	onlinecourses.swayam2.ac.in/cec20_ma13
Course Designed By: Dr S.Vennila	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	S	M	M	M	M	M	M	S
CO2	S	M	S	M	M	M	M	M	M	S
CO3	S	M	S	M	M	M	M	M	M	S
CO4	S	M	S	M	M	M	M	M	M	S
CO5	S	M	S	M	M	M	M	M	M	S

*S-Strong; M-Medium; L-Low

Second Semester

Course code	23A	Core Paper III - Biomedical Instrumentations	L	T	P	C
Core/Elective/Supportive		Core	3	1	-	4
Pre-requisite		Basic Knowledge in tools of Biochemistry	Syllabus Version		2021-2022	

Course Objectives:

The main objectives of this course are to:

1. Students learnt the principles, Instrumentation and applications of the instruments.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	The concepts and the preparation of expressing various strength of the solutions	K3
2	The principle and the applications of chromatographic techniques	K2
3	The principle and the applications of Electrophoretic techniques	K2
4	The principle and the applications of spectroscopic techniques	K2
5	The application of radioisotopes in biological field	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Buffers	15 hours

pH meter- pH scale, Henderson- Hasselbalch equation, Buffer solutions, Buffer systems ofblood-Hb, Protein and Phosphate buffer system.

Various ways of expressing and conversion of concentration of solutions-molality, molarity, normality, mole fraction. Simple problems to be worked out.

Unit:2	Chromatography Techniques	15 hours

Chromatography-principle, materials, methods & applications of paper chromatography, TLC, GLC, Adsorption, Ion-exchange, Affinity chromatography and Molecular sieve.

HPLC, FPLC and GC-MS [principles only].

Unit:3	Electrophoretic Techniques	15 hours

Electrophoresis-principles, instrumentation and applications of paper electrophoresis, **agarose** gel, starch gel, SDS-PAGE, immuno electrophoresis, isoelectric focusing; ELISA (Principles Only).

Centrifuges- Principle, Types and its applications.

Clinical Auto analyzer – Principle and applications.

Unit:4	Biomolecular Techniques	14 hours

Principle, Instrumentation and application of Colorimetry, Spectrophotometry, Fluorimetry and Flame photometry.

ECG, EEG, CT-Scan, Doppler, MRI scan- Principle and application only.

Unit:5	Tracer Techniques	14 hours

Tracer and other Techniques-Radioactive decay, units of Radioactivity, detection and measurement of Radioactivity, GM counter, Scintillation counter, Auto radiography. Applications of Radio isotopes in biological and medical sciences.

Safety Aspects and hazards of radioactivity

	Contemporary Issues	**2 hours**
Expert lectures, online seminars – webinars(self study)		
	Total Lecture hours	**75 hours**

Text Book(s)	
1	Sharma B.K. (1981) 11th Edition. Instrumental method of chemical analysis.
2	David T. Plummer, 3rd Edition (1998), An Introduction to Practical Biochemistry
3	Keith Wilson, Kenneth H. Goulding, 3rd Edition 1992.A Biologists guide to Principles and Techniques of practical Biochemistry. Cambridge University Press.
4	Wilson .K and Walker 2012, Practical Biochemistry-Principles and technics of Biochemistry and Molecular Biology 7th edition Cambridge Press India,
Reference Books	
1	Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, Biomedical Instrumentation and Measurement- 2nd Edition.
2	Kudesia V.P. Sawhaney H., (1989) Instrumental method of chemical analysis.
3	Campbell I.D Biophysical Technic, 2012, JohnWiley & Sons, USA
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	onlinecourses.nptel.ac.in/noc20_bt29
2	onlinecourses.nptel.ac.in/noc20_cy32
Course Designed By: Dr S.Vennila	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	M	L	M	M	M	S	S
CO2	S	S	S	M	L	M	M	M	S	S
CO3	S	S	S	M	L	M	M	M	S	S
CO4	S	S	S	M	L	M	M	M	S	S
CO5	S	S	S	M	L	M	M	M	S	S

*S-Strong; M-Medium; L-Low

Course code	23P	Core Biochemistry Practical – I	L	T	P	C
Core/Elective/Supportive		Core	-	-	4	4
Pre-requisite		Basic Knowledge in Biomolecules and bioseparation techniques	Syllabus Version		2021-2022	

Course Objectives:

The main objectives of this course are to:

1. able to analyse the given carbohydrate systematically
2. able to analyse amino acids systematically
3. able to characterize lipids
4. able to analyse biomolecules by separation techniques

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Facilitate students to identify the sugars	K2
2	Facilitate students to identify the aminoacids	K2
3	Characterize lipids	K2
4	Analyze biomolecules by separation techniques	K4

K1 – Remember; **K2** – Understand; **K3** – Apply; **K4** – Analyze; **K5** – Evaluate; **K6** – Create

Unit:1	Analysis of carbohydrates	26 hours

a) Monosaccharides-Glucose, Fructose, Galactose, Mannose, Pentose.
b) Disaccharides-Sucrose, Maltose and Lactose.
c) Polysaccharides-Starch and Dextrin.

Unit:2	Analysis of Amino acids	18 hours

a) Histidine b) Tyrosine c) Tryptophan d) Methionine e) Cysteine f) Arginine

Unit:3	Lipid Analysis (Group Experiments)	8 hours

a) Determination of Saponification number.
b) Determination of Acid number.

Unit:4	Demonstration Experiments	8 hours

a) Preparation of buffer and its pH measurements using pH meter.
b) Separation of amino acids by **Paper chromatography** and TLC.

	Total practical hours	60 hours

Text Book(s)

1	Laboratory manual in biochemistry by J.Jayaraman, Wiley Eastern Publishers.
2	Biochemical Methods- Sadasivam and Manickam, 3rd Edition, New Age International Publishers

Reference Books

1	David T. Plummer, An introduction to practical biochemistry.3rd Edition. Mc GRAW-Hill Publishing company Ltd.
2	Pattabiraman, Laboratory manual in biochemistry.

Course Designed By: Dr S.Vennila

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	M	M	S	S	S	S	S
CO2	S	S	S	M	M	S	S	S	S	S
CO3	S	S	S	M	M	S	S	S	S	S
CO4	S	S	S	M	M	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Third Semester

Course code	33A	Core Paper IV - Enzyme and Enzyme Technology	L	T	P	C
Core/Elective/Supportive		Core	3	1	-	4
Pre-requisite		Basic knowledge in proteins and its structure	Syllabus Version		2021-2022	

Course Objectives:

The main objectives of this course are to:

To enable the students to learn about the different types of enzymes and its isolation and purification which will pave the ways in which the students can enter in research field

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	The structure of the enzyme and its classification	K1,K2
2	Understanding the kinetics of the enzyme	K2
3	The mechanism of action of enzymes and co-enzymes	K2
4	The production, Purification and characterization of immobilized enzymes	K3
5	Applications of enzymes	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Enzymes	9 hours

Introduction, Definition, International Classification of enzymes, Numbering and nomenclature. Enzyme units.

Definition of active sites. Theories proposed – Lock and Key or template model and induced fit model, ordered and random binding of substrate. Enzyme specificity – Group specificity, optical specificity.

Enzyme as proteins Structure: Primary, Secondary, Tertiary and Quartenary structure with reference to examples.

Unit:2	Enzyme Kinetics And Enzyme Inhibitors	9 hours

Enzyme Kinetics: Derivation of Michalies-Mentons equation, transformation of MM equation, Line-Weaver Burk plot and Eadie Hoffste plot. Effect of pH, Temperature, enzyme activity, turn over number of enzymes.

Briggs and Haldane Theory (Rapid Equilibrium and Steady state Theory)

Enzyme Inhibition: Competitive, non-competitive and un-competitive inhibition.

Regulatory enzymes, allosteric enzymes and covalent modification of enzymes

Isoenzymes. Ribozymes, Abzymes (Concepts and clinical Applications only).

Unit:3	Mechanism Of Enzyme Action And Coenzymes	8 hours

Definition-Co enzymes and Metal Cofactors

Structure and functions of TPP, NAD, NADP, FAD, FMN, Coenzyme A,

Multienzyme Complex: Pyruvate dehydrogenase.

Mechanism of enzyme action: General acid base catalysis and covalent catalysis

Mechanism of action of chymotrypsin.

Determination of enzymatic reactions-Enzyme assay (any one)

Unit:4	**Enzyme Technology**	**9 hours**
Immobilized enzymes: Source and techniques of immobilization. Effect of immobilization on enzyme activity. Application of immobilized enzymes. Industrial Production of enzymes: Amylase, Proteases Industrial uses of enzymes **Enzyme data Repositories and their types and classifications**		
Unit:5	**Uses Of Enzymes In Analysis**	**8 hours**
Enzymes as Biosensors – Calorimetric biosensors, Potentiometeric biosensors, Amperometric biosensors, Optical biosensors and immunosensors. It's Principle, technique, mechanism and examples. Enzyme engineering: Artificial enzymes. Antioxidant enzymes.		
	Contemporary Issues	**2 hours**
Expert lectures, online seminars – webinars(self study)		
	Total Lecture hours	**45 hours**

Text Book(s)	
1	Satyanarayana.U., Fundamentals of Biochemistry, Allied & Books Pvt Ltd, Calcutta, 2019
2	Jain J.L, Fundamentals of biochemistry, S.Chand Publication 6th Edition, 2005
Reference Books	
1	Trevor Palmer and Philip Bonner 2rd edition, 2008, Understanding enzymes. East west publisher
2	Enzymes – Dixon and Webb
3	Enzyme Technology – Chapline & Bucke
4	Alan Welshman, 2nd edition, Hand book of enzyme biotechnology
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	Enzymes - https://nptel.ac.in/courses/102/102/102102033/
2	https://nptel.ac.in/content/storage2/courses/102101007/downloads/PPT/LEC-07-PPT.pdf
3	Enzymes Assay - https://nptel.ac.in/courses/104/105/104105032/
Course Designed By: Dr D.Chandra Prabha	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	M	S	S	M	S	S
CO2	S	S	S	S	M	S	S	M	S	S
CO3	S	S	S	S	M	S	S	M	S	S
CO4	S	S	S	S	M	S	S	M	S	S
CO5	S	S	S	S	M	S	S	M	S	S

*S-Strong; M-Medium; L-Low

Course code	33B	Core Paper V – Microbiology	L	T	P	C
Core/Elective/Supportive		Core	3	1	-	4
Pre-requisite		Basic Knowledge in structure of prokaryotic cells	Syllabus Version		2021-2022	

Course Objectives:

The main objectives of this course are to:

1. Understand the structure and types of microorganisms
2. Learn the economical uses of microorganisms
3. Learn about the pathogenesis of various microbes in the environment

Expected Course Outcomes:

On the successful completion of the course, student will be able to understand :

1	Basics in microscopy, culture methods and staining techniques	K2
2	Morphology of bacteria, algae and fungi	K2
3	Morphology of virus	K2
4	Microbial diseases, their etiology and prevention	K2
5	Pathogenesis of microbes in water, soil and food	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Historical Development Of Microbiology	**9 hours**

Historical development of microbiology ; microscopy, principle and uses of light microscope, phase contrast and electron microscopes, sterilization techniques ; culture methods ; pure culture: Isolation and maintenance ; culture media - selective and enrichment media.

Staining and smearing: Simple staining, Negative staining, and Gram's staining, Acid - fast staining and spore staining.

Growth curve and generation time. Microbial Nutrition

Unit:2	**Prokaryotes And Eukaryotes**	**9 hours**

Prokaryotes: - Morphology of bacteria; component parts; cell wall structure .

Eukaryotes: - Morphological characteristics and importance of algae;

Characteristics, reproductive structures and importance of fungi

Unit:3	Morphology Of Viruses	**9 hours**

Morphology of viruses, classification and cultivation of viruses; plaque assay.

Phages: - T_4 Phages stages - lifecycle; synthesis and assembly of protein

Lambda Phages - Life cycle; switch between lysogeny and lytic cycle.

RNA viruses: - **Influenza and Corona virus,** HIV.

DNA viruses: - Oncogenic viruses

Unit:4	**Microbial Diseases**	**8 hours**

Microbial diseases: - Normal human micro flora; host - parasitic interaction ; epidemics; exo and endotoxins.

Air borne diseases: - Aetiology, symptoms and prevention of Tuberculosis, Diphtheria, Polio - myelitis and Influenza, Waterborne diseases:- Aetiology, symptoms and pathogenesis of Typhoid, Cholera, Bacillary dysentery and Hepatitis.

Direct contact disease: - Aetiology and symptoms of Rabies

Unit:5	**Microbiology Of Water, Soil and Food**	**8 hours**
Water microbiology: - Microbes in water, Bacteriological examination of water; purification of drinking water. Soil microbiology: - Syrnbiotic and Non- symbiotic Nitrogen fixing organisms: Rhizosphere **and phosphate solubilizing microbes** Food microbiology ; Microbiology of food borne diseases- Botulism, Salmonellas, Staphylococcal poisoning Perfingeens poisoning and Mycotoxins		
	Contemporary Issues	**2 hours**
Expert lectures, online seminars – webinars(self study)		
	Total Lecture hours	**45 hours**

Text Book(s)	
1	Pelczer J, R E. C .S John Noel R Krieg, Microbiology: MC Graw Hill Book Company, 2006, 5th edition.
2	Anantha Narayanan R; C .K Jayaram panicker, 10th edition, Text Book of Microbiology - Orient Longman Publication, 2017.
Reference Books	
1	Prescott L. M; J.H Harley and D. A Klein, Microbiology, C. Brown Publishers, 2006, 5th edition
2	Ronald M. Atlas, Microbiology-Fundamentals and Applications, Macmillan Publishing Company, New York, 1993.
3	Joanne M.Willey, Linda Sherwood, Christopher.J woolverton, 2017, Prescott's Microbiology, 10th Edition, Tata McGraw Hill Publishing Company Ltd, New Delhi
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/102/103/102103015/
2	https://nptel.ac.in/courses/105/107/105107173/
3	https://nptel.ac.in/content/storage2/courses/105104102/Lecture%2023.htm
Course Designed By: Dr D.Chandra Prabha	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	M	S	M	S	S	S
CO2	S	S	S	S	M	S	M	S	S	S
CO3	S	S	S	S	M	S	M	S	S	S
CO4	S	S	S	S	M	S	M	S	S	S
CO5	S	S	S	S	M	S	M	S	S	S

*S-Strong; M-Medium; L-Low

Course code	3ZA	Skill based Subject I – Bioinformatics and Medical coding	L	T	P	C
Core/Elective/Supportive		Skill based subject	2	1	-	3
Pre-requisite		Basic Knowledge in biological databases and coding	Syllabus Version		2021-2022	

Course Objectives:

The main objectives of this course are to:

1. Through knowledge on biological databases
2. Drug designing and docking protocols
3. Understanding the importance of medical transcription

Expected Course Outcomes:

On the successful completion of the course, student will be able to understand :

1	the concepts and applications of biological databases	K2
2	the principle and applications of various search tools	K2
3	the concepts of drug designing	K2
4	the concepts of terminologies in medical coding	K2
5	the guidelines of medical transcriptionist	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	BioInformatics	6 hours

Introduction, definition, objectives and scope. Application of BioInformatics. Biological databases:
Primary protein database – SWISS PROT, TrEMBL, PIR, PDB.
Primary nucleic acid database – EMBL, GEN BANK, DDBJ.

Unit:2	Tools for database search	6 hours

FASTA- Histogram, Sequence listing, Search and Programs.
BLAST – Algorithm, Services, MEGA BLAST, PHI BLAST, PROTEIN BLAST, GAPPED BLAST, PSI BLAST

Unit:3	Protein Primary structure analyses and prediction	6 hours

Protein Primary structure analyses and prediction, BioInformatics and drug design:
Introduction, approaches – ligand based, target based. Methods of drug designing – CAMD, docking program

Unit:4	Introduction to medical terminology	5 hours

Medical terminology -root words, prefix, suffix, abbreviations, symbols. Documentation of medical records, ICD (International classification of Diseases)

Unit:5	Medical coding	5 hours

Introduction to medical coding, medical transcription, Medico legal issues, Medical Transcription software, Essentials of Medical Transcription guidelines

	Contemporary Issues	2 hours

Expert lectures, online seminars – webinars(self study)

	Total Lecture hours	30 hours

Text Book(s)	
1	Rastogi.S.C, Namita – Mendiratta and Parag Rastogi, (2004) BioInformatics – Concepts, Skills and applications
2	Mani.K and Vijayraja (2005), BioInformatics – A practical approach
Reference Books	
1	Westhead D.R, Parish J.H and Twyman R.M. (2003) Instant notes in BioInformatics, Ist Edition
2	Attwood.T.K. Parry D.J. and Smith (2001). Introduction to BioInformatics, Ist Indian Report.
3	Alok Gha, Priyanka Arora- Medical Transcription Made easy.
4	Terry Tropin M Shai, RHIA, CCS-P, AHIMAICD-10-CM- Coding guidelines made easy-2017.
5	Besty J Shiland- Medical terminology and anatomy for ICD-10.
6	Karen Smiley- Medical willing and coding for dummies, 2nd edition.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/102/106/102106065/
2	http://www.digimat.in/nptel/courses/video/102106065/L65.html
3	https://www.slideshare.net/sardar1109/bioinformatics-lecture-notes
Course Designed By: Dr D.Chandra Prabha	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	S	M	S	M	S	S
CO2	S	S	S	S	S	M	S	M	S	S
CO3	S	S	S	S	S	M	S	M	S	S
CO4	S	S	S	S	S	M	S	M	S	S
CO5	S	S	S	S	S	M	S	M	S	S

*S-Strong; M-Medium; L-Low

Fourth Semester

Course code	43A	Core Paper VI – Intermediary Metabolism	L	T	P	C
Core/Elective/Supportive		Core	3	1	-	4
Pre-requisite		Basic Knowledge in structure of biomolecules	Syllabus Version		2021-2022	

Course Objectives:

Provides much information related to carbohydrate, fat and protein metabolism that takes place in our body.

1. Interrelationship between carbohydrate, fat and protein metabolism.
2. Role of purine and pyrimidines in nucleic acid metabolism.
3. Various disorders related to each metabolism

Expected Course Outcomes:

On the successful completion of the course, student will be able to understand :

1	Concepts of thermodynamics and the mechanism of energy transfer in ETC	K2
2	Fate of the dietary carbohydrates	K3
3	Fate of the dietary lipids	K3
4	Fate of the dietary proteins	K3
5	Interrelation among the carbohydrates, fat and protein metabolism	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Bioenergetics	10 hours

Free energy and the laws of thermodynamics; Role of high energy compounds as energy currency of the cell; free energy of hydrolysis of ATP and other organophosphates. The basic metabolic pathways, anabolic, catabolic and amphibolic pathways.

Electron transport chain: - Role of respiratory chain in mitochondria; in energy capture; respiratory control.Oxidative phosphorylation: - Mechanism of oxidative phosphorylation; Chemiosmotic theory; uncouplers of oxidative phosphorylation

Unit:2	Fate of absorbed carbohydrates	14 hours

Fate of absorbed carbohydrates. Glycolysis: - Pathways and energetics; Oxidation of pyruvate to acetyl CoA. TCA Cycle: - Pathway and energetics; anaplerotic reaction. Gluconeogenesis; Pasteur effect .Glycogenesis and glycogenolysis. Pentose Phosphate Pathway (HMP shunt).

Glucuronic Acid Cycle and glyoxylate cycle (Entner- Duodoroff pathway)

Metabolism of other hexoses: - Fructose and galactose

Unit:3	Blood lipids and fate of dietary lipids	14 hours

Oxidation of fatty acids: - Carnitine cycle; beta oxidation. Alpha oxidation and omega oxidation. Biosynthesis of propionyl CoA. Biosynthesis of saturated fatty acids: - Extra – mitochondrial in a microsomal system for synthesis of fatty acids. Biosynthesis of unsaturated fatty acids: - Monounsaturated and polyunsaturated fatty acids. Biosynthesis and degradation: - Lecithin, cephalin, inositol, phosphatidyl serine, cholesterol

Unit:4	Fate Of Dietary Proteins	10 hours

Fate of dietary proteins, metabolic nitrogen pool. Catabolism of amino acid: Oxidative deamination, non – oxidative deamination, transamination, amino – acid decarboxylation, catabolism of carbon skeleton of amino acids. Catabolism of glycine, phenylalanine and tyrosine. Interrelationship between carbohydrates, fat and protein metabolism

Unit:5	**Metabolism of purines and pyrimidines**	**10 hours**
.Metabolism of purines: - de novo synthesis, salvage pathways; catabolism. Metabolism of pyrimidines: - de novo synthesis, salvage pathways; catabolism.		
	Contemporary Issues	**2 hours**
Expert lectures, online seminars – webinars(self study)		
	Total Lecture hours	**60 hours**

Text Book(s)	
1	Garrett and Grisham – Biochemistry. Saunders College Publishers, 1995.
2	Murray, K. Robert, et al., - Harper's Biochemistry. 29th edition, 2012
Reference Books	
1	Voet and Voet - Biochemistry. 4th Edition. 2010 John Wiley and Sons,
2	Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M.,W.H. Freeman and Company, New York.
3	Mathews, Freeland and Miesfeld - Biochemistry – a short course.Wiley & sons. 1996.
4	Harper's Biochemistry (2012) 29th ed., Murray, R.K., Granner, D.K., Mayes and P.A.,Rodwell, V.W., Lange Medical Books/McGraw Hill.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/104/105/104105102/
2	http://www.nptelvideos.in/2012/11/biochemistry-i.html
3	https://www.saddleback.edu/faculty/jzoval/mypptlectures/ch15_metabolism/lecture_notes_ch15_metabolism_current-v2.0.pdf
Course Designed By: Dr D.Chandra Prabha	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	M	S	M	M	S	S
CO2	S	S	S	S	M	S	M	M	S	S
CO3	S	S	S	S	M	S	M	M	S	S
CO4	S	S	S	S	M	S	M	M	S	S
CO5	S	S	S	S	M	S	M	M	S	S

*S-Strong; M-Medium; L-Low

Course code	43P	Core Biochemistry Practical - II	L	T	P	C
Core/Elective/Supportive		Core	-	-	3	3
Pre-requisite		Basic Knowledge in colorimetry and titrimetry	Syllabus Version		2021-2022	

Course Objectives:

The main objectives of this course are to:

1. Learn about the Biochemical methods for analyzing the biological components
2. Know about enzyme assays
3. Able to acquire knowledge about the separation techniques

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Expertise in estimation of various biomolecules.	K2,K4
2	Expertise in enzymic analysis	K2,K3
3	Acquire knowledge about the separation techniques	K2,K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Colorimetry	32 hours

1. Estimation of Glucose by O-Toluidine
2. Estimation of phosphorus by Fiske-Subbarow method
3. Estimation of Urea by DAM-TSC method
4. Estimation of Uric acid by Carraway method
5. Estimation of Iron by Wong's method
6. Estimation of Protein by Lowry's method
7. Estimation of Creatinine by Picric acid method
8. Estimation of RNA by Orcinol method.

Unit:2	Titrimetry	12 hours

1. Estimation of Ascorbic acid – Dye method
2. Estimation of Chloride – Vanslyke's method
3. Estimation of Reducing sugar by Benedict's method

Unit:3	Enzymes (Group Experiment)	8 hours

1. Assay of salivary amylase activity.
2. Assay of lipase activity.

Unit:4	Separation Techniques (Demonstration)	8 hours

1.Separation of serum protein by electrophoresis
2.**Agarose Gel Electrophoresis**
3. Column packing.

	Total practical hours	60 hours

Text Book(s)

1	Pattabiraman, Laboratory manual in bio-chemistry.
2	J.Jayaraman, Practical bio-chemistry.

Reference Books	
1	David T. Plummer, An introduction to practical bio-chemistry
Course Designed By: Mrs S.Seethalakshmi	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	M	S	S	S	S	S	S
CO2	S	S	S	M	S	S	S	S	S	S
CO3	S	S	S	M	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code	4ZB	Skill based Subject 2 - Basics of Information Technology	L	T	P	C
Core/Elective/Supportive		Skill Based Subject	2	1	-	3
Pre-requisite		Basic Knowledge in Information technology	Syllabus Version		2021-2022	

Course Objectives:

The main objectives of this course are to:

1. Have a fundamental knowledge on information technology and database system
2. Provide basics of internet and networking
3. Understand the functioning of Cyber security, AI and IoT

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understood the fundamentals of information technology and importance of database system	K2
2	Understood the basics of internet and concepts of networking	K2
3	Understood the fundamental functioning of Cyber security	K2
4	Understood the fundamental functioning of AI	K2
5	Understood the fundamental functioning of IoT	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Fundamentals of Information technology and Database systems	8 hours

Fundamentals of Information technology: Definitions of Compilers, Linker, Loaders, Assembler and Interpreter.

Database systems; Definitions: Data abstraction, Instances, Schemes, Entity, Entity set: Strong and weak entity sets, Primary key, Foreign key, Super key.

Unit:2	Internet and Networking	9 hours

Internet: Evolution of Internet-Internet terminologies: WWW, FTP, HTML, HTTP, Gopher, E-mail browsers,

Networking: Network architectures, Topologies, LAN, WAN, MAN AND Components of a network: Hubs, Routers, Repeaters, Bridges, Modems and cables.

Unit:3	Artificial Intelligence (AI)	8 hours

Introduction to AI – Fundamentals – Need for AI –Foundations of AI – AI environment – Application domains of AI – AI tools – Challenges and Future of AI.

Unit:4	Internet of Things	9 hours

Introduction to IoT: Evolution of IoT – Definition & Characteristics of IoT – Architecture of IoT – Technologies for IoT – Developing IoT Applications – Applications of IoT – Industrial IoT – Security in IoT

Unit:5	Cyber Security	9 hours

Cyber Crime and Information Security – Classification of Cyber Crimes - Types of Cyber Attacks - Cyber crime and Indian IT Act 2000 – Security Methods

	Contemporary Issues	**2 hours**
Expert lectures, online seminars – webinars(self study)		
	Total Lecture hours	**45 hours**

Text Book(s)	
1	Leon A and Leon M Fundamentals of Information technology.
2	Date C.J. Introduction to Database systems.
3	Andrew S. Tanenbaum Computer networks.
Reference Books	
1	Michael E Whitman and Herbert J Mattord, “Principles of Information Security”, 4th Edition,Vikas Publishing House, 2011
2	Atul Kahate, “Cryptography and Network Security”, McGraw Hill, 2013.
3	P. Kaliraj, T. Devi, Higher Education for Industry 4.0 and Transformation to Education 5.0, 2020
3	Arshdeep Bahga, Vijay Madisetti, „Internet of Things: A Hands-On Approach“, 2014. ISBN: 978-0996025515
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/106/105/106105166/
2	https://nptel.ac.in/courses/106/105/106105031/
3	https://nptel.ac.in/courses/106/106/106106129/
4	https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs24/
Course Designed By: Mrs S.Seethalakshmi	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	S	S	S	M	S	S	M	S	S
CO2	M	S	S	S	M	S	S	M	S	S
CO3	M	S	S	S	M	S	S	M	S	S
CO4	M	S	S	S	M	S	S	M	S	S
CO5	M	S	S	S	M	S	S	M	S	S

*S-Strong; M-Medium; L-Low

Fifth Semester

Course code	53A	Core Paper VII – Human Physiology	L	T	P	C
Core/ Elective / Supportive		Core	3	1	-	4
Pre-requisite		Basic Knowledge in parts of human body	Syllabus Version		2021-2022	

Course Objectives:

The main objectives of this course are to:

1. Learn about the various alimentary parts of human body
2. Understand the endocrinal activities
3. Learn about the functions of vital organs

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Visual cycle and Skeletal system	K2
2	Blood and Digestive system	K2
3	Respiratory and Excretory System	K2
4	Nervous system and Endocrine system	K2
5	Human Reproductive system	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Total 60

Unit:1	Physiology of Vision and Skeletal Muscle	10 hours

Physiology of vision: Structure of eye, image formation and defects of the eye, Receptor mechanism of the eye, photopigments, Visual cycle and color adaptation

Skeletal Muscle: Structure of skeletal muscle, contraction of muscle fibre, chemical changes during muscle contraction, sources of energy of muscle contraction.

Unit:2	Blood and Body Fluids, Digestive System	14 hours

Blood and Body fluids: Composition and function, Red blood cells, Hemoglobin, White blood cells and platelets. Blood coagulation, blood groups and blood transfusion. Formation and functions of lymph. Body buffers.

Digestive system: Secretion of digestive juices, digestion and absorption of carbohydrates, proteins and fats. Gastro intestinal hormones.

Unit:3	Respiratory System and Excretory System	15 hours

Respiratory system: Diffusion of gases in lungs, transport of oxygen from lungs to tissues through blood, factors influencing the transport of oxygen. Transport of CO_2 from tissues to lungs through blood, factors influencing the transport of CO_2.

Excretory System: Mechanism of formation of urine, composition of urine, Micturition. Renal regulation of acid balance, hormone of the kidney.

Unit:4	Nervous System and Endocrine System	10 hours

Nervous system: Structure of neuron, resting potential and action potential, Propagation of nerve – impulses, Structure of synapse, synaptic transmission (electrical and chemical theory). Structure of Neuro muscular junction and mechanism of neuro muscular transmission, Neuro transmitters.

Endocrine system: Chemical nature of hormones, mechanism of action of hormones –

intracellular receptor mechanism and second messenger mechanism (cAMP, cGMP, Ca^{2+}) Structure function and deficiency symptoms of hormones of pituitary, thyroid, parathyroid and adrenal glands. Functions of pancreatic hormones.		
Unit:5	**Reproductive System**	**9 hours**
Male Reproductive system: Structure of testis, Spermatogenesis, functions of testis. Female Reproductive system: Ovarian cycle, Structure and hormones of ovaries, menstrual cycle, menopause, pregnancy and lactation. Steroids as contraceptives		
	Contemporary Issues	**2 hours**
Expert lectures, Online seminars, webinars (self study)		
	Total Lecture hours	**60 hours**

Text Book(s)	
1	Chatterjee, C.C - Human Physiology – CBS publishers, 12th edition, 2018
2	Lecture notes on human physiology, M. M. MuthiahVol II, 1991.
Reference Books	
1	Saradha Subramaniam. Text book of human physiology.
2	Chatterjee. C. Text book Medicinal Chemistry.
3	Guyton, Text book of Medical physiology.
4	Agarwal G.R & Agarwal B.P. Text book of Biochemistry (Agarwal physiological chemistry)
5	Murray. R.G. Harper's Biochemistry, 29th edition
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/127/106/127106001/
2	https://nptel.ac.in/courses/127/106/127106001/
3	https://nptel.ac.in/content/storage2/courses/122103039/pdf/mod3.pdf
4	https://www.vedantu.com/biology/human-excretory-system
Course Designed By: P.A.Vasundra Devi	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	S	S	S	M	M	S
CO2	S	S	S	S	S	S	S	M	M	S
CO3	S	S	S	S	S	S	S	M	M	S
CO4	S	S	S	S	S	S	S	M	M	S
CO5	S	S	S	S	S	S	S	M	M	S

*S-Strong; M-Medium; L-Low

Course code	53B	Core Paper VIII – Clinical Biochemistry	L	T	P	C
Core/ Elective / Supportive		Core	3	1	-	4
Pre-requisite		Basic knowledge in metabolism of biomolecules	Syllabus Version		2021-2022	

Course Objectives:

The main objectives of this course are to:
1. Understand about clinical metabolism
2. Know about the significance of diagnostic bio chemistry

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Carbohydrate metabolism	K2
2	Lipid metabolism	K2
3	Disorders of Amino acid metabolism	K2
4	Gastric, pancreatic and intestinal functions	K2
5	Liver function tests and Kidney function tests	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Total 60

Unit:1	Disorders of Carbohydrate metabolism.	10 hours

Normal sugar level in blood, renal threshold and regulation of blood glucose concentration.Hypoglycemia; Definition and causes. Hyperglycemia; Definition and causes. Diabetes mellitus; Introduction, aetiology, types of diabetes mellitus, clinical pathology and diagnosis. Urine testing, random blood sugar and GTT
Acute and chronic complications of Diabetes mellitus
Glycosuria- Differential diagnosis of glycosuria, Fructosuria, Pentosouria, Galactosemia and Glycogen storage diseases

Unit:2	Disorders of Lipid Metabolism.	10 hours

Plasma lipids and lipoproteins. Introduction
Hyperlipoproteinemia-Types I, II, III, IV and V Alphalipoproteinemia. Hypolipoproteinemia- A beta lipoproteinemia, Hypo beta lipoproteinemia.
Tangier`s disease and LCAT deficiency. Atheroscelerosis, Fatty liver and hyper lipidemia. Hypercholesterolemia, Lipidosis and Xanthomatosis, Tay-Sach`s disease, Niemann-Pick disease.

Unit:3	Disorders of Amino Acid Metabolism	15 hours

Plasma protein abnormalities; Total plasma (Serum) protein, Fibrinogen, Albumin, Pre-albumin and Globulins. Abnormal non-protein nitrogen; Urea, Uric acid, Creatinine and Ammonia, Porphyria.
Aminoacid metabolism: Cysteinuria, phenylketonuria, maple syrup disease, alkaptonuria, Albinism and Hartnup disease.
Disorders of Purine and pyrimidine metabolism
Disorders of Purine metabolism: Normal level of uric acid in blood and urine, miscible uric acid pool, hyper uricemia and Gout; Hypouricemia – Xanthinuria and Liathiasis.
Disorders of pyrimidine metabolism: Orotic acid urea.

Unit:4	Gastric, Pancreatic and Intestinal Functions.	9 hours
Gastric function: Introduction, tests of gastric function – The insulin stimulation test, determination of Gastrin in serum and Tubeless gastric analysis. Pancreatic Function: Introduction, pancreatic function tests, serum amylase and lipase. Intestinal function: Introduction, test of monosaccharide absorption (xylose excretion test) and determination of total protein (Lowry's method).		
Unit:5	**Liver Disease And Liver Function Tests**	**14 hours**
Introduction, bilirubin metabolism and jaundice, liver function tests. Estimation of conjugated and total bilirubin in serum (Diazo method). Detection of bilirubin and bile salts in urine (Fouchet's test and Hay's ulphur test). Thymol turbidity test, prothrombin time, serum enzymes in liver disease – serum transaminases (SGPT & SGOT) and lactate dehydrogenase (LDH). Kidney function test: Introduction, Physical examination of urine, elimination tests, clearance tests; inulin clearance, Creatinine clearance test and urea clearance test, Renal blood flow and filtration fraction. **Free Radicals and Oxidative Stress** **Applications of Artificial Intelligence in Medicines**		
	Contemporary Issues	**2 hours**
Expert lectures, Online seminars, webinars(**Self-study**)		
	Total Lecture hours	**60 hours**

Text Book(s)	
1	Burtis A. Carl and Edward R.Ashwood, Tietz text book of clinical chemistry W.B.Saunders company, 2nd edition, 1994
2	MN Chatterjea and Rana Shinde, Text Book of Medical Biochemistry, Jaypee Brothers Medical Publishers (P) LTD, New Delhi, 8th Edition,2012
Reference Books	
1	Philip.D.Mayne, Clinical Chemistry in diagnosis and treatment. ELBS Publication, 6th edition, 1994.
2	Montgometry, Conway, Spector, Biochemistry – A case oriented approach. The C.V.Moshby Company, 5th edition, 1990.
3	Clinical Biochemistry,5th edition, 2013, Allan Gaw, Michael Murphy, Rajee Srivastava, Robert Cowan, Denis O Reilly
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.britannica.com/science/metabolic-disease/Disorders-of-carbohydrate-metabolism
2	https://www.slideshare.net/MohitAdhikary/gastric-and-pancreatic-function-tests
3	https://onlinecourses.nptel.ac.in/noc20_ge13/preview
Course Designed By: P.A.Vasundra Devi	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	M	M	S	S	S	S
CO2	S	S	S	S	M	M	S	S	S	S
CO3	S	S	S	S	M	M	S	S	S	S
CO4	S	S	S	S	M	M	S	S	S	S
CO5	S	S	S	S	M	M	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code	53C	Core Paper IX – Molecular Biology	L	T	P	C
Core/ Elective / Supportive		Core	3	1	-	4
Pre-requisite		Basic knowledge in Genetic materials and proteins	Syllabus Version		2021-2022	

Course Objectives:

The main objectives of this course are to:
1. Promote knowledge about synthesis of Genetic Materials and Proteins
2. Learn about gene repair mechanism and gene mutation

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Replication and DNA repair mechanism	K2
2	Transcription Process	K2
3	Genetic code and Translation Process	K2
4	Recombination Mechanisms and Gene Regulations	K2
5	Gene Mutations	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Total 60

Unit:1	DNA Replication	10 hours

Evidences for DNA as genetic material: - Experimental proof
DNA replication in prokaryotes; Formation of DNA from nucleotides; Semiconservative mechanism and experimental proof; RNA priming; Bidirectional replication; theta mode, rolling circle model.
Enzymology of DNA replication; Initiation, elongation and termination; Fidelity of replication.
Differences in eukaryotic replication; Inhibitors of replication [names only].
DNA repair mechanism: - Excision repair, mismatch repair, photo activation and SOS repair.

Unit:2	Transcription	10 hours

Prokaryotic transcription: - Central dogma; RNA polymerases; Initiation, elongation and termination of transcription.
Role of eukaryotic RNA polymerases.
RNA splicing and processing of mRNA, tRNA and rRNA. Reverse transcription.

Unit:3	Translation	14 hours

Genetic code: - Experimental evidences; Features of genetic code. Composition of prokaryotic and eukaryotic ribosomes.
tRNA - structure; activation of amino acids, coding and non - coding strands of DNA. Translation: - Initiation, elongation and termination of protein synthesis; Inhibitors of protein synthesis. Post - Translational modifications of proteins.

Unit:4	Recombination	10 hours

Recombination in bacteria: - Transformation, Transduction and Conjugation. Recombination: - Mechanism; forms of recombination, Holliday model for homologous recombination
Prokaryotic gene regulation: - Operon model; lac operon - positive and negative control; trp operon - repression and attenuation

Unit:5	**Gene Mutations and Bacterial Transposans**	**14 hours**
Gene mutations:- Types - Nutritional, Lethal, Conditional mutants. Missense mutation and other point mutations. Spontaneous mutations; chemical and radiation – induced mutations – Ames test; reversion techniques; selection of mutants; Auxotrophs; Replica plating; Penicillin cycling. Bacterial transposons:- Insertion sequences; Mechanism of transposition in bacteria		
	Contemporary Issues	**2 hours**
Expert lectures, Online seminars, webinars(**Self-study**)		
	Total Lecture hours	**60 hours**

Text Book(s)	
1	David Freifelder, Molecular Biology, Reprint, 2020, Narosa Publishing House,
2	Lehninger's Principles of Biochemistry, 6th Edition, 2015 Macmillan publishers.
Reference Books	
1	Gardner, Simmons, 8th edition, Principles of Genetics 1994.
2	Weaver, F., Robert, Hedrick, W. Philip, Genetics, W.C. Brown Publishers 1997, 3rded.
3	Harvey Lodish, David Baltiomore – Molecular Cell Biology, 4th Edition
4	Bruce Albertis – Molecular Biology of the Cell, 4th Edition
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/content/storage2/courses/102101007/downloads/HANDOUTS/LECTURE-02-Handout.pdf
2	DNA NPTEL https://nptel.ac.in/content/storage2/courses/104103018/pdf/mod4.pdf
3	https://nptel.ac.in/content/storage2/courses/102103013/pdf/mod1.pdf
Course Designed By: P.A.Vasundra Devi	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	M	S	S	M	M	S
CO2	S	S	S	S	M	S	S	M	M	S
CO3	S	S	S	S	M	S	S	M	M	S
CO4	S	S	S	S	M	S	S	M	M	S
CO5	S	S	S	S	M	S	S	M	M	S

*S-Strong; M-Medium; L-Low

Course code	53D	Core Paper X – Genetic Engineering and Bioprocess Technology	L	T	P	C
Core/ Elective / Supportive		Core	3	1	-	4
Pre-requisite		Basic knowledge in cloning and fermentation	Syllabus Version		2021-2022	

Course Objectives:

The main objectives of this course are to:

4. To Understood the Concepts of gene cloning and Recombinants
5. To Understood the Sequencing techniques and Applications of genetic engineering
6. To Understood the Fermentation Process, Recovery and application

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Concepts of gene cloning	K2
2	Recombinants – Identification and collection	K2
3	Sequencing techniques	K2
4	Applications and limitations of genetic engineering	K2
5	Fermentation- Process, Recovery and application	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Basis of Gene Cloning	12 hours

Restriction endonucleases – Types and Features; **DNA Poymerases, Klenow DNA Polymerase I**, Ligations; Linkers and Adaptors. Vectors of gene cloning: - Plasmid Vectors – Basic feature, pBR332. Bacteriophage vectors; Cosmids. Cloning hosts. Preparation of Plasmid DNA from bacteria.

Unit:2	Introduction Of DNA Into Bacterial Cells And Hybridisation	12 hours

Introduction of DNA into bacterial cells: Transformation of E. coli, selection of transformed cells, Identification of recombinants. Introduction of phage DNA into bacterial cell, Identification of recombinant phage. Genomic library and cDNA library. Hybridization probes; Southern, Northern and Western blotting techniques.

Unit:3	Techniques and Applications	10 hours

DNA sequencing: Outline of Sanger's method – Applications. **Next Generation Sequencing-Massively Parallel Signature sequencing (MPSS)**, **DNA Nanoball Sequencing**, Genetic Finger Printing – Oligonucleotide directed mutagenesis; Protein engineering. PCR – Technique and Applications. **RT PCR-Principle, Technic and Application,**

Unit:4	Expression Vectors For E.Coli	11 hours

Expression vectors for E.Coli:- Constituents; Examples of promoters – Expression cassettes – Problems caused in expression of eukaryotic genes: Fusion proteins: - Applications of gene technology: Recombinant insulin; Recombinant growth hormones. Cloning HBV surface antigen in yeast. Insect cells as host system. Safety aspects and hazards of genetic engineering.

Unit:5	**Bioprocess Technology**	**13 hours**
Fermentation: Design of a commercial fermenter; Solid substrate fermentation: Media for industrial fermentations; Batch culture and fed – batch culture. Down – stream processing. Production of amino acids; SCP; Penicillin and alcohol.		
	Contemporary Issues	**2 hours**
Expert Lectures, Online seminars, webinars(Self-study)		
	Total Lecture hours	**60 hours**

Text Book(s)	
1	R.W. Old & S.B. Primrose, Principles of Gene manipulation, Black well scientific publications, 1994
2	Principles of Gene manipulation & Genomics,2013,Sandy B.Primrose, and Richard Twyman Wiley Blackwell, 7th Edition
3	Balasubramaniam, D, C.F.A., Bryce, K. Dharmalingam, J. Green, KunthalaJayaraman concepts in Biotechnology, COSTED – IBN university press, 1996.
Reference Books	
1	T.A. Brown, Gene cloning and DNA Analysis- An introduction, Chapman and Hall, 2016, 7th Edition.
2	Glick.R, Bernard and Pasternak.J, Jack, Molecular Biotechnology, Asm press, Washington D.C, 3rd Edition 2002.
3	Glazier. N. Alexander, Hiroshnikaido, Microbial Biotechnology, W.H. Freeman & co., New york, 2nd Edition 2007.
4	Molecular Cloning: A Laboratory Manual (3 Volume Set): 4th Edition – 2013 by Michael R Green, Joseph Sambrook; Publisher: Viva Books Private Limited
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	http://www.hixonparvo.info/Gene%20Cloning.pdf
2	https://nptel.ac.in/content/storage2/courses/102103013/pdf/mod3.pdf
3	https://www.slideshare.net/Hemathangavel/massively-parallel-signature-sequencing-mpss?qid=cf12fac4-0c74-4ee0-bf34-4d2b9fa77817&v=&b=&from_search=1
Course Designed By: Dr .V.Senthamarai Selvi	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO 8**	**PO9**	**PO10**
CO1	S	S	S	M	S	S	S	M	M	S
CO2	S	S	S	M	S	S	S	M	M	S
CO3	S	S	S	M	S	S	S	M	M	S
CO4	S	S	S	M	S	S	S	M	M	S
CO5	S	S	S	M	S	S	S	M	M	S

*S-Strong; M-Medium; L-Low

Skill Based Subject

Course code	5ZC	Skill based Subject 3 – Basics of Patent and Bioethics	L	T	P	C
Core/ Elective / Supportive		SKILL BASED SUBJECT - III	2	1	-	3
Pre-requisite		Basic knowledge in patent, IPR and Bioethics	Syllabus Version		2021-2022	

Course Objectives:

The main objectives of this course are to:

1. To understand patent system and current developments in the law on patents.
2. To know the nature of patents and Bioethics.
3. To understand the knowledge in bioethics and bio-law.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Provide information for role of Patent and protection of innovations	K2,K3
2	Adequate knowledge on patents and its laws for their future innovative idea.	K2,K3
3	Knowledge about the Patent, IPR and bioethics and related issues.	K2
4	Knowledge on Bioethics complications within research and understand different policies in ethics.	K2,K3
5	Understand the importance of Biosafety guidelines and practices.	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Patent	8 hours

Patent – Definition, types of patent, issues related to patent, granting process of patent, rights provided by patent, patent protection

Unit:2	Intellectual Property Rights	9 hours

Introduction to intellectual property rights (IPR)- Overview, meaning and types Copyright – Introduction, area covered by copyright, types of rights, need of protection of copy right Trade marks- introduction, types and function

Unit:3	Ethics ad Bioethics	8 hours

Definition of Ethics and Bioethics, **Concept and Principles of Bioethics, Objective and Importance of Bioethics**, ethics in biosciences (positive and negative effects with classical examples – slow ripening fruits and controlled ripening) Awareness education on genetically engineered organisms

Unit:4	Containment Levels	9 hours

Definition and types, their impact on environment – recommended biosafety levels for infectious agents, animal facilities Need for a good laboratory practice- aspiration and responsibility

Unit:5	Ethics In Clinical Trials And Good Clinical Practices	9 hours

Ethics in clinical trials and good clinical practices (GCP) – Definition of clinical trials and GCP, general information about clinical trials, need to conduct clinical trials, phases of clinical trials, institutional setups for conducting clinical trials and ethics associated with it

	Contemporary Issues	**2 hours**
Expert Lectures, Online seminars, webinars(Self-study)		
	Total Lecture hours	**45 hours**

Text Book(s)	
1	Copy right, Patent trade mark and related state, Doctrines cases and materials on the law of intellectual property, 7th edition, Antony W Rodger, Foundation Press
2	Bioethics and Biosafety – R. Rallipalli and Geetha Bali, APH publications, 2007.
Reference Books	
1	Intellectual Property Rights – Padmanabhan, A First edition, 2012, Publisher- Lexis, Nexis-New Delhi-1
2	Biological safety principles and practices- Fleming, DA., and Hunt, DL., 2000, ASM Press.
3	IPR, Biosafety and Bioethics - Dr Goel Deepa, Shomini Parashkar by January 2013, Publisher : Pearson India
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/109/106/109106137/
2	https://nptel.ac.in/courses/127/105/127105008/
3	https://nptel.ac.in/courses/109/106/109106092/
4	https://nptel.ac.in/courses/102/103/102103013/
5	https://www.slideshare.net/sijiskariah/biosafety-50930344
Course Designed By: Dr .V.Senthamarai Selvi	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	M	M	M	S	S	S
CO2	S	S	S	S	M	M	M	S	S	S
CO3	S	S	S	S	M	M	M	S	S	S
CO4	S	S	S	S	M	M	M	S	S	S
CO5	S	S	S	S	M	M	M	S	S	S

*S-Strong; M-Medium; L-Low

Elective Courses

Course code	5EA	Elective IA - IMMUNOLOGY AND IMMUNO TECHNIQUES	L	T	P	C
Core/ Elective / Supportive		Elective	2	1	-	3
Pre-requisite		Basic knowledge in immune system and its functions	Syllabus Version		2021-2022	

Course Objectives:

The main objectives of this course are to:

- To get a foundation knowledge for the future in immunology.
- To learn the basic terminology and techniques in immunology.
- To learn about the immune system is important to the humans.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the basics and concepts of immune system and its functions.	K2
2	Understand the basic concepts of immunology and immune reactions	K2
3	Knowledge on immune system and Immuno techniques	K2
4	Knowledge on immunological disease and immunotherapy.	K2
5	Understand to knowledge on transplantation and immunization techniques	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Immunity	9 hours

Historical development of the science of the immunology. Innate and acquired immunity, Antibody mediated and cell mediated response tolerance. Primary and secondary lymphoid organs. Structure of T, B and NK cells. Receptors on the surface of lymphocytes. Structure and functions of neutrophils, Macrophages – phagocytosis and inflammation, eosinophils and basophils.

Unit:2	Antigen and Antibody	9 hours

Antigen: Properties, Specificity and Cross reactivity, antigenicity, immunogenicity, antigen determinants, Haptens, adjuvants, Self antigens (MHC) an outline only. Antibodies: Properties, classes and subclasses of immunoglobulins: Structure, specificity and distribution, Clonal selection theory of antibody formation. Antigen-antibody interaction – Precipitation and agglutination – Definition and mechanism of formation. Complement component. Cytokines and their junctions.

Unit:3	Immunotechniques	9 hours

Precipitation in gel. Oudin procedure, oahley – Fulthope procedure, immune diffusion, Ouchterlony procedure, Immuno electrophoresis and electro immuno diffusion. Agglutination: Slide agglutination, Table agglutination, Widal test. Principle and application: RIA, ELISA, Flouresent antibody technique, monoclonal antibodies-**plasma therapy**, application.**Flow Cytometry-Immunological Applications**

Unit:4	Allergy and Hypersensitivity	8 hours

Allergy and Hypersensitivity – Type I, II, III and IV, their clinical manifestations. Immuno Disease: Rheumatoid arthritis, Myasthenia gravis.

Unit:5	**Transplantation and Vaccination**	**8 hours**
Transplantation: Allograft rejection: Graft Vs Host Diseases: Immuno suppressors: mechanism of graft rejection. Resistant to tumors: NK Cells: Tumor immuno therapy: Lymphoid tumors. Vaccination: Passive and active immunization: Recombinant vaccines: DNA vaccines. Benefits and adverse effects of vaccination. CD4 Cell count in HIV infection. **Artificial Intelligence in Therapy**		
	Contemporary Issues	**2 hours**
Expert Lectures, Online seminars, webinars(Self-study)		
	Total Lecture hours	**45 hours**

Text Book(s)	
1	Text book of microbiology – Ananthanarayanan. R. and Yayaraman Panikar, 10th edition, 2017
2	Cellular and Molecular Immunolgy – Abul K. Abbas, Andrew H. Lichtman , 9th Edition – Elsevier, 2017.
Reference Books	
1	Immunology – An introduction, Tizzard R Jan, 1995.
2	Immunology – Roitt Ivann, Jonathan Brastoff, David Male, 2017, 13 th Edition
3	Immunology – Janis Kuby, 8th edition. 2018
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/102/103/102103038/
2	https://nptel.ac.in/content/storage2/courses/102103038/download/module6.pdf
3	Plasma Therapy - https://www.slideshare.net/Tareqchowdhury/therapeutic-plasma-exchange-106849551
4	Flow Cytometry - https://www.slideshare.net/richardhastings589/kumc-introduction-to-flow-cytometry?qid=9f5e0389-0114-49eb-925b-7c984e1e7935&v=&b=&from_search=1
5	https://www.iitk.ac.in/che/pdf/resources/Flow-Cytometry-reading-material.pdf
Course Designed By: Dr .V.Senthamarai Selvi	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	S	M	S	S	M	S
CO2	S	S	S	S	S	M	S	S	M	S
CO3	S	S	S	S	S	M	S	S	M	S
CO4	S	S	S	S	S	M	S	S	M	S
CO5	S	S	S	S	S	M	S	S	M	S

*S-Strong; M-Medium; L-Low

Course code		Elective I B – Introduction to Biomaterials	L	T	P	C
Core/ Elective / Supportive		Elective	2	1	-	3
Pre-requisite		Basic knowledge in biomaterials	Syllabus Version		2021-2022	

Course Objectives:

The main objectives of this course are to:
1. Promote knowledge about synthesis of Genetic Materials and Proteins
2. Learn about gene repair mechanism and gene mutation

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	First Generation Biomaterials	K2
2	Second Generation Biomaterials and their Properties	K2
3	Second Generation Biomaterials and their Applications	K2
4	DNA nanotechnology	K2
5	Advanced Techniques for Single molecule Detection	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Biomaterials	9 hours

Biomaterials and biological materials - examples and uses: first generation biomaterials – general characteristics – naturally occurring biomaterials – pure metals – alloys – ceramics – polymers – composites

Unit:2	Second generation biomaterials	9 hours

Second generation biomaterials and their properties – bioactive and biodegradable ceramics – biodegradable polymers – hydrogels

Unit:3	Third generation biomaterials	9 hours

Third generation biomaterials – characteristics – biomaterials in tissue engineering – enzyme conjugates, DNA conjugates – DNA- protein Conjugates – microarray technologies – micronanotechnology – microfabrication – nanofabrication – interaction between biological materials, molecular – biomolecules and nanomaterials.

Unit:4	Nanobiotechnology	8 hours

Nanobiotechnology – introduction – DNA nanotechnology – structural DNA assembly – nanopore and nanoparticles – biological arrays – nanoprobes for analytical applications – nanosensors – nanoscale organization – characterization – quantum size effects – nanobiosensors – sensors of the future.

Unit:5	Techniques	8 hours

Microscopies – SEM – TEM – modern advances – microanalysis – optical detection of single molecules – applications in single molecule spectroscopy – single molecule DNA detection, sorting, sequencing – DNA nanoparticles studies by AFM – DNA computer – PCR amplification of DNA fragments – molecular surgery of DNA.

	Contemporary Issues	**2 hours**
Expert lectures, Online seminars, webinars(**Self-study**)		
	Total Lecture hours	**45 hours**
Text Book(s)		
1	Nano: The essentials: Pradeep .T, 2017, Tata McGraw-Hill Publishing Company Ltd	
2	Nanoscale Technology in Biological Systems: Editors: Ralph et al, 2005, CRC Press.	
3	Nanoparticles assemblies and Superstructures: Nicholas A.Kotov, 2006, CRC Press	
4	Biomaterials: An introduction. 1992. By Park JB, Lakes RS	
Reference Books		
1	Micromachines as Tools for Nanotechnology: H.Fujitha, 2003, Springer Verlag.	
2	Nanobiotechnology: Concepts, Applications and Perspectives, C.M.Niemeyer& C.A. Mirkin, 2004, Willey VCH Verlag GMBH &co.	
3	Advances in Biomaterials, Drug delivery – AICHE. J 2003, 49(12): 2990 – 3006.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://nptel.ac.in/courses/118/107/118107015/	
2	https://nptel.ac.in/courses/113/108/113108071/	
3	Nanotechnology - https://nptel.ac.in/courses/113/106/113106093/	
4	Nanobiotechnology – https://nptel.ac.in/courses/118/107/118107015/#	
5	Nanobiotechnology - https://www.slideshare.net/ibadali14/nanobiotechnology-lecture-1?qid=12d6a742-4768-4081-b11a-58a894a5d1ed&v=&b=&from_search=2	
Course Designed By: Dr .V.Senthamarai Selvi		

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	M	M	S	M	M	S
CO2	S	S	S	S	M	M	S	M	M	S
CO3	S	S	S	S	M	M	S	M	M	S
CO4	S	S	S	S	M	M	S	M	M	S
CO5	S	S	S	S	M	M	S	M	M	S

*S-Strong; M-Medium; L-Low

Course code		Elective I C -NUTRITIONAL BIOCHEMISTRY	L	T	P	C
Core / Elective / Supportive		ELECTIVE	2	1	-	3
Pre-requisite		Basic knowledge in various types of nutrients and its function	Syllabus Version		2021-2022	

Course Objectives:

The main objectives of this course are to:

1. To understand the main features of nutritional biochemistry
2. To discuss the nutrients effects of and their functions in the body
3. To understand the biochemical processes in nutritional research

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Explore scientific basis of nutrients and knowledge of nutritional biochemistry.	K2,K1
2	Capable of describing chemical composition of nutritional worth of food	K2,K3
3	Understood the Effects of methods Nutrient analysis and energy content	K2
4	Understood the scientific active constituents micro and macro nutrients	K2
5	Understood the components of foods based on knowledge of nutrients in diet and health	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Introduction To The Science Of Nutrition	9 hours

Introduction to the science of nutrition – function of foods and its relation to nutritional and clinical health, essential nutrients, analysis of food, composition, food habits and food groups.

Unit:2	Carbohydrates	9 hours

Carbohydrates- kinds, functions, food sources. Fats- kinds, functions, food sources, essential fatty acids and cholesterol. Proteins- kinds, functions, food sources, complete and incomplete proteins.

Unit:3	BMR	9 hours

Biological value, Net protein Utilization Energy Basal metabolism, measurement of BMR, Factors affecting BMR, regulation of body temperature, energy needs, total energy requirements, estimation of energy requirements and value of foods. Balanced diet formulation- Assessment of nutritional status.

Unit:4	Mineral Nutrition	8 hours

Mineral nutrition: Essential – micro and macro mineral nutrients, distribution, sources, functions and abnormalities. Vitamins – Definition, classification, sources, distribution, functions and abnormalities.

Unit:5	Nutrition At Various Stages Of Growth And Development	8 hours

Nutrition at various stages of growth and development; diets for infants, children, adolescents, pregnant women, lactating mothers and older persons. Nutrition challenges of the future – food production and food storages, future foods, new protein foods, new fat foods and changing food habits.

	Contemporary Issues	**2 hours**
Expert lectures, Online seminars, webinars **(Self-study)**		
	Total Lecture hours	**45 hours**

Text Book(s)	
1	Principles of Nutrition &Dietetics.Dr. M. Swaminathan.The Bangalore printing & publishing Company limited.88, Mysore Road, Bangalore- 560018.
2	Advanced Text Book on Food & Nutrition –Vol. I. Dr.M.Swaminathan, Second Edition.
3	Advanced Text Book on Food & Nutrition volume-II. Dr. M. Swaminathan, Second Edition.
Reference Books	
1	Normal and Therapeutic Nutrition- Corine Rohinson.
2	Sri Lakshmi.E (2016)-Nutrition Science-New Age Publishers
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://onlinecourses.swayam2.ac.in/nce20_sc01/preview
2	https://nptel.ac.in/content/syllabus_pdf/126104004.pdf
3	https://www.slideshare.net/DrSubirKumar/food-nutrition-nutrients-diet-energy-consumption-bmi?qid=28af04db-ca98-4c07-bc56-abec1a9dcd27&v=&b=&from_search=4
4	https://nptel.ac.in/content/storage2/courses/126104004/LectureNotes/Week-1_01-Relationship%20between%20Food,%20Nutrition%20and%20Health%201-A.pdf
Course Designed By: Dr .V.Senthamarai Selvi	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	M	S	M	S	M	M	S
CO2	S	S	S	M	S	M	S	M	M	S
CO3	S	S	S	M	S	M	S	M	M	S
CO4	S	S	S	M	S	M	S	M	M	S
CO5	S	S	S	M	S	M	S	M	M	S

*S-Strong; M-Medium; L-Low

Sixth Semester

Course code	63A	Core Paper XI – Plant Biochemistry and Plant Therapeutics	L	T	P	C
Core/Elective/Supportive		Core	3	1	-	4
Pre-requisite		Basic knowledge in plant cell structure and photosynthesis	Syllabus Version		2021-2022	

Course Objectives:

The main objectives of this course are to:

1. This course presents the plant cell structure and function.and photosynthesis
2. Know the cycles of elements and phytoregulators
3. To enable the students to have a sound knowledge on the germination, senescence and secondary metabolites

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Mechanism of photosynthesis	K1
2	Cycles of elements	K2
3	Mode of action of phytoregulators	K3
4	Biochemical changes during seed germination and senescence	K4
5	Biological function of secondary metabolites.	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	PLANT CELL	12 hours

Structure and functions. Photo synthesis: - Photo synthetic pigments – chlorophyll, carotenoids and phycobillin. Light reactions – two kinds of chemical system – photo system I and II –evidences in support of light reaction – Hill's reaction, Arnon's work and Emerson effect. Dark reaction – Calvin's cycle (C3 plants) Hatch – Slack cycle (C4 cycle) and CAM plants. Photo respiration.

Unit:2	CYCLES OF ELEMENTS	12 hours

Nitrogen cycle: – Ammonification, nitrification, nitrate reduction and denitrification, nitrogen fixation- symbiotic and non-symbiotic nitrogen fixation. Sulphur cycle, phosphorus cycle and carbon cycle. Plant nutrition: Specific roles of essential elements and their deficiency symptoms in plants. Macro nutrients: - Carbon, Hydrogen, Oxygen, Nitrogen, Sulfur, Phosphorus, Calcium, Potassium, Magnesium and Iron. Micro nutrients: - Manganese, Boron, Copper, Zinc, Molybdenum and Chlorine.

Unit:3	PLANT GROWTH REGULATORS	12 hours

Chemistry, biosynthesis, mode of action and Practical applications of auxins, gibberellins, cytokinins, abscicic acid and Ethylene. Plant growth inhibitors and retardants.

Unit:4	PHOTO MORPHOGENESIS	11 hours

Photo periodism. Phytochrome - Function in growth and development of plant. Biochemistry of seed germination. Senescence: Biochemical changes during senescence. Senescence process in life cycle of plants.

Unit:5	SECONDARY METABOLITES	11 hours

Nature, distribution and biological functions of alkaloids, terpenes, flavonoids, poly phenols, tannins and steroids. Role of secondary metabolites in pathogens, insects, animals and mankind.

	Contemporary Issues	**2 hours**
Expert lectures, online seminars – webinars(self study)		
	Total Lecture hours	**60 hours**
Text Book(s)		
1	Molecular activities of plant cell – An Introduction to Plant Biochemistry. John. W.	
2	Anderson and John Brardall, Black well Scientific Publications, 1994.	
Reference Books		
1	Plant Physiology –Devlin N. Robert and Francis H. Witham, CBS Publications.	
2	Plant Biochemistry and Molecular Biology – Hans Walter Heldt, Oxford University, 4th Edition, 2010	
3	Russell Jones, Helen Ougham, Howard Thomas, Susan waaland,2012, The Molecular Life of Plants, Wiley Balckwell	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://www.intechopen.com/books/secondary-metabolites-sources-and-applications/an-introductory-chapter-secondary-metabolites	
2	https://www.toppr.com/guides/biology/plant-growth-and-development/plant-growth-regulators/	
3	https://byjus.com/biology/plant-cell/	
Course Designed By: Ms G.Sujitha		

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	M	M	S	M	S	S
CO2	S	S	S	S	M	M	S	M	S	S
CO3	S	S	S	S	M	M	S	M	S	S
CO4	S	S	S	S	M	M	S	M	S	S
CO5	S	S	S	S	M	M	S	M	S	S

*S-Strong; M-Medium; L-Low

Course code	63B	Core Paper XII – Medicinal Chemistry	L	T	P	C
Core/Elective/Supportive		Core	3	1	-	4
Pre-requisite		Basic knowledge in therapeutic uses of drugs	Syllabus Version		2021-2022	

Course Objectives:

The main objectives of this course are to:

1. General structural features of agents belonging to the therapeutic class & Relevant physicochemical properties
2. This course presents to focus on the chemical principles used for drug discovery and it also covers human biology where ever relevant
3. Course provides for the specific needs and interests of students wishing to obtain experience in a modern research program.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understood the development of the traditional and modern methods used for drug discovery; of how molecules interact.	K2
2	Learnt the fact that the pharmaceutical industry is by far the largest employer of medicine	K1
3	Learnt and developed skills in the use of reaction mechanisms	K2
4	how knowledge of reaction mechanisms can aid in understanding the mode of action of a drug	K3
5	The learnt method by which it can be synthesized, and developed.	K3

K1 - Remember; **K2** - Undestand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	INTRODUCTION AND RECEPTOR CONCEPT	12 hours

Introduction to drugs, classification of drugs, passage of drugs across biological membrane; absorption and distribution of drugs; binding of drugs to plasma proteins. Drug receptor interaction, binding forces in drug receptor interaction, types of receptors. Receptor theories, isolation of receptors, consequences of drug receptor interaction

Unit:2	DRUG METABOLISM AND ELIMINATION	12 hours

Drug metabolism, methods of study of drug metabolism, microsomal drug metabolism, metabolism via hydroxylation, conjugation deamination, N-Oxidation, azo and nitro reduction, non-microsomal oxidation, Oxidative deamination, purine oxidation, dehalogenation, hydrolysis, action of choline esterase. Elimination of drugs from the body with reference to renal system

Unit:3	CHEMOTHERAPY	12 hours

Chemotherapy: Mode of action of sulfonamides, anti-metabolites of folate, purines and pyrimidines. Antibacterials - mode of action and resistance to penicillin, streptomycin, tetracycline and chloramphenicol. Antiviral, antimalarial and antiTB drugs.

Unit:4	DRUGS ACTING ON CNS AND CARDIO-VASCULAR SYSTEM	11 hours

CNS – structure and mode of action of barbiturates, salicylates, MAO inhibitors and drugs for Parkinson's disease.

Cardio-vascular disease: Structure and mode of action of cardiac glycosides, heparin and coumarin.		
Unit:5	**DRUGS OF PLANT ORIGIN**	**11 hours**
Drug dependents and abuse – management of self-poisoning. Cancer chemotherapy- cytotoxic drugs. Immunosuppressive drug therapy.		
	Contemporary Issues	**2 hours**
Expert lectures, online seminars – webinars(self study)		
	Total Lecture hours	**60 hours**

Text Book(s)	
1	Satoskar, R.S.Bhandarkar, S.D and S.S. Ainapure, 25th edition, 2017. Pharmcology and pharamacotherapeutics. Popular Prakashnan Bombay.
2	William Foye (2012), 7th edition, Principles of medicinal chemistry
Reference Books	
1	Patrick.L.Graham (2013), An introduction to medicinal chemistry, 5th edition Oxford University Press
2	Grahame, D.G.Smith and Aronson, J.K. Oxford T.B of clinical pharmacology and drug therapy, 3rd edition, 2002
3	Tripathi.K.D (2013) Essentials of Medical Pharmacology, 7th edition, Jaypee Brothers, Medical Publishers, New Delhi
4	Shargel et al. 2012, Appllied biopharmaceutics and Pharmacokinetics, 6th edition, McGraw Hill
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://swayam.gov.in/nd1_noc20_cy16/preview
2	https://nptel.ac.in/courses/104/106/104106106/
Course Designed By: Ms G.Sujitha	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	M	M	S	M	M	S
CO2	S	S	S	S	M	M	S	M	M	S
CO3	S	S	S	S	M	M	S	M	M	S
CO4	S	S	S	S	M	M	S	M	M	S
CO5	S	S	S	S	M	M	S	M	M	S

*S-Strong; M-Medium; L-Low

Course code	63P	Biochemistry Practical – III	L	T	P	C
Core/ Elective / Supportive		Core	-	-	4	4
Pre-requisite		Basic knowledge in clinical lab technology	Syllabus Version		2021-2022	

Course Objectives:

The main objectives of this course are to:

1. Learn about the Biochemical methods for analyzing the biological components in Urine and Serum.
2. Know about enzyme assays

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Biomolecules in Urine	K5
2	Biomolecules in Serum	K5
3	Enzyme activities in Serum	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Total 60

Unit:1	Urine Analysis	30 hours

Estimation of Creatinine by picric acid method.

1. Estimation of Urea by DAM-TSC method
2. Estimation of Uric acid by Caraway's method
3. Estimation of Calcium by Permanganate method
4. Estimation of Phosphorus by Fiske-Subbarow method

Unit:2	Blood Analysis	55 hours

Estimation of Urea in serum by DAM –TSC method

1. Estimation of Uric acid in serum by Caraway method
2. **Estimation of Creatinine in serum by picric acid method**
3. Estimation of Phosphorus in serum by Fiske-Subbarrow method
4. **Estimation of Iron in serum by Wong's method**
5. Estimation of Glucose in serum by O- Toluidine method
6. Estimation of Alkaline phosphatase in serum
7. Estimation of Acid phosphatase in serum
8. Estimation of Cholesterol in serum by Zak's method

Unit:3	Kit Method: (Demonstration Experiment)	15 hours

1. Estimation of SGOT
2. Estimation of SGPT
3. Estimation of Triglycerides
4. Estimation of Hemoglobin

	Total practical hours	100 hours

Text Book(s)

1	David T. Plummer, An introduction to practical bio-chemistry
2	Pattabiraman, Laboratory manual in bio-chemistry

Reference Books	
1	J.Jayaraman, Practical bio-chemistry
Course Designed By: Dr .V.Senthamarai Selvi	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code	63Q	BIOCHEMISTRY PRACTICAL – IV	L	T	P	C
Core/ Elective / Supportive		Core Practical	-	-	4	4
Pre-requisite		Basic knowledge in microbiological, immunological enzyme assay and hematology techniques	Syllabus Version		2021-2022	

Course Objectives:

The main objectives of this course are to:

To understand the basic handling of microbiological techniques.
To practice on enzyme technology and basics Immunological techniques
To Understand and practice on Hematology techniques

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Develop skills on handling Microbial techniques	K3
2	Impart knowledge Skills on enzyme assay techniques	K3, K4
3	Practice on basics Immunological assay	K3, K4
4	Develop skills on Plant compounds and basic knowledge on PTC	K3
5	Knowledge practice on Hematology techniques	K3, K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Microbiology	18 hours

1. Microscopic measurements of microorganisms; 2. Hanging drop techniques. 3. Simple staining; 4. Gram staining; 5. Endospore staining; 6. Negative staining; 7. Fungal staining

Unit:2	Enzymes	40 hours

8. Preparation of crude enzyme extract.
9. Effect of pH on the activity of acid phosphatase and catalase.
10. Effect of temperature on the activity of acid phosphatase and catalase.
11. Effect of enzyme concentration on the activity of acid phosphatase and catalase.
12. Effect of substrate concentration on the activity of acid phosphatase and catalase.

Unit:3	Immunology	8 hours

13. RA factor (Kit method)
14. Pregnancy test – Gravindex test (Kit method)

Unit:4	Plant Biochemistry	20 hours

15. Estimation of Chlorophyll; 16. Estimation of Starch

Demonstration on plant tissue culture

17. Preparation of media; sterilization; 18. Initiation of callus culture

Unit:5	Physiology	14 hours

19. Identification blood group
20. Enumeration of RBC
21. Enumeration of WBC
22. Differential staining method
23. Bleeding time and clotting time determination.

	Total practical hours	100 hours

Text Book(s)	
1	Biochemical Methods by S. Sadasivam and Manickam
2	Practical Microbiology by RC.Dudey and Maheswari
3	Experimental Procedures in Life Sciences, S.Rajan and R.Selvi Christy, CBS Publishers & Distributors Pvt Ltd,2018
Course Designed By: P.A.Vasundra Devi	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Elective Courses

Course code	6EA	Elective – II A- Plant and Animal Biotechnology	L	T	P	C
Core/Elective/Supportive		Elective	2	1	-	3
Pre-requisite		Basic Knowledge in plant and animal tissue culture	Syllabus Version		2021-2022	

Course Objectives:

The main objectives of this course are to:
This course presents the plant and animal tissue culture methods, explains the mechanism of gene transfer, Methods of selection, Production of novel proteins and their applications.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understood the components of culture media and various tissue culture techniques.	K2
2	Learnt about the technique of genetic engineering in plants and animals.	K2
3	Learnt about the synthesis and applications of recombinant proteins from cell cultures.	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Plant Tissue Culture	12 hours

Plant tissue culture: - Media composition, nutrients & growth regulators, MS medium & B5 medium. Callus & suspension culture. Initiation & differentiation of PTC. Micropropagation:- Methods, Production of haploid plants, phytochemicals from plant tissue culture.

Unit:2	Protoplast Technology	12 hours

Protoplast technology:- Isolation, fusion of protoplasts, Electroporation, Biolistics, Regeneration of plants from protoplasts. Gene Transfer in plants:- Ti plasmid vectors, mechanism of T- DNA transfer, Vir genes. Transgenic plants: - Herbicide, Virus, Pest resistance plants, Male infertility, Genetic engineering of plant oils.

Unit:3	Mammalian Cell Culture	12 hours

Mammalian cell culture:- Establishment of cell in culture: Requirements for invitro growth; importance of serum. Cell-lines; cell transformation – properties of transformed cells, cell separation, Mass cultivation of cells: suspension culture; immobilized cultivation.

Unit:4	Genetic Engineering of Animal Cells	11 hours

Genetic Engineering of Animal cells: - Mammalian cell culture in protein production. Gene transfer into mammalian cells, Selectable markers pSV plasmids; retroviral vectors; Expression vectors; reporter genes.

Unit:5	Animal Biotechnology	11 hours

Animal Biotechnology:- Artificial insemination and embryo transfer, Invitro fertilization (IVF): embryo cloning. Human embryo research, transgenic mice, Gene therapy; the Human Genome Project. Recombinant proteins from cell cultures: - Interferons, Viral vaccines, Hybridoma technology- Monoclonal antibodies- production and applications.

	Contemporary Issues	**2 hours**
Expert lectures, online seminars – webinars(self study)		-
	Total Lecture hours	**60 hours**

Text Book(s)	
1	D. Balasubramanian and others, Concepts in Biotechnology, Universal press India 1996.
2	BIOTOL series, Invitro cultivation of animal cells- Butler worth Heineman, 2004
3	Walsh Gary and Headon R. Denis, Protein Biotechnology. John Wiley publishers, 1994.
Reference Books	
1	Plant tissue culture; Razdan; Oxford IBH publishers, 2003,2nd edition
2	Freshney; Animal cell culture; IRL press .2010, 6th edition
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/102/103/102103016/
2	https://nptel.ac.in/courses/102/104/102104059/
Course Designed By: Ms G.Sujitha	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO9	PO 10
CO1	S	S	S	S	S	M	M	M	S	S
CO2	S	S	S	S	S	M	M	M	S	S
CO3	S	S	S	S	S	M	M	M	S	S

*S-Strong; M-Medium; L-Low

Course code		Elective II B -Nanomaterials and Nanomedicine	L	T	P	C
Core/Elective/Supportive		Elective	2	1	-	3
Pre-requisite		Basic knowledge in nanomaterials and its applications	Syllabus Version		2021-2022	

Course Objectives:

The main objectives of this course are to:

1. To foundational knowledge of the nanomedicine and related fields.
2. To make the students acquire an understanding the nanomaterials and applications
3. To help them understand in broad outline of nanomaterials and nanomedicine.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Learn about the background on Nanomaterials and Nanomedicine	K2
2	Understand the synthesis of nanomaterials and their application and the impact of nanomaterials on environment	K2
3	Apply their learned knowledge to develop Nanomaterials	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Biological Materials	12 hours

Structure property relationship of Biological materials: tissues, bones and teeth, collagen rich tissues, elastic tissues, nanostructured collagen mimics in tissue Engineering. Biopolymers: Preparation of nanobiomaterials – Polymeric scaffolds collagen, Elastins: Mucopolysaccharides, proteoglycans, cellulose and derivatives; Dextrans; Alginates; Pectins; Chitin

Unit:2	Cardiovascular Implants	12 hours

Cardiovascular implants: Role of nanoparticles and nanodevices in blood clotting; Blood rheology; Blood vessels; Geometry of blood circulation; Vascular implants; Cardiac pacemakers; blood substitutes; Biomembranes.

Unit:3	Polymeric Implant Materials	12 hours

Polymeric implant materials: Polyolefin; polyamides (nylon); Acrylic polymers (bone cement) and hydrigels; Fluorocarbon polymers; Natural and synthetic rubbers, silicone rubbers; High strength thermoplastics; deterioration of polymers. Biomaterials for Ophthalmology: Contact lenses; Optical implants for glaucoma; adhesives; artificial tears; Protection gears.

Unit:4	Metallic and Ceramic Implant Materials	11 hours

Metallicand ceramic implant materials: Bone regeneration, Nano crystalline structures of Bone and Calcium phosphate cements. Cobalt-based alloys; Titanium and its alloys, Nanoparticles relating to Aluminium oxides: Hydroxyapatite; Glass ceramics; ceramic implants; carbon implants. Nano dental materials.

Unit:5	Nanoparticles	11 hours

Metallicand ceramic implant materials – metal nanoparticles and drug delivery vehicles – Nanoshells – Tectodentrimers Nanoparticle drug systems – Diagnostic applications of nanotechnology.

	Contemporary Issues	**2 hours**
Expert lectures, online seminars – webinars(self study)		
	Total Lecture hours	**60 hours**
Text Book(s)		
1	SV Bhat, Biomaterials (2nd Edition), Narosa Publishing House, New Delhi – 2005.	
2	JB Park, Biomaterials Science and Engineering, Plenum Press, New York, 1984 ChallaS.S.R.Kumar, Joseph Hormes, CarolaLeuschmal	
Reference Books		
1	Nanofabrication towards biomedical applications Willey – VCHVerlag GmbH &Co, KGaA.	
2	Freshney; Animal cell culture; IRL press.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://nptel.ac.in/courses/102/106/102106057/	
2	https://nptel.ac.in/courses/113/104/113104009/	
Course Designed By: Ms G.Sujitha		

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	M	S	M	M	S	S
CO2	S	S	S	S	M	S	M	M	S	S
CO3	S	S	S	S	M	S	M	M	S	S

*S-Strong; M-Medium; L-Low

Course code		Elective II C -Health and Hygiene	L	T	P	C
Core/Elective/Supportive		Elective	2	1	-	3
Pre-requisite		Basic knowledge in health and hygeine	Syllabus Version		2021-2022	

Course Objectives:

The main objectives of this course are to:

1. This course is aimed at providing food safety, health and hygiene information and prevent food poisoning.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understood the components of health concepts	K2
2	Learnt about the nutrition, environment, maternal and child health	K2
3	Learnt about the mental health and healthcare programmes	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Concepts of Health	12 hours

Concepts of health:- Who definition of health; Positive health; Determinants of health; Responsibility for health. Health service philosophies:- Health case; Health system; Levels of health case. Concepts of disease and concept of causation – germ theory of disease; Epidemiological triad; Multifactorial causation; Web of causation

Unit:2	Nutrition and Health	12 hours

Nutrition and Health – Food defined; Nutrition defined; Classification of foods; Nutrients – Sources and functions of Proteins, fats, carbohydrates; souces and functions of vitamins and minerals. Nutritional Profiles of principle foods; cereals, Millets, Vegetables, Fruits, Milk, and Milk products, Fish and meat, alcoholic beverages, egg, soft drink. Balanced Diet – PEM Malnutrition and its effects – Kwashiorkor and Marasmus.

Unit:3	Environment and Health	12 hours

Environment and Health – Basic health requirements in the environment – Water – Sources and uses of water, Water pollution, Water related diseases and purification of water. Air – Composition and cause of discomfort; Air pollution – Source, Air pollutants, need for proper ventilation. Housing – Social goals of housing and criteria for healthful housing.

Unit:4	Maternal and child Health	11 hours

Maternal and child Health:- Mother and child – one unit; Intranatal card; Post natal child care – care of the mother, complications of post portal period, restoration of mother to optimum health, Breast feeding; congenital malformations – Definition, incidence, Risk factors, Prenatal diagnosis and prevention. Family planning methods – Family planning definition, Natural family planning methods –BBT Cervical mucous method. Artificial family planning methods – Hormonal contraceptives – go nodal steroids; oral pills, Depot formulations.

Unit:5	Mental Health	11 hours
Mental Health – Types and causes of mental illness – Preventive aspects; Alcoholism and drug dependence – Definition, agent factors, Host factors, symptoms, environmental factors, prevention, Treatment and Rehabilitation. Health care programmes in India – National AIDS control programme and National Immunization programme.		
	Contemporary Issues	**2 hours**
Expert lectures, online seminars – webinars(self study)		
	Total Lecture hours	**60 hours**

Text Book(s)

1. Park. K., Social and preventive medicine, Bhanot publishers, 18th edition, 2005.
2. Turk and Turk., Social and preventive medicine.

Reference Books

1. Ashtekar. S., Health and Healing – A Manual of Primary health care, orient Longmans publishers. 2001.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. https://www.youtube.com/watch?v=KoDiuL6NqgQ
2. https://nptel.ac.in/content/storage2/courses/109101007/downloads/LECTURE_NOTES/Module%2016/lec25.pdf

Course Designed By: Ms G.Sujitha

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	M	S	M	M	S
CO2	S	S	S	S	S	M	S	M	M	S
CO3	S	S	S	S	S	M	S	M	M	S

*S-Strong; M-Medium; L-Low

Course code	6ED	Elective III A -CLINICAL LABORATORY TECHNOLOGY	L	T	P	C
Core/Elective/Supportive		Elective	2	1	-	3
Pre-requisite		Basic Knowledge in clinical laboratory test	Syllabus Version		2021-2022	

Course Objectives:

The main objectives of this course are to:

1. The aim and objective of various clinical laboratory test
2. The significance of various test and interpretation in diseased conditions.
3. This course has been designed to understand the blood disorders, its lab diagnosis and various type of laboratory test.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Students shall understand on the various clinical tests.	K1
2	Understand the significance of various test and interpretation in diseased conditions	K2
3	Apply the fundamentals to diagnositic tests.	K3
4	To analyze and interpret the values for both normal and disease conditions.	K4
5	Understand the basic tests can be done in home (Self Anlaysis)	K3

K1 - Remember; **K2** - Undestand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	COLLECTION &ANALYSIS	12 hours

Collection, transport, analysis of specimen – blood, routine urine, feces, sputum, semen, CSF Documentation of samples & results. Disposal of laboratory/ hospital waste: Non infectious waste , biomedical waste, infected sharp waste disposal, infected non sharp disposal – color coding as per guidelines

Unit:2	BLOOD ANALYSIS	12 hours

Blood Sugar Analysis- glucometer based analysis, HbA1C, NPN-urea, uric acid, Creatinine Clinical chemical test -Ca, P, Fe, Cu, CSF analysis.

Unit:3	ENZYMES, ENZYMES, IMMUNOGLOBULINS	12 hours

Enzymes: Acid phosphatases, LDH, CPK, CPK-MB, Alpha amylase,
Hormones – T3, T4, TSH, LH
Immunoglobulins – IgA, IgM, IgE

Unit:4	PRECIPITATION & AGGLUTINATION TEST	11 hours

Serodiagnostic procedures – precipitation tests, VDRL test, Widal Test, (Slide and Tube method) Brucella agglutination test, ASO test, RA test, CRP test. RIA, ELISA, Flouresent antibody technique.Complement fixation test, skin test – Montaux test, Lepramin test.

Unit:5	BLOOD BANK	11 hours

Blood group and Rh factor – methods of grouping, & reverse grouping , Basic blood banking procedures- cross matching, Different screening test, including Coomb'stest – direct & indirect, separation of blood components, preparation of red cell suspension, Blood transfusion & hazards

	Contemporary Issues	**2 hours**
Expert lectures, online seminars – webinars(self study)		
	Total Lecture hours	**60 hours**

Text Book(s)

1	Jacques Wallach,Interpretation of Diagnostic Test – A Synopsis, 9th Edition, Little brown andcompany, 2011
2	Joan Zilva and Pannall P.R., Clinical Chemistry and diagnosis and treatment, PG Publishing Pvt Ltd, 1995.

Reference Books

1	Varley, H. (1985), **Practical clinical BioChemistry, 4th Edition**.
2	Tietz, N. (2018) **Fundamentals of Clinical Chemistry and Molecular Diagnostics 8th edition,**W.B. Saunders Company

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.youtube.com/watch?v=QNYlX5Ne9lQ
2	https://www.slideshare.net/doctorrao/agglutination-tests-and-immunoassys
3	https://microbenotes.com/introduction-to-precipitation-reaction/

Course Designed By: Ms G.Sujitha

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	M	M	M	S	M	S
CO2	S	S	S	S	M	M	M	S	M	S
CO3	S	S	S	S	M	M	M	S	M	S
CO4	S	S	S	S	M	M	M	S	M	S
CO5	S	S	S	S	M	M	M	S	M	S

*S-Strong; M-Medium; L-Low

Course code		Elective III B- Nano Biotechnology	L	T	P	C
Core/Elective/Supportive		Elective	2	1	-	3
Pre-requisite		Basic Knowledge in nanoparticles	Syllabus Version		2021-2022	

Course Objectives:

The main objectives of this course are to:

1. This course will enable the students to know about basics of nanoparticles..
2. Application in human health and welfare.
3. Merits & Demrits of Nanomaterials

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Enable the students to gain knowledge on nanobiometrics, nanocomposites, nanoanalytics.	K1
2	Understand the basis on processing of nanoparticles and their functions.	K2
3	Apply the fundamental knowledge on naturally occurring nanoparticles and its application various organs.	K3
4	Analyse the types of nanoparticles and its beneficial application in technology.	K4
5	Understand about semiconductors	K2

K1 - Remember; **K2** - Undestand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Interdiciplinary Areas Of Biotech And Nanoscience.	12 hours

Interdiciplinary areas of Biotech and Nanoscience. It is a field that concerns the utilization of biological systems. Cells, Cellular components. Nucleic acids and proteins refinement and application of instruments – to generate and manipulate nanostructured materials to basic and applied studies

Unit:2	Interphase Systems	12 hours

Interphase systems pertaining to biocompatible inorganic devices for medical implants – microfluidic systems – microelectronic silicon substrates.

Unit:3	Nanoparticles	12 hours

Protein based nanostructures building blocks and templates – Proteins as transducers and amplifiers of biomolecular recognition events – nanobioelectronic devices and polymer nanocontainers – microbial production of inorganic nanoparticles – magnetosomes.

Unit:4	DNA	11 hours

DNA based nanostructures - Topographic and Electrostatic properties of DNA and proteins – Hybrid conjugates of gold nanoparticles – DNA oligomers – use of DNA molecules in nanomechenics and computing.

Unit:5	Semiconductor	11 hours

Semiconductor (metal) nanoparticles and nucleic acid and protein based recognition groups – application in optical detection methods – Nanoparticles as carrier for genetic material.

	Contemporary Issues	2 hours

Expert lectures, online seminars – webinars(self study)

	Total Lecture hours	60 hours

Text Book(s)	
1	K.Goser, P. Glosekotter, J. Dienstuhl Nanoelectronics and Nanosystems: From transistors to molecular devices. Overseas Press India Pvt.Ltd Springer.2008
2	RohitMajumdar- Nanotechnology Basic science and Emerging Technologies 1st edition Cyber tech publications 2008.
Reference Books	
1	Mick Wilson, Kamali Kannagara, Geoff Smith, Michelle Simmons, Burkhard Raguse, Nanotechnology: Basic Science and Emerging Technologies, Overseas Press, 2008
2	Bhushan, Bharat, Springer Handbook of Nanotechnology, 3rd Edition, 2010.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://swayam.gov.in/nd1_noc19_mm21/preview
2	https://swayam.gov.in/nd1_noc20_bt41
Course Designed By: Ms G.Sujitha	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	M	M	S	M	S	S
CO2	S	S	S	S	M	M	S	M	S	S
CO3	S	S	S	S	M	M	S	M	S	S
CO4	S	S	S	S	M	M	S	M	S	S
CO5	S	S	S	S	M	M	S	M	S	S

*S-Strong; M-Medium; L-Low

Course code		Elective III C -Sports Biochemistry	L	T	P	C
Core/Elective/Supportive		Elective	2	1	-	3
Pre-requisite		Basic Knowledge in benefits of sports	Syllabus Version		2021-2022	

Course Objectives:

The main objectives of this course are to:

1. The students will have the knowledge about the benefits of the sports in the human body.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	To enable the students understand the functioning of human physiology during sports and exercise	K1
2	Understand the Physiological changes that occurs during sports. types of organic materials and its significance	K2
3	To apply the fundamentals of various food components in role of sports.	K3
4	To analyse about the Nutritional requirements for sports	K4
5	Formulate new nutrition for sports persons.	K3

K1 - Remember; **K2** - Undestand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	SPORTS, EXERCISE & GAMES	12 hours

Introduction, calisthenics, Gymnastics, combative and swimming;
Yogasana and its importance – Padmasana, Vajrasana, Dhunurasana, and Suryanamaskar; Track and field events – Running and Jumping Team events –Kabaddi.

Unit:2	SKELETAL MUSCLE SYSTEM & METABOLIC SYSTEMS IN EXERCISE	12 hours

Skeletal muscle types; - relation with different types of activities; strength, power and endurance of muscles
Muscle metabolic systems in exercise; Recovery of muscle metabolic systems after exercise.

Unit:3	CARDIO RESPIRATORY SYSTEM	12 hours

Muscle blood flow and cardiac output during exercise; Oxygen consumption and pulmonary ventilation in exercise; Hypoxia and hypercapnia

Unit:4	PHYSICAL FITNESS ASSESMENT	11 hours

Body composition; body fat percentage by skin fold method, BMI; Ideal weight and assessment of musclemass.

Unit:5	NUTRITION FOR SPORTS AND EXERCISE	11 hours

Nutritional considerations for sports person:-Carbohydrate: Energy source for sports and exercise; carbohydrates composition for pre-exercise, during and recovery period.
Fat: Role as an energy source: effect of fasting and fat ingestion
Protein: Protein requirement during exercise, recovery process and protein supplement.
Vitamins: Role of B-complex vitamins.
Minerals: Role of Potassium and sodium.

	Contemporary Issues	2 hours

Expert lectures, online seminars – webinars(self study)

	Total Lecture hours	60 hours

Text Book(s)	
1	B.N. Dash, Health and Physical Education ,Neelkamal Publications PvtLtd. 2009.
2	M. Swaminathan, Essentials of Food and Nutrition Vol I –II.2001.
Reference Books	
1	Guyton, Human Physiology and Mechanism of Disease, 5thEdition, W. B. Saunders Publication.1991.
2	Kraure and Mohan,Food, Nutrition and Diet Therapy, 6thEdition, W. B. Sounders Company, London,2005.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://swayam.gov.in/nd2_cec20_ed04/preview
2	https://nptel.ac.in/content/storage2/courses/109101007/downloads/LECTURE_NOTES/Module%209/lec11.pdf
3	https://www.coursera.org/lecture/science-exercise/1-skeletal-muscle-structure-function-IJoQy
Course Designed By: Ms G.Sujitha	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	M	S	M	S	M	S
CO2	S	S	S	S	M	S	M	S	M	S
CO3	S	S	S	S	M	S	M	S	M	S
CO4	S	S	S	S	M	S	M	S	M	S
CO5	S	S	S	S	M	S	M	S	M	S

*S-Strong; M-Medium; L-Low

Skill Based Subject

Course code		Skill Based Subject 4 - Practical – Bioinformatics	L	T	P	C
Core/Elective/Supportive		Skill based subject	-	-	3	3
Pre-requisite		Basic Knowledge in Bioinformatics online tools	Syllabus Version		2021-2022	

Course Objectives:

The main objectives of this course are to:

1. The students will have the knowledge about insilico techniques and structure prediction tools

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Acquire skill on working tools of docking	K2
2	Gain knowledge on various insilico techniques	K2
3	Get accustomed to structure prediction tools	K3
4	Visualize different types of biomolecules	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	PRACTICAL I-BIOINFORMATICS	40 hours

- **Docking program.**
- Biological Databanks Sequence Databases, Structure Databases, Specialised Databases.
- Data retrieval tools and methods.
- Database file formats.
- Molecular visualization

Unit:2	PRACTICAL II	40 hours

- Gene structure and function prediction (using Gen Scan, GeneMark).
- Sequence similarity searching (NCBI BLAST).
- Protein sequence analysis (ExPASy proteomics tools).
- Analysis of protein and nucleic acids sequences
- Sequence analysis using EMBOSS or GCG Wisconsin Package

	Total hours	80 hours

Reference Books

1. Bio-informatics a practical approach by K.Mani and N.Vijayaraj, Aparna publications, Coimbatore.
2. Mani.K.and Vijayaraj,N. Bioinformatics a Practical Approach.

Course Designed By: Dr D.Chandra Prabha

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	M	S	S	S	S	S	S
CO2	S	S	S	M	S	S	S	S	S	S
CO3	S	S	S	M	S	S	S	S	S	S
CO4	S	S	S	M	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Allied Courses

Course code	1AH	Allied Chemistry - I	L	T	P	C
Allied		Allied I – Paper - I	4		-	3
Pre-requisite		Higher Secondary Level Chemistry	Syllabus Version	2021-2022		

Course Objectives:

The main objectives of this course are to:

1. Explain the conducting properties of metals.
2. Outline the reactivity of boron compounds, the principles of bonding, hybridisation and stereochemistry
3. To imbibe the knowledge of silicones, fuel gases, dyes and their industrial applications
4. To inculcate the chemistry behind day to day used items like toiletries, detergents etc
5. Explain the physical chemistry behind the reaction rates and solutions.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the properties metals and their conductivity, the principle behind the synthesis and applications of boron compounds.	K1-K4
2	Understand about silicones fuels gases and their industrial applications. The theory behind colours and dyes, their preparation and dyeing.	K2-K4, K6
3	Understand the bonding and structure of various hydrocarbons and electronic effects. Apperciate the optical properties of compounds and how it determines the compounds nature itself	K1-K4
4	Explain the chemistry behind toiletries and cleaning agents.	K2-K5
5	Understand the kinetics benind chemical reactions and the nature of solutions	K1-K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Conductivity of Metals and Boron Compounds	12 hours

1. **Conductivity of metals:** Band theory, Explanation of thermal and electrical conductivity of metals, limitations, Definition and examples of conductors, semiconductors and insulators.
2. **Boron compounds:** Structure, preparation, properties and uses of NaBH4, Diborane and Borazole

Unit:2	Industrial and Dye Chemistry	12 hours

1. **Industrial Chemistry:** Synthesis, properties and uses of silicones. Fuel gases: composition and uses of natural gas, water gas, semi water gas, carbureted water gas, producer gas, oil gas.
2. **Dye Chemistry:** Terms: Chromophore – auxochrome - bathochromic shift - hypsochromic shift - hyperchromic effect - hypsochromic effect - Dyes: Azo and triphyenyl methane dyes - Preparation of Methyl Orange and Malachite green

Unit:3	Covalent Bonding and Stereoisomerism	12 hours

1. **Covalent bond:** Orbital overlap – hybridization - geometry of organic molecules- CH4, C2H4, and C2H2. Definition with example: Inductive, Electromeric, Mesomeric, hyperconjucative and steric effect.
2. **Stereoisomerism:** Conditions of optical activity - optical isomerism of lactic acid and tartaric acid - geometrical isomerism of maleic and fumaric acids.

Unit:4	Chemistry of Toiletries and Cleaning Agents	12 hours
1. Toiletries: Bath soap – shower gel - water softeners - tooth pastes-ingredients - their characteristic functions-mouth washes-shaving creams-after shave preparations. **2. Cleaning Agents:** Detergents - classification - formulation-cleansing action-optical brightners-bleachers-phenoyls - hand sanitizer.		
Unit:5	**Physical Chemistry: Solutions and Kinetics**	**12 hours**
1. Solutions: Raoult's law - Deviation from ideal behaviour - positive deviation - Negative deviation - Fractional distillation. **2. Kinetics:** Rate - order - molecularity - pseudo first order - determination of order by graphical method - Effect of temperature on the rate - Energy of activation		
	Total Lecture hours	**60 hours**

	Text Book(s)
1	Principles of Inorganic Chemistry, B.R. Puri L.R. Sharma, S.Chand & Co.
2	Inorganic Chemistry, P.L.Soni, Sultan Chand & Sons.
3	Principles of physical chemistry, B.P. Puri, L.R. Sharma and M.S. Phathania, S.Chand & Company
	Reference Books
1	Advanced Organic Chemistry, B.S.Bahl, Arun bahl, S.Chand & Co.,
2	Perfumes, Cosmetics and Soaps, W.A.Poucher (Vol.3), 9th Edition, Springer Science Business Media, 1993.
3	Handbook of Cosmetic Science and Technology, Barel, A.O.; Paye, M.; Maibach, H.I.(2014), CRC Press.
4	Pharmaceutics and Cosmetics, Gupta, P.K.; Gupta, S.K.(2011), Pragati Prakashan
5	Chemical Process Industries, R. Norris Shreve and Joseph A.Brink,Jr.,4 th Edition, McGraw Hill, 1977.
	Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]
1	https://nptel.ac.in/courses/104/103/104103071/
2	https://www.youtube.com/watch?v=zdmEaXnB-5Q
3	https://www.britannica.com/science/band-theory
4	https://www.chem.purdue.edu/gchelp/solutions/whatis.html
Designed By: Dr. S. P. Rajasingh		

Mapping with Programme Outcomes							
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	M	S	M	S	S	S	S
CO2	S	S	S	S	S	M	S
CO3	M	M	S	S	S	M	S
CO4	S	S	S	S	M	M	S
CO5	S	S	M	S	S	M	M

*S-Strong; M-Medium; L-Low

Course code	2AH	Allied Chemistry - II	L	T	P	C
Allied		Allied I – Paper - II	4		-	3
Pre-requisite		Higher Secondary Level Chemistry	Syllabus Version		2021-2022	

Course Objectives:

The main objectives of this course are to:

1. To explain bioinorganic chemistry in biological systems.
2. Appreciate the need for paints and explosives.
3. To understand the role of polymers and rubbers to mankind.
4. Show the importance of fertilizers and the unavoidability of insecticides in agriculture.
5. Explain the electrochemistry and electrical storage.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Appreciate the role of metals in biological system and their therapeutic effects	K1-K3
2	Understand about the importance of paints and the need for explosives as well as the bad face of war.	K2-K5
3	Understand the importance of polymers and rubbers in our day to day life	K1-K4
4	Appreciate the need for fertilizers and insecticides in the Agricultural sector	K2-K5
5	Understand the importance of electrochemistry and energy storage devices	K2-K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Cordination Chemistry and The Importance of Metals	12 hours

1. **Coordination chemistry:** Chelation examples - Hemoglobin – Chlorophyll - Applications of EDTA in qualitative and quantitative analysis.
2. **Metals in Health:** Application of therapeutic chelating agents- Metal-based drugs cis-platin, carboplatin, platinum anti-cancer drugs, gadolinium MRI contrast agents, Gold arthritic agents

Unit:2	Paints and Explosives	12 hours

1. **Paints:** classification – constituents – Pigment Volume Concentration – Distemper – Varnishes – Lacquers - Pigments – name and formula of different coloured pigments and their uses – Toners – Nano paints
2. **Explosives**: classification – characteristics – chemistry of Nitrocellulose – nitroglycerine - gun powder - RDX – mustard gas – phosgene - nerve gas – Screening smokes

Unit:3	Polymers and Rubbers	12 hours

1. **Polymers:** Preparation, properties and uses of: Poly olefins – Polythene – PTFE – PVC – Polypropylene – Polystyrene
2. **Rubbers:** Natural and synthetic rubbers: Constitution of natural rubber – Butyl – Buna-N – Neoprene – Thiocol – Polyurethane – Silicone rubbers

Unit:4	Agricultural Chemistry – Fertilizers and Insecticides	12 hours

1. **Fertilizers:** Classification of fertilizers- Preparation and uses of Urea, DAP, NPK, SSP, TSP and bio-fertilizers (vermicompost, coircompost, panchakavia) – types and advantages of biofertilizers
2. **Insecticides:** Classification of insecticides – Structure and effects of dinitro phenols, DDT, methoxychlor and BHC – comparison of artificial pesticides and bio-pesticide.

Unit:5	Electrochemisry, Fuel cells and Energy Storage	12 hours
1. Electrochemistry: EMF (Definition) - Daniel cell - Reference electrode - Standard Hydrogen Electrode (SHE) -Saturated Calomel Electrode (SCE). Determination of pH - glass electrodes **2. Fuel cell and Energy storage:** Hydrogen - Oxygen fuel cell – Batteries: Lead-storage battery - Batteries of future:Lithium ion batteries.		
	Total Lecture hours	**60 hours**

	Text Book(s)
1	Principles of physical chemistry, B.P. Puri, L.R. Sharma and M.S. Phathania, S.Chand & Company
2	Inorganic Chemistry, P.L.Soni, Sultan Chand & Sons.
3	Principles of Inorganic Chemistry, B.R. Puri L.R. Sharma, S.Chand & Co.
4	Engineering Chemistry by Jain and Jain; Dhanpat Rai Publication Co. 2014.
	Reference Books
1	Environmental Chemistry, A.K.De, 6th Edition, New Age International, New Delhi, 2006
2	A Text Book of Environmental Chemistry and Pollution Control, S.S. Dara–S. Chand Publication 2012.
3	Chemical Process Industries, R. Norris Shreve and Joseph A.Brink,Jr.,4 th Edition, McGraw Hill, 1977.
4	History of fertilizer chemistry by T.P. Hignett, SPRINGER ,1985
	Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]
1	https://onlinecourses.nptel.ac.in/noc19_cy26/preview
2	https://nptel.ac.in/courses/126/105/126105014/
3	https://nptel.ac.in/content/storage2/courses/103107086/module1/lecture1/lecture1.pdf
4	https://nptel.ac.in/content/storage2/courses/108103009/download/M9.pdf
5	https://nptel.ac.in/courses/113105028/
6	https://www.youtube.com/watch?v=no4vRKvKxcU
7	https://www.youtube.com/watch?v=5XKpJ24P-KE
Designed By: Dr. S. P. Rajasingh	

Mapping with Programme Outcomes							
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	S	M	M	M	S	S	S
CO2	S	S	S	M	S	M	S
CO3	S	M	S	S	S	S	M
CO4	S	S	S	M	S	M	S
CO5	S	S	M	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code	2PH	Chemistry Practical	L	T	P	C
Allied		Allied Chemistry	-	-	2	3
Pre-requisite		Higher Secondary Level Lab Knowledge	Syllabus Version		2021-2022	

Course Objectives:

The main objectives of this course are to:

1. Inculcate the students how to handle the basic laboratory apparatus and perform tests.
2. Impart the first-hand knowledge and experience on estimation of an ion, acid and base.
3. Provide the student knowledge on analysis of an unknown organic substance using Preliminary and confirmation test.
4. Make the student skilful enough and prepare for a position in an analytical laboratory or a company.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Estimate the amount of ion present in the given solution through volumetric analysis	K1-K6
2	Find the groups/elements and characters present in the given organic substance through qualitative analysis	K1-K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Part I	VOLUMETRIC ANALYSIS	30 hours

1. Estimation of sodium hydroxide using standard sodium carbonate.
2. Estimation of hydrochloric acid- standard oxalic acid.
3. Estimation of oxalic acid- standard sulphuric acid.
4. Estimation of ferrous sulphate- standard Mohr salt solution.
5. Estimation of oxalic acid- standard ferrous sulphate.

Part II	ORGANIC ANALYSIS	30 hours

Systematic Qualitative Analysis of given Organic Substance and Report on the following

1. Detection of Elelments (N, S, Halogens).
2. To distinguish between aliphatic and Aromatic.
3. To distinguish between saturated and unsaturated.
4. Functional group tests for phenols, acids (mono and di), aromatic primary amine, amide, diamide, carbohydrate, Functional groups characterized by confirmatory test.

	Total Practical hours	60 hours

Text Book(s)

1	Basic Principles of Practical Chemistry, Kulandaivelu A.R. Veeraswamy R., Venkateswaran, Sultan Chand & Sons, 2017
2	Practical Chemistry,Pandey D.N., sultan chand publishers, 2018

Reference Books

1	Vogels Text book of Practical Organic Chemistry, Brian S. Furniss, Antony J. Hannaford, Peter W. G. Smith, Fifth Edition, Bath Press, Great Britan, 1989
2	Vogels Textbook of Quantitative Chemical Analysis, G H Jeffery, J Bassett, J Mendham, R C Denney,Fifth Edition, Bath Press, Great Britan, 1989

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/104/106/104106108/
2	https://www.youtube.com/watch?v=n4esSHxz_J8
3	https://www.toppr.com/guides/chemistry/organic-chemistry/qualitative-analysis-of-organic-compounds/
4	https://www.youtube.com/watch?v=7bmQkQW8bbs
5	https://www.youtube.com/watch?v=wRAo-M8xBHM
Designed By: Dr. S. P. Rajasingh	

Mapping with Programme Outcomes							
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	S	S	S	M	S	S	S
CO2	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

code	3AR	Allied B-paper I-Basic Mathematics	L	T	P	C
Core/Elective/Supportive		Allied	2	1	-	3
Pre-requisite		Students should have the basic understanding of Algebra, Matrix, Differentiation, and Integration & Central Tendency.	Syllabus Version		2021-2022	

Course Objectives:

The main objectives of this course are to:

4. Students will understand the Binomial Series, Logarithmic Series & Summation of the Series.
5. Students will understand the types of Matrices, Inverse of the Matrix, Eigen values & Vectors, Simultaneous Linear Equations.
6. Students will understand about Differentiation & Integration.
7. Students will gain knowledge about Central Tendency & Correlation

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Student can understand, apply & analyze about binomial, exponential, logarithmic & summation series.	K2,K3,K4
2	Students can apply the inverse matrix problem in cryptography	K3
3	Remember & Understand about differentiation	K1, K2
4	Understand the integration by parts	K2
5	Students can apply the Central Tendency in real life.	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Series	16 hours

Binomial, Exponential and Logarthmic series (Statement only) – Applications to summation of series only.

Unit:2	Matrix	18 hours

Quadratic Equation – Matrices – Determinant of a matrix – Inverse of a matrix – Characteristic equation of a matrix – Eigen values – Solutions of simultaneous linear equations in three variables using matrices

Unit:3	Differentiation	18 hours

Differentiation of algebraic – Exponential logarithmic and trigonometric functions – physical interpretations of derivatives with reference of velocity and acceleration – Application of differentiation of maxima and minima (simple problems)

Unit:4	Integration	18 hours

Partial differentiation (Simple problems) – Integration of simple algebraic, exponential and trigonometric functions – substitution method – Integration by parts

Unit:5	Central Tendency & Correlation	18 hours

Measures of central tendency – Mean, Median, Mode - Measures of dispersion – Quartile deviation Mean deviation - Standard deviation - Correlation – Karl pearson's coefficient of correlation – rank correlation.

Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**90 hours**

Reference Books	
1	Calculus – Volume I – T.K.Manickavasagam Pillai and others
2	Calculus – Volume II – T.K.Manickavasagam Pillai and others.
3	Algebra – T.K. Manickavasagam Pillai and others.
4	Statistical Methods – S.P.Gupta.

Related Online Contents [Websites]	
1	https://youtu.be/1plMO7ChXMU
2	https://youtu.be/MSTSBW8LPRM
3	https://youtu.be/XrGM0OANzaE
4	https://youtu.be/mOlgB_BmF2s

Course Designed By: Mrs R.Gokilamani

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	S	S	S	M	S	S	M	S	S
CO3	M	S	S	S	M	S	S	M	S	S
CO3	M	S	S	S	M	S	S	M	S	S
CO4	M	S	S	S	M	S	S	M	S	S
CO5	M	S	S	S	M	S	S	M	S	S

*S-Strong; M-Medium; L-Low

Code	4AR	Allied B-paper II-COMPUTER	L	T	P	C
Core/Elective/Supportive		Allied	2	1	-	3
Pre-requisite		Basic Knowledge in computer	Syllabus Version		2021-2022	

Course Objectives:

The main objectives of this course are to:

1. To inculcate knowledge on C concepts. This subject seeks to introduce students to philosophy, culture and visual art. It discusses the interrelatedness of key philosophical, cultural and artistic ideas and encourages a scholarly way of thinking.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Students will be able to understand about the Characteristics of Computers, Flowcharts and Algorithms	K2,K3,K4
2	Students will be able to understand C Programming Language, variables, expressions and operators	K3
3	Students will be able to understand about Input, Output function and conditional and Compound Statements	K1, K2
4	Students will be able to understand about Arrays	K2
5	Students will be able to understand about Functions and Strings	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Computer Algorithms:	10 hours

Algorithms – Characteristics of computers - An illustrative computer algorithm.

Developing Algorithms: Flowcharts - A simple model of a computer flowcharting examples

Unit:2	Programming Preliminaries	12 hours

: High level languages - C Language - Description of Programming languages - Structure of C programming language – constants - scalar variables – declaring Variable names - defining constants - Defining variables - Various Expressions and operators

Unit:3	Functions	12 hours

Input function - Output function – compound and conditional statements - While loop – do.while loop - for loop. Simple Programs using above verbs.

Unit:4	Arrays	12 hours

Arrays - Rules for arrays - multiple subscripts in arrays - Multi-dimensional arrays - for loop with arrays - Simple programs

Unit:5	Logical Operators	12 hours

. Logical operators and expressions - switch statement - break Statement - continue statement - label - goto statement. Functions - defining function - using function - rules - arrays in functions- Character data type - manipulation of strings

Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**60 hours**

Reference Books	
1	COMPUTER ROGRAMMING IN C : V.Rajaraman (PHI Publication)
2	PROGRAMMING IN ANSI C : E.Balagurusamy (Tata McGraw Hill Pub.)
3	PROGRAMMING IN ANSI C : Ashok N.Kamthane (Pearson Education)
Related Online Contents [MOOC, SWAYAM, Websites]	
1	https://nptel.ac.in/courses/106/104/106104128/
2	https://nptel.ac.in/noc/courses/noc20/SEM2/noc20-cs91/
3	https://nptel.ac.in/courses/106/106/106106210/
Course Designed By: Dr.G.Sathyavathy	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	S	S	S	M	S	S	S	S	S
CO3	M	S	S	S	M	S	S	S	S	S
CO3	M	S	S	S	M	S	S	S	S	S
CO4	M	S	S	S	M	S	S	S	S	S
CO5	M	S	S	S	M	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Code	43Q	Allied B- Computer Practical	L	T	P	C
Core/Elective/Supportive		Allied	-	-	2	2
Pre-requisite		Basic computer knowledge	Syllabus Version		2021-2022	

Course Objectives:

The main objectives of this course are to:

1. To develop students computing skills in the area of C programming

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Students will be able to do programs using Conditional Statements	K2,K3
2	Students will be able to do programs using relational operators	K4
3	Students will be able to do programs using Functions	K3
4	Students will be able to do programs using Strings	K1,K2
5	Students will be able to do programs using Arrays	K2,K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

	LIST OF PROGRAMMES	**28**

1. Write a C program to find the largest among the three given numbers.
2. Write a C program to print the given FIVE digit number in reverse order.
3. Write a C program to print first 50 terms of Fibonacci sequence.
4. Write a C program to find the smallest number in the given set of N numbers
5. Write a C program to find the given word is palindrome or not
6. Write a C program to count the number of positive , negative and zero integers from the set of N numbers.
7. Write a C program to sort the given set of N numbers in ascending order.
8. Write a C program to find the addition and subtraction of the given two square matrices
9. Write a C program to find the multiplication of the given two square Matrices.
10. Write a C program to count the number of words and number of characters in a sentence

	Contemporary Issues	**2 hours**

Expert lectures, online seminars - webinars

	Total Lecture hours	**30 hours**

Reference Books

1	COMPUTER ROGRAMMING IN C : V.Rajaraman (PHI Publication)
2	PROGRAMMING IN ANSI C : E.Balagurusamy (Tata McGraw Hill Pub.)
3	PROGRAMMING IN ANSI C : Ashok N.Kamthane (Pearson Education)

Course Designed By:Dr G.Sathyavathy

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	M	S	S	S	M	S
CO3	M	S	S	M	M	S	S	S	M	S
CO3	M	S	S	M	M	S	S	S	M	S
CO4	M	S	S	M	M	S	S	S	M	S
CO5	M	S	S	M	M	S	S	S	M	S

*S-Strong; M-Medium; L-Low

Annexure

Mission

- Developing broad based knowledge in concepts and principles of biochemistry through a rich collegial atmosphere that will equip our graduates with transferable skills and an awareness of research ethics.

- Moulding and promoting the students to translate our scientific inventions into meaningful applications for better healthcare and economic development of Nation.
- Constantly updating academic, management, and research oriented education in Biochemistry
- To identify and develop intelligent problem solving strategies in local and global issues
- Enhance the Entrepreneurship skills in Biochemistry-related areas and to provide opportunities for career development