DWARAKA DOSS GOVERDHAN DOSS VAISHNAV COLLEGE (Autonomous)
Re-accredited with "A++" Grade by NAAC (3rd Cycle)
College with Potential for Excellence, Linguistic Minority Institution
Affiliated to University of Madras
Arumbakkam, Chennai – 600 106

DEPARTMENT OF BIOCHEMISTRY

B.Sc., Biochemistry

I – VI Semesters
SCHEME AND SYLLABUS

Effective for the students admitted from the academic year 2025 onwards

INSTITUTION

VISION

To impart value-based quality academia; to empower students with wisdom and to charge them with rich Indian traditions and culture; to invoke the self, to broaden the same towards nation building, harmony and Universal brotherhood.

MISSION

To ensure sustained progress and development in imparting quality education, to pioneer new avenues of teaching and research and to emerge as an institution with potential for excellence.

DEPARTMENT OF BIOCHEMISTRY

VISION

"To become a globally recognized center of excellence in Biochemistry by fostering innovative teaching, advancing cutting-edge research, and empowering society through impactful contributions, while nurturing professionals who combine technical expertise, entrepreneurial innovation, and real-world problem-solving skills to address global challenges and drive transformative advancements."

MISSION

M1	To provide a better understanding of the subject with sound knowledge in theory and practice and apply the biochemical knowledge in solving health and environment-related problems
M2	To cultivate the ability to apply creativity and independent thinking to bridge the gap between industry and academics, to meet the industrial demands.
M3	To follow a multidisciplinary research strategy by harnessing all the available resources

PROGRAM EDUCATION OBJECTIVES (PEOs)

Our programme will produce graduates who	
PEO1	Will demonstrate a strong foundation in the principles of biochemistry, enabling them to address real-world problems in healthcare, biotechnology, pharmaceuticals, and environmental sciences.
PEO2	Will develop critical thinking, problem-solving, and research abilities and will contribute to the advancement of science and technology.
PEO3	Will exhibit effective communication skills and will be capable of working in multidisciplinary teams.
PEO4	Will adopt an ethical attitude towards social challenges and will be responsible for environmental issues.
PEO5	Will be well informed of the job opportunities and start-ups in the healthcare and other life science-based sectors.

PEO TO MISSION STATEMENT MAPPING

MISSION STATEMENTS	PEO1	PEO2	PEO3	PEO4	PEO5
M1	3	3	3	3	3
M2	3	3	3	3	3
M3	3	3	3	3	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

PROGRAM OUTCOMES (PO) IN RELATION TO GRADUATE ATTRIBUTES

PO1	Disciplinary knowledge: Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate program of study
PO2	Communication Skills: Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups.
PO3	Critical thinking, analytical reasoning, and inquiry methods: Capability to apply analytical reasoning, evaluate evidence, apply arguments, verify claims and beliefs on the basis of empirical evidence, and appreciate intellectual property. Foster innovation and build Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of problems in real-life situations.
PO4	Leadership readiness/qualities: Collaborate effectively and ethically coordinate with diverse teams, map task, set directions to achieve the vision.
PO5	Information/digital literacy: Capability to seek relevant e-resources, update scientific information, and equip skills through ICT tools.
PO6	Lifelong learner: Become a responsible Global citizen and contribute towards environmental and sustainable development goals.

MAPPING OF POs TO PEOs

PEO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
PEO 1	3	3	3	3	3	3
PEO 2	3	3	3	3	3	3
PEO 3	3	3	3	3	3	3
PEO 4	3	3	3	3	3	3
PEO 5	3	3	3	3	3	3

3-Strong Correlation 2- Medium Correlation 1- Low Correlation

PROGRAM SPECIFIC OUTCOMES

After successful completion of a 3-year B.Sc. programme, the students will be able to	
PSO1	comprehend the structure and function of biological macromolecules like proteins, nucleic acids, lipids, and carbohydrates and interpret metabolic disorders
PSO2	plan, carry out, and evaluate experiments as well as decipher data and make insightful deductions.
PSO3	develop critical thinking and problem-solving abilities by utilizing conceptual knowledge, analytical techniques, and computational and statistical approaches.
PSO4	use biochemical concepts to address practical issues in fields like environmental science, food science, biotechnology, medicine, and agriculture.
PSO5	recognize how biochemistry is multidisciplinary in tackling global issues, including energy production, climate change, and sustainable development.

DEPARTMENT OF BIOCHEMISTRY

ELIGIBILITY FOR ADMISSION

Candidates must have passed the Higher Secondary Examination (10+2) or its equivalent from a recognized Board/University with a minimum aggregate of 40% and with Chemistry and Biology/Biotechnology/Biochemistry as core subjects.

DURATION OF THE COURSE

The duration of the course for three academic years, consisting of six semesters and each semester comprises of 90 days.

BIOCHEMISTRY CURRICULUM

The B.Sc., Biochemistry curriculum is designed to provide students with a comprehensive understanding of the fundamental principles and advanced concepts in Biochemistry. The curriculum is structured across six semesters, covering essential topics such as biomolecules, enzymology, metabolism, molecular biology, immunology, bioinformatics, and nutrition. The program emphasizes upon interdisciplinary approach and integrates theoretical knowledge with practical skills through a combination of core courses, elective subjects, laboratory work, and project-based learning. Additionally, the inclusion of skill-enhancement courses and value-added programs prepares students for diverse career opportunities in academia, research, healthcare, pharmaceuticals, and biotechnology industries.

DISSERTATION

Semester VI consists of a project and dissertation for 100 marks. Students are allocated individually to dissertation with the faculty of the department. The format for dissertations is similar to the thesis style, incorporating introduction, materials & methods, results, discussion and bibliography. The dissertation is submitted in a type written and bound form after plagiarism check and a copy of each dissertation is submitted to the Department for permanent record. Each student should present/ publish a paper on his/her project.

ELIGIBILITY FOR THE AWARD OF DEGREE

A Candidate shall be eligible for the award of the degree of Bachelor of Science in Biochemistry, only if he/she has undergone the prescribed course of study in a College affiliated to the University of Madras, for a period of not less than three academic years and passed the examinations of all the Six Semesters prescribed earning a minimum of 142 credits as per the distribution given in the scheme for Part I, II, III, IV and V and also fulfilled such other conditions as have been prescribed thereof.

SCHEME ON EXAMINATIONS

As per the University Regulation, the following split-up of marks is to be followed.

(i) SPLIT UP FOR INTERNAL AND EXTERNAL MARKS FOR THEORY AND PRACTICAL

Sl. No.	Paper	Internal	External	Total
1.	**Theory**	**50**	**50**	**100**
2.	**Practical**	**50**	**50**	**100**

(ii) SPLIT UP FOR INTERNAL ASSESSMENT MARKS FOR THEORY

CIE- Continuous Internal Evaluation (50 Marks)

CIA	**30**
Generic Skill	**15**
Attendance	**5**
Total	**50**

iii) MARKING SCHEME FOR ATTENDANCE

Attendance	Marks (5)
80 % and above	5
75-80%	4
65-74%	3
51-64%	2
31-50%	1
Less than 30 %	0

iv) SPLIT UP FOR INTERNAL ASSESSMENT MARKS FOR PRACTICALS

Break-up	Marks (50)
Model Examination	25
Classroom Practicals	20
Attendance	05
Total	**50**

SCHEME OF I SEMESTER B.SC., BIOCHEMISTRY PROGRAM

SEMESTER I												
Component	**Course Category**	**Course Code**	**Name of the Course**	**Overall Credits**	**Hours Distribution**				**Total Contact Hours**	**Marks**		
					L	T	P	S		**CIA**	**ESE**	**Total**
Part I	**AECC**		Language I	3	4	0	0	0	4	50	50	100
Part II	**AECC**		English I	3	4	0	0	0	4	50	50	100
Part III	**Core Course I**	2511101	Nutritional Biochemistry	4	4	1	0	0	5	50	50	100
	Core Practical I	2511103	Nutritional Biochemistry	2	0	0	3	0	3	50	50	100
	Generic Elective I	2511102	Chemistry-I	3	3	1	0	0	4	50	50	100
	Generic Practical I	2511104	Chemistry- I	2	0	0	3	0	3	50	50	100
PART IV	**Skill Enhancement Course – DS I**	2511105	First Aid	2	3	0	0	0	3	50	50	100
	Skill Enhancement Course – NME I	2511106	Basics of Medical Terminologies	2	2	0	0	0	2	50	50	100
	Soft Skill I			2	2	0	0	0	2	50	50	100
Total				**23**					**30**			

SCHEME OF II SEMESTER B.SC., BIOCHEMISTRY PROGRAM

SEMESTER II												
Component	**Course Category**	**Course Code**	**Name of the Course**	**Overall Credits**	**Hours Distribution**				**Total Contact Hours**	**Marks**		
					L	T	P	S		**CIA**	**ESE**	**Total**
Part I	**AECC**		Language II	3	4	0	0	0	4	50	50	100
Part II	**AECC**		English II	3	4	0	0	0	4	50	50	100
Part III	**Core Course II**	2511207	Cell Biology	4	4	1	0	0	5	50	50	100
	Core Practical II	2511209	Cell Biology	2	0	0	3	0	3	50	50	100
	Generic Elective II	2511208	Chemistry-II	3	3	1	0	0	4	50	50	100
	Generic Practical II	2511210	Chemistry-II	2	0	0	3	0	3	50	50	100
PART IV	**Skill Enhancement Course-DS II**	2511211	Laboratory Skills in Biochemistry	2	3	0	0	0	3	50	50	100
	Skill Enhancement Course-NME II	2511212	Prevention and Management of Lifestyle Disorders	2	2	0	0	0	2	50	50	100
	Soft Skill II			2	2	0	0	0	2	50	50	100
Total				**23**					**30**			

SCHEME OF III SEMESTER B.SC., BIOCHEMISTRY PROGRAM

SEMESTER III												
Component	**Course Category**	**Course Code**	**Name of the Course**	**Overall Credits**	**Hours Distribution**				**Total Contact Hours**	**Marks**		
					L	T	P	S		**CIA**	**ESE**	**Total**
Part I	**AECC**		Language II	3	5	0	0	0	5	50	50	100
Part II	**AECC**		English II	3	4	0	0	0	4	50	50	100
Part III	**Core Course III**	2511313	Chemistry of Biomolecules	4	4	1	0	0	5	50	50	100
	Core Practical III	2511316	Chemistry of Biomolecules	2	1	0	2	0	3	50	50	100
	Generic Elective III	2511314	Microbiology	3	3	1	0	0	4	50	50	100
	Generic Practical III	2511317	Microbiology	2	0	0	3	0	3	50	50	100
	Discipline Specific Elective I - Employability Course I (A)	2511315 (A)	Community Medicine	3	3	0	0	0	3	50	50	100
	Or											
	Discipline Specific Elective I - Employability Course I (B)	2511315 (B)	Blood Banking and Blood transfusion		3	0	0	0		50	50	100
	Or											
	Discipline Specific Elective I - Employability Course I (C)	2511315 (C)	Basics of Medical Lab Technology		3	0	0	0		50	50	100
PART IV	**Industrial Visit**	2511318		1	-	-	-	-	-			
	EVS			-	1	0	0	0	1			
	Soft Skill III			2	2	0	0	0	2	50	50	100
Total				**23**					**30**			

SCHEME OF IV SEMESTER B.SC., BIOCHEMISTRY PROGRAM

SEMESTER IV												
Component	**Course Category**	**Course Code**	**Name of the Course**	**Overall Credits**	**Hours Distribution**				**Total Contact Hours**	**Marks**		
					L	T	P	S		**CIA**	**ESE**	**Total**
Part I	**AECC**		Language II	3	5	0	0	0	5	50	50	100
Part II	**AECC**		English II	3	4	0	0	0	4	50	50	100
Part III	**Core Course IV**	2511419	Biochemical Techniques	4	4	1	0	0	5	50	50	100
	Core Practical IV	2511422	Biochemical Techniques	2	1	0	2	0	3	50	50	100
	Generic Elective IV	2511420	Biostatistics and Computer Applications	3	3	1	0	0	4	50	50	100
	Generic Practical IV	2511423	Biostatistics and Computer Applications	2	0	0	3	0	3	50	50	100
	Discipline Specific Elective II Entrepreneurship Course II (A)	2511421 (A)	Food Standards and Quality Control	3	3	0	0	0	3	50	50	100
	Or											
	Discipline Specific Elective II Entrepreneurship Course II (B)	2511421 (B)	Phytochemistry Essentials							50	50	100
	Or											
	Discipline Specific Elective II Entrepreneurship Course II (C)	2511421 (C)	Bioenterprenurship							50	50	100
PART IV	**EVS**			2	1	0	0	0	1	50	50	100
	Soft Skill IV			2	2	0	0	0	2	50	50	100
Total				**24**					**30**			

SCHEME OF V SEMESTER B.SC., BIOCHEMISTRY PROGRAM

SEMESTER V												
Component	**Course Category**	**Course Code**	**Name of the Course**	**Overall Credits**	**Hours Distribution**				**Total Contact Hours**	**Marks**		
					L	T	P	S		**CIA**	**ESE**	**Total**
Part III	**Core Course V**	2511524	Enzymes	4	4	1	0	0	5	50	50	100
	Core Course VI	2511525	Intermediary Metabolism	4	4	1	0	0	5	50	50	100
	Core Course VII	2511526	Human Physiology	4	4	1	0	0	5	50	50	100
	Core Course VIII	2511527	Molecular Biology	4	4	1	0	0	5	50	50	100
	Core Practical V	2511529	Enzymes and Intermediary Metabolism	2	0	0	3	0	3	50	50	100
	Core Practical VI	2511530	Molecular Biology and Physiology	2	0	0	3	0	3	50	50	100
	Multi-Disciplinary Elective/ Open Elective I	2511528	Therapeutic Nutrition	3	4	0	0	0	4	50	50	100
	Internship	2511531		2					-			
Part IV	**Value Education**			2					-	50	50	100
Total				**27**					**30**			

NOTE: Internship to be carried out at the end of the IV Semester during summer vacations, and the credits and marks to be included in the grade sheet of the subsequent semester ie., V Semester.

SCHEME OF VI SEMESTER B.SC., BIOCHEMISTRY PROGRAM

SEMESTER VI												
Component	**Course Category**	**Course Code**	**Name of the Course**	**Overall Credits**	**Hours Distribution**				**Total Contact Hours**	**Marks**		
					L	T	P	S		**CIA**	**ESE**	**Total**
Part III	**Core Course IX**	2511632	Research Methodology	4	4	1	0	0	5	50	50	100
	Core Course X	2511633	Clinical Biochemistry	4	4	1	0	0	5	50	50	100
	Core Course XI	2511634	Immunology	4	4	1	0	0	5	50	50	100
	Core Practical VII	2511636	Clinical Biochemistry	2	1	0	4	0	5	50	50	100
	Discipline Specific Elective III - Employability Course III (A)	2511635 (A)	Principles of Biotechnology	3	3	0	0	0	3	50	50	100
	Or											
	Discipline Specific Elective III - Employability Course III (B)	2511635 (B)	Nutraceuticals							50	50	100
	Or											
	Discipline Specific Elective III - Employability Course III (C)	2511635 (C)	Bioinformatics							50	50	100
	Project	2511637	Project Viva voce- Dissertation	4					7	50	50	100
Part V	**Extension Activity**			1								
Total				**22**					**30**			

OVERALL CREDIT DISTRIBUTION

Component	Credits
Part I	**12**
Part II	**12**
Part III	**94**
Part IV	**23**
Part V	**1**
Total	**142**

I B.Sc BIOCHEMISTRY

FIRST SEMESTER

Core Course-I

Course Title: NUTRITIONAL BIOCHEMISTRY

Course Code	**2511101**	**Credits**	**04**
L:T:P:S	**4:1:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**100**

LEARNING OBJECTIVE

To explain the functions and health impacts of macronutrients and micronutrients, analyze nutritional requirements for various health conditions such as diabetes and renal failure, and apply evidence-based dietary principles to support health promotion and disease prevention.

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

CO1	Classify basic food groups viz. Carbohydrates, proteins and lipids and their nutritional aspects as well as calorific value
CO2	Identify and explain nutrients in foods and the specific functions in maintaining health.
CO3	Relate the nature and biomedical significance of vitamins and minerals present in food
CO4	Analyze the biological importance of major and minor trace elements (Minerals) in the food
CO5	Categorize the correlation between the importance of nutrients and lifestyle disorders viz. diabetes mellitus, renal failure and cardiovascular diseases.

Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	2	2	2	3	2	3	3	3
CO2	3	3	3	2	2	2	3	2	3	3	3
CO3	3	3	3	2	2	2	3	2	3	3	3
CO4	3	3	3	2	2	2	3	2	3	3	3
CO5	3	3	3	2	2	2	3	2	3	3	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

MODULE NO.	CONTENTS OF MODULE	HRs	COs
I	**Basic Concepts of Nutrition-** Definition, Basic food groups - Energy-yielding, Body building, and protective foods. units of energy, BMR- Factors affecting BMR, Measurements of energy food Stuffs by bomb calorimeter. Calorific value of proteins, carbohydrates and fats, RQ of foods. SDA.	10	CO1
II	**Nutritional Aspects of Macronutrients**- Nutritional Aspects of Carbohydrates- Dietary sources, RDA, Physiological role, significance of fibre in the diet. Nutritional Aspects of Proteins - Dietary sources, RDA, Physiological role; significance of essential amino acids, Protein energy malnutrition in children. Nutritional Aspects of Lipids – Dietary sources, RDA, Physiological role; significance of essential fatty acids, MUFAs, and PUFAs.	15	CO2
III	**Nutritional Aspects of Vitamins**- Classification. function, RDA dietary source and deficiency diseases of water soluble vitamins Vit B1, B2, B5,B6, B9 and B12 and Fat soluble vitamins – A, D, E& K	15	CO3
IV	**Nutritional Aspects of Minerals**- Dietary source, RDA, function and deficiency symptoms of Calcium, Phosphorus, Iron, Iodine, Sodium, Chlorine and Potassium- Supplementation of calcium, iron-rich foods	15	CO4
V	**Therapeutic Nutrition-**Diabetes mellitus-Definition. Symptoms and types. Dietary management for Diabetes Mellitus. Renal failure- Definition, Causes and types (acute & chronic). Dietary management for renal failure patients	10	CO5

RECOMMENDED BOOKS

1. Sharma, D. S. (2017). *Nutritional Biochemistry.*CBS Publishers and distributors - ISBN 10: 8123925271 / ISBN 13: 9788123925271
2. Srilakshmi, B. (2019). *Dietetics* - (Multi Colour Edition ed.). New Age International Publishers - ISBN 10: 9386649209 / ISBN 13: 9789386649201
3. B.Srilakshmi, B. (2017). *Food Science* (Multi Colour Edition). New Age International Publishers - ISBN 10: 8122438091 / ISBN 13: 9788122438093

REFERENCE BOOKS

1. Sathyanarayana. (2017). *Biochemistry.* Elsevier - ISBN: 9788131236017
2. Swaminathan. (2005). *Advanced Textbooks of Food and Nutrition.* BAPP CO PRESS.
3. Krause's. (2013). *Food, Nutrition,and Diet Therapy* (11th ed.). W.B. Saunders - ISBN-10 : 0721697844, ISBN-13 : 978-0721697840

WEB RESOURCES

1. Functions_of_foods.pdf
2. Lipids - Recommended Dietary Allowances - NCBI Bookshelf
3. Biochemistry, Water Soluble Vitamins - StatPearls - NCBI Bookshelf

I B.Sc., BIOCHEMISTRY

FIRST SEMESTER

Core Practical-I

Course Title: NUTRITIONAL BIOCHEMISTRY

Course Code	**2511103**	**Credits**	**02**
L:T:P:S	**0:0:3:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**50**

LEARNING OBJECTIVE

To perform and interpret biochemical estimations of biomolecules (amino acids, sugars, vitamins, lipids, carbohydrates, phosphorus, calcium, chloride) and analyze food sample properties like ash and moisture content using standard laboratory techniques.

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

CO1	Estimate glycine by Sorensons formal titration
CO2	Determine glucose in jaggery by Benedict's method
CO3	Evaluate the ascorbic acid content in lemon by the Dichlorophenol Indophenol dye method. Know the methodology of the extraction of lipids from seeds
CO4	Analyze the principle of the colorimeter and estimate the amount of carbohydrate and phosphorus by colorimetry
CO5	Examine the importance of minerals and estimate the amount of minerals like calcium and chlorine

Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	2	2	2	3	3	3	2
CO2	3	3	3	3	2	2	2	3	3	3	2
CO3	3	3	3	3	2	2	2	3	3	3	2
CO4	3	3	3	3	2	2	2	3	3	3	2
CO5	3	3	3	3	2	2	2	3	3	3	2

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

MODULE NO.	CONTENTS	HRs	COs
I	Estimation of Glycine by Sorenson formal titration.	3	CO1
II	Determination of reducing sugars, total sugars in jaggery/honey by the Benedict's method.	3	CO1
III	Estimation of ascorbic acid using 2, 6 – 6-dichlorophenol indophenol as link solution, present in lemon	3	CO1
IV	Extraction of lipids from oil seeds	3	CO2
V	Colorimetric estimation of carbohydrate by the anthrone method in food samples	3	CO2
VI	Colorimetric estimation of inorganic Phosphorus by Fiske Fiske-Subbarow method in a water sample.	3	CO3
VII	Estimation of Calcium in Milk	3	CO3
VIII	Estimation of Chloride by Mohr's method	3	CO4
IX	**Demonstration Experiments**		
X	Determination of ash and moisture content in a food sample	3	CO5

RECOMMENDED BOOKS

1.Jayaraman, J. (2011). *Laboratory Manual in Biochemistry.* New Age International Pvt Ltd Publishers - ISBN-10 : 812243049X, ISBN-13 : 978-8122430493

2.H.Saegal, I. (2010). *Biochemical calculations.*(2nd ed.). Wiley Publisher - ISBN-13 978-8126526437

3.Singh, S. K. (2005). *Introductory Practical Biochemistry* (2nd ed.). Alpha Science International, Ltd - ISBN 10: 8173193029 / ISBN 13: 9788173193026

REFERENCE BOOKS

1. Leo M.L. Nollet.*Handbook of Food Analysis*. (pp. 59-92), Edition: 1st, Chapter: *Determination of Moisture and Ash contents of Foods.* Publisher: Marcel Dekker, Inc,

2. S. Sadasivam A. Manickam.(2018) *Biochemical Methods* New Age International Pvt Ltd publisher's third edition

3. S.K. Sawhney, Randhir Singh. (2005). *Introductory Practical Biochemistry*(2nd Ed)

WEB RESOURCES

1.https://youtu.be/WLv8r_zBdVA

2.https://www.youtube.com/watch?v=n2Qwb8Pw8YE

3. https://youtu.be/o-ugcmSgtGc

I B.Sc., BIOCHEMISTRY

FIRST SEMESTER

Generic Elective -I
Course Title: CHEMISTRY-I

Course Code	**2511102**	**Credits**	**03**
L:T:P:S	**3:1:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**100**

LEARNING OBJECTIVE

To understand fundamental concepts of nuclear chemistry, states of matter, reaction kinetics, coordination compounds, thermodynamics, electrochemistry, and colloids, while applying these principles to solve problems in chemistry and related fields

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

CO1	Apply the concepts of fundamental particles, isotopes, isobars, isotones, and artificial radioactivity to explain carbon dating and medical applications of radioisotopes
CO2	Explain intermolecular forces (van der Waals, hydrogen bonding, dipole-dipole) and factors affecting the rate of chemical reactions.
CO3	Describe electronic displacement effects (inductive, resonance, steric), bond dissociations, and Werner's theory of coordination compounds, including nomenclature and applications
CO4	Define basic thermodynamic concepts such as work, energy, heat, intensive/extensive properties, internal energy, enthalpy, and entropy to describe exothermic and endothermic processes using the first law of thermodynamics
CO5	Analyze electrochemical cells (electrolytic and galvanic), standard electrode potentials, Nernst equation, and solution properties (normality, molarity, molality, pH, pOH, buffers), along with colloidal systems and their physical properties

Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	2	3	2	3	3	3	1	1
CO2	3	2	3	2	3	2	3	3	3	1	1
CO3	3	2	3	2	3	2	3	3	3	1	1
CO4	3	2	3	2	3	2	3	3	3	1	1
CO5	3	2	3	2	3	2	3	3	3	1	1

CORRELATION: 3- STRONG, 2- MEDIUM, 1-LOW

MODULE NO.	CONTENTS OF MODULE	HRs	COs
I	**Fundamental Particles of the nucleus**, isobars, isotopes, isotones, and Differences between chemical and nuclear reactions. Artificial radioactivity (definition only) Application of radio isotopes – Carbon dating and medical applications. **Atom**-fundamental particles present in an atom- electron, proton, and neutron. Arrangement of electrons in an atom- Bohr-Bury rule.	10	CO1
II	**States of matter-** solid, liquid, and gases (definition only). Intermolecular forces - definition of van der Waals' force, dispersion forces, Hydrogen bonding, dipole-dipole, dipole-induced dipole forces. **Rate of chemical reaction** –factors affecting rate of reactions, order integrated rate expression for first, second and zero order reactions (no derivation)– Arrhenius equation for activation energy and its applications.	10	CO2
III	**Electronic displacement effects:** Inductive, resonance and steric effects (Definitions only). Homolytic and Heterolytic bond dissociations (Definitions only with examples).**Werner Theory of Coordination Compounds** terminologies-, Complex, Ligand and its types, coordination sphere, charge of the complex, chelation, Nomenclature-Applications of coordination compounds.	10	CO3
IV	**Introduction- System** and its types, surroundings, Basic concepts - Work, energy, heat, Intensive and extensive properties. Exothermic and endothermic processes. First law of Thermodynamics (definition only) - internal energy, Enthalpy, Entropy (definition only). **Electrochemical Cells**- Electrolytic cells (definitions only). Galvanic cells – emf – standard electrode potential, half-cell reactions (definitions and examples only), Nernst equation (no derivation)	10	CO4
V	**Standard solutions** - Normality, molarity, and molality (definition only)- pH, pOH - Henderson-Hasselbach equation - Acid-base buffers (definition and examples).Solutions, suspensions, colloids- definitions only- Dispersed phase, dispersion medium- Colloids physical properties (Tyndall effect, Brownian movement).	10	CO5

RECOMMENDED BOOKS

1. Puri, S. P. (2016). *Principles of physical chemistry.* Manav Book Distributers -
2. Puri, S. (2017). *Principles of Inorganic chemistry* (33rd ed.). Milestone Publishers and distributors - ISBN-10 : 8192143333 / ISBN-13 : 978-8192143330
3. James E. Huheey, E. A. (2014). *Inorganic chemistry, principles of structure and reactivity* (14th ed.). Dorling Kinersley India pvt Ltd - ISBN-10 : 006042995X / ISBN-13 : 978-0060429959

REFERENCE BOOKS

1. Soni, P. L. (2013). *Fundamentals of Organic Chemistry.* Sultan Chand and sons -
2. Bahl, A. (2018). *A Textbook of Organic chemistry* (22nd ed.). Sultan Chand and sons - ISBN : 9789352837304
Levine, I. N. (2021). *Physical chemistry* (7th ed.). McGraw-Hill Education.

WEB RESOURCES

1. Radioisotopes | What are Radioisotopes? | ANSTO
2. Werner's Theory of Coordination Compounds - YouTube
3. 6.2.3.1: Arrhenius Equation - Chemistry LibreTexts

I B.Sc., BIOCHEMISTRY

FIRST SEMESTER

Generic Practical -I
Course Title: CHEMISTRY-I

Course Code	**2511104**	**Credits**	**02**
L:T:P:S	**0:0:3:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**50**

LEARNING OBJECTIVE

To perform qualitative analysis of organic compounds and detect adulteration in food samples using standard chemical tests and analytical techniques

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

CO1	Identify and classify acidic, phenolic, basic, and neutral organic substances while detecting nitrogen (N) and sulfur (S) through systematic qualitative analysis
CO2	Analyze functional groups such as carboxylic acids, phenols, aldehydes, ketones, carbohydrates, amines, and amides using specific chemical tests
CO3	Determine and differentiate between saturated and unsaturated compounds, as well as aliphatic and aromatic substances, using appropriate reagents and observations
CO4	Evaluate and detect adulterants like metanil yellow, rhodamine B, $NaHCO_3$, vanaspati, sugar, urea, and starch in food samples to assess quality and safety.
CO5	Apply and interpret qualitative methods for the identification of organic compounds and adulteration detection in real-world food and biochemical samples

Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	2	2	2	1	3	3	3	2
CO2	3	2	3	2	2	2	1	3	3	3	2
CO3	3	2	3	2	2	2	1	3	3	3	2
CO4	3	2	3	2	2	2	1	3	3	3	2
CO5	3	2	3	2	2	2	1	3	3	3	2

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

SL.NO.	CONTENTS	HRs	COs
I	**Qualitative Analysis of Organic Compounds** a) Identification of acidic, phenolic, basic and neutral organic substances b) Detection of N and S c) Test for aliphatic and aromatic nature of substances. d) Test for saturation and unsaturation. e) Identification of functional groups i) Carboxylic acid (Mono and Dicarboxylic acid) ii) Phenols iii) Aromatic Aldehyde (Benzaldehyde) iv) Ketones v) Carbohydrates (Monosaccharides) vi) Aromatic amines (Aniline) vii) Diamide (Urea) viii) thiourea	24	CO1, CO2, CO3, CO5
II	**Qualitative Analysis of Food Adulterants** 1: Detection of Metanil Yellow in a Given Food Sample 2: Check the Presence of Rhodamine B in the Given Food Sample 3: Test the Presence of Sugar in Honey 4: Detection of NaHCO3 (Chalk) in Flour 5: Check for the Presence of Vanaspati and Rancidity in the Ghee 6: Check the Milk for the presence of Proteins, Urea, Sugar, and Starch	10	CO4, CO5

RECOMMENDED BOOKS

1.Giri, D. O. (2016). *Practical Chemistry.* S Chand - ISBN: 9788121908122, 9788121908122
2.Clarke, H. T. (2007). *A hand book of Oraganic: Qualitative and Quantitative Analysis - ISBN : 9780713124606, 0713124601*
3.Ramamurthy, N. G. (1998). *Organic Chemistry Lab Manual* . S.Viswanathan Co. Pvt. Ltd

REFERENCE BOOKS

1.Bhattacharjee, S., and Sen, A. (2015). *Organic chemistry: A laboratory manual* . PHI Learning.
2. Sharma, B., & Singh, R. (2021). *Laboratory manual for detection of food adulterants and contaminants* . Springer. https://doi.org/10.1007/978-981-16-XXXX-X
3.Kumar, A., & Gupta, S. (2022). *Chemical analysis of food adulteration: Techniques and laboratory practices* . Elsevier. https://doi.org/10.1016/C2020-XXXX-X

WEB RESOURCES

1. https://www.youtube.com/watch?v=SYgsxZg1330
2. https://www.youtube.com/watch?v=xtZxtUHw2WE
3. https://youtu.be/gIHAe5W0Ue8

I B.Sc., BIOCHEMISTRY

FIRST SEMESTER

Skill Enhancement Course- Discipline Specific I

Course Title: FIRST AID

Course Code	**2511105**	**Credits**	**02**
L:T:P:S	**3:0:0:0**	**CIA Marks**	**50**
Exam Hours	**1.5**	**ESE Marks**	**50**

LEARNING OBJECTIVE

To understand and apply the principles and techniques of first aid, recognize symptoms of acute and chronic illnesses, administer emergency care for injuries and anaphylactic shock, manage common ailments, and respond appropriately to specific emergencies in diverse settings.

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

CO1	Explain the principles, rules, and techniques of first aid, including the proper use of a first aid kit and transport methods for injured individuals.
CO2	Apply appropriate first aid measures for conditions such as hyperglycemia, hypoglycemia, strokes, and seizures.
CO3	Analyze the types of wounds, burns, and injuries, and demonstrate emergency care techniques for open wounds, animal bites, and anaphylactic shock.
CO4	Evaluate symptoms of common ailments like fever, food poisoning, and headaches, and propose effective treatment strategies for managing them.
CO5	Respond effectively to specific emergency situations, including road accidents, disasters, and multiple casualty incidents, by implementing structured first aid protocols.

Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	3	3	3	1	2	3	3	2
CO2	3	2	2	3	3	3	1	2	3	3	2
CO3	3	2	2	3	3	3	1	2	3	3	2
CO4	3	2	2	3	3	3	1	2	3	3	2
CO5	3	2	2	3	3	3	1	2	3	3	2

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

MODULE NO.	CONTENTS OF MODULE	HRs	COs
I	**Principles and Techniques of First Aid** Definition, principles, important rules, and laws of First Aid. Dealing with an emergency. First aid kit- types and contents. First Aid Techniques: Dressings, Bandages and Transport Techniques.	6	CO1
II	**Acute and Chronic Illnesses** Diabetic emergencies – Hyperglycemia and Hypoglycemia - symptoms, first aid, and treatment. Hemorrhage, Chest discomfort, Stroke, and Seizures. - symptoms, first aid and treatment.	6	CO2
III	**Injuries and Anaphylactic Shock** Wounds - Types- Open and Closed Wounds. Emergency care for general wounds. Head injuries. Animal bites and Burns – types, symptoms, first aid and treatment.	6	CO3
IV	**Common Ailments** Blood Pressure, Constipation - travel sickness - signs, symptoms and treatment. Headache, Toothache, Earache - causes and treatment. Fever. Food poisoning.	6	CO4
V	**Specific Emergency Situations** Emergencies at schools/colleges and at work. Road and traffic accidents. Disasters. Multiple casualty incident.	6	CO5

RECOMMENDED BOOKS

1. Sathyanarayana. (2017). Biochemistry. Elsevier - ISBN: 9788131236017

2. American Red Cross, K. (1992). First aid and Safety Handbook .Little brown and company Boston - ISBN 10:0316736465 / ISBN 13: 9780316736466

3. Abhitab, L. (2004). Manual of First aid. Jaypee brothers, medical publishers - ISBN 10: 8171793843 / ISBN 13:9788171793846

REFERENCE BOOKS

1. Hubbard, J. (2013). Living Ready Manual - First Aid: Fundamentals for Pocket Survival. Krause Publications- ISBN:9781440333583

2. Goswami, S. N. (2014). First aid and Emergency Care Book for Survival. Kumar Publishing House

3. ACEP First Aid Manual : The Step-by-Step Guide for Everyone (Dk First Aid Manual) (5th ed.).(2014). DK - ISBN 10: 1465419500 ISBN 13: 9781465419507

WEB RESOURCES

1. https://www.hsdept.co.uk/services/first-aid-training/the-3-basic-principles-of-first-aid/
2. https://pubmed.ncbi.nlm.nih.gov/8954463/
3. https://youtu.be/J5AeWWQ3eN0

I B.Sc., BIOCHEMISTRY

FIRST SEMESTER

Skill Enhancement Course- Non-Major Elective I (SEC-NME I)

Course Title: BASICS OF MEDICAL TERMINOLOGIES

Course Code	**2511106**	**Credits**	**02**
L:T:P:S	**2:0:0:0**	**CIA Marks**	**50**
Exam Hours	**1.5**	**ESE Marks**	**50**

LEARNING OBJECTIVE

To demonstrate foundational knowledge of human anatomy, internal organs, common diseases, medical terminology, diagnostic samples, and drug administration routes and to be able to apply them effectively in healthcare-related fields such as medical coding, transcription, and diagnostics.

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

CO1	Identify and describe the functions of major internal organs, glands, bones, nerves, and muscles in the head, neck, thorax, abdomen, pelvis, and limbs
CO2	Define and analyze common medical terms
CO3	Define metabolic, endocrine, neurological, respiratory, and skin disorders
CO4	Identify types of biological samples used in diagnostics and assess various routes of drug administration
CO5	Explore the role of medical terminologies in coding, transcription, billing, and diagnostic labs.

Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	3	2	2	2	3	3	2
CO2	3	2	2	2	3	2	2	2	3	3	2
CO3	3	2	2	2	3	2	2	2	3	3	2
CO4	3	2	2	2	3	2	2	2	3	3	2
CO5	3	2	2	2	3	2	2	2	3	3	2

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

MODULE NO.	CONTENTS OF MODULE	HRs	COs
I	**Parts of the Human Body**- Head, neck, thorax, abdomen, pelvis, upper limbs and lower limbs. Important internal organs, glands, bones, nerves and muscles present in part. Head-eyes, ears, nose, mouth, sinuses, brain, cranial bones.	6	CO1
II	**Medical Terms-** Definition of terms, sings, and symptoms-autopsy, biopsy, artery, vein, nerve, muscle- medial, lateral, superior, inferior, dorsal, ventral, anterior, posterior-tissue, organ, ulcer, cirrhosis, necrosis, cancer, ischemia, angina pectoris, coma, anemia, edemia pus,, lymph, lymphoma, acidity, pyrexia, myopia, hypermetropia, hypoxia, cyanosis.	6	CO2
III	**Metabolic Diseases** - (Definition only) - Diabetes mellitus, Diabetes insipidus, Kernicterus, Hypertension. Endocrine disorders- hyper and hypo secretions of thyroid, pituitary, and reproductive hormones. Neurological disorders- Alzheimer's disease, schizophrenia, Parkinson's, paralysis, migraine, Respiratory disorders- asthma, wheezing, tuberculosis- problems due to smoking, pneumonia. Skin –Leucoderma, psoriasis, spontaneous burning syndrome, complications in pregnancy, abortion, miscarriage.	6	CO3
IV	**Medical Reports-** definitions of normality, molarity, molality, osmoles, equivalents, milliequivalents, concept of positive and negative tests, examples for g/mol, mEq/mol, mg/dL, mg/mol –normal range for selected blood parameters- glucose, bilirubin, creatinine, cholesterol, triglycerides, hemoglobin, CRP, urea. Types of samples- whole blood, plasma, serum, urine, CSF, lymph, sweat, gastric juice, sputum, stools (faeces). Route of administration of drugs – oral, intravenous, subcutaneous, intraperitoneal, nasal, intramuscular.	6	CO4
V	**Areas of Application of Medical Terminologies-** basic knowledge of medical coding, medical transcription, medical billing, insurance sectors, lab technicians, diagnostic labs.	6	CO5

RECOMMENDED BOOKS

1. Chatterjee Ranashinde. (2012). *Medical Biochemistry.* Jaypee - ISBN : 9789350254844

2.Jayaraman, J. (2011). *Laboratory Manual in Biochemistry.* New Age International Pvt Ltd Publishers - ISBN-10 : 812243049X, ISBN-13 : 978-8122430493

3.Kaplan. (2010). *Clinical Biochemistry* (6th ed.). Mosby - ISBN-10 : 1464137846, ISBN-13 : 978-1464137846

REFERENCE BOOKS

1. Cohen, B. J.,and DePetris, A. (2021). *Medical terminology: An illustrated guide* (9th ed.). Wolters Kluwer.

2.V.H., T. (2019). *Handbook Medical Laboratory Technology* (2nd ed.). CBS Publishers and distribution - ISBN-10 : 8123906773 / ISBN-13 : 978-8123906775

3.Tietz. (2018). *Clinical Biochemistry* (8th ed.). Saunders.

WEB RESOURCES

1. Grief Reaction and Prolonged Grief Disorder - StatPearls - NCBI Bookshelf
2. Internal Organs of Human body | Parts of The Body | Internal Organs | Body Organs in English
3. Human body | Organs, Systems, Structure, Diagram, & Facts | Britannica

I B.Sc., BIOCHEMISTRY

SECOND SEMESTER

Core Course-II

Course Title: CELL BIOLOGY

Course Code	**2511207**	**Credits**	**04**
L:T:P:S	**4:1:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**100**

LEARNING OBJECTIVE

To understand the structural organization and functions of prokaryotic and eukaryotic cells, their organelles, and the cytoskeleton, and to explain the mechanisms of membrane transport, cell division, and the roles of extracellular matrix and cell junctions in cellular communication and integrity.

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

CO1	Identify and explain the structures and purposes of the basic components of prokaryotic and eukaryotic cells, especially the organelles
CO2	Demonstrate familiarity with various elements of the cytoskeleton
CO3	State the structure, function and composition of the cell membrane and communicate the types and mechanisms of membrane transport
CO4	Illustrate the phases of cell cycle, in particular mitosis and describe the significance of meiosis in genetic diversity
CO5	Relate the structure and biological role of the extracellular matrix and cell-cell junction with physiological processes

Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	2	2	3	2	2	3	2
CO2	3	2	2	2	2	2	3	2	2	3	2
CO3	3	2	2	2	2	2	3	2	2	3	2
CO4	3	2	2	2	2	2	3	2	2	3	2
CO5	3	2	2	2	2	2	3	2	2	3	2

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

MODULE NO.	CONTENTS OF MODULE	HRs	COs
I	**Architecture of Cells**- Structural organization of prokaryotic and eukaryotic cells – microbial, plant and animal cells. The ultrastructure of the nucleus, mitochondria, RER, SER, the golgi apparatus, lysosome, peroxisome and their functions.	15	CO1
II	**Cytoskeleton-** microfilament, microtubules and intermediary filaments- structure, composition and functions.	10	CO2
III	**Biomembranes-** Structural organization of bilipid layer model and basic functions- transport across cell membranes- uniport, symport and antiport. Passive and active transport.	15	CO3
IV	**Cell Cycle-** Cell division- mitosis and its significance, meiosis (definitions and overview) , basic characteristics of cancer cells.	10	CO4
V	**Extracellular Matrix –** Collagen, laminin, fibronectin and proteoglycans- structure and biological role. Structure and role of cadherin, selectins, integrins, gap junction and tight junction.	15	CO5

RECOMMENDED BOOKS

1.Arumugam.N. (2019). *Cell biology.* Saras publication (10ed, paperback) -
2.Devasena.T. (2012). *Cell Biology.* Oxford University Press India - ISBN: 9780198075516, 0198075510
3.S.C, R. .. (2008). *Cell Biology.* Newage Publishers - ISBN-10 : 8122416888 / ISBN-13 : 978-8122416886

REFERENCE BOOKS

1.Cooper, G. a. (2013). *The Cell: A Molecular Approach.* Sinauer Associates, Inc - ISBN 10: 0878931066 / ISBN 13: 9780878931064
2.E.M.F., D. R. (2006). *Cell and Molecular Biology.* Lippincott Williams & Wilkins Philadelphia - ISBN : 0781734932 9780781734936
3. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2022). *Molecular biology of the cell* (7th ed.). W.W. Norton & Company.

WEB RESOURCES

1. 2.6: Cell Organelles - Biology LibreTexts
2. Transport by Carrier Proteins
3. Cell Cycle, Mitosis, Meiosis, and Cancer Overview Study Guide | Quizlet

I B.Sc., BIOCHEMISTRY

SECOND SEMESTER

Core Practical-II

Course Title: CELL BIOLOGY

Course Code	**2511209**	**Credits**	**02**
L:T:P:S	**0:0:3:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**50**

LEARNING OBJECTIVE

To identify plant and animal cells, visualize cell organelles, and accurately distinguish the stages of mitosis and meiosis through microscopic observation and spotter identification.

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

CO1	Identify the parts of a microscope
CO2	Demonstrate the Preparation of Slides and determine the animal and plant cells
CO3	Classify the stages of mitosis & meiosis
CO4	Identify the nucleus and mitochondria by staining methods
CO5	Differentiate the spotters of cells, organelles stages of cell division

Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	2	2	2	3	3	3	2
CO2	3	2	2	2	2	2	2	3	3	3	2
CO3	3	2	2	2	2	2	2	3	3	3	2
CO4	3	2	2	2	2	2	2	3	3	3	2
CO5	3	2	2	2	2	2	2	3	3	3	2

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

SL. NO.	CONTENTS OF MODULE	HRs	COs
1	Compound Microscope	3	CO1
2	Preparation of the Slide	3	CO2
3	Visualization of animal and plant cell by methylene blue	5	CO2
4	Identification of different stages of mitosis in the onion root tip	5	CO3
5	Identification of different stages of meiosis in onion bulbs	5	CO3
6	Visualization of nuclear fraction by acetocarmine stain	5	CO4
7	Staining and visualization of mitochondria by the Janus green stain	5	CO4
8	**Spotters** a) Nerve, Plant, and Animal cell b) Mitochondria, Chloroplasts, Endoplasmic Reticulum, c) Mitosis stages – Prophase, Anaphase, Metaphase, Telophase	5	CO5

RECOMMENDED BOOKS

1. Carlson, M., Coombs, B. & Yeo, D. (n.d.). *Preparing a Wet Mount – Experimental Skill and Investigation.* University of Manitoba.
2. Bruckner, M. Z. (n.d.). *Microscopy.* Microbial Life Educational Resources.
3. Hyams JS & Brinkley BR (eds) (1989) *Mitosis: Molecules and Mechanisms*. San Diego: Academic Press.

REFERENCE BOOKS

1. Debarati Das. *Essential Practical Handbook of Cell Biology, Genetics and Microbiology -A Practical manual*- Academic Publishers, ISBN, 9789383420599, 1st Edition, 2017
2. Dr.Venugupta.*Cell Biology Practical*, ISBN 8193651219, Prestige publisher, 1st Jan 2018.
3. DeRobertis. *Cell and Molecular Biology* , 8th edition,1st June, 1987

WEB RESOURCES

1. https://egyankosh.ac.in/bitstream/123456789/68541/3/Experiment-8.pdf
2. https://www.britannica.com/video/Mitosis-stages-metaphase-prophase-telophase-anaphase/-68421
3. https://youtu.be/-Vl4opj19tE

I B.Sc., BIOCHEMISTRY

SECOND SEMESTER

Generic Elective-II
Course Title: CHEMISTRY-II

Course Code	**2511208**	**Credits**	**03**
L:T:P:S	**3:1:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**100**

LEARNING OBJECTIVE

To understand the fundamentals of organic chemistry, water technology, industrial chemistry, photochemistry, and polymer chemistry, while applying these concepts to analyze chemical processes, properties, and applications in real-world scenarios

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

CO1	Apply hybridization concepts and reaction mechanisms to explain the behavior of organic compounds, electrophiles, nucleophiles, and free radicals.
CO2	Analyze water quality parameters while applying techniques like EDTA titration, zeolite process, demineralization, and desalination to ensure potable water standards.
CO3	Assess the synthesis, properties, and applications of fuels, silicones, fertilizers and their roles in industrial and agricultural advancements.
CO4	Explain principles of photochemical reactions and phenomena such as fluorescence, phosphorescence, chemiluminescence, and photosynthesis to understand light-induced chemical processes
CO5	Evaluate the properties and applications of polymers, rubbers, and pharmaceuticals.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	2	2	2	3	3	3	3
CO2	3	2	2	2	2	2	2	3	3	3	3
CO3	3	2	2	2	2	2	2	3	3	3	3
CO4	3	2	2	2	2	2	2	3	3	3	3
CO5	3	2	2	2	2	2	2	3	3	3	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

MODULE NO.	CONTENTS OF MODULE	HRs	COs
I	**Fundamentals of Organic Chemistry- Classification** of organic compound Hybridization in methane, ethane, ethylene, acetylene, benzene -Classificati of reagents - electrophiles, nucleophiles. Free radicals - Classification reactions - addition, substitution, elimination, condensation and polymerisatic	10	CO1
II	**Water Technology-** Water quality parameters - Contamination of water by arsenic and mercury their removal. Hardness: Types - Expression - Units. Estimation of hardness of water by the EDTA method (calcium and magnesium). Water softening: Zeolite process – Demineralization process, Desalination process	10	CO2
III	**Industrial Chemistry-**Fuels: Fuel gases: Natural gas, water gas, semi water gas, producer gas, CNG, LPG (manufacturing details not required). Silicones: Synthesis, properties and uses of silicones. Fertilizers: Urea, ammonium sulphate, potassium nitrate, NPK fertilizer, superphosphate, triple superphosphate.	10	CO3
IV	**Photochemistry** Grothus - Draper's law and Stark-Einstein's law of photochemical equivalence, Quantum yield - Hydrogen -chloride reaction. Phosphorescence, fluorescence, chemiluminescence and photosensitization and photosynthesis (definition with examples).	10	CO4
V	**Polymer Chemistry** Plastics, Polythene, PVC, Bakelite, Polyesters, Resins preparation, properties and their Applications - Natural Rubber - Synthetic rubbers - Vulcanization - Preparation and its Applications – Analgesics and Anaesthetics - Definition - Examples and Uses	10	CO5

RECOMMENDED BOOKS

1. V.Veeraiyan, (2009.) *Textbook of Ancillary Chemistry;* High mount publishing house, Chennai, firstedition,
2. S.Vaithyanathan, (2006) *Text book of Ancillary Chemistry*; Priya Publications,Karur,.
3. Arun Bahl, B.S.Bahl, (2012.) *Advanced Organic Chemistry;* S.Chand and Company, New Delhi, twenty third edition,

REFERENCE BOOKS

1. Morrison, R. T., & Boyd, R. N. (2005). *Organic chemistry* (7th ed.). Pearson Education.
2. K. Bagavathi Sundari (2006). *Applied Chemistry* - MJP Publishers B.K,Sharma, Industrial Chemistry; GOEL publishing house, Meerut, sixteenth edition,
3. Jayashree Gosh, (2006.) *Fundamental Concepts of Applied Chemistry;* Sultan & Chand, Edition

WEB RESOURCES

1. An introduction to the collision theory in rates of reaction
2. 6.1 Kinds of Organic Reactions - Organic Chemistry | OpenStax
3. Photochemistry

I B.Sc., BIOCHEMISTRY

SECOND SEMESTER

Generic Practical-II
Course Title: CHEMISTRY-II

Course Code	**2511210**	**Credits**	**02**
L:T:P:S	**0:0:3:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**50**

LEARNING OBJECTIVE

To acquire hands-on experience in volumetric analysis techniques, including acid-base, redox, and complexometric titrations and to develop skills in preparing inorganic salts, thereby enhancing their understanding of both analytical and preparative chemistry.

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

CO1	Estimate and interpret the concentration of substances (e.g., sodium hydroxide, HCl) using titration methods such as acid-base titration.
CO2	Determine and analyze the total hardness of water using EDTA titration while understanding its significance in water quality assessment
CO3	Evaluate redox titration principles in permanganometry to estimate oxidizable substances like oxalic acid and ferrous ions accurately
CO4	Utilize and assess complexometric titration methods with EDTA to estimate metal ions (e.g., magnesium sulfate) and understand their applications in analytical chemistry
CO5	Prepare and characterize inorganic salts (e.g., potash alum, ferrous ammonium sulfate, tetraammine copper(II) sulfate) by applying principles of stoichiometry and crystallization

Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	2	2	1	3	3	2	1
CO2	3	2	2	2	2	2	1	3	3	2	1
CO3	3	2	2	2	2	2	1	3	3	2	1
CO4	3	2	2	2	2	2	1	3	3	2	1
CO5	3	2	2	2	2	2	1	3	3	2	1

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

SL. NO.	CONTENTS	HRs	COs
	Volumetric Analysis		
1	Estimation of s odium hydroxide using standard Sodium carbonate.	3	CO1
2	Estimation of Borax using standard Sodium carbonate.	3	CO1
3	Estimation of HCl using Standard Oxalic Acid	3	CO1
4	Estimation of Oxalic acid using standard Ferrous ammonium sulphate.	3	CO1
5	Estimation of Total Hardness of Water	3	CO2
6	Estimation of KMnO4 Using Standard NaOH. (Permanganometry)	3	CO3
7	Estimation of Ferrous ion using standard Oxalic acid (Permanganometry)	3	CO3
8	Estimation of Magnesium sulphate using EDTA as link and Zinc sulphate as standard (Complexometry)	3	CO4
	Salt Preparations		
9	Preparation of Potash Alum	3	CO5
10	Preparation of Ferrous Ammonium Sulphate	3	CO5
11	Preparation of Tetraammine Copper (II) Sulfate Monohydrate.	3	CO5

RECOMMENDED BOOKS

1.Giri, D. O. (2016). *Practical Chemistry.* S Chand - ISBN: 9788121908122, 9788121908122

2.Clarke, H. T. (2007). *A hand book of Organic: Qualitative and quantitative Analysis -ISBN : 9780713124606, 0713124601*

3.Ramamurthy, N. G. (1998). *Organic Chemistry Lab Manual* . S Viswanathan Co. Pvt. Ltd

REFERENCE BOOKS

1.Mohan, H. (2017). *Practical organic chemistry: A laboratory manual* . S. Chand Publishing.

2.Khosla, B. D., & Garg, V. C. (2018). *Senior practical chemistry: A laboratory manual* (Revised ed.). R. Chand & Co.

3. Harris, D. C. (2020). *Quantitative chemical analysis: Laboratory manual* (10th ed.). W.H. Freeman and Company.

WEB RESOURCES

1.https://www.youtube.com/watch?v=oVbSsjGh-UI

2.https://www.youtube.com/watch?v=gDsGHYUHeBE

3. https://youtu.be/o2Joo2owvz4

I B.Sc., BIOCHEMISTRY

SECOND SEMESTER

Skill Enhancement Course- Discipline Specific II

Course Title: LABORATORY SKILLS IN BIOCHEMISTRY

Course Code	**2511211**	**Credits**	**02**
L:T:P:S	**3:0:0:0**	**CIA Marks**	**50**
Exam Hours	**1.5**	**ESE Marks**	**50**

LEARNING OBJECTIVE

To prepare reagents and buffer solutions, calibrate laboratory instruments, operate medical equipment, and apply safety protocols, ensuring effective laboratory management and maintaining high standards of accuracy and safety in the lab environment.

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

CO1	Demonstrate preparation of solutions of specific concentrations (molarity, molality, normality) and buffers (phosphate, citrate) while understanding their biological applications.
CO2	Inspect calibration of laboratory instruments such as pH meters, spectrophotometers, and colorimeters, and interpret their readings accurately.
CO3	Explain the operation of medical and analytical instruments like centrifuges, autoanalyzers, ECG, and MRI machines and their applications in biochemistry.
CO4	Recommend good laboratory practices (GLP), maintain logbooks, and adhere to standard operating procedures (SOPs) for instrument handling and maintenance.
CO5	Apply safety protocols for the disposal of chemicals, biological waste, and one-time-use labware.

Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	2	2	2	3	3	3	3
CO2	3	2	2	2	2	2	2	3	3	3	3
CO3	3	2	2	2	2	2	2	3	3	3	3
CO4	3	2	2	2	2	2	2	3	3	3	3
CO5	3	2	2	2	2	2	2	3	3	3	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

MODULE NO.	CONTENTS OF MODULE	HRs	COs
I	**Preparation of Reagents** Definition – types of solutions – concentration – solute – solvent – molecular weight – equivalent weight – various ways of expressing concentration of solutions : molarity, molality, normality. Preparation of 1M, 1 mM and IN solutions, Percentage solutions with examples.	6	CO1
II	**Preparation of Buffer Solution** pH and pOH –Definition - pH meter –Its applications– Buffer - Definition and its types – Preparation of phosphate and citrate buffers – Biological applications of buffer solutions	6	CO2
III	**Calibration of Instruments** Laboratory tools, Glasswares and Calibration of Instruments: pH meter, colorimeter, spectrophotometer, water bath, oven and incubator- Definition and applications.	6	CO3
IV	**Applications of Medical Instruments** Centrifuges, Autoanalyzers, One touch glucometer, ECG, EEG, CT scan, MRI scan, Sphygmomanometer, respiratory analyzer	6	CO4
V	**Laboratory Safety and Laboratory Waste Management** Introduction to good laboratory practices. Log Book Maintenance. Disposal of one-time used labware, used chemicals and biological waste • Basic SOPs for instrument handling and Maintenance	6	CO5

RECOMMENDED BOOKS

1. Jayaraman, J. (2011). *Laboratory Manual in Biochemistry.* New Age International Pvt Ltd Publishers - ISBN-10: 812243049X, ISBN-13 : 978-8122430493
2. Singh, S. K. (2005). *Introductory Practical Biochemistry* (2nd ed.). Alpha Science International, Ltd- ISBN 10:8173193029 / ISBN 13: 9788173193026
3. Ashwood, B. a. (2001). *Tietz Fundamentals of Clinical chemistry*. WB Saunders Company, Oxford Science PublicationsUSA - ISBN 10: 0721686346 / ISBN 13: 9780721686349

REFERENCE BOOKS

1. WORK, T. W. (2009). *Laboratory techniques in Biochemistry & Molecular Biology*.Amsterdam. North Holland Pub. Co.
2. Manickam, S. S. (2018). *Biochemical Methods* (3rd ed.). New age International Pvt Ltd publishers – ISBN 10: 8122421407 / ISBN 13: 9788122421408
3. Plummer, D. T. (n.d.). *An Introduction to Practical Biochemistry.* Tata Mc Graw Hill - ISBN: 9780070841659

WEB RESOURCES

1.https://scioninstruments.com/us/blog/the-importance-of-lab-equipment-calibration/
2.https://www.slideshare.net/slideshow/12-basic-medical-instruments-basic-medical-instruments/264804108
3. https://youtu.be/73OrxTT9VB0

I B.Sc., BIOCHEMISTRY

SECOND SEMESTER

Skill Enhancement Course- NME II

Course Title: PREVENTION AND MANAGEMENT OF LIFESTYLE DISORDERS

Course Code	**2511212**	**Credits**	**02**
L:T:P:S	**2:0:0:0**	**CIA Marks**	**50**
Exam Hours	**1.5**	**ESE Marks**	**50**

LEARNING OBJECTIVE

To understand the principles of a balanced lifestyle, including diet, exercise, hygiene, and stress management, while analyzing the causes, prevention, and control of lifestyle-related disorders and communicable diseases.

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

CO1	Define the concepts of a balanced diet, to meet recommended dietary allowances and promote optimal health.
CO2	Identify the impact of physical inactivity, substance abuse, incompatible food habits, and technology overuse on physiological, psychological, and social well-being.
CO3	Explain strategies for managing physiological disorders, psychological disorders and social disorders through lifestyle modifications.
CO4	Analyze the etiology, risk factors, and prevention strategies for non-communicable diseases and communicable diseases
CO5	Evaluate lifestyle improvement strategies, including proper nutrition, stress management and nutrigenomics, to prevent and manage diseases effectively.

Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	2	3	3	2	1	2	3	2
CO2	3	2	3	2	3	3	2	1	2	3	2
CO3	3	2	3	2	3	3	2	1	2	3	2
CO4	3	2	3	2	3	3	2	1	2	3	2
CO5	3	2	3	2	3	3	2	1	2	3	2

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

MODULE NO.	CONTENTS OF MODULE	HRs	COs
I	**Lifestyle and Balanced Diet:** Definition- Biological clock- Routine- Dress, Personal hygiene, Food, Exercise, Drink, technology, Balanced diet, Macro and micronutrients, carbohydrates, proteins, fats.Vitamins and minerals, RDA, Sources. Role of non-energy-yielding foods, water and Importance of Fibre intake.	6	CO1
II	**Lifestyle Disorders:** Lack of Physical activity, Incompatible food, irregular food habits, Substance abuse- Alcohol, cigarette smoking, drugs, technology-computer vision syndrome, mobile vision syndrome.	6	CO2
III	**Physiological, Psychological and Social Disorders** Physiological disorders: Food poisoning- Signs and symptoms, Vomiting, diarrhea, headache, stomach ache, dizziness, lethargy, hormonal imbalance, premenstrual syndrome, kidney stones and gall stones. Psychological disorders: Memory dysfunction, stress. Depression, mood swings, bipolar disorder, Lack of motivation, Accidents, Drowning, self-medication. Social disorders: Avoiding family and friends, Violence, physical assault of the weaker section, Hypertension in Early pregnancy in adolescent girls/ Abortion- Definition-signs, symptoms-preventions. Basic life support-Deaddiction.	6	CO3
IV	**Risk factors of Non-Communicable and Communicable Diseases** Non-communicable diseases- Etiology, Metabolic risk factors, modifiable risk factors, type 2 diabetes, cancer, Heart diseases, Strokes, PCOD, Infertility, Obesity. Communicable diseases- AIDS, Tuberculosis, Cholera, Typhoid, Jaundice.	6	CO4
V	**Control and Prevention, Treatment** Improved lifestyle, Food habits, Proper sleep, Exercise-Yoga, Swimming, Walking, Outdoor games, Stress management-Meditation, Music, Painting, Proper medication, Nutrigenomics.	6	CO5

RECOMMENDED BOOKS

1. Sharma, D. S. (2017). *Nutritional Biochemistry.*CBS Publishers and distributors - ISBN 10: 8123925271 / ISBN 13: 9788123925271
2. Srilakshmi, B. (2017). *Dietetics* (Multi Colour Edition ed.). New Age International Publishers - ISBN 10: 8122438091 / ISBN 13: 9788122438093
3. Srilakshmi, B. (2019). *Dietetics* - (Multi Colour Edition ed.). New Age International Publishers - ISBN 10: 9386649209 / ISBN 13: 9789386649201

REFERENCE BOOKS

1. Sathyanarayana. (2017). *Biochemistry.* Elsevier - ISBN: 9788131236017
2. Swaminathan. (2005). *Advanced Textbooks of food and Nutrition.* BAPP CO PRESS.
3. B. Kumar, M. K. (2004). *Guide to prevention of lifestyle diseases b. kumar.* Deep and Deep Publications, --ISBN 10: 8176295183 ISBN 13: 9788176295185

WEB RESOURCES

1. 6 Essential Nutrients: What They Are and Why You Need Them
2. Noncommunicable diseases
3. Symptoms of Food Poisoning | Food Safety | CDC

II B.Sc., BIOCHEMISTRY

THIRD SEMESTER

Core Course-III

Course Title: CHEMISTRY OF BIOMOLECULES

Course Code	**2511313**	**Credits**	**04**
L:T:P:S	**4:1:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**100**

LEARNING OBJECTIVE

To gain an in-depth understanding of the structure, classification, properties, and biological significance of carbohydrates, proteins, nucleic acids, and lipids.

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

CO1	Explain the structure, biological importance and physicochemical properties of carbohydrates.
CO2	Identify the structure of amino acids, classify proteins and explain their properties
CO3	Relate the structural levels of organization of proteins and describe the forces stabilizing the structure of proteins
CO4	Examine the structure of DNA and RNA with their biological functions
CO5	Define and classify lipids with examples and functions

Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	2	2	3	3	3	3	2
CO2	3	2	2	2	2	2	3	3	3	3	2
CO3	3	2	2	2	2	2	3	3	3	3	2
CO4	3	2	2	2	2	2	3	3	3	3	2
CO5	3	2	2	2	2	2	3	3	3	3	2

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

MODULE NO.	CONTENTS OF MODULE	HRs	COs
I	**Carbohydrates:** Classification of carbohydrates, stereoisomerism and optical isomerism of sugars, anomeric forms and mutarotation. Occurrence, structure and biological importance of mono, di (Lactose, maltose, sucrose) and polysaccharides (starch, cellulose, glycogen, dextrin, inulin). Physical and chemical properties of carbohydrate reactions (oxidation, reduction, reaction with phenylhydrazine, esterification, etherification) Heteropolysaccharides (Structure not needed).	15	CO1
II	**Amino Acids:** Classification and Structure of Amino Acids. Physical and chemical properties of amino acids. Protein- classification based on solubility and composition, shape, and function. Properties of proteins. Denaturation and renaturation of proteins.	10	CO2
III	**Proteins:** Determination of amino acid sequence of a polypeptide chain. Protein structure- primary, secondary, (α-helix and β-pleated sheet), tertiary and quaternary structures of proteins (basic concepts). Structure of peptide bonds. Forces stabilizing the secondary, tertiary and quaternary structure of proteins.	10	CO3
IV	**Nucleic Acids:** Structure of purine and pyrimidines, nucleosides and nucleotides. Differences between DNA and RNA, double helical structure of DNA, Types of RNA –m-RNA, t-RNA r- RNA and their biological functions.	15	CO4
V	**Lipids:** Definition and classification of lipids- chemical properties of fats- iodine value, saponification value, acid number, rancidity, RM value. Structure and biological functions of Lecithin, Cephalin, Phosphatidyl inositol, Plasmalogen, Sphingomyelin, Cerebrosides Gangliosides. Sterols (Cholesterol only), bile acids and bile salts.	15	CO5

RECOMMENDED BOOKS

1.J. L. Jain, N. J. (7th ed 2016). *Fundamentals of Biochemistry 7th edition.* S. Chand @ Co.Ltd - ISBN: 9788121924535

2.Sathyanarayana. (2017). *Biochemistry.* Elsevier - ISBN: 9788131236017Company - ISBN 10: 1464126119 / ISBN 13: 9781464126116

3. Voet, D., Voet, J. G., & Pratt, C. W. (2020). *Fundamentals of Biochemistry: Life at the molecular level* (5th ed.). Wiley.

REFERENCE BOOKS

1.Rodwell, V. (2018). *Harper's Illustrated Biochemistry.* McGrew. Hill -

2.David.L.Nelson, M. M. (7th ed 2017). *Lehninger principles of Biochemistry* . Freeman. W.H. and Company - ISBN 10: 1464126119 / ISBN 13: 9781464126116

3. Campbell, M. K., & Farrell, S. O. (2019). *Biochemistry* (9th ed.). Cengage Learning.

WEB RESOURCES

1. CH103 - Chapter 8: The Major Macromolecules - Chemistry
2. Chapter 4: DNA, RNA, and the Human Genome - Chemistry
3. (PDF) BIO CHEMISTRY UNIT 1 : AMINO ACIDS AND PROTEINS

II B.Sc., BIOCHEMISTRY

THIRD SEMESTER

Core Practical-III

Course Title: CHEMISTRY OF BIOMOLECULES

Course Code	**2511316**	**Credits**	**02**
L:T:P:S	**1:0:2:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**50**

LEARNING OBJECTIVE

To develop practical skills in the qualitative identification of carbohydrates and amino acids, in the biochemical preparation of key biomolecules and in the assessment of chemical properties of lipids through saponification, iodine, and acid number determinations.

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

CO1	Identify and differentiate carbohydrates based on their chemical nature using specific qualitative tests.
CO2	Analyze and classify amino acids based on their chemical nature using specific qualitative tests.
CO3	Demonstrate extraction principles in the preparation of biochemical substances using standard laboratory techniques.
CO4	Evaluate chemical composition and purity of edible oils through demonstration experiments on SAP number, iodine number, acid number
CO5	Apply qualitative analysis methods for carbohydrates and amino acids, and biochemical preparations to solve practical problems in biochemistry and food science

Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	2	3	2	3	3	3	3	3
CO2	3	2	3	2	3	2	3	3	3	3	3
CO3	3	2	3	2	3	2	3	3	3	3	3
CO4	3	2	3	2	3	2	3	3	3	3	3
CO5	3	2	3	2	3	2	3	3	3	3	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

Sl. No.	CONTENTS	HRs	COs
	I Qualitative analysis of Carbohydrates		
1	Qualitative analysis of Glucose	3	CO1, CO5
2	Qualitative analysis of Fructose	3	CO1, CO5
3	Qualitative analysis of Arabinose	3	CO1, CO5
4	Qualitative analysis of Maltose	3	CO1, CO5
5	Qualitative analysis of Sucrose	3	CO1, CO5
6	Qualitative analysis of Starch	3	CO1, CO5
	II Qualitative analysis of Amino Acids		
7	Qualitative analysis of Arginine	3	CO2, CO5
8	Qualitative analysis of Cysteine	3	CO2, CO5
9	Qualitative analysis of Tryptophan	3	CO2, CO5
10	Qualitative analysis of Tyrosine	3	CO2, CO5
11	Qualitative analysis of Histidine	3	CO2, CO5
12	Qualitative analysis of Proline	3	CO2, CO5
	III Biochemical Preparations		
13	Preparation of starch from potatoes	2	CO3, CO5
14	Preparation of casein from milk	2	CO3, CO5
15	Preparation of albumin from eggs	2	CO3, CO5
	IV Demonstration Experiments		
16	Determination of the Acid number of an edible oil	1	CO4, CO5
17	Determination of the Saponification number of an edible oil	2	CO4, CO5

RECOMMENDED BOOKS

1.Rageeb, Kiran Patil, M. Bakshi Rahman, Sufiyan Ahmad Raees, *A Practical Book on Biochemistry,* Everest publishing house,1st edition,2019

2.Manickam, S. S. (2016). *Biochemical Methods*. New age International Pvt Ltd publishers - ISBN 10: 8122421407 / ISBN 13: 9788122421408

3. Jayaraman, J. (2011). *Laboratory Manual in Biochemistry.* New Age International Pvt Publishers - ISBN-10 : 812243049X, ISBN-13 : 978-8122430493

REFERENCE BOOKS

1.Jones Evangeline.2011 *Manual of Practical Medical Biochemistry*, Jaypee Publishers,

2.Damodaran Geetha K. 2016 *Practical Biochemistry,* Jaypee Brothers Medical Publishers,

3.DM Vasudevan Subir Kumar Doss. 2020. *Practical textbook of Biochemistry for medical students*, Jaypee Brothers Medical Publishers

WEB RESOURCES

1. https://youtu.be/rKng5-ij6kQ
2. https://youtu.be/RSAo9qPV5R4
3. https://youtu.be/ePJr4gwN3gE

II B.Sc., BIOCHEMISTRY

THIRD SEMESTER

Generic Elective-III

Course Title: MICROBIOLOGY

Course Code	**2511314**	**Credits**	**03**
L:T:P:S	**3:1:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**100**

LEARNING OBJECTIVE

To understand the principles of microbiology, including microbial structures, cultivation techniques, food and water microbiology, and industrial applications, while applying basic microbiological methods for analysis and preservation.

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

CO1	Explain the basic structure of bacteria, fungi, protozoa, and viruses
CO2	Demonstrate the staining procedures and isolate pure cultures of bacteria
CO3	Illustrate the bacterial growth and identify the nutritional requirements of bacteria.
CO4	Analyse the types of microbes in Food microbiology and water microbiology, food spoilage and food preservation techniques used in microbiology
CO5	Predict the importance of microbial fermentation in the production of dairy products, organic acids, antibiotics and alcoholic beverages.

Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	3	3	1	3	2	3	2
CO2	3	2	2	2	3	3	1	3	2	3	2
CO3	3	2	2	2	3	3	1	3	2	3	2
CO4	3	2	2	2	3	3	1	3	2	3	2
CO5	3	2	2	2	3	3	1	3	2	3	2

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

MODULE NO.	CONTENTS OF MODULE	HRs	COs
I	Microscope-principle, parts of light microscope, history-microbiology. Structural characteristics of Bacteria, fungi (molds and yeasts) and Protozoa-plasmodium, and virus- HIV Structure	10	CO1
II	Basic microbiological techniques- Cleaning of glassware. Sterilization of glassware and media. Streak plate, spread plate and pour plate, enrichment culture, single spore isolation, serial dilution, standard plate count. Staining techniques- simple and differential.	10	CO2
III	Cultivation of bacteria- Nutritional requirements and nutritional types of bacteria, Types of culture media. Physical conditions required for bacterial growth, bacterial growth curve	10	CO3
IV	Food Microbiology. Food spoilage. Food preservation techniques- asepsis, canning, bottling, smoking, pasteurization, salting, dehydration (hot and cold). Water Microbiology-portable water, sewage water treatment- Primary, secondary and tertiary treatment.	10	CO4
V	Industrial Microbiology. Microbes in the production of d airy product- Cheese, Organic acid- citric acid, antibiotic- Penicillin and alcoholic beverages - Beer and wine.	10	CO5

RECOMMENDED BOOKS

1. Michael J. Pelczar I.R., C. E. 5th ed(2004). Microbiology. Tata McGRAW-Hill, New Delhi - ISBN 10: 0070492409 / ISBN 13: 9780070492400
2. RM, A. (2014). *Principles of Microbiology*. McGraw Hill Education.
3.Parija. (2012). *Textbook of Microbiology and Immunology, 2/e* . ELSEVIER - ISBN 10: 813124461X / ISBN 13: 9788131244616

REFERENCE BOOKS

1.Prescott. (2017). *Microbiology* (8th ed.). Mc Graw Hill, Boston - ISBN-10 1259281590 / ISBN-13 : 978-1259281594
2.Panicker, A. R. (2017). *Textbook of Microbiology* (10th ed.). Orient Longmans - ISBN 10: 1847558569 ISBN13: 9781847558565.
3.W.C, F. (2014). *Food Microbiology.* Mc Graw Hill Boston - ISBN-10 : 1259281590 / ISBN13 : 978- 1259281594.

WEB RESOURCES

1. Microbiology - Bacteria, Viruses, Fungi | Britannica
2. 17.3B: Wastewater and Sewage Treatment - Biology LibreTexts
3. Functional Properties of Microorganisms in Fermented Foods - PMC

II B.Sc., BIOCHEMISTRY

THIRD SEMESTER

Generic Practical-III
Course Title: MICROBIOLOGY

Course Code	**2511317**	**Credits**	**02**
L:T:P:S	**0:0:3:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**50**

LEARNING OBJECTIVE

To understand and apply fundamental microbiological techniques, including microscopy, culture preparation, staining, biochemical tests, and bacterial enumeration, while identifying common laboratory equipment and microbial specimens.

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

CO1	Identify, prepare, and use light and compound microscopes, agar slants, and bacterial smears to demonstrate proficiency in basic microbiological setups
CO2	Compare and evaluate streak plate, pour plate, and spread plate techniques to isolate and cultivate bacteria effectively
CO3	Apply, differentiate, and interpret simple and differential staining methods, along with the hanging drop technique, to analyze bacterial morphology and motility
CO4	Determine and enumerate bacterial counts in water and milk samples and classify laboratory equipment to build foundational knowledge of microbiology tools.
CO5	Assess and interpret biochemical tests (e.g., catalase, caseinase) and antibiotic sensitivity tests to characterize bacterial function and resistance patterns

Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	2	2	2	1	3	3	2	2
CO2	3	2	3	2	2	2	1	3	3	2	2
CO3	3	2	3	2	2	2	1	3	3	2	2
CO4	3	2	3	2	2	2	1	3	3	2	2
CO5	3	2	3	2	2	2	1	3	3	2	2

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

Sl. No.	CONTENTS	HRs	COs
1	Principles of Microscope-Light, Compound microscope	3	CO1
2	Preparation of Agar slants	3	CO1
3	Preparation of Bacterial smear.	3	CO1
4	Streak plate, Pour plate, and Spread Plate Culture techniques	3	CO2
5	Staining Techniques i) Simple Staining ii)Differential Staining	3	CO3
6	Hanging drop method for testing the motility of bacteria.	3	CO3
7	Determination of the quality of milk by the Methylene blue reductase Test	3	CO4
8	Enumeration of bacteria from water		CO4
9	Biochemical Characterization- i)Test for Catalase, ii) Test for Caseinase	3	CO5
10	Antibiotic Sensitivity test	3	CO5
11	**Spotters-**Inoculation loop, Petriplate, Incubator, Autoclave, Microscope, Slant, Spread plate, Streak Plate, L rod, Spreader, Petriplate carrier, Penicillin, Rhizopus, Mucor, Aspergillus	3	CO4

RECOMMENDED BOOKS

1. Parija, S. C. (2007). *Textbook Of Practical Microbiology* (2007 ed.). Ahuja Publishing House
2. Cappuccino, J.G., and Sherman, N. (2020*). Microbiology: A laboratory manual*.(12th ed,) Pearson
3. Benson, H. J. (2002). *Microbiological applications: Laboratory manual in general microbiology* (8th ed.). McGraw-Hill.

REFERENCE BOOKS

1.Panicker.J, A. R. (1986). *Textbook of Microbiology*. Orient Longmans - ISBN 10: 9386235250 / ISBN 13: 9789386235251

2.Pandey, V. K. (2019). *Lab Practical Micro-biology* Notion Press 2019. Notion Press

3.Dr.RC.Dubey. (2010). *Practical Microbiology*. S.Chand Publishers - ISBN : 9788121926201.

WEB RESOURCES

1. Light Microscope: Principle, Types, Parts, Diagram
2. Aseptic Laboratory Techniques: Plating Methods - PMC
3. https://youtu.be/mjrYIAye1J4

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II B.Sc., BIOCHEMISTRY

THIRD SEMESTER

Discipline Specific Elective I -Employability Course I (A)

Course Title: COMMUNITY MEDICINE

Course Code	**2511315(A)**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**100**

LEARNING OBJECTIVE

To explain the foundations of community medicine, analyze public health systems and national programs, apply strategies for disease prevention and control, evaluate maternal, child health, and nutrition interventions, and address environmental health challenges and disaster management effectively.

Job Opportunities After Completion

1. Health Inspector/Sanitary Inspector/Hospital Administrator or Healthcare Manager.
2. Public Health Officer/Executive.
3. Program Manager/Coordinator in NGOs or government health programs.
4. Field Officer/Health Worker in rural or urban areas.
5. Research Assistant/Biostatistician in public health research.

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

CO1	Explain the concept of health and disease
CO2	Analyze the significance of the healthcare delivery system in India
CO3	Identify the epidemiology, prevention, and control of communicable diseases and non-communicable diseases
CO4	Recommend the importance of maternal and child health
CO5	Identify environmental hazards that impact health, such as pollution and disasters

Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	2	3	3	3	3	3	3
CO2	3	2	3	3	2	3	1	3	3	2	3
CO3	3	2	3	3	2	3	1	3	3	2	2
CO4	3	2	3	3	2	3	1	3	3	2	2
CO5	3	2	3	3	2	3	1	3	3	2	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

MODULE NO.	CONTENTS OF MODULE	HRs	COs
I	**Foundations of Community Medicine** Introduction to Community Medicine, Concept of Health and Disease. Dimensions and Determinants of Health, Natural History of Disease and Levels of Prevention.	10	CO1
II	**Public Health Systems and National Health Programs** Healthcare Delivery System in India: Primary, Secondary, and Tertiary Healthcare, Role of AYUSH in Healthcare, National Health Programs (NHM, RNTCP, NACP, NPCB,).	10	CO2
III	**Epidemiology, Prevention, and Control of Communicable and Non-Communicable Diseases** Respiratory Infections (Tuberculosis, COVID-19), Vector-Borne Diseases (Malaria, Dengue), Non-Communicable Diseases - Cardiovascular Diseases, Diabetes, Cancer	10	CO3
IV	**Maternal and Child Health (MCH) and Nutrition** Maternal and Child Health (MCH)-Antenatal, Intranatal, and Postnatal Care. Reproductive and Child Health (RCH) Program. Nutrition in Public Health - Nutritional programs and food fortification	10	CO4
V	**Environmental Health and Disaster Management** Water, Air, and Soil Pollution-Sources and effects. Waste Management (Biomedical Waste, E-Waste) Climate Change and Health. Disaster Management	10	CO5

RECOMMENDED BOOKS

1. Park. K., (2011). *Social And Preventive Medicine*, 18th eithion, Bhanot Publishers
2. Patil R.S., (1995).*Practical Community* Health,Vora Medical publisher
3. Gupta, M. C., & Mahajan, B. K. (2022). *Textbook of Preventive and Social Medicine* (5th ed.). Jaypee Brothers Medical Publishers.

REFERENCE BOOKS

1. Ashtekar S., 2001 *Health And Healing-A manual of Primary Health Care,* Orient Longsman publishers
2. Dash.B.N., 2003, *Health and Physical,* Neelkamal, 2nd edition
3. Leon Gordis, *Text Book of Epidemiology, 7th ed., Elsevier*

WEB RESOURCES

1. https://www.unisdr.org/?spm=a2ty_o01.29997173.0.0.70995bd6Bx5dTY
2. https://mchb.hrsa.gov/?spm=a2ty_o01.29997173.0.0.70995bd6Bx5dTY
3. https://reliefweb.int/?spm=a2ty_o01.29997173.0.0.70995bd6Bx5dTY

II B.Sc., BIOCHEMISTRY
THIRD SEMESTER

Discipline Specific Elective I -Employability Course I (B)

Course Title: BLOOD BANKING AND BLOOD TRANSFUSION

Course Code	**2511315(B)**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**100**

LEARNING OBJECTIVE

To understand blood banking principles, perform blood collection and processing tasks, apply transfusion protocols and quality assurance measures, and evaluate advancements and ethical considerations in blood banking and transfusion medicine.

Job Opportunities After Completion

1. Blood Bank Technician.
2. Transfusion Medicine Technologist.
3. Laboratory Assistant in blood banks or hospitals.
4. Quality Control Associate in blood product manufacturing companies.
5. Roles in voluntary blood donation organizations and NGOs.

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

CO1	Explain the principles and scope of blood banking
CO2	Demonstrate effective blood collection, processing, and testing procedures
CO3	Evaluate transfusion reactions and ensure patient safety during transfusions.
CO4	Apply regulatory guidelines and quality assurance measures in blood banking.
CO5	Analyze advancements such as apheresis, stem cell banking, artificial blood substitutes, and automation, and discuss their implications for the future of transfusion medicine.

Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	2	3	3	3	3	3	3
CO2	3	2	3	3	2	3	1	3	3	2	3
CO3	3	2	3	3	2	3	1	3	3	2	2
CO4	3	2	3	3	2	3	1	3	3	2	2
CO5	3	2	3	3	2	3	1	3	3	2	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

MODULE NO.	CONTENTS OF MODULE	HRs	COs
I	**Introduction to Blood Banking** Definition and scope of blood banking. Importance of blood donation and voluntary blood donation programs. Blood group-types & role in Transfusion Role of blood banks in healthcare systems, emergencies, and disaster management	10	CO1
II	**Blood Processing and Storage** Blood collection methods (donor selection, venipuncture, anticoagulants). Separation of blood components (RBCs, plasma, platelets), Storage conditions and shelf life of blood products, Blood bag labeling, and inventory management. and Sterility and contamination control in blood banking	10	CO2
III	**Blood Transfusion Practices** Pre-transfusion testing (cross-matching, antibody screening), Indications for transfusion (whole blood vs. components), Transfusion procedures and monitoring, Blood transfusion reactions and management. Ethics in Blood transfusion	10	CO3
IV	**Quality Assurance and Regulatory Guidelines** Infectious disease screening (HIV, Hepatitis B/C, Syphilis, Malaria), Hemovigilance and adverse event reporting, Legal and ethical aspects of blood donation and transfusion.	10	CO4
V	**Advances in Blood Banking and Transfusion Medicine** Apheresis and its applications, Stem cell and cord blood banking, Artificial blood substitutes and future trends, Automation and digitalization in blood banking	10	CO5

RECOMMENDED BOOKS

1. Mukherjee KI, (2010). *Medical Laborotary Technology*-A Procedure for routine diagnostic tests-Volumes I, II, III, Tata Mcgraw Hill Publishing Company Ltd. New Delhi
2. Sood R. (1996). *Laborotary Technology* (Methods and interpretations) J.P. Bros, New Delhi
3. Roa, (2016). *Hand Book of Blood banking and transfusion* Medicine Jaypee Brothers Medical Publishers(P) Ltd, New Delhi

REFERENCE BOOKS

1. Blaney K D and Howard P R, (2012). *Basic and applied concepts of blood banking and transfusion* Practices, 3Rd Ed, Elsevier Mosby Publishers, Missouri
2. RudMann SV (2005). *Text Book of Blood Banking and Transfusion Medicine*, 2nd Ed, Elsevier saunders Publishers, Pennysylvania
3. Sathish Gupte, 2000. *The Text Book of Blood Banking and Transfusion Medicine*, Jaypee Brothers Medical Publishers(P) ltd, New Delhi

WEB RESOURCES

1. https://www.interesjournals.org/articles/community-medicine-the-foundation-of-public-health-and-wellbeing.pdf
2. https://www.anits.edu.in/online_tutorials/es/Unit%203.pdf
3. https://www.who.int/health-topics/blood-safety?spm=a2ty_o01.29997173.0.0.70995bd6Bx5dTY

II B.Sc., BIOCHEMISTRY
THIRD SEMESTER
Discipline Specific Elective I -Employability Course I (C)
Course Title: BASICS OF MEDICAL LAB TECHNOLOGY (BMLT)

Course Code	**2511315(C)**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**100**

LEARNING OBJECTIVE

To gain a comprehensive understanding of advanced laboratory techniques including centrifugation, chromatography, spectroscopy, electrophoresis, and radioactivity. And develop practical skills in applying these techniques for molecular analysis, protein studies, metabolic pathway elucidation, and safety in handling radioisotopes.

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

CO1	Appraise the code of conduct and safety measures for handling laboratory chemicals
CO2	Analyze samples using various lab equipment like microscopes, centrifuges and incubators
CO3	Identify the significance of normal and abnormal constituents of urine.
CO4	Examine the stool specimen for abnormalities, and document findings systematically.
CO5	Estimate the hematological parameters and interpret their clinical significance based on normal values.

Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	2	2	3	3	2	3	3
CO2	3	2	2	2	2	2	3	3	2	3	3
CO3	3	2	2	2	2	2	3	3	2	3	3
CO4	3	2	2	2	2	2	3	3	2	3	3
CO5	3	2	2	2	2	2	3	3	2	3	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

MODULE NO.	CONTENTS OF MODULE	HRs	COs
I	**Laboratory Care:** Code of conduct for laboratory personnel – safety measures in handling laboratory chemicals/Reagents, labelling, storage and usage.	10	CO1
II	**Laboratory Equipment:** Working of microscope - Phase contrast, Fluorescence, Electron microscope. Centrifuge, analytical balance, colorimeter - Usage and care. Glassware, water bath, incubator. Reporting laboratory tests and keeping records. Sterilization-Autoclave	10	CO2
III	**Urine Analysis**: Collection and preservation of urine sample. Composition of urine, Normal and abnormal constituents of urine. Urinalysis-Procedure. Examination of glucose, ketone bodies, and bile pigments in urine. Hematuria.	10	CO3
IV	**Stool Analysis:** Composition. Collection and examination of stools - inspection of feces- odour, pH, interfering substance. Test for occult blood, faecal fat, and microscopic examination of stool specimen.	10	CO4
V	**Hematology:** Collection and preservation of blood sample - Anticoagulant, hematological parameters- Estimation of Hb, PCVWBC, RBC, Platelets, ESR. Clotting time, bleeding time - normal value, clinical interpretation.	10	CO5

RECOMMENDED BOOKS

1.V.H., T. (2019). *Handbook Medical Laboratory Technology* (2nd ed.). CBS publishers and distribution - ISBN-10 : 8123906773 / ISBN-13 : 978-8123906775

2.V.H., T. (2014). *Practical Textbook of Laboratory Medicine.*CBS publishers and distribution - ISBN-10 : 8123918720 / ISBN-13 : 978-8123918723

3.Praful B. Godkar, D. P. (2014). *Textbook of Medical Laboratory Technology.* Bhalani Publishing House - ISBN-10 : 9780074632239 / ISBN-13 : 978-0074632239

REFERENCE BOOKS

1. Chatterjee Ranashinde. (2012). *Medical Biochemistry*. Jaypee - ISBN : 9789350254844

2.Tietz. (2018). *Clinical Biochemistry* (8th ed.). Saunders -

3.Sood, R. (2009). *Medical Laboratory Technology Methods and Interpretations.* Jaypee - ISBN 10: 9351523330 / ISBN 13: 9789351523338

WEB RESOURCES

1. https://www.youtube.com/watch?app=desktop&v=RNEQ5neulcY
2. https://www.youtube.com/watch?v=DfG6C0gKjhU
3. https://youtu.be/FnOvLEaC4gg

II B.Sc., BIOCHEMISTRY

FOURTH SEMESTER

Core Course-IV

Course Title: BIOCHEMICAL TECHNIQUES

Course Code	**2511419**	**Credits**	**04**
L:T:P:S	**4:1:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**100**

LEARNING OBJECTIVE

To gain a comprehensive understanding of advanced laboratory techniques, including centrifugation, chromatography, spectroscopy, electrophoresis, and radioactivity, and to apply these techniques for molecular analysis, protein studies and metabolic pathway elucidation.

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

CO1	Demonstrate the separation of biological sample by centrifugation.
CO2	Interpret the principle, methodology and applications of various chromatography techniques.
CO3	Explain the principle, methodology and applications of various spectroscopic techniques.
CO4	Identify the methodology involved in separation of proteins and nucleic acid by various electrophoretic techniques.
CO5	Outline the detection and measurement of radioactivity and understand the biological hazards of radiation and safety measures in handling radio isotopes.

Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	2	2	2	2	2	3	3
CO2	3	2	3	3	2	2	2	2	2	3	3
CO3	3	2	3	3	2	2	2	2	2	3	3
CO4	3	2	3	3	2	2	2	2	2	3	3
CO5	3	2	3	3	2	2	2	2	2	3	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

MODULE NO.	CONTENTS OF MODULE	HRs	COs
I	**Centrifugation:** Basic principles of centrifugation, RCF, Types of Rotors, Principle, procedure and applications of differential and density gradient centrifugation, Preparative and analytical ultracentrifugation, Determination of Molecular weight (Derivation excluded).	**15**	**CO1**
II	**Chromatography:** Principles of chromatography, Paper chromatography, Thin layer chromatography, Ion exchange, Affinity chromatography, Gel permeation chromatography, HPLC and GLC	**10**	**CO2**
III	**Principles of Spectroscopy:** Basic principles of electromagnetic radiation energy, wavelength, wavenumber and frequency- absorption and emission spectra, - Beer-Lambert law, Light absorption and transmittance. UV and Visible spectrophotometry, Principle Instrumentation, and applications on enzyme assays and kinetic assays, Protein structural studies. Applications of MALDI and NMR.	**15**	**CO3**
IV	**Electrophoretic Techniques:** Definition, Factors affecting electrophoresis – Principle, procedure and applications of Paper, Cellulose acetate/Nitrate, Agarose gel electrophoresis, SDS PAGE and Its applications.	**10**	**CO4**
V	**Radioactivity:** Atomic structure, radiation, types of radioactive decay, half life, units of radioactivity. Detection and measurement of radioactivity - methods based upon ionization (GM counter), methods based upon excitation (Scintillation counter).Autoradiography and isotope dilution techniques. Applications of radioisotopes in the elucidation of metabolic pathways, clinical scanning and radio dating. Biological hazards of radiation and safety measures in handling radio isotopes.	**15**	**CO5**

RECOMMENDED BOOKS

1.Anand, C. (2014). *Instrumental methods of Analysis.* Himalaya Publishing house - ISBN : 978-93-5142-088-0
2.Wilson/Walker. (2018). *Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology.* Cambridge University Press - ISBN: 9781316677056
3. AvinashUpadhyay, D. K. (2016). *Biophysical Chemistry.* Himalaya Publishing house - ISBN-10 : 8184888074 / ISBN-13 : 978-8184888072

REFERENCE BOOKS

1.Dua, S. (2010). *Biochemical Methods of Analysis: Theory and Applications.* Narosa - ISBN-10 : 1842655906 / ISBN-13 : 978-1842655900
2.Bernard J.White, J. F. (2015). *Biochemical Techniques - Theory And Practice.* CBS Publishers & Distributors.
3.Basha, M. (2020). *Analytical Techniques in Biochemistry.* Humana Press - ISBN : 978-1-0716-0134-1

WEB RESOURCES

1.Centrifuge: Principle, Parts, Types, and Applications, Chromatography: Principle, Types, Uses, Diagram
2.The Beer-Lambert Law - Chemistry LibreTexts, Electrophoresis: Overview, Principles and Types - Microbiology Notes
3. https://nptel.ac.in/courses/102103044

II B.Sc., BIOCHEMISTRY

FOURTH SEMESTER

Core Practical-IV

Course Title: BIOCHEMICAL TECHNIQUES

Course Code	**2511422**	**Credits**	**02**
L:T:P:S	**1:0:2:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**50**

LEARNING OBJECTIVE

To develop practical expertise in determining protein and nucleic acid UV absorption spectra, pH measurement, colorimetric estimation, and chromatographic separation of biomolecules while gaining experience in advanced methods such as SDS-PAGE and spectrofluorimetry for biochemical analysis.

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

CO1	Assess the absorption spectrum of proteins and nucleic acids using UV Spectroscopy
CO2	Evaluate the pH of biological samples using glass electrode
CO3	Learn the estimation of phosphorus and aminoacids using colorimetric method
CO4	Demonstrate paper chromatography, thin layer chromatography and column chromatography for detection of aminoacids, sugars, lipids and plant pigments
CO5	Demonstrate the principle and working of SDS PAGE and Spectrofluorimetry

Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	2	2	2	2	3	3	2	2
CO2	3	2	3	2	2	2	2	3	3	2	2
CO3	3	2	3	2	2	2	2	3	3	2	2
CO4	3	2	3	2	2	2	2	3	3	2	2
CO5	3	2	3	2	2	2	2	3	3	2	2

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

Sl. No.	CONTENTS	HRs	COs
1	Determination of ultraviolet absorption spectra of proteins and nucleic acid	3	CO1
2	Determination of pH of biological samples (blood, plasma, urine, saliva) phosphate buffer by glass electrode.	3	CO2
3	Colorimetric estimation of protein by Biuret method.	3	CO3
4	Colorimetric estimation of amino acids by ninhydrin method.	3	CO3
5	Paper chromatographic separation and detection of amino acids	3	CO4
6	Paper chromatographic separation and detection of simple sugars	3	CO4
7	Separation of polar and non-polar lipids by thin layer chromatography	3	CO4
8	Chromatographic separation of plant pigments using column Chromatography	3	CO4
	Demonstration Experiments		
9	Separation of serum proteins by SDS-PAGE.	5	CO5
10	Determination of Thiamine /Riboflavin by Spectrofluorimetry	5	CO5

RECOMMENDED BOOKS

1.Singh, S. a. (2014). *Introductory Practical Biochemistry* (reprint ed.). Narosa publishing house - ISBN 10: 9386217627 / ISBN 13: 9789386217622
2.Manickam, S. S. (2018). *Biochemical Methods* (3rd ed.). New age International Pvt Ltd publishers - ISBN 10: 8122421407 / ISBN 13: 9788122421408
3. Basha, M. (2020). *Analytical Techniques in Biochemistry.* Humana Press - ISBN : 978-1-07.

REFERENCE BOOKS

1. J. Jayaraman (2015) *Laboratory Manual in Biochemistry*, New Age International (P) Limited, Fifth edition
2. S. Sadasivam A. Manickam (2018). *Biochemical Methods*, New age International Pvt Ltd publishers, third edition
3. Wilson and John Walker,(2010) *Principles and techniques of Practical Biochemistry*, Cambridge University Press, 2010, Seventh edition

WEB RESOURCES

1. https://www.youtube.com/watch?v=MILiO1XnuqQ
2. https://www.youtube.com/watch?v=IGPpCHX4E7E
3. SDS-PAGE explained - Protein Separation Technique

II B.Sc., BIOCHEMISTRY

FOURTH SEMESTER

Generic Elective-IV

Course Title: BIOSTATISTICS AND COMPUTER APPLICATIONS

Course Code	**2511420**	**Credits**	**03**
L:T:P:S	**3:1:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**100**

LEARNING OBJECTIVE

To gain foundational knowledge in biostatistics, including data collection, classification, and hypothesis testing and develop practical computer skills in MS Office and internet usage, enabling them to apply statistical methods and effectively use software tools for data analysis.

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

CO1	Discuss the definition of biostatistics and its scope and ascertain the methods of data collection and presentation
CO2	Examine the usage of statistical tools like the measure of central tendency, the measure of dispersion and infer the results of skewness, kurtosis,
CO3	Evaluate the concept of hypothesis testing and deduce the t-test and chi chi-square test to make statistical decisions
CO4	Identify the basics of computer architecture and storage devices
CO5	Explain the basics of working with MS Word, Excel and PowerPoint

Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	3	2	1	3	2	2	1
CO2	3	2	3	3	3	2	1	3	2	2	1
CO3	3	2	3	3	3	2	1	3	2	2	1
CO4	3	2	3	3	3	2	1	3	2	2	1
CO5	3	2	3	3	3	2	1	3	2	2	1

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

MODULE NO.	CONTENTS OF MODULE	HRs	COs
I	**Introduction to Biostatistics:** Function and scope. Statistical enquiry. Sampling. Methods of collection of primary and secondary data. Classification and tabulation. Graphical representation-histogram and ogive. Diagrammatic representation- bar diagram and pie diagram.	10	CO1
II	**Statistical Measures:** Individual, discrete and continuous series. Measure of central tendency- mean, median and mode. Measure of variation -range, quartile deviation and standard deviation. Skewness and kurtosis.	10	CO2
III	**Hypothesis testing for the mean:** Steps involved. Null and alternate hypotheses, Level of significance, Type I and Type II errors. Student's t test, Chi-square test.	10	CO3
IV	**Fundamentals of Computers**: Introduction, generations of computers, Components of Computer- input devices, output devices, CPU, memory unit and operating system. Types of computers and its applications. List of low-level and high-level languages. Function and types of computer networks.	10	CO4
V	**MS Office and Internet**: Microsoft Word- features, creating, editing saving and printing a document. Microsoft Excel- features, components of an excel workbook, data entry and saving a new workbook. Mathematical and statistical functions. Creating and working with basic charts. Microsoft PowerPoint- Adding slides, chart, picture, text box to a presentation, duplicating and deleting slides, adding animation to a presentation and making slide show. Internet, search Engines, electronic mail.	10	CO5

RECOMMENDED BOOKS

1. Mohammad Amjad ManaullahAbid. (2019). *Fundamentals of Computers.* (1st Ed.) DreamtechPress, ISBN-978-93-89520-39-2
2. S.P. Gupta (2019), *Biostatistical methods* Sultan Chand and Sons, ISBN 93-5161-112-7
3. Veer Bala Rastogi (2018). *Biostatistics.* Medtech Publisher, ISBN: 9789384007591

REFERENCE BOOKS

1. Jerrold H. Zar (2014), *Biostatistical Analysis* (5th Ed), New Delhi: Pearson Education
2. Williams, B. K., & Sawyer, S. C. (2019). *Using information technology: A practical introduction to computers and communications* (12th ed.). McGraw-Hill Education.
3. Sinha, P. K., & Sinha, P. (2020). *Computer fundamentals* (5th ed.). BPB Publications.

WEB RESOURCES

1. https://testbook.com/learn/maths-mean-median-mode/
2. https://web.cortland.edu/andersmd/STATS/corr.html
3. https://youtu.be/kyjlxsLW1Is

II B.Sc., BIOCHEMISTRY

FOURTH SEMESTER

Generic Practical-IV

Course Title: BIOSTATISTICS AND COMPUTER APPLICATIONS

Course Code	**2511423**	**Credits**	**02**
L:T:P:S	**0:0:3:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**50**

LEARNING OBJECTIVE

To develop skills in constructing and analyzing frequency distributions, computing statistical averages and measures of dispersion, conducting statistical tests, representing data visually using Excel and using MS Office tools for document creation and data presentation.

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

CO1	Explain the statistical representation of data.
CO2	Outline the computation of various statistical tools.
CO3	Emphasis on various statistical tests and their significance
CO4	Summarize the operation and importance of computers and internet usage
CO5	Evaluate the importance of MS-Office in data manipulation and presentation

Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	2	3	2	1	3	3	2	2
CO2	3	2	3	2	3	2	1	3	3	2	2
CO3	3	2	3	2	3	2	1	3	3	2	2
CO4	3	2	3	2	3	2	1	3	3	2	2
CO5	3	2	3	2	3	2	1	3	3	2	2

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

Sl. No.	CONTENTS	HRs	COs
1	Construction of discrete and continuous frequency distribution based on biological data. (manual method or using Excel)	3	CO1
2	Representation of statistical data by histogram, bar chart, pie diagram, and line graph. (manual method or using Excel)	3	CO1
3	Computation of statistical averages- arithmetic mean, median, and mode for biological data. (manual method or using Excel)	3	CO2
4	Determination of measures of dispersion-mean deviation, standard deviation, and standard error for biological data. (manual method or using Excel)	3	CO2
5	Browsing internet using various search engine and downloading text, images and videos.	3	CO4
6	Creating an e- mail account and sending and receiving mails.	3	CO4
7	Creating, editing saving and printing a word document. Paraphrasing using quillbot.	3	CO4
8	Designing a complex table based on a biological data using excel	3	CO4
9	Creating a powerpoint presentation based on biological data using auto content wizard.	6	CO5
10	**Demonstration experiment**- Conducting test of significance –chi square test or t –test using excel.	6	CO3

RECOMMENDED BOOKS

1. Pranab Kr. Banerjee. (2009). *Introduction to Biostatistics*, 3rd edn, S. Chand and Company

2. N. Gurumani. (2009). *An Introduction to Biostatistics*, 2nd edn. MJP publishers. 3. Peter Norton (2008). *Introduction to Computer*, 6th edn Tata Mac Graw Hill Pub

REFERENCE BOOKS

1. NormanT.J.Bailey (2004). *Statistical methods in Biology*, 3rd revised edn. Cambridge university press.

2. Palanichamy S and Manoharan M (1994). *Statistical methods for Biologists*, 1st edn. Palani Paramount Publisher

3. Bland, M. (2015). *An introduction to medical statistics* (4th ed.). Oxford University Press.

WEB RESOURCES

1. https://www.youtube.com/watch?v=ODxEoDyF6R
2. https://www.youtube.com/watch?v=Rl-A-pV72sI
3. https://www.coursera.org/courses?spm=a2ty_o01.29997173.0.0.70996ee3B18sD3&query=biostatistics

II B.Sc., BIOCHEMISTRY

FOURTH SEMESTER

Discipline Specific Elective II -Entrepreneurship Course II (A)

Course Title: FOOD STANDARDS AND QUALITY CONTROL

Course Code	**2511421(A)**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**100**

LEARNING OBJECTIVE

To explain principles of food quality control and safety, identify adulterants and additives in foods, analyze food packaging techniques and hazards, and evaluate food quality using objective methods.

Entrepreneurship Opportunities: Food industry.

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

CO1	Explain the importance of Food quality control
CO2	Outline about the food additives
CO3	Identify the methods in food packaging and labelling
CO4	Outline the importance of food laws
CO5	Infer the food safety and hazards

Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	2	2	1	3	2	3	2
CO2	3	2	2	2	2	2	1	3	2	3	2
CO3	3	2	2	2	2	2	1	3	2	3	2
CO4	3	2	2	2	2	2	1	3	2	3	2
CO5	3	2	2	2	2	2	1	3	2	3	2

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

MODULE NO.	CONTENTS OF MODULE	HRs	COs
I	**Food Quality Control:** Principles of quality control, Food adulteration and hygiene - definition, Common adulterants in different foods, methods of detecting adulterated foods. Government Regulations In Quality Control: FAO/WHO Codex, AGMARK	10	CO1
II	**Food Additives:** Food additives - Definitions, Types. Leavening Agents - Definitions, Classifications. Colour of foods - Natural colours, certified artificial colours, Non-certified colors, Use and Optimum levels.	10	CO2
III	**Food Packaging:** Food Packaging: Food packaging and labelling methods. Recent trends in Packaging and labelling. Enzymes of importance in food processing- Proteases, lipases. Standards for foods - Milk and milk products	10	CO3
IV	**Food Laws:** Consumerism - Definition, Consumer Protection, Consumer Education, Legal modes of protection and Machinery for redressal of consumer grievances. Evaluation of food - Objective methods of evaluation of food	10	CO4
V	**Food Safety and Hazards:** Food Safety: Meaning of food safety, Importance of Food Quality and Safety for developing countries. Food Hazards: Physical, Chemical, and Biological hazards associated with food types.	10	CO5

RECOMMENDED BOOKS

1. A.Y.Sathe, (1999) *A first course in food analysis* - New Age Publications,
2. Norman.N. Potter and Joseph. H. Hotchkiss, (1996) *Food Science* - CBS Publishers,
3. M.Swaminathan, *Food Science, Chemistry and Experimental Foods* – Bappco Publishers.

REFERENCE BOOKS

1. Sivasankar, B. (2013) *Food Processing and preservation* 2nd edition, prentice Hall, Pvt, Ltd.
2. Srilakshmi, N.,(2002) *Food Science,* New Age International Private Ltd., New Delhi,
3. Chandrasekhar U, (2002) *Food Science and Applications in Indian Cookery*, Phoenix Publishing House Private Ltd., New Delhi.

WEB RESOURCES

1. https://www.slideshare.net/slideshow/food-quality-control/76840140
2. https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/food-packaging
3. https://www.fda.gov/food?spm=a2ty_o01.29997173.0.0.70995171klALz

II B.Sc., BIOCHEMISTRY

FOURTH SEMESTER

Discipline Specific Elective II -Entrepreneurship Course II (B)

Course Title: PHYTOCHEMISTRY ESSENTIALS

Course Code	**2511421(B)**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**50**

LEARNING OBJECTIVE

To identify and classify phytochemicals, apply extraction techniques for plant secondary metabolites, perform qualitative and quantitative phytochemical analysis, use chromatographic methods for separation and profiling, and evaluate bioactivity through antioxidant, antimicrobial, and enzyme inhibition assays.

Entrepreneurship Opportunities: in the nutraceutical, pharmaceutical, or cosmetic industries

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

CO1	Explain the classification, significance, and applications of phytochemicals and plant secondary metabolites.
CO2	Identify extraction techniques and solvent selection for efficient phytochemical extraction.
CO3	Demonstrate the ability to conduct qualitative and quantitative screening of phytochemicals
CO4	Apply chromatographic techniques like TLC, HPLC, and GC-MS for phytochemical analysis.
CO5	Evaluate phytochemical extracts in antioxidant, antimicrobial, and enzyme inhibition assays

Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	2	2	2	2	3	3	2	3
CO2	3	2	3	2	2	2	2	3	3	2	3
CO3	3	2	3	2	2	2	2	3	3	2	3
CO4	3	2	3	2	2	2	2	3	3	2	3
CO5	3	2	3	2	2	2	2	3	3	2	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

MODULE NO.	CONTENTS OF MODULE	HRs	COs
I	**Basics of Phytochemicals:** Phytochemicals – Definition and significance. Classification of plant secondary metabolites, including alkaloids, flavonoids, tannins, saponins, phenolics, terpenoids, glycosides, etc. Applications of phytochemicals in pharmaceuticals, nutraceuticals, and agriculture.	10	CO1
II	**Extraction Techniques:** Preparation of plant materials for phytochemical investigation. Methods of extraction – Maceration, Soxhlet, Ultrasonic-assisted extraction, Microwave-assisted extraction, and Pressurized liquid extraction. Choice of solvents based on polarity and target compounds. Factors influencing extraction yield and quality.	10	CO2
III	**Phytochemical Screening and Quantification:** Qualitative screening methods for major phytochemical classes – tests for alkaloids, tannins, flavonoids, terpenoids, and saponins. Quantitative analysis of phenolics using the Folin-Ciocalteu method and flavonoids using the aluminium chloride method.	10	CO3
IV	**Chromatographic Techniques:** Introduction to chromatographic methods – TLC and HPLC, GC-MS for separation and profiling of phytochemicals. Use of reference standards and calibration curves.	10	CO4
V	**Bioactivity Analysis:** In vitro antioxidant assays – DPPH, ABTS, and FRAP methods. Antimicrobial screening methods – Disc diffusion and Minimum Inhibitory Concentration (MIC). Enzyme inhibition assays with reference to amylase and lipase inhibition.	10	CO5

RECOMMENDED BOOKS

1. Sethi, P. D. (1996).Phytochemical screening: A practical approach. CBS Publishers & Distributors.
2. Harborne, J. B. (1998).Phytochemical methods: A guide to modern techniques of plant analysis. Springer.
3. Tiwari, B. K., Brunton, N. P., & Brennan, C. S. (2020).Handbook of plant food phytochemicals: Sources, stability, bioavailability, and health benefits. Wiley-Blackwell.

REFERENCE BOOKS

1. Joshi, S. G. (2000) Medicinal Plants. Oxford and IBH, New Delhi
2. Kumar, V., & Chauhan, S. M. S. (2023).Modern techniques in phytochemical research: Extraction, characterization, and applications. Elsevier.
3. Zhang, L., & Liu, R. H. (Eds.). (2020). Bioactive compounds in foods: Extraction, characterization, and health benefits. Academic Press.

WEB RESOURCES

1. https://microbenotes.com/chromatography-principle-types-and-applications/
2. https://www.intechopen.com/chapters/62876
3. https://www.phytochemicalsociety.org/?spm=a2ty_o01.29997173.0.0.70995171klALOz

II B.Sc., BIOCHEMISTRY

FOURTH SEMESTER

Discipline Specific Elective II -Entrepreneurship Course II (C)

Course Title: BIOENTREPRENEURSHIP

Course Code	**2511421(C)**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**100**

LEARNING OBJECTIVE

To understand the core concepts of bioentrepreneurship, develop entrepreneurial skills, create detailed business plans, secure funding for bio-based ventures, analyze market trends, ensure legal compliance, manage finances effectively, and leverage innovation ecosystems to successfully launch and sustain bio-based businesses.

Entrepreneurship Opportunities: in biotechnology, healthcare, and life sciences.

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

CO1	Identify essential entrepreneurial skills and the types of industries relevant to bioentrepreneurship
CO2	Evaluate the importance of aligning business plans with funding requirements and investor expectations for sustainable growth.
CO3	Apply market analysis and strategy tools to create actionable plans for launching and scaling bioentrepreneurial ventures.
CO4	Recognize the legal requirements for starting and registering a scientific company in India and evaluate the role of financial planning and budgeting in sustaining and scaling bio-based ventures.
CO5	Appreciate the role of universities, innovation centers, research institutions, and business incubators in fostering entrepreneurship development.

Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	3	3	2	3	3	3	3
CO2	3	2	3	3	3	3	2	3	3	3	3
CO3	3	2	3	3	3	3	2	3	3	3	3
CO4	3	2	3	3	3	3	2	3	3	3	3
CO5	3	2	3	3	3	3	2	3	3	3	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

MODULE NO.	CONTENTS OF MODULE	HRs	COs
I	**Introduction to Bioentrepreneurship:** Bioentrepreneurship – Introduction, Scope. Skills to develop as an entrepreneur - Creativity, leadership, managerial, Team, self-discipline, decision making; Types of industries –Pharma, Agriculture, Scientific labs; Patents, Trademarks, Copyrights – Definition and importance.	10	CO1
II	**Business Plan and Funding:** Business plan & business proposal preparation; GANNT chart; funds/support from Government agencies like MSME/banks, DBT, BIRAC, Start-up and Make in India Initiative	10	CO2
III	**Market Strategy:** Market analysis: SWOT analysis, PESTEL Analysis. Basics of market forecast for the industry; distribution channels – franchising, policies, promotion, advertising, branding, and marketing. Operations-Advertising Legal companies	10	CO3
IV	**Legal Requirements, Finance, and Accounting:** Legal requirements for starting a company; Registration of scientific company (Biotech/Pharma & Research labs) in India; Ministry of Corporate Affairs (MCA); collaborations & partnerships; Basics in accounting: concepts of balance sheet	10	CO4
V	**Entrepreneurship development:** Role of knowledge centres such as Universities, innovation centres, Research institutions and business incubators in Entrepreneurship development; Quality control and Quality assurance; Importance of CDSCO, NBA, GLP, GCP, GMP	10	CO5

RECOMMENDED BOOKS

1. Adams, D. J.,and Sparrow, J. C. (2008). *Enterprise for life scientists:* Developing innovation and entrepreneurship in the biosciences. Bloxham: Scion.
2. Shimasaki, C. D. (2014). *Biotechnology entrepreneurship:* Starting, managing, and leading biotech companies. Amsterdam: Elsevier. Academic Press is an imprint of Elsevier
3. Sethi, S. (2016). *From science to startup: The inside track of technology entrepreneurship* . Springer.

REFERENCE BOOKS

1. Sharma, P. K. (2018). *Biotechnology entrepreneurship and management* . IK International Publishing House.
2. Siegel, D. S. (2017). *Innovation and entrepreneurship in biotechnology: Translating ideas into reality* . Elsevier.
3. Jordan, J. F. (2014). *Innovation, Commercialization, and Start-Ups in Life Sciences.* London: CRC Press.

WEB RESOURCES

1. https://www.slideshare.net/slideshow/bioentrepreneurship/76774098
2. https://aits-tpt.edu.in/wp-content/uploads/2023/08/Entreprenurship-Development-min.pdf
3. https://sbir.nih.gov/?spm=a2ty_o01.29997173.0.0.70995171klALOz

II B.Sc., BIOCHEMISTRY

FIFTH SEMESTER

Core Course-V
Course Title: ENZYMES

Course Code	**2511524**	**Credits**	**04**
L:T:P:S	**4:1:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**100**

LEARNING OBJECTIVE

To gain a thorough understanding of enzyme nomenclature, classification, kinetics, mechanisms of action, including enzyme inhibition, as well as the industrial applications of enzymes in various fields.

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

CO1	Explain the structure, function, composition and classification of the enzyme.
CO2	Interpret MM plot and LB plot based on the kinetics data as well as gain knowledge on enzyme inhibition and its types.
CO3	Outline the theories of the mechanism of enzyme action and explain the principles behind enzyme catalysis.
CO4	Describe the structure and functions of various coenzymes and cofactors in the biological system
CO5	Identify the various methods for production, purification, and characterization of immobilized enzymes and discuss the application of industrially important enzymes.

Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	2	2	2	3	3	3	3	2
CO2	3	2	3	2	2	2	3	3	3	3	2
CO3	3	2	3	2	2	2	3	3	3	3	2
CO4	3	2	3	2	2	2	3	3	3	3	2
CO5	3	2	3	2	2	2	3	3	3	3	2

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

MODULE NO.	CONTENTS OF MODULE	HRs	COs
I	**Introduction:** Nomenclature, IUB system of enzyme classification, specificity, turnover number, Enzyme units (IU and Katal), active site, allosteric site.	15	CO1
II	**Enzyme Kinetics**: Rate and order of reactions, factors affecting the enzyme activity, derivation of Michaelis-Menton Equation, Significance of Km, Lineweaver and Burk plot. Enzyme inhibition – Competitive, non-competitive and uncompetitive inhibitors (kinetic derivations excluded) with suitable examples.	15	CO2
III	**Mechanism of Enzyme Action:** Fischer's Lock and key model, Koshland's Induced fit hypothesis – Activation energy. Acid base catalysis, metal ion and covalent catalysis.	15	CO3
IV	**Cofactors and Coenzymes Prosthetic group:** Structure and functions of NAD, FAD, CoA, biotin, cobamide, TPP, PLP, THF **.**	10	CO4
V	**Enzyme Application:** Industrial uses of enzymes –Amylase, Protease and Lipase-Immobilized enzymes production nd applications. Abzymes and ribozymes.	10	CO5

RECOMMENDED BOOKS

1.Trevor Palmer, P. B. (2007). *Enzymes.* Wood head Publishing - ISBN : 9780857099921, 0857099922
2.Meenakshi Meena, D. C. (2009). *Fundamental of Enzymology.* Aavinshankar Publisher 2009 - ISBN-10 : 8179102807 / ISBN-13 : 978-8179102800
3.David L. Nelson, M. M. (2017). *Principles of Biochemistry*(7th ed.). Macmillian Education –

REFERENCE BOOKS

1.Donald Voet, C. W. (2012). *Principles of Biochemistry.* Wiley - ISBN 10: 1118092449 / ISBN 13: 9781118092446
2.Sathyanarayana. (2017). *Biochemistry.* Elsevier - ISBN: 9788131236017
3.Rodwell, V. (2018). *Harper's Illustrated Biochemistry.* McGrew. Hill –

WEB RESOURCES

1. Enzymes: Structure, Types, Mechanism, Functions
2. Enzyme Kinetics.pdf
3. Lock and Key Model | Overview & Examples - Lesson | Study.com

III B.Sc., BIOCHEMISTRY

FIFTH SEMESTER

Core Course-VI

Course Title: INTERMEDIARY METABOLISM

Course Code	**2511525**	**Credits**	**04**
L:T:P:S	**4:1:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**100**

LEARNING OBJECTIVE

To develop a comprehensive understanding of intermediary metabolism, including the catabolic and anabolic processes of carbohydrates, proteins, lipids, and nucleic acids.

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

CO1	Define the concepts of metabolism and describe the energetics of glycolysis, citric acid cycle, glycogenesis, glycogenolysis, and the pentose phosphate pathway.
CO2	Identify the components and reactions of the electron transport chain and oxidative phosphorylation, including high-energy compounds, to assess their roles in energy generation.
CO3	Explain the catabolism of amino acids, transamination, deamination, decarboxylation, the urea cycle, and creatinine biosynthesis.
CO4	Analyze the energetics of fatty acid biosynthesis, β-oxidation, α-oxidation, ω-oxidation, ketogenesis, and cholesterol biosynthesis.
CO5	Evaluate the de novo and salvage pathways of purine and pyrimidine nucleotide biosynthesis, their regulation, and catabolism.

Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	2	2	3	3	3	3	3
CO2	3	2	2	2	2	2	3	3	3	3	3
CO3	3	2	2	2	2	2	3	3	3	3	3
CO4	3	2	2	2	2	2	3	3	3	3	3
CO5	3	2	2	2	2	2	3	3	3	3	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

MODULE NO.	CONTENTS OF MODULE	HRs	COs
I	**Carbohydrate Metabolism:** Introduction to Intermediary Metabolism. Metabolism-Catabolism and Anabolism. The glycolytic pathway – aerobic and anaerobic glycolysis, energetics, Pyruvate to acetyl-CoA and its energetics, citric acid cycle and its energetics. Glycogenesis and glycogenolysis –Reactions and its regulation, Pentose phosphate pathway Reactions and its significance.	15	CO1
II	**Electron Transport Chain** - components and reactions of ETC. Oxidative phosphorylation – Chemiosmotic hypothesis, Uncouplers of Oxidative phosphorylation. Energetics. High energy compounds-Definition and examples ATP, SAM	15	CO2
III	**Protein Metabolism –** Introduction- catabolism of amino acids- Phenyl alanine, Leucin Transamination, Oxidative and Non-oxidative Deamination, Decarboxylation – Urea cycle and its regulation. Biosynthesis of creatinine.	10	CO3
IV	**Lipid Metabolism –**Biosynthesis of saturated fatty acids. Oxidation of fatty acids – Beta oxidation-Role of carnitine, Energetics of Palmitic acid Oxidation, alpha oxidation and omega oxidation. Biosynthesis of cholesterol. Ketogenesis.	10	CO4
V	**Nucleic Acid Metabolism-** Biosynthesis of purine nucleotides – Denovo synthesis and salvage pathways, regulation of purine biosynthesis. biosynthesis of pyrimidine nucleotides - Denovo synthesis and salvage pathways, regulation of pyrimidine synthesis. Catabolism of purine nucleotides and pyrimidine nucleotides -regulation.	15	CO5

RECOMMENDED BOOKS

1.Sathyanarayana. (2017). *Biochemistry.* Elsevier - ISBN: 9788131236017
2.J. L. Jain, N. J. (7th ed 2016). *Fundamentals of Biochemistry 7th edition.* S. Chand @ Co.Ltd - ISBN: 9788121924535
3.Rodwell, V. (2018). *Harper's Illustrated Biochemistry.* McGrew. Hill .

REFERENCE BOOKS

1.Donald Voet, C. W. (2012). *Principles of Biochemistry.* Wiley - ISBN 10: 1118092449 / ISBN 13: 9781118092446
2.David.L.Nelson, M. M. (7th ed 2017). *Lehninger principles of Biochemistry* . Freeman. W.H. and Company - ISBN 10: 1464126119 / ISBN 13: 9781464126116
3.Robert K.Murray, D. A. (2018). *Harper's Illustrated Biochemistry* (28th ed.). The McGraw- Hill Companies - ISBN-10 : 0071625917 / ISBN-13 : 978-0071625913

WEB RESOURCES

1. Biochemistry, Glycolysis - StatPearls - NCBI Bookshelf
2. https://www.ncbi.nlm.nih.gov/books/NBK482303
3. Metabolism | Nucleotide Synthesis | Purine & Pyrimidine Synthesis

III B.Sc., BIOCHEMISTRY

FIFTH SEMESTER

Core Course-VII

Course Title: HUMAN PHYSIOLOGY

Course Code	**2511526**	**Credits**	**04**
L:T:P:S	**4:1:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**100**

LEARNING OBJECTIVE

To understand the structure and function of major physiological systems, including blood, respiratory, circulatory, digestive, excretory, nervous, and muscular systems, while analyzing their roles in maintaining homeostasis.

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

CO1	Analyze the structure and functions of blood cells, identify blood groups (ABO and Rhesus systems) and discuss lymphatic system and respiratory mechanisms.
CO2	Explain the structure and functions of the heart
CO3	Outline the mechanism of digestion of carbohydrates, Proteins, and fats
CO4	Summarize the steps involved in urine formation
CO5	Explain the structure and functions of neuron and the mechanism of transmission of a nerve impulse.

Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	2	2	3	3	3	3	3
CO2	3	2	2	2	2	2	3	3	3	3	3
CO3	3	2	2	2	2	2	3	3	3	3	3
CO4	3	2	2	2	2	2	3	3	3	3	3
CO5	3	2	2	2	2	2	3	3	3	3	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

MODULE NO.	CONTENTS OF MODULE	HRs	COs
I	**Blood Composition and Function**, types of blood cells, morphology and function. Blood groups- ABO and Rhesus system. Composition and function of lymph and the lymphatic System. Respiratory system- structure & function of different components of the respiratory units. mechanism of respiration. Gaseous Exchange, Bohr's effect.	15	CO1
II	**Circulatory System**- heart-, structure, properties of cardiac muscle, overview of systemic and pulmonary circulation, conducting system of the heart, heart rate, cardiac cycle, cardiac output, Systolic and Diastolic pressure.	10	CO2
III	**Digestive Systems**: Structure of different components of the digestive system, digestion and absorption of carbohydrates, lipids and proteins, role of bile salt in digestion of lipids, Mechanism of HCl formation in the stomach, role of various enzymes and hormones involved in the digestive process.	15	CO3
IV	**Excretory System-** Structural components of urinary system: Kidney - structure and its organization. Mechanism of urine formation- Glomerular filtration rate (GFR), Tubular Secretion and reabsorption.	10	CO4
V	**Brief Outline of Nervous System**-brain (parts and ventricles), spinal cord, nerve fibres, synapses, chemical and electrical synapses, Transmission of nerve impulses, action potential and neurotransmitters-Cholinergic and Adrenergic Neurotransmitters. Muscles-Types of muscles and their functions: myo filamentation and contraction and relaxation of skeletal muscles.	15	CO5

RECOMMENDED BOOKS

1.Sembulingam, K. S. (2019). *Essentials Of Medical Physiology.* Jaypee Brothers Medical Publishers, - ISBN 10: 9352706927 ISBN 13: 9789352706921

2.Derrickson, G. J. (2017). *Principles of Anatomy and Physiology - ISBN: 978-1-119-40006-6*

3. Hall, G. A. (2019). Text book of MEdical physiology. Elsevier india - ISBN-10 : 8131257738 - ISBN-10 : 8131257738.

REFERENCE BOOKS

1.D. Venkatesh, H. H. (2018). *Textbook of Medical Physiology.* Wolters Kluwer India Pvt. Ltd - ISBN-10 : 9387963535 / ISBN-13 : 978-9387963535

2.D. Venkatesh, H. H. (2018). *Textbook of Medical Physiology.* Wolters Kluwer India Pvt. Ltd ISBN-10 : 9387963535 / ISBN-13 : 978-9387963535

3.H. S. Ravi Kumar Patil, H. K. (2009). A Textbook of Human Physiology. I K International Publishing House Pvt. Ltd - ISBN : 9789380026503

WEB RESOURCES

1. Blood Basics - Hematology.org, Blood groups - NHS
2. 16.2: Structure and Function of the Respiratory System - Biology LibreTexts
3. Digestion and absorption of Lipids

III B.Sc., BIOCHEMISTRY

FIFTH SEMESTER

Core Course-VIII

Course Title: MOLECULAR BIOLOGY

Course Code	**2511527**	**Credits**	**04**
L:T:P:S	**4:1:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**100**

LEARNING OBJECTIVE

To understand the mechanisms behind DNA replication, transcription in prokaryotes, translation and the regulation of gene expression through operon models.

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

CO1	Infer the central dogma of molecular biology and show how DNA acts as a vehicle of inheritance through experimental evidences,
CO2	Outline the steps involved in replication and explain the events, enzymology, fidelity and inhibitors of replication in E.*coli*
CO3	Summarize the process of prokaryotic transcription
CO4	Define genetic code and relate genetic code to the translation process and explain protein biosynthesis
CO5	Explain the regulation of gene expression in prokaryotes using *lac* and *trp* Operon

Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	2	2	3	3	3	3	3
CO2	3	2	2	2	2	2	3	3	3	3	3
CO3	3	2	2	2	2	2	3	3	3	3	3
CO4	3	2	2	2	2	2	3	3	3	3	3
CO5	3	2	2	2	2	2	3	3	3	3	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

MODULE NO.	CONTENTS OF MODULE	HRs	COs
I	**Central Dogma of Molecular Biology**. DNA as the vehicle of inheritance – experimental evidence – Griffith, McLeod, McCarty and Avery, Hershey – Chase experiments.	10	CO1
II	**DNA Replication** -semi conservative mode of replication, replication fork, semi-discontinuous replication-Okazaki fragments. Enzymes of replication – DNA polymerases I, II, III, topoisomerases, helicases binding proteins and ligases. Replication in E.coli – replisomes, events at Ori C (initiation), events on the replication fork (elongation) and termination. Fidelity of replication, Inhibitors of replication.	15	CO2
III	**Transcription –** Structure and functions of prokaryotic RNA polymerases. Initiation, elongation and termination –Rho-dependent and Rho-independent termination- Hair Pin loop Formation. Inhibitors of Prokaryotic transcription.	15	CO3
IV	**Genetic Code** –Codons and anticodons. Basic features of genetic code. Deciphering of the genetic code. Wobble hypothesis. Protein biosynthesis-Prokaryotic ribosomes -Shine dalgarno sequence, Aminoacyl tRNA synthetases. Stages involved in protein biosynthesis-Initiation, elongation and termination. Inhibitors of translation.	15	CO4
V	**Regulation of Gene Expression in Prokaryotes.** Operon concept – Inducible operon, Positive and negative regulation of lac operon- role of cAMP and glucose and trp operon – attenuation.	10	CO5

RECOMMENDED BOOKS

1.Watson, J. D. (2017). *Molecular Biology of the gene* . Pearson - ISBN-10 : 9332585474 / ISBN-13 : 978-9332585478
2.David.L.Nelson, M. M. (7th ed 2017). *Lehninger principles of Biochemistry* . Freeman. W.H. and Company - ISBN 10: 1464126119 / ISBN 13: 9781464126116
3.V.Malathi. (2012). *Essentials of Molecular Biology* (1st ed.). Pearson Education - ISBN-10 : 8131773213 / ISBN-13 : 978-8131773215

REFERENCE BOOKS

1.Albert, B. (2014). *Molecular Biology of the Cell.* W.W. Norton and Company - ISBN 10: 0815344643 / ISBN 13: 9780815344643
2.Donal Voet, J. G. (2016). *Fundamentals of Biochemistry: Life at molecular level* (5th ed.). john Wiley & sons - ISBN: 978-1-118-91840-1
3.Rastogi, V. B. (2016). *Principles of Molecular biology* (2nd ed.). Medtech - ISBN-10 : 9789384007478 / ISBN-13 : 978-9384007478

WEB RESOURCES

1. DNA Experiments (Griffith & Avery, McCarty, MacLeod & Hershey, Chase)
2. DNA Replication - The Cell - NCBI Bookshelf
3. 11.7: Gene Regulation - Operon Theory - Biology LibreTexts

III B.Sc., BIOCHEMISTRY

FIFTH SEMESTER

Core Practical-V

Course Title: ENZYMES AND INTERMEDIARY METABOLISM

Course Code	**2511529**	**Credits**	**02**
L:T:P:S	**0:0:3:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**50**

LEARNING OBJECTIVE

Understand and apply biochemical techniques to estimate biomolecules, determine enzyme activity, and analyze factors affecting enzyme function in biological systems

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

CO1	Estimate the concentration of protein, pyruvate, and tryptophan in unknown solutions
CO2	Determine the effects of pH, temperature, and substrate concentration on the activity of salivary amylase to identify optimal conditions for enzymatic reactions.
CO3	Compare the enzyme activity of salivary amylase and the specific activity of alkaline phosphatase to assess their catalytic efficiency.
CO4	Demonstrate lactate dehydrogenase isoenzymes using electrophoresis.
CO5	Demonstrate laboratory skills in conducting biochemical experiments and interpretation of results in the context of metabolic processes.

Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	2	2	2	3	3	3	3	2
CO2	3	2	3	2	2	2	3	3	3	3	2
CO3	3	2	3	2	2	2	3	3	3	3	2
CO4	3	2	3	2	2	2	3	3	3	3	2
CO5	3	2	3	2	2	2	3	3	3	3	2

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

Sl. No.	CONTENTS	HRs	COs
1	Estimation of Protein in unknown solution by Lowry's method	3	CO1, CO5
2	Estimation of Pyruvate in an unknown solution	3	CO1, CO5
3	Estimation of Tryptophan in an unknown solution	3	CO1, CO5
4	Determination of optimum pH of Salivary Amylase	5	CO2,CO5
5	Determination of optimum temperature of Salivary amylase	5	CO2, CO5
6	Effect of substrate concentration on the activity of Salivary amylase	5	CO2, CO5
7	Determination of enzyme activity of Salivary amylase	5	CO3, CO5
8	Determination of specific activity of Alkaline phosphatase	5	CO3, CO5
	Demonstration Experiment		
9	Detection of LDH isoenzymes	5	CO4, CO5

RECOMMENDED BOOKS

1. Jayaraman, J. (2011). *Laboratory Manual in Biochemistry.* New Age International Pvt Ltd Publishers - ISBN-10: 812243049X, ISBN-13 : 978-8122430493
2. Singh, S. K. (2005). *Introductory Practical Biochemistry* (2nd ed.). Alpha Science International, Ltd- ISBN 10:8173193029 / ISBN 13: 9788173193026
3. Ashwood, B. a. (2001). *Tietze's Fundamentals of Clinical Chemistry*. WB Saunders Company, Oxford Science Publications - ISBN 10: 0721686346 / ISBN 13: 9780721686349

REFERENCE BOOKS

1. WORK, T. W. (2009*). Laboratory Techniques in Biochemistry & Molecular Biology* by Amsterdam. North Holland Pub. Co.
2. Manickam, S. S. (2018). *Biochemical Methods* (3rd ed.). New Age International Pvt Ltd publishers – ISBN 10: 8122421407 / ISBN 13: 9788122421408
3. Plummer, D. T. (n.d.). *An Introduction to Practical Biochemistry.* Tata Mc Graw Hill - ISBN: 9780070841659

WEB RESOURCES

1. https://www.youtube.com/watch?v=xKtIzOLcyAE
2. https://www.youtube.com/watch?v=4frKQEdtSeg
3. https://youtu.be/joLTM_cQ1IQ

III B.Sc., BIOCHEMISTRY

FIFTH SEMESTER

Core Practical-VI

Course Title: MOLECULAR BIOLOGY AND PHYSIOLOGY

Course Code	**2511530**	**Credits**	**02**
L:T:P:S	**0:0:3:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**50**

LEARNING OBJECTIVE

To acquire practical skills in molecular biology and clinical diagnostics, including the estimation of DNA and RNA concentrations, RBC count, WBC count, ESR, PCV, bleeding time, and clotting time.

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

CO1	Determine the melting temperature of DNA and estimate the concentrations of DNA and RNA in unknown solutions.
CO2	Analyze hematological tests, including RBC count, WBC count, ESR, PCV, bleeding time, and clotting time, and understand their physiological significance.
CO3	Assess blood pressure using a sphygmomanometer and interpret its clinical relevance
CO4	Explain the isolation of DNA from tissue and RNA from yeast
CO5	Demonstrate laboratory skills in conducting foundational biochemical and physiological experiments

Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	2	1	3	3	3	3	3
CO2	3	2	2	2	2	1	3	3	3	3	3
CO3	3	2	2	2	2	1	3	3	3	3	3
CO4	3	2	2	2	2	1	3	3	3	3	3
CO5	3	2	2	2	2	1	3	3	3	3	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

Sl. No.	CONTENTS	HRs	COs
1	Determination of melting temperature of DNA	3	CO1, CO5
2	Estimation of DNA in an unknown solution	3	CO1, CO5
3	Estimation of RNA in an unknown solution	3	CO1, CO5
4	Determination of RBC count	3	CO2,CO5
5	Determination of WBC count – TC, DC	3	CO2, CO5
6	Determination of ESR and PCV	3	CO2, CO5
7	Determination of Bleeding time and Clotting time	3	CO2, CO5
8	Measurement of Blood Pressure using Sphygmomanometer	3	CO3, CO5
	Demonstration Experiments		
9	Isolation of DNA from tissue	5	CO4, CO5
10	Isolation of RNA from yeast	5	CO4, CO5

RECOMMENDED BOOKS

1. Jayaraman, J. (2011). *Laboratory Manual in Biochemistry*. New Age International Pvt Ltd Publishers - ISBN-10: 812243049X, ISBN-13 : 978-8122430493
2. Singh, S. K. (2005). *Introductory Practical Biochemistry* (2nd ed.). Alpha Science International, Ltd- ISBN 10:8173193029 / ISBN 13: 9788173193026
3. Ashwood, B. a. (2001). *Tietz Fundamentals of Clinical chemistry.* WB Saunders Company, Oxford Science PublicationsUSA - ISBN 10: 0721686346 / ISBN 13: 9780721686349

REFERENCE BOOKS

1. WORK, T. W. (2009). *Laboratory Techniques in Biochemistry & Molecular Biology* by Amsterdam. North Holland Pub. Co.
2. Manickam, S. S. (2018). *Biochemical Methods* (3rd ed.). New Age International Pvt Ltd publishers – ISBN 10: 8122421407 / ISBN 13: 9788122421408
3. Plummer, D. T. (n.d.). *An Introduction to Practical Biochemistry.* Tata Mc Graw Hill - ISBN: 9780070841659

WEB RESOURCES

1. https://www.youtube.com/watch?v=8jVNcT5Dapk
2. https://youtu.be/XhsSd2vrKhs
3. https://youtu.be/KSs0SMfERuA

III B.Sc., BIOCHEMISTRY

FIFTH SEMESTER

Multi-Disciplinary Elective/Open Elective –I

Course Title: THERAPEUTIC NUTRITION

Course Code	**2511528**	**Credits**	**03**
L:T:P:S	**4:0:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**100**

LEARNING OBJECTIVE

To understand the principles of therapeutic nutrition and apply dietary management strategies to address nutritional needs in metabolic, gastrointestinal, renal, respiratory, and critical care conditions.

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

CO1	Provide comprehensive knowledge on principles and planning of therapeutic diets
CO2	Apply the nutrition knowledge in weight management, obesity
CO3	Classify hypertension and able to trace the root cause, suggest diet for hypertension
CO4	Classify hypertension and able to trace the root cause, suggest diet for hypertension
CO5	Describe the nature of fever, nutritional requirements define diet during fever

Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	2	2	2	3	2	3	3	3
CO2	3	3	3	2	2	2	3	2	3	3	3
CO3	3	3	3	2	2	2	3	2	3	3	3
CO4	3	3	3	2	2	2	3	2	3	3	3
CO5	3	3	3	2	2	2	3	2	3	3	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

MODULE NO.	CONTENTS OF MODULE	HRs	COs
I	**Diet Therapy**-Definitions & principles of diet therapy, concepts & objectives of therapeutic diet, therapeutic adaptation of normal diet: Normal diet, routine hospital diet: -clear liquid diet, full fluid diet/liquid diet, semi-solid diet, high & low-calorie diet, high & low protein diet, high & low fiber diet, low cholesterol diet.	10	CO1
II	**Weight Imbalance-** Obesity- prevalence- etiology, risk factors, assessment, treatment, life style and dietary management- Fat discrimination- SFA, MUFA, PUFA and omega- 3 and 6- fatty acids. Dietary fibre and its significance.	10	CO2
III	**Hypertension**-classification, prevalence, morbidity and mortality. Diet related factors influencing development of hypertension. Management- lifestyle, weight, salt restriction and other dietary modifications. Diet to be followed during Atherosclerosis	10	CO3
IV	**Dietary management and nutritional care in gastro intestinal disorders -** indigestion, acute gastritis and duodenal ulcers and liver diseases - hepatitis, and alcoholic live disease (cirrhosis)	10	CO4
V	**Nutritional requirement and dietary modification** during the acute, chronic and convalescent stage of fevers. Typhoid, & Malaria fever - symptoms, diagnosis, treatment and dietary management.	10	CO5

RECOMMENDED BOOKS

1. Sharma, D. S. (2017). *Nutritional Biochemistry.* CBS Publishers and distributors -ISBN 10: 8123925271 / ISBN 13: 9788123925271
2. Srilakshmi, B. (2019). *Dietetics* - (Multi Colour Edition ed.). New Age International Publishers - ISBN 10: 9386649209 / ISBN 13: 9789386649201
3. B.Srilakshmi, B. (2017). *Food Science* (Multi Colour Edition ed.). New Age International Publishers - ISBN 10: 8122438091 / ISBN 13: 9788122438093

REFEERENCE BOOKS

1. Krause's. (2013). *Food, Nutrition, & Diet Therapy* (11th ed.). W.B. Saunders -ISBN-10 : 0721697844, ISBN-13 : 978-0721697840.
2. DeBruyne, L. K., Pinna, K., & Whitney, E. (2019). *Nutrition and diet therapy* (10th ed.). Cengage Learning
3. Elia, M., Ritz, P., & Stubbs, R. J. (2010). *Clinical nutrition in practice*. Wiley-Blackwell.

WEB RESOURCES

1. https://pmc.ncbi.nlm.nih.gov/articles/PMC7998524/?utm
2. https://www.healthline.com/nutrition/typhoid-diet?utm
3. https://pmc.ncbi.nlm.nih.gov/articles/PMC4209534/?utm

III B.Sc Biochemistry

SIXTH SEMESTER

Core Course IX

Course Title: - RESEARCH METHODOLOGY

Course Code	**2511632**	**Credits**	**04**
L:T:P:S	**4:1:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**100**

LEARNING OBJECTIVE:

Upon completing the course, students will be able to gain a comprehensive understanding of research fundamentals, including different types of research, the research process, and the tools used for data collection. They will develop skills in formulating research problems, reviewing literature, creating questionnaires, and understanding research paper structure.

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

CO1	Outline the characteristics of research.
CO2	Demonstrate knowledge of the research process & Literature review
CO3	Demonstrate familiarity with common research tools.
CO4	Outline the structure and components of a thesis or research paper
CO5	Identifying funding agencies and research institutes in India

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	2	2	2	2	2	2	2
CO2	3	2	2	2	2	2	2	2	2	2	2
CO3	3	2	2	2	2	2	2	2	2	2	2
CO4	3	2	2	2	2	2	2	2	2	2	2
CO5	3	2	2	2	2	2	2	2	2	2	2

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

MODULE NO.	CONTENTS OF MODULE	Hrs	COs
I	**Research**- Definition, Characteristics, Objectives, scope of research Types of Research- Descriptive, Analytical Research, Applied, Fundamental Research, Quantitative , Qualitative Research, Conceptual vs. Empirical Research. Ethics in research & Research publication	10	CO1
II	**Research Process**- Basic Overview, Formulating the Research Problem, Defining the Research Problem, Computer & Internet: Its Role in Research, Threats and Challenges to Good Research. Literature Review Process	15	CO2
III	**Types of research tools** – Questionnaire- types, characteristics of good questionnaire, Use and Limitations of questionnaire, ,ratings scale- Numerical, graphic, standard, rating by cumulative points, uses and limitations of rating scales and attitude scale- types('equal- appearing intervals, Likert scale),uses and limitations	15	CO3
IV	**Thesis format** - structure and components of a thesis or research paper, including the title page, abstract, introduction, methods, results, discussion, conclusion, and references. Formatting- font, margins, spacing, and citation styles(APA, Chicago), reference citation tool- Mendeley. Plagiarism- Definition, consequences of plagiarism and ways of avoiding plagiarism.	15	CO4
V	**Funding sources in India** - government agencies (DBT, ICMR), non-profit organizations (Wellcome Trust /DBT India Alliance). Research institutes in India and its role in the society	10	CO5

RECOMMENDED BOOKS

1) Ranjit Kumar (2019) Research Methodology: A Step-by-Step Guide for Beginners" SAGE Publications Ltd; 5th edition
2) Kothari, C. R (2013) Research Methodology: Methods and Techniques. New Age International (P) Limited, Publishers. 2nd edition. ISBN-13: 978-8122415223
3) Trochim W.M.K.(2005). Research Methods: the concise knowledge base; Atomic Dog Publishing.

REFERENCE BOOKS

1) Panneerselvam R. (2009) Research Methodology ; PHI, Learning Pvt. Ltd., New Delhi -
2) Garg B.L., Karadia, R., Agarwal, F. and Agarwal, U.K (2002). An introduction to Research Methodology; RBSA Publishers.
3) Dr. S. Sachdeva Lakshmi Narain(2021)Research Methodology. Agarwal publisher.2021 -ISBN: 9789389918496

WEB LINKS

1. https://www.researchgate.net/publication/350008028_Research_Methodology_and_Scientific_Writing?utm
2. https://iaccheyyar.com/images/pdf/ematerials/biochemistry/researchmethodology1.pdf?utm

III B.Sc Biochemistry
SIXTH SEMESTER
Core Course X
Course Title: CLINICAL BIOCHEMISTRY

Course Code	**2511633**	**Credits**	**04**
L:T:P:S	**4:1: 0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**100**

LEARNING OBJECTIVE: Upon completing the course, students will be able to develop an understanding of the clinical aspects of metabolic disorders such as diabetes, phenylketonuria, and cystinuria, along with the associated biochemical changes. They will also gain knowledge of diagnostic tests for liver and renal functions, and enzyme patterns used in clinical diagnostics, preparing them to interpret clinical data for diseases such as jaundice, atherosclerosis, and myocardial infarction. This will enhance their ability to assess and analyze metabolic and organ-specific dysfunctions in a clinical setting.

Course Outcome

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

CO NUMBER	CO Statement
CO1	Illustrate the pathophysiology and molecular basis of Diabetes mellitus and will be able to interpret the biochemical manifestation in galactosemia, fructosuria and glycogen storage disease.
CO2	Discuss the inherited disorders like cystinuria, phenylketonuria, albinism and gout.
CO3	Explain the pathophysiology and differential diagnosis of jaundice.
CO4	Relate the clinical significance of GFT's and KFT's in the assessment of gastric function.
CO5	Demonstrate the diagnostic importance of serum enzymes and Isozymes in various disorders.

Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcome:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	1	2	1	1	2	1	3	1
CO2	3	2	2	1	2	1	1	2	1	3	1
CO3	3	2	2	1	2	1	1	2	1	3	1
CO4	3	2	2	1	2	1	1	2	1	3	1
CO5	3	2	2	1	2	1	1	2	1	3	1

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

MODULE NO.	CONTENTS OF MODULE	HRS	COS
I	**Blood glucose homeostasis:** Blood glucose relation, hypo and hyperglycemia. Diabetes mellitus- types, clinical features and metabolic changes. Glycosuria, galactosemia and fructosuria. Glycogen storage diseases.	**10**	**CO1**
II	**Inborn errors of metabolism:** Etiology and clinical manifestation of phenylketonuria, Cystinuria, Albinism, Maple Syrup Urine diseases, Hypo and hyperuricemia, Gout. Clinical features of atherosclerosis.	**15**	**CO2**
III	**Liver Function Tests**-Jaundice-types-hemolytic, hepatic and obstructive. Differential diagnosis of Jaundice. Test based on excretory function (BSP), Test based on bile pigment metabolism.	**10**	**CO3**
IV	**Renal Function Tests-** Clearance tests-Urea, Creatinine, Inulin, PAH test, Concentration and dilution tests. Gastric Function Tests Collectionof gastric contents, examination of gastric residium, FTM, stimulation tests, Tubeless gastric analysis.	**15**	**CO4**
V	**Clinical Enzymology**- Definition of functional and non-functional plasma enzymes. Isozymes and diagnostic tests, enzyme patterns in liver damage, bone disorders, Myocardial infarction.	**15**	**CO5**

RECOMMENDED BOOKS

1.T.M.Devlin. (2006). *Textbook of Biochemistry with Clinical Correlations.* CBS Publishers and Distributers - ISBN 10: 0471513482 / ISBN 13: 9780471513483

2.Gupta, P. P. (2013). Textbook of Biochemistry with Biomedical significance (2nd ed.). CBS Publishers and distributors - ISBN 10: 8123922450 / ISBN 13: 9788123922454

3.U.Chakrapani, U. (2013). *Biochemistry (with Clinical Concepts and Case Approach)* (7th ed.). Elsevier Publishers - ISBN: 9788131237137 8131237133

REFERENCE BOOKS

1.M.N.Chatterjea. (2011). *Textbook of Medical Biochemistry* . Jaypee Brothers.Medical Publishers (P)Ltd - ISBN-13: 978-9350254844, ISBN-10: 9789350254844

2.T.M.Devlin. (2006). *Textbook of Biochemistry with Clinical Correlations.* CBS Publishers and Distributers - ISBN 10: 0471513482 / ISBN 13: 9780471513483

3.Ayling, M. &. (2014). *Clinical Biochemistry* (3rd ed.). Metabolic and Clinical Aspects - ISBN 10: 0702051403 / ISBN 13: 9780702051401

WEB LINKS

1. https://www.verywellhealth.com/hypoglycemia-vs-hyperglycemia-5179943?utm
2. https://www.ncbi.nlm.nih.gov/books/NBK557773/?utm
3. https://www.mayoclinic.org/diseases-conditions/arteriosclerosis-atherosclerosis/symptoms-causes/syc-20350569?utm
4. https://www.uptodate.com/contents/hypouricemia-causes-and-clinical-significance

III B.Sc Biochemistry
SIXTH SEMESTER
Core Course XI
Course Title: IMMUNOLOGY

Course Code	**2511634**	**Credits**	**04**
L:T:P:S	**4:1:0 :0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**100**

LEARNING OBJECTIVE:

Upon completing the course, students will be able to understand the structure and functions of immune organs, immune cells, antigens, and antibodies, and gain insights into the mechanisms of immune responses including humoral and cell-mediated immunity. They will also learn diagnostic immunological techniques, vaccine types, and gain awareness of immune disorders such as hypersensitivity, autoimmune diseases, and transplantation immunology.

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

CO NUMBER	CO Statement
CO1	Explain the structure and function of the organs involved in our body's natural Defense
CO2	Classify antigens and antibodies on the basis of their properties
CO3	Explain the cooperation between the different lymphocytes in defending the Host
CO4	Examine the immunological tests and relate it to the immune status of an Individual
CO5	Illustrate the immune related diseases and mechanism of transplantation

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	2	2	2	2	2	3	2
CO2	3	2	2	2	2	2	2	2	2	3	2
CO3	3	2	2	2	2	2	2	2	2	3	2
CO4	3	2	2	2	2	2	2	2	2	3	2
CO5	3	2	2	2	2	2	2	2	2	3	2

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

MODULE NO.	CONTENT OF MODULE	HRS	COS
I	**Cells and Organs of Immune system:** Structure and function of primary lymphoid organs (thymus ,bone marrow), secondary lymphoid organs (spleen, lymph node), reticuloendothelial cells, phagocytosis.	**13**	**CO1**
II	**Antigens and Antibodies–** Nature, immunogens, haptens. Immunoglobulin types structure and function. Cells involved in antibody formation, differentiation of T and B lymphocyte, Clonal selection theory, co-operation of T-cell with B-cell. Monoclonal antibody – Production and application in biology.	**13**	**CO2**
III	**Immunity and its types**-Innate, Acquired, active and passive. Commonly used toxoid vaccines, killed vaccines, live attenuated vaccines, rDNA vaccines. Humoral and cell mediated immunity. Complement proteins-Definition, Classical pathway	**13**	**CO3**
IV	**Antigen-antibody reactions**: General features of Antigen Antibody reactions. Precipitation, Immuno diffusion, Oudin Procedure, Oakley Fulthrope Procedure, Radio immunodiffusion, Outerlony double diffusion, CIE, Rocket electrophoresis, Agglutination-Coomb's test Complement Fixation test-Wasserman's reaction, RIA, ELISA.	**13**	**CO4**
V	**Hypersensitivity** – Immediate (Type 1) and Delayed (Type IV), Auto-immune diseases with examples. Organ specific and systemic autoimmunity. SLE, RA. Transplantation – Types of Grafts, structure& functions of MHC, graft Vs host reaction, immunosuppressive Agents.	**13**	**CO5**

RECOMMENDED BOOKS:

1.Kuby, J. (2018). *Immunology(5th ed).* W.H. Freeman - ISBN-10 : 1319114709 / ISBN-13 : 978-1319114701

2.Roitt, I. (2017). *Immunology(13th ed).* Wiley Black Well - ISBN-10 : 1118415779 / ISBN-13 : 978-1118415771

3.AK, A. (2011). *Cellular and Molecular immunology.* Elsevier Health Sciences - ISBN 10: 0808921355 / ISBN 13: 9780808921356

REFERENCE BOOKS

1.Paniker. (2017). *Immunology* (10th ed.). University Press - ISBN 10: 1847558569 / ISBN 13: 9781847558565

2.Judy Owen, J. P. (2013). *Kuby Immunology.* International Edition W. H. Freeman - ISBN-10 : 1319114652, ISBN-13 : 978-1319114657

3.Rao, C. V. (2017). *Immunology* (3rd ed.). chennai: Alpha Science Int. Ltd - ISBN-10 : 1842652559 / ISBN-13 : 978-1842652558

WEB LINKS

1. https://www.youtube.com/watch?v=jXTW4F-8jd4
2. https://www.youtube.com/watch?v=lMIjCKKWask

III B.Sc., BIOCHEMISTRY

SIXTH SEMESTER

Core Practical -VII

Course Title: CLINICAL BIOCHEMISTRY

Course code	**2511636**	**Credits**	**02**
L: T:P:S	**0:0:5:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**50**

LEARNING OBJECTIVE:

Upon completing the course, students will be able to understand estimate biochemical parameters such as glucose, creatinine, urea, and cholesterol in samples using standardized methods. They will be able to determine the activity of clinically important enzymes, including AST (SGPT) and ALT (SGOT), and analyze urine samples qualitatively for normal and abnormal constituents. Students will also demonstrate the proper collection and preservation techniques for blood and urine samples, and interpret ABO blood grouping and Rh typing results.

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

CO1	Estimate biochemical parameters such as glucose, creatinine, urea and cholesterol in samples by standardized methods
CO2	Determine the activity of clinically important enzymes such as AST (SGPT) and ALT (SGOT)
CO3	Analyze urine sample qualitatively for normal and abnormal constituents
CO4	Demonstrate the collection and preservation of blood and urine samples
CO5	Interpret ABO blood grouping and Rh typing

Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcome:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	2	1	1	3	2	2	1
CO2	3	2	2	2	2	1	1	3	2	2	1
CO3	3	2	2	2	2	1	1	3	2	2	1
CO4	3	2	2	2	2	1	1	3	2	2	1
CO5	3	2	2	2	2	1	1	3	2	2	1

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

SL. NO.	CONTENTS OF MODULE	HRS	COS
1	Estimation of Glucose by Ortho Toluidine method (sugar profile)	5	CO1
2	Estimation of cholesterol by Zak's method (lipid profile)	5	CO1
3	Estimation of creatinine by Jaffe's method in serum & urine (renal profile)	5	CO1
4	Estimation of urea by diacetyl monoxime method in serum & urine (renal profile)	5	CO1
5	Assay of Serum SGOT/CK (cardio profile)	5	CO2
6	Assay of serum SGPT (liver profile)	5	CO2
7	Qualitative analysis of urine for Normal constituents (Chloride, sulphate, phosphate, Urea, Creatinine and Calcium)	5	CO3
8	Qualitative analysis of urine for Abnormal constituents: Glucose, fructose, Protein, Ketone bodies, calcium, Amino acids (Tryptophan, and cysteine)	5	CO3
Demonstration Experiments			
9	Collection and preservation of blood and urine sample	5	CO4
10	ABO Blood grouping and Rh factor typing by agglutination technique	5	CO5

RECOMMENDED BOOKS

1. Jayaraman, J. (2011). *Laboratory Manual in Biochemistry.* New Age International Pvt Ltd Publishers - ISBN-10 : 812243049X, ISBN-13 : 978-8122430493
2. Singh, S. K. (2005). *Introductory Practical Biochemistry* (2nd ed.). Alpha Science International, Ltd - ISBN 10: 8173193029 / ISBN 13: 9788173193026
3. Gowenlock, A. H. (1988). *Varley's Practical Clinical Biochemistry* (6th ed.). CBS Publishers and distributors, India - ISBN : 0849301564

REFERENCE BOOKS

1. Immunology: Overview and Laboratory Manual TobiliSam-Yellowe, Springer,1st edition, 2020
2. Laboratory Manual on Immunology and Molecular biology- Deepak Diwedi and Vinod – Lambert Academic Publishing, 2013

WEB LINKS

1.https://www.zmchdahod.org/pdf/college/Normal_Urine_Analysis-22-11-20018.pdf
2. https://www.youtube.com/watch?app=desktop&v=y4mMP8rmp3M&t=554s
3. .https://youtu.be/mWAEIvu1mV8
4. https://youtu.be/3MBiDfAkQhc
5. https://youtu.be/DyGIvs9zrVA

III BSC BIOCHEMISTRY
SIXTH SEMESTER

Discipline Specific Elective III -Employability Course III (A)

Course Title: PRINCIPLES OF BIOTECHNOLOGY

Course code	**2511635(A)**	**Credits**	**03**
L:T:P:S	**5:0:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**50**

LEARNING OBJECTIVE:

Upon completing the course, students will be able to understand the principles and applications of biotechnology, including recombinant DNA technology, cloning vectors, and screening methods. They will gain knowledge of gene transfer techniques in animals and plants, transgenic technologies, PCR, and therapeutic approaches like gene and antisense therapy, with emphasis on real-world applications such as insulin production.

Employability Opportunities: Biotechnology professionals are in demand in pharmaceuticals, agriculture, healthcare, and environmental sectors. Careers include research scientist, quality control analyst, and biotech product manager. Key skills include molecular biology, genetic engineering, and bioprocessing.

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

CO1	To Discuss the basic requirements and tools employed in genetic engineering process
CO2	Demonstrate the basic and recent techniques applied in the field of Recombinant DNA technology
CO3	Apply the basic rDNA technique to produce transgenic animal, discuss gene transfer methods, their application in pharmaceutical industry, cloning and its importance
CO4	Design experiments on plants using rDNA techniques
CO5	Handle the equipments employed in DNA amplification, describe about gene therapy and antisense RNA therapy

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	2	1	1	2	2	3	1
CO2	3	2	2	2	2	1	1	2	2	3	1
CO3	3	2	2	2	2	1	1	2	2	3	1
CO4	3	2	2	2	2	1	1	2	2	3	1
CO5	3	2	2	2	2	1	1	2	2	3	1

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

MODULE NO.	CONTENT OF MODULE	HRS	COS
I	**Biotechnology** – Introduction, Scope, definition, History and application–Brief history of recombinant technology- Restriction endonuclease- DNA cutting enzymes, DNA ligase- DNA joining enzyme, alkaline phosphatase, DNA modifying enzymes.	**10**	**CO1**
II	**Vectors**- the cloning vehicles – plasmids, bacteriophages, cosmids, artificial chromosome vectors, shuttle vectors, preparation of r-DNA, insertion of r-DNA into vector, methods of transfer, selection of recombinants and screening- genetic methods, chemical methods, South- Western screening, Nucleic acid hybridization methods, radio-active and non-radioactive labeling of probes.	**10**	**CO2**
III	**Animal Biotechnology** – animal call culture, tissue culture- gene transfer methods in animals- transfection microinjection, electroporation, cell viability, cell transformation- transgenic animals- applications.	**10**	**CO3**
IV	**Plant Biotechnology**: Agrobacterium- mediated gene transfer to plant cells, microprojectiles, transgenic plant technology- for pest resistance, herbicide tolerance, delay of fruit ripening and use of plants to produce commercially important proteins.	**10**	**CO4**
V	**PCR** – types and applications. Gene therapy, antisense therapy- production of insulin in E.coli.	**10**	**CO5**

RECOMMENDED BOOKS:

1.U.Sathyanarayana. (n.d.). *Biotechnology* –ISBN-10 : 8187134909 / ISBN-13 : 978-8187134909
2.T.A, B. (2016). *Gene cloning and DNA analysis.*Wiley Blackwell - ISBN 10: 1119072573 / ISBN 13: 9781119072577
3.Primrose, O. a. (2003). *Principles of gene manipulation* . Business service 2003- *ISBN-10 : 1405135441 / ISBN-13 : 978-1405135443*

REFERENCE BOOKS

1.Dubey, R. (2014). *A Textbook of Biotechnology* . S. Chand - ISBN 10: 8121926084 / ISBN 13: 9788121926089
2.H.K.Das. (2010). Textbook of Biotechnology. Willey -ISBN: 9788126564040
3.Loroch, R. R. (2016). *Biotechnology for Beginners.* Academic Press - ISBN: 9780128012246

WEB LINKS

1. https://youtu.be/Ll_7z4YS2Ak
2. https://youtu.be/vnmrSTJHiww
3. https://youtu.be/L7qnY_GqytM

III BSC BIOCHEMISTRY
SIXTH SEMESTER

Discipline Specific Elective III -Employability Course III (B)

Course Title: NUTRACEUTICALS

Course Code	**2511635(B)**	**Credits**	**03**
L:T:P:S	**4:0:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**50**

LEARNING OBJECTIVE:

Upon completing the course, students will be able to explain the classification and role of nutraceuticals in health and disease prevention, analyze the biochemical properties and functional benefits of bioactive compounds, evaluate their applications in cardiovascular health, diabetes, cancer, gut health, and immunity, and apply regulatory guidelines to ensure safety and compliance in nutraceutical development.

Employability Opportunities

1. Nutraceutical Product Developer
2. Quality Control Analyst in nutraceutical manufacturing.
3. Regulatory Affairs Specialist for compliance with FDA/FSSAI/EFSA guidelines.
4. Sales and Marketing Executive for nutraceutical brands.
5. Entrepreneur in functional foods, dietary supplements, or personalized nutrition.

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

CO1	Explain the importance of Nutraceuticals
CO2	Illustrate the Biochemical and Functional Aspects of Nutraceuticals
CO3	Identify the Role of Nutraceuticals in Disease Prevention
CO4	Outline the importance of nutraceuticals in gut and immune health
CO5	Infer the guidelines on nutraceuticals,

Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcome:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	2	1	1	2	2	3	1
CO2	3	2	2	2	2	1	1	2	2	3	1
CO3	3	2	2	2	2	1	1	2	2	3	1
CO4	3	2	2	2	2	1	1	2	2	3	1
CO5	3	2	2	2	2	1	1	2	2	3	1

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

MODULE NO.	CONTENTS OF MODULE	HRS	COS
I	**Introduction to Nutraceuticals** Definition and scope of nutraceuticals, Classification: Functional foods, Dietary supplements, Probiotics, Prebiotics, Role of nutraceuticals in health and disease prevention	10	CO1
II	**Biochemical and Functional Aspects of Nutraceuticals** Bioactive compounds in nutraceuticals: Polyphenols, Flavonoids, Carotenoids, Omega-3 fatty acids structure and their pharmacological properties.	10	CO2
III	**Role of Nutraceuticals in Disease Prevention** Role of omega-3 fatty acids and plant sterols in cardiovascular health; Role of dietary fiber and Polyphenols in Diabetes management; Role of Morin, fisetin, capsaicin in cancer prevention	10	CO3
IV	**Nutraceuticals in Gut and Immune Health** Gut microbiota and its role in overall health, Probiotics and prebiotics: Mechanisms and health benefits, Immunomodulatory nutraceuticals: Beta-glucans, Polyphenols, Vitamin D	10	CO4
V	**Safety, Regulations, and Future Trends** Regulatory aspects: FDA, FSSAI, EFSA guidelines on nutraceuticals, Toxicity and adverse effects of nutraceuticals, Current trends in nutraceutical research and personalized nutrition	10	CO5

RECOMMENDED BOOKS

1. Dr. Laxmikant R. Zawar, Dr. Prashant L. Pingale, et al., A Textbook of Dietary Supplements and Nutraceuticals, 2023, Everest Publishing House
2. Dr.Syed Mujtaba Ahmed, Text book of Nutraceuticals and Dietary Supplements, 2024
3. Ms. Megha Tiwari and Prof. (Dr.) Vishal Dubey , Dietary Supplements And Nutraceuticals, 2022

REFERENCE BOOKS

1. Sudhakar Kommu, Thirumurugan r, et al. Textbook of Nutraceuticals and functional foods : theory and applications 2024
2. Prof. (Dr.) Arun Mittal,Text book of dietary supplements and nutraceuticals, 2023
3. Mithun Rudrapal and Soumya Bhattacharya, Dietary Supplements and Nutraceuticals: Nutritional Requirements and Health Benefits, 2023

WEB LINKS

1. https://www.sciencedirect.com/topics/food-science/nutraceutical
2. https://pmc.ncbi.nlm.nih.gov/articles/PMC7056471/

III BSC BIOCHEMISTRY
SIXTH SEMESTER

Discipline Specific Elective III -Employability Course III (C)

Course Title: BIOINFORMATICS

Course code	**2511635(C)**	**Credits**	**03**
L:T:P:S	**3:0:1:0**	**CIA Marks**	**40**
Exam Hours	**03**	**ESE Marks**	**100**

LEARNING OBJECTIVE: Upon completing the course, students will be able to gain a comprehensive understanding of bioinformatics, biological databases, and genome-related concepts like metabolome and transcriptome. They will learn sequence alignment methods, genome comparison tools, molecular visualization techniques, and the basics of nutrigenomics and their applications in biological research and health.

Employability Opportunities: Bioinformatics offers strong employability in healthcare, pharma, research, and agri-tech sectors. Roles include bioinformatics scientist, data analyst, and software developer. Skills in genomics, AI, and data science are highly valued across industries.

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

CO NUMBER	CO Statement
CO1	Introduce the fundamentals of Bioinformatics and its applications explain the components of Bioinformatics Genome, metabolome & Transcriptome.
CO2	Discuss the concepts of sequence alignment and its types. Understand the tool used to detect the expression of genes.
CO3	Develop algorithms for interpreting biological data.
CO4	Classify biological database and to correlate the different file formats used by nucleic acid, protein database, structural and metabolic database.
CO5	Apply the various tools employed in genomic study and protein visualization. Analyse the entire genome by shot gun method.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	2	2	2	2	3	3	2
CO2	3	2	2	2	2	2	2	2	3	3	2
CO3	3	2	2	2	2	2	2	2	3	3	2
CO4	3	2	2	2	2	2	2	2	3	3	2
CO5	3	2	2	2	2	2	2	2	3	3	2

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

MODULE NO.	CONTENT OF MODULE	HRS	COS
I	**Introduction to Bioinformatics** – Bioinformatics and its applications. – Genome, Metabolome-Definition, and its applications. Metabolome-Metabolome database-E.Coli metabolome database, Human Metabolome database. Transcriptome-Definition and any three applications.	**10**	**CO1**
II	**Biological Databases** - definition, types and examples –, Nucleotide sequence database (NCBI, EMBL, Genebank, DDBJ) Protein sequence database- Swiss Prot, TrEMBL, Structural Database-PDB, Metabolic database-KEGG	**10**	**CO2**
III	**Sequence Alignment**-Local and Global alignment-Dot matrix analysis, PAM, BLOSUM. Dynamic Programming, Needleman- Wunch algorithm, Smith waterman algorithm	**10**	**CO3**
IV	**Heuristic methods of sequence alignment**-BLAST-features, types (BLASTP, BLASTN, BLASTX), PSI BLAST, result format. DNA Microarray-Procedure and applications.	**10**	**CO4**
V	**Structural genomics**-Whole genome sequencing (Shotgun approach), Comparative genomics-tools for genome comparison, VISTA servers and precomputed tools. Molecular visualization tools. Rasmol, Swiss PDB viewer. Nutrigenomics- Definition.	**10**	**CO5**

RECOMMENDED BOOKS:

1. Mount, D. w. (2004). *Bioinformatics sequence and Genome Analysis.* Cold Spring - ISBN 10: 0879697121 / ISBN 13: 9780879697129
2. S. G. Rastogi, N. (2013). *BI Mtds and Applications.* PHI learnings -
3. Ignacimuthu, S. (2013). *Basic Bioinformatics.* Alpha Science Int. Ltd - ISBN-10 : 1842658042 / ISBN-13 : 978-1842658048

REFERENCE BOOKS

1. Lesk, A. (2014). *Introduction of Bioinformatics.* Oxford University Press - ISBN 10: 0198724675 / ISBN 13: 9780198724674
2. Ramsden, J. (2015). *Bioinformatics-An Introduction.* Springer - ISBN 978-1-4471-6702-0
3. Andreas D. Baxevanis, G. D. (2020). *Bioinformatics.* Wiley - ISBN 10: 0471478784 / ISBN 13: 9780471478782

WEB LINKS

1. https://archive.nptel.ac.in/courses/102/106/102106070
2. https://onlinecourses.swayam2.ac.in/cec21_bt04/preview
3. https://onlinecourses.nptel.ac.in/noc25_bt06/preview

APPENDIX

OUTCOME-BASED EDUCATION (OBE)

Outcome-Based Education (OBE) is a student-centric teaching and learning methodology in which the course delivery, assessment are planned to achieve stated objectives and outcomes. It focuses on measuring student performance i.e. outcomes at different levels.

Outcome-based education (OBE) is an educational theory that bases each part of an educational system around goals (outcomes). By the end of the educational experience each student should have achieved the goal. There is no specified style of teaching or assessment in OBE; instead classes, opportunities, and assessments should all help students achieve the specified outcomes.

There are three educational Outcomes as defined by the National Board of Accreditation.

Program Educational Objectives (PEOs)

The Programme Educational Objectives of a program are the statements that describe the expected achievements of graduates in their career, and also in particular, what the graduates are expected to perform and achieve during the first few years after graduation.

Programme Outcomes (POs)

Program outcomes are finer statements that designate what students are expected to be able to do by the time of graduation. POs are expected to be aligned closely with Graduate Attributes.

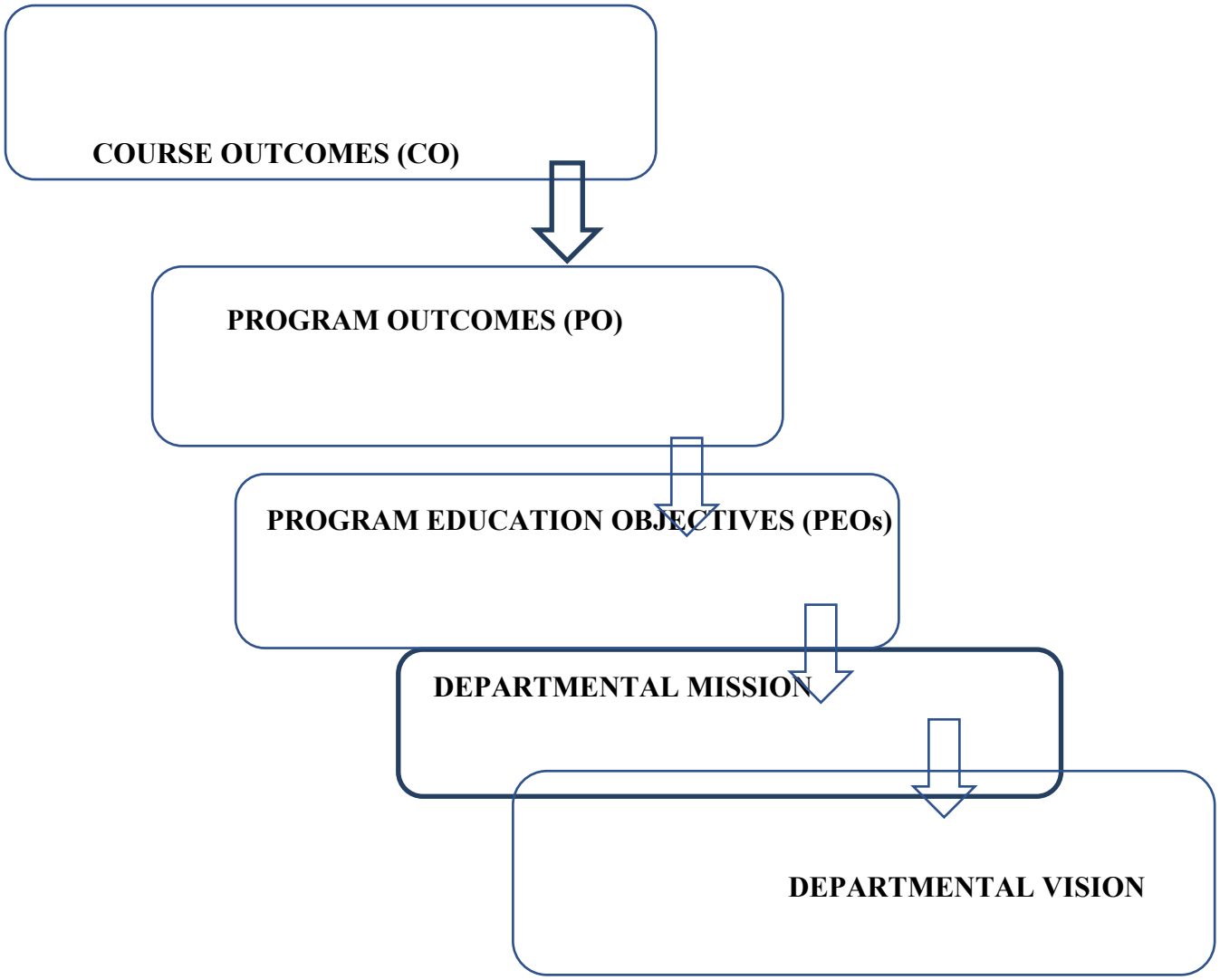
Programme Specific Outcomes (PSO)

Programme Specific Outcomes are what the students should be able to do at the time of graduation with reference to a specific discipline.

Course Outcome (CO)

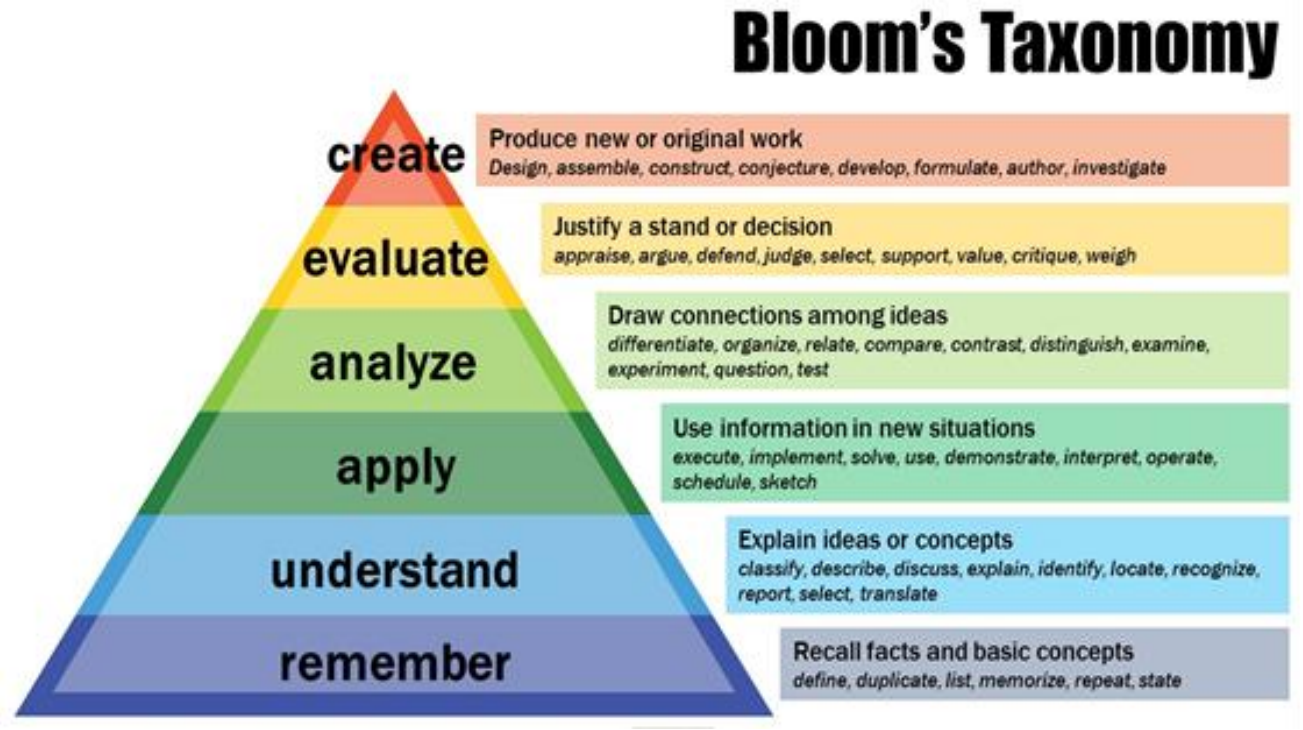
Course outcomes are statements that describe significant and essential learning that learners have achieved, and can reliably demonstrate at the end of a course.

MAPPING OF OUTCOMES



BLOOM'S TAXONOMY

Bloom's taxonomy is a classification system used to define and distinguish different levels of human cognition—i.e., thinking, learning, and understanding. Educators have typically used Bloom's taxonomy to inform or guide the development of assessments (tests and other evaluations of student learning), curriculum (units, lessons, projects, and other learning activities), and instructional methods such as questioning strategies. [eduglosarry.org]



Knowledge levels for assessment of Outcomes based on Blooms Taxonomy

Level	Parameter	Description
K1	Knowledge	It is the ability to remember the previously learned material/information
K2	Comprehension	It is the ability to grasp the meaning of material
K3	Application	It is the ability to use learned material in new and concrete situations
K4	Analysis	It is the ability to break down material/concept into its component parts/subsections so that its organizational structure may be understood
K5	Synthesis	It is the ability to put parts/subsections together to form a new whole material/idea/concept/information
K6	Evaluation	It is the ability to judge the value of material/concept/statement/creative material /research report) for a given purpose