PERIYAR UNIVERSITY

SALEM – 636 011

DEGREE OF BACHELOR OF SCIENCE

CHOICE BASED CREDIT SYSTEM

B.Sc., BIOCHEMISTRY

OBE REGULATIONS AND SYLLABUS

(SEMESTER PATTERN)

(For Candidates admitted in the Colleges affiliated to Periyar University from 2023-2024 onwards)

INDEX

THE REGULATIONS ON LEARNING OUTCOMES BASED CURRICULUM FRAME WORK FOR UNDERGRADUATE EDUCATION

1. Preamble

Biochemistry is the cross over scientific discipline that integrates the living world and chemistry. It involves the study of the structure of biomolecules and explores the biological processes at molecular level in the living organisms. It is the laboratory science that has several domains like cell biology, molecular biology, clinical biology, enzymology, immunology, physiology, pharmacology etc., It has enlightened many aspects of health and diseases and paved the way for many interdisciplinary technological innovations like metabolomics, genomics and proteomics. There is a continuous demand for biochemists in public and private health care sectors, agriculture, medical and forensic departments. Almost all food, pharmaceuticals, health and beauty care etc required quality control and safety checks for which experts in the field of Biochemistry are always in need. The syllabi for the three year B.Sc., degree programme in Biochemistry was framed in such a way that at the end of the course they could apply the knowledge and expertise in industries, diagnostic laboratories and various research fields

The programme endeavors to provide students a broad based training in biochemistry with a solid background of basic concepts as well as exposing them to the exciting advancements in the field. In addition to theoretical knowledge, significant emphasis has been given to provide hands on experience to the students in the forefront areas of experimental biochemistry. A multidisciplinary approach has been employed to provide the best leverage to students to enable them to move into frontier areas of biological research in the future.

The course defines clearly the objectives and the learning outcomes, enabling students to choose the elective subjects for broadening their skills. The course also offers skills to pursue research in the field of Biological Chemistry and thus would produce best minds to meet the demands of society.

Biochemistry, today is considered as an application oriented integrated basic science. It's an interdisciplinary science that has emerged by the confluence of principles of Chemistry, Physics and Mathematics to Biology. Advances in Biochemistry have immense positive implications on the understanding of biochemical interactions, cellular communications, hormonal mechanisms and the cross talks between them. The research in Biochemistry has been translational and there is a shift from hypothesis driven research to data dependent research that promises translational, product oriented research. Much of the advancement in Biochemistry is in the advancement of Biotechnology, as a basic science discipline Biochemistry lead to Biotechnological advancement. Considering its pivotal role in biological sciences, it is imperative to strengthen the fundamental concepts of Biochemistry.

TANSCHE REGULATIONS ON LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR UNDERGRADUATE EDUCATION	
Duration:	**3 years [UG]**
Programme Outcomes:	**PO1: Disciplinary knowledge:** Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate Programme 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:** Capability to apply analytic thought to a body of knowledge; analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge Development. **PO4: Problem solving: Capacity** to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; And apply one's learning to real life situations. **PO5: Analytical reasoning**: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples, and Addressing opposing viewpoints. **PO6: Research-related skills**: A sense of inquiry and capability for asking relevant/appropriate questions, problem arising, synthesizing and

	articulating; Ability to recognize cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyse, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation **PO7: Cooperation/Team work:** Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team **PO8: Scientific reasoning**: Ability to analyse, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective. **PO9: Reflective thinking**: Critical sensibility to lived experiences, with self-awareness and reflexivity of both self and society. **PO10 Information/digital literacy:** Capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources; and use appropriate software for analysis of data. **PO 11 Self-directed learning**: Ability to work independently, identify appropriate resources required for a project, and manage a project through to completion. **PO 12 Multicultural competence:** Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups. **PO 13: Moral and ethical awareness/reasoning**: Ability to embrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Capable of demonstrating the ability to identify ethical issues related to one's work, avoid unethical behavior

	Such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights; appreciating environmental and sustainability issues; and adopting objective, unbiased and truthful actions in all aspects of work. **PO 14: Leadership readiness/qualities:** Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way. **PO 15: Lifelong learning:** Ability to acquire knowledge and skills, including „learning how to learn", that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.
Programme Specific Outcomes:	**PSO1 – Placement:** To prepare the students who will demonstrate respectful engagement with others' ideas, behaviors, and beliefs and apply diverse frames of reference to decisions and actions. **PSO 2 - Entrepreneur:** To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations **PSO3 – Research and Development:** Design and implement HR systems and practices grounded in research that complies with employment laws, leading the organization towards growth and development.

	PSO4 – Contribution to Business World: To produce employable, ethical and innovative professionals to sustain in the dynamic business world. **PSO 5 – Contribution to the Society:** To contribute to the development of the society by collaborating with stakeholders for mutual benefit

PROGRAM OUTCOME FOR B. Sc., BIOCHEMISTRY COURSE

Programme:	**B.Sc., Biochemistry**
Programme Code:	**B.Sc., BIC**

PO1	Acquire knowledge in Biochemistry and apply the knowledge in their day today life for betterment of self and society
PO2	Develop critical ,analytical thinking and problem solving skills
PO3	Develop research related skills in defining the problem, formulate and test the hypothesis, analyses, interpret and draw conclusion from data
PO4	Address and develop solutions for societal and environmental needs of local, regional and national development
PO5	Work independently and engage in lifelong learning and enduring proficient progress
PO6	Provoke employability and entrepreneurship among students along with ethics and communication skills

PROGRAM SPECIFIC OUTCOMES

PSO1	Comprehend the knowledge in the biochemical, analytical, bio statistical and computational areas
PSO2	Ability to understand the technical aspects of existing technologies that help in addressing the biological and medical challenges faced by human kind
PSO3	Acquiring analytical and hands on skills to perform research in multidisciplinary environments
PSO4	Use library search tools and online databases and sources to locate and retrieve scientific information about a topic and techniques related to biochemistry

2. Eligibility for admission

Candidate for admission to the first year of B.Sc., Degree Course in Biochemistry shall be required to have passed the Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry.

3. Highlights of the Revamped Curriculum

- The curriculum is created to improve the relationship between business and academia
- Every semester, practical based on the course taken that semester will aid students in applying what they have learned
- Students will benefit from the introduction of skill based elective courses including Bioinformatics, Nanobiotechnology, Therapeutic nutrition, and Medical Laboratory technology as they keep up with technological advancements in their fields of study
- The fourth semester internship will give students a chance to apply what they have learned in class to a real world working experiment
- Skill enhancement courses help students venture new platforms in career.
- Equip students with employability skills; generate self-employment and small scale entrepreneurs.

4. Value additions in the Revamped Curriculum:

Semester	Newly introduced Components	Outcome / Benefits
I	**Foundation Course** It depicts the overview of entry education and makes the students assimilate with the Biochemistry course. This course will inculcate knowledge of the academic skills, laboratory skills and research	It gives a strong determination to undergo the Course. Be committed and interested in learning the subject
I, II, III, IV	**Skill Enhancement papers (Discipline centric / Generic / Entrepreneurial)**	Improve employability Develop the skill as Laboratory Analyst To make students compete with industrial expectations.
		Incorporating the interest on health, diet, lifestyle diseases will enable the students gain knowledge to get exposed themselves in medical field
		Biomedical Instrumentation skills will aid the students gain knowledge on the various instruments Used in the field of medical laboratory and research.
		Entrepreneurial skill training will increase the Chance to build their career independently. Learning this skills will encourage the students to enhance

		creativity, innovation and collaboration
		Discipline /subject specific skill will serve as a route for employability
V & VI	**Elective papers-** An open choice of topics categorized under Generic and Discipline Centric	It reinforces additional knowledge inputs along With core course. Students are familiarized with multi-disciplinary, cross disciplinary and inter Disciplinary subjects. It broadens the knowledge on immunological Aspects, pharmacology and research. Additional Employability skills are facilitated through computational biology and Bioentrepreneurship.
V semester Vacation activity	**Internship/ Industrial visit/Field visit**	Hand on training in Medical Labs/ Industry/ Research centre enable the students to explore the Practical aspects in career path. They gain confident To fix their career.
VI Semester	**Project with Viva – voce**	Self-learning is enhanced. It serves as a platform to express their innovative ideas in a practical way, which serves as a pathway to enter in the field of research.
VI Semester	**Introduction of Professional Competency skill**	The revamped curriculum caters the education to all category of learners; Learning multidisciplinary papers, updated in the curriculum will help the students to fix their career in the fields of Medical, pharmaceutical, forensic, nutritional, diagnostic coding, etc. Students are trained in the field of research to bring out the progress in the field of Medical, Agriculture

		,Nutrition ,etc. which will be a back bone for health and wealth creation and improve the quality of life
Extra Credits: **For Advanced Learners / Honors degree**		To cater to the needs of peer learners / research aspirants
Skills acquired from the Courses		Analytical, Laboratory operating, Predicting, Experimenting, Critical thinking, Problem solving, Communication, Interpersonal, Time management and Multi-tasking Skills

5. Methods of Evaluation and Assessment

Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	**100 Marks**
Methods of Assessment		
Recall(K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
Understand/ Comprehend(K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
Analyze(K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate	
	Between various ideas, Map knowledge	
Evaluate(K5)	Longer essay/Evaluation essay, Critique or justify with pros and cons	
Create(K6)	Checkknowledgeinspecificoroffbeatsituations,Discussion,Debatingor Presentations	

6. Suggestive Topics in Core Component

- Nutritional Biochemistry
- Cell Biology
- Biomolecules
- Biochemical Techniques
- Enzymes
- Intermediary Metabolism
- Clinical Biochemistry
- Molecular Biology
- Human Physiology
- Plant Biochemistry and Plant Therapeutics

7. Suggestive Elective Courses (Discipline-centric)

- Immunology
- Biochemical Pharmacology
- Research methodology
- Bioentrepreneurship
- Bioinformatics
- Biotechnology

8. Suggestive Topics in Skill Enhancement Courses (SEC)

- Biomedical Instrumentation
- First Aid
- Basics of forensic science
- Medical Laboratory technology
- Tissue culture
- Medical coding
- Microbial techniques

9. Suggestive Topics in Non – Major Elective Courses (NME) (offered to other Departments)

- Health and Nutrition
- Lifestyle Diseases
- Medicinal Diet

10. Curriculum Design for UG Programme in Biochemistry

First Year: Semester-I

Part	Course Code	Title of Course	Contact Hr./ Week	Credit	Int. Mark	Ext. Mark	Total Mark
I		Language - I	6	3	25	75	100
II		English - I	6	3	25	75	100
III	23UBCCT01	Core - I – Nutritional Biochemistry	5	5	25	75	100
	23UBCCP01	Core Practical – I Nutritional Biochemistry	5	5	40	60	100
		Allied Chemistry – I	2	2	25	75	100
		Allied Chemistry Practical - I	2	1	40	60	100
IV	23UBCFC01	**Skill Enhancement Course -I** Foundation Course Fundamentals of Biochemistry	2	2	25	75	100
		Skill Enhancement Course - **Non Major Elective Course - I** (NME- I) **Note: Choose any one NME course from other Department**	2	2	25	75	100
			30	**23**			**800**

First Year: Semester-II

Part	Course Code	Title of Course	Contact Hr./ Week	Credit	Int. Mark	Ext. Mark	Total Mark
I		Language – II	6	3	25	75	100
II		English-II	4	3	25	75	100
II	NMSDC	Language Proficiency for employability- Overview of English Communication	2	2	25	75	100
III	23UBCCT02	Core – II – Cell Biology	5	5	25	75	100
	23UBCCP02	Core Practical – II – Cell Biology	5	5	40	60	100
		Allied Chemistry – II	2	2	25	75	100
		Allied Chemistry Practical – II	2	1	40	60	100
IV		Skill Enhancement Course **Non Major Elective Course - II** (NME – II) **Note: Choose any one NME course from other Department**	2	2	25	75	100
	23UBCSE02	**Skill Enhancement Course SEC-II** (Discipline Specific/Generic) First Aid	2	2	25	75	100
			30	**25**			**800**

Second Year: Semester – III

Part	Course Code	Title of Course	Contact Hr./ Week	Credit	Int. Mark	Ext. Mark	Total Mark
I		Language – III	6	3	25	75	100
II		English-III	6	3	25	75	100
III	23UBCCT03	Core – III Biomolecules	5	5	25	75	100
	23UBCCP03	Core Practical – III Biomolecules	5	5	40	60	100
		Allied Paper – III Biostatistics	4	3	25	75	100
IV	23UBCSE03	**Skill Enhancement Course SEC – IV** (Entrepreneurial Based) Medical Laboratory Technology	1	1	25	75	100
	NMSDC	**Digital Skills for Employability-Digital Skills**	**2**	**2**	**25**	**75**	**100**
		Environmental Studies	1	-	-	-	-
			30	**22**			**700**

Second Year: Semester – IV

Part	Course Code	Title of Course	Contact Hr./ Week	Credit	Int. Mark	Ext. Mark	Total Mark
I		Language – IV	6	3	25	75	100
II		English-IV	6	3	25	75	100
III	23UBCCT03	Core – IV Biochemical Techniques	5	5	25	75	100
	23UBCCP03	Core Practical – IV Biochemical Techniques	5	5	40	60	100
		Allied Paper – IV Fundamentals of Microbiology	2	2	25	75	100
		Allied Practical – IV Microbiology	1	1	40	60	100
IV	23UBCSE05	**Skill Enhancement Course SEC – VI** (Discipline Specific/Generic) Medical Coding	2	2	25	75	100
	23UBCSE06	**Skill Enhancement Course SEC –VII** (Discipline Specific/Generic) Tissue culture	2	2	25	75	100
		Environmental Studies	1	2	25	75	100
			30	**25**			**900**

Third Year: Semester-V

Part	Course Code	Title of Course	Contact Hr./ Week	Credit	Int. Mark	Ext. Mark	Total Mark
III	23UBCCT05	Core – V – Enzymes	5	4	25	75	100
	23UBCCT06	Core VI – Intermediary Metabolism	5	4	25	75	100
	23UBCCT07	Core VII - Clinical Biochemistry	5	4	25	75	100
		Elective Paper – I (Discipline Specific/Generic)	4	3	25	75	100
		Elective Paper – II (Discipline Specific/Generic)	4	3	25	75	100
	23UBCME01 23UBCME02 23UBCME03	Immunology Biochemical Pharmacology Research Methodology **(Note: Choose any TWO Elective papers)**					
	23UBCCP05	Core Practical - V Clinical Biochemistry	5	4	40	60	100
IV		Value Education	2	2	25	75	100
	23UBCIT1	Internship / Industrial Training (Summer vacation at the end of IV semester activity)		2			
			30	**26**			**700**

Third Year: Semester-VI

Part	Course Code	Title of Course	Contact Hr./ Week	Credit	Int. Mark	Ext. Mark	Total Mark
III	23UBCCT08	Core – VIII Molecular Biology	5	3	25	75	100
	23UBCCT09	Core IX Human Physiology	5	3	25	75	100
	23UBCCT10	Core X Plant Biochemistry and Plant Therapeutics	6	4	25	75	100
		Elective Paper –III Discipline specific/Generic)	5	3	25	75	100
		Elective Paper –IV Discipline specific/Generic)	5	3	25	75	100
	23UBCME04 23UBCME05 23UBCME06	Biotechnology Bioinformatics Bioentrepreneurship **(Note: Choose any TWO Elective paper)**					
	23UBCPR01	Core Project (Group)	2	2	40	60	100
IV		Professional Competency skill Enhancement Course -	2	2	25	75	100
V		Extension Activity (Outside College Hours)	-	1			
			30	**21**			**700**

Total Credits: 140

7. Consolidated Semester wise and Component wise Credit distribution

Parts	Sem I	Sem II	Sem III	Sem IV	Sem V	Sem VI	Total Credits
Part- I	3	3	3	3	-	-	12
Part- II	3	3	3	3	-	-	12
Part- III	13	13	12	13	22	18	91
Part- IV	4	4	4	6	4	2	24
Part -V	-	-	-	-	-	1	1
Total	23	23	22	25	26	21	**140**

I YEAR: SEMESTER I

Course	**CORE THEORY - I**
Title of the Course	**NUTRITIONAL BIOCHEMISTRY**
Credit	**5**

Learning Objectives

The objectives of this course are to

- Create awareness about the role of nutrients in maintaining proper health
- Understand the nutritional significance of carbohydrates, lipids and proteins.
- Understand the importance of a balanced diet.
- Study the effect of additives, emulsifiers, and flavor enhancing substances in food.
- Study the significance of nutraceuticals.

Module I: Concepts of food and nutrition. Basic food groups-energy yielding, body building and functional foods. Modules of energy. Calorific and nutritive value of foods. Measurement of Calories by bomb calorimeter. Basal metabolic rate (BMR) - definition, determination of BMR and factors affecting BMR. Respiratory quotient (RQ) of nutrients and factors affecting the RQ. SDA-definition and determination- Anthropometric measurement and indices – Height, Weight, chest and waist circumference BMI. **12 Hrs**.

Module II: Physiological role and nutritional significance of carbohydrates, lipids and protein. Evaluation of proteins by nitrogen balance method- Biological value of proteins- Digestibility coefficient, Protein Energy Ratio and Net Protein Utilization. Protein energy malnutrition – Kwashiorkor and Marasmus, Obesity-Types and preventive measures. **12 Hrs.**

Module III: Balanced diet, example of low and high cost balanced diet- for infants, children, adolescents, adults and elderly people. ICMR classification of five food groups and its significance food pyramid. Junk foods- definition and its adverse effects. **12 Hrs.**

Module IV: Food additives: Structure, chemistry, function and application of preservatives, emulsifying agents, buffering agents, stabilizing agents, natural and artificial sweeteners, bleaching, starch modifiers, antimicrobials, food emulsions, fat replacers, viscosity agents, gelling agents and maturing agents. Food colors, flavors, anti-caking agent, antioxidants. Safety assessment of food additives. **12Hrs**

Module V: Nutraceuticals and Functional Foods: Definition, properties and function of Nutraceuticals, food Supplements, dietary supplements prebiotics and probiotics, and functional Foods. Food as medicine. Natural pigments from plants– carotenoids, anthocyanin and its benefits. **12 Hrs.**

Course Outcomes

CO	On completion of this course, students will be able to	Program Outcomes
CO1	Cognizance of basic food groups viz. Carbohydrates, proteins and lipids and their nutritional aspects as well as calorific value	PO1,PO5
CO2	Identify and explain nutrients in foods and the specific functions In maintaining health.	PO1
CO3	Classify the food groups and its significance	PO1,PO2
CO4	Understand the effect of food additives	PO1,PO2
CO5	Describe the importance of nutraceuticals and pigments	PO1,PO5,PO6

Text books

1. Gaile Moe, Danita Kelley, Jacqueline Berning and Carol Byrd-Bredbenner. 2013. Wardlaw's Perspectives in Nutrition: A Functional Approach. McGraw-Hill, Inc., NY, USA.

2. M. Swaminadhan (1995) Principles of Nutrition and Dietics. Bappco.

3. Tom Brody (1998). Nutritional Biochemistry (2nded), Academic press, USA

4. Garrow, JS, James WPT and Ralph A (2000). Human nutrition and dietetics (10thed)Churchill Livingstone.

5. Andreas M.Papas (1998). Antioxidant Status, Diet, Nutrition, and Health (1sted) CRC

Reference Books

1. Branen, A.L., Davidson PM & Salminen S. 2001. Food Additives.2nd Ed. Marcel Dekker.

2. Gerorge, A.B. 1996. Encyclopedia of Food and Color Additives. Vol. III. CRC Press.

3. Advances in food biochemistry, FatihYildiz (Editor), CRC Press, Boca Raton, USA, 2010

4. Food biochemistry & food processing, Y.H. Hui (Editor), Blackwell Publishing, Oxford, UK, 2006.

5. Geoffrey Campbell-Platt. 2009. Food Science and Technology. Wiley-Blackwell, UK.

Web resources

http://old.noise.ac.in/SecHmscicour/english/LESSON O3.pdf

https://study.com/academy/lesson/energy-yielding-nutrients-carbohydratesfat-protein.html.

https://www.nhsinform.scot/healthy-living/food-and-nutrition/eatingwell/vitamins-and-minerals

Mapping with Program Outcomes

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1	3				2		3	3	3	3
CO 2	3						3	3		3
CO 3	3	2					3	1		3
CO 4	3	2					3	3		3
CO5	3				2	2	3	3		3

S-Strong (3) M-Medium (2) L-Low (1)

I YEAR: SEMESTER -I

Course	**CORE PRACTICAL - I**
Title of the Course	**PRACTICAL 1- NUTRITIONAL BIOCHEMISTRY**
Credit	**5**

Learning objectives

The objectives of this course are to

- Impart hands-on training in the estimation of various constituents by titrimetric method
- Prepare Biochemical preparations
- Determine the ash content and extraction of lipid

TITRIMETRY 20 Hrs.

1. Estimation of ascorbic acid in a citrus fruit.
2. Estimation of calcium in milk.
3. Estimation of glucose by Benedict's method in honey.
4. Estimation of phosphorous (Plant source)

BIOCHEMICAL PREPARATIONS 15 Hrs.

Preparation of the following substances and its qualitative tests

5. Lecithin from egg yolk.
6. Starch from potato.
7. Casein and Lactalbumin from milk.

GROUP EXPERIMENT 10 Hrs.

8. Determination of ash content and moisture content in food sample
9. Extraction of lipid by Soxhlet's method.

Course Outcomes

CO	On completion of this course, students will be able to	Program Outcomes
CO1	Estimate the important biochemical constituents in the food samples.	PO1,PO3
CO2	Prepare the macronutrients from the rich sources.	PO1,PO3
CO3	Determine the ash and moisture content of the food samples	PO1,PO3
CO4	Extract oil from its sources	PO1,PO3,PO6

Text books

1. Laboratory manual in Biochemistry, J. Jayaraman, 2nd edition, New Age International Publishers, 2011,

2. An Introduction to Practical Biochemistry, David T. Plummer, 3 rd edition, Tata McGraw-Hill Publishing Company Limited, 2001.

Reference books

1. Biochemical Methods, Sadasivam S and Manickam A, 4th edition, New Age International Publishers, 2016

2. Essentials of Food and Nutrition, Vol. I & II, M.S. Swaminathan.

3. Bowman and Robert M. 2006. Present Knowledge in Nutrition. 9th edition, International Life Sciences Publishers.

4. Indrani TK. 2003. Nursing Manual of Nutrition and Therapeutic Diet, 1st edition Jaypee Brothers medical publishers.

5. Martha H. and Marie A. 2012. Biochemical, Physiological, and Molecular Aspects of Human Nutrition.3rd edition. Chand Publishers.

Web resources

1. https://www.elsevier.com/journals/clinical-biochemistry/0009-9120/guide-for-authors

2. http://rajswasthya.nic.in/RHSDP%20Training%20Modules/Lab.%20Tech/Biochemistry/Dr.%20Jagarti%20Jha/Techniques%20In%20Biochemistry%20Lab.pdf

3. https://dspace.cuni.cz/bitstream/handle/20.500.11956/111493/Clinical_biochemistrypdf.pdf?sequenCe=1&isAllowed=y

4. https://dspace.cuni.cz/bitstream/handle/20.500.11956/111493/Clinical_biochemistrypdf.pdf?sequenCe=1&isAllowed=y

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3		3				3	3	3	3
CO 2	3		3				3	3	3	3
CO 3	3		3				3	3	3	3
CO 4	3		3			3	3	3	3	3

S-Strong (3) M-Medium (2) L-Low (1)

I YEAR: SEMESTER -I

Course	**FOUNDATION COURSE**
Title of the Course	**FUNDAMENTALS OF BIOCHEMISTRY**
Credit	**2**

Learning Objectives

The main objectives of this course are to:

- Provide knowledge and overview of entry education and makes the students assimilate with the biochemistry course.
- inculcate knowledge of the academic skills, laboratory skills and research
- gives a strong determination to undergo the course
- To become committed and interested in learning the subject
- Familiarize in preparing reagents in laboratory.

Module I: Overview of Biochemistry: Definition, Importance and significance of Biochemistry, Important discoveries in Biochemistry, scope of Biochemistry in different fields –agriculture, medicine, pharmacy, nursing and clinical laboratories etc., Biochemistry Job opportunities.

Module II: Chemical Characteristics of living organisms, Biological macromolecules and importance of Carbon, Hydrogen, Oxygen, Nitrogen, Phosphorus and Sulphur in life's chemistry,

Chemical bonding (covalent, ionic, Hydrogen, Van der Waal's, hydrophobic bonds) in Biological macromolecules

Module III: Water and life: Molecular structure of water, Unique physical and chemical properties of water that support life, Effects of water on Biomolecules – hydrogen bonding in water and its importance in maintain the shape, stability and properties of biological macromolecules, Effects of non-polar compounds on water, Preparation of distilled water.

Module IV: Introduction to Biochemistry Lab: Understanding of Lab Protocols, Safety aspects in Biochemical Laboratory. Glossary of technical terms in Biochemistry, Calibration of instruments and pipettes, Concentration units: Mole, mole fraction, Molarity, Equivalent weight, Normality, Molality, percentage.

Biochemical reagent preparations for various solutions with respect to different Normality, Molarity, % Solutions (W/V), (V/V) (Problems to be worked out), Use of microscope in laboratory.

Module V: Buffers: Buffers, buffer action, buffer capacity, Henderson – Hassel Balch equation, its limitations and uses, laboratory use of buffers, physiological importance of buffers in body fluids and tissues.

Measurement of pH: indicators, pH meter, different types of electrodes, advantages and disadvantages of different electrodes, principle, working, application, factors affecting pH determination.

Course Outcomes

CO	**On completion of this course, students will be able to**	**Program outcomes**
CO1	To become aware of basic knowledge about Biochemistry course	PO1,PO5
CO2	To understand the chemical Characteristics of living matter	PO1
CO3	To describe the importance of water in life	PO1,PO2
CO4	To acquire knowledge on the preparation of lab solutions	PO1,PO2
CO5	To illustrate buffers in body fluids and tissues and measurement of pH.	PO1,PO5,PO6

Text books and Reference books

1. Fundamentals of Biochemistry, J. L. Jain, Sunjay Jain, Nitin Jain, 2013, 7th edition S. Chand & Company Ltd.

2. Voet. D, Voet. J. G. and Pratt, C.W, 2004, Principles of Biochemistry, 4th edition John Wiley &Sons, Inc.

3. David T Plummer, An Introduction to Practical Biochemistry, 3rd edition, Tata McGraw-Hill Edition

4. J. Jayaraman Laboratory Manual in Biochemistry New Age International (P) Limited Fifth edition 2015

5. S. Sadasivam A. Manickam Biochemical Methods New age International Pvt Ltd publisher's third edition 2018

6. Introductory practical Biochemistry – S.K. Sawhney, Randhir Singh, 2nd Ed, 2005.

7. Harold Varley, Practical Clinical Biochemistry, CBS. 6 edition, 2006.

Web resources

1. https://www.pdfdrive.com/biochemistry-books.html

Mapping with Program Outcomes

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1	2	3	3				3	3	3	3
3CO 2	2	3	3				3	3	3	3
CO 3	2		3	2			3	3	3	3
CO 4	2		3				3	3	3	3

S-Strong (3) M-Medium (2) L-Low (1)

I YEAR: SEMESTER- II

Course	**CORE THEORY - II**
Title of the Course	**CELL BIOLOGY**
Credit	**5**

Learning Objectives

The main objectives of this course are to

- Provide basic understanding of architecture of cells and its organelles.
- Understand the organization of prokaryotic and eukaryotic genome.
- Educate on the structural organization of bio membrane and transport mechanism
- Impart knowledge on cell cycle, cell division and basics of cells
- Familiarize the concept of mechanism of cell-cell interactions.

Module I: Architecture of cells- Structural organization of prokaryotic and eukaryotic cells microbial, plant and animal cells. The ultra-structure of nucleus, mitochondria, RER, SER, Golgiapparatus, lysosome, peroxisome and their functions. **12 Hrs.**

Module II: Cytoskeleton- microfilament, microtubules and intermediary filament- structure, composition and functions. Organization of Genome - prokaryotic and eukaryotic genome. Organization of chromatin – histones, nucleosome concept, formation of chromatin structure. Special types of chromosomes – lamp brush chromosomes, polytene chromosomes. **12 Hrs.**

Module III: Bio membranes - Structural organization of bilipid layer model and basic functions- transport across cell membranes- Uniport, symport and antiport. Passive and active transport. **12Hrs.**

Module IV: Cell cycle-Definition and Phases of Cell cycle-Cell division-Mitosis and Meiosis and its significance, Cancer cells- definition, types and characteristics of cancer cells. **12 Hrs.**

Module V: Extracellular matrix – Collagen, laminin, fibronectin and proteoglycans- structure and biological role. Structure and role of cadherin, selectins, integrins, Cell -cell interactions- Types- gap junctions, tight junctions and Desmosomes. **12 Hrs.**

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Explain the structure and functions of basic components of prokaryotic And eukaryotic cells, especially the organelles.	PO1
CO2	Familiarize the cytoskeleton and chromatin	PO1,PO2
CO3	Illustrate the structure, composition and functions of cell membrane related to membrane transport	PO1,PO2
CO4	Elaborate the phases of cell cycle and cell division-mitosis And meiosis and characteristics of cancer cells.	PO1, PO2
CO5	Relate the structure and biological role of extra cellular matrix in cellular interactions	PO1,PO2

Text books

1. Arumugam.N, Cell Biology.Saras publication (10thed, paperback), 2019

2. Devasena.T.Cell Biology. Oxford University Press India-ISBN: 9780198075516, 0198075510, 2012

3. Bruce Alberts and Dennis Bray. 2013, Essential Cell Biology. (4"ed). Garland Science.

Reference books

1. S.C, R.Cell Biology. New age Publishers -ISBN-10: 8122416888/ISBN-13: 978- 8122416886, 2008

2. Cooper, G.A.The Cell: A Molecular Approach. Sinauer Associates, Inc -ISBN10: 0878931066 / ISBN 13: 9780878931064, 2013

3...E.M.F., D.R, Cell and Molecular Biology. Lippincott Williams & Wilkins Philadelphia - ISBN: 0781734932 9780781734936, 2006

4. Lodish H.A, Berk C.A, Kaiser M, Krieger M.P, Scott A, Bretscher H, Ploegh and Matsudaira. 2007. Molecular Cell Biology, 6th Edition, WH. Freeman Publishers, New York, USA.

Web resources

https://nicholls.edu/biol-ds/bio1155/Lectures/Cell%20Biology.pdf

https://www.medicalnewstoday.com/article/320878.php

https://biologydictionary.net /cell

Mapping with Program Outcome

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1	3						3			3
CO 2	3	3					3			3
CO 3	3	3					3			3
CO 4	3	3					3	3		3
CO5	3	3					3			3

S- Strong (3) M-Medium (2) L-Low (1)

FIRST YEAR: SEMESTER -II

Course	**CORE PRACTICAL - II**
Title of the Course	**PRACTICAL- II CELL BIOLOGY**
Credit	**5**

Learning Objectives

The main objectives of this course are to

- Learn the parts of microscope
- Investigate the cells under microscope.
- Image the cells using different stains
- Identify the cells, organelles and stages of cell division
- Identify the spotters

I MICROSCOPYANDSTAININGTECHNIQUES

1. Study the parts of light and compound microscope
2. Preparation of Slides and Micrometry
3. Examination of prokaryotic and eukaryotic cell
4. Visualization of animal and plant cell by methylene blue
5. Visualization of nuclear fraction by acetocarmine stain
6. Staining and visualization of mitochondria by Janus green stain

II GROUP EXPERIMENT

7. Identification of different stages of mitosis in onion root tip

8. Identification of different stages of meiosis in onion bulb

III SPOTTERS

9. a) **Cells**: Nerve, plant and Animal cell

   b) **Organelles**: Mitochondria, Chloroplast, Endoplasmic reticulum

   c) **Mitosis stages**: Prophase, Anaphase, Metaphase, Telophase.

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Identify the parts of microscope.	PO1,PO2
CO2	Preparation of Slides	PO1,PO2
CO3	Identify the stages of mitosis & meiosis	PO1,PO2
CO4	Visualize nucleus and mitochondria by staining methods	PO1,PO2
CO5	Identify the spotters of cells, organelles and stages of cell division	PO1,PO2

Text books

1. Rickwood, D and J.R.Harris Cell Biology: Essential Techniques, John wikey1996.

2. Davis, J.M. Basic Cell culture: A practical approach, IRL 1994.

3. Ganesh M.K. and Shivashankara A.R. 2012. Laboratory Manual for Practical Biochemistry Jaypee publications, 2ndEdn.

Reference books

1. Essential practical handbook of Cell biology ,Genetics and Microbiology -A Practical manual- Debarati Das Academic publishers, ISBN, 9789383420599, 1st Edition 2017

2. Cell biology Practical, Dr. Venu gupta ISBN8193651219, Prestige publisher, 1st Jan 2018.

3. Cell and Molecular biology, De Robertis, 8th edition, 1st June, 1987

Web resources

1. http://amrita.olabs.edu.in/?sub=79&brch=18&sim=237&cnt=1
2. https://www.microscopemaster.com/organelles.html
3. https://www.pdfdrive.com/biochemistry-books.htm
4. http://medcell.med.yale.edu/histology/cell_lab.php#:~:text=The%20electron%20microscope%20is%20necessary, and%20small%20granules%20and%20vesicles.
5. http://amrita.olabs.edu.in/?sub=79&brch=18&sim=237&cnt=1
6. https://www.khanacademy.org/science/ap-biology/heredity/meiosis-and-genetic diversity/a/phases-of-meiosis
7. https://www.microscopemaster.com/organelles.html
8. https://www.pdfdrive.com/biochemistry-books.html

Mapping with Program Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	2	3					3	3	3	3
CO 2	2	3					3	3	3	3
CO 3	2	3					3	3	3	3
CO 4	2	3					3	3	3	3

S- Strong (3) M-Medium (2) L-Low (1)

SECOND YEAR: SEMESTER- II

Course	**SKILL ENHANCEMENT COURSE - I**
Title of the Course	**FIRST AID**
Credit	**2**

Learning Objectives

The main objectives of this course are to:

- Provide knowledge on the basics of first aid.
- Perform first aid during various respiratory issues.
- Demonstrate the first aid to treat injuries.
- Learn the first aid techniques to be given during emergency.
- Familiarize the first aid during poisoning.

Module I: Aims and important rules of first aid, dealing with emergency, types and content of a first aid kit. First aid technique – Dressing and Bandages, fast evacuation technique, transport techniques. **6Hrs**

Module II: Basics of Respiration – CPR, first aid during difficult breathing, drowning, choking, strangulation and hanging, swelling within the throat, suffocation by smoke or gases and asthma. **6Hrs**

Module III: Common medical aid- first aid for wounds, cuts, head, chest, abdominal injuries, shocks, burns, amputations, fractures, dislocation of bones. **6Hrs**

Module IV: First aid related to unconsciousness, stroke, fits, convulsions-seizures, epilepsy**. 6Hrs**

Module V: First aid in poisonous bites (Insects and snakes), honey bee stings, animal bites, disinfectant, acid and alkali poisoning. **6Hrs**

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Discuss on the rules of first aid, dealing during emergency and first aid techniques	PO1.PO4,PO5
CO2	Understand the first aid techniques to be given during different types of respiratory problems	PO1.PO4,PO5
CO3	Provide first aid for injuries, shocks and bone injury	PO1.PO4,PO5
CO4	Detail on the first aid to be given for unconsciousness, stroke, fits and convulsions	PO1.PO4,PO5
CO5	Gain expertise in giving first aid for insect bites and chemical poisoning	PO1.PO4,PO5

Text books

1) First aid and health Dr. Gauri Goel, Dr. Kumkum Rajput, Dr.Manjul Mungali

1SBN-978-93-92208-19-5

2) Indian First Aid Mannual-https://www.indianredcross.org/publications/FA-manual.pdf

3) Red Cross First Aid/CPR/AED Instructor Manual

Reference books

Web resources

2) https://www.redcross.org/take-a-class/first-aid/first-aid-training/first-aid-online

3) https://www.firstaidforfree.com/

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	2						3	3	3	3
CO 2	2			3	3		3	3	3	3
CO 3	2			3	3		3	3	3	3
CO 4	2			3	3		3	3	3	3
CO5	2			3	3		3	3	3	3

S-Strong (3) M-Medium (2) L-Low (1)

SECOND YEAR: SEMESTER- III

Course	**CORE THEORY - III**
Title of the Course	**BIOMOLECULES**
Credit	**4**

Learning objectives

The main objectives of this course are to:

- Introduce the structure, properties and biological significance of carbohydrates
- Comprehend the classification, functions and acid base properties of amino acids
- Elucidate the various levels of organization of Proteins.
- Impart knowledge on the classification, properties and characterization of lipids.
- Acquaint with the classification, structure, properties and functions of nucleic acids

Module I: Carbohydrates-Classification and biological significance, physical properties - stereo isomerism, optical isomerism, anomers, epimers and mutarotation. Monosaccharides: Occurrence, Linear and cyclic structure, Reactions of monosaccharides due to the presence of hydroxyl, aldehyde and keto groups. Disaccharides: Structure and properties of reducing disaccharides (lactose and mannose), non-reducing disaccharide (sucrose).Polysaccharides: Homopolysaccharides - Occurrence, structure and biological significance of starch, glycogen and cellulose. Heteropolysaccharides - Structure and biological significance of mucopolysaccharides - hyaluronicacid, chondroitin sulphate and heparin. (Structural elucidation not needed). **12Hrs**

Module II: Amino acids -Classification based on composition of side chain and nutritional significance. General structure of amino acids. 3 - And 1- letter abbreviations. Modified amino acids in protein non - protein amino acids. Physical properties of amino acids, isoelectric point, titration curve (alanine, lysine, glutamic acid), optical activity. Chemical reactions due to carboxyl group, amino group and side chains. Color reactions of amino acids. **12Hrs**

Module III: Proteins-Classification based on shape, composition, solubility and functions. Properties of proteins – Ampholytes, isoelectric point, salting in and salting out, denaturation and renaturation, UV absorption. Levels of Organization of protein structure- Primary structure,

Formation and characteristics of peptide bond, phi and psi angle, Secondary structure-α helix (egg albumin), β- pleated sheath (keratin), triple helix (collagen). Tertiary structure – with reference to myoglobin. Quaternary structure with reference to hemoglobin. **12Hrs**

Module IV: Lipids- Lipids: Bloor's classification, chemical nature and biological functions. Fatty acids: classification, nomenclature, structure and properties of fatty acids. Simple and mixed triglycerides: structure and general properties, Characterization of fats- iodine value, saponification value, acid number, acetyl number, polensky number, Reichert –Meissl number along with their significance. Compound lipids - Structure and functions of phospholipids and glycolipids. Derived lipids - Structure and functions of cholesterol, bile acids and bile salts. **12Hrs**

Module V: Nucleic acids - Structure of purine and pyrimidine bases, nucleosides and nucleotides and their biological importance. Types of DNA: A, B, C, Z DNA, structure and biological significance, superhelicity. Types of RNA: mRNA, tRNA, rRNA, hnRNA, snRNA, Secondary and tertiary structure of tRNA. Properties of DNA-Hypochromic and hyperchromic effect, melting temperature, viscosity. Denaturation and annealing. **12Hrs**

Course Outcomes

CO	**On completion of this course, students will be able to**	**Program outcomes**
CO1	Classify, illustrate the structure and explain the physical and chemical properties of Carbohydrates.	PO1
CO2	Indicate the classification, structure, properties and biological functions of amino acids.	PO1
CO3	Explain the classification and elucidate the different levels of structural organization Of proteins.	PO1
CO4	Elaborate on classification, structure, properties, functions and characterization of lipids	PO1,PO4
CO5	Describe the structure, properties and functions of different types of nucleic acids	PO1

Text books

1. Biochemistry, U.Sathyanarayana & U.Chakrapani, 2013, 5th edition Elsevier India Pvt. Ltd., Books & Allied Pvt.Ltd.

2. Fundamentals of Biochemistry, J.L.Jain, Sunjay Jain, Nitin Jain, 2013, 7th edition Chand & CompanyLtd.

3. Text book of Medical Biochemistry, MNChatterjea, Rana Shinde, 2002, 8th edition, Jaypee Brothers.

Reference books

1. David Nelson, Michael M.Cox, 2005, Principles of Biochemistry, 4th edition W.H. Freeman and Company.

2. Voet. D, Voet.J.G. And Pratt, C.W, 2004, Principles of Biochemistry, 4th edition John Wiley &Sons, Inc.

3. Zubay G.L, *et.al*, 1995, Principles of Biochemistry, 1st edition, Wm C. Brown Publishers.

Web resources

https://www.britannica.com/science/biomoleculehttps://en.wikipedia.org/wiki/Biomoleculehttps://www.khanacademy.org/science/biology/macromolecules

Mapping with Program Outcomes

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1	3						3			3
CO 2	3						3			3
CO 3	3						3			3
CO 4	3			2			3	2		3
CO5	3						3			3

S-Strong (3) M-Medium (2) L-Low

SECOND YEAR: SEMESTER- III

Course	**CORE PRACTICAL - III**
Title of the Course	**PRACTICAL III BIOMOLECULES**
Credit	**5**

Learning Objectives

The main objectives of this course are to

- Identify the biomolecules carbohydrates and amino acids by qualitative test
- Determine the quality of Lipids by titrimetric methods
- Isolate nucleic acids from plant and animal source

I) Qualitative test for 15 Hrs.

1) Carbohydrates

a) Glucose b) Fructose c) Arabinose d) Maltose e) Sucrose f) Lactose g)Starch

2) Amino acids

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

II) Titrimetric methods15 Hrs.

1) Determination of Saponification value of edible oil

2) Determination of Iodine number of edible oil

3) Determination of Acid number of edible oil

III) Group Experiments 15 Hrs.

1) Isolation of DNA from plant/animal source.

2) Isolation of RNA from rich source.

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Qualitatively analyses the carbohydrates and report the type of carbohydrate based on specific tests	PO1,PO2,PO3

CO2	Qualitatively analyze amino acids and report the type of amino acids based on specific tests	PO1,PO2,PO3
CO3	Determine the Saponification, Iodine and acid number of edible oil	PO1, PO3,PO4
CO4	Isolate the nucleic acid from biological sources	PO1,PO3

Text books

1. David T Plummer, An Introduction to Practical Biochemistry, 3rd edition, Tata McGraw-Hill Edition

2. J. Jayaraman Laboratory Manual in Biochemistry New Age International (P) Limited Fifth edition 2015

3. S. Sadasivam A. Manickam Biochemical Methods New age International Pvt Ltd publisher's third edition 2018

Reference books

1. Rageeb, Kiran Patil, M. Bakshi Rahman, Sufiyan Ahmad Raees A Practical book on Biochemistry Everest publishing house1st Edition, 2019

2. Introductory practical Biochemistry – S.K. Sawhney, Randhir Singh, 2nd ed, 2005.

3. Biochemical Tests – Principles and Protocols. Anil Kumar, Sarika Garg and Neha Garg.Vinod Vasishtha Viva Books Pvt Ltd, 2012.

4. Harold Varley, Practical Clinical Biochemistry, CBS. 6th edition, 2006.

5. Keith Wilson and John Walker. Principles and Techniques of Practical Biochemistry, 4th Edition, Cambridge University press, Britain.1995.

Web resources

1. https://www.pdfdrive.com/instant-notes-analytical-chemistry-e912659.html 14

2. https://www.pdfdrive.com/analytical-biochemistry-e46164604.html

3. https://www.pdfdrive.com/biochemistry-books.html

Mapping with Program Outcomes

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1	2	3	3				3	3	3	3
3CO 2	2	3	3				3	3	3	3
CO 3	2		3	2			3	3	3	3
CO 4	2		3				3	3	3	3

S-Strong (3) M-Medium (2) L-Low (1)

SECOND YEAR: SEMESTER- III

Course	**SKILL ENHANCEMENT COURSE - II**
Title of the Course	**MEDICAL LABORATORY TECHNOLOGY**
Credit	**1**

Learning Objectives

The main objectives of this course are to

- Impart knowledge on specimen collection and disposal of waste.
- Acquaint knowledge on collection, preservation and transfusion of blood.
- Quantify the biomolecules in biological sample
- Understand the significance of various tests and their interpretation in diseased conditions
- Acquaint knowledge on enzymes, hormones and Immunoglobulins as markers for diagnosis.

Module I: Collection, transport, analysis of specimen – blood, routine urine, feces, sputum, semen, CSF Documentation of samples & results. Disposal of laboratory/ hospital waste-Noninfectious waste, biomedical waste, infected sharp waste disposal, infected non sharp disposal – color coding as per guidelines. **6Hrs**

Module II: Determination of Blood group and Rh factor -Basic blood banking procedures- cross matching, screening test. Blood transfusion and hazards. **6Hrs**

Module III: Estimation of blood sugar – Enzymatic method, HbA1C, Qualitative and quantitative analysis of urine sample- NPN-urea, uric acid, creatinine. Mineral, vitamin and CSF analysis. **6Hrs**

Module IV: Immuno diagnostics -Widal test, VDRL test, ASO, RA, CRP and Complement fixation Test. RIA, ELISA, Skin test – Montaux and Lepramin test. **6Hrs**

Module V: Assay of clinically important enzymes- Estimation of clinically important hormones – Insulin, Thyroid and Reproductive hormones and its clinical significance. **6Hrs**

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Collect & preserve of biological samples.	PO1,PO2
CO2	Estimate the various constituents in biological sample	PO1,PO2,PO6
CO3	Perform the routine procedures adopted in blood bank	PO1,PO2.PO6
CO4	Analyze and interpret the values for both normal and disease Conditions.	PO1,PO2,PO6
CO5	Assay the enzymes and hormones &interpret clinical implications	PO1,PO2,PO6

Text Books

1 Kanai L Mukherjee and Anuradha Chakravarthy Medical Laboratory Technology IVth edition, Vol I, 2022

2. Ramnik Sood, Text Book of Medical Laboratory Technology, Jaypee Publishers, 2006

3. Tietz, N. (2018) Fundamentals of Clinical Chemistry and Molecular Diagnostics 8th edition, W.B. Saunders Company

Reference books

Web Resources

1. https://www.youtube.com/watch?v=QNYlX5Ne9lQ

2. https://www.slideshare.net/doctorrao/ agglutination-tests-and-immunoassys

3. https://microbenotes.com/introduction-to-precipitation-reaction/

Mapping with Program Outcome

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	2	3					3	3	3	3
CO 2	2	3				2	3	3	3	3
CO 3	2	3				2	3	3	3	3
CO 4	2	3				2	3	3	3	3
CO5	2	3				2	3	3	3	3

S - Strong (3) M - Medium (2) L –Low (1)

SECOND YEAR: SEMESTER- III

Course	**SKILL ENHANCEMENT COURSE - III**
Title of the Course	**BASICS OF FORENSIC SCIENCE**
Credit	**2**

Learning Objectives

The main objectives of this course are to

- Gain knowledge on the basic practices of forensic analysis.
- Perform investigation using fresh blood.
- Carry out the analysis using body fluids
- Investigate the presence of forms of drugs and poisons in body fluids.
- Execute the identification test on multiple samples.

Module I: Forensic Science: Definition, History and Development. Crime scene management and investigation; collection, preservation, packing and forwarding of physical and trace evidences for analysis. **6Hrs**

Module II: Blood – grouping and typing of fresh blood samples including enzyme .Cases of disputed paternity and maternity problems, DNA profiling. **6Hrs**

Module III: Analysis of body fluids- Analysis of illicit liquor including methyl and ethyl alcohol in body fluids and breathe. Chemical examination, physiology and pharmacology of Insecticides and pesticides. **6Hrs**

Module IV: Psychotropic drugs -Sedatives, stimulants, opiates and drugs of abuse. Identification of poisons from viscera, tissues and body fluids. **6Hrs**

Module V: Identification tests- Identification of hair, determination of species origin, sex, site and individual identification from hair. Classification and identification of fibers. Examination and identification of saliva, milk, urine and faecal matter **6Hrs**

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Gain knowledge on basics of forensic science and method for collection and preservation of samples	PO1,PO2,PO6
6CO2	Assess the paternity ,maternity problems and DNA profiling	PO1,PO2
CO3	Identify the presence of alcohol ,insecticides and pesticides in body fluids	PO1,PO2
CO4	Detail on the test performed to identify the presence of drugs and poisons in body fluids	PO1,PO2
CO5	Identify species and sex from the available body fluids	PO1,PO2

Reference books

1. An Introduction to Forensic DNA Analysis by Norah Rudin & Keith Inman USA, Second edition.

2. Forensic Science Handbook, Volume 2 & 3 by Saferstein, Richard E.

5. Forensics by Embar-Seddon, Ayn and Pass. Allan D.

6. Forensic Medicine by Adelman, Howard C & Kobilinsky, Lawrence Page 24 of 63

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	2	3					3		3	3
CO 2	2	3					3		3	3
CO 3	2	3					3		3	3
CO 4	2	3					3		3	3
CO5	2	3					3		3	3

S-Strong (3) M-Medium (2) L-Low (1)

SECOND YEAR: SEMESTER- IV

Course	**CORE THEORY - IV**
Title of the Course	**BIOCHEMICAL TECHNIQUES**
Credit	**5**

Learning objectives

The objectives of this course are to

- Introduce the basic principles, types and applications of various sedimentation techniques.
- Provide an understanding of the underlying principles of chromatographic techniques
- Demonstrate experimental skills in various electrophoretic techniques.
- Appraise the use of colorimetric and spectroscopic techniques in biology
- Impart knowledge about the measurement of radioactivity and safety aspects of radioactive isotopes.

Module I: Centrifugation - Basic principles, RCF**,** Sedimentation coefficient, Svedberg constant. Types of rotors. Preparative centrifugation- differential and density gradient centrifugation, Rate zonal and Isopycnic techniques, construction, working and applications of analytical ultracentrifuge – Determination of molecular weight (Derivation excluded).

9Hrs.

Module II: Chromatography - adsorption, partition. Principle, instrumentation and applications of paper chromatography, thin layer chromatography, ion-exchange chromatography, gel permeation chromatography and affinity chromatography. **9Hrs.**

Module III: Electrophoresis – General principles, factors affecting electrophoretic mobility. Tiselius moving boundary electrophoresis. Electrophoresis with paper and starch. Principle, instrumentation and applications of agarose gel electrophoresis and SDS-PAGE. **9Hrs.**

Module IV: Basics of Electromagnetic radiations- Energy, wavelength, wave number and frequency. Absorption and emission spectra, Lambert – Beer Law, Light absorption and transmittance. Colorimetry - Principle, instrumentation and applications. Visible and UV

spectrophotometry – Principle, instrumentation and applications –enzyme assay, structural studies of proteins and nucleic acids. **9Hrs.**

Module V: Radioactivity - Types of Radioactive decay, half-life, units of radioactivity, Detection and measurement of radioactivity - Methods based upon ionization -Geiger Muller Counter. Methods based upon excitation - Solid & Liquids scintillation counters. Autoradiography. Biological applications and safety aspects of radioisotopes. **9Hrs.**

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Describe types of rotors and identify the centrifugation Technique for the separation of biomolecules.	PO1,PO2,PO6
CO2	Demonstrate the principles, operational procedure and Applications of planar and column chromatography.	PO1,PO2, PO6
CO3	Specify the factors and explain the separation of DNA and Protein using electrophoretic technique.	PO1,PO2, PO6
CO4	State Beer's Law and illustrates the instrumentation and Uses of colorimeter and spectrophotometer.	PO1,PO2, PO6
CO5	Enumerate various methods of measurement of Radioactivity and safety aspects of radioactive isotopes.	PO1,PO2, PO6

Text books

1. Avinash Upadhyay, Kakoli Upadhyay & Nirmalendu Nath, 2002, Biophysical Chemistry, Principles and Techniques, 3rd edition, Himalaya Publishing House.

2. L.Veerakumari, 2009, Bioinstrumentation, 1stedition, MJP Publishers.

3. Keith Wilson & John Walker, 2000, Practical Biochemistry-Principles and techniques, Cambridge University Press, 4thedition.

Reference books

1. Terrance G. Cooper the tools of Biochemistry, 1977, John Wiley & Sons, Singapore.

2. Gurumani, Research Methodology for Biological Sciences, 2011, 1stedition, MJP Publishers.

3. Saroj Dua, Neera Garg, Biochemical Methods of Analysis, 2010, 1stedition, Narosa Publishing house.

Web Resources

1. https://www.britannica.com/science/chromatography
2. https://www.youtube.com/watch?v=xgxFBQZYXlE
3. https://www.youtube.com/watch?v=7onjVBsQwQ8

Mapping with Program Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	2	3				2	3	3	3	3
CO 2	2	3				2	3	3	3	3
CO 3	2	3				2	3	3	3	3
CO 4	2	3				2	3	3	3	3
CO 5	2	3				2	3	3	3	3

S-Strong (3) M-Medium (2) L-Low (1)

SECOND YEAR: SEMESTER -IV

Course	**CORE PRACTICAL - IV**
Title of the Course	**PRACTICAL IV BIOCHEMICAL TECHNIQUES**
Credit	**5**

Learning objectives

The objectives of this course are to:

- Acquaint the students with colorimetric estimations of biomolecules.
- Equip skills on various separation techniques.
- Impart knowledge about the estimation of minerals and vitamins.

I Colorimetry

1. Estimation of amino acid by Ninhydrin method.

2. Estimation of protein by Biuret method.

3. Estimation of DNA by Diphenylamine method.

4. Estimation of RNA by Orcinol method.

5. Estimation of Phosphorus by Fiske and Subbarow method.

II Chromatography

1. Separation and identification of sugars and amino acids by paper chromatography.

2. Separation and identification of amino acids and lipids by thin layer chromatography.

III Demonstration

1. Separation of serum and plasma from blood by centrifugation.
2. Separation of serum proteins by SDS-PAGE.

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Estimate the amount of biomolecules by Colorimetric method.	PO1,PO3,PO6
CO2	Quantify the amount of minerals by Colorimetric method	PO1,PO3,PO6
CO3	Separate and identify sugars, lipids and amino acids by chromatography	PO1,PO3
CO4	Operate centrifuge for the separation of serum and plasma	PO1,PO3,PO6
CO5	Demonstrate the separation of proteins electrophoretically	PO1,PO3,PO6

Text books

1. J. Jayaraman, Laboratory Manual in Biochemistry New Age International (P) Limited Fifth edition 2015.

2. S. Sadasivam A.Manickam Biochemical Methods Newage International Pvt Ltd publishers 3rd edition 2018.

3. Keith Wilson and John Walker Principles and techniques of Practical Biochemistry Cambridge University Press2010, 7th edition.

Reference books

1. S. K. Sawhney and Randhir Singh, Introductory Practical Biochemistry. Alpha Science International, Ltd. 2nd edition, 2005.

2. David T. Plummer, 2001, An Introduction to Practical Biochemistry, 3rd edition, Tata McGraw- Hill publishing company limited.

3. Varley's Practical Clinical Biochemistry by Alan H Gowenlock, published by CBS Publishers and distributors, India Sixth Edition,1988.

Web resources

https://www.pdfdrive.com/biochemistry-books.html

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	2		3			2	3	3	3	3
CO 2	2		3			2	3	3	3	3
CO 3	2		3				3	3	3	3
CO 4	2		3			2	3	3	3	3
CO 5	2		3			2	3	3	3	3

S-Strong (3) M-Medium (2) L-Low (1)

SECOND YEAR: SEMESTER- IV

Course	**SKILL ENHANCEMENT COURSE - VI**
Title of the Course	**MEDICAL CODING**
Credit	**2**

Course objectives

The objectives of this course are to

- Understand the basic concept of Medical coding
- Familiarize the student about medical terminology
- Understand about the classification of diseases based on WHO/AHA
- Understand about the CPT code used for diseases as per American Medical Association (AMA)

Module I: Introduction to Medical coding, coding theory, Health care Common Procedure Coding, First Aid and CPR. **6Hrs.**

Module II: Introduction to Medical Terminology, specialization I & II, Diagnostic coding, factors affecting diagnostic coding. **6Hrs**

Module III: Documenting medical records- Importance of Documentation, Types of dictation formats. **6Hrs**

Module IV: Introduction to Human Anatomy and Coding, ICD-10- CM classification system.

6Hrs

Module- V: Introduction to CPT coding, types of CPT coding Medical Law and Ethics**.** **6hrs**

Course Outcome

CO	On completion of this course, students will be able to	Program Outcomes
CO1	Explaining the basic concept of coding and its application. Possess the knowledge about the First aid and CPR	PO1,PO2, PO6
CO2	Possess the knowledge about medical terminology used in Medical coding industry	PO1,PO2, PO6
CO3	Possess the knowledge about the ICD-10 CM international classification of diseases based on WHO	PO1,PO2, PO6
CO4	Possess the knowledge about the CPT codes used for diseases as per American Medical Association (AMA)	PO1,PO2, PO6
CO5	Understand CPT coding and its types	PO1,PO2, PO6

Text books

1. Understanding Medical Coding, A comprehensive guide Sandra L Johnson Robin Linker
2. Buck's Step – by – step Medical Coding Elsevier reference

Reference books

1. Terry Tropin M Shai, RHIA, CCS-P, AHIMAICD-10-CMcoding guidelines made easy2017.
2. Besty J Shiland- Medical terminology and anatomy for ICD-10.

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	2	3				3	3		2	3
CO 2	2	3				3	3		2	3
CO 3	2	3				3	3		2	3
CO 4	2	3				3	3		2	3
CO5	2	2				2	3		2	3

S - Strong (3) M - Medium (2) L -Low (1)

SECOND YEAR: SEMESTER IV

Course	**SKILL ENHANCEMENT COURSE - VII**
Title of the Course	**MICROBIAL TECHNIQUES**
Credit	**2**

Learning objectives

The objectives of this course are to

- Study the growth of bacteria
- Know the parts & uses of microscope
- Learn staining methods to identify microbes
- Learn different types of culture methods
- Study food preservation methods

Module I: Growth of bacteria- Definition, growth phases, factors affecting growth (pH, temperature, and oxygen), cell count (hemocytometer, Bacterial cell- Bacillus subtilis), fungal cell (Saccharomyces) and human blood cell. **6Hrs**

Module II: Microscopy- Principle, types - Compound microscope, electron microscope- TEM, SEM, use of oil immersion objective. **6Hrs**

Module III: Stains and staining- Principles of staining, simple staining, negative staining, Differential staining, Gram and acid-fast staining, flagella staining, capsule and endospore Staining. Staining of yeast (methylene blue), lactophenol cotton blue, staining of mold (Penicillium, Aspergillus), Agaricus. **6Hrs**

Module IV: Cultivation of bacteria– Types of growth media (natural, synthetic, complex, enriched, selective- definition with example), culture methods (streak plate, spread plate, pour plate, stab culture, slant culture, liquid shake culture, anaerobiosis) - aerobic and Anaerobic bacteria. **6Hrs**

Module V: Food microbiology- Microbiological examination of food: microscopic examination and culture, phosphatase test of Pasteurized milk. Preservation of food- High temperature (boiling, pasteurization, appreciation), low temperature (freezing), dehydration, osmotic pressure, chemical preservations, radiation. Microorganisms as food SCP. **6 Hrs**

Course Outcome

CO	On completion of this course, students will be able to	Program Outcomes
CO1	Understand the growth of bacteria and to perform cell count	PO1,PO2
CO2	Acquire knowledge of microscope and its uses	PO1,PO2
CO3	Identify the microbes by staining methods	PO1,PO2, PO6
CO4	Culture microbes by various methods	PO1,PO2, PO6
CO5	Preserve foods at high and low temperature	PO,PO2, PO6

Text books

1. Sherris Medical Microbiology, 7th Edition by Authors: Kenneth Ryan, C. George Ray, Nafees Ahmad, W. Lawrence Drew, Michael Lagunoff, Paul Pottinger, L. Barth Reller and Charles R. Sterling

2. Food Microbiology: Fundamentals and Frontiers, 5th Edition by Editor(s): Michael P. Doyle, Francisco Diez-Gonzalez, Colin Hill

3. Text book of microbiology by Ananthanarayan and Panicker's

4. Textbook of microbiology by P.C. Trivedi Sonali Pandey Seema Bhadauria5.

5. Prescott's Microbiology, 10th Edition by Authors: Joanne Willey, Linda Sherwood and Christopher J. Woolverton

Reference books

1. Bailey& Scott's Diagnostic Microbiology, 14th Edition by Author: Patricia Title

2. Medical Microbiology, 7th Edition Authors: Patrick R. Murray, Ken S. Rosenthal and Michael A. Pfaller

3. Microbiology: Laboratory Theory and Application, 3rd Edition Authors: Michael J. Leboffe and Burton E. Pierce

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	2	3					3	3	3	3
CO 2	2	3					3	3	3	3
CO 3	2	3				2	3	3	3	3
CO 4	2	3				2	3	3	3	3
CO5	2	3				2	3	3	3	3

S - Strong (3) M - Medium (2) L –Low (1)

SECOND YEAR: SEMESTER -IV

Course	**SKILL ENHANCEMENT COURSE - VII**
Title of the Course	**TISSUE CULTURE**
Credit	**2**

Learning Oobjectives

The objectives of this course are to

- Introduce the tools and techniques used in tissue culture technique.
- Acquire knowledge on preparation of growth medium for culture techniques.
- Impart knowledge on procedures involved gene transfer.
- Acquaint with the process of tissue culture technique.
- Understand the importance of plant and animal tissue culture for the production and evaluation of bioactive compounds

Module l: Introduction to Tissue culture, Types- seed, embryo, Callus, Organ, Protoplast culture, Advantages and importance of tissue culture, Tools and techniques.

6Hrs.

ModuleII : Media and Culture Preparation - pH, temperature, solidifying agents. Role of Micro and macro nutrients. Maintenance of cultures. **6Hrs**

Module III : Methods of gene transfer in plants and animals - direct and indirect gene transfer Methods**.**

6Hrs.

Module IV : Cell culture technique - Explants selection, sterilization and inoculation. **6Hrs.**

Module V : Transgenic plants for crop improvement. Transgenic plants for molecular farming. Animal Cloning - an overview - Applications of animal cell culture **6Hrs.**

Course outcomes

CO	**On completion of this course, students will be able to**	**Program outcomes**
CO1	Introduction to plant tissue culture	PO1,PO2.PO3

CO2	Brief knowledge on preparation of tissue culture media	PO1,PO2
CO3	Understanding on different methods of gene transfer	PO1,PO2.PO3
CO4	Gain knowledge on plant and animal cell culture techniques	PO1,PO2,PO3
CO5	Study of applications of genetically modified plants and animals.	PO1,PO2,PO3

Text books

1. Trivedi, P.C.2000. Applied Biotechnology: Recent Advances. PANIMA Publishing Corporation.

2, Ignacimuthu. 1996. Applied Plant Biotechnology. Tata McGraw – Hill.

3. Lycett, G.W. and Grierson, D. (ed). 1990. Genetic Engineering of crop plants.

4. Grierson and Covey, S.N.1988. Plant Molecular biology.Blackie.

5. Chawla, H.S., "Introduction to Plant Biotechnology", 3rd Edition, Science Publishers, 2009.

Reference books

1. Gamburg OL, Philips GC, Plant Tissue & Organ Culture fundamental Methods, arias Publications. 1995.

2. Stewart Jr., C.N., "Plant Biotechnology and Genetics: Principles, Techniques and Applications" Wiley-Interscience, 2008.

3. Freshney, R. I. (2010). Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications. Wiley-Blackwell, 2010.6th Edition.

4. Davis, J. M. (2008). Basic Cell Culture. Oxford University Press. New Delhi.

5. Davis, J. M. (2011).Animal Cell Culture. John Willy and Sons Ltd. USA.6Freshmen R. I. (2005).Culture of Animal Cells. John Willy and Sons Ltd. USA.

6. Butler, M. (2004). Animal Cell Culture and Technology. Taylor and Francis.Keywork USA.

7. Verma, A. S. and Singh, A. (2014).Animal Biotechnology. Academic Press, ELSEVIER, USA

Web Resources

https://www.britannica.com/science/tissue-culture

https://en.wikipedia.org/wiki/Plant_tissue_culture

https://microbeonline.com/animal-cell-culture-introduction-types-methods-applications/

Mapping with Program Outcomes

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1	2	3	3				3	3	3	3
CO 2	2	3					3	3	3	3

CO 3	2	3	3				3	3	3	3
CO 4	2	3	3				3	3	3	3
CO5	2	3	3				3	3	3	3

S - Strong (3) M - Medium (2) L -Low (1)

THIRD YEAR: SEMESTER V

Course	**CORE THEORY - V**
Title of the Course	**ENZYMES**
Credit	**5**

Learning objectives

The main objectives of this course are to

- Provide fundamental knowledge on enzymes and their properties.
- Understand the mechanism of action of enzymes and the role of coenzymes in catalysis.
- Introduce the kinetics of enzymes and determine the Km and Vmax.
- Explain the effect of inhibitors on enzyme activity
- Understand the role of enzymes in clinical diagnosis and industries.

Module I: Introduction to enzymes: Nomenclature and Classification based on IUB with examples, enzyme as catalyst-Activation energy, Enzyme specificity-absolute, Group, linkage and stereo specificities. Concept of Active site, Lock and key hypothesis and induced fit theory, Enzyme expression Units-IU, turnover number, katal and specific activity. **12Hrs**

Module II: Mechanism of enzyme catalysis – Acid Base catalysis, covalent catalysis, electro static catalysis, metal ion catalysis, proximity and orientation effect. Coenzymes -Definition, types, co-enzymatic forms of vitamins- NAD/NADP, FAD, FMN, Coenzyme A TPP, PLP, lipoic acid and biotin. Multienzyme complexes - Pyruvate dehydrogenase complex. Isoenzyme with reference to LDH and CK. **12Hrs**

Module III: Enzyme kinetics --Definition of kinetics, Factors affecting enzyme activity - temperature, pH, substrate and enzyme concentration, activators-cofactors, Derivation

of Michaelis-Menton equation for unisubstrate reactions , Line weaver - Burk plot, Eadie –Hofstee plot Significance of Km and V max and their determination using the plots. **12Hrs**

Module IV: Enzyme inhibition - Reversible and irreversible inhibition - types of reversible inhibitors, competitive, non-competitive, un-competitive inhibitors. Graphical representation by L-B plot, (Kinetic derivations not required), Determination of Km and Vmax in the presence and absence of inhibitors. Allosteric enzymes - Sigmoidal curve, positive and negative modulators. **12Hrs**

Module V: Applications of enzymes -Immobilized enzymes - methods of immobilization-adsorption, covalent bonding, cross linking, encapsulation, entrapment and applications of immobilized enzymes. Biosensors – e.g. Glucose sensors. Industrial applications of enzymes – Food, textile and pharmaceutical industries. **12Hrs**

Course Outcomes

CO	**On completion of this course, students will be able to**	**Programme outcome**
CO1	Identify the major classes of enzymes, differentiate between a chemical Catalyst and a biocatalyst and define the units of enzymes.	PO1
CO2	Explain the mechanism of enzyme catalysis and the role of coenzymes in Enzyme action.	PO1,PO2
CO3	Illustrate the steady state kinetics, interpret MM plot and LB plot based on Kinetics data, and determine Km and Vmax.	PO1,PO3
CO4	Distinguish the types of inhibition along with its importance in biochemical Reactions.	PO1,PO3
CO5	Comprehend the various methods for production of immobilized enzymes and discuss the application of enzymes in clinical diagnosis and various Industries.	PO1,PO2,PO6

Text books

1. U.Sathyanarayana & U. Chakrapani, 2013, Biochemistry, 4th edition, Elsevier India Pvt. Ltd., Books & Allied Pvt. Ltd.
2. Dr. G.R Agarwal, Dr. Kiran Agarwal & O.P. Agarwal, 2015, Textbook of Biochemistry (Physiological chemistry), 18thedition, Goel Publishing House,
3. T. Devasena, 2010, Enzymology, 1stedition, Oxford University Press.

Reference books

1. Trevor Palmer, 2008, Enzymes: Biochemistry, Biotechnology, Clinical Chemistry, 2nd edition, East West Press Pvt.Ltd.

2. David L. Nelson, Michael M. Cox, 2005, Principles of Biochemistry, 4th edition W.H. Freeman and Company,

3. Voet. D, Voet.J. G.and Pratt, C.W, 2004, Principles of Biochemistry, 4th edition John Wiley & Sons, Inc.

4. Zubay G.L, *et.al*, 1995, Principles of Biochemistry, 1st edition, Wm C.Brown Publishers.

Web resources

www.biologydiscussion.com/notes/enzymes-noteshttps://www.britannica.com/science/protein/The-mechanism-of-enzymatic-actionhttps://www.youtube.com/watch?v=oVJ2LJxO6tU

Mapping with Program Outcomes

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1	3						3			3
CO 2	3	2					3			3
CO 3	3		2				3			3
CO 4	3		2				3			3
CO 5	3	2				2	3	3	3	3

S-Strong (3) M-Medium (2) L-Low (1

THIRD YEAR: SEMESTER V

Course	**CORE THEORY - VI**
Title of the Course	**INTERMEDIARY METABOLISM**
Credit	**4**

Learning Objectives

The main objectives of this course are to

- Review the basic concepts of free energy transformation and describe biological oxidation.
- Illustrate the pathways of carbohydrate metabolism.
- Explain the pathways of oxidation and biosynthesis of lipids.
- Detail the catabolism of amino acids and synthesis of specialized products from amino acids.
- Acquaint the metabolism of nucleic acids and its regulation

Module I: Bioenergetics-High energy compounds**:** Role of high energy compounds, free energy hydrolysis of ATP and other organophosphates, ATP-ADP cycle. Biological Oxidation: Electron transport chain -its organization and function. Inhibitors of ETC. Oxidative phosphorylation, P/O ratio, Peter Mitchell's chemiosmosis hypothesis. Mechanism of ATP synthesis, uncouples of oxidative phosphorylation, substrate level phosphorylation with examples. **15Hrs**

Module II: Metabolism of carbohydrates - Glycolysis, TCA Cycle, Amphibolic nature and integrating role of TCA cycle. Anaplerosis, Pentose Phosphate Pathway (HMP shunt), Gluconeogenesis, Glycogenesis, Glycogenolysis and its regulation, glyoxylate cycle, Entner- Duodoroff pathway and Cori cycle. **15Hrs**

Module III: Metabolism of lipids -Oxidation of fatty acids - α, β and ω -oxidation of saturated fatty acids, Oxidation of fatty acids with odd number of carbon atoms and unsaturated fatty acids, Ketogenesis, Biosynthesis of saturated fatty acids and unsaturated fatty acids, Biosynthesis and degradation of triglycerides, phospholipids and cholesterol.

15Hrs

Module IV: Metabolism of amino acid- Metabolic nitrogen pool, Catabolism of amino acid: Oxidative deamination, non – oxidative deamination, transamination and decarboxylation, Biogenic amines, Urea cycle and its regulation. **15Hrs**

Module V: Metabolism of nucleotides-Biosynthesis of purines and pyrimidines, - denovo synthesis and salvage pathways, Degradation of purines and pyrimidines, Conversion of ribonucleotide to deoxyribonucleotide. **15Hrs**

Course Outcomes

CO	**On completion of this course, students will be able to**	**Program outcomes**
CO1	State the concepts of bioenergetics and illustrate the mechanism of flow Of electrons and the production of ATP.	PO1,PO2
CO2	Elaborate the biochemical reactions and integration of pathways of Carbohydrate metabolism.	PO1,
CO3	Sketch the oxidation and biosynthesis of fatty acids, phospholipids, triglycerides and cholesterol with suitable examples	PO1
CO4	Explain catabolism of amino acids, synthesis of nonessential amino Acids and specialized products from amino acids.	PO1
CO5	Describe the metabolism of nucleic acids with necessary illustrations and its regulation.	PO1

Text books

1, U.Sathyanarayana & U.Chakrapani, 2015, Biochemistry, 4th Elsevier India Pvt.Ltd.

2. M.N. Chatterjea and Rana Shinde, 2002, Text book of Medical Biochemistry, 5th edition Jaypee Brothers Medical Publishers Pvt. Ltd.

Reference books

1. Lehninger Principles of Biochemistry, David L. Nelson, Michael M.Cox, 2008, 5thedition, W.H.Freeman and Company.

2. Robert K.Murray, Daryl K.Granner, Victor W. Rodwell, 2006, Harper's Illustrated Biochemistry, 27th edition, McGraw Hill Publishers.

3. Principles of Biochemistry Voet.D, Voet. J.G, and Pratt C.W., 2010, 4th edition, John Wiley &Sons, Inc.,.

4. Principles of Biochemistry, Geoffrey L. Zubay, William W. Parson, Dennis E.Vance, 1995, 2nd Edition, Wm.C. Brown Publishers.

5. Biochemistry, Garret, R. H. and Grisham, C. M. 2005, 3rd Edition. Thomson Learning INC.

Web resources

1.https://nptel.ac.in/courses/104/105/104105102/

2.http://www.nptelvideos.in/2012/11/biochemistry-i.html

3. https://www.saddleback.edu/faculty/jzoval/mypptlectures/ch15_metabolism/lecture_notes _ ch15_metabolism_current-v2.0.pdf

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3	2					3			3
CO 2	3						3			3
CO 3	3						3			3
CO 4	3						3			3
CO 5	3						3			3

S-Strong (3) M-Medium (2) L-Low (1)

THIRD YEAR: SEMESTER V

Course	**CORE THEORY - VII**
Title of the Course	**CLINICAL BIOCHEMISTRY**
Credit	**5**

Learning objectives

The main objectives of this course are to

- Comprehend the basic concepts and disorders of carbohydrate metabolism
- Explain the disorders of lipid metabolism.
- Elucidate the liver function test and kidney function test.
- Designate the gastric function test.
- Familiarize the clinical enzymology.

Module I: Disorders of carbohydrate metabolism: Maintenance of blood glucose by hormone with special reference to insulin and glucagon. Abnormalities in glucose metabolism: Diabetes mellitus; types, causes, biochemical manifestations, diagnosis and treatment, glycated hemoglobin. Inborn errors of carbohydrate metabolism, glycosuria, Fructosuria, Pentosuria, Galactosemia and Glycogen storage diseases. **15Hrs**

Module II: Disorders of Lipid Metabolism**:** Lipid Profile, Atherosclerosis, Fatty liver and hyperlipidemia. Hypercholesterolemia, Lipidosis and Xanthomatosis, Tay-Sach`s disease, Niemann-Pick disease, lipotropic agents. **15Hrs**

Module III: Liver Function Tests**:** Bilirubin metabolism and jaundice, Estimation of conjugated and total bilirubin in serum (Diazo method). Detection of bilirubin and bile salts in urine (Fouchet's test and Hay's Sulphur test). Thymol turbidity test, prothrombin time, serum enzymes in liver disease serum transaminases (SGPT & SGOT) and lactate dehydrogenase (LDH).

Kidney Function Tests**:** Measurement of urine pH, volume, specific gravity, osmolality, sediments in urine, inulin, urea and creatinine clearance tests. Concentration and dilution tests. Phenol red test. Levels of plasma protein and its significance related to kidney function. Proteinuria. **15Hrs**

Module IV: Gastric Function test: Composition of gastric juice, collection of gastric contents, examination of gastric residuum, fractional test meal (FTM), stimulation test-alcohol and histamine stimulation, Tubeless gastric analysis. **15Hrs**

Module V: Clinical enzymology**:** Enzymes of diagnostic importance- LDH, creatine kinase, transaminases, phosphatases, Isoenzymes of lactate dehydrogenase. **15Hrs**

Course Outcomes

CO	**On completion of this course, students will be able to**	**Program outcomes**
CO1	Explain the concepts of hormones and their importance to Maintain glucose and types of Diabetes, diagnosis and treatment.	PO1,PO3,PO6
CO2	Analyze the lipid profile and different deficiency state.	PO1,PO3,PO6
CO3	Describe the liver and kidney functions and specific diagnosti Methods used for biological sample.	PO1,PO3,PO6
CO4	Detail about the composition of gastric juice and special test For diagnosis.	PO1,PO3,PO6
CO5	Elaborate the enzyme markers used for diagnostic studies.	PO1,PO3,PO6

Text books

1. MN Chatterjee and Rana Shinde,Text Book of Medical Biochemistry, Jaypee Brothers Medical Publishers (P) LTD, New Delhi, 8th Edition, 2012

2. Ambika Shanmugam's Biochemistry for medical students, 8th edition, published by Wolters Kluwer India Pvt. Ltd.

Reference books

1. Philip. D. Mayne, Clinical Chemistry in diagnosis and treatment.ELBS Publication, 6th edition, 1994.

2. Thomas M. Devlin (2014) Text book of Biochemistry with clinical correlations (7thed). John Wiley and sons.

3. Tietz Fundamentals of clinical chemistry and molecular Diagnostics (2014) (7thed) Saunders.

Web Resources

1. https://www.britannica.com/science/metabolic-disease/Disorders-of-carbohydrate-metabolism

2. https://www.slideshare.net/MohitAdhikary/gastric-and-pancreatic-function-tests

3.https://onlinecourses.nptel.ac.in/noc20_ge13/preview

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3		3			2	3	2	2	3
CO 2	3		3			2	3	2		3
CO 3	3		3			2	3	3	2	3
O 4	3		3			2	3	3	2	3
CO 5	3		3			2	3	3	2	3

S-Strong (3) M-Medium (2) L-Low (1)

THIRD YEAR: SEMESTER V

Course	**ELECTIVE THEORY - I**
Title of the Course	**IMMUNOLOGY**
Credit	**4**

Learning Objectives

The objectives of this course is to

- Introduce the structure and functions of lymphoid organs and cells of the immune system
- Illustrate the structure and classification of antibodies and adaptive immune response
- Impart knowledge on the types of immunity and uses of vaccines
- Provide an understanding of immune related diseases and transplantation
- Study the Ag-Ab interaction and immunological techniques to identify antigens and antibodies

Module I: Structure and function of primary lymphoid organs (thymus, bone marrow), secondary lymphoid organs (spleen, lymph node), Cells involved in immune system- Functions- Phagocytosis -Inflammation **15Hrs**

Module II: Antigens - Nature, Immunogens, and haptens, cross reactions - Immunoglobulin- types- structure and function. Cells involved in antibody formation, Clonal selection theory, Co-operation of T-cell with B-cell. Differentiation of T and B lymphocyte -Humoral and cell mediated immunity. Monoclonal antibody – Production and application in biology. **15Hrs**

Module III- Immunity and its types-Innate, Acquired, active and passive.- Natural and Artificial - Commonly used toxoid vaccines, killed vaccines, live attenuated vaccines, rDNA Vaccines, DNA and subunit vaccines **15Hrs**

Module IV: 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.

15Hrs

Module V: Antigen-antibody reactions, General features of Antigen Antibody reactions. Precipitation, Immuno diffusion, SID and DID -Oudin Procedure, Oakley Fulthrope Procedure, Radio immunodiffusion, Ouchterlony double diffusion, CIE, Rocket electrophoresis, Agglutination-Coomb's test Complement Fixation test-Wasserman's reaction, RIA, ELISA. 15Hrs

Course Outcomes

CO	**On completion of this course, students will be able to**	**Program outcomes**
CO1	Associate structure and function of the organs involved in our body's natural Defence	PO1
CO2	Classify antigens and antibodies and the role of lymphocytes in defending the host	PO1,PO2
CO3	Describe the types of immunity and the uses of vaccines	PO1, PO4
CO4	Understand the immune related diseases and mechanism of transplantation	PO1,PO2
CO5	Examine the immunological tests and relate it to the immune status of an Individual	PO1,PO3

Text Books

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

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

3. Tizard (1995). An Introduction to Immunology. Harcourt Brace College Publications

References Books

1. Kenneth M. Murphy, Paul Travers, Mark Walport - (2007), Janeway's Immunobiology, 7thedition, Garland Science.

2. Abul K. Abbas, Andrew H. Lichtman, Jordan S. Pober - (1994), Cellular and molecular immunology, 2ndedition, B. Saunders Company.

3. Basic Immunology Functions and Disorders of the Immune System, 6th Edition - January 25, 2019 Authors: Abul Abbas, Andrew Lichtman, Shiv Pillai, ISBN: 9780323549431eBook ISBN: 9780323639095

4. Peter Delves, Seamus Martin, Dennis Burton, Ivan Roitt - (2006), Roitt's Essential Immunology, 11th edition, Wiley-Blackwell

Web resources

1. https://onlinecourses.nptel.ac.in/noc22_bt40/preview
2. https://onlinecourses.swayam2.ac.in/cec20_bt05/preview
3. https://youtu.be/8uahFPl6ny8

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3						3			3
CO 2	3		2				3			3
CO 3	3			2			3	3		3
CO 4	3	2					3	1		3
CO 5	3		3				3	3	3	3

S-Strong (3) M-Medium (2) L-Low (1)

THIRD YEAR: SEMESTER V

Course	**ELECTIVE THEORY - II**
Title of the Course	**BIOCHEMICAL PHARMACOLOGY**
Credit	**4**

Learning Objectives

The objectives of this course are to

- Introduce the basic concepts of pharmacology.
- Explain the metabolism of drugs and factors responsible for metabolism.
- Acquaint the adverse response and side effects of drugs.
- Familiarize important drugs used for common metabolic disorders.
- Provide an understanding about the action of antibiotics.

Module I: Drugs – classification based on sources, routes of drug administration - Oral/Enteral, Parenteral and Local application. Absorption of drugs, factors influencing drug absorption, distribution and excretion of drugs. **15Hrs**

Module II: Drug metabolism - Phase I and Phase II reactions, role of cytochrome P_{450}, non-microsomal reactions of drug metabolism. Factors influencing drug metabolism. Therapeutic index. **15Hrs**

Module III: Drug allergy, Drug tolerance - IC 50, LD50 of a drug, Drug intolerance, Drug addiction, Drug abuses and their biological effects. Drug resistance - biochemical mechanism. **15Hrs**

Module IV: Therapeutic Drugs - Analgesics and Non-steroidal anti-inflammatory drugs (NSAIDs) – Aspirin and Acetaminophen. Insulin, Oral antidiabetic drugs - Sulfonylureas, Biguanides. Antihypertensive drugs - ACE inhibitors, Calcium channel blockers. Anti-cancer agents – Antimetabolites. **15Hrs**

Module V: Antibiotics - Definition, Examples and Biochemical mode of action of penicillin, streptomycin, tetracycline and chloramphenicol. **15Hrs.**

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Classify the different routes of drug administration, describe the Absorption, distribution, metabolism and excretion of drugs.	PO1
CO2	Illustrate the metabolism of drugs, classify the microsomal and non-Microsomal reactions and explain the role of cytochromes.	PO1
CO3	List out the various adverse response and side effects of drugs.	PO1,PO2,PO4
CO4	Justify the use of synthetic drugs and elucidate its pharmacological Actions and its adverse effects for different disease.	PO1,PO4
CO5	Highlight the importance and explain the mode of action of important Antibiotics.	PO1,PO4

Text Books

1. N. Murugesh, A concise text book of Pharmacology –Sathya Publishers.
2. Jayashree Ghosh, A Textbook of Pharmaceutical chemistry –S. Chand & Company Ltd.
3. S C Metha, Ashutosh Kar, Pharmaceutical Pharmacology –New Age International (P) Limited, Publishers.

References Books

1. Lippincott's illustrated Reviews- Pharmacology by Mary J.Mycek, Richard A.Harvey, Pamela C. Champe, Lippincott – Raven publishers, New Delhi.
2. David. E. Golan, Principles of Pharmacology, Wolters Kluwer (India) Pvt.Ltd.
3. R.S. Satoskar, S. B. Elsevier Pharmacology and pharmacotherapy. - ISBN-10: 9788131248867 / ISBN-13: 978-8131248867, 2017.
4. Tripathi, K.Essentials of Medical Pharmacology. Jaypee Publishers- ISBN-10: 9350259370 / ISBN-13: 978-9350259375.2018.

Web Resources

https://slideplayer.com/slide/3728296/64/video/What+is+bioremediation%3F.mp4

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3						3			3
CO 2	3						3			3
CO 3	3	2		2			3	2		3
CO 4	3			2			3	2		3
CO 5	3			2			3	2		3

S-Strong (3) M-Medium (2) L-Low (1)

THIRD YEAR: SEMESTER V

Course	**ELECTIVE THEORY - III**
Title of the Course	**RESEARCH METHODOLOGY**
Credit	**4**

Learning objectives

The objectives of the course are to:

- Introduce the components of research.
- Acquaint on the experimental design and literature survey
- Analyse the data and find out the significance statistically
- Highlight the importance of computation in research.
- Provide mechanics of writing a research report hands-on experience in designing and working on small projects.

Module I: Characteristics and types of Research, Research Methods versus Methodology, Research designs in Biochemistry: experimental, *in vitro, in vivo, in situ*, clinical trials. Identification and criteria of selecting a research problem (Hypothesis); Formulation of objectives; Research plan and its components. **15Hrs**

Module II: Experimental design - Objective, Design of work, Guidelines for design of experiments, Literature Search - Databases for literature search, Material and methods, Designing biological experiments, Compilation and documentation of data. **15Hrs**

Module III: Statistical Analysis: Measures of variation - standard deviation, Non-linear regression, Standard error. Analysis of variance for one-way and two-way classified data and multiple comparison procedures. Significance - students "t" test, chi-square test. Dunnet's test. **15Hrs**

Module IV: Computer and its role in research: Basics of MS word, MS Excel: tabulation, calculation and data analysis, preparation of graphs, histograms and charts. Use of statistical software SPSS. Power Point: preparation of presentations and scientific poster designing. 15hrs.

Module V: Scientific writing for journals - Preparation of Abstract, Impact factor, h-index, i-10 index, citation index, Dissertation/Thesis writing: format, content and chapterization, writing style, drafting titles & sub-titles, captions and legends. Writing results, discussion and conclusions. Bibliography and references, referencing style - Harvard and Vancouver systems, Appendices and acknowledgement; Ethical issues in research; Intellectual property right and plagiarism. 15 Hrs

Course Outcomes

CO	On completion of this course, students will be able to	Programme outcome
CO1	Explain the types of research and formulate and plan the research.	PO1,PO3
CO2	Design experimental setup, review the literature, compile and document the data.	PO1,PO3
CO3	Analyze and validate the experimental data using statistical tools	PO1,PO2,PO3
CO4	Interpret the data using computational tools.	PO1,PO2,PO3
CO5	Compile and draft a research report, present results findings and publish ethically.	PO1,PO3,PO4

Text Books

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.

2. Kothari, C.R., Research Methodology: Methods and Techniques. 2004, New Age International.

3. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Publications.2 volumes.

4. Gurumani.N, Research Methodology for biological Sciences, 2014, MJP Publishers.

Reference Books

1. Dr. Prabhat Pandey, Dr.Meenu Mishra Pandey, Research Methodology: Tools and Techniques 2015

2. Coley, S.M. and Scheinberg, C. A., 1990, "Proposal Writing", Sage Publications.

4. Day, R.A., 1992.How to Write and Publish a Scientific Paper, Cambridge University Press.

5. Fink, A., 2009. Conducting Research Literature Reviews: From the Internet to Paper. Sage Publications

6. Scientific Thesis Writing and Paper Presentation. MJP Publishers.2010

7. Research Methodology (2 Vols-Set), Suresh C. Sinha and Anil K. Dhiman, Vedams Books (P) Ltd.2002.

Web Resources

1. https://explorable.com/research-methodology
2. http://www.scribbr.com
3. http://www.open.edu
4. http://www.macmillan .ihe.com.

Mapping with Program Outcomes

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1	3		3				3			3
CO 2	3		3				3	3	3	3
CO 3	3	2	3				3	3	3	3
CO 4	3	2	3				3	3	3	3
CO 5	3		3	2			3	3	33	3

S- Strong (3) M-Medium (2) L-Low (1)

THIRD YEAR: SEMESTER V

Course	**CORE PRACTICAL - V**
Title of the Course	**PRACTICAL V CLINICAL BIOCHEMISTRY**
Credit	**4**

Learning Objectives

The objectives of this course are to

- Introduce the methods of sample collection (blood & urine) for analytical purpose.
- Impart practical knowledge on the assay of activity of various diagnostically important enzymes
- Understand the estimation procedure for various important biomolecules.
- Help students learn the routine qualitative analysis of urine sample for diagnostic purpose.
- Train students on various hematological tests and its significance.

1. Collection and preservation of blood and urine samples.

2. Estimation of creatinine by Jaffe's method (serum & urine)

3. Estimation of urea by diacetyl monoxime method (serum & urine)

4. Estimation of uric acid (serum & urine)

5. Estimation of cholesterol by Zak's method

6. Estimation of Glucose by Ortho Toluidine method

7. Estimation of Protein by Lowry's method

8. Estimation of Hemoglobin by Shali's/Drabkins method

9. Assay of SGPT and SGOT

10. Qualitative analysis of

A) Normal constituents of urine

a) Urea, b) Creatinine, c) Phosphorus, d) Calcium

B) Abnormal constituents

a) Calcium

b) Sugar (Glucose, fructose, pentose)

c) Protein

d) Amino acids (Tyrosine, Histidine, Tryptophan)

e) Ketone bodies

f) Bile pigments with clinical significance. 80 Hrs

DEMONSTRATION EXPERIMENTS (10 Hrs.)

HEMATOLOGY

a. RBC Counting

b. Total and differential count of white blood cells

c. Packed cell volume

d. Erythrocyte sedimentation rate

e. Blood clotting time

f. Blood grouping

Course Outcomes

CO	On completion of this course, students will be able to	Programme outcome
CO1	Acquaint knowledge on collection of biological samples (urine, blood) And their preparation for diagnostic purpose.	PO1,PO2
CO2	Assay the activity of various clinically important enzymes and relate Their clinical importance.	PO1,PO2
CO3	Estimate the important biomolecules in biological samples and relate their clinical significance	PO1,PO2,PO3,PO6
CO4	Qualitatively analyze urine sample for normal and abnormal constituents in urine and interpret the results	PO1,PO2,PO3
CO5	Perform the routine hematological tests.	PO1,PO2,PO3,PO6

Text Books

1. Manickam, S.S. (2018).Biochemical Methods (3rd Ed.).New age International PvtLtd publishers - ISBN 10: 8122421407 / ISBN 13: 9788122421408

2. Plummer, D.T. An Introduction to Practical Biochemistry. Tata Mc GrawHill-ISBN: 97800708416

3. Alan H Gowenlock. 1998. Varley's Practical Clinical Biochemistry, 6th edition, CBS Publishers, India.

4. B. Godkar. 2020. Textbook of Medical Laboratory Technology Vol 1 & 2 Paperback, 3rd edition, Bhalani Publishers.

5. Kanai L Mukerjee. 1996. Medical Lab Technology, Vol I& II, 1st edition, Tata Mcgraw Hill, Pennsylvania.

6. Ranjna Chawla. 2014. Practical Clinical Biochemistry Methods and interpretations 58 (Paperback). 4th edition, Jaypee Brothers Medical Publishers, New York.

Reference books

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

2. Ashwood, B. a. (2001). Tietz, Fundamentals of Clinical chemistry. WB Saunders Company, Oxford Science Publications USA - ISBN 10: 0721686346 / ISBN 13: 978072168634

Web resources

1. https://www.elsevier.com/journals/clinical-biochemistry/0009-9120/guide-for-authors

2. http://rajswasthya.nic.in/RHSDP%20Training%20Modules/Lab.%20Tech/Biochemistry/Dr.%20Jagarti%20Jha/Techniques%20In%20Biochemistry%20Lab.pdf

3.https://dspace.cuni.cz/bitstream/handle/20.500.11956/111493/Clinical_biochemistrypdf.Pdf? Sequence=1&isAllowed=y

4.https://dspace.cuni.cz/bitstream/handle/20.500.11956/111493/Clinical_biochemistrypdf.pdf?sequence=1&isAllowed=y *

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3	3					3	3	3	3
CO 2	3	3					3	3	3	3
CO 3	3	3	3			3	3	3	3	3
CO 4	3	3	2				3	3	3	3
CO 5	3	3	3			3	3	3	3	3

S-Strong (3) M-Medium (2) L-Low (1)

THIRD YEAR: SEMESTER VI

Course	**CORE THEORY - XIII**
Title of the Course	**MOLECULAR BIOLOGY**
Credit	**4**

Learning Objectives

The objectives of this course are to

- Provide insights into the central dogma of molecular biology and explain the mechanism of DNA replication.
- Elaborate the mechanism of transcription and reverse transcription.
- Highlight the characteristics of genetic code and describe the process of protein synthesis.
- Introduce the concept of regulation of gene expression in prokaryotes
- Familiarize the different types of mutations and explain the mechanism of DNA repair.

Module I: Central Dogma of molecular Biology, DNA as the unit of inheritance. Experimental evidences by Griffith's transforming principle, Avery, McLeod and McCarthy's experiment, and Hershey and Chase Experiment. Replication in prokaryotes: Modes of replication, Meselson and Stahl's experimental proof for semiconservative replication. Mechanism of Replication – Initiation, events at Ori C, Elongation – replication fork, semi discontinuous replication, Okazaki fragments, and termination. Bidirectional replication, Inhibitors of replication. Models of replication-theta, rolling circle and D loop model. **15Hrs**

Module II: Transcription - Mechanism of transcription: DNA dependent RNA polymerase(s), recognition, binding and initiation sites, TATA/ Pribnow box, elongation and termination. Post-transcriptional modifications; inhibitors of transcription. RNA splicing and processing of mRNA, tRNA and rRNA. Reverse transcription. **15 Hrs.**

Module III: Genetic Code and its characteristics, Wobble hypothesis. Translation: Adaptor role of tRNA, Activation of amino acids, Initiation, elongation and termination of protein synthesis, post-translational modifications and inhibitors of protein synthesis. **15Hrs**

Module IV: Regulation Of Gene Expression In Prokaryotes – Principles of gene regulation, negative and positive regulation, concept of operons, regulatory proteins, activators, repressors, regulation of lac operon and trp operon. **15Hrs**

Module V: Mutation: Types-Nutritional, Lethal, Conditional mutants. Missense mutation and other point mutations. Spontaneous mutations; chemical and radiation – induced mutations.DNA repair: Direct repair, Photo reactivation, Excision repair, Mismatch repair, Recombination repair and SOS repair. **15Hrs**

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Illustrate the Central Dogma of molecular biology, explain the Multiplication of DNA in the cell and describe the types and modes of replication.	PO1
CO2	Elaborate the mechanism of transcribing DNA into RNA and Discuss the formation of different types of RNA.	PO1
CO3	Decipher the genetic code and summarize the process of translation.	PO1
CO4	Comprehend the principles of gene expression and explain the Concept of operon in prokaryotes.	PO1,PO2
CO5	Distinguish the types of mutations and explain the various mechanisms of DNA repair.	PO1,PO2

Text books

1. Veer Bala Rastogi, 2008, Fundamentals of Molecular Biology, 1st edition, An eBooks India.

2. David Friefelder, 1987, Molecular Biology, 2nd edition, Narosa Publishing House.

3. Dr.P.S.Verma and Dr.V.K.Agarwal, 2013, Cell biology, Genetics, Molecular biology, Evolution and Ecology, 1stedition, S.Chand & Company Pvt.Ltd.

Reference books

1. Karp, G., 2010, Cell and Molecular Biology: Concepts and Experiments, 6th edition, John Wiley & Sons. Inc.

2. De Robertis, E.D.P. and De Robertis, E.M.F., 2010, Cell and Molecular Biology, 8th edition, Lippincott Williams and Wilkins, Philadelphia.

3. James. D. Watson, 2013, Molecular Biology of the Gene 7th edition, Benjamin Cummings.

4. George M. Malacinski, 1992, Freifelder's Essentials of Molecular Biology, 4th edition, Narosa publishing House.

Web resources

1. www.mednotes.net/notes/biology
2. https://www.onlinebiologynotes.com/repair-mechanism-of mutation/
3. https://teachmephysiology.com/biochemistry/protein-synthesis/dna-translation/

Mapping with Program Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3						3			3
CO 2	3						3			3
CO 3	3						3			3
CO 4	3	2					3			3
CO 5	3	2					3	1		3

S-Strong (3) M-Medium (2) L-Low (1)

THIRD YEAR: SEMESTER - VI

Course	**CORE THEORY - XIV**
Title of the Course	**HUMAN PHYSIOLOGY**
Credit	**4**

Learning Objectives

The main objectives of this course are to

- Aid in understanding the physiology of respiratory and circulatory systems
- Explain the structure and physiology of the nervous and muscular system
- Explicate the functions of digestive and excretory system of the body.
- Impart knowledge about the process of reproduction.
- Emphasize the importance of various endocrine factors that regulate metabolism, growth, homeostasis and reproduction.

Module I: Respiratory System – Overview of respiratory system, Types of respiration, Transport of respiratory gases, Exchange of respiratory gases in lungs and tissues –Chloride Shift & Bohr's effect, Lungsurfactant. Circulatory System-Structure and functions of the Heart. Arterial and venous system, Cardiac cycle, Pace maker, Blood pressure and Factors affecting blood pressure. **15Hrs**

Module II: Nervous system- Structure of neuron, synaptic transmission, reflex action, neurotransmission- Resting membrane and Action potential. neurotransmitters- acetylcholine, Nor adrenaline, Dopamine, Serotonin, Histamine, GABA, Substance P. Muscular system-structure and types of muscles - skeletal, smooth and cardiac muscles, muscle proteins- types and functions, mechanism of muscle contraction. **15Hrs**

Module III: Digestive system- composition, functions of saliva, gastric pancreatic intestine and bile secretions, structure of digestive system, Digestion, absorption of carbohydrates, lipids, proteins. Excretory system – Structure of nephron, mechanism of urine formation, Concentration and acidification of Urine. Role of kidneys in the maintenance of acid base balance. **15Hrs**

Module IV: Reproductive system: Oogenesis, spermatogenesis, capacitation and transport of sperm- blood testis barrier. Fertilization, early development, Implantation, Placentation and Parturition. 15Hrs

Module V: Endocrinology- Classification of hormones, endocrine glands and their secretions, structure and functions of Insulin, thyroxine. Steroid hormones - Corticosteroids, Sex hormones – testosterone and estrogen, menstrual cycle. 15Hrs

Course Outcomes

CO	**On completion of this course, students will be able to**	**Program outcomes**
CO1	Explain the exchange of gases, design of blood vessels and cardiac Cycle.	PO1
CO2	Summarize the events in transmission of nerve impulses mechanism of muscle contraction.	PO1
CO3	Elaborate the structure and functions of digestive system, structure of nephron and mechanism of urine formation and role of kidney In maintenance of pH.	PO1
CO4	Describe the process of Oogenesis, Spermatogenesis, Fertilization, And Parturition.	PO1,PO2
CO5	Understand the role of different hormones that regulate Metabolism, growth, glucose homeostasis and reproductive function.	PO1.PO2

Text books

1. K.Sembulingam & Prema Sembulingam, 2016, Essentials of Medical Physiology, 7th edition, Jaypee Brothers Medical Publishers (P) Ltd.
2. Chatterjee.C.C., 1988, Human Physiology – VolI & II, 1st edition, Medical Allied Agency.
3. Animal Physiology – Mariakuttikan and Arumugam, Saras publication, 2017.

Reference books

1. Text book of medical biochemistry physiology- MN. Chatterjee and Rana shinde, 7th edition, Jaypee brothers- medical publishers, 2007.
2. Meyer, Meyer & Meij, 2002, Human Physiology, 3rd edition, A.I.T.B.S Publishers.
3. Guyton and Hall, 2011, Textbook of Medical Physiology, 12th edition, W.B. Saunders Company.

4. Textbook of Medical Physiology –Guyton & Hall,12th edition, Saunders Publishers, 2010
5. Human anatomy and physiology–Elaine N. Marieb, 3rd edition, Benjamin/Cummings (a Pearson educationcompany), 1995.

Web resources

https://www.youtube.com/watch?v=6qnSsV2syUE

https://www.youtube.com/watch?v=9_h0ZXx1lFw

https://slideplayer.com/slide/9431799/

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3						3	2		3
CO 2	3						3	2		3
CO 3	3						3	2		3
CO 4	3	3					3	2		3
CO5	3	3					3	2		3

S-Strong (3) M-Medium (2) L-Low (1)

THIRD YEAR: SEMESTER- VI

Course	**CORE THEORY - VX**
Title of the Course	**PLANT BIOCHEMISTRY AND PLANT THERAPEUTICS**
Credit	**4**

Learning Objectives

The main objectives of this course are to

- Convey the knowledge of photosynthesis.
- Detail the structure and types of secondary metabolites.
- Impart the idea on various plant hormones.
- Emphasize the effects of free radicals and the importance of antioxidants
- Understand the role of medicinal plants in treating diseases.

Module I: Photosynthesis- Photosynthesis apparatus, pigments of photosynthesis, photo chemical reaction, photosynthetic electron transport chain, path of carbon in photosynthesis- Calvin cycle, Hatch – lack pathway (4 ways) CAM path way, significance of photosynthesis. **15Hrs**

Module II: Secondary metabolites: Structure, Types, Sources, Biosynthesis and function of phenolics, tannins, lignins, terpenes and alkaloids. Medicinal properties of secondary metabolite. **15Hrs**

Module III: Plant hormones Structure and function of plant hormones such as ethylene, cytokinins, auxins, Absicic acid, Florigin and Gibberlins . **15Hrs**

Module IV: Free radicals, types, production, free radical induced damages, lipid peroxidation, reactive oxygen species, antioxidant defense system, enzymatic and non-enzymatic antioxidants, role of antioxidants in prevention of disease, phytochemicals as antioxidants. **15Hrs**

Module V: Plant therapeutics: Bioactive principles in herbs, plants with antidiabetic, anticancer, antibacterial, antiviral, anti-malaria and anti-inflammatory properties. **15Hrs**

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Gain knowledge on photosynthetic apparatus, pigments present, pathways, and significance of photosynthesis	PO1
CO2	Learn in detail about the structure, types, sources, and biosynthesis and functionssecondary metabolites.	PO1,PO3
CO3	Understand the structure and functions of plant hormones.	PO1
CO4	Discuss about free radicals, types and its harmful effects. Role of enzymatic and non-enzymatic antioxidant in defence mechanism, prevention in disease.	PO1,PO2.PO3
CO5	Identify the plants with antidiabetic, anticancer, antibacterial, antiviral, anti-malaria and anti-inflammatory properties.	PO1, PO2,PO3

Text books

1. Singh M.P and Panda. H2005. Medicinal Herbs with their formulations, Daya publishing house, Delhi

2. Plant Physiology-Devlin N.Robert and Francis H.Witham,CBS Publications

3. Molecular activities of plant cell – An Introduction to Plant Biochemistry. John. W.

4. Anderson and John Brardall, Black well Scientific Publications, 1994.

Reference books

1. Khan, I.A and Khanum.A2004.Role of biotechnology in medicinal and aromatic plants,Vol.1and Vol.10, Ukka 2 publications, Hyderabad.

2. Plant Biochemistry and Molecular Biology – Hans Walter Heldt, Oxford University, 4th Edition, 2010

3. Plant biochemistry (2008), Caroline bowsher, Martin steer, Alyson Tobin, garlandscience.

4. Plant physiology and development (sixth edition) by Lincoln Taiz ,Eduardo Zeiger , Ian Max Moller and Angus Murphy publisher ; Oxford university press

Web resources

1 https://www.intechopen.com/books/secondary-metabolites-sources-and-applications/anintroductory-chapter-secondary-metabolites

2 https://www.toppr.com/guides/biology/plant-growth-and development/plant growth

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3						3			3
CO 2	3		2				3	3		3
CO 3	3						3			3
CO 4	3	3	3				3	3		3
CO5	3	3	3				3	3		3

S-Strong (3) M-Medium (2) L-Low (1)

THIRD YEAR

SEMESTER VI

Course	**ELECTIVE THEORY - IV**
Title of the Course	**BIOTECHNOLOGY**
Credit	**3**

Learning Objectives

The main objectives of this course are to

- Impart knowledge on gene manipulation and gene transfer technologies
- Make the students understand the procedures involved in plant tissue culture.
- Acquire knowledge on animal cell culture and stem cell technology.
- Improve the employability skills of students by providing knowledge in recent techniques such as PCR, blotting, ELISA etc.
- Understand the application of fermentation technology.

Module I: Recombinant DNA technology

Recombinant DNA technology - Principles of gene cloning: restriction endonucleases and other enzymes used in manipulating DNA molecules. Ligation of DNA molecules, DNA ligase, linkers and adapters, homopolymer tailing, end labeling and construction maps of pBR322, λ bacteriophage. **15Hrs.**

Module II: Plant Tissue culture

Plant tissue culture- basic requirements for culture, M S medium, callus culture, protoplast culture. Vectors – Ti plasmid (cointegration vector and binary vector), viral vectors- TMV, CaMV and their applications. Transgenic plants – pest resistant, herbicide resistant and stress tolerant plants**.** **15Hrs**.

Module III: Animal Tissue culture

Animal cell lines and organ culture - culture methods and applications. Transgenic animals: transgenic mice- Production and its applications. Stem cell technology: definition, types, and applications. **15Hrs**.

Module IV: Molecular Techniques

PCR –Principle, types and its application in clinical diagnosis and forensic science. Southern blotting, Northern blotting and DNA finger printing Technique-principle and their applications. **15Hrs**

Module V: Fermentation technology

Fermentation technology – Fermentors - general design, fermentation processes - Media used, downstream processing. Production and applications of ethanol, Streptomycin and Proteases. Production of edible vaccines. **15Hrs**

Course Outcomes

CO	**On completion of this course, students will be able to**	**Program outcomes**
CO1	Acquire knowledge on rDNA technology, DNA manipulation, and use of restriction endonuclease	PO1,PO3
CO2	Get acquainted with the use of cloning and vectors in plant tissue culture.	PO1,PO2,PO3
CO3	Understand the methods for production of proteins using recombinant DNA technology and their applications, basics of tissue culture, transgenesis, stem cell technology, risks, and safety aspects and patenting in biotechnology	PO1,PO3
CO4	Gain knowledge about the importance of gene and gene manipulation technologies	PO1,PO3
CO5	Know the concept fermentation technology and its applications.	PO1,PO3

Text Books

1. James D. Watson, Amy A. Caudy , Richard M. Myers , Jan Witkowski (2006) Recombinant DNA: Genes and Genomes - a Short Course (3rd ed), W.H.Freeman & Co

2. Satyanarayana U (2008), Biotechnology, Books & Allied (P) Ltd.

3. Cassida L (2007) Industrial Microbiology, New Age International

Reference books

1. Reed G (2004) Prescott and Dunn's Industrial Microbiology, CBS Publishers & Distributors

2. Biotechnology: applying the genetic revolution- David P. Clark, Pazdernik N. J, Elsevier (2009).

3. Click B.R. and Pasternark J.J (2010). Molecular Biotechnology: Principles and Applications of Recombinant DNA. (4th ed) American Society for Microbiology

Web Sources

NPTEL Certification course - Gene Therapy by Sachin Kumar https://nptel.ac.in/courses/102/103/102103041/

Coursera Certification course –Vaccines

https://futureoflife.org/background/benefits-risks-biotechnology/

https://www.sciencedirect.com/topics/neuroscience/genetic-engineering

http://www.biologydiscussion.cm/biotechnology/techniques-biotechnology/important-techniques-of-biotechnology-3-techniques/15683

https://iopscience.iop.org/book/978-0-7503-1347-6/chapter/bk978-0-7503-1347-6ch1

https://www.slideshare.net/zeal_eagle/fermentation-technology

https://www.slideshare.net/zeal_eagle/fermentation-technology

https://www.slideshare.net/Chepkitwai/blotting-techniques-6129300

Mapping with Program Outcomes

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1	3		3		3	3	3	3	3	3
CO 2	3		3		3	3	3	3	3	3
CO 3	3		3		3	3	3	3	3	3
CO 4	3		3		3	3	3	3	3	3
CO5	3		3		3	3	3	3	3	3

S-Strong (3) M-Medium (2) L-Low (1)

THIRD YEAR: SEMESTER- VI

Course	**ELECTIVE THEORY - VII**
Title of the Course	**BIOINFORMATICS**
Credit	**3**

Learning Objectives

The objective of this course is to

- Impart knowledge on bioinformatics and applications
- Learn about biological databases
- Understand the local and global sequence alignment
- Provide insights on BLAST and Microarray
- Familiarize about structural genomics and visualization tools

Module 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 applications. **15Hrs**

Module II : Biological Databases - definition, types and examples – Nucleotide sequence database (NCBI, EMBL, Genebank, DDBJ) Protein sequence database- SwissProt, TrEMBL, Structural Database - PDB, Metabolic database-KEGG. **15Hrs**

Module III: Sequence Alignment-Local and Global alignment-Dot matrix analysis, PAM, BLOSUM. Dynamic Programming, Needleman- Wunch algorithm, Smith waterman algorithm. Heuristic methods of sequence alignment. **15Hrs**

Module IV: BLAST-features, types (BLASTP, BLASTN, BLASTX), PSI BLAST, result format. DNAMicroarray-Procedure and applications. **15Hrs**

Module 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 and applications. **15 Hrs.**

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Introduce the fundamentals of Bioinformatics and its applications Genome, metabalome & Transcriptome.	PO1
CO2	Classify biological database and to correlate the different file formats Used by nucleic acid, protein database, structural and metabolic database.	PO1, PO2. PO3
CO3	Develop algorithms for interpreting biological data.	PO1,PO2
CO4	Discuss the concepts of sequence alignment and its types. Understand the tool used to detect the expression of genes	PO1.PO2, PO3
CO5	Apply the various tools employed in genomic study and protein visualization. Analyze the entire genome by shot Gun method.	PO1.PO2

Text books

1. Basic of Bioinformatics by Rui Jiang Xuegong Zhang and Michael Q. Zhang Editors

2. Bioinformatics for Beginners Genes, Genomes, Molecular Evolution, Databases and Analytical Tools By: Supratim Choudhuri (Author)

3. Bioinformatics by Saras publication

4. Introduction to Bioinformatics by Arthur Lesk

Reference books

1. Computation in BioInformatics Multidisciplinary Applications S Balamurugan, Anand T. Krishnan, Dinesh Goyal, Balakumar Chandrasekaran

2. Chemoinformatics and Bioinformatics in the Pharmaceutical Sciences
Navneet Sharma PhD Pharmaceutics, Himanshu Ojha, Pawan Raghav, Ramesh K. Goyal

Web resources

1. https://nptel.ac.in/courses/102/106/102106065/

2. http://www.digimat.in/nptel/courses/video/102106065/L65.html

3. https://www.slideshare.net/sardar1109/bioinformatics-lecture-notes

Mapping with Program Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3						3		2	3
CO 2	3	3	3				3		3	
CO 3	3	3					3		3	
CO 4	3	3	3				3		3	
CO5	3	3					3		3	

S-Strong (3) M-Medium (2) L-Low (1)

THIRD YEAR: SEMESTER VI

Course	**ELECTIVE THEORY - VIII**
Title of the Course	**BIOENTREPRENEURSHIP**
Credit	**3**

Learning Objectives

The objectives of this course is to

- Impart knowledge on bio entrepreneurship and the types of industries
- Learn about business plan, proposal and funding agencies
- Understand the market strategy and the role of information technology in expansion of business
- Provide insights on legal requirement and accounting to establish as Bio entrepreneurship
- Familiarize about business bio incubators centers

Module I: Introduction to Bio entrepreneurship; Types of industries – Biopharma, Bio agriculture and CRO; Introduction to Trademarks, Copyrights and patents. **15 Hrs.**

Module II: Business Plan, Budgeting and Funding Idea or opportunity; Business proposal preparation; funds/support from Government agencies like MSME/banks, DBT, BIRAC, Start-up and make in India Initiative; dispute resolution skills; external environment changes; avoiding/managing crisis; Decision making ability. **15 Hrs.**

Module III: Market Strategy- Basics of market forecast for the industry; distribution channels – franchising, policies, promotion, advertising, branding and market; Introduction to information technology for business administration and Expansion. **15 Hrs.**

Module IV: Legal Requirements, Finance and Accounting; Registration of company in India; Ministry of Corporate Affairs (MCA); basics in accounting: introduction to concepts of balance sheet, profit and loss statement, double entry, bookkeeping; finance and break-even analysis; difficulties of entrepreneurship in India. **15 Hrs.**

Module V: Role of knowledge centers such as universities, innovation centers, research institutions (public & private) and business incubators in Entrepreneurship development; quality control and quality assurance; Definition, role and importance of CDSCO, NBA, GLP, GCP, GMP**.** **15 Hrs**

Course Outcomes

After completion of the course the students will be able to

CO	**On completion of this course, students will be able to**	**Program outcomes**
CO1	Understand the concept and scope for entrepreneurship	PO1
CO2	Identify various operations involved in a venture creation	PO1.PO5,PO6
CO3	Gather funding and launching a winning business	PO1.PO5,PO6
CO4	Nurture the organization and harvest the rewards	PO1.PO5,PO6
CO5	Illustrate about the Business incubator centres and Bio entrepreneurship	PO1.PO5,PO6

Text books

1. Adams, D. J. (2008). Enterprise for life scientists: Developing innovation and entrepreneurship in the biosciences. Bloxham: Scion - ISBN 10: 1904842364 / ISBN 13: 9781904842361

2. Shimasaki, C. (2014). Biotechnology Entrepreneurship: Starting, managing, and Leading Biotech Companies. Academic London Press - ISBN 10: 0124047300 / ISBN 13: 9780124047303

3. Onetti, A (2015). Business modeling for life science and biotech companies: Creating value and competitive advantage with the milestone bridge. Routledge - ISBN 10: 1138616907 / ISBN 13: 9781138616905

4. Kapeleris, D. H. (2006). Innovation and entrepreneurship in biotechnology: Concepts, theories & cases - ISBN-13: 978-1482210125, ISBN-10: 1482210126

Reference books

1. Desai, V. (2009). The Dynamics of Entrepreneurial Development and Management New Himalaya. New Himalaya House Delhi:pub - ISBN : 9789350440810 9350440814

2. Ono, R. D. (1991). The Business of Biotechnology, From the Bench of the Street. Butterworth-Heinemann - ISBN 10: 1138616907 / ISBN 13: 9781138616905

3. Jordan, J. F. (2014). Innovation, Commercialization, and Start-Ups in Life Sciences. London: CRC Press - ISBN-10 : 812243049X ,ISBN-13 : 978-8122430493

Web sources

1. http://www.simplynotes.in/e-notes/mbabba/entrepreneurship-development/

2.https://openpress.usask.ca/entrepreneurshipandinnovationtoolkit/chapter/chapter-1-introduction to-entrepreneurship/

Mapping with Program Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1	2						3			3
CO 2	2				2	3	3			3
CO 3	2				2	3	3			3
CO 4	2				2	3	3		3	3
CO 5	2				2	3	3			3

S-Strong (3) M-Medium (2) L-Low (1)

ALLIED COURSES OFFERED BY BIOCHEMISTRY

FIRST YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23UBCAT01	**Allied Biochemistry I**	(Theory) Allied I	2	1	-	-	2	2	25	75	100

Learning objectives

The objectives of this course are to

- Introduce the structure and classification of carbohydrates
- Comprehend the metabolism of carbohydrates
- Study the classification and properties of amino acids
- Elucidate the various levels of organization of Proteins
- Study functions and deficiency diseases of vitamins

Module I: Definition and classification of carbohydrates, linear and cyclic forms (Haworth projection) for glucose, fructose and mannose and disaccharides (maltose, lactose, sucrose).General properties of monosaccharides and disaccharides. Occurrence and significance of polysaccharides. 12Hrs

Module II: Metabolism- Catabolism and Anabolism. Carbohydrate metabolism- Glycolysis, TCA cycle, HMP shunt and glycogen metabolism and energetic. 12Hrs

Module III: Amino acids -Classifications, physical properties - amphoteric nature, isoelectric point and chemical reactions of carboxyl, amino and both groups. Amino acid metabolism transamination,deamination and decarboxylation. 12Hrs

Module IV: Proteins- classification - biological functions, physical properties- ampholytes, isoelectric point, salting in and salting out, denaturation, nature of peptide bond. Secondary structure, α-helix and β-pleated sheet, tertiary structure, various forces involved- quaternary structure. 12Hrs

Module V: Vitamins- Fat (A, D, E and K) and water soluble vitamins (B complex and C) - sources, RDA, biological functions and deficiency diseases. 12 Hrs

Course Outcome

CO	On completion of this course, students will be able to	Programme Outcome
CO1	Classify the structure of carbohydrates and its properties	PO1
CO2	Explain the metabolism of carbohydrates and its significance	PO1
CO3	Classify amino acids and its properties	PO1
CO4	Explain the classification and elucidate the different levels of structural organization of proteins	PO1
CO5	Identify the disease caused by the deficiency of vitamins	PO1

Text Books

1 Satyanarayan, U (2014) Biochemistry (4th ed), Arunabha Sen Books & Allied (P) Ltd, Kolkata.

2. Jain J.L. (2007) Fundamentals of Biochemistry, S. Chand publishers 311

Reference books

1. David L. Nelson and Michael M. Cox (2012) Lehninger Principles of Biochemistry (6th ed) W.H.Freeman.

2. Voet.D &Voet. J.G (2010) Biochemistry, (4th ed), John Wiley & Sons, Inc.

3. Lubert Stryer (2010) Biochemistry, (7th ed), W.H.Freeman

4. Satyanarayan,U (2014) Biochemistry (4th ed), Arunabha Sen Books & Allied (P) Ltd, Kolkata.

5. Jain J.L.(2007) Fundamentals of Biochemistry, S. Chand publishers 31

Web sources

1. onlinecourses.swayam2.ac.in/cec20_bt12

2 onlinecourses.swayam2.ac.in/cec20_bt19

Mapping with Program Outcome

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3						3			3
CO 2	3						3			3
CO 3	3						3			3
CO 4	3						3			3
CO5	3						3	3		3

S - Strong (3) M - Medium (2) L –Low (1)

FIRST YEAR: SEMESTER I

ALLIED BIOCHEMISTRY PRACTICAL-I

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23UBCAP01	Allied Biochemistry Practical I	Allied Practical I	-	-	3	-	1	2	40	60	100

Learning objectives

- Identify carbohydrates by qualitative test
- Estimate biomolecules volumetrically
- Estimate protein quantitatively

I Qualitative analysis of carbohydrates- 25Hrs

a) Monosaccharides-Glucose, Fructose

b) Disaccharides- Lactose, Maltose, Sucrose

c) Polysaccharides-Starch

II Volumetric analysis 15 Hrs

a) Estimation of ascorbic acid using 2,6 dichlorophenol indophenol as link solution

b) Estimation of Glucose by Benedict's method

c) Estimation of Glycine by Sorenson Formal titration

III Quantitative analysis (Demonstration Expt) **5 hrs**

a) Colorimetric estimation of protein by Biuret method

Course Outcome

CO	On completion of this course, students will be able to	Program Outcomes
CO1	Qualitatively analyze and report the type of carbohydrate based on specific tests	PO1,PO2.PO3
CO2	Quantitatively estimate the carbohydrates, amino acids and ascorbic acid	PO1,PO2,PO3
CO3	Estimate protein by colorimetric method	PO1,PO2,PO3

Text books

1. Laboratory manual in Biochemistry, J. Jayaraman, 2nd edition, New Age International Publishers, 2011,

2. An Introduction to Practical Biochemistry, David T. Plummer, 3rd edition, Tata McGraw-Hill Publishing Company Limited, 2001.

3. Biochemical Methods, Sadasivam S and Manickam A, 4h edition, New Age International Publishers, 2016

Mapping with Program Outcomes

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1	2	3	3				3	3	3	3
CO 2	2	3	3				3	3	3	3
CO 3	2	3	3				3	3	3	3

S - Strong (3) M – Med (1) L -Low (1)

FIRST YEAR: SEMESTER II

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23UBCAT02	Allied Biochemistry II	(Theory) Allied II	2	1	-	-	2	2	25	75	100

Learning objectives

The objectives of this course are to

- Impart knowledge on the classification, properties and characterization of lipids.
- Comprehend the metabolism of Lipids
- Acquaint with the structure, properties and functions of nucleic acids
- Learn about the enzyme kinetics and inhibition
- Study the importance of Hormones

Module I: Lipids–Bloor's classification of lipids- simple lipids, fatty acids (saturated and unsaturated), compound lipids, derived lipids. Properties of lipids- reduction, oxidation, halogenation, saponification and rancidity. Classification and functions of phospholipids, Cholesterol – structure and biological importance. 12 Hrs

Module II: Lipid metabolism- Oxidation of fatty acids (Palmitic acid) – Beta oxidation - Role of carnitine, energetics, alpha oxidation and omega oxidation. Biosynthesis of saturated fatty acids. 12 Hrs

Module III: Purine and pyrimidine bases, nucleosides, nucleotides, polynucleotides, DNA structure, various types, properties- absorbance, effect of temperature. Different types of RNA, structure and function, Genetic code. 12 Hrs

Module III: Enzymes - Nomenclature, IUB system of enzyme classification, active site, specificity, isoenzymes, units of enzyme activity factors affecting enzyme activity- substrate concentration, pH, temperature. Enzyme Kinetics - Michaelis and Menten equation. Lineweaver-Burk plot. Enzyme inhibition, competitive, uncompetitive and andnon competitive inhibition. 12 Hrs

Module V: Hormones - classification, Biological functions of Insulin, Thyroid and Reproductive hormones. 12Hrs

Course Outcome

CO	On completion of this course, students will be able to	Program Outcomes
CO1	Elaborate on classification, structure, properties, functions and characterization of lipids	PO1
CO2	Discuss the metabolism of lipids and its importance	PO1
CO3	Explain about structure, properties and functions of nucleic acids	PO1
CO4	Derive Michaelis Menten equation and concepts of enzyme inhibition	PO1,PO3
CO5	Classify the Hormones and its biological functions	PO1,PO4

Text books

1. Satyanarayan, U (2014) Biochemistry (4th ed), Arunabha Sen Books & Allied (P) Ltd, Kolkata.

2. Jain J.L.(2007) Fundamentals of Biochemistry, S. Chand publishers

Reference books

1. David L. Nelson and Michael M. Cox (2012) Lehninger Principles of Biochemistry (6th ed) W.H. Freeman.

2. Voet. D & Voet. J.G (2010) Biochemistry, (4th ed), John Wiley & Sons, Inc.

3. Lubert Stryer (2010) Biochemistry, (7th ed), W.H. Freeman

Web sources

1. onlinecourses.swayam2.ac.in/cec20_bt12

2. onlinecourses.swayam2.ac.in/cec20_bt19

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3						3			3
CO 2	3						3			3
CO 3	3		3				3			3
CO 4	3			3			3			3
CO5	3						3	3		3

S - Strong (3) M - Medium (2) L - Low(1)

FIRST YEAR: SEMESTER II

ALLIED BIOCHEMISTRY: PRACTICAL II

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23UBCAP02	**Allied Biochemistry Practical II**	**Allied Practical II**	**-**	**-**	**2**	**-**	**1**	**2**	**40**	**60**	**100**

Learning objectives

The objectives of this course are to

- Identify amino acids by qualitative test
- Prepare biomolecules from its sources
- Estimate phosphorus quantitatively

I. Qualitative analysis of amino acids

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

2)

II. Biochemical preparations

a) Preparation of casein from milk.

b) Preparation of starch from potato.

c) Preparation of albumin from egg.

III Group Experiment

Determination of Iodine/ Saponification number of an edible oil. (Demonstration).

Course Outcome

CO	On completion of this course, students will be able to	Programme Outcome
CO1	Qualitatively analyze the amino acids and report the type of amino acids based on specific tests	PO1,PO2,PO3
CO2	Prepare the macronutrients from the rich sources.	PO1,PO2,PO3
CO3	Check the quality of edible oil	PO1,PO2,PO3

Text books

1. Laboratory manual in Biochemistry, J. Jayaraman, 2nd edition, NewAge International Publishers, 2011,

2. An Introduction to Practical Biochemistry, David T. Plummer, 3 rd edition, Tata McGraw-Hill Publishing Company Limited, 2001.

Reference books

1. Biochemical Methods, Sadasivam S and Manickam A, 4h edition, NewAge International Publishers, 2016

2. Essentials of Food and Nutrition, Vol. I & amp; II, M.S. Swaminathan.

Mapping with Program Outcomes

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1	2	3	3				3	3	3	3
CO 2	2	3	3				3	3	3	3
CO 3	2	3	3				3	3	3	3

S - Strong (3) M - Medium (2) L –Low (1)

SKILL ENHANCEMENT COURSE -

NON MAJOR ELECTIVE COURSE (NME)

Choose any of the skill enhancement course (NME) for Semester I & II

FIRST YEAR

SEMESTER I/II

HEALTH AND NUTRITION

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23UBCNE01	**Health and Nutrition**	NME	1	1	-	-	2	2	25	75	100

Learning Objectives

The main objectives of this course are to

- Gain basic knowledge about health.
- Understand about vitamins.
- Learn about functions of fat on health.
- Understand the types of minerals and its functions
- Know about the importance of carbohydrates and proteins on health

Module I: Health – definition, Factors affecting human health. Importance of health care of children, adults and elderly people. Balanced diet and calorific value. 6Hrs

Module II: Vitamins-definition, classification, sources, properties, functions and deficiency symptoms. Recommended daily allowances. 6Hrs

Module III: Sources and functions of dietary fats, role of fats in health and diseases. 6Hrs

Module IV: Minerals- Role of minerals on human health, sources, biological functions, deficiency disorders with special reference to Calcium, Phosphorus, Potassium, Copper, Iron, Zinc and Selenium. Minerals in biological systems and their importance –Iron, Calcium, Phosphorus, Iodine, Copper, Zinc. 6Hrs

Module V: Role of proteins and carbohydrates in health. Functions of protein and carbohydrate and their calorific value. Dietary sources and deficiency disorders – Kwashiorkor and Marasmus – supplementation programs in India and their implications. 6Hrs

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Understand about the importance of health and diet	PO1
CO2	Discuss about the classification properties and deficiencies of vitamins	PO1
CO3	Understand about sources and functions of fats and lipids on health	PO1.PO4
CO4	Detail about the different typed of minerals and its role in health	PO1,PO4
CO5	Relate the role of proteins and carbohydrates on health	PO1,PO4

Text books

1 S. Davidson and J. R. Passmore (1986) Human Nutrition and Dietetics, (8th ed), Churchill Livingstone

2. J. S. Garrow, W. Philip T. James, A. Ralph (2000), Human Nutrition and Dietetics (10th ed), Churchill Livingstone

3. M. Swaminathan (1995) Principles of Nutrition and Dietetics, Bappco

Reference Books

1. Margaret Mc Williams (2012). Food Fundamentals (10th ed), Prentice Hall

Web Resources

1. https://www.universalclass.com/articles/health/nutrition/nutritional-needs-for-differentages.
2. nhp.gov.in/healthy living/healthy diet
3. www.anme.com.mx/libros/PrincipiesofNutrition.pdf

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3						3	3		3
CO 2	3						3	3		3
CO 3	3			2			3	3		3
CO 4	3			2			3	3		3
CO5	3			2			3	3		3

S-Strong (3) M-Medium (2) L-Low (1)

FIRST YEAR: SEMESTER I/II

LIFE STYLE DISEASES

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23UBCNE02	**Life style Diseases**	NME	2		-	-	2	2	25	75	100

Learning Objectives

The objectives of this course are to

- Create awareness on life style diseases among adolescents.
- List out the lifestyle diseases.
- Explain the common lifestyle diseases and their prevention.
- Acquaint the disorders associated with women's health.
- Impart life skills so as to prevent life style diseases.

Module I: Lifestyle diseases: Definition, Factors contributing to lifestyle diseases – Physical inactivity, Poor food habits, disturbed biological clock, sleep deprivation. 6Hrs

Module II: Top lifestyle diseases, Impact of Lifestyle diseases on family, societyandeconomyofcountry.6 Hrs

Module III: Causes, symptoms**,** types, preventive measures and treatment of Obesity, cardiovascular diiiseases, diabetes and cancer. 6 hrs

Module IV: Women's lifestyle diseases: Polycystic Ovarian Disease, Infertility, Breast and cervical cancer and Osteoporosis. 6 hrs

Module V: Prevention of lifestyle diseases: Balanced diet, sufficient intake of water, physical activity, sleep-wake cycle, stress management and meditation. 6 hrs

Course outcomes

CO	On completion of the course the students will be able to	Program Outcomes
CO1	Define Life style diseases and describe the contributing factors	PO1
CO2	Enumerate the top lifestyle diseases and its impact on life.	PO1,PO4,PO5
CO3	Elaborate the treatment and prevention measures of common lifestyle diseases.	PO1,PO4,PO5
CO4	Highlight the lifestyle diseases that affects the women's health	PO1,PO4,PO5

CO5	Illustrate the various measures for prevention of life style diseases	PO1,PO4,PO5

Textbooks

1. James M R,LifestyleMedicine,2ndEdition,CRCPress,2013
2. AkiraMiyazaki,NewFrontiersinLifestyle-RelatedDisease,Springer,2008

Reference books

1. Steyn K, Lifestyle and related risk factors for chronic diseases
2. Willett WC, Prevention of chronic disease by means of diet and lifestyle.
3. Kumar M & R. Kumar,. Guide to prevention of lifestyle diseases. Deep & Deep publications

Web resources

1. https://youtu.be/jDdL2bMQXfE
2. https://youtu.be/7WnpSB14nDM
3. https://youtu.be/ollz9MqtW-U

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	2						3	3		3
CO 2	2			2	3		3	3		3
CO 3	2			2	3		3	3		3
CO 4	2			2	3		3	3		3
CO 5	2			2	3		3	3		3

S- Strong (3) M-Medium (2) L-Low (1)

FIRST YEAR: SEMESTER I/II

MEDICINAL DIET

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23UBCNE03	**NME: Medicinal Diet**	SEC	1	1	-	-	2	2	25	75	100

Learning Objectives

The main objectives of this course are to

- Provide basic knowledge about diet
- Understand of diet modification for GI diseases
- Plan a diet for liver diseases
- Prepare diet chart for Infectious diseases
- Plan a diet for Diabetes, Renal and Cardio-vascular diseases

Module I: Principles of Therapeutic Diet: Definitions of Normal diet, Therapeutic diet, soft Diet and Liquid diet. Objectives of Diet Therapy. Advantages of using normal diet as the basis for Therapeutic diet. Normal Diet-therapeutic modification of normal diet. 6 Hrs

Module II: Diet modification in Gastrointestinal diseases: Peptic ulcer, Diarrhea, Lactose intolerance, Constipation and Malabsorption syndrome. 6 Hrs

Module III: Diet Modification in liver and gall bladder in diseases: Etiology, symptoms and dietary treatment in jaundice, hepatitis, cirrhosis of liver and hepatic coma. 6 Hrs

Module IV: Diet Modification in Infectious Diseases: Fevers, Typhoid, Tuberculosis and Viral Hepatitis. Dietary modifications in Tuberculosis. 6 Hrs

Module V: Diet Modification in Diabetes, Renal and Cardio-vascular diseases-Diabetes, acute & chronic glomerulonephritis, nephrosis, renal failure, kidney stone and Hypertension. 6 Hrs

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes

CO1	Possess basic knowledge about diet	PO1
CO2	Sketch diet plan for GI diseases	PO1,PO4,PO5,PO6
CO3	Sketch diet plan for liver diseases	PO1,PO4,PO5,PO6
CO4	Sketch a diet plan for Infectious diseases	PO1,PO4,PO5,PO6
CO5	Prepare diet chart for Diabetes Renaland Cardio-vascular diseases	PO1,PO4,PO5,PO6

Text Books

1. M.Raheena Begum, AText Book of Foods, Nutrition and Dietetics, Sterling Publishers Pvt. Ltd.

2. M.V.Raja Gopal, Sumati.R.,Mudambi, Fundamentals of foods and Nutrition, Wiley Eastern Limited, Year-1990.

3. William S.R Nutrition and Diet Therapy, 1985, 5thedition, Mosly Co. St. Louis.

Reference books

1. Rodwell Williams Nutrition and Diet Therapy, 1985, the C.V Mosly St. Louis.

2. M.V.Krause & M.A.Mohan, Food Nutrition and Diet Therapy, 1992 by W.B Saunders Company, Philadelphia, London.

3. Davidson and Passmore, Human Methods and Diabetics, 1976 the English Language Book Society and Churchill.

Web sources

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	2						3	3		3
CO 2	2			2	3	2	3	3		3
CO 3	2			2	3	2	3	3		3
CO 4	2			2	3	2	3	3		3
CO 5	2			2	3	2	3	3		3

S-Strong (3) M-Medium (2) L-Low (1)