MANONMANIAM SUNDARANAR UNIVERSITY

TIRUNELVELI – 627012

B.Sc. Biochemistry Degree

(CHOICE BASED CREDIT SYSTEM)

Learning Outcome Based Curriculum

Major & Allied Biochemistry

(Effective from the academic year 2021-2022 onwards)

MANONMANIAM SUNDARANAR UNIVERSITY, TIRUNELVELI

UG COURSES – AFFILIATED COLLEGES

B.Sc. Biochemistry

(Choice Based Credit System)

(Effective from the academic year 2021-2022 onwards)

1. Vision of the University

To provide quality education to reach the un-reached

2. Mission of the University

- To conduct research, teaching and outreach programmes to improve conditions of human living.
- To create an academic environment that honours women and men of all races, caste, creed, cultures and an atmosphere that values intellectual curiosity, pursuit of knowledge, academic freedom and integrity.
- To offer a wide variety of off-campus educational and training programs, including the use of information technology, to individuals and groups.
- To develop partnership with industries and government so as to improve the quality of the workplace and to serve as catalyst for economic and cultural development.
- To provide quality/inclusive education, especially for the rural and un-reached segments of economically downtrodden students including women, socially oppressed and differently abled.

3. Vision of the Department

Excellent education in Biochemistry to bring forth intellectual, personal and social wellbeing.

4. Mission of the Department

- Provide healthy learning environment to imbibe comprehensive knowledge, skills and values to bridge academia, industries and society.
- Promote research and open scientific platforms that transform students proficient and globally competent.
- Nurture moral values among students and help them grow as socially sensible and responsible persons.

5. Preamble

Biochemistry deals with the study of chemical and physical processes of living systems. Biochemistry holds promises in areas of Medical Science, Health Science and Agriculture. The B.Sc. Degree programme aims at providing in-depth knowledge and understanding of the core principles of Biochemistry and their practicalaspects in order to pursue higher studies and employment. The Learning Outcome Based Curriculum Framework (LOCF) for B.Sc. Biochemistry programme has been framed as per the guidelines prescribed by University Grants Commission (UGC) under Choice Based Credit System (CBCS).

6. Programme Educational Objectives (PEOs)

The B.Sc. Biochemistry programme is proposed to

PEO1: Provide the fundamental knowledge on different branches of Biochemistry.
PEO2: Impart the theoretical and practical skills in basic and modern techniques in Biochemistry and related subjects.
PEO3: Motivate the students for critical thinking and self-reflection to draw conclusions
PEO4: Inculcate moral values and help them to grow as good citizens.
PEO5: Enable the students with profound understanding in various field of applications and make them competent.

7. Programme Outcomes (POs)

On completion of B.Sc. programme, the student shall be able to

PO1: Gain proficiency in terms of National and International perspective and stay competent in the area of life sciences.
PO2: Develop various communication skills such as reading, writing, listening, speaking etc. to expose novel ideas analytical methodologies through effective writing and oral communication.
PO3: Solve the problems related to science and think systematically and independently to draw a logical conclusion.
PO4: Apply critical thinking and scientific knowledge to design, carryout, record and analyze investigations effectively.
PO5: Collaborate effectively as part of a team to solve problems, debate different points of view and interact productively with a diverse group of team members in academic world, work place and research.
PO6: Continue as a lifelong learner with moral and ethical values in all aspects of work and day to day life.

8. Programme Specific Outcomes (PSO)

On completion of B.Sc. Biochemistry programme, the student shall be able to

PSO1: Gain ability to understand the methodologies of existing technologies that help in addressing the biological and medical challenges faced by human kind through comprehensive knowledge and skills in Analytical, Physical, Metabolic, Clinical and Industrial Biochemistry.

PSO2: Develop effective communication of the fundamental concepts of biomolecules, enzymes, cell, organ system, metabolism of compounds, nutrients and their impacts in health status through enhanced reading of textbooks, library usage, presenting seminars, writing assignments etc.

PSO3: Develop problem solving ability by utilizing the conceptual knowledge and bioanalytical techniques, to solve problems.

PSO4: Develop critical thinking skill and laboratory skills in Biochemistry for designing, carrying out and interpreting experiments applied in biology and medical diagnosis.

PSO5: Work as team to share and impart in-depth knowledge about biological sciences and facilitate to pursue post-graduation in related fields in life sciences and inculcate the research aptitude.

PSO6: Contribute effectively in the development of ethical practices and societal contributions leading to responsible and competent professionals by means of awareness programmes, extension activities, extra-curricular sessions, social work etc.

9. Eligibility for admission to the course and examination

Candidates shall be admitted to the course provided he/she has passed plus two examinations of the State or Central Board with Chemistry/Biology/Biochemistry as one of the subjects or any other Science subject that may be considered as equivalent by the M.S. University.

10. Duration of the Course

The students shall undergo the prescribed course of study for a period of not less than three academic years (Six semesters). Each semester contains 90 working days.

11. Medium of instruction and examination

The medium of instruction as well as examination will be in English.

12. Theory examination

The external evaluation will be based on the examination to be conducted by the university at the end of each semester.

13. Practical examination

Practical examinations will be conducted at the end of each semester.

14. Evaluation

A. Each paper carries an internal component

B. There is a pass minimum of 40% for external and overall components

Theory External: Internal Assessment = 75:25
Practical External: Internal Assessment = 50:50

C. Internal Assessment

Internal marks for Theory shall be allocated in the following manner.

The average of the best two tests from three compulsory tests	20 Marks
Assignment	05 Marks
Total	**25 Marks**

Note: Each test will be of one hour duration.

D. Practical

Internal marks for Practical shall be allotted in the following manner.

Experimental work	20 Marks
Record	10 Marks
Model Test	20 Marks
Total	**50 Marks**

E. Project Work

Components	Marks
Project Report	75 Marks
Viva -Voce	25 Marks
Total	**100 Marks**

Note:

i) Students should carry out group project in major subject.

ii) Project report will be evaluated by Central valuation and Viva-Voce will be conducted by both the External examiner and the Guide at the end of the 6th semester.

15. Grading System

The performance of the student is indicated by the Seven Points Scale Grading System as per the UGC norms given below

Grade	Grade point	Percentage of marks	Performance
O	9.5 and above	95-100	Outstanding
E	8.5 and above	85-94	Excellent
D	7.5 and above	75-84	Distinction
A	7 and above	70-74	Very Good
B	6and above	60-69	Good
C	5 and above	50-59	Average
RA	0	Up to 49	Re-Appear

F. The overall performance level of the candidates will be assessed by the following formulae:

Cumulative weighted average of marks = $\frac{\sum(\text{marks} + \text{credits})}{\sum \text{credits}}$

Cumulative weighted average grade points = $\frac{\sum(\text{Grade points} \times \text{credits})}{\sum \text{credits}}$

16. The question paper pattern for all theory papers shall be as follows.

Duration of Exam: 3Hours

Section	Type of questions	Mark
Part-A	Multiple choice question (Two question from each unit compulsory)	1×10=10 Marks
Part-B	Internal Choice questions (One question from each unit: either/or)	5×5=25 marks
Part-C	Internal Choice questions (One question from each unit: either/or)	8×5=40 marks
	Total	**75 Marks**

17. The question paper pattern for all practical papers shall be as follows.

Duration of Practical Exam: 3 hours

1	Major experiment	25
2	Minor Experiment	15
3	Spotters	05
4	Record	05
	Total	**50 Marks**

MANONMANIAM SUNDARANAR UNIVERSITY, TIRUNELVELI

B.Sc. Biochemistry

(Choice Based Credit System)

(Effective from the academic year 2021-2022 onwards)

Programme Structure

Part I/II/III/IV/V	Sub. No	Subject Status	Subject Title	Contact hrs/ week	L hrs/ week	T hrs/ week	P hrs/ week	C Credits
Semester – I								
I	1	Language	Tamil/Other Languages	6	6	0	0	4
II	2	Language	Communicative English-I	6	6	0	0	4
III	3	Core -1	Biomolecules	4	4	0	0	4
III	4	Major Practical-1	Analysis of Biomolecules	2	0	0	2	2
III	5	Add on Major (Mandatory)	Professional English for Life Sciences – I	4	4	0	0	4
III	6	Allied I - 1	Principles of Nutrition/Allied Microbiology/Allied Biotechnology	4	4	0	0	3
III	7	Allied I - Practical 1	Analysis of Nutrients/Allied Microbiology/ Biotechnology Practical	2	0	0	2	2
IV	8	Common	Environmental Studies	2	2	0	0	2
			Subtotal	**30**	**26**	**0**	**4**	**25**
Semester – II								
I	9	Language	Tamil/Other Languages	6	6	0	0	4
II	10	Language	Communicative English-II	6	6	0	0	4
III	11	Core-2	Analytical Biochemistry	4	4	0	0	4
III	12	Major Practical-2	Analytical Biochemistry techniques	2	0	0	2	2
III	13	Add on Major (Mandatory)	Professional English for Life Sciences – II	4	4	0	0	4
III	14	Allied I - 2	Food Biochemistry and Preservation/Allied Microbiology/Biotechnology	4	4	0	0	3
III	15	Allied I - Practical 2	Food analysis/Allied Microbiology/ Biotechnology Practical	2	0	0	2	2
IV	16	Common	Value Based Education/ Social Harmony	2	2	0	0	2
			Subtotal	**30**	**26**	**0**	**4**	**25**

Semester – III								
I	17	Language	Tamil/Other Languages	6	6	0	0	4
II	18	Language	English	6	6	0	0	4
III	19	Core-3	Anatomy and Physiology	4	4	0	0	4
III	20	Major Practical – 3	Techniques in Anatomy and Physiology	2	0	0	2	2
III	21	Allied II - 1	Biophysical Chemistry/Allied Chemistry/Zoology	4	4	0	0	3
III	22	Allied II - Practical 1	Biophysical Chemistry Methods/Allied Chemistry/Zoology Practical	2	0	0	2	2
III	23	Skill Based Subject	Tools in Medical Biochemistry/Blood Banking	4	4	0	0	4
IV	24	Non-Major Elective	Biochemistry of Vision/ Vaccinology	2	2	0	0	2
IV	25	Common	Yoga*	2	2	0	0	2
			Subtotal	**30+2**	**26+2**	**0**	**4**	**27**
Semester – IV								
I	26	Language	Tamil/Other Languages	6	6	0	0	4
II	27	Language	English	6	6	0	0	4
III	28	Core-4	Enzymes	4	4	0	0	4
III	29	Major Practical – 4	Enzyme Techniques	2	0	0	2	2
III	30	Allied II - 2	Industrial Biochemistry/Allied Chemistry/Zoology	4	4	0	0	3
III	31	Allied II - Practical 2	Industrial Biochemistry Methods/Chemistry/ Zoology Practical	2	0	0	2	2
III	32	Skill Based Subject	Public Health Studies/Forensic Analysis/DNA Fingerprinting	4	4	0	0	4
IV	33	Non-Major Elective	Nutritional Biochemistry/ Chemical Biology	2	2	0	0	2
IV	34	Common	Computers for Digital Era*	2	2	0	0	2
V	35	Extension Activity	NCC/NSS/YRC/YWF	-	-	-	-	1
			Subtotal	**30+2**	**26+2**	**0**	**4**	**28**
Semester – V								
III	36	Core-5	Cell and Molecular Biology	5	5	-	-	5
III	37	Core-6	Metabolism	5	5	-	-	5
III	38	Elective 1	Biostatistics/ Clinical Biochemistry/ Environmental Biochemistry	4	4	-	-	4
III	39	Elective 2	Diagnostic Biochemistry/ Nutritional Biochemistry/ Microbial Biochemistry	4	4	-	-	4

III	40	Major Practical-5	Cell and Molecular Biology Techniques	3	-	-	3	2
III	41	Major Practical-6	Clinical Biochemistry	3	-	-	3	2
III	42	Major Practical-7	Diagnostic Biochemistry	4	-	-	4	2
IV	43	Skill Based Subject (Common)	Personality Development/Effective Communication/Youth Leadership	2	2	**-**	**-**	2
			Subtotal	**30**	**20**	**0**	**10**	**26**
Semester – VI								
III	44	Core-7	Plant Biochemistry	4	4	**-**	**-**	4
III	45	Core-8	Endocrine Biochemistry	4	4	**-**	**-**	4
III	46	Core -9	Immunochemistry	4	4	**-**	**-**	4
III	47	Elective 3	Biotechnology/ Genomics and Proteomics/ Drug Biochemistry	4	4	**-**	**-**	4
III	48	Major Practical-8	Plant Biochemistry	3	**-**	**-**	3	2
III	49	Major Practical-9	Clinical Enzymology	3	**-**	**-**	3	2
III	50	Major Practical-10	Immunochemistry Techniques	3	**-**	**-**	3	2
III	51	Group Project		5	**-**	**-**	5	7
			Subtotal	**30**	**16**	**0**	**9**	**29**
			Total	**180+4**	**140+4**	**0**	**40**	**160**

*Extra hours

Allied Biochemistry offered to B. Sc.other Major Students

Paper 1 - Chemical Biology and Biophysical Chemistry (Semesters I/III)
Practical 1- Analysis of Biomolecules -I

Paper 2 - Principles of Biochemistry (Semesters II/IV)
Practical 2- Analysis of Biomolecules -II

MSU/2021-22/UG - Colleges/Part - III (B.Sc. Biochemistry)/Semester-I/Core - 1

BIOMOLECULES

L	T	P	C
4	0	0	4

Objective

To know the various micro and macro molecules in living systems and to acquire understanding on their biological importance.

Total Hours: 60

UNIT I 10 Hours

Introduction to Biomolecules

Hierarchy of Biomolecules, Macromolecules and their building blocks in biological system. Common functional groups in organic molecules (-OH, -SH, -CHO, -COOH, -NH2, -NH etc.). Isomerism & Isomeric compounds with examples.

UNIT II 14 Hours

Carbohydrates

Classification, structure, occurrence & biological importance. Stereo isomerism - Epimers D & L form - Optical activity, Ring form of sugars - Mutarotation - α & ß configuration. Reducing &Non reducing sugars - Monosaccharides - Glucose, Fructose, Galactose, Ribose - Structure & chemical reactions (identification tests). Disaccharides - Sucrose, Maltose, Lactose - structure, function & properties. Polysaccharides - Homo & Hetero polysaccharides - Reactions of starch & dextrin.

UNIT III 12 Hours

Lipids

Definition, classification & physical properties. Types of fatty acids - Saturated & unsaturated fatty acids, MUFA, PUFA (ω-3 & ω-6 fatty acids) - Structure & biological importance. Eicosanoids - prostaglandins. Triacyl glycerol - chemistry & characterization, Saponification Number, Iodine Number, Acid Number, RM Number. Phospholipid chemistry - Lecithin, Cephalin, sphingolipids - (Sphingomyelin, cerebroside, gangliosides - structure & function only). Steroids- Cholesterol - structure & function.

UNIT IV 12 Hours

Amino acids& Proteins

Amino acids - Classification, Essential & Non-essential amino acids - sources, structure, chemical reactions & properties (physical - pH, pI, Solubility, Melting point, Rf value).
Proteins - Classification of Proteins, Properties - solubility, Denaturation, Renaturation, Structural organization of Proteins - Primary, secondary, tertiary & quaternary structure. Secondary structure - α helix, ß conformation. Monomeric and Oligomeric proteins (Myoglobin and Hemoglobin). Conjugated proteins - glycoproteins and lipoproteins

UNIT V 12 Hours

Nucleic acids

Purines, Pyrimidines - Structure & function, Nucleosides, Nucleotides. Nucleic acids - DNA - Double helical structure and Biological importance, RNA - Structure, Types & Biological Importance.

References

1. RobertKMurrayet. al.,Harper's Illustrated Biochemistry, 31stedition-McGraw Hill, 2018.
2. Nelson and Cox. Lehninger Principles of Biochemistry. Freeman, 7th ed. 2017.
3. Devlin, T.M., John Wiley & Sons, Inc. Textbook of Biochemistry with Clinical Correlations (2011) 7th ed., (New York).
4. Tymoczko, John L., Jeremy M. Berg, and LubertStryer. Biochemistry, 8th ed. Freeman 2015.
5. Garrett, Reginald, and Charles Grisham. Biochemistry. Nelson Education, 2012.
6. Voet, Donald, Judith G. Voet, and Charlotte W. Pratt. Fundamentals of biochemistry. NewYork: John Wiley & Sons,5th Edition, 2016.
7. Lippincott Williams and Wilkins; Illustrated Reviews: Biochemistry, Seventh, North American edition, 2016.
8. https://biologydictionary.net/polysaccharide
9. https://www2.chemistry.msu.edu/faculty/reusch/virttxtjml/lipids.htm

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Core – 1: Biomolecules	Cognitive Level
CO1	recall the macromolecules and their building blocks in biological system	K1
CO2	explain the classification and structure of biomolecules such as carbohydrates, lipids, proteins, aminoacids and nucleic acids	K2
CO3	experiment with chemical reactions of carbohydrates and aminoacids	K3
CO4	analyze the structural organization of proteins and protein functions	K4
CO5	assess the importance of biomolecules in the biological system	K5

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Core – 1: Biomolecules												
CO	PO						PSO					
	1	2	3	4	5	6	1	2	3	4	5	6
1	3	3	3	3	2	2	3	3	3	3	2	2
2	3	3	3	3	2	2	3	3	3	3	2	2
3	3	3	3	3	2	1	3	3	3	3	2	1
4	3	3	3	3	2	1	3	3	3	3	2	1
5	2	3	3	3	2	2	2	3	3	3	2	2

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

ANALYSIS OF BIOMOLECULES

L	T	P	C
0	0	2	2

1. Qualitative analysis of carbohydrates
    a. Analysis of monosaccharides - pentose, glucose, fructose, galactose and mannose.
    b. Analysis of disaccharides - sucrose, maltose and lactose.
    c. Analysis of polysaccharides - starch, dextrin.
2. Qualitative analysis of lipids - saturated & unsaturated fatty acids, cholesterol.
3. Qualitative analysis of amino acids - Analysis of tyrosine, tryptophan, arginine, histidine, methionine, cysteine, cystine and proline.
4. Reactions of proteins - Biuret test, Saturation tests, Precipitation by acids, alkalis, salts and heavy metals.
5. Determination of Iodine number of an edible oil.
6. Determination of Acid number of an edible oil.
7. Determination of Saponification number of an edible oil.

References

1. T. N. Pattabiraman, Laboratory Manual and Practical Biochemistry,All India Publishers & Distributors, 4th edition,2015.
2. J. Jayaraman, Laboratory Manual in Biochemistry - New Age International Publishers, 2nd edition, 2011.
3. S. Sadasivam, A. Manickam, Biochemical Methods - New Age International (P) Limited, 3rd edition, 2018.
4. David T. Plummer. An Introduction to Practical Biochemistry, Tata McGraw Hill Publishing Company, 3rd edition, 2017.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Major Practical – 1:Analysis of Biomolecules	Cognitive Level
CO1	recall the properties of biomolecules, assess the principle and categorize the chemical reactions	K1, K5
CO2	identify the carbohydrates and interpret the results obtained	K2, K3
CO3	analyze the methods of characterization of fats and evaluate the results obtained and apply the same in checking the adulteration of lipid products	K3, K4, K5
CO4	interpret the colour reactions obtained by qualitatively analyzing the aminoacids and proteins and elaborate the chemical properties	K2, K6
CO5	apply the specific chemical reactions and assess various biological samples	K3, K5

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Major Practical – 1:Analysis of Biomolecules												
CO	PO						PSO					
	1	2	3	4	5	6	1	2	3	4	5	6
1	3	3	3	3	3	1	3	3	3	3	3	1
2	3	2	3	3	3	2	3	2	3	3	3	2
3	3	2	3	3	3	1	3	2	3	3	3	1
4	3	2	3	3	3	2	3	2	3	3	3	2
5	3	2	3	3	3	2	3	2	3	3	3	2

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

Principles of Nutrition/Allied Microbiology/Biotechnology
(Select any one)

L	T	P	C
4	0	0	3

PRINCIPLES OF NUTRITION

Objective

To acquire insight on the role of nutrients and their relationship in maintaining health of the individual.

Total Hours: 60

UNIT I 12 Hours

Basic concepts in Nutrition

Introduction to Nutrition - Food as source of nutrients,Definition of Nutrition, Nutrients, Energy, Adequate, Optimum and Good nutrition. Relationship between food, nutrition and health; Malnutrition. Basis of healthy diet and basic nutrients.

UNIT II 12 Hours

Carbohydrates, Proteins and Dietary fibers

Carbohydrates - Definition, Composition, Nutritional classification, Functions, RDA and sources, Effects of too high and too low carbohydrates on health. Proteins - Definition, Composition and Functions, RDA and sources of Proteins and Amino acids - Nutritional classification - Deficiency. Dietary fiber - Classification, sources and its role in Human nutrition.

UNIT III 12 Hours

Lipids and Water

Lipids - Definition, Nutritional classification, Functions, RDA, Sources and effects of deficiency. Role and nutritional significances of PUFA, MUFA, SFA and ω3 fatty acids. Water as a nutrient, Function, Sources, Requirement, Water balance and effects of deficiency.

UNIT IV 12 Hours

Minerals

Minerals - Definition, Nutritional classification and Functions.Macro minerals- Calcium, Phosphorus, Magnesium, Sodium and Potassium - RDA, sources, Functions and effects of deficiency. Microminerals - Iron, Iodine, Copper, Fluorine and Zinc - Requirements, Sources, Functions and effects of deficiency.

UNIT V 12 Hours

Vitamins

Vitamins - Definition, Nutritional classification, Functions and Deficiency - Fat soluble vitamins - Vitamin A, D, E and K - RDA, sources and effects of deficiency. Water soluble vitamins - Thiamine, Riboflavin, Niacin, Ascorbic acid, Folic acid, Vitamin B6 and Vitamin B12 - RDA, sources and effects of deficiency.

References

1. Swaminathan, M., Essentials of Food and Nutrition, Vol I & II, Bappco Publishers, Madras 2000.
2. Srilakshmi, B., Nutrition Science, New Age International (p) Ltd, Publishers, 2012.
3. Mahtab, S, Bamji, Kamala Krishnasamy, G.N.V. Brahmam., Text book of Human Nutrition, Third edition, Oxford and IBH Publishing Co. P. Ltd., New Delhi, 2015.
4. Swaminathan, M.S. Handbook of Food and Nutrition, 5th Edition. The Bangalore Printing and Publishing Company, 2007.
5. Weighley, E.S. Robinson's Basic Nutrition and Diet Therapy, 8th Edition, Macmillan Publishers, 1997.
6. Insel, P. et al., Discovering Nutrition, 4th Edition, Jones and Bartlett Publishers, 2013.
7. M. Swaminathan, Advanced text book of food and nutrition, (Vol.1 & 2), 2nd edition.
8. Kaveri Chakrabarty, A. S. Chakrabarty, Textbook of Nutrition in Health and Disease, Springer, 2019.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Allied I – 1: Principles of Nutrition	Cognitive Level
CO1	extend specific nutrition related practices or behaviours to change in habits that contribute to poor health	K2
CO2	analyze the importance of different carbohydrates, proteins and fibers in health	K4
CO3	distinguish different types of lipids and their major functions and to describe the value of minerals in body function and regulation of human systems	K4
CO4	justify the types of vitamins and their role in maintenance of growth, regulation and overall human health	K5
CO5	formulate strategies to adapt balanced diet for maintaining good health	K6

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Allied I – 1: Principles of Nutrition												
CO	**PO**						**PSO**					
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**
1	3	3	3	3	3	2	3	3	3	3	3	2
2	3	3	3	3	3	2	3	3	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3
4	3	3	3	3	2	2	3	3	3	3	2	2
5	3	3	3	3	2	2	3	3	3	3	2	2

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/2021-22/UG-Colleges/Part-III (B.Sc. Biochemistry)/Semester-I/Allied I-Practical-1

Analysis of Nutrients/Allied Microbiology/Biotechnology Practical

L	T	P	C
0	0	2	2

ANALYSIS OF NUTRIENTS

1. Quantitative estimation of Sugar in fruits
2. Quantitative estimation of total free amino acids in vegetables
3. Quantitative estimation of calcium in milk
4. Quantitative estimation of Phosphorus in malted food
5. Quantitative estimation of Iron in malted food
6. Quantitative estimation of Ascorbic acid in fruit juice
7. Determination of Gluten content of Wheat.
8. Determination of β- Carotene in Carrot by Column chromatography

References

1. Varley, H., Gowenlock, A.H. and Hill, M. Practical Clinical Biochemistry, William; CBS Publishers; 6th Edition, 2006.
2. Sadasivam, S. and Manickam, A. Biochemical Methods, Third Edition, New age International P. Ltd., Publishers, New Delhi, 2018.
3. Raghuramulu, N., Madhavan Nair, K. and Kalyana Sundaram, National Institute of Nutrition, A Manual of Laboratory Techniques, Hyderabad, 2013.
4. Swaminathan, M. Food Science, Chemistry and Experimental Foods, Bappco Publishers, 2013.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Allied I - Practical - 1: Analysis of Nutrients	Cognitive Level
CO1	recall the essential nutrients in fruits, vegetables, cereals, milk etc.	K1
CO2	identify and interpret the composition of nutrients in plants, eggs, milk and food materials	K2, K3
CO3	analyze quantitatively the sugar, aminoacids, proteins and minerals such as calcium, phosphorous and iron to evaluate the quality of food	K4, K5
CO4	interpret the data obtained by quantitative analysis of vitamins and antioxidants and elaborate the nutritional benefits of fruits, vegetables and other food sources	K2, K6
CO5	apply the techniques for assessment of quality of raw, cooked, stored and processed form of various source of nutrition	K3

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Allied I - Practical - 1: Analysis of Nutrients												
CO	**PO**						**PSO**					
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**
1	3	3	3	3	3	3	3	3	3	3	3	3
2	3	3	2	3	3	3	3	3	2	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3
4	3	3	3	3	3	2	3	3	3	3	3	2
5	3	3	2	3	3	2	3	3	2	3	3	2

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

ANALYTICAL BIOCHEMISTRY

L	T	P	C
4	0	0	4

Objective

To gain knowledge and understanding of the basic principles and applications of various techniques in the identification, separation and purification of biomolecules and to develop skill-based interest in the analytical field.

Total Hours: 60

UNIT I 12 Hours

Water, Acid, Bases &Buffers

Water - structure, hydrogen bonding, ionic product of water - concept of pH, pOH and its calculation. Measurement of pH using pH meter.Concepts of acids, bases and buffers, Henderson - Hasselbach equation, pKa and calculation of pKa.

UNIT II 12 Hours

Solutions&Centrifugation techniques

Components of solutions, methods of expressing concentration - Mole fraction, Molality, Molarity, Parts per million, Mass percent. Isotonic, Hypertonic and Hypotonic solutions. Donnan membrane equilibrium - applications.
Centrifugation techniques - principles and applications.

UNIT III 12 Hours

Chromatography techniques

Principles and applications of Paper chromatography, Thin layer chromatography, Gel filtration chromatography, Affinity chromatography, GLC and HPLC.

UNIT IV 12 Hours

Electrophoresis techniques

Principles of Electrophoresis, factors affecting migration rate, Techniques and applications of Agarose gel electrophoresis, PAGE, SDS - PAGE and Immunoelectrophoresis.

UNIT V 12 Hours

Spectroscopy and Radioactivity

Spectroscopy techniques - basic principles of light absorption and its transmittance - Beer - Lambert's law. Principles and applications of Colorimeter, Spectrophotometer, Atomic absorption spectrophotometer and NMR spectroscopy.
Radioactivity - alpha, beta and gamma radiation. Measurement of radioactivity using Liquid Scintillation Counter, Autoradiography, Radioisotopes commonly used in metabolic studies.

References

1. Wilson and Walker.Principles and techniques of Biochemistry and Molecular Biology.7th ed. Cambridge University Press, 2012.
2. Upadhyay, Upadhyay and Nath.Biophysical Chemistry principles and Techniques.Himalaya Publ., 2010.
3. Boyer, R.Modern Experimental Biochemistry.3rd ed.AddisonWeslery Longman, 2000.
4. Sambrook. Molecular Cloning. Cold Spring Harbor Laboratory, 4thed., 2012.
5. Pavia. Intro to spectroscopy 5th ed., 2015.
6. Bisen, Prakash Singh, and Anjana Sharma, Introduction to instrumentation in life sciences. Crc Press, 2012.
7. Skoog.D, Holler F and Crouch S. Principles of Instrumental Analysis, 7th Edition, Cengage Learning custom publishing, 2016.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Core-2:Analytical Biochemistry	Cognitive Level
CO1	explain the importance of water, acids bases and buffers to perform biochemical techniques	K2
CO2	analyze and describe the types of solutions for isolation and analysis of biological molecules	K4
CO3	utilize the latest techniques such as, electrophoresis, chromatography, centrifugation in molecular level to undertake future analytical research activities in biochemistry	K3
CO4	analyse the radioisotope principle, techniques and applications and make use of it for their higher studies	K4
CO5	relate the various spectroscopic techniques for studying molecular structure and functional groups of biomolecules	K2

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Core-2 Analytical Biochemistry												
CO	PO						PSO					
	1	2	3	4	5	6	1	2	3	4	5	6
1	3	3	3	3	3	2	3	3	3	3	3	2
2	3	3	3	3	3	2	3	3	3	3	3	2
3	3	3	3	3	1	1	3	3	3	3	2	1
4	2	3	3	3	2	2	2	3	3	3	3	2
5	2	3	3	3	3	1	2	3	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

ANALYTICAL BIOCHEMISTRY TECHNIQUES

L	T	P	C
0	0	2	2

1. Preparation of Molar, Normal and Percentage solutions
2. Extraction of casein from milk.
3. Preparation of starch from potato.
4. Estimation of lactose in milk.
5. Estimation of amino acids by Sorenson's Formal titration.
6. Separation of amino acids by Paper chromatography
7. Estimation of RNA by colorimetry
8. Separation of DNA by Agarose gel electrophoresis

References

1. T. N. Pattabiraman, Laboratory Manual and Practical Biochemistry, All India Publishers & Distributors, 4th edition,2015.
2. J. Jayaraman, Laboratory Manual in Biochemistry - New Age International Publishers, 2nd edition, 2011.
3. S. Sadasivam, A. Manickam, Biochemical Methods - New Age International (P) Limited, 3rd edition, 2018.
4. David T. Plummer An Introduction to Practical Biochemistry, Tata McGraw Hill Publishing Company, 3rd edition, 2017.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Major Practical-2: Analytical Biochemistry Techniques	Cognitive Level
CO1	recall the methods for preparation of solutions at different concentrations	K1
CO2	identify the aminoacids by chromatography techniques for separation of biomolecules	K3
CO3	make use of techniques such as agarose gel electrophoresis in molecular level to undertake future study in biochemistry	K3
CO4	estimate nucleic acids using colorimetry technique and develop skill	K6
CO5	apply extraction and preparation methods for developing healthy bioproducts at large scale	K3

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Major Practical – 2: Analytical Biochemistry Techniques												
CO	PO						PSO					
	1	2	3	4	5	6	1	2	3	4	5	6
1	3	2	3	3	3	2	3	2	3	3	3	2
2	3	2	3	3	3	2	3	2	3	3	3	2
3	3	2	3	3	3	2	3	2	3	3	3	2
4	3	2	3	3	3	1	3	2	3	3	3	2
5	2	2	3	3	3	1	2	2	3	3	3	1

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

Food Biochemistry and Preservation/Allied Microbiology/Biotechnology
(Select any one)

L	T	P	C
4	0	0	3

FOOD BIOCHEMISTRY AND PRESERVATION

Objective

To understand the importance of food quality, quality assessment, food safety and standard food preservation methods.

Total Hours: 60

UNIT I 12 Hours

Concepts of Food and Nutrition

Functions of food; Basic food groups; nutrients supplied by food; Food Composition, Food analysis. Basal metabolism, Balanced diet and Recommended dietary allowance (RDA).

UNIT II 12 Hours

Food Additives and Adulterants

Food additives - definition; Common food additives, function and usage; Permissible limits of additives in foods; Implications of additives on consumers health; Food adulteration - meaning and definition; Types of food adulterants; Methods used for detection of food adulterants.

UNIT III 12 Hours

Testing of Food Quality

Food quality - meaning and need of food quality testing; Types of evaluation -subjective and objective; Subjective evaluation methods based on difference, rate, sensitivity etc.; Objective evaluation methods - tools and instruments used. Food Laws and Standards - Need and importance.

UNIT IV 12 Hours

Food preservation using low and high temperature

Importance of food preservation, Basic principles of food preservation. Preservation by the use of low and high temperature - refrigeration, freezing- advantages, factors to be considered; Preservation by the use of high temperature - drying and dehydration - methods of drying, mechanical dehydration, merits and demerits, factors affecting drying. Pasteurization

UNIT V 12 Hours

Preservation using sugar, chemicals, salts and fermentation.

Sugar concentrates - principles of gel formation, preparation of jam, jelly, sauce and squash preserves, candied, crystallized fruits; Preservation of fruit juices. Salt preservation - pickling- principle involved. Chemical preservatives - definition, permitted preservatives, FPO specification. Preservation by fermentation - common fermented foods.

References

1. Sivasankar, B. Food Processing and preservation 2nd edition, Prentice Hall, Pvt, Ltd., 2013.
2. Srilakshmi, N., Food Science, 6th Edition, New Age International Private Ltd., New Delhi, 2015.
3. Swaminathan, M., Food Science, Chemistry and Experimental Foods, Bappco Publishers, Bangalore, 2014.
4. Early, R. Guide to Quality Management Systems for the Food Industry, Blackie, Academic and Professional, London,1995.
5. Gould, W.A. and Gould, R.W. Total Quality Assurance for the Food Industries, CTI Publications Inc, Baltimore, 1988.
6. Pomeranz, Y. and Meloan, C.E. Food Analysis: Theory and Practice, CBS Publishers and Distributor, New Delhi, 1996.
7. Askar, A. and Treptow, H. Quality Assurance in Tropical Fruit Processing, Springer-Verlag, Berlin,1993.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Allied I -2: Food Biochemistry and Preservation	Cognitive Level
CO1	explain the basic concepts of food and to analyse the RDA	K2, K4
CO2	recall food additives, permissible limits and make use of methods in the detection of food adulterants	K1, K3
CO3	list out the effects of quality testing, food laws and food standards	K4
CO4	explain the basic concept of food preservation by the use of freezing, drying and dehydration	K2, K3
CO5	explain the process of preservation using sugars, chemical, salts and fermentation	K2

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Allied I - 2: Food Biochemistry and Preservation												
CO	PO						PSO					
	1	2	3	4	5	6	1	2	3	4	5	6
1	3	3	3	3	3	3	3	3	3	3	3	3
2	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3
4	3	3	3	3	3	3	3	3	3	3	3	3
5	3	3	3	3	3	3	3	3	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

Food analysis/Allied Microbiology/ Biotechnology Practical

L	T	P	C
0	0	2	2

FOOD ANALYSIS

1. Estimation of moisture content in food sample.
2. Estimation of ash content in food sample.
3. Determination of pH of food products using pH meter.
4. Determination of alcoholic acidity in food sample.
5. Qualitative analysis of Food adulterants in Milk, Ghee, Oils, Honey, Turmeric powder, Chilly powder, Tea powder and Sugar.

References

1. Srivastava R.P. Fruit and vegetable preservation – Principles and Practices, International Book Distributing Co., (IBDC), New Delhi, 2013.
2. Sadasivam, S. and Manickam, A. Biochemical Methods, Third Edition, New age International P. Ltd., Publishers, New Delhi, 2018.
3. Raghuramulu, N., Madhavan Nair, K. and Kalyana Sundaram, National Institute of Nutrition, A Manual of Laboratory Techniques, Hyderabad, 2013.
4. Swaminathan,M. Food Science, Chemistry and Experimental Foods, Bappco Publishers, 2013.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Allied I - Practical - 2: Food analysis	Cognitive Level
CO1	analyze the essential components in food samples	K4
CO2	list out the methods of assessing acidity and to determine the pH of food products	K1, K5
CO3	analyze the alcoholic acidity of food materials and make use of the techniques in assessment of food quality	K3, K4
CO4	categorize the common food adulterants and experiment with food samples to identify the adulterant in food	K3, K4
CO5	apply the screening techniques for food adulterants and evaluate assess the food quality	K3, K5

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Allied I – Practical - 2: Food analysis												
CO	PO						PSO					
	1	2	3	4	5	6	1	2	3	4	5	6
1	3	2	3	3	3	3	3	2	3	3	3	3
2	3	2	3	3	3	3	3	2	3	3	3	3
3	3	2	3	3	3	3	3	2	3	3	3	3
4	3	2	3	3	3	3	3	2	3	3	3	3
5	3	2	3	3	3	3	3	2	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

ANATOMY AND PHYSIOLOGY

L	T	P	C
4	0	0	4

Objective

To acquire a comprehensive knowledge about the structure and function of vital internal organ systems in the human body and to understand their regulation.

Total Hours: 60

UNIT I 12 Hours

Blood and Circulatory system

Blood - Composition, function, Blood cells and their function, Plasma proteins - functions. Blood groups - ABO and Rhesus systems. Blood clotting - Clotting factors. Structure of heart, blood vessels - both arteries and veins in relation, attachment and relations of major vessels to the heart, distribution and tributaries of major arteries and veins. Cardiac cycle and pressure changes, heart sounds, cardiac output, heart rate.

UNIT II 12 Hours

Gastro intestinal System

Structure of GI tract. Salivary gland - function, Functional anatomy of stomach, small and large intestines, Composition of salivary, gastric, pancreatic, intestinal and bile secretions. Digestion and absorption of carbohydrates, lipids and proteins.

UNIT III 12 Hours

Respiratory and Excretory systems

Respiratory system -Structure of Lungs, Diffusion of O_2 and CO_2 in blood, lungs and tissues. Oxygen dissociation curve - Hill's plot.

Excretory system - Structure of Kidneys, structure of nephrons - Composition and formation of urine, Renal threshold, Glomerular filtration rate.Role of lungs and kidneys in maintenance of acid-base balance.

UNIT IV 12 Hours

Musculoskeletal systems

Classification, location of the bones and muscles in the body, muscle attachment to bones (brief description) - gross features of bones and parts, muscle and bone, joints, classification, bones involved, movements and muscles that produce movements. Muscle types - Muscular contraction and relaxation.

UNIT V 12 Hours

Nervous system

Nervous system - Central nervous system, Peripheral nervous system, Autonomic nervous system. Structure of Brain and Spinal cord, Cranial nerves and functions.Brief account of degeneration and regeneration of nerves. Neurons - structure, Nerve impulse and Neurotransmitters.

References

1. Guyton and Hall Text book of Medical Physiology, Elsevier; 4thedition, 2020.
2. Murray et al. Harper's Illustrated Biochemistry 30th ed. McGraw Hill, 2015.
3. Smith et al. Principles of Biochemistry. Mammalian Biochemistry. McGraw Hill 7th ed.,1982.
4. Barrett et al. Ganong's Review of Medical Physiology. 25th ed. Lange, 2015.
5. Graaf & Rees. Schaum's Easy Outline of Human Anatomy & Physiology.3 rd ed.,2009.
6. Robin R Preston, Thad E Wilson, Physiology, Lippincott's Illustrated Reviews, 2nd edition, 2019.
7. http:/youtu.be/r-16hB76Ark/ (Oxygen Dissociation curve)
8. https://youtu.be/cKnEdvrmHK4 (Blood Groups)
9. https://youtu.be/xEHGIRpGyh4 (Oxygen transport in blood)
10. 10.https://youtu.be/hnWk0dVb8fQ (Digestion and absorption)

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Core – 3: Anatomy and Physiology	Cognitive Level
CO1	outline the action of heart in terms of how blood collects and how blood is pumped through the heart and state the composition of the blood	K2
CO2	summarize the major functions of each organ in the digestive system	K2
CO3	analyze the structure and functions of different parts of lungs and kidneys	K4
CO4	explain the anatomy of muscles and skeleton and how they are organized in the human body	K1, K2
CO5	compare and contrast central autonomic and peripheral nervous system	K5

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Core – 3: Anatomy and Physiology												
CO	PO						PSO					
	1	2	3	4	5	6	1	2	3	4	5	6
1	3	3	3	3	2	3	3	3	3	3	2	3
2	3	3	3	3	2	3	3	3	3	3	2	3
3	3	3	3	3	3	3	3	3	3	3	3	3
4	3	3	3	3	2	3	3	3	3	3	2	3
5	3	3	3	3	2	3	3	3	3	3	2	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

TECHNIQUES IN ANATOMY AND PHYSIOLOGY

L	T	P	C
0	0	2	2

1. Identification of Blood grouping
2. Determination of Rh typing
3. Enumeration of RBC
4. Enumeration of WBC
5. Enumeration of blood platelets
6. Determination of Erythrocyte sedimentation rate
7. Estimation of Haemoglobin by Drabkin's method
8. Determination of Packed Cell Volume (PCV)

References

1. Estridge, Reynold and Walter, Basic Medical Laboratory Techniques - 4th edition, Delmar Publishers, 2000.
2. Kanai L Mukherjee, VolI-III.Medical Lab Technology, Tata McGraw Hill Education India, 3rd edition, 2010.
3. RamnikSood,Textbook of Medical Lab Technology, Jaypee Brothers Medical Publishers (P) Ltd., 6th edition, 2009.
4. T. N. Pattabiraman, Laboratory Manual and Practical Biochemistry, All India Publishers & Distributors, 4th edition,2015.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Major Practical – 3: Techniques in Anatomy and Physiology	Cognitive Level
CO1	name the four major blood types and naturally occurring antibodies to red call antigens	K1
CO2	relate the occurrence of D-antigen and its importance in prevention of hemolytic disease of the new born and blood transfusion	K1
CO3	utilize specific technique and determine the number of blood cells for clinical pathology studies	K3, K5
CO4	illustrate and diagnose an infection or inflammatory process or other diseases	K2
CO5	measure inflammatory state of infectious diseases or chronic inflammatory conditions	K5

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Major Practical – 3: Techniques in Anatomy and Physiology												
CO	PO						PSO					
	1	2	3	4	5	6	1	2	3	4	5	6
1	3	3	3	3	3	3	3	3	3	3	3	3
2	3	3	3	3	2	2	3	3	3	3	3	3
3	3	2	3	3	2	2	3	2	3	3	3	2
4	3	3	3	3	2	2	3	3	3	3	3	2
5	3	2	3	3	3	2	3	2	3	3	3	2

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

Biophysical Chemistry/Allied Chemistry/Zoology
(Select any one)

L	T	P	C
4	0	0	3

BIOPHYSICAL CHEMISTRY

Objective

To introduce the basic concepts of Chemistry and Physics underlying Biochemistry for a better understanding and application of Biochemistry in various fields.

Total Hours: 60

UNIT I 12 Hours

Bioenergetics

Energy requirement in cell metabolism, Structure and role of mitochondria, High energy phosphate bond, Energy currency of cell, Laws of thermodynamics, Activation energy, Biological systems as open, non-equilibrium system, Concept of free energy, unavailable energy, entropy, enthalpy, Standard free energy, Gibbs free energy.

UNIT II 12 Hours

Electrochemistry

Single and standard electrode potentials, Reference electrodes - Primary reference electrode, Standard hydrogen electrode, Secondary reference electrode, Saturated calomel electrode, Determination of standard electrode potentials of Zinc and Copper electrodes, Use of electrodes in biology.

UNIT III 12 Hours

Surface chemistry

Adsorption - Physical adsorption and Chemisorption, Factors affecting adsorption of gases on solids, Colloidal state - Distinction between true solution, colloids and suspension. Lyophilic, Lyophobic, Multimolecular and Macromolecular colloids. Tyndall effect, Brownian movement, Coagulation, Osmosis, Dialysis, Adsorption, Ultrafiltration - Physiological importance.

UNIT IV 12 Hours

Biophysical principles

Protolysis of water, pH, Concept of Acids and Bases, Acid - Base neutralization curve, Bond and forces in Biomolecules, Specific gravity - Characteristics, Factors influencing and Biological importance, Viscosity and Resistance - Characteristics, Factors influencing and Biological applications. Concept of buffers and its significance, Determination of pH - Indicators and pH meter.

UNIT V 12 Hours

Photochemistry

Interaction of radiation with matters, Difference between thermal and photochemical process, Laws of photochemistry - Grotthuss- Draper law, Stark - Einstein law, Quantum yield, Actinometry, example of low and high Quantum yield, Role of photochemical reaction in biochemical process, Chemiluminescence, Photosensitized reactions - Energy transfer reactions**.**

References

1. Nelson and Cox. Lehninger Principles of Biochemistry. Freeman, 7th ed. 2017.
2. Voet, Donald, Judith G. Voet, and Charlotte W. Pratt. Fundamentals of biochemistry. NewYork: John Wiley & Sons,5th Edition, 2016.
3. Douglas Skoog, F. James Holler and Stanley Crouch, Principles of Instrumental Analysis, 6th edition, 2006.
4. B.R. Puri, L.R. Sharma and Madhan S Pathania,Principles of Physical Chemistry, Vishal Publishing Co., 2017.
5. Gurudeep Raj. Advanced Physical Chemistry, Goel Publishing House,1999.
6. Sharma K K and Sharma L K A Textbook of Physical Chemistry, Vikas Publishing House, 6th edition,2016.
7. Lewis and Randall, Thermodynamics, 2000.
8. Atkins P W, Physical Chemistry, 11th Edition, Oxford Universities Press Private Limited,2018.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Allied II –1:Biophysical Chemistry	Cognitive Level
CO1	outline the Fundamental concepts of bioenergetics in biochemical process	K2
CO2	relate the principles and applications of electrochemical techniques in area of bioanalysis	K2
CO3	apply the basic principles underlying the behaviour of macromolecules in solution and in the solid state and that of colloidal solution to draw industrial applications	K3
CO4	justify the physical basis for the function of biological macromolecules	K5
CO5	determine the reaction rate and the mechanism of chemical and photochemical reactions	K5

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Allied II –1:Biophysical Chemistry												
CO	PO						PSO					
	1	2	3	4	5	6	1	2	3	4	5	6
1	3	3	3	3	3	2	3	3	3	3	3	2
2	3	3	3	3	3	2	3	3	3	3	3	2
3	2	3	3	3	3	2	2	3	3	3	3	2
4	2	3	3	3	3	2	2	3	3	3	3	2
5	3	3	3	3	3	2	3	3	3	3	3	2

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

Biophysical Chemistry Methods/Allied Chemistry/Zoology Practical

L	T	P	C
0	0	2	2

BIOPHYSICAL CHEMISTRY METHODS

1. Preparation of normal molar standard solution and serial dilutions.
2. Preparation of buffers (acetate, phosphate, borate buffers).
3. Determination of coefficient of viscosity of water by capillary flow method.
4. Determination of pH titration curve of amino acid and calculation ofpka values.
5. Determination of pH titration curve of protein and calculation ofpI values.
6. Determination of pH by using pH meter.
7. Determination of surface tension of liquid.
8. Determination of viscosity of liquid.
9. Acid – Base titration.

References

1. BeeduSashidhar Rao and Vijay Desphande, Experimental Biochemistry: A student Companion, ISBN-13: 978-9389633924, Dreamtech Press, 2020.
2. Ira N Levine,Physical Chemistry, McGraw-Hill Education; 6th edition, 2008.
3. M. Viswanathan, P.S. Raghavan,Practical Physical Chemistry, ISBN-13: 978-8130929699, Viva Books, 2015.
4. Theodore E. Brown,Chemistry: The Central Science, 13th Edition, Pearson, 2014.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Allied II - Practical - 1: Biophysical Chemistry Methods	Cognitive Level
CO1	develop skill to prepare solutions at desired concentrations and desired volumes for its use in biophysical techniques	K3
CO2	make use of the principle and handling of pH meter and Viscometer for analyzing biomolecules	K3
CO3	analyse different titration curves for aminoacids and proteins in area of bioanalysis	K4
CO4	predict the coefficient of viscosity of water and apply in bioindustries and biological research	K3, K6
CO5	determine the surface tension of liquids in various industries biochemistry research	K5

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Allied II – Practical - 1: Biophysical Chemistry Methods												
CO	PO						PSO					
	1	2	3	4	5	6	1	2	3	4	5	6
1	3	2	3	3	3	2	3	2	3	3	3	2
2	3	2	3	3	3	2	3	2	3	3	3	2
3	2	2	3	3	3	2	2	2	3	3	3	2
4	2	2	3	3	3	2	2	2	3	3	3	2
5	3	2	3	3	3	2	3	2	3	3	3	2

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/2021-22/UG - Colleges/Part - III (B.Sc. Biochemistry)/Semester-III/Skill Based Courses in Biochemistry

Tools in Medical Biochemistry/Blood Banking
(Select any one)

L	T	P	C
4	0	0	4

TOOLS IN MEDICAL BIOCHEMISTRY

Objective

To introduce the basic concepts of clinical biochemistry, hematology, serology and pathology to develop skill in analysis of patient samples in a clinical laboratory.

Total Hours: 60

UNIT I 12 Hours

General laboratory and Instrument maintenance

Organization of laboratory and safety precautions in laboratory and personal cleanliness and care. Quality assurance and disposal of wastes. Cleaning of equipments and glasswares. Maintenance and use of refrigerator, deep freezers, incubators, ovens, water bath, autoclaves, centrifuges, etc. Maintenance and knowledge of various components of microscopes.

UNIT II 12 Hours

Clinical Biochemistry

Principle, types, uses, care and maintenance of Photoelectric colorimeter, Spectrophotometer and Flame photometer. Principle, types and uses of Autoanalyser, Blood gas analyser & role of Computers in laboratory. Quality control: Role of quality control and its importance. Accuracy, Reliability, Precision.

Biochemical test profiles: Principle and examination of glucose tolerance test, liver function tests, kidney function tests, thyroid function test and lipid profile.

UNIT III 12 Hours

Clinical Pathology

Specimen collection: Collection of Whole blood,Urine, C.S.F & other body fluids. Use of anticoagulants, Separation of Plasma and Serum.

Physical and chemical examinations of urine and microscopic examination for crystals, cells and casts. Semen analysis (count, motility, abnormal forms etc.).

UNIT IV 12 Hours

Hematology

Collection of blood, preparation and use of different anticoagulant vials, preparation of blood smears, staining of blood film and mounting of slides. Preparation of reagents for haemoglobin, counting of leukocytes, RBC, platelets and reticulocyte count, determination of ESR and PCV and techniques of these tests. Recognition of blood cells in peripheral blood smears. Preparation of hemolysate and determination of foetal haemoglobin and haemoglobin electrophoresis, Preparation of reagents and techniques of coagulation profile.

UNIT V 12 Hours

Serology

Haemagglutination, Precipitation and Flocculation tests - RA factor, CRP, ASO, VDRL, and Widaltest. Principles of ELISA test and use of ELISA reader- TORCH, Hepatitis, HIV testing and EBV etc. Separation of plasma proteins and Immunoglobulins by gel electrophoresis.

References

1. Varley, H., Gowenlock, A.H. and Hill, M. William,Practical Clinical Biochemistry, CBS Publishers; 6th Edition, 2006.
2. Wilson and Walker. Principles and techniques of Biochemistry and Molecular Biology. 7th ed. Cambridge University Press, 2012.
3. Ramakrishnan,Prasannan&Rajan,Textbook of Biochemistry, Orient BlackSwan; 3rdedition,2001.
4. M.N. Chatterjee, Rana Shinde,Medical Biochemistry,Jaypee Brothers, 8th edition, 2012
5. Estridge, Reynold and Walter,Basic Medical Laboratory Techniques- 4th edition, Delmar Publishers, 2000.
6. Kanai L Mukherjee, Medical Lab Technology- Vol I-III. Tata McGraw Hill Education India, 3rd edition, 2010.
7. RamnikSood,Textbook of Medical Lab Technology,Jaypee Brothers Medical Publishers (P) Ltd., 6th edition, 2009.
8. T. N. Pattabiraman, Laboratory Manual and Practical Biochemistry, All India Publishers & Distributors, 4th edition,2015.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Skill Based Subject: Tools in Medical Biochemistry	Cognitive Level
CO1	list the general laboratory instruments and its maintenance in clinical biochemistry to ensure accurate results and proper functioning	K1
CO2	explain standard use of laboratory instrument to analyze different tests in biochemistry	K2
CO3	analyze biochemical profile in urine and blood samples and interpret the results in order to determine clinical diagnosis	K4
CO4	assess blood for hematological assay and interpret the result in relation to health and diseases	K5
CO5	identify serological test and apply to sample testing in clinical labs	K3

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Skill Based Subject: Tools in Medical Biochemistry												
CO	PO						PSO					
	1	2	3	4	5	6	1	2	3	4	5	6
1	3	3	3	3	3	3	3	3	3	3	3	3
2	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3
4	3	3	3	3	3	3	3	3	3	3	3	3
5	3	3	3	3	3	3	3	3	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

BLOOD BANKING

L	T	P	C
4	0	0	4

Objective

To understand the importance of blood donation and to develop skills in blood banking services including donormotivationand selection, so as to ensure adequate availability of safe blood.

Total Hours: 60

UNIT I 12 Hours

Blood

Introduction to Blood Banking, Composition and functions of blood and blood components, Collection of blood - Requirements, Preparation, Venepuncture. Hemolysis and prevention. Separation of serum and plasma.

UNIT II 12 Hours

Immunohematology

Basic principles of Immunohematology, Human blood group system - ABO blood group system, Percentage of different groups, Bombay blood group, Rh blood group system. Principles and methods of ABO blood grouping and Rh typing - slide and tube methods.

UNIT III 12 Hours

Blood collection and Preservation

Anticoagulants in Blood Bank, Blood containers - Blood bags, types, Safety in blood bags. Blood collection for transfusion - Preparation, Phlebotomy, Changes in blood on keeping, Preservation of blood and blood components.

UNIT IV 12 Hours

Blood transfusion

Types and indication of various blood transfusion, Donor selection - WHO recommendations, Universal donor/recipient. Compatibility testing - Importance, Methods - major and minor compatibility tests. Interpretation of compatibility test and reporting methods. Release of blood for transfusion, Precautions to be followed.

UNIT V 12 Hours

Screening procedures for blood transfusion

Screening tests in donor blood - HBsAg, HCV, HIV-ELISA, VDRL, Identification of Malarial and Filarial parasites and LD bodies (Principles and methods).

References

1. Henry Bernard, J., Sanford,T and Davidson, Clinical diagnosis and Management by laboratory methods,W.B. Saunders, New York, 2002.
2. Gradwohls, (ed) Ales C. Sonnenwirth and Leonard Jarret, M.D,Clinical Laboratory Methods and Diagnosis B.I. publications, New Delhi, 2000.
3. Richard. R, Clinical Laboratory Medicine, Medical public., Chicago,1989
4. Williams and J. William, Haematology, Mc Graw Hill, New York. 9th edition, 2016.
5. M.N. Chatterjee, Rana Shinde, Medical Biochemistry, Jaypee Brothers, 8th edition, 2012
6. Estridge, Reynold and Walter, Basic Medical Laboratory Techniques - 4th edition, Delmar Publishers, 2000.
7. Kanai L Mukherjee, Medical Lab Technology - Vol I-III. Tata McGraw Hill Education India, 3rd edition, 2010.
8. RamnikSood, Textbook of Medical Lab Technology, Jaypee Brothers Medical Publishers (P) Ltd., 6th edition, 2009.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Skill Based Subject: Blood Banking	Cognitive Level
CO1	recall advanced blood banking methods to apply in transfusion medicine	K1, K3
CO2	apply theoretical concepts of Immunology and state the characteristics of ABO, Rh and other blood group systems to utilize in blood bank laboratory	K3
CO3	explain the donor blood collection process, storage requirements and transport methods	K5
CO4	choose the indication and list the causes of transfusion to solve problems in clinical transfusion	K5
CO5	apply the testing process for transfusion by producing neat, accurate results	K3

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Skill Based Subject: Blood Banking												
CO	**PO**						**PSO**					
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**
1	3	3	3	3	3	3	3	3	3	3	3	3
2	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3
4	2	3	3	3	3	3	2	3	3	3	3	3
5	3	3	3	3	3	3	3	3	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/2021-22/UG - Colleges/Part - IV (B.Sc. Biochemistry)/Semester-III/Non Major Elective Courses in Biochemistry

Biochemistry of Vision/Vaccinology
(Select any one)

L	T	P	C
2	0	0	2

BIOCHEMISTRY OF VISION

Objective

To enable students to acquire specialized knowledge about Human eye, process of vision and to know the clinical disorders affecting eye.

Total Hours :30

UNIT I 6 Hours

Introduction

The Human eye - Anatomy - Cornea, Sclera, Choroid, Ciliary body, Iris, Retina, Aqueous humor, Lens, Vitreous body, Structure and function of cones and rods.

UNIT II 6 Hours

Process of vision

Role of vitamins- Vitamin A and retinoic acid, Vitamin C and Vitamin E in eye function. Retinol transport, metabolism and function, Lens proteins - collagen, laminin, fibronectin, crystalline and proteoglycan. Arachidonic acids and Eicosanoids.

UNIT III 6 Hours

Retinal pigments and phototransduction

Retinal pigments, phototransduction - mechanism - second messengers - adenylate cyclase system, phosphoinositide breakdown, Guanylate cyclase and ANF.

UNIT IV 6 Hours

Metabolism in lens, cornea and retina

Biochemical composition of lens, retina, vitreous and tears. Metabolism of carbohydrates in the lens, cornea and retina. Glucose transport, insulin and aldose reductase. Glutathione metabolism in the lens.

UNIT V 6 Hours

Clinical disorders

Kerato conjunctivitis, Mucin deficiency diseases, corneal dystrophies, Mucopolysaccharidoses and Mucolipidoses, Aging and Cataracts, Sugar cataracts, Radiation cataracts and Selenium cataract and their risk factors, Glaucoma.

References

1. Nelson and Cox. Leininger's Principles of Biochemistry. Freeman, 7th ed., 2017.
2. Tymoczko, John L., Jeremy M. Berg, and LubertStryer. Biochemistry, 8th ed. Freeman, 2015.
3. Garrett, Reginald, and Charles Grisham. Biochemistry. Nelson Education, 2012.
4. Voet, Donald, Judith G. Voet, and Charlotte W. Pratt. Fundamentals of biochemistry. NewYork: John Wiley & Sons,5th Edition, 2016.
5. Lippincott Williams and Wilkins; Illustrated Reviews: Biochemistry, Seventh, North American edition, 2016.
6. Guyton and Hall Text book of Medical Physiology,14th edition, 2020
7. DavidWhikehart, Biochemistry of the eye, University of Alabama at Birmingham, AL, USA Paperback, Butterworth Hainemann (www.elsevier .com)
8. Vaclav HlavacHuman eye physiology (www.sight savers.org).

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Non-Major Elective: Biochemistry of Vision	Cognitive Level
CO1	recall the parts of human eye and relate how they work together to provide vision	K1, K2
CO2	summarize the process of vision and relate the role of vitamins to promote healthy vision	K1, K2
CO3	identify the role of retinal pigments and phototransduction in metabolic regulation of cellular function	K3
CO4	appraise the carbohydrate metabolism in lens, cornea and retina necessary for the maintenance of vision and their importance	K5
CO5	analyze various clinical disorders in vision to develop therapy	K4

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Non-Major Elective: Biochemistry of Vision												
CO	PO						PSO					
	1	2	3	4	5	6	1	2	3	4	5	6
1	3	2	3	2	2	3	3	2	3	2	2	3
2	2	2	2	2	2	2	2	2	2	2	2	2
3	2	2	3	2	2	2	2	2	3	2	2	2
4	2	3	2	2	2	2	2	3	2	2	2	2
5	3	3	3	2	2	3	3	3	3	2	2	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

VACCINOLOGY

L	T	P	C
2	0	0	2

Objective

To learn about basic concepts of infection & immunity and to acquire knowledge about immunization practices.

Total Hours :30

UNIT I 6 Hours

Introduction to infection and immunity

Sources of infection and infectious diseases, Immunity innate and acquired immunity prevention of infectious diseases - vaccines - Historical aspects - Edward Jenner, cowpox and small pox vaccine Louis Pasteur and anti-rabies vaccine.

UNIT II 6 Hours

Vaccines

Definition, Types - Live attenuated, killed, subunit, antitoxins, Antivenom, nucleic acid (DNA) vaccines. Currently licensed vaccines - Recombinant delivery systems for future vaccines - New approaches for better vaccines, Anti-idiotypic vaccines - Adjuvants.

UNIT III 6 Hours

ImmunizationPractices

Therapeutic principles - new approaches to immunization - mucosal vaccine, maternal immunization. National immunization schedule for pregnant women, neonatal and children recommended by WHO.

UNIT IV 6 Hours

Vaccines based on production

Recombinant vaccines; polynucleotide as vaccines; biosynthetic and chemically synthesized vaccines; subunit vaccine; anti idiotype vaccine; fusion vaccines; mixed particle vaccines; human mucosal vaccine; combination vaccines; Edible vaccines produced in transgenic plants and microencapsulation.

UNIT V 6 Hours

EPI Vaccines

Production of tetanus toxoid, diphtheria toxoid, pertussis vaccine, BCG vaccines; preparation of Hepatitis B vaccine rabies vaccine and AIDS vaccine.

References

1. Richard A Goldsby et al. Kuby Immunology. WH Freeman & Co. 7thed, 2013.
2. Abbas et al. Cellular and Molecular Immunology. 9th ed. Elsevier, 2018.
3. Janeway, C. (Ed), Travers. Immunobiology 9th ed. Garland Publ., 2016.
4. Coico and Sunshine. Immunology: A short course. 7th ed. Wiley-Liss, 2015.
5. Roitt et al. Roitt's Essential Immunology. 13 th ed Wiley-Blackwell Sci., 2017.
6. Eli Benjamini AU et al. immunology 5thed.Garland publ., 2001.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Non-Major Elective: Vaccinology	Cognitive Level
CO1	relate the principle, strategies, vaccine history and the challenges to overcome vaccine development against target infectious diseases	K1
CO2	categorize the different types of vaccines and illustrate with examples in control of diseases	K2, K4
CO3	identify recent developments towards improved vaccines in aspects of vaccinations and safety	K3
CO4	appraise the various vaccines under expanded programme on immunization to reduce the incidence of common infectious diseases	K5
CO5	outline the prospects for producing vaccines against diseases and recognize the adverse effect of immunization	K2

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Non-Major Elective: Vaccinology												
CO	**PO**						**PSO**					
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**
1	3	2	3	3	3	3	3	2	3	3	3	3
2	3	2	3	3	3	2	3	2	3	3	3	3
3	3	2	3	3	3	2	3	2	3	3	3	3
4	3	2	3	3	3	3	3	2	3	3	3	3
5	3	2	3	3	3	2	3	2	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

ENZYMES

L	T	P	C
4	0	0	4

Objective

To understand the basic principles of enzymology and to understand a mechanistic overview of enzyme activity and regulation in cell

Total Hours: 60

UNIT I 12 Hours

Introduction to Enzymes

General characteristics of enzymes, enzyme specificity, Nomenclature, definition with examples of holoenzyme, apoenzyme, coenzymes, cofactors, activators, inhibitors, Unit of enzymes. Definition of IU, Katal, Enzyme turn over number and specific activity. Mechanism of enzyme action, Active site.

UNIT II 12 Hours

Cofactors and Multienzyme complexes

Role of cofactors in enzyme catalysis - NAD/NADP, FMN/FAD, Coenzyme A, Pyridoxal Phosphate and Tetrahydrofolate with suitable examples. Mechanism of action of chymotrypsin&lysozyme. Multienzyme complexes- Pyruvate dehydrogenase complex.

UNIT III 12 Hours

Enzyme Kinetics

Factors affecting enzyme activity- enzyme concentration, substrate concentration, pH and temperature. Derivation of Michaelis - Menten equation for uni-substrate reactions. Km and its significance. Line weaver - Burk plot.

UNIT IV 12 Hours

Enzyme Inhibition

Reversible and irreversible inhibition, Competitive inhibition, Non-competitive inhibition and Uncompetitive inhibition with suitable examples. Allosteric enzymes.

UNIT V 12 Hours

Enzyme regulation

General mechanism of enzyme regulation - Feedback inhibition, Enzyme repression, induction; Reversible and irreversible covalent modifications with specific examples. Immobilized enzymes and their industrial applications. Isoenzymes and their medical applications.

References

1. Palmer T. Understanding enzymes. Prentice Hall, 2004.
2. Buchholz et al Biocatalysts and Enzyme Technology. 2nd ed. Wiley-Blackwell, 2012.
3. Pandey et al. Enzyme Technology. Springer, 2010,
4. Nelson, Cox. Lehninger Biochemistry. 7th ed. Freeman, 2017.
5. Balasubramanian et al. Concepts in Biotechnology. Univ Press, 2004.
6. Dixon and Webb. Enzymes, 3rd ed. Longmans, 1979.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Core–4: Enzymes	Cognitive Level
CO1	understand and justify the nature and importance of enzymes in living cells	K2 &K5
CO2	categorize the enzyme based on the classification, nomenclature and properties	K4
CO3	build information on basis of enzymatic reaction, their types and mechanism	K6
CO4	rate the mechanism of enzyme action, kinetics of enzyme catalyzed reaction and inhibitors	K5
CO5	discover the mechanism of enzyme regulation and enzyme turnover	K4

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Core-4: Enzymes												
CO	**PO**						**PSO**					
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**
1	3	3	2	3	2	3	3	3	2	3	2	3
2	3	3	2	3	2	2	3	3	2	3	2	2
3	2	3	2	3	2	1	2	3	2	3	2	1
4	2	3	2	2	2	2	2	3	2	2	2	2
5	2	2	3	2	2	2	2	2	3	2	2	2

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

ENZYME TECHNIQUES

L	T	P	C
0	0	2	2

I. Enzyme kinetics of Urease, Amylase, Alkaline phosphatase (Any one)

1. Preparation of crude enzyme extract – Effect of pH,Temperature,Substrate concentration,Enzyme concentration and Determination of Km

II.Determination of specific activity of (Any two)

1. Hexokinase in liver
2. Glucose-6-phosphatase in liver
3. Arginase in liver

References

1. Rodney F Boyer, Modern Experimental Biochemistry, 3rd edition, Pearson Education, 2002.
2. T. N. Pattabiraman, Laboratory Manual and Practical Biochemistry, All India Publishers & Distributors, 4th edition,2015.
3. J. Jayaraman, Laboratory Manual in Biochemistry - New Age International Publishers, 2nd edition, 2011.
4. S. Sadasivam, A. Manickam, Biochemical Methods - New Age International (P) Limited, 3rd edition, 2018.
5. David T. Plummer An Introduction to Practical Biochemistry, Tata McGraw Hill Publishing Company, 3rd edition, 2017.
6. AlnFersht, Enzymes Structure and Mechanism, NewYork: Freeman, 2nd edition,1999.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Major Practical – 4: Enzyme Techniques	Cognitive Level
CO1	analyse the kinetics of enzyme catalysed reaction to optimize the conditions for the maximum enzyme activity	K4
CO2	apply different techniques to extract and quantify enzymes	K3
CO3	identify the source of various enzymes of biological importance	K3
CO4	assess the activity of liver enzymes in unknown samples	K5
CO5	evaluate the alternations in liver enzyme activity and interpret the significance	K5

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Major Practical – 4: Enzyme Techniques												
CO	PO						PSO					
	1	2	3	4	5	6	1	2	3	4	5	6
1	3	2	3	3	3	2	3	2	3	3	3	2
2	2	2	3	3	3	2	2	2	3	3	3	2
3	2	2	3	3	3	1	2	2	3	3	3	1
4	3	2	3	3	3	1	3	2	3	3	3	1
5	3	2	3	3	3	2	3	2	3	3	3	2

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

Industrial Biochemistry/Allied Chemistry/Zoology
(Select any one)

L	T	P	C
4	0	0	3

INDUSTRIAL BIOCHEMISTRY

Objective

To impart understanding and application ofthe basic principles and techniques of Biochemistry in various industries

Total Hours: 60

UNIT I 12 Hours

Bioprocess Technology

Principles of Fermentation, Types of Fermentation- Batch, Fed batch, Semicontinuous and Continuous culture techniques. Fermenters- Design and Types- Continuous stirred tank fermenter (CSTF) and Airlift fermenters. Fermentation culture media, Downstream processing

UNIT II 12 Hours

Production of Metabolites

Fermentative production of Antibiotics- Penicillin and Streptomycin. Organic acids- Citric acid and Lactic acid. Amino acids- Glutamic acid and Lysine. Vitamins- B12 and B2.

UNIT III 12 Hours

Production of Enzymes and Proteins

Immobilized Enzymes - Immobilization - Definition- Industrial and Medical applications of Immobilized enzymes. Enzymes- Amylase and Protease. Production of therapeutic proteins- Immunoglobulins, Vaccines. Biosensors- Types and Applications.

UNIT IV 12 Hours

Carbohydrates of Industrial importance

Manufacturing and byproducts of sugar industry. Production of Starch and Cellulose. Manufacturing of plant and microbial polysaccharides. Modified Carbohydrates- Agarose and Sepharose.

UNIT V 12 Hours

Biofertilizers and Biopesticides

Biofertilizers - Blue green algal fertilizers (Azolla, Anabaena), Seaweed fertilizers-Mycorrhiza. Biopesticides- Insecticidal toxin of Bacillus thuringiensis-Mode of action.

References

1. G P Garg, Industrial Biochemistry, Discovery Publishing Pvt.Ltd, 2010.
2. A.H Patel, Industrial Microbiology, 2nd edition; Laxmi Publications, 2011.
3. L. E Casida, J R, Industrial Microbiology, 2nd edition; New Age International Publishers, 2019.
4. Cruegers Biotechnology, A text book of Industrial Microbiology, Wulf Crueger and Anneliese Crueger; Edited by K.R. Aneja; 3rd edition; Medtech Publisher, 2017.
5. Joanne Willey, Prescott's Microbiology, McGraw-Hill Education; 10th edition, 2016.
6. Michael Pelczar, Microbiology, McGraw Hill Education; 5th edition, 2001.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Allied II–2:Industrial Biochemistry	Cognitive Level
CO1	recall the application of biochemical principles in industries	K1
CO2	explain the principle of fermentation technology and different types of fermenters	K2
CO3	analyze the technique of immobilization and apply the function of enzymes in various industries	K3, K4
CO4	evaluate the byproducts produced in sugar industry and discuss the useful applications	K5
CO5	assess the application and advantages of biofertilizers and biopesticides	K5

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Allied II –2:Industrial Biochemistry												
CO	**PO**						**PSO**					
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**
1	3	3	2	3	3	3	3	3	2	3	3	3
2	3	3	2	3	3	3	3	3	2	3	3	3
3	3	2	3	3	3	3	3	2	3	3	3	3
4	3	2	3	3	3	3	3	2	3	3	3	3
5	2	2	3	3	3	3	3	2	2	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

Industrial Biochemistry Methods/Chemistry/Zoology Practical

L	T	P	C
0	0	2	2

INDUSTRIAL BIOCHEMISTRY METHODS

1. Mushroom production- Solid state fermentation
2. Production of Wine from Grapes
3. Separation of Milk protein by Precipitation
4. Production of Ethyl alcohol from molasses and whey by yeast
5. Microbiological Examination of Milk
6. Fermentation of Fruit juices
7. Isolation of Rhizobium from legume root nodules

References

1. T.C.K Sugitha, P. Raja, R. Rajesh and U. Sivakumar, Practical Manual cum workbook Industrial Microbiology, Tamil Nadu Agricultural University Publication, 2020.
2. Anil Kumar Puniya and Shilpa Vij, Practical Manual on Food and Industrial Microbiology, National Dairy Research Institute Publication, 2010,
3. Naveen Varghese and Joy P P, Microbiology Laboratory Manual, Kerala Agricultural University, 2014.
4. Prescott and Dunn, Industrial Microbiology, CBS Publishers, 4th edition, 2004.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Allied II – Practical- 2: Industrial Biochemistry Methods	Cognitive Level
CO1	tell about fermentation process and apply different methods of fermentation techniques	K1, K3
CO2	show the production of mushroom, wine and ethyl alcohol using fermentation process and utilize the techniques employed for further production process	K1, K3
CO3	explain the separation procedure involved in milk protein separation and categorize the microbiological examination of milk	K2, K4
CO4	analyze the isolation of rhizobium from root nodules of legumes and interpret the fermentation of fruit juices	K4, K5
CO5	plan about production of various products industrially	K6

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Allied II – Practical- 2: Industrial Biochemistry Methods												
CO	**PO**						**PSO**					
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**
1	3	2	3	3	3	3	3	2	3	3	3	3
2	3	2	3	3	3	3	3	2	3	3	3	3
3	3	2	3	3	3	3	3	2	3	3	3	3
4	3	2	3	3	3	3	3	2	3	3	3	3
5	3	2	3	3	3	3	3	2	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

Public Health Studies/Forensic Analysis/DNA Fingerprinting
(Select any one)

L	T	P	C
4	0	0	4

PUBLIC HEALTH STUDIES

Objective

To pursue a career working in community and public health programs and education in voluntary, private and governmental agencies.

Total Hours: 60

UNIT I 12 Hours

Concept of health and diseases

Preventive Medicine, Social Medicine, Definition of health, Dimension of health, Spectrum of health, Determinants of health and Indicator of Health. Natural history of disease, concept of disease control, levels of prevention and modes of intervention for diseases and condition, International classification of diseases.

UNIT II 12 Hours

Principles of epidemiology and epidemiologic methods

Aims of epidemiology, epidemiological approaches, rates and ratios, measurements of mortality, measurement of morbidity. Preventive measures of communicable diseases-Chicken pox, influenza, diphtheria, Whooping cough, tuberculosis, Dengue, Malaria, Filariasis, Rabies, Plague, Japanese encephalitis, Leishmaniasis, Leprosy, sexually transmitted diseases and AIDS.Pandemic diseases with reference to Covid 19.

UNIT III 12 Hours

Nutrition and Health

Concept of balanced diet. Common Nutritional deficiency disorders, Assessment of Nutritional status, Social aspects of Nutrition. Nutrition surveillance, Food hygiene, Milk hygiene, Meat hygiene, Food borne diseases, Community Nutrition Programmes, Diets in disease condition like Diabetes and hypertension.

UNIT IV 12 Hours

Demography & Family planning

Demographic cycles, Demographic trends, fertility, National Health Policy, National Population policy, Contraceptive methods and its evaluation. Health education and communication: Health education objectives contents, principles, communication in health education, Audio Visual Aids, Practice and Planning of Health education.

UNIT V 12 Hours

Health agencies, Health Planning and Management

International Health agencies - WHO, UNICEF, Voluntary Health Agencies.Health Planning - Objectives, Planning cycle, Management process, methods and techniques, Health system in India, Evaluation of Health Services, Planning for a Health programme in a community.

References

1. Park. K. Textbook of Preventive and Social medicine. Jabalpur: BanarsidasBhanot, 23rd edition, 2015.
2. John M. Last,Public health and preventive medicine - 13th edition. Norwalk, Connecticut. Appleton & Lange. 1991.
3. Walter W. Holland, Oxford Textbook of Public Health: Volume 2: Methods of Public Health, 1991.
4. RajvirBhalwaret.al.,Textbook of Public Health and Community Medicine, 2009.
5. Mahajan and Gupta- Textbook of Preventive and Social Medicine, 4th edition,Jaypee Brothers Medical Publishers Pvt. Ltd., 2013.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Skill Based Subject: Public Health Studies	Cognitive Level
CO1	recall the concept of health and diseases, their history and classification	K1
CO2	illustrate the epidemiological approaches and develop the preventive measures of various communicable diseases	K2, K3
CO3	make use of the role of nutrition and diet in health and assess the importance of food hygiene	K3, K5
CO4	create awareness regarding health policies and importance of health education	K6
CO5	mark the international health agencies and their health planning cycles,their management process and techniques	K5

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Skill Based Subject: Public Health Studies												
CO	PO						PSO					
	1	2	3	4	5	6	1	2	3	4	5	6
1	3	3	2	2	3	3	3	3	2	2	3	3
2	3	3	2	2	3	3	3	3	2	2	3	3
3	3	3	2	2	3	3	3	3	2	2	3	3
4	2	3	3	2	3	3	2	3	3	2	3	3
5	2	3	3	2	3	3	2	3	3	2	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/2021-22/UG - Colleges/Part -III(B.Sc. Biochemistry)/Semester-IV/Skill Based Courses in Biochemistry

FORENSIC ANALYSIS

L	T	P	C
4	0	0	4

Objective

To understand the field of forensic science and to learn the application of Biochemistry subject to provide assistance in the development of forensic analysis.

Total Hours: 60

UNIT I 12 Hours

Introduction to Forensic Science

Forensic Science - Definition, concepts, scope, basic principle andhistorical aspects of forensic science, Forensic science in Indian Scenario, Frye standard and Daubert standard. Need of forensic science in present scenario.
Forensic Science Laboratories in India - Central and State level laboratories, various duration- ballistics, biology, chemistry, serology. Ethics in forensic science.Crime scene management and investigation; collection, preservation, packing and forwarding of physical and trace evidences for analysis.

UNIT II 12 Hours

Forensic characterization

Fresh blood - Chemistry and properties, Presumptive and Confirmatory tests, Individualization - Blood group determination and polymorphic enzyme typing. Analysis of stains of blood, Stain pattern of blood and allied body fluids for their groups and enzymes types, forensic significance of DNA profiling: Application of disputed paternity and maternity cases, Child swapping, missing person identity. DNA chips, SNP'S and limitations of DNA profiling.

UNIT III 12 Hours

Forensic Toxicology

Forensic Toxicology - Definition, areas of forensic toxicology, Role of the forensic toxicologists. Poisons - Definition, Classification of poisons. Extraction methods of some important poisons and their metabolic studies. Extraction, isolation and identification of poisons form viscera tissues and body fluids. Chemical examination of Insecticides and Pesticides. Analysis of traces of Petroleum products in forensic exhibits, Classification and identification of fibres.

UNIT IV 12 Hours

Forensic Pharmacology

Psychotropic drugs - Narcotics, Stimulants, Depressants and Hallucinogens. Analysis of narcotic drugs addicts and crime. Drugs of abuse. Dope tests - Analysis of narcotics drugs and psychotropic substances in post-mortems blood. Analysis and Identification of Non-alcoholic and alcoholic illicit liquors including methyl and ethyl alcohol in blood, urine, body fluid and breathe.

UNIT V 12 Hours

Individual Identification tests

Analysis of common body fluids like saliva, milk, sweat, urine and Faecal matters, their collection and identification. Identification of hair, determination of species origin, sex, site and individual identification from hair. Forensic Examination and identification of semen stains including species origin and individualcharacteristics. Significance of analysis of bones and teeth in forensic investigation.

References

1. Norah Rudin & Keith Inman USA, An Introduction to Forensic DNA Analysis, Second edition, CRC Press,2001.
2. Saferstein, Richard E, Forensic Science Handbook, Volume 2 & 3, 2004.
3. Stewart Gail B, Forensics, Cengage Gale, 2006.
4. B. J. Fisher, W.J. Tilstone, C. Woytowicz, Introduction to Criminalistics: The foundation of Forensic Science, 2009. ISBN-13: 978-0120885916
5. Parikh C. K. (1999), Parikh's Textbook of Medical Jurisprudence, Forensic Medicine and Toxicology 6th edition, CBS Publishers & Distributors Pvt. Ltd., New Delhi, ISBN: 978812390675
6. AK Jaiswal, TabinMillo (2014), Handbook of Forensic Analytical Toxicology 1 st edition Jaypee Brothers Medical Publishers, New Delhi, ISBN 9789351522249.
7. David Freifelder (1983), Molecular Biology 2 nd edition Jones & Bartlett publishers, Inc., ISBN: 81-85198-34-9.
8. V.V. Pillay,Textbook of forensic medicine and toxicology 16th edition, 2011 ISBN: 978-81-8191-347-0. Paras medical publishers, Hyderabad.
9. https://www.slideshare.net/jaguarsciteacher/forensic-science-6068919
10. https://slideplayer.com/slide/8723091/
11. https://www.youtube.com/watch?v=68Y-OamcTJ8

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Skill Based Subject: Forensic Analysis	Cognitive Level
CO1	outline the development of forensic science to accomplish the crime scenes	K1, K3
CO2	classify the type of cybercrime scene and resolve the issues arising in relation with crime scene management	K2, K5
CO3	assess the nature of the body fluid found at the crime scene and to present comprehensive knowledge of various methods of analysis and laboratory investigation of different types of body fluids	K5
CO4	appraise and justify the importance of identification of teeth, bones, semen, body fluids, fecal matters for forensic investigation	K5
CO5	perceive the significance of toxicology studies in forensic science and analyze various category of drugs and toxic substances encountered in forensic investigation	K2, K5
C06	justify the basic principle and forensic significance of DNA analysis and DNA typing	K5

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Skill Based Subject: Forensic Analysis												
CO	PO						PSO					
	1	2	3	4	5	6	1	2	3	4	5	6
1	2	3	3	3	3	3	2	3	3	3	3	3
2	2	3	3	3	3	3	2	3	3	3	3	3
3	2	3	3	3	3	3	2	3	3	3	3	3
4	2	3	3	3	3	3	2	3	3	3	3	3
5	3	3	3	3	3	3	3	3	3	3	3	3
6	2	3	3	3	3	3	2	3	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

DNA FINGER PRINTING

L	T	P	C
4	0	0	4

Objective

To promote the use of DNA technology in various areas relating to social welfare including crime and civil matters, plant and animal stock improvement, certification of cell lines, detection, prevention and treatment of diseases.

Total Hours: 60

UNIT I 12 Hours

Molecular basis of life

General introduction. Experimental Proof of DNA and RNA as genetic material. Structure and functions of DNA and RNA. Watson and Crick model of DNA and other forms for DNA (A and Z). Functions of DNA and RNA including ribozymes.

UNIT II 12 Hours

Introduction of Genetic engineering

Tools for genetic engineering, DNA manipulative enzymes - Restriction enzymes and DNA Ligases. Gene cloning vector - Plasmids, Bacteriophage and Cosmids. Isolation of plasmid DNA (E. coli). Gene Libraries - Genomic DNA and cDNA cloning techniques, expression of cloned DNA in E. coli. Separation of DNA by agarose gel electrophoresis. Polymerase chain reaction (PCR). Blotting techniques - Southern, Western and Northern blot. Nucleic acid sequencing - Sanger's method.

UNIT III 12 Hours

DNA finger printing

History of finger print science and its developments, Anthropometry, the origin of finger print science, the stages of its evolution. The different procedures in recording of finger prints. Tools for DNA Finger printing - Minisatellite based, Micro satellite based, SNP based techniques for DNA finger printing, Single locus to Multilocus, Singleplex to Multiplex. Low throughput to High throughput.

UNIT IV 12 Hours

Application of DNA

Application of DNA in fingerprinting - History, Agriculture, Veterinary, Medicines, Forensics, Ecology, Conservation.

UNIT V 12 Hours

Modern fingerprint lab, Field equipment and chemicals.

Alternate Light Source (ALS) - poly light, Cyanoacrylate fumigation chamber, Cyanowand iodine fuming apparatus, Electrostatic dust lighting kit (DLK), Reflective Ultraviolet Imaging system (RUVIS), Fluorescent FP powders for multicolored surfaces.

References

1. Primrose S B, Twyman R M, Principles of gene manipulation and genomics, 7th ed, Blackwell science Ltd, 2014.
2. Alberts B, Johnson A D, Lewis J, Morgan D, Molecular Biology of the cell, 2014.
3. Das H K, Text book of Biotechnology, 5th ed, Wiley India, 2017.
4. Brow T A, Gene cloning and DNA Analysis, An Introduction, 7th ed, Blackwell scientific publications, 2016.
5. Theiman W J, Palladino M, Introduction to Biotechnology, 3rd ed, 2014.
6. Glick B R & Patten C L, Molecular Biotechnology: Principles and applications of recombinant DNA, 5th ed, John Wiley & Sons, 2017.
7. Brown T A, An Introduction to gene cloning, 6th ed, Chapman &Hall, 2010.
8. Dubey R C, Text of Biotechnology, S Chand & Co, 2014.
9. Bernard T Glick and Jack J Pasternak, Molecular Biotechnology, 4th ed, Panima Publishing Corporation, 2014.
10. Klug W S, Cumming's M R, Essentials of Genetics, 10th ed, Mentics Hail. New Jersey, 2020.
11. https://WWW.bio.miami.edu/dana/dox/restrictionenzymes.html#:~:text=A%20 restriction%20 enzyme%20 is% 20a, the%20 bacteria %20that%20 manufacture%20 them
12. https://WWW.Youtube.Com/Watch?V=YSFqEZ6jvOK
13. https://WWW.Youtube.Com/Watch?V=npb06rF6Qww
14. https://WWW.Youtube.Com/Watch?V=2JKDu8kijrs
15. https://Knowgenetics.Org/recombinant-dna-technology/
16. https://WWW.Sciencedirect.Com/topics/biochemistry-genetics-and-molecular-biology/recombinant-dna-technology

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Skill Based Subject: DNA Fingerprinting	Cognitive Level
CO1	recall the structure and functions of genetic material	K1
CO2	tell the types of vectors and outline the techniques in rDNA technology	K1, K2
CO3	explain the history of finger print science and experiment with the available scientific tools	K2, K3
CO4	assess the applications of DNA in finger printing	K5
CO5	formulate chemicals for DNA analysis and identification	K6

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Skill Based Subject: DNA Fingerprinting												
CO	PO						PSO					
	1	2	3	4	5	6	1	2	3	4	5	6
1	3	3	3	3	3	3	3	3	3	3	3	3
2	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3
4	3	3	3	3	3	3	3	3	3	3	3	3
5	3	2	3	3	3	3	3	2	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

Nutritional Biochemistry/Chemical Biology
(Select any one)

L	T	P	C
2	0	0	2

NUTRITIONAL BIOCHEMISTRY

Objective

To acquire knowledge about the biological basis of nutrition and the mechanisms by which diet can influence health

Total Hours: 30

UNIT I 6 Hours

Introduction

General introduction and definition of food and nutrition, Function of foods and its relation to nutrition and clinical health, essential nutrients, analysis of food composition, food groups.

UNIT II 6 Hours

Importance and Source of nutrients

Physiological role, nutritional significance and food sources of carbohydrates, fats, proteins, minerals (Calcium, phosphorous, sodium and potassium) and trace elements (Copper, Cobalt, Zinc, Iodine and Iron). Protein malnutrition (Kwashiorkor) and under nutrition (Marasmus)

UNIT III 6 Hours

Vitamins

Definition, classification, sources, absorption, daily requirements, metabolism, physiology, nutritional significance and deficiency. RDA for infants, children, adolescents (male and female) pregnant & lactating women and old age.

UNIT IV 6 Hours

Calorific value and Basal metabolism

Measurement of food stuffs by Bomb calorimeter. Calorific values of proteins, carbohydrates and fats. Energy -Basal metabolism, measurement of BMR, factors affecting BMR, regulation of body temperature, energy needs, total energy requirement.

UNIT V 6 Hours

Food

Food production, food storages, functional foods, new protein foods, new fat foods and changing food habits. Food adulteration and Hygiene.

References

1. Swaminathan, M., Essentials of Food and Nutrition, Vol I & II, Bappco Publishers, Madras 2000.
2. Srilakshmi, B., Nutrition Science, New Age International (p) Ltd, Publishers, 2012.
3. Mahtab, S, Bamji, Kamala Krishnasamy, G.N.V. Brahmam., Text book of Human Nutrition, Third edition, Oxford and IBH Publishing Co. P. Ltd., New Delhi, 2015.
4. Swaminathan, M.S. Handbook of Food and Nutrition, 5th Edition. The Bangalore Printing and Publishing Company, 2007.
5. Weighley, E.S. Robinson's Basic Nutrition and Diet Therapy, 8th Edition, Macmillan Publishers, 1997.
6. Insel, P. et al., Discovering Nutrition, 4th Edition, Jones and Bartlett Publishers, 2013.
7. M. Swaminathan, Advanced text book of food and nutrition, (Vol.1 & 2), 2nd edition.
8. Kaveri Chakrabarty, A. S. Chakrabarty, Textbook of Nutrition in Health and Disease, Springer, 2019.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Non-Major Elective: Nutritional Biochemistry	Cognitive Level
CO1	explain the basic concepts of food, its function and its importance in health	K2
CO2	justify the physiological role and nutritional significance of various nutrients	K5
CO3	apply knowledge and compare the sources, daily requirements, nutritional significance and the deficiency symptoms at different stages of life	K3, K4
CO4	assess the calorific value of food stuffs and relate the factors affecting BMR and total energy needs	K2, K5
CO5	explain the process of food production, its storage and examine the changing food habits and food adulteration	K2, K4

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Non-Major Elective: Nutritional Biochemistry												
CO	PO						PSO					
	1	2	3	4	5	6	1	2	3	4	5	6
1	3	3	3	2	3	2	3	3	3	2	3	2
2	3	3	2	2	2	2	3	3	2	2	2	2
3	3	3	2	3	3	3	3	3	2	3	3	3
4	2	3	3	2	3	2	2	3	3	2	3	2
5	2	3	3	2	3	3	2	2	3	2	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

CHEMICAL BIOLOGY

L	T	P	C
2	0	0	2

Objective

To learn about the basic concepts of biomolecules and to acquire in-depth knowledge about enzymes and proteins.

Total Hours: 30

UNIT I r 6 Hours

Macromolecules and their building blocks

Structure and function of Nucleic acids, Carbohydrates, lipids, Proteins and Amino acids, Purine and pyrimidine bases, Fatty acids and sugars. Small molecules of biological importance - Vitamins and minerals.

UNIT II 6 Hours

Enzymes

Definition, Classification, catalysis, kinetics, activation and inhibition. Coenzymes and cofactors and their relevant reactions, Allosteric enzymes.

UNIT III 6 Hours

Proteins

Classification, structure and function. Primary, secondary, Tertiary and Quaternary structure. Physical methods to study protein folding.

UNIT IV 6 Hours

Chemical approaches to study protein functions

Mutagenesis, foldamer, unnatural amino acid incorporation, solid phase peptide synthesis, non-ribosomal peptide synthesis; Proteomics - kinases and phosphatases. Post translation modifications.

UNIT V 6 Hours

Chemical biology applications

Bio-imaging (GFP, metal detection) nucleic acid catalysis, catalytic antibodies, Cell surface glycoproteins, engineered polyketide synthases, DNA - template synthesis.

References

1. Robert K Murray et. al., Harper's Illustrated Biochemistry, 31st edition-McGraw Hill, 2018.
2. Nelson and Cox. Lehninger Principles of Biochemistry. Freeman, 7th ed. 2017.
3. Devlin, T.M., John Wiley & Sons, Inc. Textbook of Biochemistry with Clinical Correlations,7th ed., (New York),2011.
4. Tymoczko, John L., Jeremy M. Berg, and LubertStryer. Biochemistry, 8th ed. Freeman 2015.
5. Garrett, Reginald, and Charles Grisham. Biochemistry. Nelson Education, 2012.
6. Voet, Donald, Judith G. Voet, and Charlotte W. Pratt. Fundamentals of biochemistry.NewYork: John Wiley & Sons,5th Edition, 2016.
7. Lippincott Williams and Wilkins; Illustrated Reviews: Biochemistry, Seventh, North American edition, 2016.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Non-Major Elective: Chemical Biology	Cognitive Level
CO1	define the biomolecules and outline their significance in biological system	K1, K2
CO2	explain the classification and catalytic role of enzymes and coenzymes in biochemical pathways	K2
CO3	illustrate the structural organization of protein and analyze folding characteristics using physical methods	K2, K4
CO4	compare protein functions through biochemical approaches	K2
CO5	experiment with methods of bioimaging, nucleic acid catalysis, catalytic antibodies, cell surface glycoproteins etc.	K3

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Non-Major Elective: Chemical Biology												
CO	**PO**						**PSO**					
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**
1	3	3	2	2	2	2	3	3	2	2	2	2
2	3	3	3	2	2	1	3	3	3	2	2	1
3	3	3	3	3	1	2	3	3	3	3	1	2
4	3	3	3	3	3	2	3	3	3	3	3	2
5	3	3	3	3	2	3	3	3	3	3	2	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

CELL AND MOLECULAR BIOLOGY

L	T	P	C
5	0	0	5

Objective

To provide in depth knowledge of the biological aspects of prokaryotic and eukaryotic cells and their molecular mechanisms.

Total hours: 75

UNIT I 15 Hours

The Cell

Structural organization of prokaryotic and eukaryotic cells. Ultrastructure of Nucleus, Mitochondria, Endoplasmic reticulum, Golgi apparatus, Lysosome and Peroxisomes. Membrane - Fluid mosaic model.

UNIT II 15 Hours

Membrane transport, Cell cycle and Cell division

Membrane transport - Simple diffusion, Active transport - Symport, Antiport, Na^+ K^+ ATP ase, Ca^{++}ATP ase carriers. Cell junction - desmosome, tight junction and gap junction, Cell cycle, Cell division - Mitosis and Meiosis.

UNIT III 15 Hours

Genome organization and Replication

Structure of Chromatin - Coding and Noncoding sequences of DNA. Experimental evidences of DNA as the genetic material. DNA replication in prokaryotes - Semi conservative replication. Replication in eukaryotic chromosome. DNA repair - Methylase and Mismatch repair, Excision, Recombination and SOS repair.

UNIT IV 15 Hours

Transcription

RNA types and functions. Prokaryotic and Eukaryotic transcription - RNA polymerases, Initiation, Elongation and Termination of RNA synthesis. Inhibitors of transcription.

UNIT V 15 Hours

Translation and Gene regulation

Genetic code - Salient features, Wobble hypothesis. Translation - Activation of amino acids, Initiation, Elongation and Termination. Post translational modifications. Inhibitors of translation. Regulation of gene expression in prokaryotes - lac, trp and ara operons.

References

1. Karp. Cell & Molecular Biology 8thed. Wiley, 2016.
2. Lodish et al Molecular Cell Biology 8th ed. Freeman, 2016.
3. Murray et al. Harper's Illustrated Biochemistry 30th ed. McGraw Hill, 2015.
4. Nelson and Cox. Lehninger Principles of Biochemistry. Freeman, 7th ed., 2017.
5. De Robertis and De Robertis. Cell and Molecular Biology. Lippincott Williams and Williams 8th (Paperback), 2017.
6. Alberts et al. Molecular Biology of the cell 6th ed. Garland Sci., 2014.
7. Krebs JE et al. Lewin's. Genes XII. Jones & Bartlett Publ., 2017.
8. Watson. Molecular Biology of the Gene. 7th ed. Pearson Edu., 2013.
9. Watson et al. Recombinant DNA: Genes and genomes - A short course. 3 rd ed. Freeman, 2006.
10. Twyman. Advanced Molecular Biology. BIOS Sci Publ., 2000.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Core – 5: Cell and Molecular Biology	Cognitive Level
CO1	classify and outline the structures and functions of basic components of a cell	K2, K4
CO2	explain the movement of substances into and out of cells	K2
CO3	summarize the roles of different enzymes involved in replication of DNA	K2
CO4	explain how the leading and lagging strands are replicated differently	K5
CO5	analyze the cellular processes for turning the information within DNA into protein product	K4

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Core – 5: Cell and Molecular Biology												
CO	PO						PSO					
	1	2	3	4	5	6	1	2	3	4	5	6
1	3	3	3	3	2	3	3	3	3	3	2	3
2	3	3	2	2	1	1	3	3	2	2	1	1
3	3	3	2	2	1	2	3	3	2	2	1	2
4	3	3	2	2	2	1	3	3	2	2	2	1
5	3	3	3	3	1	2	3	3	3	3	1	2

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

METABOLISM

L	T	P	C
5	0	0	5

Objective

To offer fundamental insight about the biosynthesis and degradation of biomolecules and about the integration of various metabolic pathways occurring in living cells.

Total Hours: 75

UNIT I 15 Hours

Bioenergetics and Biological Oxidation

Concept of Bioenergetics- Principles of thermodynamics, concept of free energy, Standard free energy, Entropy, Enthalpy and Activation energy. Endergonic and Exergonic processes. High energy phosphate compounds,feature and significance of ATP as energy currency of the cell.
Biological Oxidation - Mitochondrial electron transportchain - organization, sequence of electron carriers, Inhibitors of ETC. Mechanism of oxidative phosphorylation- chemiosmotic theory, site of oxidative phosphorylation, P/O ratio, inhibitors and uncouplers of oxidative phosphorylation.

UNIT II 15 Hours

Metabolism of Carbohydrates

Glycolysis – Pathway and energetics, fates of pyruvate – Conversion of Pyruvate to lactate, alcohol and acetyl CoA. Citric acid cycle and its energetics, Cori's cycle, pentose phosphate pathway (HMP shunt) and its significance. Metabolism of Glycogen - glycogenesis and glycogenolysis. Gluconeogenesis and its significance.

UNIT III 15 Hours

Metabolism of Lipids

Biosynthesis of fatty acids- Synthesis of palmitic acid, linolenic acid, linoleic acid and palmitoleic acid. Oxidation of fatty acids - α, β and ω oxidation. Role of carnitine in β-oxidation,β-Oxidation of palmitic acid and bioenergetics. Metabolism of Triglycerides, Phospholipids and Cholesterol. Metabolism of ketone bodies - formation utilization, excretion and its significance.

UNIT IV 15 Hours

Metabolism of Amino acids

General reactions of amino acids-transamination,oxidative deamination anddecarboxylation. Biosynthesis and catabolism of non-essential amino acids - tyrosine, tryptophan, phenyl alanine and methionine. Formation and disposal of ammonia - Urea cycle.
Integration of carbohydrates, lipid and protein metabolism.

UNIT V 15 Hours

Metabolism of Nucleic acids

Nucleotide biosynthesis - denovo and salvage pathway for biosynthesis of purines and pyrimidines, Inhibitors of nucleotide biosynthesis. Mechanism of purine and pyrimidine catabolism. Biosynthesis and breakdown of Heme.

References

1. Nelson and Cox. Leininger's Principles of Biochemistry. Freeman, 7th ed., 2017.
2. Voet and Voet. Fundamentals of Biochemistry. 5th. Wiley, 2016.
3. Murray et al. Harper's Illustrated Biochemistry 30th ed. McGraw Hill, 2015.
4. Berg, Tymoczko,Stryer, Biochemistry, 8th ed. Freeman, 2015.
5. Kuchel et al. Schaum's Outline of Biochemistry. McGraw Hill. 3 rd ed., 2011.
6. Garrett, Reginald H - Grisham, Charles MBiochemistry.6th edition, Broks/Cole, Cengage Learning, 2016.
7. Christopher K. Mathews, K.E. Van Hole, Kevin G. Ahern Biochemistry 3rd edition.Pearson Education, Singapore, 2003.
8. https://www.slideshare.net/syed_ismail/metabolism-43769484.
9. https://www.slideshare.net/senchiy/nucleic-acids-and-nucleotide.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Core – 6: Metabolism	Cognitive Level
CO1	perceive the role of metabolic pathways is living system and commemorate the entire concept of cellular metabolism	K5
CO2	demonstrate various biochemical changes that govern the basic thermodynamic principles	K2
CO3	recall and summarize the enzymes and reactions involved in various metabolic pathway	K1, K2
CO4	assess the significance of carbohydrate, lipids, protein and nucleic acids metabolism and correlate the disease associated with the defects	K5
CO5	relate the distinct role of metabolic pathways used by cells to harvest the energy	K2

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Core – 6: Metabolism												
CO	**PO**						**PSO**					
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**
1	3	3	3	3	2	2	3	3	3	3	2	2
2	2	2	3	3	2	2	2	2	3	3	2	2
3	3	3	3	3	2	2	3	3	3	3	2	2
4	2	2	3	3	2	2	2	2	3	3	2	2
5	3	2	3	3	2	2	3	2	3	3	2	2

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

Biostatistics/Clinical Biochemistry/ Environmental Biochemistry
(Select any one)

L	T	P	C
4	0	0	4

BIOSTATISTICS

Objective

To introduce statistical science to students and to make them skilful in data analysis related to biological research.

Total Hours: 60

UNIT I 12 Hours

Data collection

Primary and Secondary data, organization of data- Editing, Classifying and Tabulating. Frequency distribution. Diagrammatic representation of data - Diagrams, Graphs and Charts.

UNIT II

12 Hours

Measures of Central tendency

Mean - Arithmetic mean, Geometric mean, Harmonic mean, Median and Mode.

UNIT III 12 Hours

Measures of Dispersion

Range, Standard deviation, Mean deviation, Quartile deviation, Coefficient of variation.

UNIT IV 12 Hours

Matrix

Matrices- types, Determinant of a matrix, Rank of a matrix, Singular and Nonsingular matrix. Solving system of linear equations using matrix method.

UNIT V 12 Hours

Sampling theory

Population sample, Sample size, Sampling distribution, Standard error, Types of sampling, students t- Test, ANOVA (elementary level).

References

1. S P Gupta, Statistical methods, Sultan Chand & sons, 2012.
2. Wayne W Daniel, Chand L Cross, Biostatistics, A foundation for analysis in health science, 11th ed, Wiley Publishers, 2018.
3. Jerrold H Zar, Biostatistical Analysis, 5th ed, John Wiley and sons, 2010.
4. E Padmini, Biochemical calculation and Biostatistics, 2nd ed, Wiley India Pvt Ltd, 2010.
5. S Karthikeyan, R M Chaturvedi, R M Bhosale, Biostatistics and Research methodology, 1st ed, Bhalani publishing house, 2016.
6. Suresh K Sharma, Research methodology and Biostatistics, 2016.
7. Nagewara Rao, Biostatistics and Research methodology,Pharmamed press, 2018.
8. IndranilSaha, Bobby Paul, Essentials of Biostatistics &Research methodology, 3rd ed, Academic Publishers, 2020.
9. https://WWW.scribbr.com/methodology /sampling methods/
10. https://books.google.com/books/about/A Text book of Biostatistics.html?id=RzpFK
11. https://microbenotes.com/primary-data-and-secondary-data

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Elective 1: Biostatistics	Cognitive Level
CO1	recall and explain the basics of data collection methods	K1, K2
CO2	categorize and utilize the measure of central tendency in sample statistics	K3, K4
CO3	make use of standard deviation in biological data analysis	K3
CO4	analyze matrix and its types	K4
CO5	analyze sampling distribution and assess standard error for biological studies	K4, K5

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Elective 1:Biostatistics												
CO	**PO**						**PSO**					
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**
1	3	3	3	3	3	3	3	3	3	3	3	3
2	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3
4	2	3	3	3	3	2	2	3	3	3	3	2
5	3	3	3	3	3	2	3	3	3	3	3	2

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

CLINICAL BIOCHEMISTRY

L	T	P	C
4	0	0	4

Objective

To gain a comprehensive knowledge about the principles of Biochemistry related to metabolic disorders and their clinical diagnosis.

Total hours: 60

UNIT I 12 hours

Disorders of carbohydrate metabolism

Regulation of blood glucose level, Hypoglycemia, Hyperglycemia, Diabetes mellitus-types, clinical features, diagnostic tests- blood and urine tests, Glucose tolerance test, renal threshold for glucose, glycogen storage diseases, lactosuria, ketonemia and ketonuria.

UNIT II 12 hours

Disorders of lipid metabolism

Lipoproteins - Hyperlipoproteinemia - types, LCAT deficiency, Hyper and Hypo cholesterolemia, lipidosis, Xanthomatosis, Atherosclerosis - etiology, clinical features and its complications,Fatty liver andlipid storage diseases.

UNIT III 12 Hours

Disorders of amino acid metabolism and protein abnormalities

Inborn errors of amino acid metabolism- Cystinuria, Phenylketonuria, Maple syrup urine disease, Albinism, Hartnup's disease, Wilson's disease.Proteinuria.Hypouricemia, Gout-types and clinical features.

UNIT IV 12 Hours

Function tests

Detoxification function of liver. Jaundice - types, clinical features. Liver function tests.Renal function tests - Glomerular filtration test- test for renal blood flow, test for tubular function. Pancreatic function test.

UNIT V 12 Hours

Enzymes in clinical diagnosis

Isoenzymes in clinical diagnosis.Clinical significance ofLDH, CPK, AST, ALT, Alkaline phosphatase, Acid phosphatase, Choline esterase, Amylase and Lipase.

References

1. Varley, H., Gowenlock, A.H. and Hill, M. William, Practical Clinical Biochemistry, CBS Publishers; 6th Edition, 2006.
2. Andrew Day, Philip Mayne, Clinical Chemistry in diagnosis and treatment, 6th edition, Hodder Arnold Publication, 1994.
3. W.J. Marshall, S. K. Bengert, M. Lapsley,Clinical Chemistry,8th edition, Elsevier, 2016.
4. Robert K Murray et. al., Harper's Illustrated Biochemistry, 31st edition-McGraw Hill, 2018.
5. Tietz Textbook of Clinical Chemistry and Molecular Diagnostics,7th edition Saunders, 2014.
6. Harrison's Principles of Internal Medicine. Vol 1 & 2, 19 th edition McGraw Hill, 2015.
7. M.N. Chatterjee, Rana Shinde, Medical Biochemistry, Jaypee Brothers, 8th edition, 2012.
8. Shivananda Nayak B, Essentials of Medical Biochemistry, 3rd ed, Jaypee Brothers Medical Publishers Pvt Ltd, New Delhi, 2016.
9. Thomas M Devlin, Text book of Biochemistry with clinical correlations, 7th ed, 2010.
10. Michael Bishop, Clinical chemistry – Principles, techniques and correlations, enhanced edition, 8th ed, Jones and Bartlett Publications, 2020.
11. Peter Rae, Mike Crane, Rebecca Pattenden, Clinical Biochemistry, 10th ed, Wiley Blackwell, 2017.
12. https://www.britannica.com/science/metabolic - disease/Disorders of carbohydrate metabolism
13. https://www.Slideshare.net/MohitAdhikary/Pancreatic function test

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Elective 1: Clinical Biochemistry	Cognitive Level
CO1	outline carbohydrate metabolism and its disorders	K2
CO2	illustrate lipid metabolism and its disorders	K2
CO3	explain the disorders of amino acid metabolism and list out the protein abnormalities	K1, K2
CO4	make use of Liver function test, Renal function test and Pancreatic function test in Clinical lab diagnosis	K3
CO5	discuss the role of enzymes and evaluate their activity states in tissue and blood samples for clinical diagnosis	K6

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Elective 1: Clinical Biochemistry												
CO	PO						PSO					
	1	2	3	4	5	6	1	2	3	4	5	6
1	3	3	3	3	3	3	3	3	3	3	3	3
2	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3
4	3	2	3	3	3	3	3	3	2	3	3	3
5	2	3	3	3	3	3	3	2	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

ENVIRONMENTAL BIOCHEMISTRY

L	T	P	C
4	0	0	4

Objective

To acquire broad knowledge of the field of Environmental chemistry including methods for ultra-trace analysis of pollutants.

Total Hours: 60

UNIT I 12 Hours

Introduction

Concept and scope of Environmental Biochemistry Nutrient cycling- Hydrogen cycle, Oxygen cycle, Nitrogen cycle, Carbon cycle, Phosphorus cycle, Sulphur cycle and mineral cycle.

UNIT II 12 Hours

Water

Hydrological cycle, Water resources, Pathways and rate of waste releases to water. Eutrophication, water sanitation, Water purification, Analysis of drinking water, quality of drinking water. Recycling and Reuse of Water- desalination.

UNIT III 12 Hours

Lithosphere

Soil formation, composition of soil, soil air, soil water, micro and macro nutrients. Types of pollutants in soil - classification, characteristics, ill effects, disposal methods. Acid base and ion exchange reactions in soil.

UNIT IV 12 Hours

Atmosphere

Atmosphere structure- composition of atmosphere, chemical and photo chemical reactions in the atmosphere. Types of pollutants in atmosphere - oxides of nitrogen, oxides of sulphur, oxides of carbon, ozone, organic gases with specific reference to Greenhouse effect and ozone depletion, photochemical smog.

UNIT V 12 Hours

Chemical toxicology

Toxic chemicals present in the environment, impact of toxic chemicals on enzymes. Biochemical effects of pesticides, carcinogens and detergents. Radiation pollution- causes, ill effects, protection, control of radiation pollution. Safety methods of disposal of radioactive wastes. Thermal pollution- causes, ill effects, control of thermal pollution Noise pollution- causes, ill effects, control of noise pollution.

References

1. Hutzinger, Hand book of Environmental Chemistry, Vol-3, 1980.
2. Perry,The teachers hand book of Environmental studies, Blandford press, 1974.
3. P.C. Mishra,Advantages in ecology and Environmental sciences, APH Publishing Corporation, 2005.
4. B.K. Sharma, Environmental chemistry, Publisher: Krishan Prakashan ,2014.
5. A. K. De, Environmental chemistry, 7th Edn., New Age International Pvt Limited, New Delhi, 2012.
6. K. C. Agarwal,Fundamentals of Environmental Biology, Nidhi Publishers, 2nd edition, 2008.
7. Mark J. Hammer, Water and waste water technology, Prentice Hall India Learning Private Limited; 7th edition, 2012.
8. S. N. Kaul and A. Gautam, Water and waste water analysis, Daya Publishing House, India, 2002.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Elective 1: Environmental Biochemistry	Cognitive Level
CO1	define the role of nutrient cycling and identify nutrient cyclers that keeps the ecosystem functioning	K1, K3
CO2	evaluate the water quality characteristics associated with ground water	K5
CO3	explain air, water, nutrients and process of soil formation for maintaining environmental sustainability	K2
CO4	list out the major sources of common air pollutants and how these affect the human health and ecosystem	K4
CO5	identify toxic elements in environment and define their detrimental effects	K5

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Elective 1: Environmental Biochemistry												
CO	**PO**						**PSO**					
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**
1	3	2	3	3	2	1	3	2	3	3	2	1
2	3	3	3	3	2	3	3	3	3	3	2	3
3	3	2	3	3	3	2	3	2	3	3	3	2
4	3	3	3	3	3	3	3	3	3	3	3	3
5	3	2	3	3	3	2	3	2	3	3	3	2

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

Diagnostic Biochemistry/Nutritional Biochemistry/Microbial Biochemistry
(Select any one)

L	T	P	C
4	0	0	4

DIAGNOSTIC BIOCHEMISTRY

Objective

To impart specialized knowledge and understanding of various diagnostic procedures adopted in clinical laboratory and also to acquire basic knowledge of the diseases.

Total Hours: 60

UNIT I 12 Hours

Clinical chemistry tests

Blood group and Rh factor, glycosylated haemoglobin, fructosamine test, GTT, Determination of Ca, P, Fe, Cu in serum. CSF analysis.

UNIT II 12 Hours

Enzymes, Hormones and Immunoglobulin assay

Acid phosphatases, LDH, CPK, CPK-MB, Alpha amylase, Hormones- T3, TSH, LH. Immunoglobulins - IgA, IgM, IgE.

UNIT III 12 Hours

Sero diagnostic procedures

Precipitation tests, VDRL test, Widal test, (Slide and tube methods) Agglutination test - ASO test, RA test, CRP test. Complement fixation test, Skin test- Montaux test, Lepramine test.

UNIT IV 12 Hours

Clinical Pathology tests

Complete haemogram, complete urine analysis, complete motion analysis, semen analysis. Test for amino acidurias - Test for phenyl ketonuria, DNPH test, Test for keto acids, Nitroprusside test for Cystinuria and homocystinuria.

UNIT V 12 Hours

Blood Analysis

Blood tests in Blood banks and its importance. Coomb's test, Coagulation studies, Prothrombin test (PT), Partial Thromboplastin Time (PTT), Plasma fibrinogen.

References

1. Varley, H., Gowenlock, A.H. and Hill, M. William, Practical Clinical Biochemistry, CBS Publishers; 6th Edition, 2006.
2. Andrew Day, Philip Mayne, Clinical Chemistry in diagnosis and treatment, 6th edition, Hodder Arnold Publication, 1994.
3. W.J. Marshall, S. K. Bengert, M. Lapsley, Clinical Chemistry, 8th edition, Elsevier, 2016.
4. Robert K Murray et. al., Harper's Illustrated Biochemistry, 31st edition-McGraw Hill, 2018.
5. Tietz Textbook of Clinical Chemistry and Molecular Diagnostics,7th edition Saunders, 2014.
6. Harrison's Principles of Internal Medicine. Vol 1 & 2, 19 th edition McGraw Hill, 2015.
7. Praful B. Godkar& Darshan P. Godkar, Textbook of Medical LaboratoryTechnology- set of 2 volumes, 3rd edition, Bhalani publishing House, 2014.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Elective 2: Diagnostic Biochemistry	Cognitive Level
CO1	develop knowledge in the general laboratory instruments and equipment to know about the specimen processing for microbial and biochemic analysis	K3
CO2	explain the principles and application of various biochemical tests	K2
CO3	categorize the basic requirements and methods adopted to diagnose the disease conditions in medical laboratory	K4
CO4	list out the significance of enzymes in diagnosis of diseases	K1
CO5	appraise the process of biological sample collection and its interpretation	K5
CO6	develop competency in techniques in branches like haematology, clinical pathology, blood bank, histopathology and cytology	K6

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Elective 2: Diagnostic Biochemistry												
CO	PO						PSO					
	1	2	3	4	5	6	1	2	3	4	5	6
1	3	3	3	3	3	3	3	3	3	3	3	3
2	3	3	3	3	3	3	3	3	3	3	3	3
3	3	2	3	3	3	3	3	2	3	3	3	3
4	3	3	3	3	3	3	3	3	3	3	3	3
5	2	2	3	3	3	3	2	2	3	3	3	3
6	3	2	3	3	3	3	3	2	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/2021-22/UG-Colleges/Part -III (B.Sc. Biochemistry)/Semester-V/Major Elective-2

NUTRITIONAL BIOCHEMISTRY

L	T	P	C
4	0	0	4

Objective

To acquire knowledge regarding the biological basis of nutrition and the mechanisms by which diet can influence health.

Total Hours: 60

UNIT I 12 Hours

Introduction

General introduction and definition of Nutrition. Basic food groups - Energy yielding, Body building and Protective foods. Basic concepts of energy expenditure, Unit of Energy. Functions of Food and its relation to Nutrition and Clinical health.

UNIT II 12 Hours

Importance and Source of nutrients

Physiological role and Nutritional significance of Carbohydrates, Proteins, Fats and Minerals (Calcium, Phosphorous, Sodium and Potassium) and trace elements (Copper, Cobalt, Zinc, Iodine and Iron)

UNIT III 12Hours

Vitamins

Definition, Classification, Sources, Absorption, Daily requirements, Metabolism and Nutritional significance. RDA for infants, Children, Adolescents (male and female), Pregnant and Lactating women, Old age.

UNIT IV 12 Hours

Nutritional Disorders

Protein Malnutrition (Kwashiorkor) and Undernutrition (Marasmus), their preventive and curative measures. Deficiency diseases of Vitamins. Nutrigenetics and Nutrigenomics (brief outline)

UNIT V 12 Hours

Calorific value and Basal metabolism

Measurement of Food stuffs by Bomb Calorimeter. Calorific value of Proteins, Carbohydrates and Fat. Energy - Basal metabolism - Measurement of BMR, Regulation of body temperature, energy needs and total energy requirements.

References

1. Swaminathan, M.S. Handbook of Food and Nutrition, 5th Edition. The Bangalore Printing and Publishing Company, 2007.
2. Srilakshmi, B. Nutrition Science, 2nd Edition, New Age International Publishers, 2006.
3. Weighley, E.S. Robinson's Basic Nutrition and Diet Therapy, 8th Edition, Macmillan Publishers, 1997.
4. Bamji, M.S.et al. Text book of Human Nutrition, 3rd Edition, Oxford and IBH Publishers, 2009.
5. Insel, P. et al., Discovering Nutrition, 4th Edition, Jones and Bartlett Publishers, 2013.
6. M. Swaminathan, Advanced text book of food and nutrition, (Vol.1 & 2), 2nd edition.
7. Kaveri Chakrabarty, A. S. Chakrabarty, Textbook of Nutrition in Health and Disease, Springer, 2019.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Elective 2: Nutritional Biochemistry	Cognitive Level
CO1	explain the basic concepts of food, its function and its importance in health	K2
CO2	analyze the physiological role and nutritional significance of micro and macronutrients	K4
CO3	define vitamins, classify and compare the daily requirements, nutritional significance and the deficiency symptoms	K1, K4
CO4	assess the calorific value of food stuffs and elaborate the factors affecting BMR and total energy requirements	K5
CO5	explain the process of food production and its storage and elaborate the same in food industries	K2, K6
CO6	adapt new protein and fat foods and examine the changing food habits and will get aware of food adulteration	K6

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Elective 2: Nutritional Biochemistry												
CO	PO						PSO					
	1	2	3	4	5	6	1	2	3	4	5	6
1	3	3	3	3	3	3	3	3	3	3	3	3
2	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3
4	2	3	3	3	3	3	2	3	3	3	3	3
5	3	3	3	3	3	3	3	3	3	3	3	3
6	3	3	3	3	3	3	3	3	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MICROBIAL BIOCHEMISTRY

L	T	P	C
4	0	0	4

Objective

To learn the classification, morphology, metabolism and applications of microbes.

Total Hours: 60

UNIT I 12 Hours

General introduction to microorganism

Scope and classification of microorganisms - Bacteria, Archaebacteria, Algae, Fungi, Protozoa and Viruses. Bacterial cell- structure and morphology. Growth of microorganisms- nutritional requirements and physical conditions. Cultivation of bacteria- types, Bacterial growth curve, Growth media- types. Isolation and maintenance of pure culture.

UNIT II 12 hours

Methods of microbiology

Enumeration of microorganisms. Staining methods- types. Microscopy - principles and applications of light, phase contrast, fluorescence and electron microscopy.

UNIT III 12 Hours

Viruses and Bacteriophages

General characteristics, structure and classification. Bacteriophages - lytic and lysogenic cycle. Animal viruses of special interest- Retro viruses (eg. HIV), Influenza virus, Tumour viruses. Plant viruses eg. TMV virus.

UNIT IV 12 hours

Metabolism of microorganisms

Aerobic metabolism - Uptake of nutrients into the cell - Active transport, facilitated diffusion and group translocation. Catabolism and Anabolism of hexoses, amino acids, nucleotides and lipids, Polymerisation and Assembly. Anaerobic metabolism - fermentation- ATP regeneration, Electron transport, denitrification, nitrate reduction, hydrogen sulphide formation.

UNIT V 12Hours

Applications of microorganisms

Alcoholic fermentation by yeast and bacteria, Formation of methane, citrate, succinate, lactate, vinegar, cheese and wine. Anaerobic fermentation - production of acetone and butanol. Aerobic fermentation- production of antibiotics, amino acids and enzymes.

References

1. Atlas and Bartha,Microbial Ecology, Pearson; 4th edition, 1997.
2. R Ananthanarayan and CK Jayaram Paniker ,Text book of Microbiology, Universities Press (India) Pvt. Ltd.; Eleventh edition, 2020.
3. Atlas, Principles of Microbiology, McGraw Hill Education; 2nd edition, 2014.
4. Daniel Caldwell R., Microbial Physiology and Metabolism, Star Pub Co; 2nd edition, 1999.
5. Prescott's Microbiology, Joanne Willey, McGraw-Hill Education; 10th edition, 2016.
6. Michael Pelczar,Microbiology, McGraw Hill Education; 5th edition, 2001.
7. Casida L.E. JR,Industrial Microbiology, New Age International Private Limited, 2019.
8. Flickinger and Drew Encyclopedia of Bioprocess Technology. 5 vol. set. (eds). 1999, John Wiley & Sons.
9. John. L. Ingraham, Catherine A. Ingraham. Introduction to Microbiology –A case history approach. Houghton Mifflin; 3rd Revised edition, 2003.
10. https://www.slideshare.net/syed_ismail/metabolism-43769484

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Elective 2:Microbial Biochemistry	Cognitive Level
CO1	compare the diversity and similarity of microorganisms	K2
CO2	categorize various types and working procedures of microscopy for microbial identification	K4
CO3	relate the architecture of viruses and bacteriophages	K1
CO4	formulate biochemical methods for the manufacture of valuable bioproducts by exploiting microbial metabolism	K5
CO5	demonstrate diverse metabolic processes of microbes and its biological significance in various industries	K2

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Elective 2: Microbial Biochemistry												
CO	PO						PSO					
	1	2	3	4	5	6	1	2	3	4	5	6
1	3	2	3	3	2	2	3	2	3	3	2	2
2	2	2	3	2	2	2	2	2	3	2	2	2
3	2	1	2	3	2	1	2	1	2	3	2	1
4	3	2	3	3	2	2	3	2	3	3	2	2
5	3	3	3	2	1	1	3	3	3	2	1	1

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/2021-22/UG-Colleges/Part-III (B.Sc. Biochemistry)/Semester-V/Major Practical-5

CELL AND MOLECULAR BIOLOGY TECHNIQUES

L	T	P	C
0	0	3	2

1. Study of divisional stages in Mitosis.
2. Study of divisional stages in Meiosis.
3. Preparation of human bloodsmear and differential staining of blood cells
4. Microscopic examination of epithelial cells, plant cells.
5. Thermal denaturation of DNA
6. Isolation of RNA from yeast
7. Extraction of genomic DNA

Demonstration experiments (Any two)

8. Separation of DNA by Agarose gel electrophoresis
9. Separation of proteins by SDS-PAGE
10. Western Blotting of protein

References

1. K. V. Chaitanya, Cell and Molecular Biology: A Lab Manual, ISBN-13: 978-8120348004, PHI Publishers, 2013.
2. Whitney Hable, Cell Biology Lab Manual,Kendall Hunt Publishing; 1st edition, 2009.
3. Estridge, Reynold and Walter, Basic Medical Laboratory Techniques, 4th edition, Delmar Publishers, 2000.
4. T. N. Pattabiraman, Laboratory Manual and Practical Biochemistry, All India Publishers & Distributors, 4th edition,2015.
5. J. Jayaraman, Laboratory Manual in Biochemistry - New Age International Publishers, 2nd edition, 2011.
6. S. Sadasivam, A. Manickam, Biochemical Methods - New Age International (P) Limited, 3rd edition, 2018.
7. David T. Plummer An Introduction to Practical Biochemistry, Tata McGraw Hill Publishing Company, 3rd edition, 2017.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Major Practical-5:Cell and Molecular Biology Techniques	Cognitive Level
CO1	explain why cells in the body undergo mitosis and what takes place in each phase	K1&K2
CO2	identify stages of meiosis by picture, explain why meiosis involves two rounds of nuclear division	K3
CO3	determine the success of DNA hybridization-based bioassays	K5
CO4	explain the purification of RNA from biological samples	K2
CO5	apply and appraise the separation of proteins based on their molecular weights	K3&K5

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Major Practical-5:Cell and Molecular Biology Techniques												
CO	PO						PSO					
	1	2	3	4	5	6	1	2	3	4	5	6
1	3	3	3	3	3	3	3	3	3	3	3	3
2	3	2	3	3	3	2	3	2	3	3	3	2
3	3	2	3	3	3	2	3	2	3	3	3	2
4	3	2	3	3	3	2	3	2	3	3	3	2
5	3	2	3	3	3	1	3	2	3	3	3	1

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/2021-22/UG-Colleges/Part-III (B.Sc. Biochemistry)/Semester-V/Major Practical-6

CLINICAL BIOCHEMISTRY

L	T	P	C
0	0	3	2

1. Estimation of Blood Sugar by Asatoor and King method
2. Estimation of Blood Urea by DAM method
3. Estimation of Serum Uric acid by Caraway method
4. Estimation of Serum Iron by Ramsay method
5. Estimation of Serum Phosphorus by Fiske and Subbarao method
6. Estimation of Serum Total protein and A/G ratio by Biuret method
7. Estimation of Serum Cholesterol by Zak's method
8. Estimation of Serum Creatinine by Jaffey's Alkaline Picrate method.

References

1. Practical Clinical Biochemistry, Varley, H., Gowenlock, A.H. and Hill, M. William, CBS Publishers; 6th Edition, 2006.
1. Estridge, Reynold and Walter, Basic Medical Laboratory Techniques - 4th edition, Delmar Publishers, 2000.
2. T. N. Pattabiraman, Laboratory Manual and Practical Biochemistry, All India Publishers & Distributors, 4th edition,2015.
3. J. Jayaraman, Laboratory Manual in Biochemistry - New Age International Publishers, 2nd edition, 2011.
4. Henry Bernard, J., Sanford,T and Davidson, W.B. Clinical diagnosis and Management by laboratory methods, Saunders, New York, 2002.
5. Gradwohls, (ed) Ales C. Sonnenwirth and Leonard Jarret, M.D. Clinical Laboratory Methods and Diagnosis, B.I. publications, New Delhi, 2000.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Major Practical-6: Clinical Biochemistry	Cognitive Level
CO1	recall the colorimetry methods for the estimation of various biochemical parameters in blood, plasma and serum	K1
CO2	analyse each biochemical parameter using suitable colorimetry methods and report the results	K4
CO3	interpret the estimated values of blood sugar, urea, serum uric acid, total protein, cholesterol, creatinine, iron and phosphorus for assessing the health condition of an individual	K2
CO4	assess the significance of enzymatic method for the estimation of triglycerides for detection of coronary artery diseases	K5, K6
CO5	apply the practical clinical biochemistry skills obtained in the clinical labs and start their own career	K3

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Major Practical-6: Clinical Biochemistry												
CO	PO						PSO					
	1	2	3	4	5	6	1	2	3	4	5	6
1	3	2	3	3	3	3	3	2	3	3	3	3
2	3	2	3	3	3	3	3	2	3	3	3	3
3	3	2	3	3	3	3	3	2	3	3	3	3
4	3	2	3	3	3	3	3	2	3	3	3	3
5	3	2	3	3	3	3	3	2	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

DIAGNOSTIC BIOCHEMISTRY

L	T	P	C
0	0	4	2

1. Differential counting of leukocytes
2. Determination of Bleeding time and Clotting time
3. Qualitative analysis of Abnormal constituents of urine
4. Estimation of Chloride in urine
5. Estimation of Calcium in urine
6. Determination of the Titrable acidity and ammonia in urine
7. Determination of Urea Clearance
8. Determination of Creatinine Clearance
9. Glucose Tolerance Test

References

1. Practical Clinical Biochemistry, Varley, H., Gowenlock, A.H. and Hill, M. William, CBS Publishers; 6th Edition, 2006.
2. Estridge, Reynold and Walter, Basic Medical Laboratory Techniques - 4th edition, Delmar Publishers, 2000.
3. Kanai L Mukherjee, Medical Lab Technology- Vol I-III. Tata McGraw Hill Education India, 3rd edition, 2010.
4. RamnikSood,Textbook of Medical Lab Technology, Jaypee Brothers Medical Publishers (P) Ltd., 6th edition, 2009.
5. T. N. Pattabiraman, Laboratory Manual and Practical Biochemistry, All India Publishers & Distributors, 4th edition,2015.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Major Practical – 7: Diagnostic Biochemistry	Cognitive Level
CO1	identify the types of leukocytes in blood smear and develop their skills for pathological analysis	K3, K6
CO2	assess blood and evaluate bleeding disorders	K5
CO3	analyse specimens from human origin such as urine, blood, feces, semen etc. to help diagnosis	K4
CO4	make use of procedures for various investigations to diagnose organ dysfunctions	K3, K6
CO5	develop practical skills in lab methods aiding assessment of human health and disease maintenance	K5, K6

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Major Practical-7: Diagnostic Biochemistry												
CO	PO						PSO					
	1	2	3	4	5	6	1	2	3	4	5	6
1	3	3	3	3	3	3	3	3	3	3	3	3
2	2	3	3	3	3	3	2	3	3	3	3	3
3	3	3	2	3	3	3	3	3	2	3	3	3
4	2	3	2	3	3	3	2	3	2	3	3	3
5	3	2	3	3	3	3	3	2	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

PLANT BIOCHEMISTRY

L	T	P	C
4	0	0	4

Total Hours: 60

Objective

To gain knowledge about the biochemical principles underlying plant metabolism, growth and development.

UNIT I 12 Hours

Plant physiology andPhotosynthesis

Water reactions of plants, mechanism of H_2O absorption - Active and Passive transport, apoplast and symplast concept.Ultrastructure of chloroplast- Photosynthetic pigments, Light reaction, Photo system I & II. Electron transport- Photo phosphorylation.

UNIT II 12 Hours

Carbon Metabolism

CO_2 fixation and reduction- C3 plants (Calvin cycle), C4 plants (Hatch-Slack pathway), CAM plants (crassulacean acid metabolism), Photo respiration.

UNIT III 12 Hours

Nitrogen fixation

Nitrogen and Sulphur metabolism- Biochemistry of nitrogen fixation- nitrogenase, nitro reductase, nitrate reductase. NIF genes, Nitrate assimilation. Sulphate activation- reduction and sulphite reduction.

UNIT IV 12 Hours

Plant growth regulators

Plant growth regulators- Chemistry, Synthesis, Physiological role of Auxin, Gibberellin, Cytokinin, Ethylene and Abscisic acid.

UNIT V 12 hours

Seed germination and dormancy

Physiological and biochemical changes, Factors affecting seed germination and dormancy (water, light, temperature, salinity, stress). Photoperiodism-Phytochrome- Vernalization.

References

1. Dey P M, Plant Biochemistry, Elsevier India, 2013.
2. Goodwin and Mercer. Introduction to Plant Biochemistry, 2nd Edition, CBS, 2005.
3. Devlin N Robert and Francis H Witham, Plant Physiology, 4th ed, PWS Publications, 1983.
4. Lincoln Taiz and Eduardo Zeiger, Plant Physiology, 3rd ed, Sinauer Associates, 2002.
5. Hans WatterHeldt, Plant Biochemistry and Molecular Biology, 4th ed, Oxford University, 2010.
6. Russel Jones, Helen Ougham, Howard Thomas, Susan Waaland, The Molecular life of Plants, Wiley Blackwell, 2012.
7. B. Thayumanavan, S Krishnaveni, K Parvathi, Biochemistry for Agricultural sciences, Galgotia Publications Pvt Ltd, 2004.
8. Salisbury & Ros, Plant Physiology, 3rd ed, CBS Publications, 2006.
9. https://byjus.com/biology/plant-cell/
10. https://www.topper.com/guides/biology/plant growth and development/ plant growth regulators/

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Core – 7: Plant Biochemistry	Cognitive Level
CO1	outline the water reactions of plants and mechanism of photosynthesis	K2
CO2	list out the carbon reactions in C3, C4 and CAM plants	K2, K4
CO3	analyze the cycles of elements and its fixation	K4
CO4	recall the mode of action of phyto regulators and list out the biological functions of secondary metabolites	K1, K4
CO5	assess the water reaction of plants and the biochemical changes during seed germination and dormancy	K5

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Core – 7: Plant Biochemistry												
CO	**PO**						**PSO**					
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**
1	3	3	3	3	2	1	3	3	3	3	2	1
2	3	2	3	3	2	1	3	2	3	3	2	1
3	3	2	3	3	1	2	3	2	3	3	1	2
4	3	2	3	3	2	2	3	2	3	3	2	2
5	3	2	3	3	1	3	3	2	3	3	1	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

ENDOCRINE BIOCHEMISTRY

L	T	P	C
4	0	0	4

Objective

To provide the basis for understanding the endocrine organs and its hormones during health and diseases and their management.

Total hours: 60

UNIT I 12 Hours

Introduction to Endocrine system

The Endocrine glands, Hormones- Definition, Classification,Mechanism of hormone action - Class I and Class II hormones. Hormone receptors- structural features and regulation. Role of second messengers in hormone action. Feedback regulation of hormones.

UNIT II 12 Hours

Hypothalamus and Pituitary hormones

Structure, Biological action and Regulation of Hypothalamic releasing factors, Vasopressin and Oxytocin. Biosynthesis, Secretion, Transport, Regulation and Biological effects of Growth hormone, FSH, LH, TSH, ACTH and Prolactin. Hyper and hypo activity of pituitary and hypothalamus - Acromegaly, Dwarfism,Diabetes insipidus and Hypopituitarism.

UNIT III 12 Hours

Thyroid and Parathyroid hormones

Biosynthesis, Secretion, Transport, Regulation and Biological effects of Thyroid hormones. Hypo and hyperthyroidism. Anti-thyroid agents. Parathyroid hormone, Role of parathyroid hormone, calcitonin and calcitriol in maintaining calcium and phosphorus homeostasis. Hypo and Hyper parathyroidism.

UNIT IV 12 Hours

Pancreatic Hormones

Hormones of the Pancreas, islets of Langerhans- cell types, Biosynthesis, Mechanism of action and Biological effects of Insulin and Glucagon.Hormonal action of Somatostatin and Pancreatic polypeptide.

UNIT V 12 Hours

Adrenal and Gonadal hormones

Biosynthesis, Secretion, Transport, Mechanism of action and Biological effects GlucocorticoidsandMineralocorticoidsandAdrenal medullary hormones. Pathophysiology of adrenal gland secretions. Biological effects of Androgens and Estrogens.

References

1. ShlomoMelmed et al., Williams Text Book of Endocrinology, 13 th edition, Saunders, 2015.
2. Robert K Murray et. al., Harper's Illustrated Biochemistry, 31st edition-McGraw Hill, 2018.
3. Nelson and Cox. Lehninger. Principles of Biochemistry. Freeman, 7th ed., 2017.
4. Andrew Day, Philip Mayne, Clinical Chemistry in diagnosis and treatment, 6th edition, Hodder Arnold Publication, 1994.
5. W.J. Marshall, S. K. Bengert, M. Lapsley, Clinical Chemistry, 8th edition, Elsevier, 2016.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Core – 8: Endocrine Biochemistry	Cognitive Level
CO1	recall the structural organization and regulation of endocrine systems in maintaining homeostasis	K1
CO2	relate the anatomical relationship of the pituitary gland and hypothalamus in clinical domain	K2
CO3	interpret the role of thyroid function and understand the complexity of endocrine-related disorders	K2, K5
CO4	assess the importance of pancreatic hormones and point out in detail the cells of islets of langerhans and evaluate its effect on carbohydrates, lipids and protein metabolism	K5
CO5	explain the organization of adrenals and gonads, interpret the relationship between medulla, sympathetic nervous system and its effect in stress response	K5

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Core – 8: Endocrine Biochemistry												
CO	**PO**						**PSO**					
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**
1	3	3	3	3	2	3	3	3	3	3	2	3
2	2	3	3	3	2	3	2	3	3	3	2	3
3	3	3	3	3	2	2	3	3	3	3	2	2
4	2	3	3	3	2	3	2	3	3	3	2	3
5	2	3	3	3	2	3	2	3	3	3	2	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

IMMUNOCHEMISTRY

L	T	P	C
4	0	0	4

Objective

To learn about the structural features of the components of the immune system as well as their functions.

Total Hours: 60

UNIT I 12 Hours

Infection

Types, factors influencing infection - pathogenicity. Sources and carriers of infectious agents, Immune system- definition and properties, cells of immune system, Lymphoid organs - structure and function. Types of immunity- Innate and Acquired immunity.

UNIT II 12 Hours

Antigens

Definition, properties, antigenicity, immunogenic determinants and haptens. Types of antigens, Immunoglobulins- basic structure classes and distribution of antibodies.

UNIT III 12 Hours

Antigen antibody interactions

Molecular mechanism of binding, affinity, avidity, valency, cross reactivity and multivalent binding, complement system. Complement components, classical and alternative pathway. Antigen recognition - T & B cell activation. Immunological memory. Lymphokines and cytokines.

UNIT IV 12 Hours

Transplantation immunology

Tissue types, graft rejection and role MHC and T cells. Prevention of graft rejection, Hypersensitivity- immediate and delayed types, mechanisms of reaction. Immunisation practice. Active and Passive immunization. Tumor immunology - tumor antigens, immune surveillance and NK cells. Primary and secondary immune deficiency disorders.

UNIT V 12 Hours

Immunological techniques

Production of monoclonal and polyclonal antibodies. Principles and applications of RIA, ELISA, complement fixation tests, precipitation, Immunodiffusion,Immunoelectrophoresis, agglutination test - heamagglutination, latex agglutination (Widal, VDRL).

References

1. Goldsby et al. Kuby Immunology. WH Freeman & Co. 7thed., 2013.
2. Abbas et al. Cellular and Molecular Immunology. 9th ed. Elsevier, 2018.
3. Janeway, C. (Ed), Travers. Immunobiology 9th ed. Garland Publ., 2016.
4. Coico and Sunshine. Immunology: A short course. 7th ed. Wiley-Liss, 2015.
5. Roitt et al. Roitt's Essential Immunology. 13thed Wiley-Blackwell Sci., 2017.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Core – 9: Immunochemistry	Cognitive Level
CO1	define antigens and explain their properties	K1, K2
CO2	explain the structure, properties and importance of Ag-Ab interaction	K2
CO3	outline the mechanism of transplantation and its importance	K3
CO4	apply various types of immunotechniques and serological tests	K3
CO5	examine the impact of community acquired and healthcare associated infection	K4

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Core – 9: Immunochemistry												
CO	PO						PSO					
	1	2	3	4	5	6	1	2	3	4	5	6
1	3	3	3	3	2	3	3	3	3	3	2	3
2	3	3	3	3	2	2	3	3	3	3	2	3
3	3	3	3	3	2	2	3	3	3	3	2	2
4	3	3	3	3	2	3	3	3	3	3	2	3
5	3	3	3	3	2	3	3	3	3	3	2	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

Biotechnology/Genomics and Proteomics/Drug Biochemistry
(Select any one)

L	T	P	C
4	0	0	4

BIOTECHNOLOGY

Objective

To know the basics of biotechnology and to develop understanding of its applications.

Total Hours: 60

UNIT I 12 Hours

Recombinant DNA technology

Introduction and scope of Biotechnology. Recombinant DNA technology - Definition, General principle, Restriction endonucleases- Types and role, Role of Ligases. Vectors- Salient features Plasmids, Cosmids and Phages.

UNIT II 12 Hours

Plant Biotechnology

Vectors for gene transfer in plant cells - Ti plasmids, Cointegrate, Intermediate and Helper plasmids, Binary vectors, Gene transfer Technique using Agrobacterium. Selectable marker, Reporter genes and Promoters. Transgenic plants- Pest resistant, Herbicide resistant and Stress Tolerant plants.

UNIT III 12 Hours

Animal Biotechnology

Vectors for gene transfer in animal cells - Animal Viral vectors and Yeast vectors. Gene transfer-Vector less mode(Microinjection, Particle Bombardment, Electroporation). Mapping of human genome and Gene therapy.

UNIT IV 12 Hours

Tissue culture

Plant tissue culture- steps involved. Plant tissue culture media. Micropropagation and Somaclonal variation. Protoplast culture and Somatic hybridization. Animal tissue culture - Primary culture, Cell lines. In-vitro fertilization and Embryo transfer in humans.

UNIT V 12 hours

Microbial Biotechnology

Basic principles of Microbial growth, design and types of fermenters (any two), Downstream processing, oil spill cleanup by microbes, Biodegradable plastics, Bioleaching.

References

1. Gupta PK. Elements of Biotechnology, Rastogi Publication, 2nd ed., 2010.
2. R C Dubey, A text book of Biotechnology, S. Chand and company Ltd., 4th edition, 2006.
3. H. K. Das, Text book of Biotechnology, Wiley, 5th edition, 2017.
4. Ratledge and Kristiansen. Basic Biotechnology 3rd ed. Cambridge Univ. Press, 2006.
5. Gupta PK. Elements of Biotechnology, Rastogi Publication, 2nd ed., 2010.
6. Nicholls DTS. An Introduction to Genetic Engineering. 3rd ed. Cambridge Univ Press. 2008.
7. Glick and Pasternak. Molecular Biotechnology. 4th ed. ASM Press, 2009.
8. Winnacker EL. From Genes to clones. 4thed VCH Publ., 2003.
9. Primrose, Twyman and Old. Principles of gene manipulation. 8th ed. Wiley-Blackwell, 2016.
10. Satyanarayana U, Biotechnology, Generic, 12th edition, 2018.
11. Smith. JE. Biotechnology. Cambridge Univ Press. 5th ed., 2012.
12. https://youtu.be/fg3pvxej0ia (Gene splicing and rDNA)
13. https://youtu.be/xoqfjjobgmo (Gene therapy)
14. https://yotu.be/utlkkvqxbww (Protoplast fusion)

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Elective 3:Biotechnology	Cognitive Level
CO1	recall the scope of biotechnology and its importance	K1
CO2	outline the principles of rDNA technology and the tools used in rDNA technology	K2
CO3	explain the vectors used for gene transfer in plant cells and develop the gene transfer technique to produce transgenic plants	K2, K3
CO4	categorize the vectors and methods used in gene transfer in animals	K4
CO5	demonstrate the basic principles microbial growth and asses the fermentation process and its recovery using Downstream processing	K2, K5
CO6	outline the role of microbes in oil spill cleanup and bioleaching and formulates biodegradable plastics	K2

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Elective 3: Biotechnology												
CO	PO						PSO					
	1	2	3	4	5	6	1	2	3	4	5	6
1	3	3	3	3	2	3	3	3	3	3	2	3
2	3	3	3	3	2	2	3	3	3	3	2	2
3	3	3	3	3	2	2	3	3	3	3	2	2
4	3	2	3	3	3	2	3	2	3	3	3	2
5	2	2	3	3	3	3	2	2	3	3	3	3
6	2	2	3	3	3	3	2	2	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

GENOMICS AND PROTEOMICS

L	T	P	C
4	0	0	4

Objective

To introduce contemporary methods for genomic and proteomic analysis with emphasis on the application of biological mass spectrometrymethods to a wide range of research.

Total Hours: 60

UNIT I 12 Hours

Genome maps

Types of Genome maps and their uses: High and low resolution maps - Map elements, Polmorphic markers, line sine, RFLP, SNP. Types of Maps: Cytogenic - Linkage map, Transcript map, Physical map- Comparative map, integrated map Practical uses of Genomic maps: Locating Genomic regions, target identification, arrangement of genes, SMP diagnosis, Positional specific cloning, Predicting Gene function, identifying regulatory genes.

UNIT II 12 Hours

Structural annotations

Locating coding regions and other structural elements of the gene. Various approaches in gene prediction, gene prediction in prokaryotes and eukaryotes. Hidden - Markov model.

UNIT III 12 Hours

Human Genome and Genomic analysis

Size, features, composition and characteristics of human genome- Sequence repeats, transposable elements, gene structure and pseudogenes. Genome analysis - Gene order (Synteny), Chromosome rearrangement, compositional analysis, clustering of genes and composite genes.

UNIT IV 12 Hours

Proteomics

Structural element and terminology - phi and psi bonds, letter code for amino acids, helix, sheet strand, loop and coil. Active site, Architecture, blocks, class and domains, fold, motif, PSSM, profile. Protein structure prediction: Use of sequence pattern- Leucine zipper, coiled coil, transmembrane, signal peptide and cleavage site. Secondary structure prediction: Chou-Fasman/GOR method, neutral network, nearest neighbour method, tertiary structure prediction, threading, profile, contact potential and modelling.

UNIT V 12 Hours

Proteome analysis

2D Electrophoresis - Immobilized pH gradient, Sample preparation, first dimension criteria, second dimension criteria, Stabilization. Data analysis - Mass spectrometry methods for protein identification and analysis.

References

1. Lesk A. Introduction to Genomics. 4 th ed. Oxford Univ Press. 2013.
2. Primrose. Principles of genome analysis. 3rd ed. Wiley 2002.
3. T.A. Brown. Genomes, 4thed, Garland Science, 2007.
4. Hartwell etal. Genetics: From Genes to Genomes. 5th ed. 2014.
5. Dale and von Schantz. From Genes to Genomes: Concepts and applications of DNA technology. 3rd ed. Wiley-Interscience. 2011.
6. Lovrik Introducing Proteomics. Wiley-Blackwell. 2011.
7. Twyman. Principles of Proteomics. 2nd ed. 2013
8. Liebler DC. Introduction to proteomics. Humana Press. 2nd ed. 2009.
9. Hodgman et al. Instant Notes in Bioinformatics. 2nd ed. Taylor and Francis, 2009.
10. Gibas and Per Jambeck. Developing bioinformatics computer skills. 2nd ed. O'Reilly Associates, 2013.
11. Baxevanis, Ouellette. Bioinformatics. A practical guide to the analysis of genes and proteins. 3 rd ed. Wiley Interscience, 2004.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Elective 3: Genomics and Proteomics	Cognitive Level
CO1	recall the properties of the entire complement of proteins from a given cell or organism	K1
CO2	determine how the properties of proteins change in response to various physiological states	K1, K5
CO3	identify individual protein and bioinformatics tool to analyze and assemble the MS data	K3
CO4	analyze the function of genes and the elements that regulate genes throughout the genome	K4
CO5	find variations in the DNA sequence among people and determine their significance	K1

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Elective 3: Genomics and Proteomics												
CO	PO						PSO					
	1	2	3	4	5	6	1	2	3	4	5	6
1	3	3	3	3	3	3	3	3	3	3	3	3
2	3	3	3	3	3	2	3	3	3	3	3	2
3	3	3	3	3	3	3	3	3	3	3	3	3
4	3	3	3	3	3	2	3	3	3	3	3	2
5	3	3	3	3	3	3	3	3	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

DRUG BIOCHEMISTRY

L	T	P	C
4	0	0	4

Objective

To introduce the biochemical concept of drug absorption, action and transformation of common drugs which are utilized optimally for the treatment of diseases.

Total Hours: 60

UNIT I 12 Hours

Introduction

Drugs -source and nature,classification and nomenclature of drugs, dosage forms and dose response curve and LD50.Passage of drugs across biological membrane; Absorption and distribution of drugs; Binding of drugs to plasma proteins. Routes of drug administration.

UNIT II 12 hours

Receptor and Drug targets

Drug receptors, Drug - receptor interaction, Binding forces in drug receptor interaction, types of receptors, consequences of drug receptor interaction.Drug action not mediated by receptors.
Drug targets- Enzymes, Receptors, Carrier protein, Structural protein, Nucleic acids, Lipids and Carbohydrates.

UNIT III 12 Hours

Drug metabolism and elimination

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

UNIT IV 12 Hours

Chemotherapy

General principles of Chemotherapy - Chemotherapy of Tuberculosis, Malaria, Leprosy, Fungal and Viral diseases. Chemotherapy ofCancer. Mode of action of sulfonamides, antimetabolites of folate, Purine and Pyrimidine. Anti-bacterial - Mode of action and resistance to Penicillin, Streptomycin, Tetracycline and Chloramphenicol.

UNIT V 12 Hours

Drugs acting on CNS and GI tract

Drugs for peptic ulcer, diarrhea and constipation. Anti-parkinsonian drugs, antipyretics and anti-inflammatory drugs. Adverse response to drugs, drug tolerance, and intolerance, drug induced side effects, commonly abused drug and their biological effects. Drug induced disease.

References

1. Mohammed Ali,Text book of pharmaceutical chemistry, CBS Publishers and Distributors, New Delhi, 2018.
2. William O. Foye, Thomas L. Lenke, David A. Williams, Principles of MedicinalChemistry, 4 th Edition, B.I.WaverelyPvt., Ltd., New Delhi, 2012.
3. Goodman, Gilman, The pharmacology, Volumes I and II, 1991.
4. Rang, Tale, Basic and clinical pharmacology 7th edition – Katzung, Prentice Hall, 2012.
5. Manfred E Wolf,Burger's medicinal chemistry and drug discovery. Principles and practice,John Wiley, 2012.
6. Bertram Katzung, Basic and Clinical Pharmacology, (12th edition), LangePublishers, 2012.
7. Gareth Thomas, Fundamentals of Medicinal Chemistry, Wiley BlackwellPublishers, 2003.
8. K.D. Tripathi, Essentials of Medical Pharmacology 6 th edition, Jaypee Brothers Medical publishers(P) Ltd., New Delhi, 2013, ISBN No: 81-8448-085-7.
9. Bertram G. Katzung, Susan B. Masters, Anthony J. Trevor Basic and ClinicalPharmacology, 12 th edition, McGraw Hill medical publishers Ohio, 2012, ISBN: 978-0-07-176402-5
10. S.K. Kulkarni Handbook of Experimental Pharmacology, 4 th edition, Vallabh-Prakashan publication, New Delhi, 2013, ISBN: 9788185731766.
11. Ernest Hodgson, A textbook of Modern Toxicology. 3 rd edition. John Wiley & Sons,Inc., New York, 2004. ISBN 0-471-26508-X.
12. https://www.slideshare.net/swaroophassan/drug-metabolism-40740005.
13. https://www.slideshare.net/MalayPandya1/drug-metabolism-111690745.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Elective 3:Drug Biochemistry	Cognitive Level
CO1	recall and explain the basic concepts of pharmacology	K1, K2
CO2	summarize the mechanism of action of drug inside the system	K2
CO3	explain the theories and principles of drug action, drug metabolism and pharmacodynamics	K2
CO4	distinguish therapeutic and harmful effects of drugs	K4
CO5	apply specialized language and knowledge relevant to Drug biochemistry	K3
CO6	assess the absolute and relative bioavailability of drugs from different dosage forms using either plasma or urine data	K5

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Elective 3: Drug Biochemistry												
CO	PO						PSO					
	1	2	3	4	5	6	1	2	3	4	5	6
1	2	3	3	3	3	3	2	3	3	3	3	3
2	2	3	3	3	3	3	2	3	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3
4	3	3	3	3	3	3	3	3	3	3	3	3
5	2	2	3	3	3	3	2	2	3	3	3	3
6	2	2	3	3	3	3	2	2	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

PLANT BIOCHEMISTRY

L	T	P	C
0	0	3	2

1. Estimation of Iron content from Plant sources
2. Estimation of Protein from Soya beans
3. Estimation of Carbohydrates from Wheat
4. Estimation of Chlorophyll content in leaves
5. Estimation of Vitamin C from Citrus Fruits
6. Estimation of Fructose from fruit
7. Determination of DNA from leaves
8. Determination of total free amino acids from leaves

References

1. T. N. Pattabiraman, Laboratory Manual and Practical Biochemistry, All India Publishers & Distributors, 4th edition,2015.
2. J. Jayaraman, Laboratory Manual in Biochemistry - New Age International Publishers, 2nd edition, 2011.
3. S. Sadasivam, A. Manickam, Biochemical Methods - New Age International (P) Limited, 3rd edition, 2018.
4. David T. Plummer An Introduction to Practical Biochemistry, Tata McGraw Hill Publishing Company, 3rd edition, 2017.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Major Practical – 8:Plant Biochemistry	Cognitive Level
CO1	list out the various micro and macromolecules in plant sources and select suitable method for the isolation, separation and estimation procedures	K1, K4
CO2	apply the principle and biochemical methods of estimating various micro and macromolecules in plant material	K3
CO3	estimate the iron, protein and carbohydrate content in a plant sample	K6
CO4	illustrate the types of plant pigments, estimate Chlorophyll and Vitamin C	K2, K6
CO5	develop skill for the extraction and determination of fructose, free aminoacids and DNA from leaves	K3

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Major Practical – 8:Plant Biochemistry												
CO	**PO**						**PSO**					
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**
1	3	3	3	2	2	3	3	3	3	2	2	3
2	3	3	3	2	1	2	3	3	3	2	2	2
3	3	3	3	2	2	3	3	3	3	2	2	3
4	3	3	3	2	2	3	3	3	3	2	2	3
5	3	3	3	2	1	2	3	3	3	2	2	2

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

CLINICAL ENZYMOLOGY

L	T	P	C
0	0	4	2

Assay of the activity of serum enzymes

1. Alkaline phosphatase
2. Acid phosphatase
3. Aspartate transaminase
4. Alanine transaminase
5. Lactate dehydrogenase
6. Amylase
7. Lipase

References

1. Rodney F Boyer, 3rd edition,Modern Experimental Biochemistry, Pearson Education, 2002.
2. Varley, H., Gowenlock, A.H. and Hill,Practical Clinical Biochemistry, M. William, CBS Publishers; 6th Edition, 2006.
3. Estridge, Reynold and Walter, Basic Medical Laboratory Techniques - 4th edition, Delmar Publishers, 2000.
4. T. N. Pattabiraman, Laboratory Manual and Practical Biochemistry, All India Publishers & Distributors, 4th edition,2015.
5. J. Jayaraman, Laboratory Manual in Biochemistry - New Age International Publishers, 2nd edition, 2011.
6. Henry Bernard, J., Sanford,T and Davidson, W.B. Clinical diagnosis and Management by laboratory methods, Saunders, New York, 2002.
7. Gradwohls, (ed) Ales C. Sonnenwirth and Leonard Jarret, M.D. Clinical Laboratory Methods and Diagnosis, B.I. publications, New Delhi, 2000.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Major Practical – 9: Clinical Enzymology	Cognitive Level
CO1	justify the assay methods of serum enzymes of clinical relevance	K5
CO2	outline the importance of clinical enzymes for its assay and diagnosis of various clinical states	K2
CO3	evaluate the activities of clinically important enzymes	K5
CO4	develop hands on skills for the assay methods of AST, ALT, LDH, alkaline and acid phosphatases in serum	K3, K6
CO5	appraise the results obtained for clinical isoenzymes and differentially correlate for the disease diagnosis	K5

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Major Practical – 9: Clinical Enzymology												
CO	PO						PSO					
	1	2	3	4	5	6	1	2	3	4	5	6
1	3	3	3	3	3	3	3	3	3	3	3	3
2	3	3	3	3	3	3	3	3	3	3	3	3
3	3	2	3	3	3	3	3	2	3	3	3	3
4	3	2	3	3	3	3	3	2	3	3	3	3
5	3	2	3	3	3	3	3	2	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

IMMUNOCHEMISTRY TECHNIQUES

L	T	P	C
0	0	3	2

1. Dot ELISA technique
2. Widaltest - Slide and Tube method
3. VDRL Slide test
4. Mantoux test
5. HBsAg Card test
6. HIVCard test

Demonstration Experiments

7. Immunodiffusion - Ouchterlonytechnique
8. Immuno electrophoresis

References

1. David T. Plummer. An Introduction to Practical Biochemistry, Tata McGraw Hill Publishing Company, 3rd edition, 2017.
2. Varley, H., Gowenlock, A.H. and Hill, Practical Clinical Biochemistry, M. William, CBS Publishers; 6th Edition, 2006.
3. Estridge, Reynold and Walter, Basic Medical Laboratory Techniques - 4th edition, Delmar Publishers, 2000.
4. Kanai L Mukherjee, Medical Lab Technology - Vol I-III. Tata McGraw Hill Education India, 3rd edition, 2010.
5. RamnikSood, Textbook of Medical Lab Technology, Jaypee Brothers Medical Publishers (P) Ltd., 6th edition, 2009.
6. T. N. Pattabiraman, Laboratory Manual and Practical Biochemistry, All India Publishers & Distributors, 4th edition,2015.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Major Practical – 10: Immunochemistry Techniques	Cognitive Level
CO1	relate the principle and methods of identification of antigens and antibodies	K1
CO2	develop skills in the technique of separation of proteins by SDS-PAGE and Western Blotting	K2
CO3	appraise hands on skill in the isolation and quantification of specific immunoglobulins in serum	K5
CO4	apply hands on skills in immunotechniques in clinical laboratories and blood banks	K3
CO5	analyse the clinical data using wide range of immunological methods for diagnosis of bacterial or viral infections	K4

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Major Practical – 10: Immunochemistry Techniques												
CO	PO						PSO					
	1	2	3	4	5	6	1	2	3	4	5	6
1	3	3	3	3	3	2	3	3	3	3	3	2
2	3	2	3	3	3	3	3	2	3	3	3	3
3	3	2	3	3	3	3	3	2	3	3	3	3
4	3	3	3	3	3	2	3	3	3	3	3	2
5	3	3	3	3	3	3	3	3	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/2021-22/UG - Colleges/Part - III (B.Sc.)/Allied Biochemistry- 1

(For B.Sc. other Major Students - Semesters I/III)

CHEMICAL BIOLOGY AND BIOPHYSICAL CHEMISTRY

L	T	P	C
4	0	0	3

Total Hours: 60

UNIT I 12 Hours

Carbohydrates

Introduction to Biochemistry - Biomolecules-Classification,structure and Biologicalimportance of carbohydrates (Mono,Di and Oligosaccharides), forms of isomers. Polysaccharides-Homopolysaccharides and Heteropolysaccharides - Starch, Dextrin,Mucopolysaccharides, Bacterial cell wall polysaccharides.

UNIT II 12 Hours

Lipids

Classification of Lipids- structure and properties, PUFA and MUFA - Physiological importance. Structure and Physiological importance of Cholesterol and Phospholipids.

UNIT III 13 Hours

Amino acids and Proteins

Classification of Amino acids, Structure and properties of Amino acids, Essential & Non - essential amino acids. Classification and Biological importanceof Proteins,Confirmation of Protein structure. Properties - Denaturation and Renaturation. Fibrous andGlobular proteins- Myoglobin and Hemoglobin.

UNIT IV 12 Hours

Nucleic acids and Vitamins

Structure of Nitrogenous bases. DNA - Structure, RNA - Structure and biological functions. Vitamins- Fat soluble and Water soluble - Biological importance.

UNIT V 12 Hours

Techniques in Biochemistry

Basic principles, types and applications of Centrifugation, Chromatography, Spectroscopy and Electrophoresis.

References

1. Nelson and Cox. Lehninger. Principles of Biochemistry. Freeman, 7th ed. 2017.
2. Devlin, T.M., John Wiley & Sons, Inc. Textbook of Biochemistry with Clinical Correlations (2011) 7th ed., (New York).
3. Tymoczko, John L., Jeremy M. Berg, and LubertStryer. Biochemistry, 8th ed. Freeman 2015.
4. Garrett, Reginald, and Charles Grisham. Biochemistry. Nelson Education, 2012.
5. Voet, Donald, Judith G. Voet, and Charlotte W. Pratt. Fundamentals of biochemistry. NewYork: John Wiley & Sons,5th Edition, 2016.
6. Lippincott Williams and Wilkins; Illustrated Reviews: Biochemistry, Seventh, North American edition, 2016.
7. Wilson and Walker. Principles and techniques of Biochemistry and Molecular Biology.7th ed. Cambridge University Press, 2012.
8. Upadhyay, Upadhyay and Nath. Biophysical Chemistry principles and Techniques. Himalaya Publ., 2010.
9. Boyer, R. Modern Experimental Biochemistry.3rd ed. Addison Weslery Longman, 2000.
10. https://biologydictionary.net/polysaccharide
11. https://www2.chemistry.msu.edu/faculty/reusch/virttxtjml/lipids.htm

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Allied Biochemistry 1: Chemical Biology and Biophysical Chemistry (Semesters I/III)	Cognitive Level
CO1	outline the biological importance of various biomolecules	K2
CO2	list out the classification and structure of carbohydrates, lipids, proteins, aminoacids and nucleic acids	K1
CO3	categorize the properties and structural organization of proteins of biological importance	K4
CO4	assess the importance of nucleic acids and vitamins in biological system	K5
CO5	experiment with techniques such as centrifugation, chromatography, spectroscopy and electrophoresis	K3

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Allied Biochemistry 1: Chemical Biology and Biophysical Chemistry (Semesters I/III)												
CO	**PO**						**PSO**					
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**
1	3	2	3	3	3	2	3	2	3	3	3	1
2	3	3	3	3	2	1	3	3	3	3	2	2
3	3	2	3	3	2	2	3	2	3	3	2	1
4	3	2	3	3	2	1	3	2	3	3	2	1
5	3	3	3	3	3	2	3	3	3	3	3	2

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation

ANALYSIS OF BIOMOLECULES – I

L	T	P	C
0	0	2	2

1. Qualitative analysis of carbohydrates

Analysis of monosaccharides – pentose, glucose, fructose.

Analysis of disaccharides – sucrose, maltose and lactose.

Analysis of polysaccharides – starch.

2. Qualitative analysis of amino acids

Analysis of tyrosine, tryptophan, arginine, histidine, methionine, cysteine.

3. Reactions of proteins – biuret, saturation test, precipitation by acids, alkalis, salts and heavy metals.
4. Estimation of iodine number of an edible oil.
5. Determination of saponification number of an edible oil.
6. Determination of acid number of an edible oil.

References

1. T. N. Pattabiraman, Laboratory Manual and Practical Biochemistry, All India Publishers & Distributors, 4th edition,2015.
2. J. Jayaraman, Laboratory Manual in Biochemistry - New Age International Publishers, 2nd edition, 2011.
3. S. Sadasivam, A. Manickam, Biochemical Methods - New Age International (P) Limited, 3rd edition, 2018.
4. David T. Plummer. An Introduction to Practical Biochemistry, Tata McGraw Hill Publishing Company, 3rd edition, 2017.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Allied Practical 1: Analysis of Biomolecules – I	Cognitive Level
CO1	recall the properties of biomolecules and outline the principles of their analysis	K1, K2
CO2	identify the different classes of carbohydrates and interpret the results obtained	K2, K3
CO3	identify the aminoacids present in biological samples	K3
CO4	interpret the results obtained by qualitatively analyzing the proteins and examine the chemical properties	K2, K5
CO5	analyze the methods of characterization of oils and fats and apply the same in checking the adulteration of lipid products	K3, K4

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Allied Practical 1: Analysis of Biomolecules – I												
CO	PO						PSO					
	1	2	3	4	5	6	1	2	3	4	5	6
1	3	2	3	3	3	2	3	2	3	3	3	2
2	3	3	3	3	3	1	3	3	3	3	3	1
3	3	2	3	3	3	1	3	2	3	3	3	1
4	3	2	3	3	3	2	3	2	3	3	3	2
5	3	3	3	3	3	2	3	3	3	3	3	2

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/2021-22/UG - Colleges/Part - III (B.Sc.)/Allied Biochemistry - 2

(For B.Sc. other Major Students - Semesters II/IV)

PRINCIPLES OF BIOCHEMISTRY

L	T	P	C
4	0	0	3

Total hours: 60

UNIT I 12 Hours

Enzymes

General characteristics and classification of enzymes. Holoenzyme, Apoenzyme, Coenzymes. Enzyme specificity, Units of enzyme activity. Mechanism of enzyme action.

UNIT II 12 Hours

Enzyme kinetics

Factors affecting enzyme activity- Enzyme concentration, Substrate concentration, pH and Temperature. Michaelis Menten equation, Lineweaver-Burk plot. Km and its significance. Enzyme inhibition - Reversible and Irreversible inhibition - Competitive inhibition, Non-competitive and Uncompetitive inhibition.

UNIT III 12 Hours

Metabolism

Glycolysis, Oxidation of pyruvate to acetyl coenzyme A. TCA cycle, HMP shunt, Glycogen metabolism. β-Oxidation and biosynthesis of fatty acid. Transamination, deamination and decarboxylation of amino acids.Urea cycle.

UNIT IV 12 Hours

Electron transport chain

Electron transport chain and its significance, Inhibitors of ETC, Oxidative phosphorylation-Chemiosmotic theory, site of oxidative phosphorylation. P/O ratio, Inhibitors and Uncouplers ofoxidative phosphorylation.

UNIT V 12 Hours

Clinical Biochemistry

Isoenzymes and their medical applications. Clinical significance of SGOT, SGPT, CPK, LDH, ALP, ACP. Diabetes mellitusand its diagnosis. GTT, Liver function test, Renal function test.

References

1. Satyanarayana U, Fundamentals of Biochemistry, Allied & Book Pvt Ltd, Calcutta, 2019.
2. Jain J L, Fundamentals of Biochemistry, 6th ed, S. Chand Publications, 2005.
3. Trevor Palmer, Enzymes-Biochemistry, Biotechnology, Clinical Chemistry, Philip Bonner, 2nd ed, East West Publications, 2008.
4. Philip Mayne, Clinical Chemistry in diagnosis and treatment, 6th ed, Taylor and Francis Ltd, 1994.
5. Marshall, Clinical Biochemistry - Metabolic and clinical aspects, 3rd ed, 2014.
6. Nader Rifae, Tietz textbook of clinical chemistry and Molecular Diagnostics, 6th ed, 2017.
7. Robert K Murray et. al., Harper's Illustrated Biochemistry, 31st edition-McGraw Hill, 2018.
8. David L Nelson, Michael M Cox, Lehninger's Principles of Biochemistry, 7th ed, 2017.
9. LubertStryer, Biochemistry, 9th ed, Worth Publications, 2019.
10. https://nptel.ac.in/courses /102/102/102102033 - Enzymes.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Allied Biochemistry 2: Principles of Biochemistry (Semesters II/IV)	Cognitive Level
CO1	recall the general characteristics of enzymes and its classifications	K1
CO2	explain the kinetics of various enzymes	K2
CO3	analyze the fate of dietary carbohydrates and its disorders	K4
CO4	summarize the mechanism of energy transfer in ETC	K2
CO5	make use of the activity of enzymes in clinical diagnosis, evaluate liver and kidney functions	K3, K5

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Allied Biochemistry 2: Principles of Biochemistry (Semesters II/IV)												
CO	**PO**						**PSO**					
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**
1	3	2	3	3	3	1	3	2	3	3	3	1
2	3	2	3	3	3	2	3	2	3	3	3	2
3	3	3	3	3	3	2	3	3	3	3	3	2
4	3	2	3	3	3	1	3	2	3	3	3	1
5	3	3	3	3	3	2	3	3	3	3	3	2

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

ANALYSIS OF BIOMOECULES - II

L	T	P	C
0	0	2	2

1. Estimation of DNA from Animal tissue/Plant tissue sources
2. Estimation of RNA from yeast
3. Estimation of Iron from Plant sources
4. Estimation of Carbohydrates from Wheat
5. Estimation of Calcium from milk
6. Estimation of Vitamin C from Citrus Fruits
7. Estimation of Chlorophyll from leaves
8. Estimation of protein from Soya beans

References

1. T. N. Pattabiraman, Laboratory Manual and Practical Biochemistry, All India Publishers & Distributors, 4th edition,2015.
2. J. Jayaraman, Laboratory Manual in Biochemistry - New Age International Publishers, 2nd edition, 2011.
3. S. Sadasivam, A. Manickam, Biochemical Methods - New Age International (P) Limited, 3rd edition, 2018.
4. David T. Plummer An Introduction to Practical Biochemistry, Tata McGraw Hill Publishing Company, 3rd edition, 2017.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Allied Practical 2: Analysis of Biomolecules – II	Cognitive Level
CO1	apply the basic techniques in biochemistry for analysis of nucleic acids in biological samples	K3
CO2	make use of colorimetric method to assess biomolecules and minerals from biological samples	K3, K5
CO3	identify suitable techniques for separation of biomolecules from different sources	K3
CO4	analyze specific biomolecules from plant and tissue sources	K4
CO5	develop hands on experience nucleic acids using colorimetry technique	K6

Remember (K1); Understand (K2); Apply (K3); Analyze (K4); Evaluate (K5); Create (K6)

Mapping

Allied Practical 2: Analysis of Biomolecules – II												
CO	PO						PSO					
	1	2	3	4	5	6	1	2	3	4	5	6
1	3	2	3	3	3	2	3	2	3	3	3	2
2	3	3	3	3	3	1	3	3	3	3	3	1
3	3	2	3	3	3	1	3	2	3	3	3	1
4	3	2	3	3	3	1	3	2	3	3	3	1
5	3	3	3	3	3	2	3	3	3	3	3	2

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MANONMANIAM SUNDARANAR UNIVERSITY, TIRUNELVELI

Model Question Paper
B.Sc. (CBCS) DEGREE EXAMINATIONS
Biochemistry – Main

BIOMOLECULES
(For those who joined in June 2021and afterwards)

Time: Three hours Maximum: 75 marks

PART A- (1x10= 10 marks)
Answer ALL questions
Choose the correct answer

Question No.	Questions	Course Outcome	Cognitive level
1	Geometrical isomerism is exhibited by molecules possessing a) double bond b) one or more similar functional groups c) (a) and (b) d) (a) only	CO1	K1
2	The two strands in DNA are held together by a) covalent bond b) H- bond c) Vanderwaals force d) all of the above	CO1	K2
3	The end product of hydrolysis of starch is a) soluble starch b) glucose c) maltose d) dextrins	CO3	K3
4	Which one of the polysaccharides is not a polymer of glucose? a) amylose b) inulin c) glycogen d) cellulose	CO3	K2
5	Hydrolysis of a triacyl glycerol is also known as a) saponification b) esterification c) hydrogenation d) dehydration	CO2	K3
6	Iodine value of an oil shows the extent of a) polymerization b) molecular size c) unsaturation d) esterification	CO2	K5
7	The reagent for detection of aminoacid is a) Molish reagent b) dichlorophenol indophenols c) ninhydrin d) 2:4 dinitrophenylhydrazine	CO3	K3
8	The aminoacids exist as zwitter ions when they are in a) solid state b) acidic solution c) alkaline solution d) neutral solution	CO4	K4, K5
9	Nucleoside contains a) base b) sugar c) phosphate d) (a) and (b)	CO5	K1, K2
10	Ribonucleic acid does not contain a) adenine b) d- ribose c) uracil d) hydroxymethyl cytosine	CO5	K1, K2

PART B (5x5 = 25 marks)

Answer ALL questions choosing either (a) or (b).

Question No.	Questions	Course Outcome	Cognitive level
11.a	Define isomers? Give examples of isomeric compounds.	CO1	K1
11.b	What is a Hydrogen bond? Write the importance of Hydrogen bonding in DNA.	CO1	K1
12.a	Outline the structure of glucose proposed by Haworth	CO2	K2
12.b	What are epimers? Compare D and L form.	CO2	K1, K2
13.a	List out the biological significance of PUFA.	CO5	K4
13.b	Examine the characterization of fat by Acid number.	CO2	K4
14.a	Write the importance of Zwitter ions with suitable examples.	CO3	K5
14.b	Explain Denaturation of proteins by various agents.	CO4	K5
15.a	Illustrate the structural components of Nucleosides.	CO2	K2
15.b	Outline the structure of tRNA with a neat diagram.	CO2	K2

PART C – (8x5 = 40marks)

Answer ALL questions choosing either (a) or (b).

Question No.	Questions	Course Outcome	Cognitive level
16.a	Discuss the forces stabilizing the protein structure.	CO4	K6
16.b	Elaborate the functional groups in organic molecules.	CO1	K6
17.a	Explain Mutarotation.	CO2	K5
17.b	Explain Osazone formation by reducing sugars and its significance.	CO3	K5
18.a	Categorize essential fatty acids and mention its significance.	CO5	K4
18.b	Analyze the structure & functions of Cholesterol.	CO2	K4
19.a	Classify the different aminoacids with suitable examples.	CO2	K4
19.b	Distinguish the Primary and secondary structure of proteins.	CO4	K4
20.a	Classify the types of RNA and mention their biological significance.	CO5	K2
20.b	Summarize the structure and biological significance of DNA.	CO5	K2

MANONMANIAM SUNDARANAR UNIVERSITY, TIRUNELVELI

Model Question Paper
B.Sc. (CBCS) DEGREE EXAMINATIONS
Biochemistry – Allied

CHEMICAL BIOLOGY AND BIOPHYSICAL CHEMISTRY
(For those who joined in June 2021and afterwards)

Time: Three hours Maximum: 75 marks

PART A- (1x10= 10 marks)
Answer all questions
Choose the correct answer

Question No.	Questions	Course Outcome	Cognitive level
1	The shape of lactososazone is a) powderpuff b) needle c) star d) broken glasses	CO2	K1
2	The heteropolysaccharide which has anticoagulant action is a) heparin b) hyaluronic acid c) chondroitin sulphate d) keratin sulphate	CO2	K2
3	The fatty acids mainly present in animal fats is a) palmitic acid and oleic acid b) stearic acid and lauric acid c) palmitic acid and stearic acid d) linoleic acid and linolenic acids	CO1	K1
4	Naturally occurring fatty acids are usually with a) even number of carbon atoms b) odd number of carbon atoms c) both d) none of the above	CO2	K2
5	When proteins are coagulated, a) the primary structure is changed b) secondary structure is changed c) tertiary structure is changed d) (b) and (c)	CO3	K3
6	α- helix of a protein is stabilized by a) covalent bond b) Hydrogen bond c) ionic bond d) Vander Waal's force	CO3	K3
7	The number of nucleotide units present in a DNA molecule are a)1000 -5000 b)1000 – 4000 c)1500 -8000 d)1600 -9000	CO4	K4
8	Ribonucleic acid does not contain a) adenine b) d- ribose c) uracil d) hydroxymethyl cytosine	CO4	K2
9	Ultracentrifuges are used for	CO5	K3

	a) separation of macromolecules b) purification of macromolecules c) studying the properties of macromolecules d) all of the above		
10	Which of the following factors affect electrophoretic mobility? a) electric field b) sample c) pH d) all of the above	CO5	K5

PART B (5x5 = 25 marks)

Answer ALL questions choosing either (a) or (b).

Question No.	Questions	Course Outcome	Cognitive level
11.a	Outline the structure of glucose.	CO2	K2
11.b	Explain the identification test for starch.	CO2	K2
12.a	What are lipids? Explain the types of lipids with suitable examples.	CO2	K1, K2
12.b	Classify fatty acids with suitable example.	CO1	K2
13.a	Define Isoelectric point. Explain the significance in biological system.	CO3	K1, K4
13.b	List out the Essential amino acids and its importance.	CO1	K1, K4
14.a	Explain the structure of tRNA and its function.	CO4	K5
14.b	Compare the composition of Nucleic acids	CO4	K5
15.a	Elaborate Beer-Lambert's law.	CO5	K6
15.b	Discuss the applications of SDS-PAGE.	CO5	K6

PART C – (8x5 = 40marks)

Answer ALL questions choosing either (a) or (b).

Question No.	Questions	Course Outcome	Cognitive level
16.a	Assess the reactions of phenylhydrazine with glucose.	CO2	K5
16.b	Explain heteropolysaccharides with suitable examples.	CO2	K5
17.a	Categorize the Essential fatty acids.	CO1	K4
17.b	Distinguish Iodine number and Acid number	CO2	K4
18.a	Identify the biological importance of proteins in humans.	CO3	K3
18.b	Organize the tertiary structure of proteins.	CO3	K3
19.a	Summarize the types and functions of B Vitamins in metabolism.	CO4	K2
19.b	Interpret the biological importance of fat-soluble vitamins.	CO4	K2
20.a	Discuss the principles and applications of UV spectrophotometry.	CO5	K6
20.b	Elaborate the principles and applications of agarose gel electrophoresis.	CO5	K6