

MANONMANIAM SUNDARANAR UNIVERSITY, TIRUNELVELI

UG COURSES – AFFILIATED COLLEGES

B.Sc. Biochemistry

(Choice Based Credit System)

(with effect from the academic year 2020-2021 onwards)

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 – 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	Physiology	4	4	0	0	4
III	20	Major Practical-3	Techniques in Physiology	2	0	0	2	2
III	21	Allied-3	Chemistry - I	4	4	0	0	3
III	22	Allied Practical-3	Inorganic Quantitative Analysis	2	0	0	2	2
III	23	Skill Based Subject	Biochemical Diagnostic Tools/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	Enzymology	4	4	0	0	4
III	29	Major Practical-4	Enzymes and Enzyme Kinetics	2	0	0	2	2
III	30	Allied-4	Chemistry - II	4	4	0	0	3
III	31	Allied Practical-4	Inorganic Qualitative Analysis	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	Intermediary Metabolism	5	5	-	-	5
III	37	Core-6	Plant Biochemistry	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	Isolation and Characterization of Biomolecules	3	-	-	3	2
III	41	Major Practical-6	Clinical Biochemistry-I	3	-	-	3	2
III	42	Major Practical-7	Clinical Enzymology	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	Cell and Molecular Biology	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	Clinical Biochemistry-II	2	-	-	2	2
III	49	Major Practical-9	Immunology and Molecular Biology Techniques	3	-	-	3	2
III	50	Major Practical-10	Microbial Techniques	2	-	-	2	2
III	51	Group Project		7	-	-	7	7
			Subtotal	30	16	0	14	29
				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)

Paper 2 - Biochemistry (Semesters II/IV)

1. Objectives of the course

- To provide the fundamental knowledge on different branches of Biochemistry
- To impart the theoretical and practical skills in basic and modern techniques in Biochemistry and related subjects
- To motivate the students for critical thinking and self-reflection to draw conclusions
- To inculcate moral values and help them to grow as good citizens
- To enable the students with profound understanding in various field of applications and make them competent

2. 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 Biology/Biochemistry as one of the subjects.

3. 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.

4. Medium of instruction and examination

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

5. Theory examination

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

6. Practical examination

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

7. 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.

8. 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	6 and 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:

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

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

9. 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

10. 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

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

Composition of blood, function, types of blood cells and their function. Blood groups - ABO and Rhesus systems. Blood clotting; clotting factors - intrinsic and extrinsic factors, Mechanism of blood clotting. Structure of Heart. Cardiac cycle and pressure changes, heart sounds, cardiac output, heart rate.

UNIT II

12 Hours

Respiratory system

Structure of Lungs. Diffusion of O₂ and CO₂ in blood, lungs and tissues. Oxygen dissociation curve – Hill's plot. Role of lungs in acid-base balance.

UNIT III

12 Hours

Excretory system

Structure of kidneys, structure of nephrons - Composition and formation of urine, Renal regulation of acid-base balance, Renal threshold, Glomerular filtration rate.

UNIT IV

12 Hours

Digestive system

Structure of GI tract. Composition of salivary, gastric, pancreatic, intestinal and bile secretions. Digestion and absorption of carbohydrates, lipids and proteins.

Sensory organs

Neurons- structure, Nerve impulse and Neurotransmitters. Structure of eye and ear. Muscle types- Muscular contraction and relaxation. Role of Vitamin A in Vision.

References

1. C.C. Chatterjee, Human physiology - 11th edition, CBS Publishers & Distributors, 2016.
2. Guyton and Hall Text book of Medical Physiology, Elsevier; 4th edition, 2020.
3. Murray et al. Harper's Illustrated Biochemistry 30th ed. McGraw Hill, 2015.
4. Smith et al. Principles of Biochemistry. Mammalian Biochemistry. McGraw Hill 7th ed.,1982.
5. Barrett et al. Ganong's Review of Medical Physiology. 25th ed. Lange, 2015.
6. Graaf & Rees. Schaum's Easy Outline of Human Anatomy & Physiology.3rd ed., 2009.
7. Robin R Preston, Thad E Wilson, Lippincotts Illustrated Reviews, 2nd edition, 2019.

TECHNIQUES IN PHYSIOLOGY

L	T	P	C
0	0	2	2

1. Identification of Blood group
2. Enumeration of RBC
3. Enumeration of WBC
4. Differential count of leukocytes
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)
9. Determination of Bleeding time and Clotting time

References

1. Estridge, Reynold and Walter, Basic Medical Laboratory Techniques - 4th edition, Delmar Publishers, 2000.
2. Kanai L Mukherjee, Vol I-III. Medical Lab Technology, Tata McGraw Hill Education India, 3rd edition, 2010.
3. Ramnik Sood, 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.

CHEMISTRY – I

L	T	P	C
4	0	0	3

Objective

To learn the fundamentals of organic chemistry, to know the therapeutic effects of drugs, to acquire basic idea of medicinal plants and chemicals used in everyday life and to know about drinking water quality management.

Total Hours: 60

UNIT I

12 Hours

Fundamentals of Organic Chemistry

Classification of Organic compounds - Hybridization in Methane, Ethane, Acetylene, Benzene. Classification of reagents - Electrophiles, Nucleophiles and Free radicals. Classification of reactions - Addition, Substitution, Elimination, Condensation and Polymerisation. Reaction intermediates - structure and stability of Carbocations - Carbanions.

UNIT II

12 Hours

Drugs and Pharmaceuticals

Definition, examples, uses and side effects of Antibiotics, Antipyretics, Analgesics, Anti-inflammatory agents, Sedatives, Antiseptics, Antihistamines, Hypnotics and Antidepressants. Antihyperglycemic, Antimalarial and Antiviral drugs.

UNIT III

12 Hours

Phytochemistry

Chemical constituents and medicinal uses of Indian Medicinal plants - Palak, Vallarai, Kizhanelli, Thumbai, Hibiscus, Adadodai, Thoothuvalai, Nochi, Thulasi, Aloe vera, Neem.

Essential oils - Extraction by Steam distillation - Source and medicinal uses of Eucalyptus oil, Sandal wood oil and Lemon grass oil.

UNIT IV

12 Hours

Applied Chemistry

General survey of chemicals used in everyday life. Cosmetics - Talcum powder, Tooth powder, Shampoo, Nail polish, Sun screens, Boot polish, Chalk piece - General formulation & preparation. Possible hazards of cosmetics use.

Lubricants - Classification, criteria of good lubricating oils, synthetic lubricating oils, poly glycols and poly alkene oxides - greases or semi solid lubricants, solid lubricants - Graphite.

UNIT V

12 Hours

Water Quality Management

Water Pollution - Definition, sources of water pollution, types of water pollutants - sewage and domestic wastes, industrial effluents, agricultural discharges, detergents, disease causing agents and radioactive materials. Eutrophication and its effects.

Purification of water for domestic use - Use of chlorine, Ozone and UV light. Water quality standards for drinking water - BIS & WHO. Definition, importance and determinations of BOD and COD.

References

1. Bahl and Arun Bahl, Organic Chemistry, S. Chand and Sons, New Delhi, 2005.
2. Morrison & Boyd, Organic Chemistry, VIth ed, Prentice Hall of India Pvt. Ltd., New Delhi, 1998.
3. P. L. Soni, Text book of Organic Chemistry, S. Chand and Company Ltd., New Delhi, 29th edition, 2012.
4. K. S. Tewari and N. K. Vishnoi, A Text Book of Organic Chemistry, Vikas Publishing House; 3rd edition, 2006.
5. Sawyer. W, Experimental cosmetics, Dover publishers, New York, 2000.
6. S. Lakshmi, Pharmaceutical Chemistry, S. Chand and Sons, New Delhi, 1995.
7. Jeyashree Gosh, A text book of Pharmaceutical Chemistry, S. Chand and Company, NewDelhi, 2017.
8. Satoskar, RS, Bhandarkar, SD., and Rege, NN., Pharmacology and Pharmacotherapeutics & quot; Popular Prakashan (P) Ltd., 2006.
9. Dr.S.S.Dara, Dr S.S.Umare, A text book of Engineering Chemistry,S. Chand &Company ltd Edition, 2014.
10. A.Ravikrishnan, Text book of Engineering chemistry Srikrishnan,5thedition, 2014.
11. Dr.Veeraiyan V., Text book of Ancillary Chemistry, Highmount Publishing house, Chennai-14. Edition, 2006.
12. Vaithyanathan S. and Others, Textbook of Ancillary Chemistry, Priya Publications, Karur- Edition, 2006.
13. R.Gopalan,S.Sundaram Text book of Ancillary chemistry, Sultan & Chand and sons Edition, 2006.

INORGANIC QUANTITATIVE ANALYSIS

Acidimetry and alkalimetry

1. Estimation of oxalic acid – Std. oxalic acid
2. Estimation of Na_2CO_3 – Std. Na_2CO_3
3. Estimation of hydrochloric acid – Std. oxalic acid

Permanganometry

4. Estimation of ferrous ammonium sulphate – Std. ferrous ammonium sulphate
5. Estimation of oxalic acid – Std. oxalic acid
6. Estimation of ferrous sulphate – Std. oxalic acid
7. (Minimum 4 volumetric estimations)

**MSU/2020-21/UG - Colleges/Part - III (B.Sc. Biochemistry)/Semester-III/ Skill Based
Courses in Biochemistry**

Biochemical Diagnostic Tools/Blood Banking
(Select any one)

L	T	P	C
4	0	0	4

BIOCHEMICAL DIAGNOSTIC TOOLS

Objective

To introduce the basic concepts of clinical biochemistry, microbiology 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 with regards to infected materials and chemical burns. Quality assurance and disposal of wastes. Cleaning of equipments and glasswares. Maintenance and use of refrigerator, deep freezers, incubators, ovens, water bath, autoclaves, centrifuges, anaerobic chambers etc. Maintenance and knowledge of various components of microscopes and applications of various types of balances.

UNIT II

12 Hours

Clinical Biochemistry and Clinical Pathology

Principle, types, uses, care & maintenance of Photoelectric colorimeter, spectrophotometer and flame photometer. Principle, types, uses of Auto analyser, Blood Gas analyser & role of computers in laboratory. Biochemical test profiles: Principle and examination of glucose tolerance test, liver function tests, kidney function tests, thyroid function test and lipid profile. Physical chemical and microscopic examinations of urine. Semen analysis (count, motility, abnormal forms etc.).

UNIT III

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, platelet profile.

UNIT IV

12 Hours

Microbiology

Cleaning and methods of sterilization of glass wares, media, instruments including syringes, needles and sharp instruments. Preparation of media, plugging of test tubes, preparation of swab sticks, reagents, nutrient agar, blood agar, chocolate agar, Loeffler's serum, Dorsetts egg medium, L.J. medium, peptone water, sugar media etc. Staining method: Gram stain, Ziehl-Nelsen stain, Albert's stain etc. Motility preparations, hanging drop preparation, steps in bacterial identification of Cocci, Corynebacteria, Diptheria, Mycobacteria, Gram negative bacilli and Grampositive bacilli.

UNIT V

12 Hours

Principles and techniques of Haemagglutination, Precipitation and Flocculation

Techniques of RA factor, CRP, ASO, VDRL and Widal test. Principles of ELISA test and use of ELISA reader- TORCH, Auto Antibodies, Hepatitis, HIV testing and EBV etc. Principles and techniques of electrophoresis- 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, Prasanna & Rajan, Textbook of Biochemistry, Orient BlackSwan; 3rd edition, 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. Ramnik Sood, 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.

**MSU/2020-21/UG - Colleges/Part - III (B.Sc. Biochemistry)/Semester-III/ Skill Based
Courses in Biochemistry**

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 donor motivation and selection, so as to ensure adequate availability of safe blood.

Total Hours: 60

UNIT I

12 Hours

Blood

Composition of blood, Basic principle involved in Immunohematology prior to blood transfusion, Collection of blood - requirements, preparation, Venepuncture. Haemolysis and prevention. Separation of serum.

UNIT II

12 Hours

Collection of blood

Blood collection for transfusion, Changes in blood on keeping, Anticoagulants in blood bank, Preservation of blood - precautions, Blood containers - Blood bags, Safety in blood bags.

UNIT III

12 Hours

Blood groups

Human blood group system - A, B, AB, O, Sub groups - A1 and A2, Percentage of different groups, (D) factor system. Principles and Methods of blood grouping and Rh typing- tube and slide methods.

UNIT IV

12 Hours

Blood transfusion

Types and indication of various blood transfusion, Universal donor/recipient. Donor selection, Compatibility test - importance, types and methods - major and minor. Interpretation of compatibility test between all available donor and patient and reporting methods. Release of blood transfusion, Precautions to be followed.

Screening procedures for blood transfusion

Screening procedures for blood transfusion - 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. Ramnik Sood, Textbook of Medical Lab Technology, Jaypee Brothers Medical Publishers (P) Ltd., 6th edition, 2009.

**MSU/2020-21/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 :36

UNIT I

7 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

7 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

8 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.

Clinical disorders

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

References

1. Nelson and Cox. Lehningers Principles of Biochemistry. Freeman, 7th ed., 2017.
2. Tymoczko, John L., Jeremy M. Berg, and Lubert Stryer. 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. New York: 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. David Whitehart, Biochemistry of the eye, University of Alabama at Birmingham, AL, USA Paperback, Butterworth Hainemann (www.elsevier.com)
8. Vaclav Hlavac Human eye physiology (www.sight_savers.org).

**MSU/2020-21/UG - Colleges/Part -IV (B.Sc. Biochemistry)/Semester-III/ Non Major
Elective Courses in Biochemistry**

VACCINOLOGY

L	T	P	C
2	0	0	2

Objectives

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

Total Hours :36

UNIT I

7 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

7 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

7 Hours

Practices of immunization

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

UNIT IV

8 Hours

Vaccines based on production

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

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. 7th ed, 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.

ENZYMOLGY

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

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 III

12 Hours

Enzyme inhibition

Reversible and irreversible inhibition, competitive inhibition, non-competitive inhibition and uncompetitive inhibition. Allosteric enzymes.

UNIT IV

12 Hours

Cofactors in enzyme catalysis

Role of cofactors in enzyme catalysis NAD/NADP, FMN/FAD, Coenzyme ATP, Pyridoxal Phosphate, Tetrahydrofolate, Mechanism of action of chymotrypsin, lysozyme. Multienzyme complexes - pyruvate dehydrogenase complex.

Enzyme regulation

General mechanism, 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.

ENZYMES AND ENZYME KINETICS

L	T	P	C
0	0	2	2

1. Enzyme kinetics of amylase - Effect of pH, Temperature, Enzyme concentration and Substrate concentration.
2. Enzyme kinetics of alkaline phosphatase - Effect of pH, Temperature, Enzyme concentration and Substrate concentration.

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. Aln Fersht, Enzymes Structure and Mechanism, NewYork: Freeman, 2nd edition, 1999.

CHEMISTRY – II

L	T	P	C
4	0	0	3

Objective

To study the basic concepts of Bioinorganic, Physical, Nuclear Chemistry and applications of Chemistry in Biological, Medical, Industrial and Agricultural fields.

Total Hours: 60

UNIT I

12 Hours

Bioinorganic chemistry

Metal ions present in biological systems, Classification of elements according to their action in biological system. Geochemical effect on the distribution of metals. Sodium/Potassium pump, Calcium pump, Excess and deficiency of some trace elements. Toxicity of metal ions (Hg, Pb, Cd and As) reasons for toxicity, Use of chelating agents in medicine. Applications of ions in bio-systems - Haemoglobin, storage and transfer of iron, Role of Mg^{2+} ions in energy production and Chlorophyll, Role of Ca^{2+} in blood clotting, stabilization of protein structures & structural role (bones).

UNIT II

12 Hours

Physical chemistry

Photochemistry - Laws of Photochemistry, Beer-Lambert's Law, Grothuss-Draper Law, Einstein's Law, Quantum efficiency, reasons for high and low quantum yields. Determination of Quantum yield, fluorescence, phosphorescence, thermoluminescence, chemiluminescence and bioluminescence, photochemical and thermal reactions, primary and secondary processes in photo chemical reactions. Role of photochemical reactions in biochemical processes, photosensitised reactions.

UNIT III

12 Hours

Nuclear Chemistry

Composition of nucleus, packing fraction of stability of nucleus n/p binding energy. Fundamental particles of nucleus, isotopes, isobars, isotones and isomers. Separation of isotopes by diffusion method - group displacement law.

Difference between Chemical reactions and Nuclear reactions, Nuclear fusion & fission. Radioactive series, Definition and Units of radioactivity, Half-life period. Characteristics of Radiations, Applications of radioisotopes - Carbon dating, rock dating and medicinal applications.

UNIT IV

12 Hours

Industrial Chemistry

Fuel gases - Natural gas, Water gas, Producer gas, LPG gas, Gobar gas, and Oil gas.

Soaps and Detergents - Cleaning action of soaps and detergents. Safety matches, fireworks & explosives, Paints and Varnishes.

UNIT V

12 Hours

Agrochemistry

Pesticides - Classification of Pesticides based on the use and chemical composition. Insecticides - Plant products - Nicotine, pyrethrin, Inorganic pesticides - borates, Organic pesticides - DDT and BHC. Fungicide - Sulphur compounds, Copper compounds, Bordeaux mixture. Herbicides, Rodenticides, Repellents.

Fertilizers - Definition, Classification and Composition. Preparation and uses of Urea, Ammonium sulphate, Triple Superphosphate, NPK and mixed Fertilizers.

References

1. K. K. Rohatgi Mukherjee, A text book of Fundamental of Photochemistry, Wiley Eastern Ltd New Delhi, Bangalore Edition, 1978.
2. Puri B.R., Sharma and Pathania, Text book of Physical Chemistry, Vishal Publishing Co., New Delhi. Edition, 2006.
3. Puri, Sharma & Kalia, Principles of Inorganic Chemistry, Milestone Publishers and Distributors, 2008.
4. P. L. Soni, Text book of Organic Chemistry, S. Chand and Company Ltd., New Delhi, 29th edition, 2012.
5. S. Bahl., Arun Bahl, Text book of Physical chemistry, S.Chand &Company Ltd Edition 2007.
6. B. K. Sharma, Industrial Chemistry, 19th Edition, Krishna Prakashan Media P. Ltd., 2016.
7. 8.B. N. Chakrabarty, Industrial Chemistry, Oxford and IBH Publishing Co. Pvt.Ltd., Calcutta
8. Soil Fertility & Fertilisers – Samuel L. Tisdale, Werner L. Nelson, James D. Beaton, John L. Havlin. Fifth edition, Macmillan
9. Harry, O Buckman N Yle C. Brandy, Nature and properties of soils - Macmillan
10. R.C.Paliwal, K.Goel, R.K.Gupta, Insecticides, Pesticides and Agro based Industries – Small Business Publications.

INORGANIC QUALITATIVE ANALYSIS

L	T	P	C
0	0	2	2

1. Inorganic simple salt containing one acidic radical (interfering radical) and one basic radical
2. Acidic radical Interfering acidic radicals: Borate, Fluoride, Oxalate and Phosphate.
3. Basic radicals
Group I: Lead
Group II: Copper, Cadmium
Group III: Ferric iron
Group IV: Cobalt, Nickel
Group V: Barium
Group VI: Magnesium, Ammonium.
(Minimum 4 experiments)

MSU/2020-21/UG - Colleges/Part - III (B.Sc. Biochemistry)/Semester-IV/ Skill Based Courses in Biochemistry

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 and coding system.

UNIT II

12 Hours

Principles of epidemiology and epidemiologic methods

Aims of epidemiology, epidemiological approaches, rates and ratios, measurements of mortality, measurement of morbidity. Epidemiology of communicable diseases - Small pox, chicken pox, influenza, diphtheria, Whooping cough, tuberculosis, Dengue, Malaria, Filariasis, Rabies, Plague, Japanese Encephalitis, Leishmaniasis, Leprosy, Sexually transmitted diseases and Acquired Human immunodeficiency syndrome.

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 of Health education, Counselling process. International Health agencies: WHO, UNICEF, Voluntary Health Agencies.

UNIT V

12 Hours

Health Programmes in India

Health Planning and Management: 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, monitoring and supervision and ethics.

References

1. Park. K. Textbook of Preventive and Social medicine. Jabalpur: Banarsidas Bhanot, 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. Rajvir Bhalwar et. 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.

MSU/2020-21/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

Forensic Science

Definition, History and Development, Crime scene management and investigation; collection, preservation, packing and forwarding of physical and trace evidences for analysis

UNIT II

12 Hours

Blood

Fresh blood - grouping and typing of fresh blood samples including enzyme types. Analysis of stains of blood and allied body fluids for their groups and enzyme types. Cases of disputed paternity and maternity problems, DNA profiling.

UNIT III

12 Hours

Analysis of body fluids

Analysis of illicit liquor including methyl and ethyl alcohol and alcohol in body fluids and breathe. Analysis of petroleum products. Chemical examination, physiology and pharmacology of Insecticides and pesticides.

UNIT IV

12 Hours

Psychotropic drugs

Sedatives, stimulants, opiates and drugs of abuse. Extraction, isolation and identification of poisons from viscera, tissues and body fluids.

Identification tests

Identification of hair, determination of species origin, sex, site and individual identification from hair. Classification and identification of fibers. Examination and identification of saliva, Urine, faecal matter and milk. Examination and identification of semen stains including the species origin and individual characteristics.

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, Tabin Millo (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.

MSU/2020-21/UG - Colleges/Part - III (B.Sc. Biochemistry)/Semester-IV/ Skill Based Courses in Biochemistry

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

An 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), Restriction digestion of DNA's. 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, Evolution of term finger printing- Global and Indian scenario. Principle of DNA finger printing. Technological developments in DNA finger printing. 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 through put to High throughput.

UNIT IV

12 Hours

Application of DNA

Application of DNA in finger printing History, Agriculture, Veterinary, Medicines, Forensics, Ecology, Conservation.

UNIT V

12 Hours

Critical issues in DNA fingerprinting

Genetics issues, Technical issues, Statistical issues. Case studies: Historic cases, erratic cases. Application oriented case studies. Critical issues related case studies.

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.

**MSU/2020-21/UG - Colleges/Part - IV (B.Sc. Biochemistry)/Semester-IV/ Non Major
Elective Courses in Biochemistry**

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: 36

UNIT I

7 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

7 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

7 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

8 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.

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. Brahman., 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.

**MSU/2020-21/UG - Colleges/Part - IV (B.Sc. Biochemistry)/Semester-IV/ Non Major
Elective Courses in Biochemistry**

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: 36

UNIT I

7 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

7 Hours

Enzymes

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

UNIT III

7 Hours

Proteins

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

UNIT IV

8 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.

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 Lubert Stryer. 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. New York: John Wiley & Sons, 5th Edition, 2016.
7. Lippincott Williams and Wilkins; Illustrated Reviews: Biochemistry, Seventh, North American edition, 2016.

INTERMEDIARY 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

Carbohydrate metabolism

Glycolysis, oxidation of pyruvate to acetyl co A. TCA cycle, Bioenergetics, Cori's cycle, metabolism of hexoses- galactose, fructose, mannose, pentose phosphate pathway, Glyoxylate pathway, Glycogen metabolism, Glucuronate pathway, gluconeogenesis.

UNIT II

15 Hours

Lipid metabolism

Oxidation of fatty acids - α , β and ω oxidation, β -Oxidation, role of carnitine in β -oxidation. Biosynthesis of fatty acid- saturated fatty acid - synthesis of palmitic acid, Unsaturated fatty acid - synthesis of linolenic acid, linoleic acid and palmito oleic acid, biosynthesis of triacylglycerol, biosynthesis of phospholipids, biosynthesis of cholesterol.

UNIT III

15 Hours

Bioenergetics

Laws of thermodynamics and concepts of free energy, enthalpy and entropy. High energy phosphate compounds and significance of ATP. Electron transport chain and its significance, inhibitors of ETC, oxidative phosphorylation- chemiosmotic theory, site of oxidative phosphorylation, P/O ratio, inhibitors and uncouplers of oxidative phosphorylation.

UNIT IV

15 Hours

Amino acid metabolism

Transamination, deamination and decarboxylation of amino acids. Metabolism of non-essential amino acids - tyrosine, phenylalanine, Urea cycle. Integration of carbohydrate, lipid and protein metabolism, ketogenesis.

Nucleotide metabolism

Purine and pyrimidine biosynthesis and degradation.

References

1. Nelson and Cox. Lehninger 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, Brooks/Cole, Cengage Learning, 2016.
7. Christopher K. Mathews, K.E. Van Hole, Kevin G. Ahern Biochemistry 3rd edition. Pearson Education, Singapore, 2003.

PLANT BIOCHEMISTRY

L	T	P	C
5	0	0	5

Total Hours: 75

Objective

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

UNIT I

15 Hours

Photosynthesis

Ultrastructure of chloroplast - photosynthetic pigments, Light reaction, photo system I & II. Electron transport- photo phosphorylation.

UNIT II

15 Hours

Metabolism

CO₂ fixation and reduction - C₃ plants (Calvin cycle), C₄ plants (Hatch-Slack pathway), CAM plants (crassulacean acid metabolism), photo respiration.

UNIT III

15 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

15 Hours

Plant growth regulators

Plant growth regulators - chemistry, synthesis, physiological role of auxin, Gibberellin, Cytokinin, Ethylene and Abscisic acid.

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 Watter Heldt, 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.

MSU/2020-21/UG-Colleges/Part -III (B.Sc. Biochemistry)/Semester-V/Major Elective - I

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

Probability

Addition and Multiplication theorems, Theoretical distribution - Binomial Poisson and Normal distributions.

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. Indranil Saha, Bobby Paul, Essentials of Biostatistics & Research methodology, 3rd ed, Academic Publishers, 2020.

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, Benedict's method, glucose tolerance test, renal threshold for glucose, glycogen storage diseases, lactosuria, ketonemia and ketonuria.

UNIT II

12 hours

Disorders of lipid metabolism

Plasma lipids and lipoproteins - Hyper lipoproteinemia - types, LCAT deficiency, Hyper and Hypo cholesterolemia, lipidosis, Xanthomatosis, atherosclerosis and fatty liver.

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, Gout and Hypouricemia. Disorders of protein metabolism - proteinuria, fibrinogen, albumin, globulin and A/G ratio.

UNIT IV

12 Hours

Function tests

Liver and kidney function tests. Jaundice - types, clinical features, diagnostic tests - Vandenberg test, Fouchet's test, Hay's test and test for urobilinogen. Renal clearance - urea, uric acid and creatinine. Renal blood flow. Pancreatic function test.

Enzymes in clinical diagnosis

Isoenzymes - LDH, CPK, AST, ALT, Alkaline phosphatase, Acid phosphatase, Choline esterase, Amylase and Lipase. Electrophoretic pattern of isoenzymes in myocardial infarction, liver and muscular diseases.

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, 19th 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.

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.

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.

MSU/2020-21/UG-Colleges/Part -III (B.Sc. Biochemistry)/Semester-V/Major Elective-II

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

L	T	P	C
4	0	0	4

DIAGNOSTIC BIOCHEMISTRY

Objective

To enable students to acquire specialized knowledge and understanding of selected biochemistry diagnostic principles and methods.

Total Hours: 60

UNIT I

12 Hours

Clinical chemistry tests

Blood group, glycosylated haemoglobin, fructosamine, GTT, uric acid, Ca, P, Fe, Cu, 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) Brucella 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.

Blood Analysis

Blood tests in Blood bank, blood group and Rh factor, Coomb's test, Coagulation studies, Prothrombin test (PT), Partial Thromboplastin Time (PTT), Plasma fibrinogen. Test for amino acidurias - Test for phenyl ketonuria, DNPH test, Test for keto acids, cyanide nitroprusside test for cystinuria and homocystinuria.

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 Laboratory Technology- set of 2 volumes, 3 rd edition, Bhalani publishing House, 2014.

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

12 Hours

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)

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.

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 micro organisms - bacteria, archaeobacteria, 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.

Applications of microorganisms

Alcoholic fermentation by yeast and bacteria, Formation of methane, citrate, succinate, lactate, vinegar, cheese and wine. Anaerobic fermentation - production of acetone, 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.

ISOLATION AND CHARACTERIZATION OF BIOMOLECULES

L	T	P	C
0	0	3	2

1. Isolation and Estimation of DNA from animal tissue
2. Isolation and Estimation of RNA from yeast
3. Estimation of Iron from Plant sources
4. Estimation of Protein from Soya beans
5. Estimation of Carbohydrates from Wheat
6. Estimation of Chlorophyll content in leaves
7. Estimation of Vitamin C from Citrus Fruits
8. Estimation of fructose from fruit.
9. Separation of lipids by Thin Layer Chromatography
10. Separation of plant pigments by column chromatography

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.

CLINICAL BIOCHEMISTRY – I

L	T	P	C
0	0	3	2

Blood analysis

1. Estimation of blood sugar by King and Asatoor method
2. Estimation of blood urea by DAM method
3. Estimation of serum uric acid by Caraway method
4. Estimation of serum calcium by titrimetric method
5. Estimation of serum iron by Ramsay method
6. Estimation of serum phosphorus by Fiske and Subbarao method
7. Estimation of serum protein and A/G ratio by Biuret method
8. Estimation of serum cholesterol by Zak's method
9. 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.

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

References

1. Rodney F Boyer, 3rd edition, Modern Experimental Biochemistry, Pearson Education, 2002.
2. Varley, H., Gowenlock, A.H. and Hill, 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.

CELL AND MOLECULAR BIOLOGY

L	T	P	C
4	0	0	4

Objective

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

Total hours: 60

UNIT I

12 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

12 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

12 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

12 Hours

Transcription

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

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 arabinose operons.

References

1. Karp. Cell & Molecular Biology 8 th ed. 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 8 th (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.

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

Hormones - definition, classification, biosynthesis, circulation in blood, modification and degradation. Mechanism of hormone action, class I and Class II 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

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. Role of parathyroid hormone, calcitonin and calcitriol in maintaining calcium and phosphorus homeostasis. Hypo and hyper para thyroidism.

UNIT IV

12 Hours

Hormones of Pancreas

Hormones of the pancreas, islets of Langerhans - cell types, biosynthesis, mechanism of action and biological effects of insulin and glucagon. Gastro intestinal hormones.

Adrenal hormones

Biosynthesis, secretion, transport, biological effects, mechanism of action and excretion of adrenal cortical and medullary hormones. Pathophysiology of adrenal gland secretions. Biological effects of androgens and estrogens, ovarian cycle.

References

1. Shlomo Melmed 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.

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.

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. 7th ed., 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.

MSU/2020-21/UG-Colleges/Part -III (B.Sc. Biochemistry)/Semester-VI/Major Elective-I

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

Tissue culture

Plant tissue culture - Micro propagation and Somoclonal variation, Protoplast culture. Animal cell & Tissue culture - Primary culture, cell lines, In vitro fertilization & embryo transfer in humans.

UNIT II 12 Hours

Recombinant DNA technology

General principles, Salient features of cloning vectors, restriction enzymes. Types of cloning vector, plasmids, cosmids, M-13 phage, Macro & microinjection, particle bombardment, electroporation (Vector less mode).

UNIT III 12 Hours

Plant Biotechnology

Vectors for gene transfer (Ti, Ri Plasmids, Co integrate, intermediate & helper plasmids), binary vectors, viruses as vectors: gene transfer techniques using Agrobacterium, Selectable marker, reporter genes & promoters. Transgenic plants, crop improvement, resistance to herbicide, insects, pests & viruses.

UNIT IV 12 Hours

Animal Biotechnology

Genetic engineering in animals, animal viral vector & yeast vectors. Biotechnology of silkworm. Mapping of human genome, genetic engineering approaches for the correction of genetic disorder.

Microbial Biotechnology

Bioprocess - Basic principles of microbial growth. Types, design and operation of fermenters, Antifoaming devices & agents. Downstream processing, Oil spill clean-up by microbes, Biodegradable plastics, Bioleaching.

References

1. Ratledge and Kristiansen. Basic Biotechnology 3rd ed. Cambridge Univ. Press, 2006.
2. Gupta PK. Elements of Biotechnology, Rastogi Publication, 2nd ed., 2010.
3. Dale and von Schantz. From Genes to Genomes: Concepts and applications of DNA technology. 3rd ed. Wiley-Interscience, 2011.
4. Nicholls DTS. An Introduction to Genetic Engineering. 3rd ed. Cambridge Univ Press. 2008.
5. Glick and Pasternak. Molecular Biotechnology. 4 th ed. ASM Press, 2009.
6. Singh B.D. Biotechnology. Expanding horizons, 2004 Kalyani Publ.
7. Winnacker EL. From Genes to clones. 4 thed VCH Publ., 2003.
8. Watson et al. Recombinant DNA 3rd ed. Freeman, 2006.
9. Primrose, Twyman and Old. Principles of gene manipulation. 8 th ed. Wiley-Blackwell, 2016.
10. Smith. JE. Biotechnology. Cambridge Univ Press. 5 th ed., 2012.

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 spectrometry methods to a wide range of research.

Total Hour: 60

UNIT I

12 Hours

Genome maps

Types of Genome maps and their uses: High and low-resolution maps - Map elements, Polymorphic 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.

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, neural network, nearest neighbour method, tertiary structure prediction, threading, profile, contact potential and modelling.

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. 3 rd ed. Wiley 2002.
3. T.A. Brown. Genomes, 4 th ed, Garland Science, 2007.
4. Hartwell et al. 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.

DRUG BIOCHEMISTRY

L	T	P	C
4	0	0	4

Objective

To introduce the biochemical concept of drug absorption, drug action and drug transformation of common drugs.

Total Hours: 60

UNIT I

12 Hours

Drugs and receptor concept

Introduction to drugs, Classification of drugs, Passage of drugs across biological membrane; Absorption and distribution of drugs; Binding of drugs to plasma proteins. Drug receptor interaction, Binding forces in drug receptor interaction, types of receptors, receptor theories, isolation of receptors, consequences of drug receptor interaction.

UNIT II

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 III

12 Hours

Chemotherapy

Mode of action of sulphonamides, anti-metabolites of folate, purines and pyrimidines. Antibacterials - mode of action and resistance to penicillin, streptomycin, tetracycline and chloramphenicol. Antiviral, antimalarial and anti-TB drugs.

UNIT IV

12 Hours

Drugs acting on CNS and Cardiovascular system

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

Immunity to bacteria and viruses

Skin test; Mantoux and penicillin test. Resistant to tumors; NK cells; Tumour immune therapy; lymphoid tumours. Vaccination; Passive and active immunization; Recombinant vaccines; DNA vaccines. Benefits and adverse effects of vaccination. CD4 cell count in HIV infection.

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 Medicinal Chemistry, 4 th Edition, B.I. Waverly Pvt., 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), Lange Publishers, 2012.
7. Gareth Thomas, Fundamentals of Medicinal Chemistry, Wiley Blackwell Publishers, 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 Clinical Pharmacology, 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.

CLINICAL BIOCHEMISTRY – II

L	T	P	C
0	0	3	2

1. Qualitative analysis of normal constituents of urine
2. Qualitative analysis of abnormal constituents of urine
3. Estimation of urea from urine
4. Estimation of Creatinine from urine
5. Estimation of Chloride from urine
6. Estimation of phosphorus from urine
7. Estimation of calcium from urine
8. Determination of the titrable acidity and ammonia in urine

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. Ramnik Sood, 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.

IMMUNOLOGY AND MOLECULAR BIOLOGY TECHNIQUES

L	T	P	C
0	0	3	2

1. Dot ELISA technique
2. Widal test
3. VDRL test
Demonstration Experiments
4. Immunodiffusion - Ouchterlony
5. Immuno electrophoresis
6. Separation of proteins by SDS-PAGE
7. Western Blotting of protein
8. Separation of animal DNA by Agarose gel 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. Ramnik Sood, 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.

MICROBIAL TECHNIQUES

L	T	P	C
0	0	3	2

1. Simple staining
2. Negative staining
3. Gram staining
4. Acid fast staining
5. Microbial growth curve
6. Biochemical Characterization of Bacteria
 - a. Indole test
 - b. Methyl Red test
 - c. Triple Sugar Iron Agar test
 - d. Voges Proskauer test
 - e. Citrate Utilization test
 - f. Catalase test
 - g. Urease test
 - h. Oxidase test
 - i. Nitrate test

References

1. N Kannan, Lab Manual in General Microbiology - Palaniappa Brothers, 2000.
2. P Gunasekaran, Lab Manual in Microbiology - New Age International Pub, 2000.
3. Joanne Willey, Prescott's Microbiology, McGraw-Hill Education; 10th edition, 2016.
4. Michael Pelczar, Microbiology, McGraw Hill Education; 5th edition, 2001.
5. Kanai L Mukherjee, Medical Lab Technology - Vol I-III. Tata McGraw Hill Education India, 3rd edition, 2010.
6. Ramnik Sood, Textbook of Medical Lab Technology, Jaypee Brothers Medical Publishers (P) Ltd., 6th edition, 2009.

MSU/2020-21/UG - Colleges/Part - III (B.Sc.)/Allied Biochemistry – I

(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

Carbohydrates - classification, structure, occurrence & reaction & biological importance. Reducing and non-reducing sugar- Monosaccharides - glucose, fructose - structure & chemical reactions (Identification test). Disaccharides - sucrose, maltose, lactose - structure, function & properties. Polysaccharides - Homo & Hetero polysaccharides- reactions of starch and dextrin.

UNIT II

12 Hours

Lipids

Lipids - definition, classification & physical properties. Types of fatty acids - saturated & unsaturated fatty acids, PUFA (ω -3 & ω -6 fatty acids). Triacyl glycerol - chemistry and characterisation, Saponification number, iodine number, acid number, RM number. Steroids - Cholesterol – structure & function.

UNIT III

12 Hours

Amino acids, proteins and nucleic acids

Amino acids - classification, essential & non-essential amino acids. Proteins- classification of proteins, properties - solubility, denaturation, renaturation and biological importance. Purines, pyrimidines- structure & function, nucleotides, nucleosides. Nucleic acids - DNA - Double helical structure and biological importance. RNA - structure, types, function & biological importance.

UNIT IV

12 Hours

Acid bases and buffers

Concept of pH. Measurement of pH using pH meter. Concepts of acids, bases and buffers, Henderson - Hassel Bach equation. Centrifugation techniques - principles and applications Chromatography techniques - principle and application of paper chromatography, thin layer chromatography and gel filtration chromatography.

UNIT V

12 Hours

Spectroscopy and Electrophoresis techniques

Spectroscopy techniques - basic principles of light absorption and its transmittance - Beer-Lambert's law. Principles and applications of UV and Visible spectroscopy. Electrophoresis techniques - Principles, factors affecting migration rate, Techniques and applications of Agarose gel electrophoresis, PAGE and SDS-PAGE.

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 Lubert Stryer. 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. New York: 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 Wesley Longman, 2000.

ANALYSIS OF BIOMOLECULES – I

L	T	P	C
0	0	2	2

1. Qualitative analysis of carbohydrates:
 - i. Analysis of monosaccharides – pentose, glucose, fructose
 - ii. Analysis of disaccharides – sucrose, maltose and lactose Analysis of polysaccharides – starch.
2. Qualitative analysis of amino acids.
 - i. 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 edible oils.
5. Determination of saponification number of edible oils.
6. Determination of acid number of edible oils.

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.

MSU/2020-21/UG - Colleges/Part - III (B.Sc.)/Allied Biochemistry - II

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

BIOCHEMISTRY

L	T	P	C
4	0	0	3

Total hours: 60

UNIT I

12 Hours

Enzymes - general characteristics, classification, definition with examples. Holoenzyme, apoenzyme, coenzyme, unit of enzymes. Definition of IU, katal, Enzyme turn over number and specific enzyme activity. Multienzyme complexes - Fatty acid synthase complex. Mechanism of enzyme action: Active site, Role of cofactors in enzyme catalysis NAD/NADP, FMN/FAD, coenzyme A, pyridoxal phosphate.

UNIT II

12 Hours

Enzyme kinetics: Factors affecting enzyme activity - enzyme concentration, substrate concentration, pH and Temperature. Deviation of Michaelis Menten equation for unisubstrate reactions. Km and its significance. Lineweaver-Burk plot. Enzyme inhibition; reversible and irreversible inhibition, competitive inhibition, non-competitive and un competitive inhibition (deviation not required). Isoenzymes and their medical application.

UNIT III

12 Hours

General introduction to metabolism: carbohydrate metabolism - glycolysis, oxidation of pyruvate to acetyl co A. TCA cycle, pentose phosphate pathway, glycogen metabolism (Structure not required) Lipid metabolism; sources of lipids, oxidation of fatty acid, β -oxidation role of carnitine in β -oxidation. Biosynthesis of saturated fatty acid- synthesis of palmitic acid.

UNIT IV

12 Hours

Electron transport chain and its significance, inhibitors of ETC, oxidative phosphorylation - chemiosmotic theory, site of oxidative phosphorylation. P/O ratio, inhibitors and uncouplers of oxidative phosphorylation. Purine and Pyrimidine biosynthesis and degradation.

Amino acid metabolism Transamination, deamination and decarboxylation of amino acids. Metabolism of glycine, tryptophan, lysine. Urea cycle, ketogenesis.

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. Lubert Stryer, Biochemistry, 9th ed, Worth Publications, 2019.
10. <https://nptel.ac.in/courses/102/102/102102033> - Enzymes.

ANALYSIS OF BIOMOLECULES – II

L	T	P	C
0	0	2	2

1. Isolation and Estimation of DNA (Animal tissue, Plant tissue sources)
2. Isolation and 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
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.