ANNAMALAI UNIVERSITY
MASTER OF SCIENCE
(2020-2021)

M.Sc. BIOCHEMISTRY

PREAMBLE

PG : Course profile and syllabi of courses offered in semester I to IV along with its evaluation components (With effect from 2020 – 2023 batch onwards) are presented in this booklet.

PROGRAMME PROFILE M.Sc. (Bio Chemistry)

COURSE OUTCOMES:

1. Be able to design and Contact Scientific experiments and analyzing the resulting data.
2. Able to work as a member of team.
3. Be knowledge in classical laboratory techniques and be able to use modern instrumentation.
4. Knowledgable of ethical practicals in science.
5. Be able to access search and use the chemical literature.
   Target suills for lead scientific anticles & critical understanding of the contacts. Spouen & written presentation of scientific tapics & research results.

PROGRAMME SPECIFIC OUTCOME

1. Acquire knowledge and skills to undertake a career in research in an academic setup.
2. Apply the knowledge of experimental approaches to save problems of a chemical nature & ability to entered that knowledge to the solution.
3. Drug development and synthesize the knowledge & apply the same for multitude of laboratory applications.
4. Understand and apply the concepts of life Sources, empower the technical knowledge know & practical hands-on braining in the field.
5. Its academic, research, industrial & pharmaceutical applications.

PROGRAMME OUTCOME

1. The students achieved for best computational performance in a specific context.
2. They cultivate the highest level of learning and technological key outcomes.

3. We were choose social welfare oriented skill based subject and its applications in biology, helps to the students & social welfare.
4. We were organizing many extension activities live internship programme, industrial visit, hands on training workshop, project oriented instrumentation programmes. It exposes the students for job opportunity and individual talents.
5. These competence of a course possess upon achieved for course specific goals

The Course of Study and the Scheme of Examination

Sl. No.	*Study Components*		*ins. hrs / week*	*Credit*	*Title of the Paper*	*Maximum Marks*		
	Course Title					*CIA*	*Uni. Exam*	*Total*
SEMESTER I								
1	Core Practical	Paper 1	5	4	Advances in cell biology	25	75	100
2		Paper 2	5	4	Chemistry of Biomolecules	25	75	100
3		Paper 3	5	3	Human physiology	25	75	100
4			4		Isolation and characterization techniques and quantitative analysis.			
5			5		Molecular biology and microbial techniques			
Internal Elective for same major students (Choose any one)								
	Core Elective	**Paper-1**	3	3	A. Pharmaceutical Biochemistry B. Plant Biochemistry C. Cancer Biology	25	75	100
External Elective for other major students (Inter/multi disciplinary papers)								
	Open Elective	**Paper-1**	3	3	A. Bioinstrumentation B. Developmental Biology C. Nanoscience and Technology	25	75	100
			30	**17**		**125**	**375**	**500**
SEMESTER II						*CIA*	*Uni. Exam*	*Total*
	Core Practical	Paper 4	4	4	Analytical Biochemistry	25	75	100
		Paper 5	4	4	Molecular Biology	25	75	100
		Paper 6	4	4	Metabolic Regulation and Disorders	25	75	100
		Paper 1	4	3	Isolation ,Characterization Techniques and Quantitative Analysis,	25	75	100
		Paper 2	4	3	Molecular Biology and Microbiology Practical	25	75	100
Internal Elective For Same Major Students (Choose Any One)								
	Core Elective	**Paper-2**	4	3	A. Microbiology B. Bioinformatics C.Biochemical and Environmental Toxicology	25	75	100

External Elective for other major students (Inter/multi disciplinary papers)								
	Open Elective	**Paper-2**	4	3	A. Herbal Medicine B. Herbal Drug Development C. Organic Farming	25	75	100
	***Field Study**		-	2	Summer internship/PG Service learning/Experiential learning/industrial visit	100	-	100
	Compulsory Paper		2	2	**Human Rights & Duties**	25	75	100
			30	**28**		**300**	**600**	**900**

*** Field Study**

There will be field study which is compulsory in the first semester of all PG courses with 2 credits. This field study should be related to the subject concerned with social impact. Field and Topic should be registered by the students in the first semester of their study along with the name of a mentor before the end of the month of August. The report with problem identification and proposed solution should be written in not less than 25 pages in a standard format and it should be submitted at the end of second semester. The period for undergoing the field study is 30 hours beyond the instructional hours of the respective programme. Students shall consult their mentors within campus and experts outside the campus for selecting the field and topic of the field study. The following members may be nominated for confirming the topic and evaluating the field study report.

(i). Head of the respective department

(ii). Mentor

(iii). One faculty from other department

SEMESTER I

Core Paper 1

Advances in cell biology

Course objectives

1. To study the structure and function of cells
2. To understand about extracellular matrix and cell communication.
3. To Understanding the function of intracellular organelles
4. Understanding the function of cell cycle mechanism
5. Understanding the Division of cells and Cell Death
6. To study the concepts of cell signaling.

Unit-I: Structure and function of cells & Transport mechanism

Structure and function of cells–prokaryotes and eukaryotes, difference**,** Structure and organization of membrane – structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active & passive transport, ion pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes. Extracellular matrix, cell-cell communication.

Unit–II: Cell components, cell division & cell death

Plasma membrane, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility and cell division: amitosis mitosis; meiosis and genetic recombination; Cell cycle and cancer: Control of the cell cycle-cyclins and CDKs,regulation of cell cycle; factors and genes regulating cell cycle. Mechanisms of cell death: apoptosis; necrosis and autophagy.

UNIT-III Cytoskeletal network

Microfilaments - Action – Structures, Assembly, Myosin, Microtubules - Organisation And dynamics, Kinesin and dynem, Cilia and Flagella - Structure and functions, Intermediary fi1aments. Striated muscle - structure, excitation - contraction.

UNIT-IV Cell-cell and Cell-matrix adhesion

Cell junctions – Anchoring , tight and gap junctions, Adhesion molecules – selectins, cadherins, integrins, immunoglobulin superfamily. Cell-Cell, interaction:- ECM; Collagen, hyaluronan, proteoglycans, laminin, integrins and fibronectins. Carbohydrates - cell surface carbohydrates - lectins, selectins. Blood group antigens.

UNIT-V Cell signaling

Cell signaling – signaling molecules and their receptor, functions of cell surface receptor, pathways of intra cellular signal transduction, second messengers, G protein coupled receptors, receptor tyrosine kinases, Ras, MAP kinase.

Unit 1

P.S.Verma,V.K.Agarwal,Cell Biology.

Unit 2

Cooper,G.M. and Hausman,R.E. 2013. The Cell: A Molecular Approach, 6th Edition, Sinauer Associates, Inc.

Unit 3

P.S.Verma,V.K.Agarwal,Cell Biology.

Unit 4

Cooper,G.M. and Hausman,R.E. 2013. The Cell: A Molecular Approach, 6th Edition, Sinauer Associates, Inc.

Unit 5

Cooper,G.M. and Hausman,R.E. 2013. The Cell: A Molecular Approach, 6th Edition, Sinauer Associates, Inc.

REFERENCES:

1. Cell and Molecular Biology. De Robertis and De Robertis. Lea and Febiger 8th ed (1987).
2. Molecular Biology of the Cell - Alberts , 4th ed. Garland Sci. 2002.
3. Molecular Biology of the Cell – 2014 by Bruce Alberts, Alexander D. Johnson, Julian Lewis, David Morgan, Martin Raff, and Keith Roberts; Publisher: W. W. Norton & Company; 6 edition.
4. Molecular Biology of the Gene – 2017 by James D. Watson, A. Baker Tania, P. Bell Stephen, Gann Alexander, Levine Michael and Losick Richard; Publisher: Pearson Education; Seventh edition.
5. Cell Biology – 2013 by Gerald Karp; Publisher: Wiley; Seventh edition.
6. Advances in Cell Biology: Volume 2, 2013 by David M. Prescott; Publisher: Springer; Softcover reprint of the original 1st ed. 1971 edition.
7. The Cell: A Molecular Approach -2013 by Geoffrey M. Cooper, and Robert E. Hausman; Publisher: Sinauer Associates Inc; 6th edition.
8. Cell Biology" by Channarayappa
9. Molecular Cell Biology" by Harvey Lodish and Arnold Berk
10. 10. Cell Biology" by Kimball T W
11. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology" by Verma P S and Agarwal V K
12. Cell Biology" by Gerald Karp

E-Materials

1. https://msu.edu/~potters6/te801/Biology/biounits/cellstructure&function.htm
2. https://www.khanacademy.org/science/biology/cell-signaling/mechanisms-of-cell-signaling/a/introduction-to-cell-signaling
3. https://www.khanacademy.org/test-prep/mcat/cells/transport-across-a-cell-membrane/a/passive-transport-and-active-transport-across-a-cell-membrane-article
4. http://www.edu.pe.ca/gray/class_pages/rcfleming/cells/notes.html
5. https://en.wikipedia.org/wiki/Cell_cycle
6. https://en.wikipedia.org/wiki/Apoptosis
7. https://biologydictionary.net/microfilament/
8. https://en.wikipedia.org/wiki/Intermediate_filament
9. https://www.microscopemaster.com/cilia-and-flagella.html
10. https://en.wikipedia.org/wiki/Striated_muscle_tissue
11. https://en.wikipedia.org/wiki/Cell_junction
12. https://en.wikipedia.org/wiki/Cell%E2%80%93cell_interaction
13. https://www.ncbi.nlm.nih.gov/books/NBK2264/

14. https://courses.lumenlearning.com/suny-wmopen-biology1/chapter/signaling-molecules-and-cellular-receptors/
15. https://en.wikipedia.org/wiki/G_protein-coupled_receptor
16. .http://www.biolchem.ucla.edu/labs/Tim_Lane/CourseMBI297PTKmaterials/PTKfiles/Wk1_2REV_Schlessinger2000.pdf.

Course Outcome:

1. **After studied unit- 1,** the student will be able to
    - Get Knowledge on Structure and function of prokaryotic and eukaryotic cells
    - understand the structure and functions of cells and transport across membrane.
    - Aware of structure of model membrane
    - Well versed on Extracellular matrix, cell-cell communication.
    - Familiar with Sorting and regulation of intracellular transport.

2. **After studied unit- 2**, the student will be able to
    - advance their knowledge in cell cycle events
    - familiar with regulation of cell cycle at molecular level
    - Understand the mechanisms of cell death.
    - Get knowledge on Cell components
    - Get well versed with the mechanism of cancer cells.
3. **After studied unit- 3**, the student will be able to
    - Understand of structure and functions of cytoskeleton.
    - Well versed on Microfilaments –Actin and myosin
    - Familiar with organization and dynamics of microtubules
    - Get knowledge on intermediary filaments.
    - Aware of contraction and excitation of striated muscles
4. **After studied unit- 4**, the student will be able
    - to understand cell junctions
    - Familiar with cell adhesion molecules
    - Well versed with cell-cell interaction
    - Aware of importance of ECM
    - Comprehend the value of blood group antigens
5. **5.After studied unit- 5**, the student will be able to
    - understand of cell signaling process
    - knowledge on signaling molecules
    - get familiar with cell surface receptors and its function
    - comprehend the pathways of intra cellular signal transduction
    - aware of secondary messengers

SEMESTER I

Core Paper 2

Chemistry of Biomolecules

Course objectives:

1. This course emphasizes on various Biomolecules and its significance.
2. To enable students the biological importance of lifeless chemical compounds.
3. To enable the students to learn the basic functions and structures of Biomolecules
4. On successful completion of the course the students should have understood the significance of the complex bio-molecules, polysaccharides, lipids and proteins.
5. To enable the students to learn the basic functions, structures and biological importance of nucleic acids and porphyrins.
6. To study the structure and functions of vitamins and minerals.

Unit- I: Water and Carbohydrates

Water - Unique properties, weak interactions in aqueous systems, ionization of water, buffers. Classification, chemical properties of carbohydrates, Chemistry and biological roles of homo and heteropolysaccharides. Structural elucidation of polysaccharides; Oligosaccharides – lectin interaction in biochemical processes. Structure and role of proteoglycans, glycoproteins and glycolipids (gangliosides and lipopolysaccharides).

Unit-II: Lipids

Classification of Lipids, Biological significance of lipids, Fatty acids and their physiochemical properties. Structure and properties of Prostaglandins. Storage lipids - triacyl glycerol and waxes. Structural lipids in membranes – glycerophospholipids, galactolipids and sulpholipids, sphingolipids and sterols, structure, distribution and role of membrane lipids. Lipids as signals, cofactors and pigments.

Unit-III: Amino acids and Proteins

Amino acids–classification, structure and physiochemical properties,chemical synthesis of peptides – solid phase peptide synthesis. Proteins – classification, purification, and criteria of homogeneity. Structural organization, sequence determination and characterization of proteins. Conformation of proteins – Ramachandran plots. Denaturation of proteins. Apoprotein and Prosthetic group- Porphyrins – Structure and properties of porphyrins – heme, Chlorophyll and Cytochromes.

Unit-IV Nucleic acids

Nucleotides- structure and properties, physicochemical properties of
nucleicacids, cleavage of nucleic acids by enzymatic methods, non – enzymatic transformation of nucleotides and nucleic acids, methylation, Sequencing, chemical synthesis of DNA. Three dimensional structure of DNA. Different forms of DNA – circular DNA and Supercoiling. Types of RNA mRNA,tRNA, rRNA, Sn RNA,Si RNA,Hn RNA. Structure of t-RNA. Nucleotides as source of energy, component of coenzymes, second messengers.

UNIT-Vitamins and Porphyrins

Water soluble - thiamine, riboflavin, niacin, pyridoxine, folic acid, ascorbic acid sources, structure, biochemical functions, deficiency diseases, daily requirements. Fat soluble - vitamin A, vitamin D2, vitamin E and vitamin K - sources, structure, biochemical functions, deficiency diseases, daily requirements. Porphyrins the porphyrin ring system, chlorophyll, hemoglobin, myoglobin and cytochrome.

Text Books

Unit-1

Nelson,D.L. and Cox,M.M. 2013**.** Lehninger Principles of Biochemistry, 6th Edition, W.H. Freeman & Co.

Unit-2

Berg,J.M. *et al*., 2012. Biochemistry, 7th Edition, W. H. Freeman & Co.

Unit-3

Biochemistry" by L Stryer

Unit-4

Biochemistry" by V Voet and J G Voet

Unit-5

Biochemistry" by L Stryer

REFERENCES:

1. Voet,D. *et al.,* 2012. Fundamentals of Biochemistry: Life at the Molecular level, 4th Edition, John Wiley and Sons.

2. Zubay,G.L. 1998. Biochemistry, Wm.C. Brown Publishers.

3. Sinden,S.R. DNA structure and function, First Edition, Academic Press, 1994.

4. Carl Branden and John Tooze, Introduction to Protein Structure, Second Edition, Garland Publishing, 1999.

5. Garrett,R. and Grisham,C. 2010. Biochemistry, 4th Edition, Saunders College Publishing.

6 .Chemistry of Biomolecules" by R J Simond

7. "Biomolecules: Chemistry of Living System" by VK Ahluwalia

8. Cell Biology (Cytology, Biomolecules and Molecular Biology)" by Verma P S and Agarwal V K

9.Text book of Biochemistry with clinical correlations by Thomas.M.Devlin,John Wileyliss,Hobokhen NJ Publishers 2006

10.Biochemistry And Molecular Biology Of Antimicrobial Drug Action, 6th Edition Paperback – 2005. by FRANKLIN T.J. ET. AL (Author) ...

E-Materials

1. https://biochimia.usmf.md/sites/default/files/inline-files/Lesson-2-Water.pdf
2. https://www.tuscany-diet.net/carbohydrates/classification-functions/
3. https://www.sciencedirect.com/topics/chemistry/glycoprotein
4. https://byjus.com/biology/lipids/
5. https://chem.libretexts.org/Bookshelves/Biological_Chemistry/Supplemental_Modules_(Biological_Chemistry)/Lipids/Fatty_Acids/Prostaglandins
6. https://en.wikipedia.org/wiki/Membrane_lipid
7. https://www.britannica.com/science/protein/Physicochemical-properties-of-the-amino-acids
8. https://www.britannica.com/science/porphyrin
9. http://www.sakshieducation.com/CSIR/Story.aspx?nid=74427
10. https://www.news-medical.net/life-sciences/-Types-of-RNA-mRNA-rRNA-and-tRNA.aspx
11. https://homepages.rpi.edu/~bellos/new_page_1.htm
12. https://www.chemistryworld.com/features/step-by-step-synthesis-of-dna/3008753.article
13. https://www.healthline.com/nutrition/water-soluble-vitamins#b1
14. https://www.healthline.com/nutrition/fat-soluble-vitamins
15. http://nsdl.niscair.res.in/jspui/bitstream/123456789/762/1/Porphyrins.pdf

Course Outcome

1.After studied unit -1, the student will be able

- understand about the properties of water and buffers.
- knowledge on polysaccharides and its types.
- get familiar with structural elucidation of polysaccharides
- Well versed with proteoglycans, glycoproteins and glycolipids
- aware of oligosaccharides an its interaction in biochemical process

2.After studied unit -2, the student will be able to

- gives a clear understanding about the classifications and biological significanceof lipids.
- Well versed on Fatty acids and their physiochemical properties.
- Get familiar with Structure and properties of Prostaglandins
- Aware of structure, distribution and role of lipids in membranes
- Well known with Lipids as signals, cofactors and pigments.

3.After studied unit -3, the student will be able to

- Clear Knowledge regarding classification and structure of amino acids.
- Familiar with chemical synthesis of peptides.
- Get aware of protein characterization.
- Well known with Conformation of proteins and Ramachandran Plot.
- Understand the porphyrin sand its importance in biochemical reaction.

4.After studied unit -4, the student will be able to

- Understand the structure and properties of Nucleic acids.
- Well known with enzymatic methods for cleavage of nucleic acid.
- Well versed with chemical synthesis of DNA

- Understand the different forms of DNA
- Get aware of types of RNA and its function.

5.After studied unit -5, the student will be able to

- Get an idea about structure and functions of vitamins
- Well known with sources and Daily requirements of various vitamins
- Knowledge of structure and functions of porphyrins
- Aware of Deficiency of vitamins and porphyrins .
- Well versed with Biochemical important porphyrins hemoglobin and chlorophyll

SEMESTER I

Core Paper 3

HUMAN PHYSIOLOGY

Course Objectives

1. This course provides a comprehensive, balanced introduction to this exciting, evolving and multi-disciplinary field.

2. To understand the circulatory cells, blood and its components.

3. To enable the students to learn or to know the biological, physiological activities of various organs.

4. To understand the functions, anatomy, histology of each organ systems.

5. To understand ho the body works and explains the mechanisms.

6. To understand in depth knowledge of main structure composing human body

Unit-I: Blood and its components

Composition, types and functions of blood and plasma. Blood volume, blood volume regulation, immunity, homeostasis, blood groups. Haemopoiesis. Blood coagulation - mechanism, fibrinolysis, anticoagulants. Hemoglobin - structure, abnormal types, anemia, Blood corpuscles.

Unit-II: Anatomy of heart and functions of sense organs

Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation of all above. Sense organs – Vision, hearing and tactile response.

Unit-III: Digestive and Excretory system

Digestive secretions - composition, functions and regulation of saliva,gastric, pancreatic, intestinal and bile secretions. Digestions and absorption of carbohydrates, lipids, proteins and nucleic acids. Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, electrolyte balance, acid-base balance.

Unit-IV: Respiratory and nervous system

Comparison of respiration in different species, anatomical considerations,transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration. Neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture. Muscle physiology.

Unit-V: Endocrine system

Secretion and functions of hormones of thyroid, pituitary and gonads. Role of hormones in reproduction and pregnancy. Mechanism of action of hormones.

Text Books

Unit-1: 1. Guyton,A.C. and Hall,J.E. 1996. Human Physiology and Mechanisms of Disease, 6th
Edition, Saunders.
Unit-2: Chatterjee,C.C. 1985. Human Physiology, 11th Edition. Medical Allied Agency.

Unit-3: Bipin Kumar. 2001. Human Physiology. Campus Book International, New Delhi.

Unit-4: Guyton,A.C. and Hall,J.E. 1996. Human Physiology and Mechanisms of Disease, 6th
Edition, Saunders.
Unit-5: Chatterjee,C.C. 1985. Human Physiology, 11th Edition. Medical Allied Agency.

REFERENCE

1. Ganong,W.F. 2005. Review of Medical Physiology, 22nd Edition, McGraw-Hill.
2. Vander,A.J. *et al*., 1981. Human Physiology: Tata Mc Graw Hill Publishing Co., New Delhi.
3. Chaudhuri,S.K. 2006. Concise Medical Physiology, New central Book Agency.
4. Principles of Biochemistry- Smith et al. Mammalian Biochemistry. McGraw Hill 7th ed. (for unit 3, unit 4) 1983.
5. Guyton, A. C. and Hall, J. E. 2006. Textbook of Medical Physiology. 11th Edition. Saunders, Philadelphia. USA.
6. Martini, F.H. and Nath, J. L. 2009. Fundamentals of Anatomy & Physiology. Pearson Benjamin Cummings. USA.
7. Bipin Kumar. 2001. Human Physiology. Campus Book International, New Delhi.
8. Essentials of Medical Physiology by Sembulingam
9. Handbook Of Human Physiology by Vidya Ratan
10. Human Physiology and Mechanisms of Disease by Arthur C Guyton

E- Materials

1. https://healthengine.com.au/info/blood-function-and-composition
2. https://www.medicalnewstoday.com/articles/319544#hematopoiesis-and-health
3. https://www.sciencedirect.com/topics/chemistry/hemoglobin
4. https://www.webmd.com/heart/picture-of-the-heart#1
5. https://www.healio.com/cardiology/learn-the-heart/ecg-review/ecg-interpretation-tutorial/introduction-to-the-ecg
6. https://www.livescience.com/60752-human-senses.html
7. https://www.britannica.com/science/human-digestive-system/Secretions
8. https://opentextbc.ca/biology/chapter/15-3-digestive-system-processes/
9. https://www.britannica.com/science/excretion
10. https://en.wikibooks.org/wiki/Human_Physiology/The_Muscular_System
11. https://www.britannica.com/science/nervous-system
12. https://healthengine.com.au/info/respiratory-system
13. https://courses.lumenlearning.com/boundless-ap/chapter/hormones/
14. https://www.yourhormones.info/students/topics/hormones-in-human-reproduction/
15. https://www.webmd.com/diabetes/endocrine-system-facts

Course Out Comes

1. **After studied unit-1,** the student will be able to
    - Obtain a deep knowledge regarding blood and its components.
    - Get to know about the haemopoiesis.
    - Get a well versed knowledge on coagulation of blood.
    - Aware of various types of blood groups and its significance
    - Attain an information on Blood corpuscles

2. **After studied unit-2,** the student will be able to
    - know about heart and its regulation.
    - Conclude about the cardiac cycle and anatomy of heart structure
    - Interpret ECG – its principle and significance
    - Infer blood pressure and its complications
    - Understand various sense organs

3. **After studied unit-3,** the student will be able to
    - describe composition, functions and regulation of digestive secretion
    - get well versed on Digestions and absorption of carbohydrates, lipids, proteins and nucleic acids.
    - Infer the mechanism of Urine formation
    - Express the Comparative physiology of excretion in kidneyurine concentration,
    - Fet familiar with regulation of water, electrolyte and acid-base balance.

4. **After studied unit-4,** the student will be able to
    - obtain an insight about respiration in different species
    - Comparison of respiration in different species
    - Well versed in transport and exchange of gases
    - Get familiar with Neurons and gross neuroanatomy of the brain and spinal cord.
    - Get knowledge on Muscle physiology.

5. **After studied unit-5,** the student will be able to
    - provide knowledge about Hormone and its regulation
    - know about Role of hormones in reproduction and pregnancy.
    - Give insight into Mechanism of action of hormones.
    - Get familiar with Thyroid hormones .
    - Get knowledge on Muscle physiology.

SEMESTER I

CORE ELECTIVE

PAPER 1

(Choose any one out of the given 3)

A. PHARMACEUTICAL BIOCHEMISTRY

Course Objectives

1. The main objective of the course is to understand pharmacokinetics
2. It helps the students understanding the pharmascience in a variety of applications in drug therapy.
3. It helps students to understand the metabolism of drug
4. Students are able to understand the adverse reactions to drugs and its complications.
5. It describes the mechanism of action and effect of drugs
6. It gives an idea about chemotherapy and management of drug abuse

UNIT-I: General Principles: Basic principles of drug action-Pharmacokinetics: Absorption, distribution and elimination of drugs, routes of drug administration. Pharmacokinetics. Origin of drug from plants and animals.

UNIT-II: Drug metabolism – general pathways of drug metabolism (different types of reaction in phase I and phase II with examples), metabolism and excretion of drugs. Mechanism of drug action, combined effect of drugs. Factors modifying drug action, tolerance and dependence.

UNIT-III

Pharmacodynamics - receptor concepts, theory, drug receptor interaction (DRI), Factors affecting DRI, Cholinergic and anticholinergic drugs, Adrenergic and adrenergic blockers, General anesthetics, Local anesthetics. Adverse reactions to drugs and common drug receptor interactions.

UNIT-IV

Mechanism of action of drugs used in therapy of: Respiratory system – cough, bronchial – asthma, pulmonary tuberculosis. GIT – Digestants, appetite suppressants. Hypolipidemia agents, vomiting, constipation and peptic ulcer.

UNIT-V

Drugs of plant origin: Drug dependence and abuse – Management of self poisoning cancer. Chemotherapy – Cytotoxic drug. Immuno suppressive drug therapy. New Biological Targets for Drug Development. Novel Drug Screening Strategies.

Text Books

Unit-1:

Basic pharmacology- Foxtercox Bulter Worth's, 1980.

Unit-2

The pharmacology Vol I and II- Goodman And Gillman, Mc Graw Hill

Unit-3

Basic pharmacology- Foxtercox Bulter Worth's, 1980.

Unit-4

The pharmacology Vol I and II- Goodman And Gillman, Mc Graw Hill

Unit-5

Essentials of Pharmaceutical Biochemistry, by Harbans Lal (Author)

References:

1. Pharmacology and pharmacotherapeutics- R.S.Satoskar. S.D.Bhandhakar & S.S.Anilapure Popular Prakashar Bombay.
2. Principles of medicinal chemistry- William O. Foge.B.I. Waverks Pvt Ltd, New Delhi.
3. Oxford textbook of clinical pharmacology and drug therapy. D.G. Burger's medicinal Chemistry & Drug Discovery.
4. Principles and practice- Manfred.E. Wolf John Wiley and sons
5. Pv pharmaceutical biochemistry textbook binding – 2017 By S.S Haque S.S Randhawa
6. Biochemistry For The Pharmaceutical Sciences Paperback – Import, 29 Mar 2011 by Charles P. Woodbury Jr. (Author)
7. Pharmaceutical Biochemistry,**Vyas S. P** and D.V.Kohli **1st edition (1 December 2009)**
8. Pharmaceutical Chemistry - I Kindle Edition by Dr. A. V. Kasture (Author), Late Dr. S. G. Wadodkar (Author)
9. Shargel,L. et al., 2012. Applied Biopharmaceutics and Pharmacokinetics, 6th Edition, McGraw-Hill Medical,
10. Foreman,J.C. and Johansen,T.J. 1996. Text Book of Receptor Pharmacology,2nd Edition, CRC Press

E- Materials

1. https://www.sciencedirect.com/topics/neuroscience/pharmacokinetics
2. https://www.genelex.com/what-is-pharmacogenetics/
3. https://www.merckmanuals.com/home/drugs/administration-and-kinetics-of-drugs/drug-metabolism
4. https://www.sciencedirect.com/science/article/pii/B9780323481106000016
5. https://link.springer.com/chapter/10.1007/978-3-662-38180-9_3
6. https://www.msdmanuals.com/professional/clinical-pharmacology/pharmacodynamics/overview-of-pharmacodynamics
7. https://www.pharmacologyeducation.org/drugs/anaesthetic-drugs
8. https://www.pharmacologyeducation.org/clinical-pharmacology/adverse-drug-reactions
9. https://doctorlib.info/pharmacology/illustrated/31.html

10. https://doctorlib.info/pharmacology/illustrated/32.html
11. https://en.wikiversity.org/wiki/Pharmacology/Gastrointestinal_tract
12. https://www.pharmacologyeducation.org/drugs/respiratory-system
13. https://en.wikipedia.org/wiki/Drug_development
14. https://www.webmd.com/mental-health/addiction/drug-abuse-addiction#1
15. https://www.healthline.com/health/chemotherapy

Course Out Comes

1. **After studied unit-1,** the student will be able to
    - understand about the pharmacokinetics
    - Relate mechanism and origin of drug from plant and animals.
    - Recount the Absorption of drugs
    - Describe Distribution and elimination of drugs
    - Portray Various routes of drug administration
2. **After studied unit-2,** the student will be able to
    - to understand metabolism of drugs,
    - get knowledge on excretion of drugs
    - elucidate mechanism of drug action
    - know the combined effect of drugs
    - well versed with factors modifying drug action, tolerance and dependence.

3. **After studied unit-3,** the student will be able to
    - Get clear idea on Pharmacodynamics
    - Aware of General and local anesthetics and common drug receptor interactions
    - Elucidate Drug receptor interaction and factors affecting DRI
    - get A Clear Knowledge regarding Cholinergic and anticholinergic drugs.
    - Familiar with Adverse reactions to drugs.

4. **After studied unit-4,** the student will be able to
    - Provides an idea on mechanism of action of drugs used in therapy of various diseases- Respiratory and GI Tract
    - Get an overview on Hypolipidemia agents
5. **After studied unit-5,** the student will be able to
    - note about drug dependence
    - aware of drug abuse and its management.
    - Describe Novel Drug Screening Strategies .
    - Familiar with management of self poisoning, cancer
    - Get knowledge on chemotherapy

CORE ELECTIVE

PAPER 1

B. PLANT BIOCHEMISTRY

Course objectives:

1. This course presents an Introduction and provides a comprehensive, balanced introduction to this exciting, evolving and multi-disciplinary field.
2. To enable the students to learn or to know the aspects of photosynthesis.
3. To understand the concept of Nitrogen fixation process and interaction between assimilation and metabolism.
4. To understand the plant metabolism, nutrient absorption and its deficiency.
5. To be aware of various plant hormones and its roles.
6. To identify the process of Dormancy- Germination, Reproduction and budding process.

Unit-I: Photosynthesis

Photosynthesis –organization of thylakoid; role of photosynthetic pigments; light absorption and energy conservation. Light absorption by pigment molecules; the reaction centre complex. The photo systems I and II; cyclic and noncyclic photophosphorylation.Carbon reactions in C3, C4 and CAM plants - Calvin cycle; Hatch-Slack pathway. Pathways of glucose oxidation in plants; starch biosynthesis and degradation; Photorespiration: role of photorespiration in plants.

Unit-II: Nitrogen fixation

Nitrogen fixation – symbiotic and non-symbiotic. Symbiotic nitrogen fixation in legumes by Rhizobia-enzymology of nitrogen fixation; regulation of nif and nod genes of nitrogen fixation. Interaction between nitrate assimilation and carbon metabolism.

UNIT-III: Plant metabolism

Plant metabolism - carbohydrates, proteins, sugars, Transport in plants- Transpiration, Stomata, Mineral Nutrition - Biogeo cycles (Carbon, Nitrogen and Sulphur) Nutrient absorption and translocation, Nutrient functions in growth and development, Nutrient deficiency symptoms, toxicity problems.

UNIT-IV: Phytohormones

Phytohormones : Auxins, cytokinins, Gibberellins, ethylene- Structure, Physiological function and metabolism, Plant movement, apical dominance. Stomatal movements and morphogenesis. Photoperiodism and vernalization – flower induction, initiation and development, action of phytohormones.

UNIT-V: Dormancy

Biological rhythm in plants, dormancy, seed germination, development and maturation, bud dormancy, floreign, senescence, aging. Plant defenses, environmental and genetic control. Secondary metabolites- structure and functions.

Text Books

Unit-1: Heldt,H.W. 2004. Plant Biochemistry, 3rd Edition, Academic Press.
Unit-2: Srivastava, H.S. (2006), Plant Physiology, Biochemistry and Biotechnology,Rastogi Publications, Meerut.

Unit-3: A Textbook of Plant Physiology, Biochemistry and Biotechnology" by S K Verma and Mohit Verma

Unit-4: Srivastava, H.S. (2006), Plant Physiology, Biochemistry and Biotechnology,Rastogi Publications, Meerut.

Unit-5: A Textbook of Plant Physiology, Biochemistry and Biotechnology" by S K Verma and Mohit Verma

Reference Books

1. Buchannan,B. *et al*, 2002. Biochemistry and Molecular Biology of Plants, 1st Edition, Wiley.
2. Chawla,H.S. (2004) Introduction to plant Biotechnology, Science Publishers, Plymouth,U.K.
3. Razdan, M.K. (2007), Introduction to Plant Tissue culture, II edition, Oxford and IBA Publications Co Pvt Ltd.
4. Dey, P.M. and Harborne, J.B. 1997. Plant Biochemistry, 1st Edition, Academic Press.
5. Lea, P.J. and Leegood, R.C. 1999. Plant Biochemistry and Molecular Biology, 2nd Edition, Wiley.
6. A Textbook of Plant Physiology, Biochemistry and Biotechnology" by S K Verma and Mohit Verma
7. The New Frontiers in Plant Biochemistry by T Akazawa and T Asahi
8. Introduction To Plant Biochemistry Paperback – 2005 by Goodwin / Mercer
9. Plant Biochemistry Hardcover – Import, 7 Oct 2004 by Hans-Walter Heldt Professor Em (Author), Birgit Piechulla (Author)
10. Introduction to Plant Physiology Hardcover – Import, 25 Nov 1998by William G. Hopkins

E- Materials

1. https://www.britannica.com/science/photosynthesis
2. http://www.biologydiscussion.com/photosynthesis/hatch-slack-c4-pathway-of-co2-fixation/51623
3. https://biodifferences.com/difference-between-photosystem-i-and-photosystem-ii.html
4. https://www.britannica.com/science/nitrogen-fixation
5. https://bio.libretexts.org/Bookshelves/Microbiology/Book%3A_Microbiology_(Boundless)/5%3A_Microbial_Metabolism/5.15%3A_Nitrogen_Fixation/5.15E%3A_Genetics_and_Regulation_of_N%E2%82%82_Fixation
6. https://link.springer.com/chapter/10.1007/978-3-662-04064-5_9
7. https://www.scitechnol.com/plant/plant-metabolism.php

8. http://landresources.montana.edu/nm/documents/NM9.pdf
9. https://www.cropnutrition.com/resource-library/how-vegetable-plant-roots-absorb-nutrients
10. http://www.plantcell.org/content/22/3/tpc.110.tt0310
11. https://biology4isc.weebly.com/plant-movement.html
12. https://www.britannica.com/science/photoperiodism
13. https://www.gardeningknowhow.com/garden-how-to/info/plant-dormancy.htm
14. https://www.apsnet.org/edcenter/disimpactmngmnt/topc/Pages/OverviewOfPlantDiseases.aspx
15. https://www.intechopen.com/books/secondary-metabolites-sources-and-applications/an-introductory-chapter-secondary-metabolites

Course Out Comes

1**. After studied unit-1,** the student will be able to

- know photosynthesis process
- understand the role of photosynthetic pigments
- aware of The photo systems I and II; cyclic and noncyclic photophosphorylation.
- Enumerate the Pathways of glucose oxidation in plants
- Know the role of photorespiration in plants.

2**. After studied unit-2,** the student will be able to

- Know about symbiotic and non-symbiotic nitrogen fixation in plants
- Realize the Interaction between nitrate assimilation and carbon metabolism.
- Well versed in symbiotic nitrogen fixation of legumes.
- Get familiar with regulation of nif and nod genes of nitrogen fixation
- Understand the enzymology of nitrogen fixation

3**. After studied unit-3,** the student will be able to

- know about various plant metabolic pathways and their significance
- explain the Transpiration and Biogeo cycles
- well versed in Nutrient absorption and translocation
- familiar with Nutrient functions in growth and development.
- Aware of Nutrient deficiency symptoms, toxicity problems.

4. **After studied unit-4,** the student will be able to

- learn about various types of plant hormones and their functions
- gain knowledge on Plant movement, apical dominance.
- Realize Stomatal movements and morphogenesis
- Discover more about Photoperiodism and vernalization.

- Gain familiarity with Flower induction, initiation and development

5. **After studied unit-5,** the student will be able to

- learn about dormancy and plant secondary metabolites..
- get well versed on Biological rhythm in plants
- identify the process of Dormancy- Germination, Reproduction and budding process.

- Get knowledge on Plant defenses, environmental and genetic control
- Aware of senescence, aging of plants.

CORE ELECTIVE

PAPER 1

C. CANCER BIOLOGY

Course objectives:

1. This course presents an Introduction and provides a comprehensive, balanced introduction to this exciting, evolving and multi-disciplinary field.
2. To enable the students to learn or to know the aspects of photosynthesis.
3. To understand the concept of Nitrogen fixation process and interaction between assimilation and metabolism.
4. To understand the plant metabolism, nutriet absorption and its deficiency.
5. To be aware of various plant hormones and its roles.
6. To identify the process of Dormancy- Germination, Reproduction and budding process.

UNIT-I

Introduction: Cancer cell-morphology and growth characteristics. Types of growth-hyperplasia,
dysplasia, anaplasia and neoplasia. Types and prevalence of cancer. Nomenclature of neoplasms, classification based on origin/organ.

UNIT-II

Epidemiology of cancer. Endocrinology of cancer. Agents causing cancer-radiation, viruses, chemicals. Multistep carcinogenesis: Initiation, Promotion, Progression. Paraneoplastic syndromes.

UNIT-III

Molecular mechanism of oncogenesis - proto oncogenesis, oncogene, oncoproteins, tumour suppressor genes involved in cancer. Free radicals and antioxidants in cancer. Diet and cancer.
Cell cycle and cancer: Control of the cell cycle-cyclins and CDKs

UNIT-IV

Apoptosis and cancer (Intrinsic and extrinsic pathways). Mechanism of apoptosis, signaling pathways. Types and their impact on apoptosis and oncogenesis. Principles and methods of cancer diagnosis-Biochemical, genetic, cytotoxic, cell growth and viability tests.

UNIT-V

Cancer therapy: Different forms of therapy, chemotherapy, radiation therapy, gene therapy, immune therapy, surgical therapy and biologic therapy. Principles of cancer biomarkers and their applications.

Text Books

Unit-1

The Biology of cancer of A new Approach by P R Burch

Unit-2

Franks,L.M. and Teich,N.M. 1991. An introduction to Cellular and Molecular Biology of cancer, 2nd Edition, Oxford University Press.

Unit -3

Vincent,T. *et al*., 2011. Principles and Practice of Oncology: Primer of the Molecular Biology of Cancer, 1st Edition, Lippincott Williams and Wilkins.

Unit -3 and Unit -5

Weinberg,R.A. 2013. The Biology of Cancer, 2nd Edition, Garland Science.

Reference Books

1. McKinnell, R.G. *et al*., 2006. The Biological Basis of Cancer, 2nd Edition, Cambridge University Press.
2. Pelengaris,S. and Khan,M. 2002. The Molecular Biology of Cancer, 2nd Edition, Wiley Blackwell.
3. Hesketh,R. 2013. Introduction to Cancer Biology, Cambridge University Press.
4. An Introduction To Cellular And Molecular Biology of Cancer" by Peter J Selby Margaret A Knowles

5.Principles of Cancer Biology" by Kleinsmith

6.The Biology of Cancer: A New Approach" by P R Burch

E-Materials:

1. https://www.ncbi.nlm.nih.gov/books/NBK9553/
2. https://accessmedicine.mhmedical.com/content.aspx?bookid=499&sectionid=41568284
3. https://www.wcrf.org/dietandcancer/cancer-trends/worldwide-cancer-data
4. https://webpath.med.utah.edu/NEOHTML/NEOPL103.html
5. https://en.wikipedia.org/wiki/Epidemiology_of_cancer
6. https://www.ncbi.nlm.nih.gov/pubmed/12734426
7. https://www.mayoclinic.org/diseases-conditions/paraneoplastic-syndromes/symptoms-causes/syc-20355687
8. https://www.ncbi.nlm.nih.gov/pubmed/18069259
9. https://en.wikipedia.org/wiki/Tumor_suppressor
10. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5666732/
11. https://en.wikipedia.org/wiki/Cyclin-dependent_kinase
12. http://www.remedypublications.com/open-access/exploiting-the-extrinsic-and-the-intrinsic-apoptotic-pathways-for-cancer-therapeutics-704.pdf
13. https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/cytotoxicity-test
14. https://www.webmd.com/cancer/immunotherapy-approach-19/basics/slideshow-cancer-treatments
15. https://en.wikipedia.org/wiki/Cancer_biomarker

Course Out Comes

1. **After studied unit-1, the student will be able to**
   - To know Cancer cell-morphology and growth characteristics.
   - Well versed with growth-hyperplasia.
   - Familiar with Types of cancer
   - Knowledge on Nomenclature of neoplasm.
   - Aware on prevalence of cancer .
2. **After studied unit-2, the student will be able to**
   - Knowledge on Epidemiology of cancer.
   - Familiar with radiation, viruses.
   - To know Multistep carcinogenesis
   - Aware on Paraneoplastic syndromes.
   - Well versed with Endocrinology of cancer

3. **After studied unit-3, the student will be able to**
   - Aware on oncogenesis
   - Knowledge on , tumour suppressor
   - To know antioxidants in cancer.
   - Well versed with Diet and cancer.
   - Familiar with Cell cycle

4.After studied unit-4, the student will be able to
- Familiar with Apoptosis and cancer.
- To know oncogenesis
- Well versed with cancer diagnosis
- Knowledge on genetic, cytotoxic.
- Aware on cell growth and viability tests

5.After studied unit-5, the student will be able to
- To know chemotherapy
- Aware on radiation therapy
- Aware on gene therapy and immune therapy
- Familiar with biologic therapy
- Well versed with cancer biomarkers

SEMESTER I

OPEN ELECTIVE

PAPER 1

(Choose any one out of the given 3)

A. BIOINSTRUMENTATION

Course Objectives

1. It helps the students in understanding the basic science in a variety of applications.
2. It includes the development of different tools and methods for identification, analysis and examination of physical properties of different biochemical compositions to provide better chemical information.
3. To introduce an fundamentals of transducers as applicable to physiology
4. To explore the human body parameter measurements setups
5. To make the students understand the basic concepts of forensic techniques.
6. To give basic ideas about how biomolecules are detected by instrumentation

Unit-I: Microscopy

Principles and application of light phase contrast, fluorescence, scanning and transmission electron microscopy.

Unit-II: Centrifugation Techniques

Centrifugation: Svedberg's constant, sedimentation velocity and sedimentation equilibrium. Differential and density gradient centrifugation, construction of preparative and analytical ultra-centrifuge.

Unit-III: Chromatographic techniques

Chromatographic techniques: Principles and applications of paper, TLC, ion exchange, gel filtration, affinity, GLC and HPLC .

Unit-IV: Electrophoretic techniques

Electrophoretic techniques: Polyacrylamide gel electrophoresis, SDS PAGE, 2D electrophoresis, agarose gel electrophoresis, isoelectric focusing, and pulse field electrophoresis.

Unit-V: Spectroscopic techniques

Spectroscopic techniques: Principles of colorimeter, spectrophotometer,fluorimeter. BeerLambert's Law and its limitations. Extinction coefficient, Atomic absorption spectroscopy, UV-Visible, Spectrofluorimetry, Flame Photometry.

Text Books

Unit-1:

Bioinstrumentation by L Veerakumari

Unit-2

Wilson,K. and Walker,J. 2005. Principles and Techniques of Practical Biochemistry, 6th Edition Cambridge University.Press.

Unit-3

Wilson,K. and Walker,J. 2005. Principles and Techniques of Practical Biochemistry, 6th Edition Cambridge University.Press.

Unit-4

Wilson,K. and Walker,J. 2005. Principles and Techniques of Practical Biochemistry, 6th Edition Cambridge University.Press.

Unit-5

.

Upadhyay,A. Upadhyay,K. and Nath,N. 2009. Biophysical Chemistry: Principles and Techniques, Third Edition, Himalaya Publishing. 11th Edition

References

1. Sharma,B.K. 2004.Instrumental Methods of Chemical analysis, 23rd Edition Goel Publications.
2. Homie,D.J. and Peck,H. Analytical Biochemistry, Third Edition, Longman group,1998.
3. Physical Biochemistry – Principles and Applications, 2nd Edition, John Wiley and Sons, USA.
4. Allen, J.P. (2008) Biophysical Chemistry, 1st Edition, Markono Print Media Limited, Singapore
5. Charles, R., Cantor, I. and Schimmel, P.R. (2004) Biophysical Chemistry, Part II, W.H.Freeman & Co., New York.
6. Hunt, G and Mehta, M. (2007) Nanotechnology Risk, Ethics and Law, Earthscan, London
7. Nolting, B. (2006) Methods in Modern Biophysics, 2nd Edition, Springer Publications, New Jersey.
8. Roshan, J. K. (2008) Advanced Biophysics, Anmol Publications Pvt, Ltd, New Delhi Sheehan, D. (2009)
9. Physical Biochemistry – Principles and Applications, 2nd Edition, John Wiley and Sons, USA.
10. “Principles of Analytical Chemistry” by F W Fifield and D Kealey

E- Materials

1. http://www.biologyreference.com/La-Ma/Light-Microscopy.html
2. https://www.microscopyu.com/techniques/fluorescence/introduction-to-fluorescence-microscopy
3. https://www.fei.com/introduction-to-electron-microscopy
4. https://microbenotes.com/centrifugation-principle-types-and-applications/
5. http://www.labcompare.com/10-Featured-Articles/135690-Analytical-and-Preparative-Ultracentrifuges/
6. http://www.biologydiscussion.com/biochemistry/centrifugation/methods-used-for-separation-of-particles-in-centrifugation-3-methods/12453
7. http://www.biologydiscussion.com/biochemistry/chromatography-techniques/top-12-types-of-chromatographic-techniques-biochemistry/12730

8. http://hiq.linde-gas.com/en/analytical_methods/liquid_chromatography/high_performance_liquid_chromatography.html
9. http://hiq.linde-gas.com/en/analytical_methods/gas_chromatography/index.html
10. https://ruo.mbl.co.jp/bio/e/support/method/sds-page.html
11. https://www.sciencedirect.com/topics/medicine-and-dentistry/two-dimensional-gel-electrophoresis
12. https://www.cleaverscientific.com/applications/agarose-gel-electrophoresis-of-dna/
13. http://www.labcompare.com/Spectroscopy/Atomic-Absorption-Spectrophotometer/
14. http://hiq.linde-gas.com/en/analytical_methods/other_spectroscopy/index.html
15. https://www.sciencedirect.com/topics/medicine-and-dentistry/spectrofluorometry

Course Out Comes

1. **After studied unit-1,** the student will be able to
   - obtain the knowledge about the microscope handling and the basic difference between the ordinary microscope and electron microscope.
     - Obtain a deep knowledge regarding microscopy .
     - Get to know about the light phase contrast microscopy.
     - Get a well versed knowledge on fluorescence
     - Aware of scanning and transmission electron microscopy.

2. **After studied unit-1,** the student will be able to
   The student will be able to learn the centrifugation techniques and applications

     - Obtain a deep knowledge regarding Centrifugation .
     - Get to know about the Svedberg's constanty.
     - Get a well versed knowledge on sedimentation equilibrium.
     - Aware of analytical ultra-centrifuge
     - Get a well versed knowledge on Density gradient centrifugation

3. **After studied unit-3,** the student will be able to

     - Learn the chromatographic techniques for the separation of the individual compound from the mixture of compound.
     - Obtain a deep knowledge regarding applications of paper chromatographic techniques, .
     - Get to know about the TLC.
     - Get a well versed knowledge on ion exchange chromatography

     - Aware of HPLC

4. **After studied unit-4,** the student will be able to

     - Learn the electrophoretic techniques for the separation of proteins nucleic acids.
     - Obtain a deep knowledge on nucleic acids .
     - Get to know about the Polyacrylamide gel electrophoresis .

- Get a well versed knowledge on Agarose gel electrophoresis
- Aware of pulse field electrophoresis.

5. **After studied unit-5**, the student will be able to

- obtain knowledge about the different spectroscopic techniques and their applications in detail.
- Obtain a deep knowledge on Principles of colorimeter .
- Get to know about the BeerLambert's Law and its limitations .
- Get a well versed knowledge on Atomic absorption spectroscopy
- Aware of Flame Photometry

SEMESTER I

OPEN ELECTIVE

PAPER 1
B. DEVELOPMENTAL BIOLOGY

UNIT -I Basic concepts of development :

Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development

UNIT -II Gametogenesis, fertilization and early development:

Production of gametes, cell surface molecules in sperm-egg recognition in animals; embryo sac development and double fertilization in plants; zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; embryogenesis, establishment of symmetry in plants; seed formation and germination.

UNIT-III Morphogenesis and organogenesis in animals :

Cell aggregation and differentiation in Dictyostelium; axes and pattern formation in Drosophila, amphibia and chick; organogenesis – vulva formation in Caenorhabditis elegans, eye lens induction, limb development and regeneration in vertebrates; differentiation of neurons, post embryonic development- larval formation, metamorphosis; environmental regulation of normal development; sex determination.

UNIT-IV Morphogenesis and organogenesis in plants:

Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy; transition to flowering, floral meristems and floral development in Arabidopsis and Antirrhinum

UNIT-V Apoptosis

Programmed cell death, aging and senescence

Text books

- Developmental Biology- Scott F Gilbert.
- Essential Developmental Biology - Jonathan Slack
- Principles of Development - Lewis Wolpert
- Developmental Biology,-Werner A Muller
- Website: virtual embryo- http://people.ucalgary.ca/~browder/virtualembryo/dev_biol.html

References

- Developmental Biology, Eighth Edition" by Scott F Gilbert.
- Essential Developmental Biology by Jonathan Slack
- Developmental Biology, Werner A Muller
- Principles of Development - Lewis Wolpert

SEMESTER I

OPEN ELECTIVE

PAPER 1

C. NANOSCIENCE AND TECHNOLOGY

Course objectives:

1.The main objective of this course is to introduce about concepts in Nanoscience and technology.
2. This course emphasizes to learn about nanoparticles and its types, synthesis, characterization of nanoparticles and microscopy techniques
3. Nanocarriers and drug delivery system in nanomedicine provides the learner to know about the treatment of diseases using nanoparticles.
4. To understand the characterization of Nano material

5.To be aware of Bio mimics.

6 .To identify the active and passive targeting of diseased cells

Unit- I Nanoscience and nanotechnology

Introduction to Nanoscience and Nanotechnology;
Milestones inNanotechnology; Overview of Nanobiotechnology and Nanoscale processes; Physicochemical properties of materials in Nanoscales. Types of Nanomaterials (Quantum dots, Nanoparticles, Nanocrystals, Dendrimers, Buckyballs, Nanotubes); Polymers in nano material synthesis- natural and synthetic polymers.

Unit-II Nanomaterials

Top down and bottom up synthesis -Gas, liquid, and solid phase synthesis of nanomaterials; Polymers in nano material synthesis- natural and synthetic polymers. Lithography techniques (Photolithography, Dip-pen and Electron beam lithography); Thin film deposition; Electrospinning. Bio-synthesis of nanomaterials.-Green synthesis

Unit-III Characterization techniques

Characterization of Nano material**;** Absorption, Fluorescence, and Resonance; Microscopy measurements: SEM, TEM, AFM and STM. Confocal and TIRF imaging.

Unit-IV Biomolecules and bio mimics

Reactive groups on biomolecules (DNA & Proteins); Surface modification and conjugation to nanomaterials. Fabrication and application of DNA nanowires;Nanofluidics to solve biological problems. Bio mimics.

Unit-V: Nanocarriers

Properties of nanocarriers; drug delivery systems used in nanomedicine;Enhanced Permeability and Retention effect; Blood-brain barrier; Active and passive targeting of diseased cells; Health and environmental impacts of nanotechnology.

Text books:

Unit-I

Nanotechnology,Fundamentals and Applications by Manasi karkare

Unit-2

1.Hand book of Nanostructured materials and nanotechnology by Nalva

Unit-3 to Unit-4

Nanomaterials By A K Bandyopadhyay

Unit-5

Nanotechnology,Fundamentals and Applications by Manasi karkare

REFERENCES:

1. Nanobiotechnology: Concepts, Applications and Perspectives, Christof M. Niemeyer (Editor), Chad A. Mirkin (Editor), Wiley-VCH; 1 edition, 2004.
2. Nanobiotechnology: Bioinspired Devices and Materials of the Future by Oded Shoseyov and Ilan Levy, Humana Press; 1 edition 2007.
3. Nanobiotechnology Protocols (Methods in Molecular Biology) by Sandra J Rosenthal and David W. Wright, Humana Press; 1 edition, 2005.
4. Bio-nanotechnology Concepts and applications. Madhuri Sharon, Maheshwar Sharon, Sunil Pandey and Goldie Oza, Ane Books Pvt Ltd, 1 edition 2012.
5. Microscopy Techniques for Material Science. A. R. Clarke and C. N. Eberhardt (Editors) CRC Press. 1st Edition, 2002.

E-Materials

1.http://www.ox.ac.uk/sites/files/oxford/field/field_document/Materials%20Science%20Workshop%20presentation.pdf
2. https://copublications.greenfacts.org/en/nanotechnologies/l-2/3-nanoparticle-properties.htm
3. https://www.sciencedirect.com/topics/materials-science/polymer-nanoparticles
4.https://www.sciencedirect.com/topics/materials-science/polymer-nanoparticles
5.https://www.sciencedirect.com/topics/engineering/green-synthesis
6.https://en.wikipedia.org/wiki/Characterization_of_nanoparticles
7.https://www.olympuslifescience.com/en/microscopresource/primer/techniques/confocal/applications/tirfmintro/
8. https://www.slideshare.net/anamikabanerjee92/semtem-afm
9. https://www.sciencedirect.com/topics/engineering/biomolecule
10.https://en.wikipedia.org/wiki/Nanocarriers

Course Outcome

On successful completion of the course, students can able to

1.After studied unit -1, the student will be able to

- Describe history of nanotechnology, Properties of nanoparticles.
- Knowledgeable on Nanoparticles types
- Aware of Physicochemical properties of materials in Nanoscales.
- Well versed on Nanocrystals
- Familiar with synthetic polymers

1.After studied unit -1, the student will be able to

- Describe the bottom up and top down approaches and synthesis of nanoparticles using physical, chemical and biological method
- Knowledgeable on Lithography techniques
- Aware of Thin film deposition
- Well versed on Electrospinning
- Familiar with Green synthesis and Bio-synthesis of nanomaterials

3.After studied unit -1, the student will be able to

- Describe the characterization of nanoparticles using Microscopy techniques
- Knowledgeable on SEM, TEM, AFM,
- Aware of Characterization of Nano material
- Well versed on Fluorescence, andResonance .
- Familiar with Confocal and TIRF imaging.

4.After studied unit -1, the student will be able to

- Design, carry out surface modification of biomolecules and conjugation to nanomaterials and apply nature's nano in biology (Biomimics)
- Aware of conjugation to nanomaterials
- Well versed on nature's nano in biology
- Knowledgeable on Biomimics
- Familiar with application of DNA nanowires

5.After studied unit -1, the student will be able to

- Apply theoretical knowledge to solve the problems in treatment of diseases using nanoparticles in nanomedicine.
- Aware of Properties of nanocarriers
- Well versed on drug delivery systems
- Knowledgeable on Blood-brain barrier
- Familiar with environmental impacts of nanotechnology

SEMESTER II

CORE PAPER-4

ANALYTICAL BIOCHEMISTRY

Course objective

- **To** Understand the working principles of analytical instruments.
- **To** Apply and analyze the biochemical samples using analytical instruments
- To make the student familiar with the basic concepts *of* chromatography and spectroscopy utilized for food analysis
- To acquired some technical knowledge of, and some practical experience with, analysis in electrophoresis
- To promote capacity building and research biodiversity use and conservation worldwide through the application of molecular markers

UNIT I - ELECTROCHEMICAL TECHNIQUES AND ELECTROPHORESIS

Electrochemical techniques – principles, electrochemical cells – pH, Henderson – Hasselbalch equation, buffer capacity, pH measurement, glass electrode. Oxygen electrode – principle and application. Biosensors.
Separation of DNA fragments – Agarose gel electrophoresis of DNA, Pulsed field gel electrophoresis. Autoanalyser – principal, instrumentation and applications. Isoelectric point-2D gel electrophoresis. Electrophoresis of proteins: SDS-PAGE, Native gels, Gradient gel, Isoelectric focusing,cellulose acetate elecrophoresis, continuous flow electrophoresis; Detection, estimation and recovery of proteins.

UNIT II - ENZYME ASSAY, CENTRIFUGATION AND RADIOCHEMICAL TECHNIQUES

Enzyme monitoring technique – Assay methods, Immobilized enzymes.
Centrifugation: Preparative and Analytical ultracentrifuges. Analytical centrifugation - Schlieren optical system - applications - determination of molecular mass and purity of macromolecules
Radiochemical methods – Basis concepts, counting methods and application. Autoradiography. Applications of radioisotopes in the biological sciences.

UNIT III – CHROMATOGRAPHY AND SPECTROSCOPY TECHNIQUES

GC, HPLC – principle, components, limitations and applications. Optical rotatory dispersion, Circular dichroism, X-ray diffraction, Nuclear magnetic resonance, Electron spin resonance and Mass spectrometry – basic principle and application principle and applications of trubidimetry and nephelometry. Flow cytometry and cell separation. Use of lasers for spectroscopy.

UNIT IV – MOLECULAR TECHNIQUES

Restriction endonucleases, Restriction mapping, Nucleic acid probes – cloned probes, oligonucleotide probes and labelling of nucleic acid probs. Membrane blotting and hybridization of nucleic acids – Southern, Northern, Western, dot-plot and Fluorescent insitu hybridization. RFLR – Technique & applications.

PCR basic principle, technique, diagnostic and laboratory applications of PCR, RAPD Construction of DNA and Oligonucleotide microarray.

UNIT V–MOLECULAR MARKERS ANALYSIS

Diagnostic applications of nucleic acid probes – sickle cell anaemia, thalassemia, haemophilia and lymphoid malignancy. Mutagenicity testing – Ames test. Comet assay and DNA fragmentation assay. Identifying protein – DNA interactions – DNA foot printing, DNA finger printing – Technique and applications. HLA typing – applications.

Text Books

- Wilson K. & Walker, "*Practical Biochemistry",* Cambridge University press, 5th edition, 2000 Wilson, K. and Walker, J. (2012)
- David T. Plummer. "*An introduction to Practical Biochemistry",* 2005.
- Keith Wilson and John Walker - Principles and techniques of Biochemistry and Molecular Biology, Cambridge University Press, 6th Edition,2006.
- Boyer R. - Experimental Biochemistry, Addison Wesley, 3rd Edition, 2002.
- Bernard R. Glick and Jack.J. Pasternak - Molecular Biotechnology, ASM Press Washington 3rd Edition, 2003.

References Books

- David Frifelder. *Physical Biochemistry*, W. H. Freeman; 3 edition, 2005
- Galen Wood Ewing Mcgraw, *"Instrumental Methods of Chemical Analysis"* by - Hill College , Fifth edition .
- D W Brown - Organic Spectroscopy, Wiley New York 1st Edition, 1998.
- M.Valcatcel - Principles of analytical chemistry-A Text book. Springer, 2000.
- David James Holme and Hazel Pack - Longman, 1994
- Robert D. Braun, "*Introduction to Instrumental Analysis"*, Pharma Book Syndicate,2006.
- Serdyuk, I.N., Zaccai, N.R. and Zaccai, J. (2007) Methods in Molecular Biophysics – Structure, Dynamics and Function, Cambridge University Press, India

. **E- Resources**

- www.kau.edu.sa › Files › Subjects › principals and techiniques of bioche...
- https://epdf.pub/analytical-biochemistry.html
- https://www.scribd.com/document/262054613/Analytical-Biochemistry-3rd-Ed-David-Holme-Hazel-Peck

Course outcomes:

1. **After studied unit – 1, the student will be able to**

- gain Practical knowledge , hands on tools and techniques for the characterization of bio-molecules will help the students in advanced research programs.
- Choose and plan the use of suitable electrophoretic techniques for actual analytical problems.
- understand the Role of pH and buffers in biological system.
- Identify and quantify various biomolecules..
- Well versed on autoanalyser and its roles.

2. **After studied unit – 2, the student will be able to**

- appreciate the role of radioisotopes in biology
- Understand the principle and applications of Centrifugation techniques.
- Explain the principle, operation and applications of various centrifuges
- Understand separation of proteins based on mass and charge.
- Distinguish the process of identifying the sub-units in a protein.

3. **After studied unit – 3, the student will be able to**

- Understand the strengths, limitations and creative use of techniques for problem-solving.
- Describe how a spectrophotometer operates, and give examples of their uses
- Characterize certain functionalities of biomolecules by using spectroscopic techniqueques.
- Explain the principles of the most important liquid and gas chromatographic techniques
- Report and discuss chromatographic analyses in a scientifically methods

4. **After studied unit – 4, the student will be able to**

- gain laboratory skills in molecular biology techniques such as micropipetting, PCR and RFLR
- understand the fundamental molecular tool and their applications
- update knowledge on analytical instruments by visiting laboratories
- describe the use of nucleic acids as tools in molecular research
- decide and apply appropriate tools and techniques in molecular biology.

5. **After studied unit – 5, the student will be able to**

- familiar with the different types of molecular markers most used in genetic studies and has experience in the construction and comparison of genetic maps.
- Understands the main applications of molecular markers in genetic studies and breeding programmes.
- Acquire practical experience in DNA extraction and in the use of markers.
- Has practical experience in the use of computer software for the construction of genetic maps.
- gain insight of molecular biology techniques that are instrumental in analysis of genes at DNA level

SEMESTER II

CORE PAPER-5

MOLECULAR BIOLOGY

Objectives
To enable the students

- Understand the history and scope of molecular biology.
- Acquire working knowledge of gene & to know how genes are expressed.
- Appreciate how genetic engineering & biotechnology influence a health care in the next century.
- Gain knowledge of biological and/or medicinal processes through the investigation of the underlying molecular mechanisms.
- learn about DNA, RNA and their replication, mutations, DNA repair mechanism

UNIT-I : DNA REPLICATION

Types of replication, evidence for semiconservative replication - Meselson and Stahl experiment, Replication in prokaryotes and inhibitors of replication, replication bubble, bidirectional replication, replicon, action of SSB, primase, DNA gyrase, topoisomerases, DNA polymerase I, II, and III, lagging and leading strand synthesis, Okazaki fragments, replication in RNA virus, retroviruses,. Eukaryotic replication and inhibitors of replication,

UNIT-II : TRANSCRIPTION

Transcription - definition, coding strand, template strand, sense strand and antisense strand, promotor, foot-printing experiment, DNA - dependent RNA polymerase role of Prinbnow box, template binding, prokaryotic transcription, Rho - dependent and independent transcription, posttranscriptional processing in prokaryotes, split genes, overiapping genes, housekeeping genes, biosynthesis of rRNA and tRNA, eukaryotic transcription, RNA editing - post-transcriptional modifications of eukaryotic RNAs, RNA splicing,

UNIT-III : GENETIC CODE AND TRANSLATION

Genetic code - definition, deciphering of the genetic code, codon dictionary, salient features of genetic code. structure of tRNA, activating enzymes, binding of amino acids to tRNA, wobble mechanism and its significance, composition of prokaryotic and eukaryotic ribosomes, leader region, Shine-Dalgarno sequence, reading frameshift, prokaryotic and eukaryotic protein biosynthesis - initiation, elongation, translocation and termination, polysomes, post-translational modifications in prokaryotes and eukaryotes, inhibitors of protein synthesis.

UNIT-IV : PROTEIN TRANSPORT AND GENE EXPRESSION

Protein targeting, translocation, heat shock proteins, glycosylation, SNAPs and SNAREs, bacterial signal sequences, heat shock proteins, mitochondrial, chloroplast and nuclear protein transport, endocytosis-viral entry, ubiquitin TAG protein destruction, Protein folding- models, molecular chaperones.

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Regulation of gene expression , Regulation of transcription in prokaryotes– the lac, trp, Arab,Gal operon, DNA methylation in prokaryotes, DNA methylation in eukaryotes-cytosine methylation, CpG islands. gene amplifications.

UNIT-V : MUTAGENESIS, DNA DAMAGE AND REPAIR

Mutagenesis and replication fidelity, misincorporation of nucleotides during DNA synthesis, transient and spontaneous chemical changes in DNA, frameshift mutagenesis, DNA damage - different types, DNA repair - direct reversal repair, direct repair of nicks, excision repair, nucleotide excision repair, mismatch repair, long and short patch mismatch repair, recombination error, SOS response and mutagenic repair.

Course outcomes:

After studied unit – 1, the student will be able to

- Know about genome organization or living organisms, study of genes genome, chromosome etc.
- Learn structural levels of nucleic acids- DNA and RNA and genome organization in prokaryotes
- Learn molecular events in the DNA replication and role of different enzyme
- acquire knowledge related to discovery of DNA as genetic material, DNA replication
- Learning structural levels of nucleic acids- DNA and RNA and genome organization in prokaryotes and eukaryotes

After studied unit – 2, the student will be able to

- learn expressed genes or transcripts can be translated into proteins following acentral dogma
- . describe how gene expression is regulated at the transcriptional and post-transcriptional level.
- Describe how pre-rRNAs and pre-tRNAs are processed into mature rRNAs and tRNAs.
- Learn structural levels of transcription, posttranscriptional processing in prokaryotes
- The student can predict how a change in a specific DNA or RNA sequence can result in changes in gene expression.

After studied unit – 3, the student will be able to

- Understand the strengths, limitations and creative use of techniques for problem-solving.
- Identify the major features of proteins - peptide bond, amino and carboxyl terminals, side chains, alpha carbon
- Describe the mechanisms of protein transport to various sub cellular sites and process of protein degradation

- Understand the processes of transcription and translation, including how they are both similar and different in prokaryotic and eukaryotic organisms.
- Understanding the principles and applications of Polymerase Chain Reaction

After studied unit – 4, the student will be able to

- gain laboratory skills in molecular biology techniques such as micropipetting, PCR and RFLR
- Learn about the Molecular markers and its classification and applications
- Learn the methods of DNA sequencing and various tools and techniques of molecular biology
- Compare the structure of eukaryotic cells with the structure of simpler prokaryotic cells and with the structure of viruses
- understands the process of Genetic Recombination – and the elements of recombination in E. coli

After studied unit – 5, the student will be able to

- familiar with the different types of molecular markers most used in genetic studies.
- understand the biology and application of antisense technologies and biology of cancer
- gives in-depth knowledge of biological and/or medicinal processes through the investigation of the underlying molecular mechanisms.
- make students learn mutation and mutagenesis
- acquire knowledge related to discovery of DNA as genetic material, DNA replication, transcription, DNA repair and translation

Text Books

- Alberts, "*Molecular Biology of the Cell"*, 4th ed, Garland Sci, 2002.
- Lodish et al, "*Molecular Cell Biology"*, 4th ed, Freeman, 2000..
- Cell and molecular biology - G. Karp, John Wiley & Sons Inc, 2002
- Principles of Biochemistry – 7th edition, Lehninger, Nelson & Cox, Macmillan worth Publishers, 2013
- Principles of Cell and Molecular Biology. (2nd edn.)., Kleinsmith, L. J. & Kish, V.M. 1995
- Molecular Biology of the Cell. (3rd edn.)., Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K., Watson, J.D. (eds.) 1994. Garland Publishing, Inc., New York
- Genetics: Analysis and Principles by Robert J Brooker, (2017), 6th Edition, McGraw Hill Education.
- Genetics: A Conceptual Approach by Benjamin Pierce, (2017), 6th Edition, WH Freeman
- Concepts of Genetics by William S. Klug, (2013), 10th edition, Pearson Publishers

Reference Books

- Stansfield et al. "*Molecular Cell Biology, 2nd edition",* Schaum's Outlines, McGraw Hill, 2002.
- Lewin. "*Genes VII"*, 2nd edition, Oxford University Press, 2000.
- Biochemistry - D.Voet and J. Voet. John Wiley and Sons Ltd, 1990

- Genes VII - B. Lewin Oxford University Press, Cell Press, London, 2000
- Twyman. "*Advanced Molecular Biology"*, 3rd ed, Viva Publ, 2005
- Genetics: A Molecular Approach by peter J. Russell (2016), Pearson Education
- The Cell: A Molecular Approach by Geoffery M Cooper, (2013), 6th Edition, Sinauer3.Associates Inc
- .Karp's Cell and Molecular Biology: Concepts and Experiments by Janet Iwasa (2016), John Wiley & Sons Inc; 8 edition
- Cell Biology by Thomas D Pollard (2017), 3rd Revised edition, Elsevier -Health Sciences Division.
- Principles of Genetics by Peter Snausted (2011), 6th Edition, John Wiley & Sons Inc.
- Principles of Genetic by Tamarin, (2017), 7th Edition, McGraw Hill Education.

E- Resources

- http://www.freebookcentre.net/Biology/Molecular-Biology-Books.html
- https://www.amazon.in/Molecular-Biology-N-Vidyavathi-ebook/dp/B078KWF9BN
- https://pothi.com/pothi/book/ebook-kaushlendratripathi-introduction-molecular-biology
- https://www.worldcat.org/title/molecular-biology/oclc/1062496183
- https://www.us.elsevierhealth.com/medicine/molecular-biology

SEMESTER II

CORE PAPER-6

METABOLIC REGULATION AND DISORDERS

Objectives:
To enable the students

- Understand the rate of acceleration of the biochemical reactions in the presence of the biocatalyst (enzymes).
- Enhance the knowledge about the key biochemical pathways in metabolism and their regulations.
- Analyze the importance of biochemical metabolic pathways.
- acquire the concept of anabolism, catabolism and role of high energy compounds in the cell.
- Ability to relate various interrelated physiological and metabolic events

UNIT-I : BIOENERGETICS AND BIOLOGICAL OXIDATION

Free energy and entropy.Phosphoryl group transfers and ATP. Enzymes involved in redox reactions. The electron transport chain - organization and role in electron capture.
Oxidative phosphorylation - Electron transfer reactions in mitochondria. F_1F_0 ATPase - Structure and mechanism of action. The chemiosmotic theory. Inhibitors of respiratory chain and oxidative phosphorylation - Uncouplers and ionophores.Regulation of oxidative phosphorylation. Mitochondrial transport systems - ATP/ADP exchange, malate / glycerophosphae shuttle,. Mitochondrial diseases

UNIT-II : CARBOHYDRATE METABOLISM

Glycolysis and gluconeogenesis– pathway, key enzymes and co-ordinate regulation. The citric acid cycle and regulation. The pentose phosphate pathway. Metabolism of glycogen and regulation. Glycogen storage diseases. Blood glucose homeostasis– role of tissues and hormones. Metabolism of alcohol.

UNIT-III : LIPID METABOLISM AND ASSOCIATED DISORDERS

.
Oxidation of fatty acids - α,β and ω. Biosynthesis of fatty acids. Metabolism of triglycerides, phospholipids and sphingolipids. Metabolism of Cholesterol and associated disorders. Ketogenesis. Metabolic adaptations in starvation and obesity. lipoproteins and associated disorders

UNIT-IV : AMINO ACID, PURINE AND PYRIMIDINE METABOLISM

Overview of biosynthesis of nonessential amino acids Catabolism of amino acid nitrogen - Transamination, deamination, ammonia formation and the urea cycle.

Disorders of the urea cycle. Disorders of amino acid metabolism– phenylketonuria, alkaptonuria and albinism
Metabolism of purines and pyrimidines ,catabolism of purines and pyrimidines. Disorders associated with abnormalities in the metabolism of purines and pyrimidine

UNIT-V PORPHYRINS,PHOTOSYNTHESIS,METABOLIC INTEGRATION AND HORMONAL REGULATION 13 Hrs

Biosynthesis and degradation of heme. Disorders associated with defects in biosynthesis of heme .Integration of metabolism - Interconversion of major foodstuffs.Metabolic profile of the liver, adipose tissue and brain. Metabolic inter relationships in various nutritional and hormonal states– obesity, aerobic, anaerobic endurance, exercise, pregnancy, lactation, IDDM, NIDDM and starvation
Course outcomes:

After studied unit – 1, the student will be able to

- learn basic concepts of Bioenergetics, mechanisms of oxidative phosphorylation and photophosphorylation
- understand composition and structure of biomembranes, transport mechanisms across biological membranes
- Get a mechanistic overview of enzyme activity and regulation in cells.
- Understand the metabolic pathways, the energy yielding & energy requiring reactions in biological system.

After studied unit – 2, the student will be able to

- Describe the synthesis and degradation of carbohydrates, lipids and proteins and also their interrelations.
- Gain knowledge about the carbohydrate metabolism.
- Understand the diseases related to carbohydrate metabolism
- Acquire knowledge related to regulation of various pathway
- gain knowledge about the fine-tuning of metabolism by means of enzyme regulation

After studied unit – 3, the student will be able to

- Get a knowledge about how energy can be derived from fat
- Understand the synthesis of saturated, unsaturated fatty acids and triacyl glycerides.
- Acquire knowledge for the purpose and the process of lipogenesis
- Gain knowledge about the purpose and process of ketogenesis.
- Describe the Cholesterol is kept in balance by homeostatic mechanisms: higher dietary intake leads to reduced synthesis in the body.

After studied unit – 4, the student will be able to

- Know the inborn errors associated with amino acid metabolism
- Gain knowledge on urea cycle and its importance

- Get a knowledge about Amino acid synthesis depends on the formation of the appropriate alpha-keto acid, which is then transaminated to form an amino acid.

- Understand the metabolic defects in different enzymes of urea biosynthesis, although distinct at the molecular level, present similar clinical signs and symptoms.

After studied unit – 5, the student will be able to

- Think laterally and in an integrating manner and develop interdisciplinary approach.

- Gain knowledge of metabolic pathways to biotechnological and biochemical research

- learn the hormonal regulation of metabolism and discuss the role of Metabolic inter relationships in various nutritional and hormonal states.

- Understand the nucleotide metabolism
- assess the crucial role of some hormones with regard tothe integration of metabolic pathways

Text Books

- Principles of Biochemistry – 7th edition, Lehninger, Nelson & Cox, Macmillan worth Publishers, 2013
- Stryer, "*Biochemistry"*, 5th edition, Freeman, 2002.
- Murray et al., "*Harper's Biochemistry"*, 29th edition, Mc. GrawHill, 2012
- Primer for the Exercise and Nutrition Sciences: Thermodynamics, Bioenergetics,Metabolism, Christopher B. Scott. 2010.
- Bioenergetics (Biochemistry Research Trends), Jeffrey W. Berkin, 2011.
- Bioenergetics: Energy Conservation and Conversion (Results and Problems in Cell Differentiation), Günter Schäfer, 2008

References Books

- Donald Voet, J.G. Voet, John Wiley," *Biochemistry"*, 4th edition, 2006.
- Davidson & Sittman, "*Biochemistry NM., 3rd edition",* Lippincott. Willams and Wilkins, 2005
- Champe P.C and Richard A Harvey, *Lippincotts Biochemistry,* Williams & Wilkins Publishers, 2004.

. **E- Resources**

- https://www.kobo.com/us/en/ebook/enzymes-6
- https://www.elsevier.com/books/the-enzymes/dalbey/978-0-12-373916-2
- https://www.kobo.com/us/en/ebook/metabolic-regulation
- https://www.kobo.com/us/en/ebook/hepatic-de-novo-lipogenesis-and-regulation-of-metabolism
- https://www.elsevier.com/books/metabolic-regulation/vogel/978-0-12-299255-1

CORE PRACTICAL

PAPER-1

A. ISOLATION AND CHARACTERIZATION STUDIES

1. Isolation and estimation of glycogen from liver.

2. Isolation and estimation of DNA from liver and spleen.

3. Isolation and estimation of RNA from plant tissues or yeast.

4. Denaturation of DNA and UV absorption studies. (demonstration).

B. QUANTITATIVE ANALYSIS

1. Estimation of Ascorbic Acid

2. Estimation of inorganic phosphorus by Fiske and SubbaRao method.

3. Determination of pyruvate or lactate

4. Determination of tryptophan.

5. Determination of protein by Lowry's method.

6. Estimation Of Iron

C. TECHNIQUES

1. Preparation of buffers and measurement of pH using indicators and pH meter.

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

3. Separation of plant pigments by column chromatography.

4. Separation of serum proteins by PAGE.

5. PCR Technique - Demonstration

References

1. Practical Biochemistry - K. Wilson and I. Walker. 5th edition, Cambridge University press, 2000.

2. Practical Biochemistry – Shawney.

3. Biochemical Methods - S.Sadasivam & A.Manickam, New Age International.

CORE PRACTICAL

PAPER -2

MOLECULAR BIOLOGY AND MICROBIOLOGY PRACTICAL

A. IMMUNOLOGICAL AND MOLECULAR BIOLOGY TECHNIQUES

1. Grouping of blood and Rh typing.
2. Latex agglutination test for rheumatoid factor and pregnancy.
3. ELISA - demonstration.
4. Extraction of genomic DNA and electrophoresis in agarose gel. (Demonstration)
5. Determination of molecular size of DNA. (Demonstration)
6. Restriction enzyme digestion and electrophoresis. (Demonstration)
7. Immunodiffusion
8. Production of antisera

B. MICROBIAL TECHNIQUES

1. Handling and maintenance of microscopy.
2. Sterilization techniques - principles, methods, moist heat, dry heat, filter types CDC, safety levels.
3. Preparation of media - liquid, solid, agar deep. Slant and plate.
4. Staining techniques - simple, differential and special staining.
5. Pure culture techniques - streak plate, pour plate.
6. Growth curve - non-visual method turbidity method.
7. Identification and enumeration of microorganisms from soil - streak plate, pour plate.
8. Identification and enumeration of microorganisms from water - standard plate count, MPN test and membrane filtration technique.

References

1. Practical Biochemistry For Medical Students - Raghu, JAYPEE, 2006
2. Practical Clinical BiochemistryHardcover–Harold Varley,Sixth Edition, Alan H Gowenlock.
3. An Introduction to Practical Biochemistry - David T. Plummer Third Edition, Tata Mc Graw Hill
4. Medical laboratory Technology Volume I, II & III - KL Mukherjee
5. Haematology for students Practitioners - Ramnik Sood
6. Biochemical Methods - S.Sadasivam & A.Manickam, New Age International.
7. Medical laboratory Technology Volume I, II & III - KL Mukherjee

CORE ELECTIVE

PAPER-2
(to choose 1 out of 3)

A. Microbiology

UNIT - I GENERAL MICROBIOLOGY

Introduction and scope of microbiology. Brief study of structure and organization of major groups of microorganisms - archaebacteria, cyanobacteria, eubacteria, fungi, algae, protozoa and viruses. Culture of microorganisms - batch, continuous and pure cultures. Control of microorganisms - physical, chemical and chemotherapeutic agents.Preservation of microorganisms.

UNIT - II ENVIRONMENTAL MICROBIOLOGY

Microbiology of soil - soil microflora, role of soil microbes in biogeochemicalcycles (C,N,S) - Marine and fresh water microbiology. Contamination of domestic and marine waters. Water purification and sewage treatment. Microbes in waste water treatments. Microbiology of air.

UNIT - III INDUSTRIAL MICROBIOLOGY

Selection of industrially useful microbes. Fermentors and fermentation technology. Industrial production of alcohol, vinegar, lactic acid, enzymes and amino acids. Microbiology of food: sources of contamination, food spoilage and food preservation methods.

UNIT - IV MEDICAL MICROBIOLOGY

Disease reservoirs; Epidemiological terminologies.Infectious disease transmissions. Respiratory infections caused by bacteria and viruses; Tuberculosis, sexually transmitted diseases including AIDS; Vector bone diseases, water borne diseases, Public health and water quality. Pathogenic fungi, Antimicrobial agents, Antibiotics.Penicillins and cephalosporins, Broad spectrum antibiotics.Antibiotics from prokaryocytes, antifungal antibiotics - mode of action, Resistance to antibiotics.

UNIT - V APPLIED MICROBIOLOGY

Role of microbes in the manufacture of antibiotics and vaccines. Microorganisms as biofertilizers. Microbes as foods - SCP production. Role of microbes in biogas production, petroleum industry and mining. Microbial degradation of lignin, cellulose and pesticides. Microbial immobilization. Microbes in biological warfare.

Text Books

- Pelczar et al., "*Microbiology",* 3rd edition, Tata McGraw-Hill, New Delhi, 2004.
- Prescott et al., "*Microbiology",* 2nd edition, WMC Brown Publishers, USA, 2003.

Reference Books

- Martin Alexander , "*Introduction to soil microbiology",* 4th edition, WileyInternational, NY, 2004
- Gladwin & Trattler, "*Clinical Microbiology Made Ridiculously Simple"*, 6th edition, Medmaster, UK,2013

Text Books

1. Medical Microbiology- Jawetz, Melnick and Adelberg's, Lange Med. Brooks, et al 1998.
2. Microbiology. 4th ED - Davis, et al. Lippincott Williams and Wilkins, 1989.
3. Microbiology -Joklik, et al. Zinsser's McGraw Hill Professional, 1995.
4. Brack Biology of Microorganisms, 10th ed- Madigan, et al. Prentice Hall, 2002.
5. Microbiology, 5th Ed. - Pelczar et al. McGraw Hill, 2000.
6. Microbiology -Prescott et al. Mcgraw Hill, 1999.

General Microbiology. 5thed,Stainer RY, et al. Prentice Hall, 1986

CORE ELECTIVE

PAPER-2

B. BIOINFORMATICS

Objectives:
To enable the students

- Understand the impact of Bioinformatics methodology in Biological Sciences.
- Distinguish between the commercial and research perspectives of Bioinformatics.
- Assess the interface between computational and Biological Science.

UNIT-I INTRODUCTION TO BIOINFORMATICS

Bioinformatics-an overview and definition, objectives and scope-genomics, proteomics and computer aided drug design. Bioinformatics and internet – challenges and applications

UNIT-II BIOLOGICAL DATABASE AND ITS TYPES

Introduction to data types and source. General introduction of biological database; Nucleic acid databases-NCBI, DDBJ,SWISS-PROT and EMBL. Protein databases – primary, composite and secondary. Specialized genome databases ; SGD, TIGR and ACeDB, structure databases – CATH, SCOP and PBD sum.
Lab demo class-NCBI, EMBL and DDBJ

UNIT –III DNA SEQUENCE ANALYSIS

DNA sequence analysis- DNA sequence, features of DNA sequence analysis, EST-differential approaches to EST analysis and c-DNA libraries.

UNIT – IV PROTEIN DATA BANK

Protein information resources- Biological databases, primary sequence databases, composite protein sequence databases, secondary databases- PROSITE, PRINTS, PROFILES and IDENTITY.

UNIT –V SEQUENCE ALIGNMENT

Pair wise alignment – database searching (Needleman algorithm), comparing two sequence - identity and similarity, FASTA and BLAST, Multiple sequence alignment - Definition - Clustal W.

Lab demo class- FASTA, BLAST and Clustal W

Text Books

- Attwood T.K and D.J Parry, *Introduction to Bioinformatics*, Pearson Education Ltd., New Delhi 2014.
- N. Gautham, *Bioinformatics-Database and Algorithm*, Narrosa publishing house 2007

Reference Books

- Andreas D Baxevanis and Francis Quellette B F,*Bioinformatics- A Practical guide to the analysis of genes and proteins*, Willey publication, New Delhi 2016.

- Arthur M. Lesk, *Introduction to Bioinformatics*, second edition, oxford university press, UK 2006.
- Jerry Gu, Phlip E Bowrne, *Structural Bioinformatics*, Willey- blockwell publication, New Delhi 2009

e- Resources

- https://www.lehigh.edu/~inbios21/PDF/Fall2008/Lopresti_11142008.pdf
- www.aun.edu.eg/.../Procedure%20**Bioinformatics**22.../Xiong%20-%20Es...
- www.iasri.res.in/**ebook**/CAFT_sd/Concepts%20of%20**Bioinformatics**.pdf
- goldenhelix.com/.../**ebooks**/Teaching-**Bioinformatics**-Concepts-Practical-...
- nptel.ac.in

CORE ELECTIVE

PAPER-2

C. BIOCHEMICAL AND ENVIRONMENTAL TOXICOLOGY

UNIT-I

Definition and scope of toxicology: Eco-toxicology and its environment significance toxic effects. Basis for general classification & nature, dose - response relationship. Synergism and Antagonism, Determination of ED 50 & LD 50.

Acute and chronic exposures. Factors influencing toxicity. Pharmaco dynamics & Chemo dynamics.

UNIT-II

Principles & procedures of testing for acute toxic effects. Regulators guidelines, mammalian systems affected & the clinical signs of systemic toxicity. Factors affecting acute toxicity studies. Biochemical basis of toxicity. Mechanism of toxicity: Genotoxicity. Tissue specific toxicity.

UNIT-III

Toxicity testing : Test Protocol, Genetic Toxicity Testing & Mutagenesis Assays: *Invivo* test systems- Bacterial Mutation Tests: Reversion Tests, Ames test, Fluctuation Tests & Eukaryote Mutation Tests In Vivo Mammalian Mutation Tests – host mediated assay & dominant lethal test. Use of drosophila in toxicity testing. DNA repair assays. Chromosome damage test.

UNIT-IV

Food toxicology: Toxicology of food additives. Metal toxicity: Toxicology of Arsenic, Mercury, Lead and Cadmium. Environmental Factors Affecting Metal Toxicity- Effect of Light, Temperature & PH. Diagnosis of toxic changes in liver and kidneys: Metabolism of Haloalkanes. Haloalkenes & Paracetomol with their toxic effects on tissues.

UNIT-V

Air pollution: common air pollutants and their sources. Air pollution & ozone.Air pollution due to chloroflurocarbons (CFCS) and asbestos. Occupational toxicology and assessment of

occupational hazards: industrial effluent toxicology & environmental health. An overview of regulatory agencies: responsibilities of regulatory agencies. Management of toxicological risks. Regulatory approaches. Regulatory systems and organizations.

References:

1. Casarett and Doull's Toxicology, III rd edition - Klaassen C D, Amdur M O &Doull J (1986), Macmillan publishing company, New York. 26

2. Industrial Toxicology - Williams P L&Burson J L Van- Nostrand Reinhold, New York,1985

3.Principles and methods of toxicology, II nd edition -Hayes A W, Raven press New York, 1988

4. Toxicology, Vol I - Stewart C P&Stolman A Academic press, New York, 1960

OPEN ELECTIVE

PAPER-2

(to choose 1 out of 3)

A. HERBAL MEDICINE

Unit I Ethnomedicine

Ethnomedicine: Definition, history and scope. Collection of ethnic information.Importance of medicinal plants: Role in human health care.Introduction to basic concepts of folk medicine and Ayurveda, Naturopathy and Yoga: methods of disease diagnosis and treatment.

Unit II Importance of medicinal plants – role in human health care – health and balanced diet (Role of proteins, carbohydrates, lipids and vitamins).

Unit III Tribal medicine – methods of disease diagnosis and **t**reatment – Plants in folk religion – Aegle marmelos, Ficus benghalensis, Curcuma domestica, Cyanodon dactylon and Sesamum indicum.

Unit IV Traditional knowledge and utility of some medicinal plants in Tamilnadu – Solanum trilobatum, Cardiospermum halicacabum, Vitex negundo, Adathoda vasica, Azadirachta indica, Gloriosa superba, Eclipta alba, Aristolochia indica and Phyllanthus fraternus.

Unit V Plants in day today life – Ocimum sanctum, Centella asiatica, Cassia auriculata, Aloe vera. Nutritive and medicinal value of some fruits (Guava, Sapota, Orange, Mango, Banana, Lemon, Pomegranate) and vegetables - Greens (Moringa, Solanum nigrum Cabbage).

References

- Ethnobiology – R.K.Sinha & Shweta Sinha. Surabhe Publications – Jaipur. 2001
- Tribal medicine – D.C. Pal & S.K. Jain Naya Prakash, 206,
- Bidhan Sarani, Calcutta , 1998
- Contribution to Indian ethnobotany – S.K. Jain, 3rd edition, Scientific publishers, B.No. 91, Jodhpur, India. 2001
- A Manual of Ethnobotany – S.K.Jain, 2nd edition, 1995.

OPEN ELECTIVE

PAPER-2

B. HERBAL DRUG DEVELOPMENT

UNIT 1 GENERAL METHODS OF PROCESSING OF HERBS:
Definition, sources, identification and authentification of herbs. Different methods of processing of herbs like collection, harvesting, garbling, packing and storage conditions. Methods of drying – Natural and artificial drying methods with their merits and demerits.

UNIT II METHODS OF PREPARATION AND STANDARDIZATION OF HERBAL RAW MATERIALS AND EXTRACTS
Principles of extraction and selection of suitable extraction method with their merits and demerits.Standardization of herbal raw materials including Pharmacognostical, physical, chemical and biological methods with examples

UNIT III. ISOLATION AND ESTIMATION OF PHYTOCONSTITUENTS
Different methods (including industrial) for isolation and estimation of phytoconstituents from the following drugs (with special emphasis on HPLC and HPTLC).Alicin from Garlic.Piperine from Piper nigram / Piper longum. Bacosides from Bacopa monnier.Berberine from Berberis aristata.

UNIT IV HERBAL FORMULATION DEVELOPMENT:
Selection of herbal ingredients. Different dosage forms of herbal drugs. Evaluation of different dosage forms. Stability studies of herbal formulations

UNIT V HERBAL COSMETICS
Cosmetics preparations: Incorporating the herbal extracts in various cosmetic formulations like Skin care preparations (Creams and Lotions), Sunscreens and Sunburn applications, Hair care preparations (Hair oils and Hair shampoos) and Beautifying preparations(Lipsticks, Face powders and Nail polish).

Text Books

- Herbal drug industry by R.D. Choudhary, Ist edition, eastern publisher, New Delhi: 1996.
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PAPER-2

C. ORGANIC FARMING

UNIT I Concept of organic farming

Introduction:Farming,organicfarming, concept and development of organic farming. Principles and Types of organicfarming3. Benefits of organic farming.

UNIT II Organic plant nutrient management1.

Organic farming systems- Soiltillage- Land preparation and mulching Water management

UNIT III Organic plant protection

Plant protection-cultural-mechanical- -biopesticide-biocontrolagents-organic vermicompost .

UNIT IV Organic crop productionpractices

Organic crop production methods-rice-vegetables- amaranthus-medicinal and aromatics plants , Income generation activities: Apiculture, Mushroom production, Terrace farming .Quality of Organic Food,-natural source for antioxidants for health defence-antioxidant capacity of fruits and vegetables

UNIT V Entrepreneurship Development

Organic food and human health -organic certification process -marketing of organic product to increase Entrepreneurship -Dates Processing & Packaging - production of Fruit Juices, Making of Organic Jams, Production of Organic Honey

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