KANNUR UNIVERSITY

(Abstract)

M.Sc. Biochemistry Programme- Scheme, Syllabus, Pattern of Question Paper & Model Question Paper under Choice Based Credit and Semester System (in Outcome Based Education System-OBE) in Affiliated Colleges- Implemented with effect from 2023 Admission-Approved --Orders issued

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ACADEMIC C SECTION

ACAD C/ACAD C1/11165/2023 Dated: 22.11.2023

Read:-1.G.O. (Rt) No.1144/2022/HEDN Dated 26.07.2022

2.U. O. No. ACAD A/ASO A2/14768/2022 dated 11.06.2023

3.Syllabus of M.Sc Biochemistry programme submitted by the Principal, SSITS vide e-mail dtd.05.06.2023

4. Orders of Vice Chancellor in file of even No. dated 05.08.2023.

5. Letter No. Acad C1/1165/2023 dtd.22.08.2023.

6.Remarks furnished by the Dean, Faculty of Science vide e-mail dtd. 23.09.2023

7.Letter of even No. dated 13.10.2023

8.Syllabus resubmitted by the Principal, SSITS, Thaliparamba vide e mail dtd 01.11.2023

9. E mail dtd 06.11.2023 from Dean Faculty of Science

10.Orders of Vice Chancellor in file of even No. dated 22 -11 -2023.

ORDER

1. As per paper read (1) above, sanction has been accorded by the Government, to start M. Sc. Biochemistry Programme (CBCSS) at Sir Syed Institute for Technical Studies, Karimbam and University has granted provisional affiliation for the same during the academic year 2023-24 vide paper(2) above.

2.In the circumstance of nonexistence of Board of Studies, and considering the exigency of matter, as ordered by the Vice- chancellor (Paper read 4) the syllabus of the programme, prepared and submitted by the College authorities (Paper read 3) was forwarded to the Dean, Faculty of Science for scrutiny (vide Paper read 5)

3.After vetting the syllabus, the Dean, Faculty of Science vide paper read (6) put forth some suggestions / remarks and the same has been forwarded to the Principal, SSITS, vide Paper read 7 above, for incorporating in the syllabus .

4. The Principal Syed Institute for Technical Studies (SSITS) , vide Paper read 8 above, resubmitted the revised draft scheme, syllabus, Pattern of Question Paper & Model Question paper of M.Sc. Biochemistry Programme under Choice Based Credit and Semester System (in OBE- Outcome Based Education) after incorporating the suggestions put forth by the Dean Faculty of Science and also prepared in accordance with the PG Regulation 2023 of Affiliated colleges, for implementation w.e.f. 2023 admission and the Dean, Faculty of Science vide Paper Read 9 above, recommended that the draft syllabus can be considered for approval.

5.The Vice Chancellor, after considering the matter in detail and in exercise of the powers of the Academic Council conferred under 11(1) Chapter III of Kannur University Act, 1996 and all other enabling provisions read together with, **accorded sanction to implement the scheme, syllabus, Pattern of Question Paper & Model Question paper of M.Sc. Biochemistry**

Programme under Choice Based Credit and Semester System(in OBE-Outcome Based Education System) in Affiliated Colleges under the University w. e. f. 2023 admission, subject to report to the Academic Council.

6. The scheme, syllabus, Pattern of Question Paper & Model Question paper of M.Sc. Biochemistry Programme under Choice Based Credit and Semester (in OBE-Outcome Based Education System) in Affiliated Colleges under the University w. e. f 2023 admission, is uploaded in the University website.

7. Therefore, Orders are issued accordingly.

Sd/-

Narayanadas K

DEPUTY REGISTRAR (ACAD)

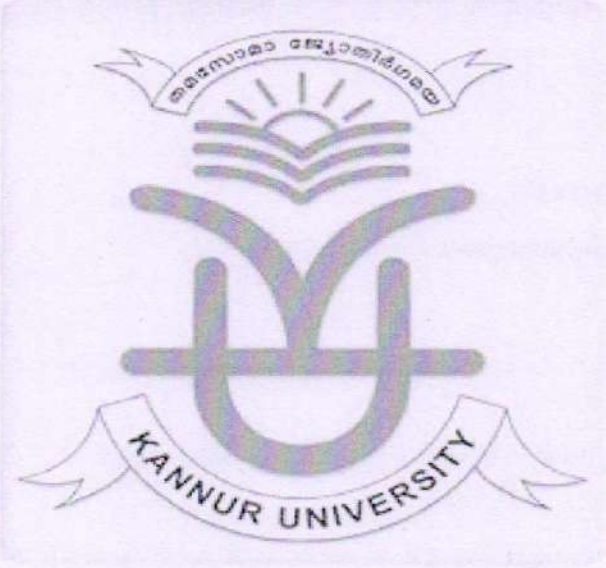
For REGISTRAR

To: 1. The Principal, Sir Syed Institute for Technical Studies, Taliparamba
2. Convener, curriculum committee.

Copy To: 1. The Examination Branch (through PA to CE)
2. PS to VC/PA to PVC/PA to Registrar
3. DR/ARI Academic, EXCI
4.The Computer Programmer
5. Web manager (For uploading in the website)
6. SF/DF/FC
7. EP V Section.

Forwarded /By Order

SECTION OFFICER



KANNUR UNIVERSITY

Course Structure and Syllabus

for

M.Sc. Biochemistry Programme

under

Curriculum for Choice Based Credit and Semester System for Postgraduate Programme in Affiliated Colleges - 2023

(OBE - Outcome Based Education - system)

Kannur University

Thavakkara, Civil Station P.O.

Kannur District.

Kerala 670 002, India.

Prepared by:

1. Mrs. Anila Aneesh
2. Mrs. Aiswarya V V
3. Mrs. Aswathi Sreenivasan C V

(Asst. Professors, Dept of Biochemistry, SSITS, Taliparamba)

Verified by:

Mrs. Veena G O,

Asst. Professor & HoD, Dept of Biochemistry, SSITS, Taliparamba

ELIGIBILITY

Qualification: Candidates with the following B.Sc. degrees are eligible for admission to M.Sc. Biochemistry Programme:

B.Sc. Degree (BSc Biochemistry/Biotechnology/Zoology/Botany/ Plant Science/ Life Science/ Microbiology) of Kannur University or an equivalent degree of any other University recognized by thisUniversity or with any other subjects with Biochemistry as one of the subjects of study at UG level with not less than 50% marks or equivalent GPA in Core Course/Part III excluding Complimentary Courses/subsidiaries.

Age and other criteria: As per the Kannur University PG Regulations on Admission.

INTRODUCTION

M.Sc. in Biochemistry or Master of Science in Biochemistry is a two-year full-time postgraduate degree programme that deals with the study and application of various chemical procedures and their analysis including respirations, metabolism at a cellular level or a molecule level in a living organism.

Biochemical understanding is fundamental to all biological disciplines. While much of modern biochemistry aims to provide an understanding of fundamental biological processes at a molecular level, it also contributes to the solving of medical problems and the discovery of safe and effective drugs.

Vision

The vision of our Post Graduate Programme in Biochemistry is to empower students with a deep understanding of the molecular mechanisms that govern life, fostering a curiosity-driven approach to scientific inquiry. We aim to cultivate future leaders in the field who will drive groundbreaking research, advance medical discoveries, and address pressing global challenges through their comprehensive knowledge of biochemistry and its interdisciplinary applications. We envision shaping visionary scientists who will shape the future of biochemistry and contribute significantly to scientific progress and societal well-being.

Mission

The mission of our Post Graduate Programme in Biochemistry is to provide a rigorous and comprehensive education that equips students with advanced knowledge and research skills in biochemistry. We are dedicated to fostering critical thinking, interdisciplinary collaboration, and ethical conduct in our students. Our program aims to produce graduates who excel in biochemical research, contribute to scientific advancements, and address real-world challenges. We are committed to creating a dynamic learning environment that empowers students to become leaders in the field of biochemistry and make a positive impact on society.

Scheme of the M.Sc. Biochemistry Programme

(2023 Admission)

SEMESTER I

Sl. No.	Course Code	Name of the course	Credit	Teaching hours per week	CE Mark	ESE Mark
C	**Core Courses**					
1	MSBCH01C01	Basic Biochemistry	4	4	10	40
2	MSBCH01C02	General Microbiology	4	4	10	40
3	MSBCH01C03	Cellular Biochemistry	4	4	10	40
4	MSBCH01C04	Genetics	4	4	10	40
5	MSBCH01C05	Practical I (Basic Biochemistry and Genetics)		5		
6	MSBCH01C06	Practical II (General Microbiology&Cellular Biochemistry)		4		
		Total	16	25	40	160

Note: End semester examinations for practical courses shall be conducted at the end of second semester

SEMESTER II

	Course Code	Name of the Course	Credit	Teaching hours per week	CE Mark	ESE Mark
	Core Courses					
7	MSBCH02C07	Immunology	4	5	10	40
8	MSBCH02C08	Molecular Biology	4	4	10	40
9	MSBCH02C09	Enzymology	4	4	10	40
10	MSBCH01C05	Practical I (Basic Biochemistry and Genetics)	2		10	40
11	MSBCH01C06	Practical II (General Microbiology&Cellular Biochemistry)	2		10	40
12	MSBCH02C10	Practical III (Enzymology)	2	4	10	40
13	MSBCH02C11	Practical IV (Immunology& Molecular Biology)	2	4	10	40
14	MSBCH02C12	Internship / Field visit/ Minor project within Institution *	1		10	40
	Elective Courses (Students can choose one course from the given courses)					
15	MSBCH02E01	**Analytical Biochemistry**	3	4	10	40

16	MSBCH02E02	Cancer Biology	3	4	10	40
17	MSBCH02E03	Neuro Biology	3	4	10	40
		Total	24	25	90	360

* Internship / mini project of minimum 30-hour duration

SEMESTER III

	SI	Paper	Credit	Teaching hours per week	CE Mark	ESE Mark
	Core Courses					
18	MSBCH03C13	Metabolism & Regulation	3	3	10	40
19	MSBCH03C14	Clinical biochemistry	3	3	10	40
20	MSBCH03C15	Genetic engineering	3	3	10	40
21	MSBCH03C16	Practical V (Metabolism & Regulation and Genetic engineering)		4		
22	MSBCH03C17	Practical VI (Clinical biochemistry)		4		

	Elective Courses (Students can choose one course from the given courses)					
23	MSBCH03E04	Bioinformatics	3	4	10	40
24	MSBCH03E05	Biosafety and Bioethics	3	4	10	40
25	MSBCH03E06	Stem cell and Regenerative biology	3	4	10	40
	Open Elective Courses (Students can choose one open elective course either from the parent institute or from other institutes)					
26	MSBCH03O01	Intellectual Property Rights	4	4	10	40
27	MSBCH03O02	Proteomics	4	4	10	40
28	MSBCH03O03	Plant and Animal Cell Culture	4	4	10	40
		Total	16	25	50	200

Note: End semester examinations for practical courses shall be conducted at the end of fourth semester

SEMESTER IV

	SI	Paper	Credit	Teaching hours per week	CE Mark	ESE Mark
	Core Courses					
29	MSBCH04C18	Nutritional Biochemistry	3	4	10	40

30	MSBCH04C19	Plant Biochemistry	3	4	10	40
31	MSBCH04C20	Molecular Endocrinology	3	3	10	40
32	MSBCH03C16	Practical V (Metabolism & Regulation and Genetic engineering)	2		10	40
33	MSBCH03C17	Practical VI (Clinical biochemistry)	2		10	40
34	MSBCH04C21	Practical VII (Nutritional Biochemistry & Plant Biochemistry	2	4	10	40
35	MSBCH04C22	Project	6	6	10	40
	Elective Courses (Students can choose one course from the given courses)					
36	MSBCH04E07	Biostatistics	3	4	10	40
37	MSBCH04E08	Developmental Biology	3	4	10	40
38	MSBCH04E09	Pharmacology And Toxicology	3	4	10	40
			24	25	80	320

MSBCH01C01: BASIC BIOCHEMISTRY [Contact hours: 56]

Course Learning Outcomes:

Upon successfully completing this course, the student will be able to

1. Explain the structure, function and importance of carbohydrate
2. Explain the structure & function of amino acid & proteins.
3. Analyze the structure& function of lipids.
4. Interpret the basic structure & function of nucleic acid.

Module I: (14 hrs.)

Molecular logic of Life, Water-structure, Biological buffer system, Major constituents of cells, Biomolecules, Carbohydrates: Classification, structure, Chemical properties of carbohydrates, reactions of monosaccharides, formation of glycosidic bond, oligosaccharides, chemistry and biological role of homo and heteropolysaccharides; Structural polysaccharides (Cellulose and Chitin), storage polysaccharides (Starch, Glycogen and Inulin), Mucopolysaccharides, Blood group substances, Peptidoglycans.

Module II: (14 hrs.)

Amino acids: Classification, structure and physico-chemical properties of amino acids, Essential and non-essential amino acids, Acid base properties and general reactions of amino acids, Nonprotein or unusual amino acids, Peptide bond formation and stability

Proteins: Classification of proteins, structural organization of proteins-Primary, Secondary, Tertiary and Quaternary structure, confirmation of proteins- Quaternary structure-hemoglobin. Conformation of proteins: Ramachandran plot, Domains, Motif and Folds. Denaturation, isoelectric precipitation and folding of proteins.

Module III: (14 hrs.)

Lipids: Classification of lipids, Structure and properties of fatty acids, waxes, phospholipids, cerebrosides and gangliosides, lipoproteins, Structure and functions of prostaglandins, Prostacyclin, Leukotrienes, steroids and bile acids.

Module IV: (14 hrs.)

Nucleic acids: Definition, Classification, Purines and pyrimidines, nucleosides and nucleotides, Watson - Crick Model of DNA, A, B and Z DNA, RNA: Types of RNA; mRNA, tRNA, and rRNA.

References

1. Leininger's Principle of Biochemistry. Nelson L D and M M Cox. Macmillan Worth Publication Inc.
2. Biochemistry. Jeremy M. Berg John and Tymoczko LubertStryer. W H Freeman & Co. NY.
3. Biochemistry with Clinical Correlation. Thomas M Devlin. Wiley- Liss Publication.
4. Biochemistry. Donald Voet, Judith G Voet, Charlottewpratt. John Wiley and Sons.
5. Biochemistry. JeoffreryZubay. Wm C Brown Pub.
6. Biochemistry. Mathews C K and KE van Holde. Benjamin Cumming Pub. Co.
7. Biophysical chemistry. Cantor and Schimmel. W H Freeman & Co. NY.
8. Biochemistry. Jeremy M. Berg John and TymoczkoLubertStryer. W H Freeman & Co. NY.
9. Biochemistry with Clinical Correlation. Thomas M Devlin. Wiley- Liss Publication.
10. Biochemistry. Donald Voet, Judith G Voet, Charlottewpratt. John Wiley and Sons.
11. Biochemistry. JeoffreryZubay. Wm C Brown Pub.
12. Biochemistry. Mathews C K and KE van Holde. Benjamin Cumming Pub. Co.

MSBCH01C02: GENERAL MICROBIOLOGY [Contact hours: 60]

Course Learning Outcomes:

Upon successfully completing this course, the student will be able to

1. To analyze the structure and function of plasma membrane and various transport mechanism
2. To analyze Cytoskeleton, Cellular organelles and organization of chromosome.
3. To Explain Cell communication and cell signaling
4. To interpret cell cycle, cancer and apoptosis.

Module I **(15 hrs)**

Introduction to microbiology: The importance of microorganisms, Microorganisms and their natural environment. History and scope of microbiology. Major divisions of life: Domains & kingdoms, Principles of bacterial taxonomy- Numerical taxonomy, identifying characters -morphological, physiological, biochemical and molecular characters, Major categories and groups of Eubacteria and Archaebacteria. Morphology and reproduction of algae, and fungi. General properties and classification of viruses. Bacteriophages viroid's and Prions.

Module II **(15 hrs)**

The study of microbial structure: Microscopy: Bright field, Dark field, fluorescent, phase contrast and electron microscopes. Specimen preparation and staining: Principles and types of staining, Fungal staining, Determination of bacterial motility-Hanging drop method. Controlling microbial growth: Physical control methods, chemical control methods. Evaluation of antimicrobial agent effectiveness. Determination of antibiotic sensitivity.

Module III **(15 hrs)**

An overview of microbial world: Prokaryotic cell structure and function, Prokaryotic cell organization, prokaryotic cell membranes, intra cytoplasmic membrane, the cytoplasmic matrix, inclusions, bacterial cytoskeleton, the nucleoid, ultra structure of prokaryotic cell wall, Antibiotics inhibiting cell wall synthesis, the outer membrane proteins and antibiotic influx in Gram negative bacteria. Components external to the cell wall (capsule, s lime layer, S layer), bacterial pili, and fimbriae, bacterial flagella, flagellar movement twitching and gliding motility. The bacterial endospore- structure and resistance, sporulation.

Module IV **(15 hrs)**

Microbial Growth: The growth curve, Measurement of microbial growth: Cell mass and cell numbers. Continuous culture of microorganisms-Chemostat and turbidostat. Influence of environmental factors on microbial growth. Microbial growth in natural environment- cell to cell communication within microbial populations. Microbial nutrition: the nutrient requirements. Isolation of pure cultures-Enrichment culturing, dilution plating, Spread, streak plate, uptake of nutrients by the cell, passive processes and active processes, iron uptake, Preservation of microbial cultures-sub culturing, Overlaying cultures with mineral oils, lyophilization, storage at low temperatures.

References:

1. Pelczar MJ Jr., Chan ECS and Kreig NR., Microbiology, 5th Edition, (1998) Tata McGraw Hill.
2. Prescott's Microbiology,11th Edition, (2019) Joanne Willey, Kathleen Sandman and Dorothy Wood. Mc Graw-Hill
3. General Microbiology ,5th Edition, Roger Y Stanier
4. Brock biology of Microorganisms,16th Edition, Michael T Madigan, Kelly S. Bender, Daniel H. Buckley, David A. Stahl and Thomas Brock, Pearson higher Ed,2021
5. Microbiology: An Introduction,13th Edition, (2018) Gerard J Tortora, Berdell R Funke and Christi5.ne L. Case, Pearson Benjamin Cummings

6.Textbook of Microbiology 12th Edition, (2022) Ananthanarayan, Paniker, Universities Press

MSBCH01C03: CELLULAR BIOCHEMISTRY [Contact hours: 56]

Course Learning Outcomes:

Upon successfully completing this course, the student will be able to

1. To explain the structure and function of plasma membrane and various transport mechanism
2. To explain the about Cytoskeleton, Cellular organelles and organization of chromosome
3. To interpret Cell communication and cell signaling
4. To explain the cell cycle, cancer and apoptosis.

Module I: (14 hrs.)

Plasma membrane: Structure and functions of plasma membrane, characteristics of fluid mosaic model, biochemical composition, lipid anchored membrane proteins, Role of plasma membrane in cell signaling. Transport mechanism, passive and active transport, co-transport, symport, antiport, uniport, ion channels, bulk transport, endocytosis, exocytosis, phagocytosis, pinocytosis. Role of clathrin, COPI and COPII in transport.

Module II: (14 hrs.)

Cytoskeleton and organization, microtubules, microfilaments and intermediary filaments. Structure and function of nucleus and nucleolus. Morphology of chromosomes. Structure and functions of mitochondria, lysosome, endoplasmic reticulum, Golgi complex, and ribosomes. Transport from ER to Golgi complex, protein sorting in TGN, glycosylation in Golgi complex. Packaging of genetic material: nucleosome model. Organization of chromatin: chromosome structure.

Module III: (14 hrs.)

Cell communication :General principles of cell communication, cell adhesion, roles of different adhesion molecules, cellular junction types, their role, extracellular matrix components, Cell-cell and cell- matrix interaction. Cell signaling: receptors, signaling through G protein coupled receptors.

Module IV: (14 hrs.)

Cell cycle: Molecular control of cell cycle. Cancer biology: Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer & the cell cycle. Interaction of cancer cells with normal cells, apoptosis.

References

1. Cell biology- concepts and experiments. Gerald Karp. Mc Graw Hill.
2. Cell and molecular biology. De Robertis. Holt- Saunders.
3. Lehninger's Principles of Biochemistry. Nelson D. L. and Cox M. M..Fourth edition, W. H. Freeman & Co. New York.
4. Molecular biology of the cell. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Roff, Keeth Roberts, Peter Walter. Garland Science Taylor and Francis group.
5. The world of the cell. Becker, Kleinsmith, Wayne M Lewis J. Pearson edn.
6. The cell- molecular approach. Geoffrey M. Cooper, Robert E. Housman. ASM press

MSBCH01C04: GENETICS [Contact hours: 60]

Course Learning Outcomes:

Upon successfully completing this course, the student will be able to

1. To explain the fundamental genetics
2. To analyze genetic problems
3. To analyze the linkage and crossing over, chromosomal disorders
4. To explain the population genetics and its applications

Module **(17 hrs)**

Fundamentals of genetics: Mendelian genetics, Complete, incomplete dominance & codominance. Applying chi square in Mendelian Genetics. Multiple alleles, Lethal alleles, Epistasis. Epigenetics & trans generational epigenetics. Sex determination mechanism & dosage compensation. Sex limited & sex influenced traits. Chromosomal and genic balance theory of sex determination. Extra chromosomal inheritance: Criteria for extra chromosomal inheritance. Maternal Inheritance in humans (mitochondrial inheritance, Leigh syndrome), cytoplasmic inheritance, Maternal effect. Polygenic inheritance. Human genetic pedigree analysis. Perform a pedigree analysis & interpret the result.

Module II **(13 hrs)**

Linkage and crossing over: Linkage maps, tetrad analysis, Coupling and repulsion hypothesis, theories of crossing over, three-point test cross. Recombination: Homologous and non-homologous

recombination, transposition and site-specific recombination. Bacterial genetics-conjugation, transduction and transformation.

Module III **(15 hrs)**

Cytogenetics- Numerical (Euploidy, Aneuploidy) and Structural alterations (deletion, duplication, inversion, translocation, morphological variations) in chromosomes and their genetic implications. Autosomal/sex chromosomal/sex reversal; Mechanisms – mitotic/meiotic nondisjunction/ chromosomal rearrangements; Some examples (Syndromes/Cancer/Infertility) -Gene mutations.

Module IV **(15 hrs)**

Population genetics: Populations, gene pool, Allelic frequency, genotypic frequency, Hardy-Weinberg law. Concepts and rate of change in gene frequency through mutation, random genetic drift, migration, inbreeding and natural selection. Molecular evolution: concept of neutral evolution, molecular divergence and molecular clocks. Adaptive radiation; Speciation, Isolating mechanisms; Allopatricity and Sympatricity; Convergent evolution; Origin of new genes and proteins; Gene duplication and divergence. Use of various databases for population genetic studies-European Variation Archive, GWAS, gnomAD, dbSNP.

References:-

1. Introduction to genetic analysis (12th ed.) -Griffiths, University Anthony J F, Wessler, University Susan R, Carroll, D. S. B., & Doebley, J. (2020).W.H. Freeman Co.
2. Principles of Genetics (7th ed.)-D. Peter Snustad, Michael J. Simmons (2015) John Wiley
3. Genetics: A conceptual approach (7th ed.)-Benjamin A Pierce et al. (2019) W H Freeman & Co
4. i Genetics-A molecular approach-Peter J Russell(2015) Pearson education(3rd ed.)Pearson College Div; Solution Manual, Student, Study Guide edition
5. Concepts of genetics (12th ed.) -William Klug,Michael Cummings,Spencer *et al* (2019) Pearson
6. Lewin's Genes XII-Jocelyn E Krebs,Elliott S Goldstein et al (2017) Jones and Bartlett Publishers, Inc

7. Strickberger's Evolution (5th ed.) -Brian K Hall & Benedikt Hallgrimssòn (2013) Jones and Bartlett Publishers, In

MSBCH01C05-PRACTICAL I

Course Learning Outcomes:

Upon successfully completing this course, the students will be able to

1. Analyse carbohydrates and proteins
2. Calculate the level of serum cholesterol
3. Calculate the level of blood glucose
4. Explain the process of bacterial conjugation experimentally
5. Formulate the protocol for transformation
6. Analyse Barr body

Experiments

1. Qualitative analysis of carbohydrates
2. Qualitative analysis of proteins
3. Qualitative analysis of lipids
4. Quantitative estimation of serum cholesterol
5. Quantitative estimation of protein
6. Quantitative estimation of blood glucose
7. Bacterial conjugation experiment

8. Transformation.
9. Detection of Barr body in Buccal epithelial Smear
10. Human karyotype analysis
11. Genetic problems

MSBCH01C06- PRACTICAL II

Course Learning Outcomes:

Upon successfully completing this course, the students will be able to

1. Categorize mitosis and meiosis
2. Create thin sections of tissues and stain with tissue specific stains
3. Calculate the quantity of DNA by Diphenylamine method
4. Calculate the quantity of RNA by Orcinol method
5. Analyse micrometry
6. Formulate the protocol for staining of micro-organisms
7. Define anaerobic cultivation
8. Create protocol for microbial culturing

Experiments:

1. Mitosis.
2. Meiosis.

3. Polytene chromosome staining
4. Cell fractionation.
5. Preparation of thin sections of tissues and staining with tissue specific stains (Toluidine blue, Orange G, Safranin etc.)
6. Estimation of DNA by Diphenylamine test.
7. Estimation of RNA by Orcinol method.
8. Micrometry: measurement of microorganisms.
9. Motility determination: hanging drop method.
10. Staining: simple, Gram's, acid-fast, spore, capsule and granular staining.
11. Media preparation: liquid, solid. -Differential, Selective
12. Pure culture techniques: streak plate, pour plate, spread plate.
13. Anaerobic cultivation: RCM, anaerobic jar.
14. Biochemical tests for identification of bacteria.

MSBCH02C07: IMMUNOLOGY [Contact hours: 56]

Course Learning Outcomes:

Upon successfully completing this course, the student will be able to

1. To study the cells and organs of immune system
2. To explain the immunity and immune mechanism
3. To know the antigen antibody interactions
4. To understand hypersensitivity reactions

Module I(12HRS)

Lymphoid organs (primary and secondary), organization of immune system, Types of immunity-Natural and acquired, specific and non-specific immune response. Cells and organs of immune system, antigenic determinants/Epitopes.Haptens, adjuvants, classification, structure and biological functions of immunoglobulins, Isotypes, allotypes and idiotypes.

Module II (12HRS)

Active and passive immunity, Humoral and cell mediated immune response, T-Cell and B-Cellactivation.Antigen presenting cells (APCs), Antigen processing and presentation. T-Cell and BCell receptors, Complement system, Alternate and classical pathways of complement activation.

Module III (18HRS)

Antigen-antibody interactions, precipitation reactions-immune diffusion, radial immune diffusion, immunoelectrophoresis, immunofluorescence, Western blotting, Hybridoma Technology, Production of polyclonal and monoclonal antibodies and their application. Theories of antibody formation. Cytokines. Disorders of immune response-Hypersensitivity, Basic concepts, types of hypersensitivity, Autoimmune diseases-Hashimoto's thyroiditis, RA.

Module IV (14HRS)

Complement fixation tests. Major histocompatibility complex (MHC). Immunodeficiencies, AIDS. Cancer immune therapy. Graft rejection, HLA typing, Immunosuppressive drugs (cyclosporine, methotrexate, steroids), RIA and ELISA.

Reference:

1. KUBY Immunology, Judith A. Owen, Jenni Punt, Sharon A. Stranford, Patricia P. Jones, 2013, 7thEdn. W. H.Freeman and Company • New York.

2. Textbook of Microbiology and Immunology, Subhash Chandra Parija, 2012, 2ndEdn., Elsevier India PrivateLimited.

3. A text book of Microbiology, Ananthanaryana and Paniker, 2005, 7thEdn., Orient longman private limited.

4. Roitt'sEssential immunology – Peter J. Delves, Seamus J. Martin Dennis R. Burton, Ivan M. Roitt, 2017 13th, John Wiley and Sons, Ltd.

5. World of Microbiology and Immunology K. Lee Lerner and Brenda Wilmoth Lerner, 2003 1stEdn., The GaleGroup, Inc,Thomson Learning.

6. Immunology – a short course elibezamini and Sidney Leskowitz, Alan R. Lisi Inc. New York, 1988.

7. Immunology III, Joseph A. Bellantilgaku – Shein Saunders International Ed. 1985.

8. Immunology at a glance J.H. L. Playfeir 4th Ed. Blackwell Scientific Publication 1987.

MSBCH02C08: MOLECULAR BIOLOGY [Contact hours: 56]

Course Learning Outcomes:

Upon successfully completing this course, the student will be able to

1. To analyse about replication, Mutation and Repair.
2. Toexplain the mechanism of transcription
3. To interpret various steps involved in protein synthesis
4. To explain regulation of Gene expression in prokaryotes and eukaryotes.

Module I -Replication. (14hrs)

Classical experiments in Molecular Biology. Replication in prokaryotes and eukaryotes: enzymes and protein factors, Mechanism of replication, Cellularcontrol.Telomeres, telomerase and end replication, role of telomerase in aging and cancer. Mutation and Repair - mutation subtypes, mismatch, base-excision, nucleotide excision and direct repair. DNA recombination - homologous, non - homologous and site-specific.

Module II– Transcription (14hrs)

Prokaryotic and eukaryotic transcription - RNA polymerases - general and specific transcription factors- regulatory elements. Mechanism of transcription regulation and transcription termination. Post-transcriptional modification – of mRNA, tRNA and rRNA, RNA Splicing. Inhibitors of transcription.

Module III– Translation (14hrs)

Genetic code - Prokaryotic and eukaryotic translation - translational machinery. Mechanism of initiation - elongation and termination. Regulation of translation. Inhibitors of translation. Post translational modification of proteins.

Module IV-Regulation of Gene Expression (14hrs).

Regulation of Gene expression in prokaryotes: induction and repression. Operon model-Lac operon, tryptophan operon and Arabinose operon. Regulation of Gene expression in eukaryotes: interaction with RNA, DNA binding proteins Gene dosage, Gene amplification, regulatory transcription factors, Histone acetylation and deacetylation.

References

1. Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., Losick, R. (2014) Molecular Biology of Gene. Cold Spring harbor, New York.

2. Nelson, D.L. and Cox, M.M. (2012) Lehninger's Principle of Biochemistry. W.H. Freeman, New York.

3. Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A., Martin, K.C. (2016) Molecular Cell Biology. W.H. Freeman, New York.

4. Krebs, J.E., Goldstein, E.S., Kilpatrick, S.T. (2014) Lewin's Gene XI. Jones and Bartlett Learning, Massachusetts.

MSBCH02C09: ENZYMOLOGY [Contact hours: 56]

Course Learning Outcomes:

Upon successfully completing this course, the student will be able to

1. To explain the nomenclature, methods of isolation and purification, activity and uses of enzymes.
2. To analyse the structure and function of enzymes.
3. To explain the enzyme kinetics and kinetic parameters
4. To understand the mechanism of enzyme inhibition

Module I (14 hrs.)

Enzymes: basic definitions, nomenclature (EC recommended and classical), enzyme isolation and purification, measurement of enzyme activity, specific activity, molar activity (turn over number), criteria for purity. Coenzymes. Synthetic enzymes,

abzymes, isoenzymes and ribozymes. Use of enzymes in medicine and industry. Immobilized enzymes.

Module II (14 hrs.)

Enzyme structure and function: folding of the polypeptide chain, Activesite and its location, binding site. Allosteric enzymes: Subunit Interactions, regulation of enzyme activity, Jacob and Monod model of allosteric enzymes,Koshland model, detailed discussion using haemoglobin, ATPase (Effects of ATP and CTP) as examples. K-Class and V-Class allosteric enzymes-Structure and their function in metabolism.

Module III (14 hrs.)

Enzyme kinetics: Single substrate –single intermediate, Michaelis –Menten and Briggs Haldane kinetics, graphical analysis of kinetic data, progress curves and linear plots, determination of Vmax and Km–experimental aspects. Importance of Km and Vmax.

Module IV (14 hrs.)

Enzyme inhibition: Mechanisms and rate studies, degree of inhibition, competitive, non-competitive and uncompetitive inhibition, activation, graphical analysis (primary and secondary kinetic plots), two substrate reactions, sequential and Ping –Pong mechanisms, nature of rate equations, examples. Irreversible inhibition. Alteration of Km and Vmax in various types of inhibition. Feedback inhibition.

REFERENCES

1. Palmer, T. Understanding Enzymes, 4th ed., Prentice Hall/Ellis Horwood, London (1995).
HandbookofEnzymeTechnology-AlanWeisman-3rdedPrentice-Hall

2. Price, Nicholas C., and Lewis Stevens. Fundamentals of Enzymology. Oxford Science Publications. Second edition. New York, 2001.
3. Bugg, T. D. H. (2012) Introduction to Enzyme and Coenzyme Chemistry, Third Edition, John Wiley & Sons Ltd, Chichester, UK.
4. Donald Voet and Judith Voet, Fundamentals of Biochemistry, 4nd edition; 2006.
5. Buchholz, Klaus, Volker Kasche, and Uwe Theo Bornscheuer. Biocatalysts and enzyme technology. John Wiley & Sons, 2012.

MSBCH02C10-PRACTICAL III

Course Learning Outcomes:

Course Learning Outcomes:

Upon successfully completing this course, the student will be able to

Experiments:

1. Assay of Alkaline and acid phosphatases in serum samples
2. Assay of serum amylase
3. Effect of pH on enzyme activity
4. Effect of temperature on enzyme activity
5. Effect of substrate concentration on enzyme activity
6. Effect of time on enzyme activity
7. Determination of Michaelis-Menten constant (KM) of an enzyme by Lineweaver-Burk method.

8. Ammonium sulfate fractionation of enzyme and desalting by dialysis/Sephadex G-25filtration

9. Determination of total activity and specific activity of enzymes Trypsin, Pepsin etc

10. Extraction of enzymes from animal tissues and isoenzyme analysis by PAGE

11. Purification of amylase from plant source

MSBCH02C11-PRACTICAL IV

Course Learning Outcomes:

Upon successfully completing this course, the student will be able to

1 Design and apply DNA isolation techniques for purification of DNA from various sources

2. Analyse and quantify DNA.

3.Familiarise the protocol for the isolation of Plant RNA

4. Familiarise the protocol for protein isolation and SDS-PAGE

5. Analyse protein fingerprinting in Bacteria

6. Analyse Bacterial gene expression using lac promoter

7. Demonstrate types of blotting techniques

8.Demonstrate Hemagglutination reaction

9. Demonstrate Immunodiffusion techniques

10. Isolate industrially important microorganism from environment, conduct primary and secondary screening techniques to identify important strains

11.Prepare fermented food and beverages like cheese, yogurt, sauerkraut and wine

12.Perform acid and alcohol estimation of wine

13.Perform immobilization techniques to improve fermentation process

Experiments

1. Extraction genomic of DNA .
2. Extraction of plasmid DNA .
3. Spectrophotometric analysis of purity of isolated DNA
4. Agarose gel electrophoresis of genomic and plasmid DNA
5. Restriction digestion of chromosomal DNA
6. Restriction digestion of plasmid DNA
7. Isolation of DNA fragment from agarose gel
8. Isolation of RNA
9. Analysis of RNA by formaldehyde-agarose electrophoresis
10. Preparation and identification of lymphocytes
11. Haemagglutination reaction.
12. Latex agglutination.
13. Single radial immunodiffusion.
14. Double diffusion in two dimensions.
15. Immunoelectrophoresis.
16. Affinity and ion exchange chromatography
17. Clinical diagnosis of viral diseases by ELISA.

MSBCH02E01: ANALYTICAL BIOCHEMISTRY

[Contact hours: 56]

Course Learning Outcomes:

Upon successfully completing this course, the students will be able to

1. To explain the principle and function of various instruments in biochemistry
2. To interpret about working methods of various type Microscope.
3. To understand different type of separation techniques.
4. To analyze detailed function of chromatography and electrophoresis.

Module I Electrochemical techniques & Photometry- (14hrs)

Basic principles of electrochemistry - pH electrode- ion-selective- gas- sensing and oxygen electrodes - Elementary details of Biosensors. Principles and techniques of colorimetry &spectrophotometry Beer-Lambert's Law - instrumentation - hypo and hyperchromicity - Fluorimetry – Flow cytometry - Atomic absorption spectrometry- Circular Dichroism- Optical rotary Dispersion-Nuclear Magnetic Resonance Spectroscopy – Infra Red Spectroscopy.

Module II Microscopy –(14hrs)

Microscopy- basic principles and applications– Light– Compound– Phase contrast– Dark Field Fluorescence Microscopy Scanning Electron Microscopy - Transmission Electron Microscopy (TEM) - Scanning Tunneling Microscopy- (STM) – Confocal Microscopy.

Module III Centrifugation (12hrs)

Basic principles of Centrifugation – instrumentation, centrifugation units - Types of centrifuges –rotors, accessories - centrifugation methods - sedimentation velocity - sedimentation equilibrium –colloids - cell fractionation methods.

Module IV Chromatography and Electrophoresis(16hrs)

Types of chromatography - column, thin layer, paper, adsorption, partition, gas liquid ion exchange, affinity, High Performance Liquid Chromatography -principles of each type- instrumentation and accessories- detection methods & systems – qualitative and quantitative aspects – applications;

Types of Electrophoresis – paper and gel – agarose and PAGE – pulse field – capillary – isoelectric focusing – blotting techniques: western, Southern & northern. Applications

References

1. James, P. Allen. (2008). Biophysical Chemistry, Wiley Blackwell, New Jersey.

2. Wilson, K. and Walker, J. (2010) Principles and Techniques of Biochemistry and Molecular

Biology, Cambridge University Press, Cambridge.

3 Horst, F. (2010) Basic One and Two-dimensional NMR Spectroscopy, Wiley-VCH, New Jersey.

4. Murphy, D.B. and Davidson, M. W. (2012) Fundamentals of Light Microscopy and Electron Imaging, Wiley-Blackwell, New Jersey.

5. Frei elder, D.M. (1983) Physical Biochemistry- Application to Biochemistry and Molecular Biology, W.H. Freeman, New York

6.. Biophysical chemistry. Cantor and Schimmel. WH Freeman and Company, New York.

MSBCH02E02: CANCER BIOLOGY [Contact hours: 59]

Course Learning Outcomes:

Upon successfully completing this course, the student will be able to

1. To understand about cancer.
2. To explain about cancer cell biology.
3. To analyze about Carcinogenesis & Free radicals and Cancer cell regulation
4. To analyze about diagnosis and treatment of cancer.

Module I (I 7 hrs)

Introduction to Cancer: Growth characteristics of cancers cells. Morphological and ultra structural properties of cancer cells. Types of growth -hyperplasia, dysplasia, anaplasia and neoplasia. Nomenclature of neoplasms. Differences between benign and malignant tumors. Hall marks of cancer. Epidemiology of cancer.

Module II (14hrs)

Cancer cell biology and biochemistry: Aberrant metabolism during cancer development. Warburg effect. Paraneoplastic syndromes. Tumor markers. Cellular proto-oncogenes-oncogenes activation. Growth factors- EGF, TNF-α and TGF-β and growth factor receptors–Signal transduction in cancer –transcription factors- NFAT, NF-kB, SMAD and STAT in cancer. RAS signaling in cancer. Cancer endocrinology.

Module III (14hrs)

Carcinogenesis & Free radicals: Chemical carcinogenesis- stages in chemical carcinogenesis - Initiation, promotion and progression. Ames test. Radiation and Viral carcinogenesis - DNA and RNA viruses in human cancer. Free radicals, antioxidants in cancer.

Cancer cell regulation: Cell Cycle Regulation-Tumor suppressor genes p53, p21, Rb, BRCA1 and BRCA2. Telomeres and Immortality; cell- cell interactions, cell adhesion-invasion and metastasis - VEGF signaling, angiogenesis.

Module IV (14 hrs)

Hypoxia; Epigenetics-Role of DNA methylation in gene silencing- epigenetic silencing; Apoptosis in cancer-cell death by apoptosis–role of caspases; Death signaling pathways-mitochondrial and death receptor pathways. Autophagy in cancer.

Diagnosis and Cancer treatment :Different types of diagnostic approach to detect cancer. Strategies of cancer treatment– chemotherapy - gene therapy; Immunotherapy- Immune checkpoint therapy and CAR T-Cell therapy; Radiotherapy and Cancer vaccines. Resistance against anticancer drugs. Nutrition and cancer management. Phytomedicine in cancer. Cancer drug discovery: genomics and proteomics approach. Cancer stem cells.

References

1. Weinberg, R.A. (2013) The Biology of Cancer, Garland Science, New York.

2. McKinnell, R.G., Parchment, R.E., Perantoni, A.O., Pierce, G.B., Damjanov, I (2006). The Biological Basis of Cancer, Cambridge University Press, Cambridge.

3.Pelengaris, S. and Khan, M. (2013). The Molecular Biology of Cancer. Wiley-Blackwell Publication, New Jersey

4. Alison, M.R. (2003). The Cancer Hand Book. Nature Publishing Group.

5. Hanahan, D. and Weinberg R.A. (2011) Hallmarks of Cancer: The Next Generation. Cell.; 144(5):646-674. doi: 10.1016/j.cell.2011.02.013.27

6. PDQ Cancer Information Summaries. Bethesda (MD): National Cancer Institute (US);

MSBCH02E03: NEUROBIOLOGY[Contacthours:54]

Course Learning Outcomes:

Upon successfully completing this course, the students will be able to

1. To explain developmental Neurobiology
2. To understand neuromorphology and neurocellular anatomy
3. To interpret about neurotransmitters
4. To explain about neurodegenerative diseases

Module I (10hrs)

Developmental Neurobiology: Organogenesis and neuronal multiplication, axonal and dendritic growth, glial multiplication and myelination, growth in size, regeneration and repair mechanisms, plasticity.

Module II (15hrs)

Neuromorphology and neurocellular anatomy: Central nervous system – General features of neurons,cellular organization of neurons, Dendritis and Axons, neurotubules, neurofilaments, synapse neuralgia,astrocytes,oligodendrocyte, ependymal cells, Schwancells.Peripheral nervous system (PNS): Muscle,nerve endings, sensory receptor and effector endings; peripheral nerves, spinal and cranial nerves: Plexuses ganglia, afferent pathway sand sense organs. Spinal cord: Topographical anatomy, spinal nerves, spinal meanings, joint reflexes, gray and white matter of spinal cord.

Module III (15hrs)

Neurotransmitters: Acetylcholine, Dopamine, Norepinephrine, Serotonin, Histamine, Epinephrine, Gamma-aminobutyric acid, Glycine, Glutamate, Aspartate, NO2, and CO -Chemistry, synthesis, storage and release of neurotransmitters, transmitter action, synaptic modulation and mechanism of neuronal integration. Secondary Messengers: Importance of cyclic nucleotides and protein phosphorylation in nervous system. Involvement of protein kinases and calcium in neuronal metabolism. Neuropeptides: Classes of neuropeptides, mode of action, role of neuropeptides in obesity and pain neuro peptide receptors.

Module IV (14 hrs.)

Learning and Memory: Correlation of behavioral and biochemical events, measurement of learning and memory, agents affecting learning and memory, biochemical correlates of excitation, learning and

behavior. Neurodegenerative diseases: Parkinson's, Alzheimer's disease, amyotrophic lateral sclerosis, senile dementia. Psychopharmacology and Biochemical theories of Mental Disorder: Chemistry of neuroleptics and anxiolytics, antidepressants, hallucinogenic agents, biochemical theories of mental disorders.

References

Basic Neurochemistry: Principles of Molecular, Cellular, and Medical Neurobiology (Eighth Edition, 2012, Elsevier Inc.) Edited by: Scott T. Brady, George J. Siegel, R. Wayne Albers and DonaldL. Price.ISBN: 978-0-12-374947-5

1. Elements of Molecular Neurotoxicology: SmithC.U. M,7th ed.2003.

2. Guyton and Hall Textbook of Medical Physiology: 12e (Guyton Physiology), 2010: John E. Hall |ISBN-10:1416045740|ISBN-13: 978-1416045748.

3. John E. Hall PhD (Author) Ganong's Review of Medical Physiology, 24th Edition, 2012 (LangeBasic Science): Kim E Barrett, Susan M. Barman, Scott Boitano, Heddwen L. Brooks. ISBN-10:0071780033|ISBN-13:978-0071780032.

4. Neuroanatomy, 4th Revised edition, 2010 : Alan R. Crossman, David Neary. ISBN-10:0702030864|ISBN-13:978-0702030864.

MSBCH03C13: METABOLISM AND REGULATION [Contact hours: 56]

Course Learning Outcomes:

Upon successfully completing this course, the students will be able to

1. Illustrate the structure of mitochondria and how energy production occur in the organelle. Comprehend the role of oxidative phosphorylation in bioenergetics and ATP generation
2. Explain the metabolism of carbohydrates
3. Compare and contrast aspects of lipid metabolism
4. Discuss the important biochemical steps in the metabolism of amino acids and nucleic acids

Module I (14hrs)

Bioenergetics: Principles of energy, energy transduction, membrane energy interconversions, high energy compounds, standard free energy of hydrolysis of ATP.Mitochondria - ultrastructure, electron transport chain, components and different complexes in detail. Mobile electron carriers. Proton transport during electron flow, inhibitors of electron transport chain. Mitochondrial electron transporters and shuttle systems. Functions of ATP, substrate level phosphorylation, oxidative phosphorylation - mechanisms - energy coupling, chemical and chemiosmotic, conformational coupling, inhibitors and uncouplers, control of oxidative phosphorylation.

Module II (14hrs)

Metabolism of Carbohydrates: Overview of glycolysis, gluconeogenesis, citric acid cycle, galactose and fructose metabolism. Detailed study of regulatory mechanism and energetics. Importance of pyruvate dehydrogenase. Significance of Cori and glyoxylate cycle. Pentose phosphate pathway- significance and regulation machinery. Biosynthesis, degradation& regulation of glycogen.

Module III (12hrs)

Metabolism of Lipids: Introduction, Trasport of fatty acid in to mitochondria, beta-oxidation of fatty acids. De novo synthesis of fatty acids. Biological regulation, significance and energetics of fatty acid metabolism. Metabolism of ketone bodies - Formation, utilization, excretion and clinical significance. Metabolism of triglycerides, phospholipids. Cholesterol – Biosynthesis, regulation, transport and excretion.

Module IV (16hrs)

Metabolism of Amino Acids: Overview of biosynthesis and degradation of amino acids (without structure) Transamination, deamination and decarboxylation reactions of amino acids .Urea cycle-regulation and significance .

Metabolism of Nucleic acids: Nucleotide biosynthesis - de novo and salvage pathways for biosynthesis of purine and pyrimidine. Mechanism of feedback regulation. Biosynthesis of dNTPs. Mechanism of purine and pyrimidine catabolism.

Reference

1. Cox, Michael M. Lehninger, Principles of Biochemistry. Freeman, 2013

2. Tymoczko, John L., Jeremy M. Berg, and LubertStryer. Biochemistry: a short course. Macmillan, 2011.

3. Garrett, Reginald, and Charles Grisham. Biochemistry. Nelson Education, 2012.

4. Voet, Donald, Judith G. Voet, and Charlotte W. Pratt. "Fundamentals of biochemistry." New York: John Wiley & Sons 2008.

5. Zubay, Geoffrey L., William W. Parson, and Dennis E. Vance. Principles of biochemistry: student study art notebook. Wm. C. Brown, 1995

MSBCH03C14 : CLINICAL BIOCHEMISTRY [Contact hours: 56]

Course Learning Outcomes:

Upon successfully completing this course, the students will be able to

1. To understand about specimen collection.
2. To study clinical enzymology and Diseases related to digestion and absorption of foods
3. To understand different disorders of metabolism.
4. To understand about molecular diagnosis of genetic defects.

Module I (14hrs)

Specimen collection and automation Specimen collection and processing: Blood collection methods, anticoagulants. Cerebrospinal fluid (CSF): Composition and collection, gross examination, cell counts, chemical examination and bacteriologic examination. Amniotic fluid: Origin, collection, composition and routine analysis of amniotic fluid. Collection and examination of Synovial fluid, Pleural fluid, Pericardial fluid and Peritoneal fluid. Collection of urine: Timed urine specimens, urine preservatives. Basic concepts and definitions of automation in the clinical laboratory. Multifunction Workstations (Automated Specimen Processing), Total Laboratory Automation Systems. Post assay processing, Signal processing, Data handling and Process control, Instrument clusters, Microtiter plate systems, Automated pipetting stations.

Module II (14hrs)

Clinical enzymology and Diseases related to digestion and absorption of foods: Principles of diagnostic enzymology, Factors affecting enzyme levels in blood. Principle, assay, and clinical significance of transaminases, creatine kinase, lactate, Dehydrogenase, phosphatases, 5'nucleotidase, gamma –glutamyl transferase, amylase, lipase, trypsin, chymotrypsin, choline esterase, glutamate dehydrogenase and glucose -6-phosphate dehydrogenase. Enzyme pattern in diseases: Myocardial infarction, hepatobiliary diseases.

Gastritis and gastric atrophy (hyperacidity), Achlorhydria (hypochlorhydria), Ulcers - Peptic ulcer, Zollinger –Ellison syndrome, Meckel's diverticulum. Pancreatitis, Lactose intolerance, Monosaccharide malabsorption, Disaccharidase deficiency, Steatorrhea, Chyluria, Cholelithiasis, Sprue, Porphyrias.

Module III (14hrs)

Metabolic disorders: Carbohydrate metabolism: Diabetes mellitus, insulin receptors and C-peptide, assay of insulin, proinsulin and insulin antibodies. Hemoglobin AIC, fructosamines, insulin tolerance test, Glycogen storage diseases, galactosemia, fructosuria, pentosuria; plasma lipids and lipoprotein abnormalities: hypercholesterolemia- lipidosis and hypolipoproteinemia's. Disorders of nucleic acid metabolism-hypo and hyperuricemia, gout; Disorders of erythrocyte metabolism- hemoglobinopathies, thalassemias and anemias. Disorders of amino acid metabolism-PKU, tyrosinemia, aminoaciduria's

Module IV (14hrs)

Molecular diagnosis of genetic defects: Diagnosis of genetic diseases by molecular biology techniques (cystic fibrosis, Hemochromatosis, thalassemias, sickle cell diseases) DNA probes; restriction fragment length polymorphism (RFLP); polymerase chain reaction (PCR); amplification of mRNA. AIDS, Clinical diagnosis. Oncogenic enzymology: acid phosphatase, alkaline phosphatase, lactate dehydrogenase. Body fluid constituents of use in oncology.

References

1. Notes on Clinical Biochemistry by John K. Candlish (1992) publisher: World Scientific Publishing Company ISBN: 9810210663 ISBN-13: 9789810210663, 978-9810210663
2. Clinical Biochemistry: Metabolic And Clinical Aspects by William J. Marshall, Stephan K. Bangert, Elizabeth S.M. Ed. S.M (ed) Marshall (2008) Publisher: Elsevier Science Health Science Div ISBN: 0443101868 ISBN-13: 9780443101861, 978-0443101861
3. Biochemistry by John K. Joseph (2006) Publisher: Campus Books International ISBN: 8180301109 ISBN -13: 9788180301100, 978-8180301100
4. Basic Medical Biochemistry: A Clinical Approach by Dawn B PH.D. Marks, Allam D. Marks colleen M. Smith (1996) Publisher; LippincottWilliams& Wilkins; illustrated edition ISBN -10: 068305595X ISBN-13: 978-0683055955
5. Clinical Chemistry, 6/e Ie by William J Marshall, Stephen K Bangert(2008) Publisher: Else ISBN: 0723434603, ISBN-13:978- 0723434603
6. Tietz fundamental of clinical Chemistry, 6/e by Carl A Burits, Edward R Ashwood (2008) publisher: Else ISBN: 8131213749, ISBN-13: 9788131213742,978-8131213742

MSBCH03C15: GENETIC ENGINEERING (Contact hours: 55]

Course Learning Outcomes:

Upon successfully completing this course, the student will be able to

1. To Understand the basic principles of r DNA technology.
2. To get clear idea about cloning methods and gene library construction
3. To explain the protein expression systems and vectors.
4. To comprehend transgenic animals and applications of r DNA technology

Module I (13hrs)

Recombinant DNA technology: basic principles of recombinant DNA technology, restriction endonuclease; cloning vectors: plasmid vectors, phage vectors, cosmids, high capacity cloning vectors-BACS, YACS, PACS and human artificial chromosomes; gene transfer methods:physical,chemical and biological Screening of recombinants: marker inactivation,nucleicacid hybridization and immunological screening for expressed genes.

Module II (15hrs)

Cloning strategies: Directional Cloning, Bluntendedcloning; Cloning of fusion proteins; Introducing tags to cloned proteins. Library Construction: cDNA and genomic DNA libraries, cDNA cloning and cloning from genomic DNA. Techniques in gene manipulation: Site directed mutagenesis; Random mutagenesis using PCR; protein engineering to improve enzymes, DNA shuffling.

Module III (15hrs)

Expression systems: Expression vectors for optimum protein synthesis, solubilization of expressed proteins. Tet-on and Tet-Off systems. Prokaryotic expression systems; Eukaryotic expression systems; Insect cell expression systems-baculovirustransfer vector.

Module IV (12hrs)

Transgenic Animals/ Cells: Transgenic animal, Retroviral DNA micro injection and engineered stem cells methods for producing transgenic mice. Whole-body Knockouts and

conditional knockouts. Use of TALEN, ZFN and CRISPR-CAS in genome editing. Applications of recombinant DNA technology: production of therapeuticproteins, GMO.

References:

1) Rapley, RalphandDavidWhitehouse,eds.Molecularbiologyandbiotechnology.RoyalSocietyof Chemistry, 2014.
2) U.Satyanarayana, Biotechnology,BooksAndAllied(p)Limited,2013.
3) JamesD.Watson, Recombinant DNA, W.H. Freeman,1992
4) JohnE.Smith, Biotechnology, CambridgeUniversityPress,2009.
5) B.D.Singh,"Biotechnologyexpandinghorizons."Kalyani, India(2009).
6) S.B.Primrose,MolecularBiotechnology, BlackwellScientificPublications,1991
7) SandhyaMitra, Genetic Engineering: PrinciplesandPractice,McGraw-HillEducation,2015
8) Pamela Peters, Biotechnology: aguideto geneticengineering,Wm.C.BrownPublishers,1993

MSBCH03C16: Practical V

1. Estimation of urea
2. Estimation of uric acid
3. Estimation of creatinine
4. Determination of bilirubin
5. Estimation of glucose
6. Precipitation of calcium and estimation of calcium
7. Assay of acid phosphatase enzyme activity
8. Determination of catalase activity from liver/serum
9. Assay of alcohol dehydrogenase/glutamate dehydrogenase enzyme activityinliver/serum
10. Determination of alanine transaminase enzyme activity
11. Culture of *E.coli* cells and plasmid isolation
12. Preparation Of Competent cells
13. Calcium Chloride mediated transformation
14. Ligation of DNA
15. Polymerase chain reaction
16. Restriction Fragment length polymorphism
17. Random amplified polymorphic DNA
18. Sub -Clonig of GEP Protein

Reference

1.Sambrook J. and Russel, D. W. (2012). Molecular Cloning: A labrotory manual A Set of 3 Volumes,

CHSL Press, New York.

MSBCH03C17-Practical VI

1.Estimation of total proteins in serum

2.Estimation of serum albumin by BCG

3.Estimation of albumin – globulin ratio in Serum

4.Estimation of serum bilirubin

5.Assay of SGOT& SGPT -DNPH method

6.Assay of alkaline phosphatase-King &Amstrong method

7.Estimation of blood urea by diacetyl monoxime method

8.Estimation of creatinine by Jaff' s method

9.Biochemical analysis of urine.

References

1 Introductory Practical biochemistry, S.K sawhney&Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81- 7319-302-9, p 195-303

2.Standard Methods of Biochemical Analysis, S.K Thimmaiah (ed), Kalayani Publishers, Ludhiana ISBN 81-7663-067-5, p12-18

3.Experimental Biochemistry: A Student companion, BeeduSasidharRao& Vijay Deshpande (ed), I.K International Pvt. LTD, New Delhi ISBN 81-88237-41-8, p 13-17, p 49-72

4.Practical Biochemistry, R.C Gupta &Bhargava (eds) CBS Publishers and distributors, New Delhi, ISBN 81-239-0124-0, p 9-27

5.Practical Clinical Chemistry, Harold Varley, CBS Publishers and distributors, New Delhi.

6.Gradwhols Clinical Laboratory Techniques. Stanley &Raphael.W.E. company, London, UK

7.Bisswanger, H. (2011) PracticalEnzymology.John Wiley and Sons, New Jersey

MSBCH03E04: BIOINFORMATICS [Contact hours: 55]

Course Learning Outcomes:

Upon successfully completing this course, the student will be able to do the following

1.Comprehend the fundamentals of bioinformatics and familiarize with genome information and special features and sequencing of nucleic acids and proteins.

2. To compare the categories of biological databases; information retrieval from databases using the bioinformatics tools BLAST and FASTA.

3.Analysis of genomes from different organisms and methods of phylogenetic analysis

4.Use the structure visualization tools commonly employed in proteomics.

5. Comprehend the fundamentals of bioinformatics and familiarize with genome information and special features and sequencing of nucleic acids and proteins.

Module I (15hrs)

Introduction to Bioinformatics: Scope of Bioinformatics. Genome information and special features, coding sequences (CDS), untranslated regions (UTR's), expressed sequence tags (EST). Databases: Protein sequence data bank: PIR, SWISSPROT, UNIPROT, PROSITE, PFAM. Nucleic acid sequence data bank: Gen bank, EMBL, DDBJ. Structural databases: PDB, CATH, SCOP. Retrieving information from NCBI with Entrez. Choose a gene/ protein with some prior knowledge and extract all the information relevant to this gene/protein in the databases listed.

Module II (15hrs)

Genomics: Structural genomics - Genome sequencing, Sequencing of DNA & RNA. Analysis of NGS & RNASeq data. Genome annotation. Performing genome annotation studies with RAST. Functional genomics-ESTs, SAGE, Comparative genomics, comparison of genetic sequence of organisms. HGP and its significance. Transcriptomics-comparative transcriptomic approach to study differential gene expression

Module III (15hrs)

Measurement of sequence similarity: Sequence alignment - Global and local alignment, pairwise and multiple sequence alignment. Homology and similarity search tool: BLAST and FASTA. Performing Sequence alignment with BLAST. Phylogenetic analysis-elements of phylogeny, methods of phylogenetic analysis,. Phylogenetic tree. Phylogenetic analysis tools-Phylip, ClustalW. Constructing phylogenetic trees.

Module IV (10hrs)

Proteomics: Protein sequence information, sequence to structure relationships. Studying homology modelling with SWISS MODEL. Bioinformatics tools for analysis of proteomics data (tools available at ExPASy proteomics server). Structure visualization tools: Rasmol, SPDBV.

References:

1. Bioinformatics: A beginner's guide by Jean-Michel Claverie and Gerdic Notredame, 2003, Wiley
2. Introduction to Bioinformatics by Attwood, Parry-Smith, Phukan, 2007, Pearson Education
3. Fundamental concepts of Bioinformatics by Krane D.E and Raymer M.L., 2003, Pearson Education
4. Bioinformatics: Databases and Algorithms by N. Gautham, 2006, Alpha Science International Ltd.
5. Bioinformatics: Sequence and Genome analysis by Mount DW, 2004, Cold Spring Harbour Laboratory Press, New York
6. Bioinformatics (4 Ed) - Baxevanis AD, Bader GD Wishart DS (Eds), 2020, Wiley
7. Bioinformatics: Methods and applications (4 ed) by S. C. Rastogi, N. Mendiritta, P. Rastogi, 2013, PHI Learning
8. Essential Bioinformatics by Jin Xiong, 2006, Cambridge University Press
9. Structural Bioinformatics (2 ed) Gu and Bourne, 2009, Wiley
10. An introduction to Medicinal Chemistry (7 ed) by Patrick G, 2023, Oxford University Press.
11. Pharmacology and Pharmacotherapeutics (25 ed) by– Satoskar, Rege, TRipathi and Bhandarkar, 2017, Popular Prakashan.

12. Foye's Principles of Medicinal chemistry (6 ed) by Lemke, Williams, Roche and Zito, 2008, Wolters Kluwer, Lippincott Williams & Wilkins

MSBCH03E05: BIOSAFETY AND BIOETHICS [Contact hours: 55]

Course learning Outcomes

1. Define Biosafety and bioethics in the context of modern biotechnology.
2. Analyse the potential bio risks associated with biotechnology and molecular genetics research.
3. Comprehend basic ethical principles which guide bioscience research.
4. Apply the basic concepts of biosecurity and Bioethics on real life issues.
5. Recall biosafety guidelines and understand the various hazards related to environmental release.
6. Conduct environmental assessments and apply these guidelines for any rDNa related activities in the future.
7. Understand the social and ethical issues related to plant and animal biotechnology.

Module I (10hrs)

Biosafety: Introduction – biosafety issues in biotechnology. Biological Safety Cabinets, Primary Containment for Biohazards. Biosafety Levels - Levels of Specific Microorganisms, Infectious Agents and Infected Animals. Biological containments and physical containments.

Module II (15hrs)

Biosafety Guidelines: Guidelines and regulations (National and International including Cartegana Protocol) – operation of biosafety guidelines and regulations of Government of India; Definition of GMOs & LMOs. Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture. Environmental release of GMOs - Risk - Analysis, Assessment, management and communication.

Module III(15hrs)

Guidelines for rDNA research activities- large scale experiments, release to environment, import and shipment, mechanism of implementation of biosafety guidelines. Quality control of biologicals produced by rDNA technology. Revised guidelines for research in transgenic plants.

Module IV(15hrs)

Bioethics: Introduction to ethics and bioethics, framework for ethical decision making. Ethical, legal and socioeconomic aspects of gene therapy, germ line, somatic, embryonic and adult stem cell research. Ethical implications of GM crops, GMO's, human genome project, human cloning, designer babies, biopiracy and biowarfare. Eugenics and its possible approaches. Animal right activities - Blue cross in India- society for prevention of cruelty against animals. Ethical limits of Animal use. Greenpeace - Human Rights and Responsibilities.

References

1. Intellectual Property laws: containing Acts, rules & regulations. Universal Law Publishing Co.
2. CRC Handbook of Laboratory Safety. A Keith Furr, CRC Press
3. Recombinant DNA Safety Guidelines.1990. Department of Biotechnology, Ministry of
4. Science and Technology, Govt. of India
5. Intellectual Property law. A Chandrashekaran, C Sitaraman and Co Pvt. Ltd.
6. Intellectual Property Protection and Sustainable Development, Philippe Cullet
7. Bioethics. Shaleesha. A Stanley, Wisdom Education Services

MSBCH03E06: STEM **CELL AND REGENERATIVE BIOLOGY**

[Contact hours: 55]

Course Learning Outcomes

1. Learn the basics of stem cells, its types and properties.

2. Comprehend stem cell research techniques.

3. Analyse biomedical applications of stem cells.

4. Assess and recognize the ethical considerations in human stem cell therapy.

Module I(10hrs)

Introduction to Stem Cells

Types, sources and properties of stem cell, stem cell niches-Stem cell formation and differentiation-Pluripotency, differentiation of stem cells and organogenesis during embryonic development, mechanism of stem cell renewal, cell cycle regulation in stem cell.

Module II (15hrs)

Techniques in stem cell research

Isolation characterization and maintenance of stem cells, stem cell labelling, molecular imaging techniques in stem cell research, stem cell cryopreservation.

Module III (15hrs)

Application of Stem Cells

Mammalian Nuclear Transfer Technology; Stem cell gene therapy, stem cells for therapy for Neurodegenerative diseases, muscular dystrophy, Tissue systems Failures, Diabetes, Kidney failure; Liver failure; Cancer; Hemophilia.

Module IV (15hrs)

Ethical consideration

Human stem cell research: Ethical considerations; religious considerations; clinical regulatory consideration and Patient advocacy books.

References

1. Slack, J.M., 2018. *The Science of Stem Cells*. John Wiley & Sons.
2. Robert Lanza, John Gearhart, Brigid Hogan, and others eds.. Essentials of Stem Cell Biology. San Diego, Calif., Elsevier Academic Press, 2006.
3. Quesenberry, P.J., Stein, G.S., Forget, B.G. and Weissman, S.M. eds., 1998. *Stem cell biology and gene therapy*. John Wiley & Sons.
4. Atala, A. and Lanza, R. eds., 2012. Handbook of stem cells. Academic Press.

MSBCH03O01: INTELLECTUAL PROPERTY RIGHTS [Contact hours: 55]

Course Learning Outcomes:

1. Have an understanding of the fundamental legal principles relating to copyright, patents, designs, trademarks.
2. Identify, apply and assess principles of law relating to each of these areas of intellectual property
3. Understand the legal and practical steps needed to ensure that intellectual property rights remain valid and enforceable
4. Learn the treaties, patents acts and agreements related to international trade.
5. Comprehend the current and emerging issues relating to the intellectual property protection, including those relating to traditional knowledge, biotechnology and international trade
6. Analyse and understand the patenting of plants, animals and other life forms.

Module I(10hrs)

Intellectual Property Rights: Introduction to IPR, Types of IP - Patents, Trademarks, Trade secrets, Copyright & Related Rights, Industrial Design, Traditional Knowledge and geographical Indications. Importance of IPR – patentable and non-patentable matters, patenting life.

Module II(15hrs)

Agreements and Treaties - History of GATT & TRIPS Agreement; Madrid Agreement; WIPO Treaties; Budapest Treaty; PCT; Indian Patent Act 1970 & recent amendments. IPR and WTO regime - Consumer protection and plant genetic resources. Transfer of technology and patent sharing.

Module III (15hrs)

Patents and Patent Laws: Objectives of the patent system - Basic, principles and general requirements of patent law. Biotechnological inventions and patent law - Legal development - Patentable subjects and protection in Biotechnology. patentability of microorganisms, plant patent, animal patent,

patentability of genes and vectors – FDA. Legal protection for plants and other higher organisms. plant breeders' rights and farmers' rights. Sui-generis plant variety protection.

Module IV(15hrs)

Patent Filing Procedures - National & PCT filing procedure, Time frame and cost, Status of the patent applications, Precautions while patenting, disclosure/ nondisclosure, financial assistance for patenting, introduction to existing schemes. Patent licensing and agreement. Patent infringement - meaning, scope, litigation, case studies.

References:

1. Intellectual Property laws: containing Acts, rules & regulations. Universal Law Publishing Co.
2. CRC Handbook of Laboratory Safety. A Keith Furr, CRC Press
3. Recombinant DNA Safety Guidelines.1990. Department of Biotechnology, Ministry of
4. Science and Technology, Govt. of India
5. Intellectual Property law. A Chandrashekaran, C Sitaraman and Co Pvt. Ltd.
6. Intellectual Property Protection and Sustainable Development, Philippe Cullet
7. Bioethics. Shaleesha. A Stanley, Wisdom Education Servi

MSBCH03O02: PROTEOMICS (Contact hours: 56]

Course Learning Outcomes:

Upon successfully completing this course, the students will be able to

1. To explain Proteomics
2. To analyze Structural Proteomics
3. To explain Proteomic Techniques for Analysis
4. To explain Protein expression and Proteomic approach for Clinical studies

Module - I – Introduction to Proteomics (12hrs)

Human genome - Genomes to Proteomes - HUPO –Human Proteome Project, Branches of proteomics - Protein extraction Methods: Subcellular fractionation, Density gradients, Ultrafiltration, - Protein fractionation - Affinity purification –Removal of interfering compounds, salts, DNA, lipids, Protein solubilization methods, chaotropes, detergents, etc - Sample handling and storage - Stable Isotope Labeling with Amino acids in Culture (SILAC).

Module II – Structural Proteomics (12hrs)

Protein structure-function relationship – Disulfide bonds, Post translational modifications, Glycosylation, Phosphorylation, other modifications, Applications - methods for detection of protein protein interactions - Yeast 1 and 2 hybrid systems – Phage display – Surface Plasmon Resonance (SPR) - Fluorescence Resonance Energy Transfer (FRET).

Module III – Proteomic Techniques for Analysis (16hrs)

1D and 2-D gel electrophoresis – Mass Spectrometry – Principles - MALDITOF - RP chromatography /Tandem mass spectrometry – Protein sequence analysis -Peptide mass finger printing- N-terminal determination methods- Protein modification – Protein microarrays – Tissue microarray – Infra red Protein array with Quantitative Readout (IPAQ) -- Algorithms for proteomics –OMSSA - SEQUEST - MASCOT.

Module IV Protein expression and Proteomic approach for Clinical studies (16 hrs.)

Protein expression: Expression Systems –, E. coli, Yeast, Pitchia pastoris, Bacculovirus - introduction, detection and purification of expressed transgenes - antibody capture – antibody generation and Engineering –Protein/peptide chemical synthesis –- Protein-polynucleotide interactions Reconstitution of proteins in lipid vesicles, - Liposomes-Peptide and protein drugs.

Proteomic approach for Clinical studies: Protein Biomarker Discovery and Validation - low abundance and hydrophobic proteins. High through put techniques to identify protein molecules in sample Body fluid profiles, blood disease profiles, diabetes profiles stroke and myocardial infarction, Alzheimer, Proteomics in Biotechnology.

References

1. Twyman, R.M. (2014) Principles of Proteomics, Taylor & Francis group, New York, USA.

2. Comai,. L, Katz,.J., Mallick, P. (2017) Proteomics: Methods and Protocols. Humana Press Inc., New York.

3. Cathy H. Wu.C.H, Cecilia N. Arighi.C.N. and Karen E. Ross. K.E. (2017) Protein Bioinformatics, Humana Press Inc., New York.

4. O'Connor C.D. and Homes. B. D. (2007) Proteomics, Scion Publishing Ltd., Banbury.

MSBCH03O03: PLANT AND ANIMAL CELL CULTURE (Contact hours: 55]

Course Learning Outcomes:

Upon successfully completing this course, the students will be able to

1. To explain about animal Cell Culture
2. To analyze tissue culture techniques
3. To explain about the production of novel plants
4. To understand the protoplast culture

Module I (12hrs)

Animal Cell Culture: Historical Background, Importance and progress in Animal Cell Culture Technology, Laboratory setup and equipment's, aseptic technique, different cell culture media and supplements, Importance of Serum and Serum Free Media, preparation and sterilization of cell culture media and supplements.

Module II (12hrs)

Tissue culture techniques: Disaggregation of tissue and primary culture, Types of primary culture; Chick embryo fibroblast culture; Chick liver and kidney culture; Secondary culture; Trypsinization; Cell separation ; Continuous cell lines; Passage number; Anchorage and Anchorage independent cells and cultures; Suspension culture; Organ culture and Histotypiccultures: tissue specific stem cells; embryonic hematopoietic and neural stem cells, classification and sources, uses.

Module III (15hrs)

Production of novel plants: Tissue culture as a technique to produce novel plants and hybrids, tissue culture media, initiation and maintenance of callus and suspension cultures, single cell clones. Organogenesis, somatic embryogenesis. Transfer and establishment of whole plants in soil. Shoot tip culture, rapid clonal propagation and production of virus free plants, embryo culture and embryo rescue.

Module IV (16hrs)

Protoplast culture: Protoplast isolation, culture and fusion; Selection of hybrid cells and regeneration of hybrid plants; Symmetric and asymmetric hybrids, cybrids, anther, pollen and ovary culture for production of haploid plants and homozygous lines. Somaclonalvariation.Invitro mutation-sexual incompatibility and male sterility Cell culture reactors: Scale up in suspension and in monolayers with an example each.Geneediting, gene knock out, Applications in cell culture.

References

1. Freshney, Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, Wiley Blackwell

2. Ed. John R.W Masters Animal cell culture-Practical approach 3rd edition, Oxford university press.

3. R. Sasidhara, Animal Biotechnology MJP publishers-Chennai.

4. Plant biotechnology-J Hammond, et.al; Springer Verlag.

5. Biotechnology in crop improvement –H S Chawla.

6. Practical application of plant molecular biology-R J Henry, Chapman and Hall.

7. An introduction to plant tissue culture-M K Razdan, Oxford &IBH

8. Cell culture and somatic cell genetics of plants (Vols.1to3)-A K Vasil, Academic Press.

9. Principles of plant biotechnology: An introduction to genetic engineering in plants SH Mantell, Blackwell Scientific Publications.

10. Advances in biochemical engineering/ Biotechnology-Anderson, et.al, Springer.

11. Plant cell and tissue culture-S Narayanswamy, Tata McGraw Hill Education Indi

MSBCH04C18: NUTRITIONAL BIOCHEMISTRY (Contact hours: 56]

Course Learning Outcomes:

Upon successfully completing this course, the students will be able to

1. To explain the basic concepts of nutrition
2. To explain the nutritional role of proteins and carbohydrates
3. To study the nutritional aspects of minerals and vitamins
4. To understand the nutritional aspects of fats, Nutrional management of various diseases.

Module I(12hrs

Principle food components, Balanced diet, Nutritional Requirement, recommended daily requirements, Recommended dietary allowances (RDA), Body composition and energy requirements, Measurement of energy expenditure, direct and indirect calorimetry, BMR Factors affecting BMR.

Module II (14hrs)

Nitrogen balance and muscle protein turnover, essential and non-essential amino acids, Protein requirement, Biological value of proteins, Protein calorie deficiency state, Kwashiorkor andMarasmus.Carbohydrates- role and importance in diet, classification, dietary fiber

Module III (16hrs)

Mineral Nutrients - Micro nutrients and Macro nutrients, dietary sources, deficiency symptoms and recommended dietary allowances of trace elements and macro minerals (Calcium, Phosphorus, Magnesium, Iron, Sodium, Potassium, Iodine, Zinc).

Vitamins: Fat soluble vitamins- Biological sources, requirement, functions and deficiency symptoms of vitamins A, D, E and K -Water soluble vitamins- classification, properties, dietary sources, requirement, chemistry and physiological significance of thiamine, riboflavin, niacin, pantothenic acid, vitamin B6, folic acid, biotin, vitamin B12 and Vitamin C.

Module IV (14hrs)

Essential fatty acids, energy value of fats, phospholipids in nutrition, Starvation, Nutritional management of diabetes and obesity. Nutrition for infants, children, pregnant and lactating women and in old age. Importance ofnutrition under stress conditions.

Reference

1. Food Lipids Chemistry, Nutrition, and Biotechnology, Casimir C. Akoh 2016, 4thEdn. CRC Press Taylor &Francis Group.

2. Essentials of Human NutritionSecond Edition, Jim Mann, A. Stewart Truswell, 2002 2ndEdn.., Oxford University Press Inc., New York

3. Harper's Illustrated Biochemistry, Victor Rodwell and David Bender and Kathleen Botham and Peter Kennelly and P. Anthony Weil 2018, 31st Edition, Tata Mc.Graw Hill Eduation.

4. Trace Elements in Human and Animal Nutrition, E. Underwood, 1977 4th Edition, Academic Press.

5. The Book of Human Nutrition, MS. Bamji, Kamalakrishnaswamy and G.N.V. Brahmam 2017, 4th Edition, Oxford&Ibh Publ.

6. Essentials of food and nutrition, Vol. 1 and 2, M.S.Swaminathan, 1974, Ganesh & Co. Madras, India.

7. Nutritional Biochemistry, Patricia Trueman, 2007, Mjp Publishers.

MSBCH04C19: PLANT BIOCHEMISTRY (Contact hours: 56]

Course Learning Outcomes:

Upon successfully completing this course, the students will be able to

To explain the plant cell structure, antioxidant defense system in plants

To analyze the process of photosynthesis

To study the importance of plant hormones

To understand the secondary metabolites and stress metabolism in plants

Module I(12hrs)

Structure and functions of plant cell- cell wall, plasmodesmata, meristematic cells, vacuoles, secretary systems and root quiescent zone. Absorption, adsorption and transport of water and ions in plants, Evapotranspiration. Antioxidant defense system in plants: Enzymatic and non-enzymatic components of antioxidative defense mechanism.

Module II (14hrs)

Photosynthesis: Introduction; Photosynthetic pigments (chlorophylls, carotenoids &phycobilin's), PS I and PS II their locations; Photophosphorylation - coupling between electron transport and generation of NADPH and AT Chloroplast ATP synthase, Complexes associated with thylakoid membranes, light harvesting. complexes. Pathway and regulation of CO2 fixation in C3, C4 and CAM plants; Photorespiration- pathway and its significance.

Module III (14hrs)

Plant hormones: Structure, Biosynthesis, physiological function and mechanism of action of plant hormones-auxins, gibberellins, cytokinins, Indole acetic acid, ethylene and abscisic acid, jasmonic acid. Photochemical and hormonal control in plants. Seed germination and dormancy. Factors effecting seed germination and biochemical changes during seed germination.

Module IV(16hrs)

Secondary metabolites in plants: Nature, distribution, biosynthesis and function of plant terpenoids, phenolics, lignin's, Flavonoids, tannins, and alkaloids. Stress metabolism in plants: Bioic and abiotic stresses, salinity, water stress, heat, chilling and their impact on plant growth. Heavy metals, radiations and their impact on plant growth, criteria of stress tolerance. Use of pheromones and pest management. Plant based edible vaccines, types, properties, advantages and disadvantages.

Reference

1. Plant Biochemistry Hans -Walter Heldt Birgit Piechulla in cooperation with Fiona Held, 2011, 4thEdn, Academic Press, London NW1 7BY, UK.

2. Introduction to plant physiology, William G. Hopkins and Norman P. A. Huner, 2008–4 thEdn., John Wiley &Sons, Inc.

3. Plant physiology, L. Taiz and E-Zeigler, 2003, 5thEdn., Sinauer Associates, Inc., Publishers.

4. Introduction to plant biochemistry, T W Goodwin and E I Mercer. 1983, Pergaman Press, Oxford, NY.

5. Seed physiology of development and germination, J D Bewley and M black, 1994, 2ndEdn. Plenum Press NY.

6. Biochemistry and Molecular Biology of Plants by Bob, B. Buchanan, W. Gruissen and R.L. Jones, 2000,Published by American Society of Plant Physiologists and distributed by Panima Educational Book Agency, New Delhi.

7. Introduction to plant Biochemistry (Goodwin).

8. Plant Biochemistry and molecular Biology (P.J.Lea and R.G.Heagood).

9. Plant biochemistry by P.M Dey and J.B Harborne Harcourt Asia PTE Ltd., Singapore

MSBCH04C20: MOLECULAR ENDOCRINOLOGY [Contact hours: 56]

Course Learning Outcomes:

Upon successfully completing this course, the students will be able to

1. To explain about scope of Endocrinology, endocrine system, hormones and second messenger system.
2. To analyse the hormones of Hypothalamus, pineal gland, Thyroid gland ,adrenal gland ,pancreas hormones involved in calcium metabolism and neurohormones.
3. To understand hormones of female and male reproductive system
4. To understand various endocrinopathies.

Module I (12hrs)

Definition and scope of Endocrinology- Historical and anatomical aspects of mammalian endocrine system. Definition of a hormone- chemical nature of mammalian hormones- types of hormone receptors- secondary messenger system, general mechanism of peptide and non- peptide hormones action. Feed-back regulation of Endocrine System.

Module II(16hrs)

The Endocrines of Hypothalamus- Hypo-Physio tropic hormones- Neurovascular hypothesis. Pituitary gland hormones- chemistry and biochemical functions. Pineal gland hormones- chemistry- biochemical functions- mechanism of action. Thyroid gland hormones- chemistry- biochemical functions- mechanism of action. Parathyroid glands- biochemical functions. Adrenal gland: Hormones of adrenal gland- chemistry- mechanism of action biochemical functions. Pancreas- Insulin/glucagon: chemistry- biochemical functions- mechanism of action. Somatostatin. Hormones involving in calcium metabolism- chemistry- mechanism of action. Euro-hormones- the brain-renin angiotensin, Urotensin- neuropeptides.

Module III(14hrs)

Hormones of female and male reproductive system: Ovarian steroid hormones chemistry- biosynthesis and transport; Synthesis, chemistry and metabolism of androgens- dynamics of steroid hormone production and metabolism mechanisms of action of sex steroid hormones. Testicular and ovarian

determining genes – Mullerian-inhibiting substance genes- molecular basis of male and female contraception.

Module IV(14hrs)

Endocrinopathies: Hypo-physical, Thyroid, parathyroid, adrenal and pancreas. Disorders of pituitary hormone axis- thyrotoxicosis- hypothyroidism- Hashimoto's thyroiditis- metabolic bone diseases- Cushing syndrome- Addison's diseases Diabetes mellitus- androgen deficiency syndromes- Testicular neoplasm Klinefelter's syndrome and Turner's syndrome. Clinical evaluation of endocrine functions- overview.

References

1. Henry M. Kronenberg, ShlomoMelmed, Kenneth S. Polonsky, P. Reed Larsen.

William Textbook of Endocrinology, 11th ed. Saunders Elsevier 2008

2. Bolander, F. F. Molecular Endocrinology, III ed. Academic Press, 2004.

Suggested Reading:

1. Lehninger's Principle of Biochemistry.: Nelson Cox. 3rd ed. MacMillianWorth Publ. 2000.

2. Endocrinology: Mac E. Hadely. 5th ed. Pearson Education, 2000.

MSBCH04C21: PRACTICAL VII

1. Estimation of total protein
2. Estimation of Vit-C from fruit juice.
3. Estimation of calcium from milk.
4. Estimation of total phenolic content from black-Tea.
5. Determination of iodine number from vegetable oil.
6. Estimation of phosphorous from milk.
7. Isolation of egg albumin from egg white.
8. Isolation of cholesterol from egg yolk.
9. Isolation of starch from potatoes.
10. Isolation of casein from milk.
11. Preparation of extracts of crude drugs/herbs by successive solvent extraction method to record the percentage yield and for subjecting them to phytochemical screening
12. Preliminary phytochemical screening

a. Cold and hot extraction methods

b. Qualitative chemical examination. - Detection of phytoconstituents by test tube methods – Alkaloids phenolcs, flavonoids, glycosides, steroids, triterpenoids, saponins, tannins.

13. Identification of alkaloids in a mixture by TLC
14. Quantitative analysis of phytoconstituents by various methods

a. Determination of total phenolic content

b. Determination of total flavonoid content

c. Determination of total antioxidant activity

15. Screening of herbal extracts/products for free radical scavenging and antioxidant activities.

16. Isolation of natural products by column chromatography

Reference

1. Krause's Food and Nutrition Care process. (2012); Mahan, L.K Strings, S.E,
2. Raymond, J. Elsevier's Publications. ISBN- 978-1-4377-2233-8.
3. The vitamins, Fundamental aspects in Nutrition and Health (2008); G.F.
4. Coombs Jr. Elsevier's Publications. ISBN-13- 978-0-12- 183493-7.
5. Principles of Nutritional Assessment (2005) Rosalind Gibson. Oxford UniversityPress.DebojyotiDas's Biochemistry Book

MSBCH04E07: BIOSTATISTICS [Contact hours: 60]

Course learning Outcomes:

Upon successfully completing this course, the student will be able to

1. Demonstrate the classification of statistical data, data presentation, concept of population and sample and various approaches used in sampling.
2. Apply numerical, tabular, and graphical descriptive techniques commonly used to characterize and summarize statistical data.
3. Explain the types of correlation between variables, concept of regression and probability
4. Apply the tests of significance.
5. Explain the basic principles of experimental design and ANOVA.

Module I **(17 hrs)**

Data: Population and sample, sampling theory, methods of sampling - random sampling and non-random sampling. Different types of numerical data - primary and secondary data, qualitative and quantitative data, ranked data, discrete and continuous data. Presentation of data. Frequency distribution tables: Relative and cumulative frequency distributions, Graphical representation of data: line charts, bar charts, pie chart, pictograms, histograms, frequency polygon, frequency curve, ogives.

Module II **(15hrs)**

Measures of central tendency: arithmetic mean, median, mode, geometric mean and harmonic mean. Measures of dispersion: range, interquartile range, variance and standard deviation, coefficient of variation. Correlation and regression: types of correlation between variables, scatter diagram, correlation coefficient, regression coefficient, regression line. Normal distribution curve - symmetric and asymmetric, kurtosis and skewness.

Module III **(13 hrs)**

Probability: Definition of probability, Permutation and combination, random experiment, sample space, event, types of events. Conditional probability. Addition and multiplication theorems of probability.

Module IV **(15hrs)**

Tests of significance - Estimation, confidence limit, degrees of freedom, level of significance, standard error, p - value, testing of hypothesis - Student's t-test, z-test, chi-square test. Principles of experimental designs: completely randomized, randomized complete block design. Latin square designs, augmented block design, simple bacterial experiments, analysis of variance (ANOVA).

References:

1. Principles of Biostatistics. Pagano M. & Kimberlee G. Duxbury Press. 3rd edition. 2022.
2. Biostatistical analysis. Zar, JH. Pearson Education. 5th edition. 2010
3. Fundamentals of Biostatistics. Khan and Khanum; Ukaas publications. 6th edition 2020
4. Biostatistics-How it works. Steve Selvin; Pearson Education. 2003
5. An Introduction to Biostatistics. N. Gurumani.
6. Probability and Statistical Inference. Hogg R. V. Tanis E. A., Prentice Hall, New Jersey.
7. Experimental Design Data Analysis for Biologists. Quinn G. P. & Keogh M. J. Cambridge University Press.
8. Statistical Methods in Biology. Bailey NTJ, Cambridge University Press.
9. Biostatistics for the Biological and Health Sciences. Marc Triola, Mario Triola. Pearson.

MSBCH04E08: DEVELOPMENTAL BIOLOGY (Contact hours: 54]

Course learning Outcomes:

Upon successfully completing this course, the student will be able to

1. To analyze the basic concepts of developmental biology
2. To explain mammalian embryonic development
3. To explain cell signaling and communication during development
4. To understand organogenesis in model organism and aging.

Module 1– Introduction to Developmental Biology(12h)

History and 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.

Module II– Early embryonic development (12h)

Early mammalian development: Production and structure of human gametes. Molecular events during mammalian fertilization, acrosome reaction, zygote and prevention of polyspermy. Patterns and molecular mechanism of mammalian cleavage, formation of blastula, gastrulation, neural tube and differentiation of neurons. Formation of extra embryonic membranes, anterior-posterior, dorsalventral and left-right axis formation.

Module III Cell- cell communication and signaling in development (15h)

Concepts of induction and competence, epithelial-mesenchymal interactions, role of FGF-RTK pathway, JAK-STAT, Hedgehog family, Wnt family, TGF-β superfamily, Notch pathway and developmental signals from extracellular matrix. Juxtacrine signaling and cell patterning.

Module IV– Model organisms, organogenesis and Sex determination (15h)

C. elegans: Study of cell lineage, mosaic development and organogenesis vulva formation. Axes and pattern formation in Drosophila and Amphibia. Organs derive from ectoderm, mesoderm and endoderm.

Vertebrate eye lens induction and development of tetrapod limb. Sex determination in Mammals and Drosophila. Metamorphosis of frog, regeneration in Salamander limbs and mammalian liver. Ageing: types, Theories of ageing –Telomeres and Telomerase. Regulations of ageing process. Anti-ageing approaches.

References

1. Balinsky, B.I. (2012) An Introduction to Embryology, Cengage, Boston.

2. Gilbert, S.F. (2013) Developmental Biology, Sinauer Associates Inc., Massachusetts.

3. Wolpert, L., Tickle, C., Arias, A.M. (2015) Principles of Development, Oxford University Press, Oxford.

4. Slack, J.M.W. (2012) Essential Developmental Biology, Wiley Blackwell Publishers, New Jersey.

5. Kanungo, M.S. (2005) Genes and Aging, Cambridge University Press, Cambridge

MSBCH04E09 :PHARMACOLOGY AND TOXICOLOGY

[Contacthours:56]

Course learning Outcomes:

Upon successfully completing this course, the student will be able to

1. To explain about dosage forms, route of administration, site of action & Mechanism of action of drugs.
2. To analyse about the metabolism of drugs.
3. To understand about the drug potency and drug efficacy &Clinical Toxicology.
4. To explain the various pharmacological activity of drugs.

Module I (14hrs)

General Pharmacology :Introduction to pharmacology, sources of drugs, Classification of drugs based on sources, dosage forms, route of administration, site of action of drugs. Mechanism of action, concept of receptors, combined effect of drugs, factors modifying drug action. Dose response curve- ED50 and LD50.

Module II (14hrs)

Pharmacokinetics: Absorption and distribution of drugs, importance of drug – protein interaction. Drug metabolism: chemical pathway of drug metabolism, phase I and phase II reactions, role of cytochrome P450, non- microsomal reactions of drug metabolism, drug metabolizing enzymes. Drug elimination of liver and kidney. General principles of chemotherapy: chemotherapy of parasitic infections, fungal infections, viral diseases. Introduction to immunomodulators and chemotherapy of cancer.

Module III (14hrs)

Therapeutics: Biochemical mode of action of antibiotics- penicillin and chloramphenicol, actions of alkaloids, antiviral and antimalarial substances. Biochemical mechanism of drug resistance-sulphonamides. Drug potency and drug efficacy. Clinical Toxicology Definition, classification of toxicity – occupational, environmental and pharmaceutical. Types of toxins and their mechanism of action. Factors affecting toxicity- Drug tolerance, intolerance, addiction, allergy, hypersensitivity, antagonism and synergism. Methods of detection.

Module IV (14hrs)

Screening for pharmacological activity: Analgesic, anti-inflammatory and antipyretic agents, gastrointestinal drugs, antiulcer and laxatives, antioxidants, anticancer and anti-fertility agents. Drugs for metabolic disorders like antidiabetic, anti-hyperlipidemic, anti-obesity and hepatoprotective agents. Drug abuses and their biological effects. Rational prescription of drugs. Toxicity of anticancer drugs. Clinical symptoms of toxicity and marker parameters.

References

1. F S K Barar, Essentials of Pharmacotherapeutics, S. Chand Limited, 2000.
2. J. Lippincotco, pharmaceutical chemistry, Philadelphia.
3. Bertram Katzung, Anthony Trevor, Basic and Clinical Pharmacology, McGraw Hill Professional, 2014.
4. Golan, David E., Armen H. Tashjian, and Ehrin J. Armstrong, eds. Principles of pharmacology: the pathophysiologic basis of drug therapy. Lippincott Williams & Wilkins, 2011.
5. Klaassen, Curtis D., ed. Casarett and Doull's toxicology: the basic science of poisons. McGraw-Hill, 2013.
6. Screening methods in pharmacology. Robert A Turner, academic press, Newyork.
7. Goodman & Gilman. The pharmacological basis of therapeutics, Pentagon press.

Pattern of Question Papers

First Semester M.Sc. Degree Examination November 2023

MSBCH00C00: Name of the Paper

Time: 3 Hrs. Max. Marks: 40

Section A

Answer any five questions. Each question carries 2 marks

(Revised Bloom's Taxonomy level 1,2)

1.

2.

3.

4.

5.

6.

(5 x 2 = 10 Marks)

Section B

Answer any three questions. Each question carries 4 marks

(Revised Bloom's Taxonomy level 6)

7.

8.

9.

10.

11.

(3 x 4 = 12 Marks)

Section C

Answer any three questions. Each question carries 6 Marks

(Revised Bloom's Taxonomy level 3,4,5)

12.

13.

14.

15.

16.

Model Question Paper

First Semester M.Sc. Degree Examination November 2023

MSBCH01C01: BASIC BIOCHEMISTRY

Time: 3 Hrs. Max. Marks: 40

Section A

Answer any five questions. Each question carries 2 marks

1. What are the features of peptide bond?
2. Mention the forces stabilizing the structure of protein
3. Name two purines and draw their structure.
4. What are epimers? Give one example
5. What are the structural differences between glucose and fructose?
6. Define stereoisomerism. What is its significance in protein chemistry?

(5×2=10 Marks)

Section B

Answer any three questions. Each question carries 4 marks.

7. Describe the structure of tRNA.
8. huGive a brief account on heteropolysaccharides.
9. Write short notes on protein hormones.
10. Describe the sequence of events which leads to the origin of life.
11. Explain DNA polymorphism.

(3×4=12 Marks)

Section C

Answer any three questions. Each question carries 6 marks.

12. Describe the chemistry and functions of lipids.

13. Explain the mechanisms of neurotransmission.
14. Write short notes on polysaccharides.
15. Watson - Crick Model of DNA,
16. Write a note on glycosaminoglycans.

(3×6=18 Marks)