Bharatiya Vidya Bhavan

BHAVAN'S VIVEKANANDA COLLEGE
OF SCIENCE, HUMANITIES & COMMERCE
Sainikpuri, Secunderabad – 500094
Autonomous College - Affiliated to Osmania University
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Department of Biochemistry & Nutrition

PROGRAM NAME: M.Sc. BIOCHEMISTRY (Academic year 2023-24)

		SEMESTER I						
PAPERS	Code	TITLE	Course Type	Teaching hrs/week	Credits	Internal marks	Final exam marks	Total
			Theory					
1	BI101	Chemistry of Biomolecules	DSC	3	3	30	70	100
2	BI102	Endocrine biochemistry, Vitamins and Nucleic Acids	DSC	3	3	30	70	100
3	BI103	Cell biology and Bioenergetics	DSC	3	3	30	70	100
4	BI104	Basic Bio-Analytical Techniques	DSC	3	3	30	70	100
			Practicals					
5	BI 101P	Chemistry of Biomolecules		4	2	--	50	50
6	BI 102P	Endocrine biochemistry, Vitamins and Nucleic Acids		4	2	--	50	50
7	BI103P	Cell biology and Bioenergetics		4	2	--	50	50
8	BI104P	Basic Bio-Analytical Techniques		4	2	--	50	50
	Total			**28**	**20**	**120**	**480**	**600**

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PROGRAM NAME: M.Sc. BIOCHEMISTRY (w.e.f 2023-24)

SEMESTER-II

PAPERS	Code	TITLE	Course Type	Teaching hrs/week	Credits	Internal marks	Final exam marks	Total
Theory								
1	BI201	Metabolism	DSC	3	3	30	70	100
2	BI202	Enzymology	DSC	3	3	30	70	100
3	BI203	Molecular Biology	DSC	3	3	30	70	100
4	BI204	Biochemical Genetics	DSC	3	3	30	70	100
Practicals								
5	BI201P	Metabolism		4	2	--	50	50
6	BI202P	Enzymology		4	2	--	50	50
7	BI203P	Molecular Biology		4	2	--	50	50
8	BI204P	Biochemical Genetics		4	2	--	50	50
	Total			**28**	**20**	**120**	**480**	**600**

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PROGRAM NAME: M.Sc. BIOCHEMISTRY (2024-25)

SEMESTER-III

PAPERS	CODE	TITLE	Course Type	Teaching hrs/week	Credits	Internal marks	Final exam marks	Total
			Theory					
1	BI301	Gene expression and Advanced Bioanalytical Techniques	DSC	3	3	30	70	100
2	BI302	Immunology and Immunotechnology	DSC	3	3	30	70	100
3	BI303A BI303B	**Elective I** A: Nutrition and Clinical Biochemistry B: Nanobiochemistry	DSE	3	3	30	70	100
4	BI304A BI304B	**Elective II** A: Physiology and Reproductive Biology B: Evolution, Ecology and Developmental Biology	DSE	3	3	30	70	100
5	BI305	MOOCS		4	2	-	50	50
			Practicals					
6	BI 301P	Gene expression and Advanced Bioanalytical Techniques		4	2	--	50	50
7	BI 302P	Immunology and Immunotechnology		4	2	--	50	50
8	BI303AP BI303BP	**Elective I** A: Nutrition and Clinical Biochemistry B: Nanobiochemistry		2	1	-	25	25
9	BI304AP BI304BP	**Elective II** A:Physiology and Reproductive Biology B: Evolution, Ecology and Developmental Biology		2	1	-	25	25
	Total			**28**	**20**	**120**	**480**	**600**

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PROGRAM NAME: M.Sc. BIOCHEMISTRY (2024-25)

SEMESTER-IV

PAPERS	CODE	TITLE	Course Type	Teaching hrs/week	Credits	Internal marks	Final exam marks	Total
Theory								
1	BI401	Biostatistics &Bioinformatics	DSC	3	3	30	70	100
2	BI402	Cell-cell communication and Signalling	DSC	3	3	30	70	100
3	BI403A BI403B	**Elective III** A: General Microbiology, Bacteriology and Virology B: Biotechnology	DSE	3	3	30	70	100
4	BI 404	Project work		7	5	50	100	150
Practicals								
5	BI 401P	Biostatistics & Bioinformatics		4	2	--	50	50
6	BI 402P	Cell-cell communication and Signalling		4	2	--	50	50
7	BI403P	**Elective III** A: General Microbiology, Bacteriology and Virology B: Biotechnology		4	2	-	50	50
		Total		**28**	**20**	**140**	**460**	**600**

A. Lai Lady
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Department of Biochemistry& Nutrition

PROGRAM NAME: M.Sc. BIOCHEMISTRY (Academic year 2023-24)

COURSE NAME: CHEMISTRY OF BIOMOLECULES

PAPER CODE: BI101 **PPW: 3**
YEAR/SEMESTER: I/I **NO OF CREDITS: 3**

COURSE OBJECTIVE: To explain the chemistry of proteins, lipids and porphyrins.

CREDITWISE COURSE OBJECTIVES:

COb1 To describe the structure, classification and properties of amino acids and proteins.
COb2 To describe structure, classification and properties of carbohydrates.
COb3 To explain the structure, classification and properties of lipids and porphyrins.

CREDIT 1 Aminoacids and Proteins **15h**

1. Classification and structure of aminoacids
2. Essential, non - essential, and non - protein or unusual amino acid.
3. General Properties and Acid- Base Reactions of AA, (pKa Values)
4. Peptide bond - stability and formation, polypeptides.
5. Methods for determining amino and carboxy terminal and molecular weight
6. Primary structure of protein
7. Secondary structure α helix, βsheet, 3_{10}helix
8. GN Ramachandran plots. *Phi, Psi and omega angle*
9. Tertiary & Quarternary structure (myoglobin, hemoglobin)
10. Small peptides (glutathione, peptide hormones)
11. Cyclic peptides (Gramicidin)
12. Classification of proteins - globular, fibrous,
13. Membrane, Metallo - proteins, SCOP,CATH
14. Denaturation (pH, temperature, chaotropic agents), Renaturation
15. Protein folding, role of Chaperons in folding

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CREDIT 2 Carbohydrates **15h**

1. Classifications and structure of Carbohydrates
2. Configurations and conformations
3. Reactions of Monosaccharides
4. Stability and formations of glycosidic bonds
5. Disaccharides and Oligosaccharides
6. Structural Polysaccharides (Cellulose, Chitin, Chitosan)
7. Storage polysaccharides (Starch, Glycogen, Inulin)
8. Hemicelluloses- Lignins, Pectins,
9. Hetero-Polysaccharides /acidic Muco Polysaacharides Glycosaminoglycan
10. Chemistry and biological role of Hyaluronic acids, Chondroitin sulphate,
11. Keratan sulphate, dermatan sulphate, heparin
12. Glycoproteins and Proteoglycans
13. Bacterial cell wall Polysaccharides- Peptidoglycans
14. Blood group substances
15. Structural determinations of polysaccharides

CREDIT 3 Lipids & Porphyrins **15h**

1. Classification of lipids & fatty acids
2. Biological significance of lipids & fatty acids
3. Steroids, Sterols, relation to vitamin D
4. Steroid hormones
5. Bile acids and salts
6. Phospholipids
7. Oils, waxes, isoprene units
8. Lipoproteins
9. Glycolipids
10. Sphingolipids
11. Structure &function of porphyrins: Heme
12. Structure &function of porphyrins: Chlorophyll
13. Cerebrosides, Gangliosides
14. Prostaglandins, Prostacyclins, Eicosanoids
15. Thromboxanes, Leukotrienes

REFERENCES:

1.Lehninger's Principles of Biochemistry, David L. Nelson, Michael M Cox Publisher:W H Freeman.

2.Biochemistry-Jeremy M Berg, John L Tymoczko, and LubertStryer.: W H Freeman

3.Biochemistry,4thEdition-Donald Voet, Judith G. Voet. –Publisher John Wiley & Sons.

COURSE OUTCOMES:

At the end of the course students will be able to:

BI101.CO1 Relate structural organization of aminoacids and proteins with their properties and functions.

BI101.CO2 Differentiate the structural features and properties of various carbohydrates.

BI101.CO3 Associate the different classes of lipids with their tissue distribution.

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PROGRAM NAME: M.Sc. BIOCHEMISTRY (Academic year 2023-24)

COURSE NAME: CHEMISTRY OF BIOMOLECULES

PAPER CODE: BI101P **PPW: 4**
YEAR/SEMESTER: I/I **NO OF CREDITS: 2**

CREDIT WISE COURSE OBJECTIVES
Cob4 To explain the qualitative and quantitative methods for the analysis of amino acids.
Cob5 To describe qualitative and quantitative methods for analysis of lipids

CREDIT 4 Aminoacid analysis **30h**

1. Qualitative analysis of amino acids.
2. Determine pKa and pI of acidic, basic, and neutral amino acids.
3. Estimation of amino acids by Ninhydrin method.
4. Quantification of glycine by formal titration.
5. Estimation of tryptophan by Spies and Chambers method

CREDIT 5 Lipid analysis **30h**

1. Qualitative analysis of lipids.
2. Saponification value of fats.
3. Iodine number of oil.
4. Peroxide value of fats.
5. Acid value of fats.

At the end of the course students will be able to:

BI101P.CO4 Analyze amino acids and proteins qualitatively and quantitatively in research labs/industries.
BI101P.CO5 Apply the knowledge of qualitative and quantitative analysis of lipids from various samples in research/industry.

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PROGRAM NAME: M.Sc. BIOCHEMISTRY (Academic year 2023-24)

COURSE NAME: ENDOCRINE BIOCHEMISTRY, VITAMINS AND NUCLEIC ACIDS

PAPER CODE: BI102 **PPW: 3**
YEAR/SEMESTER: I/I **NO.OF CREDITS: 3**

COURSE OBJECTIVE: To understand the physiology of endocrine system, structural features, types and properties of carbohydrates, nucleic acids and vitamins.

CREDIT-WISE COURSE OBJECTIVES:
COb1 To outline the organization, chemistry, mechanism of action and physiological functions of endocrine system.
COb2 To explain the importance of vitamins in human health.
COb3 To discuss the structural features of nucleic acids.

CREDIT 1 Endocrine system **15h**

1. Endocrine glands Types and secretion of hormones
2. Control of hormone secretion
3. Mechanism of hormone action
4. Pituitary gland: Structure, Anterior Pituitary: hormones secreted and functions
5. Posterior Pituitary- Hormones secreted and their functions
6. Disorders related to pituitary hormones
7. Thyroid gland and Parathyroid gland: Structure and functions
8. Disorders: hypothyroidism, hyperthyroidism
9. Parathormone and associated disorders
10. Adrenal gland: Structure
11. Secretions of adrenal cortex and their functions, hypoadrenalism, hyperadrenalism
12. Secretions of adrenal medulla and their functions
13. Pancreas: Islets of Langerhans, alpha and beta cells
14. Functions of Insulin and glucagon, deficiency of insulin
15. Testes and Ovaries Structure, Functions of testosterone, estrogens and progesterone

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CREDIT 2: Vitamins **15h**

1. Water Soluble Vitamins; Structure and Classifications
2. Water Soluble Vitamins: Chemistry, Biological Source and physiological significance
3. Fat Soluble Vitamins: Structure and Classification
4. Fat Soluble Vitamins: Chemistry, Biological Source and Significance
5. Structure, function and the deficiency disorder of Vit Bl (Thiamine), B2 (Riboflavin)
6. Structure, function and the deficiency disorder of B3 (Niacin) and Vit B5 (Pantothenic acid)
7. Structure, function and the deficiency disorder of B6 (Pyridoxine) and B7(Biotin)
8. Structure, function and the deficiency disorder of Vit B9 (Folic acid) and B 12 (Cobalamins)
9. Structure, function and the deficiency disorder of Vit C (Ascorbic acid)
10. Structure, function and the deficiency disorder of Vit A (Retinol)
11. Structure, function and the deficiency disorder of Vit D (Calciferol)
12. Structure, function and the deficiency disorder of Vit E (Tocopherol)
13. Structure, function and the deficiency disorder of Vit K (Phytonadione)
14. Recommended daily allowance of vitamins
15. Vitamin supplementation

CREDIT 3 Chemistry of Nucleic Acids

15h

1. Purines: structure and functions
2. Pyrimidines- structure and functions,
3. Nucleosides, nucleotides, phosphodiester bond
4. Unusual bases, Modified bases: Structure and properties.
5. Structure of DNA – Watson Crick Model, A- and Z- forms.
6. Supercoiling of DNA – negative and positive, linking number.
7. Properties of DNA – denaturation and renaturation
8. T_m (factors affecting T_m) and Cot curves.
9. Structure of mRNA, tRNA
10. Structure of rRNA, siRNA / miRNA.
11. Properties of RNA-denaturation and renaturation
12. Difference between DNA and RNA.
13. Hetero duplex mapping
14. D loops and R loops.
15. Catalytic RNA.

REFERENCES:

1. Lehninger Principles of Biochemistry, David L. Nelson, Michael M. Cox Publisher: W. H. Freeman.
2. Biochemistry-Jeremy M Berg, John L Tymoczko, and LubertStryer.: W H Freeman.
3. Biochemistry, 4th Edition - Donald Voet, Judith G. Voet – Publisher John Wiley & Sons.
4. Principles of Biochemistry: Mammalian Biochemistry: Smith EL, Hill RL, White A, McGraw Hill

COURSE OUTCOMES:

At the end of the course students will be able to:

BI102.CO1 Categorize the types of hormones with their physiology and analyse the process of endocrine regulation.
BI102.CO2 Implement the importance of vitamins in daily health.
BI102.CO3 Distinguish the structural features and properties of nucleic acids.

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PROGRAM NAME: M.Sc. BIOCHEMISTRY (Academic year 2023-24)

COURSE NAME: ENDOCRINE BIOCHEMISTRY, VITAMINS AND NUCLEIC ACIDS

PAPER CODE: BI102P **PPW: 4**
YEAR/SEMESTER: I/I **NO OF CREDITS: 2**

CREDIT WISE COURSE OBJECTIVES
COb4 To explain the qualitative and quantitative methods for the analysis of carbohydrates.
COb5 To explain the qualitative and quantitative methods for analysis of nucleic acids.

CREDIT 4 Carbohydrate analysis **30 h**
1. Qualitative analysis of carbohydrates
2. Quantitative analysis of carbohydrates
3. Estimation of Fructose
4. Estimation of total sugars by phenol sulfuric acid method
5. Estimation of reducing sugars by DNS

CREDIT 5 Nucleic acid analysis **30 h**
1. Estimation of DNA by DPA
2. Assessment of DNA purity by A260/A280 method
3. Estimation of RNA by Orcinol method
4. Separation of purines by paper chromatography
5. Separation of pyrimidines by paper chromatography

COURSE OUTCOMES:
At the end of the course students will be able to:

BI102P.CO4 Apply the knowledge of qualitative and quantitative analysis of carbohydrates from various samples in research/industry.
BI02P.CO5 Identify and analyse nucleic acids qualitatively and quantitatively in molecular biology/ biotech labs or industry.

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PROGRAM NAME: M.Sc. BIOCHEMISTRY (Academic year2023-24)

COURSE NAME: CELL BIOLOGY AND BIOENERGETICS

PAPER CODE: BI103 **PPW: 3**
YEAR/SEMESTER: I/I **NO OF CREDITS: 3**

COURSE OBJECTIVE: To familiarize the students with the concepts of Cell biology, Biomembranes and Bioenergetics.

CREDIT-WISE COURSE OBJECTIVES:

COb1 To describe the structural organization of cells and the process of Cell cycle and apoptosis
COb2 To describe the composition and organization of biomembranes.
COb3 To explain the concepts of thermodynamics and its relevance to biological energy production

CREDIT I Structure of Prokaryotic & Eukaryotic cells **15 h**

l. Classification of prokaryotes and eukaryotes (systems of classification)
2. Ultrastructure of eubacteria, cyanobacteria, mycoplasma
3. Ultra structure of plant cell
4. Ultrastructure of animal cell
5. Composition of cytoskeleton: microfilaments, microtubules, intermediate filaments
6. Function of cytoskeleton
7. Nuclear skeleton: lamina, scaffold
8. Structure of Chromosomes (centromere, telomere, kinetochore)
9. Euchromatins, heterochromatin
10. Formation and structure of special chromosomes (polytene and lampbrush)
11. Cell cycle
12. Mitosis and meiosis
13. Cell cycle check points and regulation
14. Apoptosis
15. Regulation of Apoptosis

CREDIT 2 Biomembranes **l5h**

1. Composition and Structure of Cell membrane
2. Membrane Dynamics

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3. Membrane Lipids: Composition distribution and Functions
4. Membrane Proteins: Composition distribution and Functions
5. Trans - membrane proteins and their classification
6. Methods of detecting Trans membrane proteins, Hydropathy plots
7. Membrane Asymmetry
8. Fluid Mosaic Model of Membrane
9. Membrane fluidity and its regulations, Flip flop.
10. RBC membrane structure.
11. Membrane transport: active and passive transport, symport and antiport; Na^+-K^+ ATPase
12. Transport channels: voltage gated, ion gated and ligand-gated channels
13. Aquaporin, Glucose transporters, Valinomycin: structure and mechanism
14. Artificial membranes; Reconstitution of functional membrane system from purified components
15. Liposomes , Micelles and vesicles

CREDIT 3 Bioenergetics **15 h**

1. Elements of importance in biochemistry (H,C,N,O,P,S), types and energy of bonds and interactions (ionic, covalent, coordinate, H-bonds, van der Waals, hydrophobic interactions).
2. Laws of thermodynamics, Gibbs free energy, relevance of entropy and enthalpy in biological systems and reactions.
3. Thermodynamically coupled reactions
4. Order of the reactions: first and second order reactions
5. Log and lnscales in biological processes (exponential growth curves, radioactive decay)
6. Biological oxidation, Redox potential, Nernst equation
7. Enzymes involved in biological oxidation
8. High energy compounds
9. Oxidative phosphorylation
10. High energy bonds, phosphate potential, Forces stabilizing membrane
11. ETC in mitochondria
12. ETC in Chloroplasts
13. Uncouplers and inhibitors of energy transfer.
14. Shuttle pathways- Glycerol phosphate shuttle, Malate- Aspartate shuttle
15. Biological Fluorescence (GFP and derivatives), Bioluminescence.

REFERENCES:

1. Lehninger Principles of Biochemistry, David L. Nelson, Michael M. Cox Publisher: W. H. Freeman.
2. Biochemistry, 4th Edition - Donald Voet, Judith G. Voet – Publisher John Wiley & Sons
3. Molecular Cell Biology, 4th edition. Harvey Lodish, Arnold Berk, S Lawrence Zipursky, Paul Matsudaira, David Baltimore, and James Darnell. New York: W. H Freeman

COURSE OUTCOMES:

At the end of the course students will be able to:

BI103.CO1 Illustrate the structural organisation of cell
BI103.CO2 Differentiate the structural organization of various biomembranes and membrane transport mechanisms with their functions.
BI103.CO3 Relate the concepts of Thermodynamics to biological oxidation and energy production

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COURSE NAME: CELL BIOLOGY AND BIOENERGETICS

PAPER CODE: BI103P **PPW: 4**
YEAR/SEMESTER: I/I **NO OF CREDITS: 2**

CREDIT- WISE COURSE OBJECTIVES:

COb4 To explain the importance of good laboratory practices, preparation of buffers and titrimetric methods
COb5 To demonstrate bioanalytical techniques for separation of proteins, nucleic acids and subcellular organelles

CREDIT 4 Laboratory maintenance, safety and basic methods **30 h**

1. GLP; Use of balance and pH meter, Lab safety,
2. Calculations and preparation of standard solutions (primary, working standard)
3. Preparation of buffers: Phosphate, Citrate and Tris-buffer
4. Titration: Estimation of Calcium in milk
5. Titration: Estimation of vitamin C in lemon juice

CREDIT 5 Separation and identification of biomolecules **30 h**

1. SDS PAGE for protein
2. Agarose gel for DNA
3. Desalting proteins by dialysis
4. Gel filtration (size exclusion)
5. Cell fractionation (centrifuge)

COURSE OUTCOMES:

At the end of the course students will be able to:
BI103P.CO4 Implement the knowledge of good laboratory practices and select suitable buffers for biochemical experiments and also carry out titrimetric procedures.
BI103P.CO5 Apply different techniques for analysis of biomolecules and cell organelles in biological samples.

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PROGRAM NAME: M.Sc. BIOCHEMISTRY (Academic year 2023-24)

COURSE NAME: BASIC BIOANALYTICAL TECHNIQUES

PAPER CODE: BI104 **PPW: 3**
YEAR/SEMESTER: I/I **NO OF CREDITS: 3**

COURSE OBJECTIVE: To explain the principle, instrumentation and applications of various bio-analytical and cell study techniques.

CREDIT- WISE COURSE OBJECTIVES:

COb1 To familiarize with principle, instrumentation and applications of various spectroscopic techniques and chromatographic techniques
COb2 To explain centrifugation, electrophoresis and tracer techniques with their applications in biology.
COb3 To explain the principles and working of various analytical tools to study cell structure and function.

CREDIT 1 Spectroscopy and Chromatography **15 h**

1. Colorimetry, Beer Lambert's Law-application and limitation, Molar extinction coefficient, Absorption maximum
2. UV - Vis Spectrophotometer - Instrumentation, application
3. Fluorescence Spectroscopy - principle, instrumentation, application
4. Infrared (IR) spectroscopy - principle, instrumentation, application
5. Raman spectroscopy - principle, instrumentation, application
6. CD - and ORD - principle, instrumentation, application
7. Partitioning and counter current distribution;
8. PC and TLC -principle, instrumentation, application
9. GC - principle, instrumentation, application
10. Ion – exchange chromatography - principle, instrumentation, application
11. Gel filtration (Gel exclusion chromatography) - principle, application
12. Affinity chromatography -principle instrumentation, application; immunoprecipitation
13. HPLC and RP-HPLC - principle, instrumentation, application
14. FPLC, LC - principle, instrumentation, application
15. Peptide mapping and N-Terminal sequencing of proteins

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CREDIT 2 Centrifugation, Electrophoresis and Tracer techniques 15h

1. Centrifugation, RCF and types of rotors. Ultra centrifugation - principle, instrumentation, application
2. CsCl density gradient and sucrose gradient centrifugation - principle, application
3. Electrophoresis - moving boundary and zonal electrophoresis, Native and SDS PAGE
4. IEF and 2D PAGE, PAGE for DNA sequencing
5. Agarose Gels, PFGE, Zymography
6. Denaturing gels for RNA, Southern and Northern Blots
7. Western Blot
8. Stable and radioactive isotopes, theory of radioactivity
9. Half life and emission spectra of biologically useful isotopes:^{2}H, ^{3}H, ^{14}C, ^{18}O, ^{32}P, ^{35}S, ^{125}I;
10. Detection of radio activity by Scintillation counting. Autoradiography Isotopes used for labelling proteins, (^{3}H, ^{14}C,^{35}S , ^{125}I) and nucleic acids (^{3}H, ^{32}P)
11. GM counter, gamma counter
12. Fluorography, applications of Phosphor -imaging, luxmetry and chemiluminescence as alternative to radioactivity.
13. Radiation hazards and safe disposal of radioactivity waste
14. Isotope dilution method pulse chase
15. Historic examples -^{14}C and ^{18}O to study photosynthesis: ^{32}P and ^{35}S to study viral replication (Hershey - Chase experiment ^{16}N and ^{15}N in DNA replication Meselson and Stahl experiment)

CREDIT 3 Microscopy and Cell Study 15h

1. Simple and compound microscope.
2. Phase contrast,
3. Dark field and polarization microscopy.
4. Electron microscopy: SEM, freeze fracture.
5. Electron microscopy: TEM
6. Fluorescence microscopy
7. Confocal microscopy, imaging live cells.
8. FRET
9. FRAP
10. Flow-Cytometry and cell sorting (FACS).
11. Cell counting- hemocytometer
12. Plant tissue culture.
13. Animal tissue culture
14. Insect tissue culture.
15. Methods of cell disruption and fractionation, isolation of organelles.

REFERENCES:

1. Principles and Techniques of Practical Biochemistry- Wilson. K. And Walker. J. Pub: Cambridge Press
2. Physical Biochemistry- Friefelder, Publisher D. W.H. Freeman Press
3. Biophysical Chemistry: Principles and Techniques, 2nd edition by A. Upadhyay, K. Upadhyay and N. Nath. Himalaya Publishing House, Delhi.

COURSE OUTCOMES:

At the end of the course students will be able to:

BI104.CO1 Apply relevant spectroscopic and chromatographic methods to study of molecular mass physical and chemical properties biomolecules.
BI104.CO2 design protocol for separating and identifying proteins or nucleic acids using centrifugation, electrophoresis and tracer technique methods.
BI104.CO3 identify suitable methods to study cells.

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Department of Biochemistry& Nutrition

PROGRAM NAME: M.Sc. BIOCHEMISTRY (Academic year 2023-24)

COURSE NAME: BASIC BIOANALYTICAL TECHNIQUES

PAPER CODE:BI104P **PPW: 4**
YEAR/SEMESTER: I/I **NO OF CREDITS: 2**

CREDIT WISE COURSE OBJECTIVES

COb4 To explain the quantitative methods for the analysis of amino acids, minerals and proteins.
COb5 To demonstrate chromatographic techniques for separation of biomolecules

CREDIT 4 Quantitation of Biomolecules by Spectroscopy **30 h**
1. Absorption spectrum of tyrosine, determination of molar extinction coefficient
2. Estimation of concentration of biomolecules based on Beer Lambert's Law
3. Estimation of inorganic phosphate by Fiske-Subbarow method
4. Estimation of protein by Biuret method
5. Estimation of protein by Lowry method

CREDIT 5 Separation of Biomolecules by Chromatography **30 h**
1 Separation of plant pigments by paper Chromatography
2. l-D and 2-D paper chromatography of amino acids
3 TLC of plant pigments and lipids
4 Anion/ Cation-exchange capacity of resin
5 Separation of amino acids by ion-exchange chromatography

COURSE OUTCOMES:

At the end of the course students will be able to:

BI104P.CO4 analyse amino acids and proteins quantitatively in research lab and industries.
BI104P.CO5 apply different chromatographic techniques for separation of biomolecules in biological samples in industries and research labs

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Department of Biochemistry& Nutrition

PROGRAM NAME: M.Sc. BIOCHEMISTRY (Academic year 2023-24)

COURSE NAME: METABOLISM

PAPER CODE: BI201 **PPW : 3**
YEAR/SEMESTER: I/II **NO OF CREDITS: 3**

CREDIT- WISE COURSE OBJECTIVES:

COURSE OBJECTIVE: To explain the metabolism of proteins, carbohydrates, lipids, porphyrins and nucleic acids.

CREDITWISE COURSE OBJECTIVES:

COb1 To describe various metabolic pathways of amino acids and associated genetic defects
COb2 To discuss on metabolism of various carbohydrates.
COb3 To explain metabolic pathways of lipids, porphyrins and Nucleic acids

CREDIT 1 Metabolism of Amino Acids and Proteins **15h**

1. Metabolic fate of dietary proteins and amino acids
2. Overview of biosynthesis of amino acids
3. Glucogenic and ketogenic amino acids
4. Degradation of aminoacids to pyruvate and oxaloacetate
5. Degradation of aminoacids to acetyl – CoA
6. Degradation of aminoacids to succinyl– CoA
7. Metabolism of branched chain amino acids
8. Role of glutamate cycle in formation and circulation of ammonia
9. Glucose-alanine cycle
10. Urea cycle
11. Linking of citric acid and urea cycles
12. Amino acids as biosynthetic precursors (Synthesis of glutathione, neurotransmitters)
13. Genetic defects in metabolism of amino acids: albinism, phenylketonuria, maple syrup urine disease
14. Genetic defects in metabolism of amino acids: homocystinuria, alkaptonuria, methylmalonic academia
15. Genetic defects in metabolism of urea: argininemia, ariginino succinic acidemia, carbamoyl phosphate synthetase – I deficiency

CREDIT 2 Metabolism of Carbohydrates **15h**

1. Reactions and energy balance in glycolysis
2. Regulation of glycolysis; entry of other sugars
3. Reactions and energy balance in gluconeogenesis

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4. Pyruvate dehydrogenase complex
5. Reactions and energy balance in TCA cycle
6. Pentose phosphate pathway
7. Pasteur effect and Crabtree effect
8. Anaplerotic reactions
9. Glyoxylate cycle
10. Glucuronic acid cycle
11. Glycogen metabolism
12. Photosynthesis reactions for biosynthesis of glucose
13. C3 carbon fixation
14. C4 carbon fixation and Crassulacean acid metabolism
15. Biosynthesis of starch and sucrose

CREDIT 3 Metabolism of Lipids, Porphyrins & Nucleic Acids **15h**

1. Fate of dietary lipids, apo-lipoproteins
2. Fatty acid biosynthesis, desaturation of fatty acids
3. Beta oxidation and its regulation, breakdown of odd chain fatty acids and energy yield
4. ω-oxidation and α – oxidation pathway and their regulation
5. Metabolism of phospholipids and sphingolipids
6. Biosynthesis of cholesterol and other steroids and their regulation
7. Fate of acetyl CoA, formation of ketone bodies and ketosis
8. Biosynthesis of prostaglandins, prostacyclins, thromboxanes and leukotrienes
9. Metabolism of porphyrins
10. Biosynthesis of purines
11. Degradation of purines
12. Biosynthesis of pyrimidines
13. Degradation of pyrimidines
14. *de novo* purine and pyrimidine synthesis
15. Salvage pathway of purine and pyrimidine synthesis

References:

1. Lehninger Principles of Biochemistry, David L. Nelson, Michael M. Cox; Publisher: W.H.Freeman.
2. Biochemistry – Jeremy MBerg, JohnLTymoczko, and Lubert Stryer.; Publisher:WH Freeman
3. Biochemistry, 4th Edition – Donald Voet, Judith G. Voet. – Publisher John Wiley & Sons.
4. Principles of Biochemistry Mammalian Biochemistry: Smith EL, Hill RL,…White A Publisher: McGraw Hill

COURSE OUTCOMES:

At the end of the course students will be able to :

BI201.CO1 correlate the genetic defects with impaired amino acid metabolism.
BI201.CO2 relate various metabolic events of carbohydrates and their significance.
BI201.CO3 illustrate various metabolic pathways of lipids, porphyrins and nucleic acids.

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Department of Biochemistry& Nutrition

PROGRAM NAME: M.Sc. BIOCHEMISTRY (Academic year 2023-24)

COURSE NAME: METABOLISM

PAPER CODE: BI201P **PPW: 4**
YEAR/SEMESTER: I/II **NO OF CREDITS: 2**

CREDIT WISE COURSE OBJECTIVES
Cob4 To explain the quantitative estimation of Protein metabolites in biological samples
C0b5 To discuss the quantitative determination of Carbohydrates, Lipids and Nucleic Acids in biological samples

CREDIT 4 Metabolism of Amino acids, Proteins and Porphyrins **30 h**

1. Estimation of dietary proteins
2. Estimation of urea
3. Estimation of creatinine (urine)
4. Estimation of bilirubin
5. Fractionate BSA by salt precipitation

CREDIT 5 Metabolism of Carbohydrates, Lipids and Nucleic Acids **30 h**

1. Estimation of blood glucose
2. Estimation of sucrose and starch
3. Estimation of serum cholesterol
4. Estimation of nucleic acids by spectrophotometry
5. Estimation of phospholipids and lecithin

COURSE OUTCOMES:

At the end of the course students will be able to:

BI201P.CO4 Analyze proteins and their metabolites in research labs/industries.
BI201P.CO5 Determine quantitatively the content of carbohydrates, lipids and nucleotides in biological samples in research and food industry.

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Department of Biochemistry& Nutrition

PROGRAM NAME: M.Sc. BIOCHEMISTRY (Academic year 2023-24)

COURSE NAME: ENZYMOLOGY

PAPER CODE: BI202 **PPW : 4**
YEAR/SEMESTER: I/II **NO OF CREDITS: 3**

COURSE OBJECTIVE: To explain the concepts of enzyme catalysis, their role in cellular homeostasis and industrial applications.

CREDITWISE COURSE OBJECTIVES:

COb1 To explain enzyme catalysis, coenzymes and active site residues.
COb2 To discuss enzyme kinetics, enzyme inhibitors and industrial importance of enzymes.
COb3 To explain various catalytic and regulatory mechanisms of enzyme activity.

CREDIT 1 Enzymes and Coenzymes **15h**

1. Thermodynamics of catalysis, Energy of activation
2. Relation of ΔG and Keq
3. Coupled reactions (endergonic and exergonic) in biochemical pathways
4. Methods to isolate and purify enzymes
5. Assays, Activity Units, Specific activity
6. Nomenclature and classification of enzymes.
7. Metal, co-factor and co-enzyme requirements
8. Vitamin cofactors: TPP, FMN/FAD
9. NAD/NADP, Pantothenic acid
10. Vitamin cofactors: PLP, Biotin
11. Folate, Cobalamin, Phylloquinone
12. Factors affecting catalysis (pH, temperature, pressure, enzyme and substrate concentration)
13. Chemicals to identify active site residues: Arg, Cys, Lys, His
14. Site–directed mutagenesis to identify active site residues
15. Triose Phosphate Isomerase

CREDIT 2 Enzyme Kinetics & Industrial Applications **15h**

1. Single substrate assumptions, Michaelis –Menten kinetics (derive equation and transformations)
2. Steady state , Briggs -Haldane equation.
3. Transformation of Michaelis – Menten equation. Lineweaver Burk plot, Eadie-Hofstee plot.

A. Lai Jaddy 15/2/24
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4. Inhibitors (competitive, uncompetitive, noncompetitive, suicide), effect on kinetic constants
5. Bi-substrate reactions: ordered, random, sequential, Ping - Pong
6. Enzyme inhibitors as drugs: reverse transcriptase and protease inhibitors as anti– HIV drugs
7. Multiple sites; Cooperativity in binding (oxygen binding to hemoglobin)
8. Cooperativity- MWC model, KNF model
9. Slow transition and Hysteretic behavior in enzymes
10. Convergent and divergent evolution of enzymes
11. Enzymes in dairy (Rennin, lipases, lactases) and Food processing technology (invertase, pectinases, papain)
12. Enzymes in detergent (lipases, cellulases, proteases) and paper (cellulases).
13. Enzymes in bioremediation.
14. Enzyme engineering: Designing High –Through put enzyme assays
15. Enzymes as biosensors.

CREDIT 3 Catalytic Mechanisms of Enzymes **15h**

1. Types of catalysis: acid - base catalysis, transition state.
2. Covalent catalysis
3. Metal ion catalysis
4. Reversible and irreversible activation of enzymes (pro-enzymes, phosphorylation)
5. Enzyme activation by ligand binding and dimerization
6. Protein tyrosine kinase receptors
7. Catalytic mechanism of RNase
8. Catalytic mechanism of trypsin and chymotrypsin
9. Catalytic mechanism of lysozyme
10. Catalytic mechanism of subtilisin
11. Catalytic mechanism of carboxypeptidase
12. Allosteric regulation of aspartate transcarbamylase
13. Regulation of glutamine synthetase
14. Multi-enzyme complex: fatty acid synthase
15. Abzymes

REFERENCES:

1. Fundamentals of Enzymology, Price.NC. And Stevens. L., Oxford University Press
2. Enzymes- Biochemistry, Biotechnology, Clinical chemistry- Palmer, T., Affiliated East-West press
3. Fundamentals of Enzyme Kinetics, Segel I H; Wiley Inter science,
4. Biochemical calculations, 2nd Edition by Irwin H. Segel. John Wiley & Sons,
5. Lehninger's Principles of Biochemistry, David L. Nelson, Michael M. Cox Publisher: W. H. Freeman

COURSE OUTCOMES:

At the end of the course students will be able to:

BI202.CO1 interpret the concepts of enzyme catalysis in their experimental work.

BI202.CO2 differentiate kinetic behavior of enzyme reactions and also apply knowledge of enzymes in industries.

BI202.CO3 demonstrate knowledge of enzyme catalytic mechanisms in designing research work. .

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Department of Biochemistry& Nutrition

PROGRAM NAME: M.Sc. BIOCHEMISTRY (Academic year 2023-24)

COURSE NAME: ENZYMOLOGY

PAPER CODE: BI202P **PPW : 4**
YEAR/SEMESTER: I/II **NO OF CREDITS: 2**

CREDIT WISE COURSE OBJECTIVES:

CObj1 To explain the methods for isolation and assay of enzymes from biological sources.
CObj2 To demonstrate various factors affecting enzyme activity.

CREDIT 4 Enzymes and Coenzymes **30 h**

1. Isolation of urease (horse gram /any source)
2. Assay of urease
3. Isolation of beta-amylase (sweet potato)
4. Assay of beta-amylase
5. Isolation and assay of catalase (liver / any source)

CREDIT 5 Enzyme kinetics **30 h**

1. Effect of time on enzyme activity
2. Effect of enzyme concentration on enzyme activity
3. Effect of pH on enzyme activity
4. Effect of temperature on enzyme activity
6. Effect of [S] on enzyme activity; determination of K_m and V_{max}

COURSE OUTCOMES:

At the end of the course students will be able to:

BI202P.CO3. choose appropriate methods for isolation of enzymes from biological samples in research/industries.
BI202P.CO4. determine optimal conditions and various factors influencing the enzyme activity and apply it in research/ industry.

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Department of Biochemistry& Nutrition

PROGRAM NAME: M.Sc. BIOCHEMISTRY (Academic year 2023-24)

COURSE NAME: MOLECULAR BIOLOGY

PAPER CODE: BI203 **PPW : 4**
YEAR/SEMESTER: I/II **NO OF CREDITS: 3**

COURSE OBJECTIVE: To describe mechanisms related to replication, repair, transcription, translation and protein targeting in prokaryotic and eukaryotic cells.

CREDITWISE COURSE OBJECTIVES:
CObj1 To explain the mechanism of prokaryotic and eukaryotic DNA replication and DNA repair mechanisms.
CObj2 To describe prokaryotic and eukaryotic transcription and translation mechanisms.
CObj 3 To discuss protein targeting and degradation mechanisms.

CREDIT 1 DNA Replication and Repair **15h**

1. Models of replication – random, conservative, semi conservative
2. Replication of circular chromosomes by theta model –φ X174, E.coli
3. Replication of circular chromosomes by rolling circle (lambda phage) Strand displacement models (mt-DNA)
4. Prokaryotic and eukaryotic DNA polymerases, helicases, ligases, topoisomerases
5. Initiation – primosome,ori - sequences, accessory proteins
6. Elongation –replisome, leading and lagging strands, Okazaki fragments
7. Termination, Inhibitors of replication
8. Replication of linear chromosomes, telomeres, telomerase
9. Amplification –Polytene and double minute chromosomes
10. Types of DNA damage –oxidation, deamination, alkylation, adducts, breaks
11. Direct repair – MGMT, photo - reactivation, AlkB
12. Base Excision Repair (Short and Long Patch) and Nucleotide Excision Repair, Mismatch Repair
13. Mechanism of Recombination
14. Repair of DSBs by NHEJ and Homologous recombination
15. SOS repair

CREDIT 2 Transcription and Translation **15h**

1. Prokaryotic and eukaryotic RNA polymerases
2. Initiation: prokaryotic and eukaryotic promoter sequences

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3. Elongation, Termination – rho dependent and independent
4. Post – transcriptional modifications -capping, Poly A addition
5. RNA Splicing
6. RNA editing
7. Inhibitors of transcription
8. Structure of ribosome
9. Genetic code , Wobble hypothesis
10. Initiation of translation (role of cap, IRESIFs)
11. Elongation of translation (role of EFs) and Termination of translation (role of RFs)
12. Post translational modifications of proteins: Phosphorylation, Acetylation, Ubiquitylation, Methylation, Glycosylation
13. Post translational modifications of proteins: SUMOylation, Palmitoylation, Myristoylation,Prenylation, Sulfation
14. Protein splicing of inteins
15. Inhibitors of protein synthesis

CREDIT 3 Protein Targeting and Degradation **15h**

1. Post translational modifications of proteins, role in targeting (isoprenylation)
2. Signal peptide
3. Signal recognition particle(SRP)
4. Nuclear Localization Signal (NLS)
5. Mitochondrial and chloroplast localization signal
6. Chaperones and HSPs in protein folding
7. Vesicular trafficking
8. Lysosomal pathways : endocytosis and crinophagy
9. Lysosomal pathways: macroautophagy and microautophagy
10. Lysosomal storage diseases
11. Ubiquitin – proteasome pathway
12. Immuno proteasome
13. Misfolded proteins in neurodegenerative diseases
14. PEST sequences and proteolysis
15. Action of cytotoxic, hemotoxic, myotoxic & hemorrhagic venoms

REFERENCES:

1. Lehninger Principles of Biochemistry, David L. Nelson, Michael M. Cox Publisher: W. H. Freeman.
2. Molecular Biology of the Cell, 3rd edition. Bruce Alberts, Dennis Bray, Julian Lewis, Martin Raff.
3. Biochemistry, 4th Edition - Donald Voet, Judith G. Voet – Publisher John Wiley & Sons.
4. The Cell: A Molecular Approach, by Geoffrey M. Cooper and Robert E. Hausman, pub. ASM Press.

COURSE OUTCOMES:

At the end of the course students will be able to:

BI203.CO1 differentiate between prokaryotic and eukaryotic DNA replication and use the concepts of DNA repair mechanisms to maintain genetic stability.

BI203.CO2 compare the role of proteins involved in prokaryotic and eukaryotic transcription and distinguish the different types of translation and translational systems.

BI203.CO3 relate the significance of protein targeting and degradation in storage and neurodegenerative diseases.

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Department of Biochemistry & Nutrition

PROGRAM NAME: M.Sc. BIOCHEMISTRY (Academic year 2023-24)

COURSE NAME: MOLECULAR BIOLOGY

PAPER CODE:BI203P **PPW: 4**
YEAR/SEMESTER: I/II **NO OF CREDITS: 2**

CREDIT WISE COURSE OBJECTIVES

COb4 To explain the methods for isolation and separation of DNA and chromosomes from different sources.
COb5 To discuss the methods for analysis of glycoproteins and subcellular fractions from eukaryotic cells.

CREDIT 4 DNA replication and repair **30 h**

1. Isolation of DNA from plant source (Onion).
2. Isolation of DNA from animal source.
3. Isolation of DNA from microbial source (Plasmid).
4. Agarose gel electrophoresis: separation of super coiled, linear and circular DNA.
5. Amplification of DNA by PCR.

CREDIT 5 Transcription, Translation and Protein targeting **30 h**

1. Determination of glycoproteins (Total sugar by Phenol Sulphuric acid and protein by Lowry method).
2. Isolation of RNA from yeast.
3. Cell fractionation: Isolation of cell organelles.
4. Mitochondrial fraction (Identification using a Marker)
5. Nuclear fraction (Identification using a Marker)

COURSE OUTCOMES:

At the end of the course students will be able to:

BI203P.CO4 : Execute isolation, amplification and analysis of DNA in molecular biology/biotech labs.
BI203P.CO5: Utilize cell fractionation methods to isolate specific organelles for further studies in research.

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Department of Biochemistry& Nutrition

PROGRAM NAME: M.Sc. BIOCHEMISTRY (Academic year 2023-24)

COURSE NAME: BIOCHEMICAL GENETICS

PAPER CODE: BI204 **PPW : 4**
YEAR/SEMESTER: I/II **NO OF CREDITS: 3**

COURSE OBJECTIVE: To familiarize the students with the concepts of inheritance, linkage, bacterial genetics and use of model organisms.

CREDITWISE COURSE OBJECTIVES:

COb1 To discuss the patterns of inheritance and types of mutations.
COb2 To explain the concept of linkage, mapping and pedigree analysis.
COb3 To describe mapping of genes and use of model organisms to study various biological processes.

CREDIT 1 Mendelian Genetics **15h**

1. Mendel's laws of inheritance
2. Importance of meiosis in heredity
3. Non – Mendelian Inheritance: Cytoplasmic inheritance
4. Maternal effect, Maternal influence
5. Gene interactions - Epistasis, Expressivity, Penetrance
6. Polygenic inheritance
7. Sex linked, sex limited, and sex influenced inheritance
8. Mutations: spontaneous/ induced, somatic/ germinal
9. Forward/ reverse, transition/ transversion
10. Silent, missense, nonsense and frame shift mutations
11. Leaky and conditional mutations
12. Reversion and suppression of mutations
13. Detection, selection and isolation of microbial mutants, Estimation of mutation rates
14. Mutagens – physical, chemical
15. Transposon mutagenesis, site – directed mutagenesis

CREDIT 2 Linkage and Mapping **15h**

1. Discovery of linkage, Morgan's experiments
2. Cytological proof of crossing over
3. 2 – and 3 – point crosses
4. Recombination and Interference
5. Tetrad analysis
6. Mapping human genes by pedigree analysis

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7. Fundamentals of population genetics (HW Law)
8. Pedigrees of autosomal dominant and autosomal recessive inherited traits
9. Pedigrees of X-linked recessive and X-linked dominant traits
10. Mobile genetic elements – Discovery,
11. Structure of transposons, Zea Ac/ Ds and Spm elements
12. Mechanism of transposition replicative and conservative
13. *Drosophila* copia, Yeast Ty elements
14. CRISPR-Cas9 gene editing
15. Using recombination to make knockout cells / organisms

CREDIT 3 Bacterial genetics and Model organisms **15h**

1. Discovery of conjugation
2. Mapping bacterial genes by conjugation
3. Discovery of transformation
4. Mapping bacterial genes by transformation
5. Discovery of transduction
6. Mapping bacterial genes by transduction
7. Mapping phage genes – Fine structure of rII locus: Complementation analysis
8. Fine structure of rII locus: Deletion mapping
9. *Dictyostelium* to study cell – cell communication and differentiation.
10. *Neurospora* to study one gene – one enzyme hypothesis
11. *Arabidopsis* to study flower development
12. *Drosophila* to study embryonic development (homeotic mutations)
13. *Danio* to study vertebrate development
14. *Xenopus* to study embryogenesis
15. *Mus* inbred and knockout strains, NOD and nude mice

REFERENCES:

1. Microbiology – Prescott L M, Harley JP. & Klein DA, McGraw - Hill
2. Principles of Genetics by Eldon John Gardner, Michael J.Simmons,D.Peter Snustad;John Wiley
3. Modern Genetic Analysis Anthony JF Griffiths, William M Gilbert, Jeffrey H Miller, and Richard C Lewontin. Pub.W.H.Freeman

COURSE OUTCOMES:

At the end of the course students will be able to:

BI204.CO1 interpret the chemical basis of heredity and the importance of mutations.
BI204.CO2 demonstrate the concept of linkage and mapping genes by pedigree analysis.
BI204.CO3 predict bacterial gene mapping to different gene transfer mechanisms and relate the biological processes of a model organism to higher organisms.

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Department of Biochemistry& Nutrition

PROGRAM NAME: M.Sc. BIOCHEMISTRY (Academic year 2023-24)

COURSE NAME: BIOCHEMICAL GENETICS

PAPER CODE:BI204P **PPW: 4**
YEAR/SEMESTER: I/II **NO OF CREDITS: 2**

CREDIT WISE COURSE OBJECTIVES

COb4: To explain mendelian genetics, pedigree analysis and population genetics.
COb5 : To demonstrate mitosis, meiosis, karyotyping and transformation.

CREDIT 4 Mendelian Genetics and Linkage and Mapping **30 h**

1. Problem solving: 2 and 3 point crosses
2. Problem solving: tetrad analysis
3. Problem solving: pedigree analysis
4. Problem solving: Hardy Weinberg equilibrium
5. Cytological proof of crossing over

CREDIT 5 Bacterial genetics and Model organisms **30 h**

1. Demonstration of stages of mitosis (onion root tip)
2. Demonstration of stages of meiosis (anthers)
3. Study of flower development : *Arabidopsis*
4. Karyotyping
5. Transformation of Bacterial cells.

COURSE OUTCOMES

At the end of the course students will be able to:

BI204P.CO4 : analyse the inheritance of traits in plants and animals in research labs.
BI204P.CO5 : Execute cytogenetics and transformation techniques in research/biotech labs.

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Department of Biochemistry & Nutrition

PROGRAM NAME: M.Sc. BIOCHEMISTRY (2024-25)

COURSE NAME: GENE EXPRESSION AND ADVANCED BIOANALYTICAL TECHNIQUES

PAPER CODE: BI301
YEAR/SEMESTER: II/III

PPW: 3
NO OF CREDITS: 3

COURSE OBJECTIVE: To familiarize the students with prokaryotic and eukaryotic gene regulation, genetic engineering methods as well as advanced bioanalytical techniques.

CREDITWISE COURSE OBJECTIVES:

COb1 To explain the prokaryotic and eukaryotic gene regulation mechanisms.
COb2 To discuss about various tools and techniques of recombinant DNA technology.
COb3 To explain the principles and applications of advanced bioanalytical techniques for analysis of biomolecules.

Credit 1 Gene Regulation in Prokaryotes and Eukaryotes **15h**

1. Operon concept for gene regulation. Positive (+ve) & Negative (-ve) control
2. Lac operon & Trp operon
3. Dual function of repressor ara operon
4. Lambda Phage: Lytic / lysogenic switch; anti-termination
5. Phase variation in Salmonella flagellar protein synthesis
6. Sporulation gene expression in Bacillus
7. Riboswitch, control of plasmid copy number
8. Chromatin structure in active and inactive regions DNA methylation.
9. Eu-chromatin, histone acetylation, histone code
10. Transcriptional control- cell specific expression promoters, enhancers, Transcription factors
11. RNA transport and stability; Translational feedback.
12. Gene silencing: regulation by siRNA.
13. Gene silencing: inactivation of mammalian X chromosome.
14. Gal operon of yeast, Antigenic variation in Trypanosoma
15. MAT locus and mating type switch in yeast

A. Lai Jody
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Credit 2 Recombinant DNA Technology and Genetic Engineering **15h**

1. Enzymes in rDNA technology: Restriction endonucleases (discovery, properties)
2. Enzymes in rDNA technology: DNA and RNA polymerases
3. Enzymes in rDNA technology: Nucleases, Kinases, Phosphatases and Ligases
4. Prokaryotic vectors (plasmids, cosmids, phage, phagemid, BAC)
5. Eukaryotic vectors (YAC)
6. Shuttle vectors, Targeting vectors,
7. Construction of cDNA and genomic DNA libraries
8. Screening library (+ve) & (-ve) selection strategies, Preparation of probes
9. Yeast 2 hybrid assay
10. Phage display
11. Reporter genes GFP, beta- gal, luciferase
12. Expression in heterologous systems in bacteria,
13. Expression in heterologous systems in yeast cells.
14. Expression in heterologous system in insect cells.
15. Expression in heterologous system in mammalian cells

Credit 3 Advanced Bioanalytical techniques **15h**

1. DNase – I hypersensitivity mapping
2. DNA – Foot printing
3. PCR, RT-PCR , RFLP
4. Chromatin IP methods (ChIP)
5. Mass spectrometry – MALDI TOF, LC-MS, MS-MS.
6. ICP-MS, ICP-OES
7. Organic peptide synthesis
8. Atomic force microscopy
9. Light Sheet Fluorescence Microscopy
10. Atomic absorption spectroscopy
11. Dynamic and static light scattering
12. Zeta potential measurement – LASER Doppler Velocimetry
13. X-ray Crystallography
14. NMR
15. ESR

References

1. Genes VIII, Lewin, B, Publish Oxford University Press
2. Principles of Gene Manipulation: An introduction to GE – Old, R. and Primrose, S.B. Blackwell Sci. Pub
3. Molecular Biotechnology Glick, BR and Pasternak, JJ. Publish ASM Press
4. Molecular Biology of the Gene by Watson JD, Losick R. Pub Pearson Education

COURSE OUTCOMES

At the end of the course the student will be able to

BI301.CO1 Illustrate various gene regulatory strategies employed in both prokaryotes and eukaryotes.

BI301.CO2 Apply genetic engineering and recombinant DNA methods in biotech projects and industries

BI301.CO3 Identify suitable advanced bioanalytical techniques for analysis of biomolecules

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Department of Biochemistry & Nutrition

PROGRAM NAME: M.Sc. BIOCHEMISTRY (2024-25)

COURSE NAME: GENE EXPRESSION AND ADVANCED BIOANALYTICAL TECHNIQUES

PAPER CODE: BI301P **PPW: 4**
YEAR/SEMESTER: II/III **NO OF CREDITS: 2**

CREDITWISE COURSE OBJECTIVES:

COb4 To demonstrate methods of recombinant DNA techniques .
COb5 To describe different advanced bioanalytical techniques and isolation and characterization of RNA

Credit 4 Recombinant DNA Technology **30h**

1. Isolation of plasmid DNA
2. Restriction mapping of DNA (experiment and problems
3. Restriction Ligation
4. RFLP (experiment & problems)
5. Gene cloning (demonstration)

Credit 5 Advanced Bioanalytical techniques **30h**

1. Atomic absorption spectroscopy: Estimation of metal ions (ppm)
2. ICPMS: Estimation of metal ions (ppb and ppt)
3. Dynamic Light Scattering: Determination of zeta potential of macromolecules
4. Isolation of RNA and its characterization
5. Agarose gel electrophoresis of DNA and gel documentation.

COURSE OUTCOMES:

BI 301P.CO4 apply the knowledge of recombinant DNA techniques in molecular biology and biotech industries.
BI 301P.CO5 Integrate the knowledge in analyzing biological samlples using advanced bioanalytical techniques in analytical and research labs.

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Department of Biochemistry & Nutrition

PROGRAM NAME: M.Sc. BIOCHEMISTRY (2024-25)

COURSE NAME: IMMUNOLOGY AND IMMUNOTECHNOLOGY

PAPER CODE: BI 302 **PPW: 3**
YEAR/SEMESTER: II/III **NO OF CREDITS:3**

COURSE OBJECTIVE: To provide a basic understanding of the components and mechanism of immune system and the techniques for production of antibodies and vaccines.

CREDIT WISE COURSE OBJECTIVES:

COb1 To describe the components of immune system and the mechanisms involved in immune response.
COb2 To explain the concept of transplantation immunology, hypersensitivity and discuss the basis of autoimmune diseases.
COb3 To discuss the various immunological techniques and vaccine development methods.

Credit 1 Components of Immune System and Immune response **15h**

1. Elements of Immune system - Natural & acquired immunity, Specific & non-specific immune response.
2. Cells & organs induced in immune system
3. Antigenic determinants, Epitopes, Concept of haptens. T-Cell and B-Cell epitopes, Super-antigens
4. Classification, structure, and biological properties of immunoglobulins
5. Isotypes, allotype, idiotypes variations
6. Mucosal and neonatal immunity
7. Theories of antibody formation, Generation of antibody diversity
8. Genomic rearrangements & genes involved in antibody production
9. Humoral & cell-mediated immune response
10. T cell& B cell activation. T cell and B cell receptors
11. Antigen processing & presentation
12. MHC proteins structure & functions
13. Regulation of immune response.
14. Assembly and secretion of Ig. Class switching regulation
15. Cytokines in immune response

Credit 2 Complement system and Immune Disorders **15h**

1. Complement system –. Complement activation and types
2. Classical, Alternative and Mannan-binding lectin pathways and its regulation,

3. Biological functions of complement fixation, Complement fixation test
4. Transplantation immunology (Types of graft rejection, mechanism of graft rejection,
5. Graft vs host response
6. Immune response to tumors
7. Hypersensitivity – Gel & Coombs classification. Allergen
8. Type I, II, III and V Hypersensitivity and mechanism of activation
9. Tests for diagnosis of hypersensitivity, Tuberculin test
10. Auto immune diseases; classification
11. Mechanism and study of selected autoimmune diseases
12. Immuno- deficiency disorders – primary and secondary. AIDS
13. Immunosuppressive drugs/agents & their mechanism of action
14. ADA Deficiency
15. Microbial evasion of immune response

Credit 3 Immunotechnology **15h**

1. Adjuvants – types of and their applications
2. Production of polyclonal antibodies. Experimental animals models for production of antibodies.
3. Methods of antibody purification (Salt precipitation, Affinity chromatography)
4. Hybridoma technology – production of monoclonal antibodies and their applications; antibody engineering
5. Antigen-antibody binding analysis - Equilibrium dialysis; Affinity and Avidity of antibodies
6. Antigen-antibody interactions , Agglutination reaction and visualization
7. Gel diffusion techniques (Ouchterlony, Mancini techniques),
8. Immune-electrophoresis (Rocket, counter-, 2-D),
9. Immuno-fluorescence, RIA,
10. Enzyme immune assay (ELISA) and their types
11. Western blotting
12. FACS techniques
13. Vaccines – Types, traditional vaccines and their applications
14. Newer vaccine strategies (DNA, recombinant DNA, RNA, peptide and anti-idiotypic vaccines)
15. Vaccination schedules. Benefits and adverse consequences of vaccination

References:

1. Kuby Immunology – Edited Thomas J. Kindt, Richard A Goldsby, Publisher WH Freeman & Co
2. Roitt's Essential Immunology, Tenth Edition, Ivan Roitt, Peter Delves
3. Veterinary Immunology: Ian R. Tizard, I.R. Thomson press
4. The Immune System. By Peter Parham Publisher Garland publishing

COURSE OUTCOMES:

At the end of the course students will be able to:

BI 302.CO1 Identify the components of immune system and interpret cellular processes involved in immune reactions.

BI302.CO2 Interpret the causes of hypersensitive reactions, autoimmune diseases and response to immunosuppressive drugs.

BI302.CO3 Apply the principles of antigen-antibody interactions in immunological methods including diagnostics and also provides awareness on significance of vaccination.

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Department of Biochemistry & Nutrition

PROGRAM NAME: M.Sc. BIOCHEMISTRY (2024-25)

COURSE NAME: IMMUNOLOGY AND IMMUNOTECHNOLOGY

PAPER CODE: BI 302P **PPW: 4**
YEAR/SEMESTER: II/III **NO OF CREDITS:2**

CREDIT WISE COURSE OBJECTIVES

COb4 To describe the methods for purification and characterization of IgG.
COb5 To demonstrate various methods of studying antigen-antibody interaction.

Credit 4 Immunology **30h**

1. Isolate Ig from serum (human/bovine) by ammonium salt precipitation.
2. Purify IgG by gel filtration.
3. Estimate the protein by Lowry's method in all fractions
4. SDS PAGE of Ig fractions
5. Characterize IgG by Western blot

Credit 5 Immunotechnology **30h**

1. Agglutination: ABO and D Ag typing
2. RID
3. ODD
4. Rocket immunoelectrophoresis
5. ELISA, sandwich ELISA

References:

1. Experimental Biochemistry: A Student companion- Sashidhar Rao, B and Deshpande, V. IK International (P) Ltd
2 . An Introduction to Practical Biochemistry. By: David T Plummer. Publisher Tata McGraw-Hill

COURSE OUTCOMES:

At the end of the course students will be able to:
BI 302P.CO4 Apply appropriate methods for purification and characterisation of IgG in research/ industry.
BI 302P.CO5 choose suitable immunodiffusion methods to study antigen antibody interactions.

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Department of Biochemistry & Nutrition

PROGRAM NAME: M.Sc. BIOCHEMISTRY (2024-25)

COURSE NAME: (ELECTIVE I) NUTRITION AND CLINICAL BIOCHEMISTRY

PAPER CODE: BI303A **PPW: 3**
YEAR/SEMESTER: II/III **NO OF CREDITS: 3**

COURSE OBJECTIVE: To explain the importance of nutrition **in** daily life**,** biochemical tests for disease detection and role of liver in detoxification.

CREDITWISE COURSE OBJECTIVES:
COb1 To describe the concepts of nutrition and food quality for healthy life.
COb2 To discuss the use of biochemical tests as well as hormone tests in disease assessment.
COb3 To explain the role of liver in drug detoxification process and assessment of liver function.

Credit 1 Nutrition and Food Science **15h**

1. Ayurveda: multipronged approach to treatment – lifestyle, diet, and medicine, healthy aging
2. Balanced diet, Macro & Micro Nutrients, Calorific values of foods.
3. Nutritional composition of fruits, cereals, pulses, nuts and fibres, vegetables, milk and milk products
4. BMR, BMI and factors affecting them.
5. Absorption; Control of food intake (leptin, ghrelin, peptide YY)
6. Malnutrition (PEM, Marasmus, Kwashiorkor), Obesity (BMI and other metrics)
7. Eating disorders; Anorexia and bulimia; Diet and longevity, ageing.
10. Food spoilage and preservation
11. Food adulteration and hygiene, Principles of quality control
12. Food contaminants (metals, pesticides and aflatoxins) and food additives
13. Pre-biotics, Probiotics and Dietary fibres
14. Nutraceuticals and Functional foods (Millets)
15. RDA for infants, children, adults and expectant / nursing mothers

Credit 2 Clinical Biochemistry **15h**

1. Sample collection, serum, plasma and anticoagulants, factors affecting the sample collection – Place, time, temperature and posture, Deproteinization, Identification, transport and storage
2. Quality control and assurance in clinical biochemistry
3. Complete Blood picture, prothrombin time, ESR and Erythrocyte metabolic disorders

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4. Composition (including formed elements) and Coagulation of blood
5. Haemoglobin determination, Types and Abnormal Hbs.
6. Hemoglobinopathies – Sickle cell Anaemia and Thalassemia
7. Thrombosis and Thrombolysis
8. Complete Urine Examination – Normal and abnormal constituents
9. Acid and Bases in the body; Plasma buffers and electrolytes; Mechanism of acid-base balance
10. Water and Electrolyte balance. Assessment of Na^+, K^+ and Cl^- levels in the body
11. Respiratory and renal regulation of pH, Acidosis and alkalosis (both metabolic and respiratory).
12. Hormone tests – Thyroid function tests, Pregnancy test
13. Glucocorticoids- Cortisol, DHEA, Estrogen, Progesterone,
14. Glucocorticoids- FSH, Testosterone and Prostate Specific Antigen (PSA)
15. Enzymes as Tumor markers

Credit 3 Liver and Xenobiotics **15h**

1. Structure and anatomy of liver, Liver functions, Fatty liver.
2. Pharmacopeia drug deposition and mechanisms of drug detoxification
3. Cytochrome P450 enzymes, molecular biology, catalytic cycle, isozymes, inhibitors
4. Dose response relationship, drug-receptor interactions
5. Pharmacodynamics; pharmacokinetics
6. Phase I reactions - modifications
7. Phase II reactions – conjugation
8. Phase III reactions - modifications and elimination,
9. Environmental factors influencing drug metabolism
10. Effects and metabolism of model toxins: aflatoxins, bacterial exotoxins (types I, II, and III)
11. Serum enzymes in liver diseases- SGPT, GGT, SGOT, ALT
12. Alkaline phosphatase, Leucine amino peptidase
13. Liver function tests- conjugated and total bilurubin in serum, albumin: globulin ratio, Hippuric acid and bromsulphthalein tests.
14. Bile pigments in urine/faeces, carbohydrate tolerance
15. Nutrient drug interactions

References:

1. Nutritive value of Indian foods by C. Gopalan, B.V. Rama Sastri and S.C. Balasubramanian. National Institute of Nutrition, ICMR.
2. Essentials of Food and Nutrition –Swaminathan M. Bangalore Press
3. Manual of Nutritional Therapeutics, 2nd edition, Alpers (1991), Little Brown Publications, Washington.
4. Textbook of Medical Biochemistry by MN Chatterjea and Rana Shinde, Jaypee Brothers
5. Teitz Fundamentals of Clinical Biochemistry by Carl A. Burtis, Edward R. Ashwood and David E. Bruns. Saunders, Elsevier
6. Clinical Biochemistry: An Illustrated Colour Text (Paperback) 3rd Ed by Allan Gaw, Michael Murphy,Robert Cowan, Denis O'Reilly, Michael Stewart and James Shepherd. Churchill Livingstone.
7. Davidson's Principles and Practice of Medicine: A Textbook for Students and Doctors (Hardcover) 15th Ed by LSP Davidson, J MacLeod and CRW Edwards. Publisher: Churchill Livingstone

COURSE OUTCOMES

At the end of the course, the students will be able to

BI303A.CO1. recommend appropriate diet to meet nutritional requirements of population
BI303A.CO2. Interpret the results of biochemical tests and hormone tests in health and disease.
BI303A.CO3. apply the knowledge to assess liver functions and drug detoxification mechanisms in liver.

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Department of Biochemistry & Nutrition

PROGRAM NAME: M.Sc. BIOCHEMISTRY (2024-25)

COURSE NAME: NUTRITION AND CLINICAL BIOCHEMISTRY

PAPER CODE: BI303AP **PPW: 2**
YEAR/SEMESTER: II/III **NO OF CREDITS: 1**

CREDIT WISE COURSE OBJECTIVE:

COb4 To demonstrate the methods for nutritional assessment of foods and qualitative as well as quantitative analysis of blood and urine constituents.

Credit 4 Nutrition and Clinical Biochemistry **30h**

1. Nutritional assessment by clinical testing; Anthropometric and Biochemical testing. Proximate analysis of common foods, Determine total carbohydrate and lipid content in a food item, Detection of adulterants in Milk, Adulterants in oils and food stuffs
2. Sample collection: Blood sample collection, Separation of serum and plasma
3. Determination of A:G ratio in serum, Assay serum alkaline phosphatase, Assay serum ALT (SGPT)
4. Qualitative analysis of abnormal constituents in urine
5. Determine PCV, ESR, differential count, glycosylated haemoglobin (Hb1A), osmotic fragility of RBC

COURSE OUTCOME

At the end of the course students will be able to:

BI 301AP.CO4 apply the methods for nutritional evaluation of food in food industries and also evaluate blood and urine constituents in diagnostic labs.

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Department of Biochemistry & Nutrition

PROGRAM NAME: M.Sc. BIOCHEMISTRY (2024-25)

COURSE NAME: (ELECTIVE II) NANOBIOCHEMISTRY

PAPER CODE: BI303B **PPW: 3**
YEAR/SEMESTER: II/III **NO OF CREDITS: 3**

COURSE OBJECTIVE: To explain the synthesis, characterisation and biochemical applications of nanomaterials.

CREDIT WISE COURSE OBJECTIVES:

CObl To explain the classification, structure and properties of nanomaterials.
COb2 To describe the methods for the synthesis and characterization of nanomaterials
COb3 To discuss the biological applications of nanomaterials

Credit 1 Concept of Nanomaterials **15h**

1. Introduction to nanoscale.
2. Chronological development of Nano science
3. Classification of nanomaterial based on dimension (1D, 2D, 3D and QD)
4. Classification of nanomaterial based on composition (Carbon, metal, semiconductor, dendrimer, composite, hybrid)
5. Biological (cellular) nanostructures
6. Biomolecular motors
7. Thin films
8. Colloidal structure
9. Vesicular structure: nanovesicle, nanosphere, nanocapsule.
10. Asymmetric nanostructures: Nanorod, nanocube, nanotube, nanoprism, nanowire.
11. Nanopore: Sequencing
12. Self-assembly properties
13. Catalytic property and applications
14. Plasmonic (Noble metal) and fluorescence (QD, nanoclusters) properties
15. Bio-inspired nanomaterials (Ceramic scaffold: Alumina, Titanium dioxide)

Credit 2 Synthesis and characterization method **15h**

1. Top down and Bottom up approach
2. Top down approach: Solid phase methods (Grinding, Ball milling, mechanical alloying)

3. Bottom up approach: Solid phase methods (Chemical methods: Chemical Vapour Deposition (CVD), plasma, thermal decomposition)
4. Bottom up approach: Solid phase methods (Physical methods: Vapour Deposition(PVD), flame hydrolysis, LASER, plasma, molecular beam epitaxy (MBE))
5. Bottom up approach: Liquid phase methods (Liquid/liquid type: Chemical reduction, pyrolysis, solvothermal synthesis)
6. Bottom up approach: Liquid phase methods (Sedimentation type: Sol-gel, co-precipitation, alkaline precipitation, hydrolysis, colloidal synthesis)
7. Nanolithography
8. Size and morphology: TEM and SEM
9. Finer structural details: Atomic force microscopy
10. Crystal plane alignment :X-ray diffraction
11. Elemental study: EDX, XPS
12. Hydrodynamic size: Dynamic light scattering
13. Molecular weight and solvent association: Static light scattering
14. Solution stability: Zeta potential measurement – LASER Doppler Velocimetry
15. Nanodrop

Credit 3 Applications of Nanobiochemistry **15h**

1. Drug delivery: Classification of candidates, structure, example (nanotubes, quantum dots, polymeric conjugates Dendritic nanostructure)
2. Drug delivery mechanism: active targeting and passive targeting
3. Factors influencing drug delivery route; balancing pharmacokinetics and pharmacodynamics.
4. Chemodynamic therapy (CDT)
5. Tumor starving therapy (TST)
6. Tumor targeted imaging: hybrid nanostructure (Fe/Au nanoshell)
7. Molecular nano submarine and its anti-cancer application
8. Nanobiosensor: principle and classification
9. Sugar biosensing using FRET (Fluorescence resonance energy transfer) and ECL (electro chemiluminescence)
10. DNA biosensing using Silica Nanowire (SiNW)
11. Nanomaterials for Photoablation and hyperthermia
12. Nanoengineered hydrogel
13. Nanozymes: Nanomaterial based artificial enzyme
14. Nanotoxicity: Developing genotoxicity and ecotoxicity
15. Nanotoxicity: Containment strategies

COURSE OUTCOMES

BI 303B.CO1 identify nanomaterials with suitable properties for biological applications.
BI303B.CO2 select suitable methods for synthesis and characterization of nanoparticles
BI303B.CO3 analyze the biochemical applications of nanoparticles.

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PROGRAM NAME: M.Sc. BIOCHEMISTRY (2024-25)

COURSE NAME: (ELECTIVE II) NANOBIOCHEMISTRY

PAPER CODE: BI303BP **PPW: 2**
YEAR/SEMESTER: II/III **NO OF CREDITS: 1**

COURSE OBJECTIVE:
COb4 To demonstrate the synthesis and characterization of nanomaterials

Credit 4 Synthesis and characterization of nanomaterials **30h**

1. Chemical synthesis of nanoparticles (gold, silver nanoparticles).
2. Natural or green synthesis of metal nanoparticles.
3. Characterization of nanoparticles using UV-vis spectroscopy.
4. Quantitation of nanoparticles by ICPMS
5. Estimation of aqueous stability of various nanoparticles using DLS and Zeta potential.

COURSE OUTCOME:

BI 303BP.CO4 Implement suitable methods for synthesis and characterization of nanomaterials in biotech industries.

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Department of Biochemistry & Nutrition

PROGRAM NAME: M.Sc. BIOCHEMISTRY (2024-25)

COURSE NAME: ELECTIVE II PHYSIOLOGY AND REPRODUCTIVE BIOLOGY

PAPER CODE: BI304A **PPW: 3**
YEAR/SEMESTER: II/I **NO OF CREDITS: 3**

COURSE OBJECTIVE: To provide basic understanding of nerve, muscle and reproductive physiology in humans.

CREDITWISE COURSE OBJECTIVES:

COb1 To outline the physiology of neurotransmission
COb2 To explain the physiology of muscle contraction and related disorders
COb3 To discuss reproductive biology in humans

CREDIT 1 Neurophysiology **15h**

1. Structure of Brain and typical nerve cells.
2. Division of vertebrate nervous system: CNS, PNS,
3. ANS, regions of the brain
4. Functioning of the sensory and motor nerves
5. Types of neuronal cells – Neuroglia, microglia, astrocytes,
6. Oligodendrocytes, Schwann, satellite and epididymal cells
7. Nerves: regeneration of nerve fibers, generation of nerve impulse, all or none principle.
8. Mechanism of synaptic transmission, transmission of nerve impulse.
9. Types of neurotransmitters and their receptors, mode of signaling
10. Electrical synapse and giant neurons
11. Sensory organs – eye, ear, Sensory organs: skin, tongue
12. Vision: visual system
13. Rhodopsin and classical GPCR mechanism, termination of visual signal
14. Cone cells, specialization in color vision, physiology of colour blindness
15. Similarity between vision, olfaction and gustation

CREDIT 2 Structure and Physiology of Muscle **15h**

1. Basic structure of muscle
2. Various types of muscle: striated, cardiac, smooth, fast twitch, slow twitch
3. Mechanism of muscle contraction
4. Regulation of muscle contraction

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5. Role of actin and myosin in non-muscle cells.
6. Role of Cytochalasins
7. Cytokinesis.
8. Muscle gene expression, regulation at transcriptional and posttranscriptional level.
9. Role of muscle proteins in cell locomotion
10. Neuro-muscular transmission
11. Electromyography, Sherrington starling Kymograph (recording drum)
12. Disorders of muscle: dystrophy, myopathy
13. myositis, myotonia
14. Paralysis, Myasthenia gravis
15. Detection and treatment of muscle disorders

CREDIT 3 Human Reproductive Biology **15h**

1. Anatomy of Female reproductive system
2. Endocrinology of Female reproductive system
3. Anatomy of male reproductive system
4. Endocrinology of male reproductive system
5. Gametogenesis
6. Menstrual cycle
7. Fertilization
8. Implantation
9. Endocrinology of pregnancy
10. Endocrinology of parturition
11. Female infertility causes and treatment
12. Male infertility causes and treatment
13. Reproductive aging (menopause and andropause)
14. Methods of Birth control
15. Placenta as source of stem cells, cord banking

REFERENCES:

1. Human Physiology by Guyton and Hall Press Pub Saunders
2. Biochemistry, 4th Edition - Donald Voet, Judith G. Voet – Publisher John Wiley & Sons.
3. Human reproductive Biology by Jones and Lopez Pub
4. Principles of Biochemistry: Mammalian Biochemistry: Smith EL, Hill RL, White A, McGraw Hill

COURSE OUTCOMES:

At the end of the course students will be able to:

BI304A.CO1 apply the understanding of the physiological process of neuotransmission
BI304A.CO2 apply the knowledge of muscle physiology in health and disease conditions.
BI304A.CO3 correlate the knowledge of the human reproductive system to fertility and pregnancy.

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Department of Biochemistry & Nutrition

PROGRAM NAME: M.Sc. BIOCHEMISTRY (2024-25)

COURSE NAME: PHYSIOLOGY AND REPRODUCTIVE BIOLOGY

PAPER CODE:BI 304AP **PPW: 2**
YEAR/SEMESTER:II/III **NO OF CREDITS: 1**

COURSE OBJECTIVE

COb4 to demonstrate the analytical methods for biomolecules related to nerve , muscle and reproductive physiology

CREDIT 4 Physiology and Reproductive Biology **30 h**

1. Histopathology: Techniques for tissue processing and slide staining. Histopathology of Uterus, Ovary, Oviduct and Placenta, Testes
2. Assay of serum AST (SGOT)/ALT(SGPT), Assay serum LDH.
3. Lipid profile: HDL/LDL cholesterol
4. Pregnancy test, Detection of hCG,
5. Estimation of dopamine (Spectrophotometric method)

COURSE OUTCOME:

At the end of the course students will be able to
BI304AP. CO4 analyse serum enzymes, lipid profile and neurotransmitters in biological samples.

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Department of Biochemistry & Nutrition

PROGRAM NAME: M.Sc. BIOCHEMISTRY (2024-25)

COURSE NAME: EVOLUTION, ECOLOGY AND DEVELOPMENTAL BIOLOGY

PAPER CODE: BI304B **PPW: 4**
YEAR/SEMESTER: II/I **NO OF CREDITS: 3**

COURSE OBJECTIVE: To familiarize the students with the concepts of Evolution, Ecology and Developmental biology

CREDITWISE COURSE OBJECTIVES:

COb1 to effectively communicate the principles of evolution and its application to human biology
COb2 to explain the concepts of ecosystem, types of ecology, environmental toxicology and biodiversity
COb3 to provide the basic understanding of fertilization and embryogenesis

CREDIT 1 Evolution **15h**

1. Origin of life
2. Evolution of life forms – a theory
3. Evidences for evolution
4. Theories of evolution
5. Selection in action
6. Adaptive radiation
7. Biological evolution
8. Population and genetic evolution
9. Mechanism of evolution
10. Hardy-weinberg principle
11. Evolution above species level
12. Isolation
13. Speciation
14. A brief account of evolution
15. Origin and evolution of man

CREDIT 2 Ecology **15h**

1. Ecosystem structure and function, energy dynamics,
2. Distribution of Flora and Fauna
3. Types of ecology,

4. Mineral cycling—(carbon and nitrogen) primary production and methods of measurement of primary productivity.
5. Population Ecology: Concept and Characteristics of a population, Population growth curves,
6. Species interactions: Types of interactions, Positive interactions- Mutualism, symbiosis,
7. Commensalism, protocooperation, Herbivory, carnivory, antibiosis and competition
8. Community Ecology: Characteristics of communities,
9. Analytical, Quantitative- Frequency ,density, abundance ,cover and basal area
10. Qualitative—Physiognomy, phenology,
11. Stratification, sociability, vitality and life forms,
12. Raunkiaer concept, Ecotones.
13. Concept of climax- Monoclimax and Polyclimax theories
14. Environmental toxicology: Effects of Toxic chemicals, Pollutants, Natural contaminants.
15. Biodiversity: Levels of Biodiversity-Species, Ecosystem and Genetic Diversities,

CREDIT 3 Developmental biology **15 h**

1. Basic concepts of development : Potency, commitment, specification, induction, competence, determination and differentiation
2. Morphogenetic gradients
3. Cell fate and cell lineages
4. Stem cells
5. Genomic equivalence and the cytoplasmic determinants
6. Imprinting
7. Gametogenesis
8. Fertilization and early development
9. Embryo sac development and double fertilization in plants
10. Embryogenesis in plants, symmetry, seed formation and germination.
11. Embryogenesis in animals, Zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals.
12. Morphogenesis and organogenesis in animals
13. Axes and pattern formation in Drosophila, amphibia and chick; limb development and regeneration in vertebrates.
14. Differentiation of neurons, post embryonic development
15. Morphogenesis and organogenesis in plants

REFERENCES:

Reference Books
1. Fundamentals of Ecology, 2nd Edition, (2001) By MC Dash, Tata Graw Hill.
Cell Biology, Genetics, Molecular Biology and Ecology (2005) by P.S Verma and V.K. Agarwal, SS Chand and Company.

COURSE OUTCOMES:

At the end of the course students will be able to:
BI304B.CO1 develop basic understanding of the concepts and theories of evolution.
BI304B.CO2 identify various types of ecosystems, their diversity, functioning and conservation needs.
BI304B.CO3 distinguish the difference in the pattern of development among various species.

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Department of Biochemistry & Nutrition

PROGRAM NAME: M.Sc. BIOCHEMISTRY (2024-25)

COURSE NAME: EVOLUTION, ECOLOGY AND DEVELOPMENTAL BIOLOGY

PAPER CODE:BI304BP **PPW: 4**
YEAR/SEMESTER:II/I **NO OF CREDITS: 2**

CREDIT WISE COURSE OBJECTIVE

COb4 To demonstrate the methods for analysis of ions and histology of embryogenesis in various species

CREDIT 4 Evolution, Ecology and Developmental Biology **15 h**

1. Determination of quantitative characters by random quadrat method -Abundance, Density, Frequency and Dominance
   To determine the important value index(IVI) of plant species in the campus
2. Similarity and Dissimilarity Index
   Estimation of Carbonates, Bicarbonates, Chlorides & Fluorine.
3. Estimation of Dissolved Oxygen, BOD, COD.
   Preparation of biological spectrum
   IUCN threatened categories: Rare, and Endangered
4. Vulnerable categories of plant species from Telangana.
   Mapping of in situ plant conservation in India.
   Ex situ conservation: Seeds of crop plants.
5. Histology of embryogenesis in plants
   Histology of embryogenesis in animals, Development of zebra fish

COURSE OUTCOME:
At the end of the course students will be able to:
BI304BP.CO4 analyse quantitatively ions and interpret histology of embryogenesis

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Department of Biochemistry & Nutrition

PROGRAM NAME: M.Sc. BIOCHEMISTRY (2024-25)

COURSE NAME: BIOSTATISTICS AND BIOINFORMATICS

PAPER CODE: BI401 **PPW: 3**
YEAR/SEMESTER: II/IV **NO OF CREDITS: 3**

COURSE OBJECTIVE: To explain the concepts of statistical methods and bioinformatics methods in biological data analysis

CREDIT WISE COURSE OBJECTIVES

CObj1 To discuss the appropriate statistical method for data analysis in biochemistry
CObj2 To explain the different databases and sequence alignment methods for genomes and proteomes
CObj3 To describe the methods for sequencing of genomes and proteomes and applications of genomics

Credit 1 Biostatistics **15h**

1. Biostatistics fundamentals (sample, population, variable); Types of variables, Measurement and measurement scales
2. Measures of central tendency (mean, median, mode)
3. Measurement of dispersion (range, variance, standard distribution)
4. Study of bivariate data: correlation and regression; Regression to calculate concentration of DNA/protein, molecular weight of DNA/protein
5. Graphical methods to depict data (histograms, bar-plots, pie charts, line graphs)
6. Probability in biology, Laws of Probability, Bayesian probability
7. Normal distribution, Binominal distribution and Poisson distribution
8. Student's t – test
9. F – test , Chi – square test; Contingency tests
10. CRD: Completely Randomized Design; 1-way ANOVA
11. RCBD: Randomized Complete Block Design; 2-way ANOVA
12. Non-parametric tests: sign test, Wilcoxon signed rank test
13. Non-parametric tests: Mann-Whitney test, Kruskal-Wallis test, and Friedman tests
14. Design of experiments: factorial experiments
15. Quality control in biochemistry

Credit 2 Bioinformatics **15h**

1. Introduction of Bioinformatics: scope, history
2. Bioinformatics web portals- NCBI, EBI, ExPASy

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3. DNA sequence databases-GenBank, EMBL, DDBJ
4. Protein sequence databases- UniProt, SWISSPROT, PIR, TeMMBL
5. Protein structure databases- PDB, SCOP, CATH, DSSP, CCDC
6. Functional database- KEGG, SWISS 2D-PAGE, COGS, PROSITE
7. Secondary or sequence cluster database - ProDom, SYSTERS, ProtoMap.
8. Sequence alignment: Dot matrix, match, mismatch, scoring method, gap penalty.
9. Comparing DNA/ protein sequences: pairwise local and global alignment
10. BLAST and FASTA- principle, classification and variation.
11. Scoring matrices- PAM and BLOSUM matrices
12. Multiple sequence alignments- Clustal-W, COBALT
13. Proteins motifs and MS profiles databases
14. Comparing protein sequences, alignment methods
15. Predicting secondary structure-ab initio, Homology folding, threading

Credit 3 Genomics and Proteomics **15h**

1. Genomics and its branches
2. HGP and Strategies for sequencing genomes (shotgun and hierarchical sequencing)
3. 1st generation sequencing methods (Maxam and Gilbert Method; Sanger's method)
4. 2nd and 3rd Generation DNA sequencing methods (Next Generation Sequencing: Pyrosequencing, Solexa, SoLiD, Helicos, SMaRT, IonTorrent)
5. Genetic and Physical maps of the genome, EST, STS
6. Genome annotation, re-sequence mapping and GWAS
7. Gene and genome duplications, and transposable elements
8. Epigenomics
9. Metagenomics
10. Paleogenomics and synthetic genomics
11. Relation of proteome to genome and transcriptome
12. Post-translational modification (kinome, glycosylation)
13. HUPO goals and accomplishments
14. Methods for sequencing proteins: Edman degradation
15. 2D gels and peptide maps

References:

1. Statistics, Basic Concepts and Methodology for the Health Sciences Daniel WW, Pub Wiley India
2. Biostatistics –Arora & Malhan, Himalaya Publishing House
3. Introduction to Bioinformatics- Attwood T K and parry –smith, D.J. Pearson Education
4. Bioinformatics (Sequence and Genome Analysis) Mount David W, Press CSH
5. Discovering Genomics, Proteomics and Bioinformatics – Campell&Heyer, Benjamin / Cummings pub

COURSE OUTCOMES:

At the end of the course, students will be able to

BI401.CO1 choose relevant statistical methods for biological data analysis.

BI401.CO2 use genome and protein databases and sequence alignment methods for retrieval and alignment of sequences

BI401.CO3 apply the knowledge of genome and proteome sequencing methods in genome and proteome analysis

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PROGRAM NAME: M.Sc. BIOCHEMISTRY (2024-25)

COURSE NAME: BIOSTATISTICS AND BIOINFORMATICS

PAPER CODE: BI401P
YEAR/SEMESTER: II/IV

PPW: 4
NO OF CREDITS: 2

COURSE OBJECTIVE: To describe the use of statistical methods and bioinformatics tools in biological data analysis.

CREDIT WISE COURSE OBJECTIVES:

COb4 To explain statistical methods in data analysis and the use of biological databases.
COb5 To discuss the *in silico* tools and techniques in bioinformatics

Credit 4 Applications of Biostatistics and Bioinformatics databases **30h**

1. Descriptive statistics (Mean, median, mode, range, variance and standard deviation)
2. Graphical methods to depict data (bar plots, pie charts, line graphs)
3. Correlation and Regression
4. OMIM database and human genetic disorders and KEGG database for pathways
5. Retrieve DNA sequence, protein sequence, protein structure from database (NCBI, PDB)

Credit 5 Sequence alignment techniques and *in silico* processes **30h**

1. Local and global alignment of DNA, protein
2. Multiple sequence alignments
3. Primer design for PCR and *in silico* PCR
4. *In silico* restriction mapping
5. *In silico* translation, R programming

COURSE OUTCOMES:

At the end of the course, the students will be able to

BI401P.CO4 Perform basic statistical analysis of biological data and retrieve DNA and protein sequences and structure from databases
BI401P.CO5.Use suitable tools of bioinformatics to align, amplify and translate nucleotide sequences and align protein sequences.

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Department of Biochemistry & Nutrition

PROGRAM NAME: M.Sc. BIOCHEMISTRY (2024-25)

COURSE NAME: CELL-CELL COMMUNICATION AND SIGNALING

PAPER CODE: BI 402 **PPW: 3**
YEAR/SEMESTER: II/III **NO OF CREDITS:3**

COURSE OBJECTIVE: To explain the importance of extracelluar matrix and tumor suppressor genes in animals and signal transduction in bacteria and plants.

CREDIT WISE COURSE OBJECTIVES

CObj1 To discuss the molecules of extracellular matrix and tumor suppressor genes in cancer biology
CObj2 To explain the types of signalling molecules in cell-cell communication.
CObj3 To discuss the mechanisms of signal transduction in bacteria and plants

Credit 1 Extracellular matrix (ECM), cytoskeleton and cancer biology **15h**

1. Molecules in ECM of animal tissue, Collagen, Elastin, Fibronectin.
2. Molecules of ECM- Laminins, proteoglycans, integrins
3. ECM remodeling
4. Cell-Cell junctions and cadherin's
5. Functions and origin of cytoskeleton
6. Myosin and actin
7. Cell polarization and mechanism of cell polarization
8. cell migration
9. Proto – oncogenes,
10. Modes of action of oncogenes
11. monomeric G – proteins
12. Ras, c-Myc and leukemia
13. Tumor suppressor genes- p53
14. Tumor suppressor genes-RB and retinoblastoma
15. BRCA and breast cancer

Credit 2 Cell Signaling and Signal Transduction **15h**

1. Cell communication and type of signaling molecules.
2. Types of receptors and their structure.
3. Signal cascades their importance
4. GPCR, mechanism of signal transduction; inhibitory and stimulatory G alpha (one eg each)

5. GPCR signal termination
6. Tyrosine kinase receptors mediated signaling
7. Insulin, growth factors EGF, VEGF signaling mediated
8. MAPK pathway, role in signaling
9. JAK-STAT pathway
10. Second messengers – Calcium and calmodulin
11. Phosphoinositides
12. NO, cAMP, cGMP
13. Important signaling enzymes and their regulation: PKC, CAM-kinases
14. PI3-kinase
15. Phospholipases and Phosphatases

Credit 3 Signal Transduction in Bacteria and Plants **15h**

1. Introduction of signaling components in bacteria
2. Chemotaxis, Protein kinases in bacteria
3. His - kinases: structure and role
4. Plant signaling system : an overview
5. Response of plants to light, temperature and environmental factors
6. Cell surface Receptors in plants
7. Phytochromes and Cryptochromes
8. Stress signaling in plants (biotic)
9. Stress signaling in plants (abiotic)
10. Role of growth regulators in plants: Ethylene, auxins
11. Role of Cytokinins, Giberrelins and Abscissic acid
12. Signaling in yeast
13. STAT pathway in yeast
14. Protein - Protein interactions in signaling
15. Drugs: targeting signaling molecules

References:

1. Biochemistry of Cell Signaling, Helmreich JM, Oxford Press
2. Cell signaling – John T Hancock, Oxford University press
3. Cell biology. Second edition: Edited by C A Smith and E J Wood. Chapman & Hall publ.
4. Molecular Cell Biology, 4th edition. Harvey Lodish, Arnold Berk, S Lawrence Zipursky, Paul Matsudaira, David Baltimore, and James Darnell. New York: W. H Freeman.
5. Molecular Cell Biology, 4th edition. Alberts B, Johnson A, Lewis J, et The al New York: Garland Science; 2002

COURSE OUTCOMES:

At the end of the course students will be able to:

BI 402.CO1 apply the knowledge of extracellular matrix molecules and tumor suppressor genes in cancer progression
BI 402. CO2 identify the role of signaling molecules in signal transduction
BI 402. CO3 distinguish between the signaling pathways in bacteria and plants.

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PROGRAM NAME: M.Sc. BIOCHEMISTRY (2024-25)

COURSE NAME : CELL-CELL COMMUNICATION AND SIGNALING

PAPER CODE: BI 402P **PPW: 4**
YEAR/SEMESTER: II/III **NO OF CREDITS:2**

COURSE OBJECTIVES:
Cob 4 To demonstrate basic experiments of cell culture to understand cell cell communication
Cob 5 To explain basic experiments of bacterial and yeast growth

Credit 4 Basic experiments: Cell-cell communications **30h**

1. Cell line assays: Preparation of suspension and adherent cells
2. Trypan blue and MTT assays,
3. Analysis of phosphoproteins
4. Chemotaxis assay-eukaryotes
5. Egg experiments – Osmosis, Diffusion

Credit 5 Basic experiments : Signal transduction in Bacteria and Yeast **30h**

1.Sterilization methods: autoclaving & surface sterilization Preparation of culture media
2. Isolation of pure cultures, Bacterial growth curve
3. Gram Staining, Differential staining: Acid fast staining, Giemsa
4. Chemotaxis-bacteria
5. Yeast budding experiment

References:

1.Practical Medical Microbiology by R Panjarathinam. Jaypee Brothers Medical Publishers (P) Ltd.
2 Practical Medical Microbiology by Mackie &Mc Cartney. Elsevier
3 Microbiology – A Laboratory Manual by Cappuccino and Sherman. Pearson Education India.
4 Practical Medical Microbiology by Chandra Prakash Bhatt. A.K. Books and Educational Enterprises
5. A Practical guide to Clinical Virology by L. R. Haaheem, John R. Pattison and Richard J. Whitley
6 Virology Methods Manual by Brian WJ Mahy and Hillar O Kangro. Elsevier

COURSE OUTCOMES

At the end of the course the student will be able:

BI 402P CO 4 employ the methods of cell culture in industry/ research
BI 402P CO 5 identify and characterize the bacteria, isolated from various samples.

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Department of Biochemistry & Nutrition

PROGRAM NAME: M.Sc. BIOCHEMISTRY (2024-25)

COURSE NAME: GENERAL MICROBIOLOGY, BACTERIOLOGY AND VIROLOGY

PAPER CODE: BI403A **PPW: 3**
YEAR/SEMESTER: II/IV **NO.OF CREDITS: 3**

COURSE OBJECTIVE: This course gives an overview of the fundamentals related to bacterial and viral growth, culture methods, their classification, purification and life cycles.
CREDIT WISE COURSE OBJECTIVES:

CObl To explain the classification of microorganisms and their isolation, assay methods, **cultivation** and purification.
COb2 To outline the Photosynthesis, Morphology, Reproduction and pathogenesis of bacteria and their role in probiotics and antibiotics.
COb3 To discuss the diversity, structure, pathogenicity, life cycles of viruses and phage application in therapy.

Credit 1 General and Applied Microbiology **15h**

1. Introduction and Classification of Microorganisms
2. General Characteristics and structure of Bacteria
3. General Characteristics and structure of Archae
4. General Characteristics and structure of Fungi
5. General Characteristics and structure of Algae
6. Sub viral agents: viroids, virusoids and prions
7. Type of media for Bacterial cultures– Selective and Enriched media
8. Methods of sterilization - Physical and chemical methods
9. Isolation of pure cultures
10. Bacterial growth curve and kinetics of growth.
11. Batch, Continuous and synchronous cultures
12. Isolation and purification of viruses by filtration, ultracentrifugation and affinity chromatography
13. Cultivation and propagation of viruses
14. Viruses: One step growth, single burst and eclipse experiments
15. Viral assay methods – Plaque assays, pock assay, hemagglutination assay, transformation assay.

Credit 2 Bacteriology **15h**

1. Classification of Bacteria
2. Bacterial Photosynthesis

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3. Introduction to medical bacteriology. Infections – Types and transmission
4. Gram positive pathogens, Morphology, Reproduction and pathogenesis – Staphylococcus
5. Gram negative pathogens Morphology, Reproduction and pathogenesis – E.coli and Salmonella
6. Morphology, Reproduction and pathogenesis of Mycobacterium tuberculosis
7. Analysis of air, water and milk borne bacteria
8. Probiotic bacteria and their relevance to health
9. Domestic, municipal and industrial wastes Disposal. Microorganisms in the recycling process
10. Biodegradation of lignocellulosic waste, phenolic compounds and hydrocarbons.
11. Biotransformation of antibiotics and steroids.
12. Bioremediation of pollutants, metals and metallothioneins
13. Microbial metabolism – Autotrophs and Heterotrophs
14. Industrial uses of Bacteria
15. Antibacterial agents

Credit 3 Virology (Prokaryotic and Eukaryotic viruses) **15h**

1. Classification of viruses (Bacteriophages, plant and animal viruses):
2. Baltimore & ICTV systems, Genome diversity
3. Structure and composition of bacteriophages
4. Life cycle of model bacteriophages infecting E coli – λ (lytic lysogenic)
5. Life cycle of ϕ X 174, M13
6. Life cycle of T4, T7
7. Life cycle of Qß, Mu
8. Applications of phages - therapy; Concern over phage contamination in
9. industry (dairy)
10. Eukaryotic viruses Host – virus interactions, permissive/non - permissive
11. hosts; Cytopathic effects
12. Structure, life cycle and pathogenicity of Geminivirus
13. Structure, life cycle and pathogenicity of TMV
14. Structure, life cycle and pathogenicity of Adenovirus and SV 40 virus
15. Structure, life cycle and pathogenicity of Rotavirus and Rubella,
16. Structure, life cycle and pathogenicity of Influenza and Measles viruses
17. Structure, life cycle and pathogenicity of HIV and Hepatitis B Virus

References:

1. Microbiology by Pelczar M.J., Ried, RD and Chan, ECS.
2. Microbiology by Gerard J. Tortora, Berdell Ra. Funke and Christine L. Case. Publ: Pearson Education Inc
3. Medical Microbiology-David Green wood
4. Virology – Saravanan
5. Virology – Maharajan
6. Molecular Virology – A. J. Cann
7. An introduction to Viruses – Biswas

COURSE OUTCOMES:

At the end of the course students will be able to:

BI403A. CO1 Identify appropriate bacterial and virus culturing methods.

BI403A. CO2 categorize the pathogenic bacteria and industrial important bacteria in probiotics and antibiotics.

BI403A.CO3 categorize the viruses and identify suitable purification and assay methods for isolation of viruses.

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Department of Biochemistry & Nutrition

PROGRAM NAME: M.Sc. BIOCHEMISTRY (2024-25)

COURSE NAME: (ELECTIVE III) BIOTECHNOLOGY

PAPER CODE: BI403B **PPW: 3**
YEAR/SEMESTER: II/IV **NO.OF CREDITS: 3**
COURSE OBJECTIVE: To describe various resources available in the production of biotechnological products for the welfare of human life.

CREDITWISE COURSE OBJECTIVES:
COb1 To explain the production of various metabolites by microbes and concepts of nanotechnology
COb2 To discuss the strategies in genetic engineering of plants and their use as bioreactors.
COb3 To describe the tools and techniques in engineering animal and the latest developments in the field of protein engineering.

CREDIT 1 Microbial Biotechnology **15 h**

1. Large scale cultivation of microbes; Fermenter design and control of growth
2. Downstream processing, Production of biomass, single cell protein
3. Production of low molecular weight primary and secondary metabolites
4. Microbial insecticides
5. Production of enzymes for research (restriction enzymes)
6. Production of enzymes for industry (high fructose corn syrup, cheese, food processing)
7. Microbial polysaccharides-Xanthan gum, Dextran, Pullulan,
8. Mannan, Curdlan, Alginate
9. Microbial mining (heavy metal mining, mineral leaching, Sulfur cycle)
10. Microbial production of human insulin,
11. Microbial production of human growth hormone
12. Microbial production of interferon, tissue plasminogen activator
13. Superbug and microbial degradation of oil (bioremediation)
14. Methods and applications of immobilized cells
15. Methods and applications of immobilized enzymes

CREDIT 2 Plant Biotechnology and Nanotechnology **15 h**

1. Plant cell culture: callus, differentiation into plantlets
2. Isolation of protoplasts and protoplast fusion
3. Plant vectors

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4. Agrobacterium tumefaciens and Ti plasmids
5. Transgenic technology
6. GM plants, GM foods, Genetic engineering appraisal committee (GEAC)
7. IPR and farmers' rights in GM plants
8. Terminator technology
9. Antisense RNA,Antisense DNA
10. Plantibodies (example dental caries)
11. Case studies (genes involved, commercial value, problems) of StarLink corn, Bt Cotton
12. Case studies of Zeneca tomato paste, FlavrSavr tomato
13. Case studies of Golden rice, Herbicide resistant plants (Roundup Ready)
14. Nanomaterials- structure, properties and types. Chemical and green synthesis of nanoparticles.
15. Nanobiotechnology and its applications

CREDIT 3 Animal Biotechnology and Protein engineering **15 h**

1. Development, maintenance and growth of animal cell lines
2. Cloning of mammalian and non-mammalian species (Polly, Molly, and Dolly)
3. Production of viral vaccines
4. Production high value therapeutics, interferon, PEGylated interferon
5. Plasminogen activator, urokinase
6. Chimeric antibodies and antibody engineering
7. Immunotoxins as therapeutic agents
8. Gene knockouts
9. Human gene therapy
10. "Humanized" animals as organ farms
11. Large-scale and site-directed mutagenesis, high throughput screening tools in protein engineering
12. Altering kinetic properties and pH dependence of enzymes
13. Increasing stability, enhancing specific activity of enzymes
14. Natural and recombinant fusion proteins, tags for protein purification
15. Methods of drug design and delivery

References:

1. Introduction to Biotechnology, William J. Thieman, Michael A. Palladino, Benjamin Cummings Publ
2. Biotechnology- Arora, Himalaya pub. House
3. Principles of Gene Manipulation, by R.W. Old, S.B. Primrose, Wiley-Blackwell Publications.
4. Biotechnology, Applying the genetic revolution. David P Clark and Nanette J. Pazdernik. Academic Press.
5. Culture of animal cells. 6th Edition. A manual of Basic technique and specialized applications, By R Ian Freshney. Wiley Blackwell publishers.
6. Text book of Nanoscience and Nanotechnology by Murty B.S., Shankar, P., Raj, B., Rath, B.B and Murday, J. Springer.
7. Text book of Nanoscience and Nanotechnology by T. Pradeep, McGraw Hill Education (India) Private Limited.

COURSE OUTCOMES:

At the end of the course students will be able to:

BI403B.CO1 apply the knowledge for production of metabolites by downstream processing and use appropriate methods to synthesize nanoparticles.

BI403B.CO2 Apply genetic engineering methods to use plants as bioreactors.

BI403B.CO3 Design protocols for the production of biotechnological products using animal systems and apply the knowledge of protein engineering in development of novel proteins or drugs.

Bharatiya Vidya Bhavan

BHAVAN'S VIVEKANANDA COLLEGE

OF SCIENCE, HUMANITIES & COMMERCE
Sainikpuri, Secunderabad – 500094
Autonomous College - Affiliated to Osmania University
(Reaccredited with 'A' grade by NAAC)

Department of Biochemistry & Nutrition

PROGRAM NAME: M.Sc. BIOCHEMISTRY (2024-25)

COURSE NAME: BIOTECHNOLOGY

PAPER CODE : BI403P **PPW: 4**
YEAR/SEMESTER: II/IV **NO.OF CREDITS: 2**

CREDITWISE COURSE OBJECTIVES:

COb4 To demonstrate the methods for culturing, isolation and identification of bacteria and fungi.
COb5 To learn the strategies involved in the production of important metabolites and their applications

Credit 4 General Microbiology **30h**

1. Methods of Isolation and identification of fungi.
2. Antibiotic sensitivity: Paper disc and agar well diffusion assay,
3. Broth dilution assay -Determination of MIC
4. Bacterial motility: Hanging drop method.
5. Widal Test/ VDRL test

Credit 5 Biotechnology **30h**

1. Biotransformation of Antibiotics and Steroids
2. Biodegradation of phenolic compounds hydrocarbons, Dye decolourization by microorganisms
3. Isolation of protoplasts, regeneration and protoplast fusion
4. Production and isolation of industrially important enzymes
5. Green synthesis of nanoparticles.

References:

1. Introduction to Biotechnology, William J. Thieman, Michael A. Palladino, Benjamin Cummings Publ
2. Biotechnology- Arora, Himalaya pub. House
3. Principles of Gene Manipulation, by R.W. Old, S.B. Primrose, Wiley-Blackwell Publications
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COURSE OUTCOMES

At the end of the course students will be able to:
BI403P.CO4 employ the methods of isolation and identification of bacteria or fungi from various sources in biotech lab/ industry or in research.
BI403P.CO5 implement the appropriate methods to produce industrially important metabolites for various application.

23/3/24

Head, Dept. of Biochemistry & Nutrition
Bhavan's Vivekananda College
Sainikpuri, Secunderabad - 500 094

Professor Karuna Rupula
Department of Biochemistry
University College of Science
Osmania University
Hyderabad-500 007 (TS)

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Department of Biochemistry & Nutrition

PROGRAM NAME: M.Sc. BIOCHEMISTRY (2024-25)

COURSE NAME: PROJECT

PAPER CODE : BI404
YEAR/SEMESTER: II/IV

PPW: 7
NO.OF CREDITS: 5

COURSE OBJECTIVE: To inculcate research aptitude and train to propose and execute research project independently

COb1 To discuss a suitable research topic and present a research design seminar.
COb2 To explain the progress of proposed research through seminars
COb3 To report the research findings in the form of dissertation
COb4 To explain the results of the research work in the form of a power point presentation
COb5 To discuss and present the results during viva voce.

Internal Assessment		
Credit 1	Research Design Seminar	25 marks
Credit 2	Progress Seminar 1	25 marks
Semester end Assessment		
Credit 3	Dissertation	25 marks
Credit 4	Final presentation	50 marks
Credit 5	Viva Voce during final presentation	25 marks

COURSE OUTCOMES

At the end of the course students will be able to:
BI404.CO1 Implement the knowledge in designing the research work and execute it effectively.
BI404.CO2 analyze the results of their project work through progress seminar
BI404.CO3 interpret the research data and prepare a detailed project report
BI404.CO4 organise the research work in the form of a final presentation and present in National/International Seminars/Conferences.
BI404.CO5 defend the results of project work and apply the strategies followed for the research work in R & D labs.

A. Lai Yadu
23/3/24.

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