ANNAMALAI UNIVERSITY

408 - M. Sc. Biochemistry

Programme Structure and Scheme of Examination (under CBCS)
(Applicable to the candidates admitted from
the academic year 2022 -2023 onwards)

Course Code	Study Components & CourseTitle	Hours/Week	Credit	Maximum Marks		
				CIA	ESE	Total
	SEMESTER – I					
22PBIOC11	Core Course - I :Chemistry of Biomolecules	5	3	25	75	100
22PBIOC12	Core Course - II : Cell Biology	5	3	25	75	100
22PBIOC13	Core Course – III :Enzymes	5	3	25	75	100
22PBIOP14	Core Practical – I : Quantitative and Qualitative analysis and Enzymology	9	6	40	60	100
22PBIOE15	Core Elective – I	4	4	25	75	100
22PBIOO16	Open Elective – I	2	3	25	75	100
	Total	**30**	**22**			**600**
	SEMESTER – II					
22PBIOC21	Core Course–IV : Metabolism and Regulation	5	3	25	75	100
22PBIOC22	Core Course– V : Analytical Techniques	5	3	25	75	100
22PBIOC23	Core Course – VI :Molecular Biology	5	3	25	75	100
22PBIOP24	Core Practical – II : Analytical and Molecular Biology Techniques	9	6	40	60	100
22PBIOE25	Core Elective – II	4	4	25	75	100
22PHUMR27	Compulsory Course: Human Rights	2	2	25	75	100
	Total	**30**	**21**			**600**

List of Core Electives(Choose 1 out of 3 in each Semester)

Semester	Course Code	Course Title	H/W	C	CIA	ESE	Total
I	22PBIOE15-1	Human physiology	4	4	25	75	100
	22PBIOE15-2	Nutritional Biochemistry	4	4	25	75	100
	22PBIOE15-3	Developmental Biology	4	4	25	75	100
II	22PBIOE25-1	Bioinformatics	4	4	25	75	100
	22PBIOE25-2	Microbiology	4	4	25	75	100
	22PBIOE25-3	Cancer Biology	4	4	25	75	100

List of Open Electives(Choose 1 out of 3 in each Semester)

Semester	Course Code	Course Title	H/W	C	CIA	ESE	Total
I	22PBIOO16-1	Food and Nutrition	2	3	25	75	100
	22PBIOO16-2	Bioinstrumentation	2	3	25	75	100
	22PBIOO16-3	Medical Lab Technology	2	3	25	75	100

SEMESTER - I CORE - I	22PBIOC11: CHEMISTRY OF BIOMOLECULES	CREDIT:3 HOURS:5

COURSE OBJECTIVES

1. To create knowledge on the classification of carbohydrate and its significance.
2. To enable students to learn about the biological importance of lipids and role of membrane lipids
3. To make students aware on classification, structure and properties of aminoacids and proteins
4. To provide knowledge on structure and properties, physicochemical properties of nucleic acids
5. To impart basic knowledge of vitamins and their biological functions

Unit- I: Water and Carbohydrates **Hours: 15**

Water - Unique properties, weak interactions in aqueous systems, ionization of water, buffers. Carbohydrates: classification-properties of monosaccharides, Oligosaccharides-Disaccharides, Polysaccharides– occurrence, structure and biological functions of cellulose, chitin, starch and glycogen. Chemistry and biological roles of homo and heteropolysaccharides. Structure and role of glycoproteins and glycolipids (gangliosides and lipopolysaccharides).

Unit-II: Lipids **Hours: 15**

Lipids – Introduction, classification: structure and functions. Fatty acids: saturated, unsaturated and hydroxy fatty acids. PUFA, Phospholipids and glycolipids – structure and functions. Structure and functions of cholesterol. . lipids as signal, cofactor and pigments. Lipoproteins – classification and composition.

Unit-III: Amino acids and Proteins **Hours: 15**

Amino acids–classification, structure and physiochemical properties, chemical synthesis of peptides – solid phase peptide synthesis. Classification of protein. Structural organization ,Primary structure – determination of amino acid sequence of proteins. Conformation of proteins – Ramachandran plots. Properties of proteins.

Unit-IV Nucleic acids **Hours: 15**

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

UNIT- Vitamins **Hours 15**

Water soluble - thiamine, riboflavin, niacin, pyridoxine, folic acid, ascorbic acid sources, structure, and biochemical functions, deficiency diseases, daily requirements. Fat soluble - Vitamin A, Vitamin D, Vitamin E and Vitamin K - sources, structure, biochemical functions, deficiency diseases, daily requirements.

COURSE OUTCOMES

1) Understand about the structure and properties and importance of carbohydrates
2) Interpret the significance of lipids, Aware of structure, distribution and role of lipids in membranes
3) **E**xplain the structure and importance of Amino acids and role role of priteins and its conformation
4) **U**nderstand the structure and properties of Nucleic acids,, chemical synthesis of DNA and types of RNA and its functions
5) **G**et an overall idea about structure and functions of vitamins.

Text Books

1. Jain,J.L& Jain, (2005) Fundamentals of Biochemistry. Sixth Edition,S.Chand& Company, New Delhi.
2. Nelson, D.L. and Cox, M.M (2008). Lehninger Principles of Biochemistry. 5thEdition,W.H. Freeman and Company, New York.
3. Zubay, G. (1999). Biochemistry, 4th Edition, WCB. Mcgraw-Hill, New York.

Supplementary Readings

1. Victor W. Rodwell,(2015) Harpers Illustrated Biochemistry 30th Edition Paper back– Import,
2. Donald Voet, Judith, G. Voet, and Charlotte, W Pratt, (2008). Fundamentals of Biochemistry, 3rd Edition. John Wiley & Sons, New Jersey.
3. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2011), Biochemistry. Freeman, 7th edn, .
4. Devlin A, Text book of biochemistry (1997) 4th edition John Wiley, Inc publication, New York.
5. Bery J.M., Tymoezko J.L. and Stryer L. (2008) Biochemistry, 5th Edition, W.H. Freeman and Company, New York
6. Murray, K.R. Granner, K.D.Mayes, P.A. and Rodwell W.V. (2009).Harper's Biochemistry,23rd Edition, Prentice Hall International Inc.,New Jersey.

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	**3**	**3**	**3**	**2**	**3**
CO2	**3**	**3**	**2**	**3**	**2**
CO3	**3**	**2**	**3**	**2**	**3**
CO4	**2**	**3**	**3**	**2**	**2**
CO5	**3**	**2**	**2**	**3**	**2**

SEMESTER - II CORE - II	22PBIOC12: CELL BIOLOGY	CREDIT:3 HOURS:5

COURSE OBJECTIVES

1) To study the structure of cells and membrane transport mechanism.
2) To understanding the structure & function of intracellular organelles and cell division.
3) To understand the structure of cytoskeleton and cell cycle mechanism
4) To understand about extracellular matrix molecules and cell-cell communication.
5) To know the concepts and mechanisms of cell signaling.

UNIT-I Structure and function of cells & Transport mechanism 15 Hours

Structure and function of prokaryotic and eukaryotic cell, Structure and organization of membrane – structure of membrane model, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active & passive transport, ion pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes.. Endocytosis and endosome-endosome fusion, Classification of endocytosis, phagocytosis and pinocytosis, clathrin-independent endocytosis, receptor-mediated endocytosis.

UNIT–II Organelles & cell division 15 Hours

Isolation and characterization of sub-cellular organelles. Plasma membrane, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast-structure & function. Cytoskeleton and its role in motility and cell division: amitosis mitosis; meiosis and genetic recombination

UNIT-III Cytoskeleton & cell cycle 15 Hours

Structure and movement of cilia and flagella. Microtubules, structure, and dynamics. Assembly of various extracellular matrix and their role in integrating cells into tissues and cell-cell interactions. Control of cell cycle in yeast and mammalian cells. Role of various cycle-CDK complexes in the transition of various checkpoint of cell cycle.

UNIT-IV Cell-cell and Cell-matrix adhesion 15 Hours

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

UNIT-V Cell signaling **15 Hours**

Cellular Signaling: General principles of signaling by cell surface receptors, endocrine, paracrine and autocrine signaling, types of cellular responses induced by signaling molecules, components of intracellular signal-transudation pathways. G protein coupled receptor system, General mechanism of the activation of effectors molecules associated with GPCRs, GPCRs that activate or inhibit adenylate cyclase, activate phospholipase C, regulating ion channels. Signaling of growth factors (EGF and Insulin) via activation of receptor tyrosine kinases. Ras/ MAP kinase pathway.

COURSE OUTCOMES

1) Acquire knowledge about structure of cells and membrane transport mechanism.
2) Learn the structure & function of intracellular organelles and cell division
3) Gain knowledge about the structure of cytoskeleton and cell cycle mechanism
4) Understand types of cell junctions, cell adhesion molecules, extracellular matrix molecules and cell-cell communication.
5) Comprehend the concepts and mechanisms of cell signaling pathways.

Text Books

1. Gerald Karp (2013). *Cell Biology* (7th edition.) Wiley.
2. De Robertis and De Robertis.(1987). *Cell and Molecular Biology* (8th edition) Lea and Febiger.
3. Channarayappa (2010) *Cell Biology*. University Press.

Supplementary Readings

1. Bruce Alberts, Alexander D. Johnson, Julian Lewis, David Morgan, Martin Raff, and Keith Roberts (2014). *Molecular Biology of the Cell* (6th edition)W. W. Norton & Company.
2. James D. Watson, A. Baker Tania, P. Bell Stephen, Gann Alexander, Levine Michael and Losick Richard (2017).*Molecular Biology of the Gene*(7th ed) Pearson Education.
3. Gerald Karp (2013).Cell Biology (7th ed.) Wiley.
4. David M. Prescott (2013). *Advances in Cell Biology*: Volume 2, Springer.
5. Geoffrey M. Cooper, and Robert E. Hausman (2013).*The Cell: A Molecular Approach* (6th edition) Sinauer Associates Inc.

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	2	3
CO2	3	3	2	3	2
CO3	2	2	3	3	3
CO4	2	3	3	3	2
CO5	3	2	2	3	2

SEMESTER - I CORE – III	22PBIOC13: ENZYMES	CREDIT:3 HOURS:5

COURSE OBJECTIVES

1. To impart knowledge on classification and active sites of enzymes.
2. To provide knowledge on enzyme kinetics.
3. To create awareness on role of inhibitors and catalytic enzymes.
4. To impart basic knowledge on coenzymes and isoenzymes.
5. To develop sound knowledge on Industrial and clinical enzymology.

UNIT-I : CLASSIFICATION AND PURIFICATION **15 Hours**

Nomenclature and classification of enzymes, isolation and purification of enzymes –criteria of purity - specific activity. Enzyme units - Katal, IU. Measurement of enzyme activity - two point. Active site - determination of active site amino acids - chemical probe and site-directed mutagenesis, Brief account of nonprotein enzymes - ribozymes and abzymes

UNIT-II : ENZYME KINETICS **15 Hours**

Kinetics of single substrate enzyme - catalysed reactions - Michaelis - Menten equation, importance of Vmax, Km, MM equation, and turnover number; Lineweaver - Burk plot, Eadie - Hofstee plot, and Hanes - Woolf plot . Activation energy. Pre steady - state kinetics and relaxation kinetics. Kinetics of Allosteric enzymes - MWC and KNF models Hill' equation coefficient. Kinetics of bi - substrate enzyme - catalysed reactions - Ping-pong bi-bi, random order and compulsory order mechanism.

UNIT-III : ENZYME CATALYSIS AND INHIBITION **15 Hours**

Reversible inhibition - competitive, uncompetitive, noncompetitive, mixed, substrate and allosteric inhibition.Irreversible inhibition.

Mechanism of enzymic action , mechanism of serine proteases - chymotrypsin, lvsozyme, carboxy peptidase A and ribonuclease.

UNIT-IV : COENZYMES AND ISOENZYMES **15 Hours**

Coenzymes - prosthetic group, classification - vitamin and nonvitamin coenzymes, thiamine pyrophosphate - mechanism of oxidative and nonoxidative decarboxylation, transketolase reaction, Role of coenzymes in transamination and decarboxylation reaction, folate coenzymes and vitamin C, lipoic acid, coenzyme Q, S-adenosyl methionine. Isoenzymes.

UNIT-V : INDUSTRIAL AND CLINICAL USES OF ENZYMES **15 Hours**

Industrial uses of enzymes - sources of industrial enzymes, thermophilic enzymes, amylases, glucose isomerases, cellulose degrading enzymes, lipases, proteolytic enzymes in meat and leather industry, detergents and cheese production. Clinical enzymology - Enzymes as thrombolytic agents, anti-inflammatory agents. Immobilization of enzymes and their applications.

COURSE OUTCOMES

1) Familiarize with classification of enzyme system, isolation of enzymes and criteria of purity
2) Well versed with Enzyme kinetics, importance of Km and Vmax.
3) Familiarize with mechanism of action of serine proteases, chymotrypsin, Lysozyme and Caarboxy peptidase and types of inhibition
4) Aware of Coenzymes-classification and isoenzymes
5) Get thorough knowledge on industrial uses of enzymes, isomerases and able to interpret Clinically important enzymes

Text Books

1. Trevor Palmer, Philip Bonner *Enzymes: Biochemistry, Biotechnology, Clinical Chemistry* 2nd edition, Horwood Publishing Limited, 2007
2. Dixon and Webb, *Enzymes*, 3rd edition, Academic Press, New York, 2000.
3. Understanding enzymes - Palmer. Prentice Hall; 4 Sub edition, 1995 • Enzymes - Boyer. Academic Press; 3rd edition, November 1983
4. Biochemistry - Metzler. (2000) Academic Press.
5. Champe P.C and Richard A Harvey, (2004) *Lippincotts Biochemistry,* Williams & Wilkins Publishers.

Supplementary Readings

1. E.S. West, W.R. Todd, H.S. Mason and J.T. van Bruggen, (2000) *A Text Book of Biochemistry,* 4th edition*,* Oxford and IBH Publishing Co., New Delhi.
2. Nicholas C. Price, Lewis Stevens, and Lewis Stevens,(2000) *Fundamentals of Enzymology: the Cell and Molecular Biology of Catalytic Proteins*, 3rd edition, Oxford University Press, USA.
3. David L. Nelson Michael M. Cox Lehninger (2004) *Principles of Biochemistry*, W. H. Freeman; 4th edition,
4. Biochemistry - Stryer. (2006) W. H. Freeman; 6 edition.

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	**3**	**3**	**3**	**2**	**2**
CO2	**3**	**2**	**2**	**3**	**3**
CO3	**3**	**2**	**3**	**3**	**3**
CO4	**2**	**3**	**3**	**3**	**2**
CO5	**3**	**2**	**2**	**2**	**3**

SEMESTER: I PART: CORE PRACTICAL – I	22PBIOP14: QUANTITATIVE ANALYSIS AND ENZYMOLOGY	CREDIT:6 HOURS:9

COURSE OBJECTIVES

1. Understand the Importance of Qualitative Test in the Laboratory for Diagnoses.
2. Analyze the test for Carbohydrates, Amino Acids, Proteins and Lipids.
3. Plan and execute an enzyme assay &Understand the enzyme activity
4. Analyse kinetic inhibition data and to determine the mechanism of inhibition
5. To describe the factors affecting enzymatic reactions &Experimental approach to enzyme action.

A. QUANTITATIVE ANALYSIS

1. 1. Estimation of Ascorbic Acid from citrus fruits
2. 2. Estimation of inorganic phosphorus from cereals
3. Determination of pyruvate or lactate
4. Determination of tryptophan.
5. Quantitative analysis of reducing sugars (DNSA method) and Proteins (Biuret method)
6. Estimation of Iron
7. Estimation of beta carotene from carrot
8. Estimation of glycogen from liver

B. ENZYMOLOGY

1. Assay of enzyme activity of Salivary amylase
2. Effect of substrate concentration on enzyme activity (Salivary Amylase) and determination of Km value.
3. Effect of inhibitor on activity of Salivary Amylase.
4. Assay of enzyme activity of Urease
5. Effect of pH on enzyme activity of Acid phosphatase/Alkaline phosphatase from potato and chicken liver.
1. Effect of temperature on enzyme activity (ACP/ALP).

COURSE OUTCOMES

1) Exposure to basic reactions of biomolecules.
2) Understand the Importance of Qualitative Test in the Laboratory for Diagnoses.
3) Analyze the Tests for Carbohydrates, Amino Acids, Proteins and Lipids standard methods.
4) Aware of the influence of enzyme structure on catalytic properties.
5) Analyze the action of enzymes as biocatalysts and in factors that influence Enzyme activity.

Text Books

1. David T. Plummer (1999), *An Introduction to practical Biochemistry,*(3rd revised edition).
2. J.Jayaraman (2011), *Laboratory MannualinBiochemistry,*New Age international limited publication.

Supplementary Readings

1. Pattabiraman (2015), Laboratory Mannual in Biochemistry (4th Ed.).
2. Singh .S.P. (2013), Practical Mannual of Biochemistry, (6th Ed.). CBS Publication

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	2
CO2	3	2	3	3	2
CO3	3	2	3	3	3
CO4	3	3	3	3	3
CO5	3	3	2	3	3

SEMESTER:I PART:CORE ELECTIVE-1	22PBIOE15-1: HUMAN PHYSIOLOGY	CREDIT:4 HOURS:4

COURSE OBJECTIVES

1. To learn the structure and functions of the different organs present in the human body
2. To impart basic knowledge of digestive system of man, respiratory system of man
3. To discuss the renal system, Mechanism of urine formation and homeostatic regulation.
4. To learn about cardiac system and composition of blood. .
5. To learn the different types of muscles, muscle contraction and muscle proteins.

UNIT I DIGESTIVE SYSTEM 15 Hours

Digestion-Digestive system of man, Digestive processes at various regions of digestive system-Liver, stomach, pancreas, gallbladder , microvillus and intestine. Composition functions and regulation of saliva, gastric, pancreatic, and intestinal juice and bile secretions. Digestion and absorption of carbohydrates, lipids, proteins and nucleic acids.

UNIT II RENAL PHYSIOLOGY 15 Hours

Renal system: structure of kidney & nephron. Mechanism of urine formation-Glomerular filtration, tubular reabsorption of water and electrolytes and tubular secretion. Homeostatic regulation of water and electrolytes, Counter current mechanism. Regulation of acid-base balance. Role of renin-angiotensin &ADH, renal failure.

UNIT III RESPIRATORY PHYSIOLOGY 15 Hours

Respiratory system: functional anatomy of air passages and lung respiratory muscles, mechanism of respiration, pulmonary ventilation, alveolar surface tension, lung volumes and capacities. Gas-exchange in the lungs &Blood, Regulation of respiration-Role of 2,3-diphosphoglycerate,O_2 Dissociation Curve, Bohr's effect and chloride shift, oxygen toxicity& therapy, artificial respiration.

UNIT IV - CARDIO PHYSIOLOGY 15 Hours

Cardiac system – physiologic anatomy of heart- genesis and spread of cardiac impulses-coronary crculation, cardiac cycle, heart sound, cardiac output, cardiovascular regulatory mechanisms, Blood Pressure, E.C.G-Measurement Of ECG. Composition of blood, blood coagulation – mechanism and regulation. Fibrinolysis, anticoagulants.

UNIT V MUSCLE & NERVE PHYSIOLOGY 15 Hours

.Nervous system- structure of neuron and Conduction of nerve impulse, Synapse-types, basic functions of synapses & neurotransmitters. Synaptic transmission, Neuromuscular junction. Central nervous system-Brain and spinal cord, Cerebrospinal fluid. Basis of EEG, sleep, learning & memory. Muscles - types of muscle -skeletal and smooth muscle-contractile elements, Molecular basis of muscle contraction.

COURSE OUTCOMES

1) To learn about the digestion and absorption of various macromolecules.
2) To learn and gain knowledge about the blood cells and cardiac system.
3) To understand the mechanism of respiration and its types.
4) To acquire the knowledge about the structure and functions of kidney, nephron and mechanism of urine formation.
5) To gain the knowledge about the structure, types and functions of muscles and nervous system.

Text Books

1. Ganong W. E, 2019. Review of Medical Physiology", 26thed, Tata Mc. GrawHill.
2. Guyton. A.C, Hall. J.E, 2005."Textbook of Medical Physiology", 11thed.
3. Saunders Company.
4. Jain, J.L & Jain, (2005) Human physiology. Sixth Edition,S.Chand&Company,New Delhi.
5. K..Sembulingam,PremaSembulingam,(2012)" Essentials of medical physiology"sixth edition, Jaypee publishers.

Supplementary Readings

1. Meyer, HS Meij, AC Meyer,' Human Physiology', AITBs Publishers and Distributors.
2. K. SaradhaSubramanyam,"A Hand Book of Basic Human physiology", S.Chand & Co.,Ltd.
3. Y.Rajalaskshmi, 'Guide to Physiology', S.Chand&Co., Ltd
4. C.C.Chatterjee, 1985. Human physiology, 11th edition
5. Gerard J. Tortora and Sandra Grabowski. Principles of Anatomy and Physiology 10th Edition By Publisher: John Wiley and Sons.

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	3	3
CO2	3	3	3	3	2
CO3	3	2	3	2	3
CO4	3	5	3	3	2
CO5	3	2	3	3	2

SEMESTER:I PART:CORE ELECTVE-2	22PBIOE15-2: NUTRITIONAL BOCHEMSTRY	CREDIT:4 HOURS:4

COURSE OBJECTIVES

1. To learn and gain knowledge about the Nutritional disorders.
2. To study the nutritional aspects of various foodstuffs and its measurement.
3. To study the functional aspects of Macro and micronutrients.
4. To understand the nutritional management of diet in different age groups.
5. To learn and gain knowledge about the functional foods.

UNIT 1 NUTRITIONAL DISORDER 15 Hours

Introduction: Diet-composition, fibre in diet. Disorders associated with protein metabolism-marasmus and kwashiorkor, Biological value of proteins, Chemical score. Fats: sources, essential and non-essential fatty acids-disorders concerned with fatty acid metabolism. Refsum'sdisease, atherosclerosis and fatty liver. Disorders of protein malnutrition.

UNIT II BASAL METABOLIC RATE 15 Hours

Basal metabolic rate-factors affecting BMR-determination of BMR, direct and indirect methods-Benedict's Roth apparatus-respiratory quotient, BOD. SDA, Anthropometry: height, weight, skin fold thickness and arm circumference and their importance in nutrition.BOD&POD. Nutritional dietary management of diabetes & renal disorders.

UNIT III MICRO AND MACRONUTRENTS 15 Hours

Macro nutrients – calcium, phosphorus, magnesium, sodium, potassium, chloride, sulfur-daily requirements, functions and deficiency manifestations. Micro nutrients-lron, copper, iodine, manganese/z inc, molybdenum, cobalt, fluorine, selenium and chromium -daily requirements, functions and deficiency manifestations.

UNIT IV- NUTRITIONAL MANAGEMENT 15 Hours

Objectives of diet therapy-regular diet and rationale for modifications in energy and other nutrients, texture-fluid,soft diets etc. Glycemic index. Nutritional management of Cardiovascular diseases, Diabetes mellitus, Nutrition at different stages of life-during infancy, adolescence, pregnancy, lactation and old age.

UNIT V RECENT ADVANCES IN CLINICAL NUTRITION 15 Hours

Neutraceuticals: Adverse effects of neutraceuticals.Functional foods-Health benefits of functional foods in Immune function&mental health. Probiotics and prebiotics: Types &Health benefits.Antioxidants-Role of antioxidants in human health, Phytoceuticals (polyphenols, flavonoids & terpenes).

COURSE OUTCOMES

1) Students gain knowledge about diet and different nutritional disorders.
2) To understand and gain knowledge about different types of nutritional measurements.
3) Students are able to comprehend the daily requirements and functions of vitamins & minerals.
4) Students are able to demonstrate and exhibit different dietary plan for different age groups & disease condition.
5) Students are able to gain knowledge about importance of neutraceuticals and antioxidants in human health.

Text Books

1. M. Swaminathan,1987, "Food and Nutrition Vol I&II", Second edition, Bangalore, Bappco Publishers.
2. Mahan ,L. KandEscott-Stump,S (2000):Krause's Food Nutrition and Diet therapy,10thed, W-13 Saunders Ltd
3. U.Sathayanarayana,(2006). Biochemistry. 3rd Edition by Books and Allied (P) Ltd., India.

Supplementary Readings

1. Williams, SR(1993):Nutrition and Diet Therapy,7thed, Times Mirror/Mosby College Publishing
2. Shills,ME,Olson,JA,Shike,M and Ross,A.C(1999):Modern Nutrition in Health and Disease,9thed,A.Vaiiams and willons
3. Davidson and Passmore(2000):Human Nutrition and Dietetics
4. Anthony A.Albanase(1972),Newer Methods of Nutritional Biochemistry, Academic Press
5. Patricia Trueman, 2007, "Nutritional Biochemistry" (I edition), Chennai, MJ publishers
6. M.N Chatterjea and RanaShinde," Text book of Medical biochemistry",4th edition, Jaypee Publishers, New Delhi

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	3	2
CO2	3	2	2	3	3
CO3	2	3	2	2	3
CO4	2	2	3	3	3
CO5	3	2	3	2	3

SEMESTER:I PART:CORE ELECTVE-3	22PBIOE15-3: DEVELOPMENTAL BIOLOGY	CREDIT:4 HOURS:4

COURSE OBJECTIVES

1. able to list the types of characteristics that make an organism ideal for the study of developmental biology.
2. Know the broad phylogenetic relationships of animal phyla and some of the traits used to support our current understanding of these evolutionary relationships.
3. Familiarize with the events that lead up to and comprise the process of fertilization.
4. Able to draw the first four rounds of cell division of the sea urchin embryo &Understand how the planes of cell division relate to cell fate specification.
5. Develop a critical appreciation of methodologies specifically used to study the process of embryonic development in animals.

UNIT-I Basic concepts of development **12 Hours**

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

UNIT-II Gametogenesis, fertilization and early development **12 Hours**

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

UNIT-III Morphogenesis and organogenesis in animals **12 Hours**

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

UNIT-IV Morphogenesis and organogenesis in plants **12 Hours**

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

UNIT-V Genetic disorders and Apoptosis **12 Hours**

Medical implications of developmental biology- genetic disorders in human development Programmed cell death, aging and senescence- Definition, stages of apoptosis and senescence.

COURSE OUTCOMES

1) Acquire Knowledge about the Developmental Biology of Frog and Chick
2) Impart Basic Knowledge about the process of fertilization
3) Provide a broad, comprehensive look at embryology with special emphasis on vertebrate models
4) Identify the cellular behaviors that lead to morphological change during development
5) Gain knowledge on the basis of development and regeneration of the animal body, and molecular mechanisms regulating developmental processes

Text Books

1) Sastry K.V. (2017). *Endocrinology and Reproductive biology*. Rastogi publications.
2) Sembulingam. K and PremaSembulingam. (2009). *Essentials of Medical Physiology*. Jaypee Brothers. New Delhi. 2nd ed.,
3) Laura Nuño de la Rosa, Gerd B Müller .(2021). *Evolutionary Developmental Biology – A Reference Guide.* Springer Reference.
4) Bob B. Buchanan, Wilhelm Gruissem, Russell L. Jones (2015). *Biochemistry and Molecular Biology of Plant.* 2nd Ed.
5) Gerd B. Müller (2013). *Origination of Organismal Form*. MIT Press

Supplementary Readings

1) Richard. E. Jones., Kristin H. Lopez. (2016). *Human reproductive biology.* 3rd ed.,
2) C.C. Chatterjea (Vol I & Vol II). (2006). *Human Physiology.* Medical Allied Agency. 11th ed.,
3) Benjamin Pierce (2016).*Genetics: A Conceptual Approach*. 6th Ed.,
4) Gerald Karp (2013). *Cell and Molecular Biology: Concepts and Experiments.* 7th Ed.,
5) Scott F. Gilbert (2010).*Developmental Biology. 9th Ed.,*

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	**3**	**3**	**2**	**3**	**2**
CO2	**3**	**2**	**2**	**3**	**3**
CO3	**2**	**3**	**2**	**2**	**3**
CO4	**2**	**2**	**3**	**3**	**3**
CO5	**3**	**2**	**3**	**2**	**3**

SEMESTER - II CORE - IV	22PBIOC21: METABOLISM AND REGULATION	CREDIT:3 HOURS:5

COURSE OBJECTIVES

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

UNIT-I : BIOENERGETICS AND BIOLOGICAL OXIDATION

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

UNIT-II : CARBOHYDRATE METABOLISM

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

UNIT-III : LIPID METABOLISM

Oxidation of fatty acids – β-oxidation of saturated , unsaturated and odd carbon fatty acids α and ω oxidation Biosynthesis of fatty acids. Metabolism of triglycerides, phospholipids and sphingolipids. Metabolism of Cholesterol and its regulation. Biosynthesis of Eicosenoids. Lipoprotein metabolism.

UNIT-IV : AMINO ACID, PURINE AND PYRIMIDINE METABOLISM

Overview of biosynthesis of nonessential amino acids Catabolism of amino acid nitrogen - Transamination, deamination, ammonia formation and the urea cycle. Disorders of the urea cycle. Disorders of amino acid metabolism– phenylketonuria, alkaptonuria and albinism

Metabolism of purines and pyrimidines-denovo and salvage pathways of purine biosynthesis, Purine catabolic pathway, Metabolism of Pyrimidines-Biosynthesis ad catabolism. Regulation of metabolism of nucleotides.

UNIT-V: PORPHYRINS, PHOTOSYNTHESIS, METABOLIC INTEGRATION AND HORMONAL REGULATION

Biosynthesis and degradation of heme. Disorders associated with defects in biosynthesis of heme. Integration of metabolism - Interconversion of major foodstuffs. Metabolic profile of the liver, adipose tissue and brain. Metabolic inter

relationships in various nutritional and hormonal states– obesity, aerobic, anaerobic endurance, exercise, pregnancy, lactation, IDDM, NIDDM and starvation

COURSE OUTCOMES

1) Learn basic concepts of Bioenergetics, mechanisms of oxidative phosphorylation and photophosphorylation
2) Gain knowledge about the carbohydrate,protein and lipid metabolism.
3) Understand the diseases related to metabolism
4) Acquire knowledge related to regulation of various pathway
5) Well versed about metabolic inter relationships in various nutritional and hormonal states.

Text Books

1) Lehninger, Nelson & Cox, Principles of Biochemistry (2013) Macmillan worth Publishers, 7th Edition, 2013.
2) Stryer, Biochemistry, 5th edition, Freeman, 2002.
3) Murray et al., "*Harper's Biochemistry"* (2012) 29th edition, Mc. GrawHill**.**

Supplementary Readings

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

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	**3**	**2**	**3**	**3**	**3**
CO2	**2**	**3**	**3**	**3**	**2**
CO3	**3**	**3**	**3**	**2**	**3**
CO4	**3**	**3**	**3**	**2**	**3**
CO5	**3**	**2**	**3**	**3**	**3**

SEMESTER - II CORE – V	22PBIOC22: ANALYTICAL TECHNIQUES	CREDIT:3 HOURS:5

COURSE OBJECTIVES

1. To understand the bio-analytical techniques along with their theory,
2. To acquire knowledge about the working principle, common instrumentation and possible applications.
3. To develop the skills to understand the theory and practice of bio analytical techniques.
4. To provide scientific understanding of applications of analytical techniques.
5. To acquire knowledge about the basic concepts of radioactivity.

UNIT I CHROMATOGRAPHY **15 Hours**

Principle, instrumentation and applications of thin layer, Gas chromatography and HPTLC. Column chromatography- packing, loading, elution, detection and its types. Ion-exchange chromatography- preparation of resins, procedure and applications. Molecular exclusion chromatography-principle, gel preparation, operation and applications. Affinity chromatography– principle, materials, procedure and applications. HPLC– principle, materials, instrumentation and applications,

UNIT II ELECTROPHORETIC AND ELECTROCHEMICAL TECHNIQUES **15 Hours**

Electrophoresis: General principles. Support media. Cellulose acetate electrophoresis. Electrophoresis of proteins–native gels, SDS-PAGE, gradient gels, isoelectric focusing, 2-D PAGE. Detection, estimation and recovery of proteins in gels. Electrophoresis of nucleic acids– agarose gel electrophoresis, DNA sequencing.

UNIT III CENTRIFUGATION TECHNIQUES **10 Hours**

Centrifugation–principle, types of centrifuges, rotors-types, preparative centrifugation– types, instrumentation and applications. Analysis of subcellular fractions. Analytical ultracentrifuge– instrumentation and applications. Sedimentation velocity and sedimentation equilibrium.

UNIT IV SPECTROSCOPIC TECHNIQUES **20 Hours**

Laws of absorption and absorption spectrum, UV-visible spectrophotometery and spectro fluorimetry. Flame spectroscopy– principle and applications of atomic absorption and flame emission.NMR, FTIR, mass spectroscopy: principle, instrumentation and application. LCMS, GCMS.

UNIT V RADIOISOTOPE TECHNIQUES **15 Hours**

Units of radioactivity, Detection and measurement of radioactivity– GM counter, solid and liquid scintillation counting, quenching and quench correction, scintillation cocktails and sample preparation. Cerenkov counting, Autoradiography, Applications of radioisotope in biology. Radiation hazards and safety aspects.

COURSE OUTCOMES

1) To gain knowledge about the Principle, instrumentation and application of various types of chromatography and its interpretation**.**
2) To acquire knowledge about the principle, preparation, instrumentation and application of different kinds of electrophoretic techniques.
3) To get in-depth understanding about the basic principle: types of rotors, instrumentation and application of different types of centrifugation process.
4) Able to exhibit their knowledge about the principle, instrumentation and application of spectroscopic techniques.
5) Able to demonstrate their skills in basic concepts of radioactivity, its measurement and application.

Text Books

1) AvinashUpadhyaye, and NirmalendheNath, (2002). Biophysical Chemistry Principles and Techniques. 3rd edition, Himalaya Publishers,New Delhi.
2) Keith Wilson, and John Walker, (2010). Principles and Techniques of Practical Biochemistry. 7th edition, Cambridge University Press. UK.
3) Boyer, R. 2000.Modern Experimental Biochemistry. 3rd ed. Addison Weslery Longman.

Supplementary Readings

1) Simpson CFA & Whittacker, M. Electrophoretic techniques.
2) Sambrook, 2001.Molecular Cloning. Cold Spring Harbor Laboratory.
3) Friefelder and Friefelder, 1994, Physical Biochemistry – Applications to Biochemistry and Molecular Biology. WH Freeman & Co.
4) Pavia, 2000, Introduction to Spectroscopy, 3rd ed. Brooks /Cole Pub Co.

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	2	3	2	3	2
CO2	2	3	3	3	3
CO3	3	3	2	3	3
CO4	3	2	3	2	3
CO5	3	3	3	3	2

SEMESTER - II CORE - VI	22PBIOC23: MOLECULAR BIOLOGY	CREDIT:3 HOURS:5

COURSE OBJECTIVES

1) To understand the mechanisms and factors involved in replication process.
2) To acquire knowledge about transcription process in prokaryotes and eukaryotes.
3) To know about the features of genetic code and translation process
4) To gain knowledge about protein targeting, transport, and gene regulation.
5) To learn about different repair systems present in DNA damage.

UNIT-I : DNA REPLICATION **15 Hours**

Replication: Types of replication, evidence for semiconservative replication - Meselson and Stahl experiment, DNA Polymerases in prokaryotes and eukaryotes. Replication in prokaryotes-Initiation, elongation and termination, inhibitors of replication, bidirectional replication, replicon, replication in RNA virus, Eukaryotic replication and inhibitors of replication.

UNIT-II : TRANSCRIPTION **15 Hours**

Transcription - definition, coding strand, template strand, sense strand and antisense strand, promotor,, DNA - dependent RNA polymerase, prokaryotic transcription: initiation, elongation and termination, posttranscriptional processing in prokaryotes, split genes, overlapping genes, eukaryotic transcription, spliceosome machinery, alternative splicing, polyadenylation and capping, processing of rRNA and tRNA. Catalytic roles of RNA; RNA editing.post-transcriptional modifications of eukaryotic RNAs, DNA-Protein interaction: foot-printing experiment.

UNIT-III : GENETIC CODE AND TRANSLATION **15 Hours**

Genetic code - definition, deciphering of the genetic code, codon dictionary, salient features of genetic code. wobble hypothesis, composition of prokaryotic and eukaryotic ribosomes, prokaryotic and eukaryotic protein biosynthesis - initiation, elongation, and termination, polysomes, post-translational modifications in prokaryotes and eukaryotes, inhibitors of protein synthesis.

UNIT-IV : PROTEIN TRANSPORT AND GENE EXPRESSION **15 Hours**

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

Regulation of gene expression Lac, Trp, Ara, Gal operon, DNA methylation in prokaryotes, DNA methylation in eukaryotes- CpG islands.

UNIT-V: DNA DAMAGE AND REPAIR **15 Hours**

Mutagenesis, Different types of DNA damages, recognition of DNA damage, types of DNA repair systems including photoreactivation, excision repair, mismatch repair, recombination repair, transcription coupled repair and SOS repair. Diseases associated with DNA repair problems

COURSE OUTCOMES

1) Understand the mechanisms and factors involved in replication process in prokaryotes and eukaryotes.
2) Acquire knowledge about transcription process in prokaryotes and eukaryotes, inhibitors and its modification.
3) Comprehend the features of genetic code and steps involved in translation process.
4) Gain knowledge about protein targeting, transport to different organelles, and gene regulation with respect to different operons.
5) Understand the mechanisms of various DNA repair systems and diseases caused due its disorders.

Text Books

1) G. Karp (2019).*Cell and molecular biology* (9th edition), John Wiley & Sons Inc.
2) Lehninger, Nelson & Cox,(2013).*Principles of Biochemistry* (7th edition) Macmillan worth Publishers.
3) Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K., Watson, J.D. (1994). *Molecular Biology of the Cell.* (3rd edition.), Garland Publishing, Inc., New York

Supplementary Readings

1) Robert J Brooker (2017).*Genetics: Analysis and Principles*, (6th Edition), McGraw Hill Education.
2) Benjamin Pierce (2016).*Genetics: A Conceptual Approach*, (6th Edition), WH Freeman
3) Kleinsmith, L. J. & Kish, V.M. (1997) *Principles of Cell and Molecular Biology*. (2nd edition). Pearson.
4) Jocelyn E. Krebs, Elliott S. Goldstein ,Stephen T. Kilpatrick (2014) Lewin. *Genes XI* (11th edition), Oxford University Press.
5) Twyman.(2005) *Advanced Molecular Biology* (3rd edition), Viva Publ.

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	3	2
CO2	2	2	3	2	3
CO3	2	3	2	3	3
CO4	3	2	3	2	3
CO5	3	3	3	3	2

SEMESTER: II CORE PRACTICAL :II	22PBIOP24: ANALYTICAL AND MOLECULAR BIOLOGY TECHNIQUES	CREDIT:6 HOURS:9

COURSE OBJECTIVES

1. Train in various chromatographic and electrophoresis techniques for biochemical analysis.
2. Train in using different instruments and preparation of solutions.
3. Attain technical competence in the specific discipline.
4. Experiment the molecular biological techniques.
5. Understand the concept of estimations of DNA and RNA

A.ANALYTICAL TECHNIQUES

1. Preparation of buffers and measurement of pH using indicators and pH meter.
2. Determination of Titrable Acidity and Ammonia in Urine
3. Separation of amino acids by paper chromatography – circular/ ascending/ descending
4. Separation of amino acids sugars and lipids by thin layer chromatography.
5. Separation of plant pigments by column chromatography.
6. Separation of serum proteins by PAGE.
7. PCR Technique - Demonstration

B. MOLECULAR BIOLOGY TECHNIQUES

1. Isolation and estimation of DNA from liver and spleen.
2. Isolation and estimation of RNA from plant tissues or yeast
3. Plasmid DNA isolation from E. coli
4. Estimation of DNA by UV Method
5. Extraction of genomic DNA and electrophoresis in agarose gel. (Demonstration)
6. Determination of molecular size of DNA. (Demonstration)
7. Restriction enzyme digestion and electrophoresis. (Demonstration)

COURSE OUTCOME

1) Gain the basic knowledge on the theory, operation and function of analytical instruments.
2) Separate biomolecules by appropriate chromatographic and electrophoretic methods.
3) Know the electrophoretic techniques to isolate the genetic material
4) Understanding the fundamentals of hereditary materials and their role in functioning of Human system
5) Various basic techniques to isolate, characterize the microbes morphologically will be known to them.

Text Books

1) Damodaran Geetha K. Practical Biochemistry. (2016) Jaypee Brothers Medical Publishers.
2) Apurba S Sastry, (2021) Essentials Of Practical Microbiology 2nd Edition Jaypee,publishers.

Supplementary Readings

1) Gupta Prem Prakash. (2017) Essentials Of Practical Biochemistry. Jaypee Brothers Medical Publishers..
2) Apurba Sankar Sastry, Sandhya Bhat K. (2018) Essentials of Practical Microbiology. Jaypee Brothers Medical Publishers.
3) Rakesh S. Sengar, Amit Kumar, Reshu Chaudhary, Ashu Singh,(2018) Advances in Molecular Techniques CRC Press,1st Edition.
4) Ralph Rapley, David White. (2021) House Molecular Biology and Biotechnology, Publisher Royal Society of Chemistry.
5) M.R.Green and J. Sambrook (2012) Molecular cloning, A Laboratory Manual Vol. IIII. Fourth edition, Cold Spring Harbor Laboratory Press

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	3
CO2	2	3	3	3	3
CO3	3	3	3	3	2
CO4	3	3	3	2	3
CO5	3	2	2	3	3

SEMESTER : II CORE ELECTIVE:2	22PBIOE25-3 : BIOINFORMATICS	CREDIT : 4 HOURS :4

COURSE OBJECTIVES

1. Understand the basics concepts of Bioinformatics and its significance in Biological data analysis.
2. Able to understand the different biological databases.
3. Overview about the biological macromolecular structures.
4. Become familiar with a variety of currently available genomic and proteomic databases
5. Learn how to compare and analyze biological sequences

Unit I History of Bioinformatics **12 Hours**

Objectives and scope of Bioinformatics Fields related to Objectives, scope, genome mapping as a source of Bioinformatics , Search Engines.

Unit II Review of basics about structure of macromolecules **12 Hours**

DNA, RNA and Proteins. Online resources for Bioinformatics – Biological Databases – NCBI, Genbank, EMBL, Swissprot, PDB. Executing search and retrieval of data. Sequence alignment – Multiple sequence alignment – Pairwise alignment.

Unit III Bioinformatics in genomics and proteomics **12 Hours**

Gene sequencing tools traditional methods – Maxam and Gilbert's method, Sanger's sequencing – structure prediction tools – Nucleic acid and protein structure prediction – Gene and protein expression analysis – similarity search databases – FASTA, BLAST. Analysis of Phylogeny - Phylogenetic tree construction.

Unit IV Structure based drug discovery **12 Hours**

Structure based drug discovery – Molecular docking of novel compounds – SAR and QSAR, Introduction to Simulation softwares in biology – Autodock, ADMET.

Unit V Visualization tools and Applications of Bioinformatics **12 Hours**

Protein structure visualization tools – RasMol, HEX, Argus Lab Swiss PDB Viewer - Structure Classification, alignment and analysis – SCOP, CATH, FSSP, UNIX. Medicine, Agriculture, Environmental monitoring - Emerging areas in bioinformatics.

COURSE OUTCOMES

1) Explain the concepts of biology in Computer science and scope of bioinformatics.
2) Illustrate the types of biological data bases.
3) Appraise the features of DNA sequence analysis.
4) Understand the concepts of FASTA & BLAST.
5) Explain the applications of bioinformatics.

Text Books

1) Manoj Kumar, (2020) Introduction to Bioinformatics Notion press.
2) Shoba Ranganathan, Kenta Nakai, Christian Schonbach (2018) Encyclopedia of Bioinformatics and Computational Biology: ABC of Bioinformatics Elsevier
3) Hamid R Arabnia, Quoc Nam Tran Emerging (2015) Trends in Computational Biology, Bioinformatics, and Systems Biology: Algorithms and Software Tools (Emerging Trends in Computer Science and Applied Computing) Morgan Kaufmann; 1st Edition
4) Asheesh Shanker , (2018) Bioinformatics: Sequences, Structures, Phylogeny Springer
5) Paola Lecca, (2011)Systemic Approaches in Bioinformatics and Computational Systems Biology: Recent Advances Business Science Reference
6) Arthur Lesk (2019) Introduction to Bioinformatics Oxford University Press
7) Jamil Momand, Alison McCurdy, Silvia Heubach (2016) Concepts in Bioinformatics and Genomics ,Oxford University Press

Supplementary Reading

1) Pedagogy PowerPoint presentation, Video lectures, Demonstration and hands on teaching, Group discussion, Seminar and assignment.
2) 2 Ibrokhim Y. Abdurakhmonov 2016 Bioinformatics: Updated Features and Applications BoD – Books on Demand
3) 3 Paul M. Selzer, Richard J. Marhöfer, 2018 Oliver Koch Applied Bioinformatics: An Introduction Springer
4) Prakash S. Lohar (2019) Bioinformatics MJP Publisher
5) 5 Noor Ahmad Shaik, Khalid Rehman Hakeem, Babajan Banaganapalli, RamuElango (2019)Essentials of Bioinformatics, Volume I: Understanding Bioinformatics: Genes to Proteins Springer

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	2
CO2	3	2	2	3	3
CO3	2	2	2	2	3
CO4	2	2	3	3	2
CO5	3	2	3	2	3

SEMESTER : II CORE ELECTIVE:2	22PBIOE25-3: MICROBIOLOGY	CREDIT : 4 HOURS : 4

COURSE OBJECTIVES

1. To learn about the structure and organization of major groups of microogranisms
2. Gain knowledge about the microorganisms in soil, air, water and their treatment
3. Familiarize with the industrially important microorganisms
4. Acquire knowledge about the diseases caused by the microorganisms and mode of ction of antibiotics
5. Gather knowledge about the uses of microorganisms in the production of antibiotics, vaccines and biofertilizers

Unit I Morphology and Ultra structure **12 hours**

Ultra structure of bacteria, fungi, algae andprotozoa. Classification of microbes, molecular taxonomy. Cell walls oeubacteria (peptidoglycan) and related molecules. Outer membrane ofGram– negative bacteria. Cell wall and cell membrane synthesis, flagella and motility, cell inclusions like endospores, gas vesicles. Purple and green bacteria, cyanobacteria, homoacetogenic bacteria, Acetic acid bacteria,Budding and appendaged bacteria, spirilla, spirochaetes, Gliding and sheathed bacteria, Pseudomonads, Lactic and propionic acid bacteria.

Endospore forming rods and cocci, Mycobacteria, Rickettsia and Mycoplasma. Archaebacteria.

Unit II Microbial growth and metabolism **12 hours**

Microbial growth– definition.Mathematical expression of growth, growth curve, measurement of growth and growth yields, synchronous growth, continuous culture, factors affecting growth. Microbial metabolism– overview. Photosynthesis in microbes.Role of chlorophylls, carotenoids and phycobilins, Calvin cycle. Chemolithotrophy; Hydrogen– iron– nitrite oxidising bacteria; nitrate and sulfate reduction; methanogenesis and acetogenesis, fermentations– diversity, syntrophy-role of anoxic decompositions. Nitrogen metabolism, nitrogen fixation, hydrocarbon transformation.

Unit III Microbiological Techniques **12 hours**

Methods of microbial identification. Pure culture techniques. Theory and practice of sterilization. Principles of microbial nutrition, construction of culture media, Enrichment culture techniques for isolation of chemoautotrophs, chemoheterotrophs and photosynthetic microbes.

Unit IV Viruses: Bacterial, plant, animal and tumor viruses. **12 hours**

Classification and structure of viruses. Lytic cycle and lysogeny. DNA viruses; positive and negative strand, Double stranded RNA viruses. Replication; example of Herpes, pox, adenoviruses, Retroviruses. Viroids and prions.

Unit V Medical Microbiology **12 hours**

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

COURSE OUTCOMES

1) Familiar with classification and structure of microorganisms.
2) Well versed with microbial growth and metabolism.
3) Able to do the procedures of sampling and test of significance.
4) Familiar with culture media preparation and sterilization procedures.
5) Gain knowledge about the infections caused by microorganisms and mode of action of antibiotics.

Text Books

1) Madigan, Brock Biology of microorganisms- 10th ed. Prentice Hall, 2002.
2) Davis, Lippincott Williams and Wilkins, 1989.Microbiology 4th edn
3) Joklik, Zinsser's Microbiology Mc Graw-Hill Professional, 1995.
4) Pelczar, Microbiology 5th ed- Mc Graw Hill, 2000.

Supplementary Readings

1) General Microbiology 5th ed- Stainer Ry, Prentice Hall 1986.
2) Medical Microbiology- Brooks, Jawetz, Melnick and Adelberg's Lange Med, 1998.Textbook of Microbiology & Immunology: Edition- Subhash Chandra Parija et 2014.
3) Medical Microbiology: 7th -Patrick R. Murray 2012.

OUTCOME MAPPING

		PO1	PO2	PO3	PO4	PO5
CO1		3	3	2	3	2
CO2		3	2	2	3	3
CO3		2	3	2	2	3
CO4		2	2	3	3	3
CO5		3	2	3	2	3

SEMESTER : II CORE ELECTIVE:3	22PBIOE25-3: CANCER BIOLOGY	CREDIT : 4 HOURS : 4

COURSE OBJECTIVES

1. To understand the different types of cancer and its assessment methods
2. ToFamiliarize with different types of carcinogens and their effects
3. To know about the different stages of carcinogenesis
4. To gain knowledge about the cellular and molecular mechanisms of invasion
5. To learn about the molecular methods of analysis of cancer

Unit I Introduction to Cancer **12 Hours**

Types of growth– hyperplasia, metaplasia, dysplasia, anaplasia and neoplasia. Nomenclature of neoplasms. Differences between benign and malignant tumours. Tumour assessment– grading and staging,

Unit II Carcinogenesis **12 Hours**

Cancer cell-morphology and growth characteristics. Types of growth hyperplasia, dysplasia, anaplasia and neoplasia. Types and prevalence of cancer. Nomenclature of neoplasms, classification based on origin/organ. Screening for chemical carcinogens– Ames test and whole animal bioassay

Unit III Genetic Basis of Cancer **12 Hours**

Molecular mechanism of oncogenesis - proto oncogenesis, oncogene, oncoproteins, tumour suppressor genes involved in cancer. Free radicals and antioxidants in cancer. Diet and cancer

Unit IV Apoptosis and Cancer **12 Hours**

Apoptosis and cancer (Intrinsic and extrinsic pathways). Mechanism of apoptosis, signaling pathways(Caspase, P53 and caspase 3) .Types and their impact on apoptosis and oncogenesis. Principles and methods of cancer diagnosis-Biochemical, genetic, cytotoxic, cell growth and viability tests.

Unit V Tumour therapeutics **12 Hours**

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

COURSE OUTCOMES

1) Gain knowledge about the different type of cancers and their assessment.
2) Familiarize with morphological characteristics, identification of tumor markers and their assessment.
3) Acquire knowledge about the genetic and epigenetic changes in cancer.
4) Comprehend the cell cycle control and cell cycle deregulation.
5) Understand the different molecular techniques to assess cancer and to know the therapies.

Text Books

1) The Biology of cancer of A new Approach by P R Burch
2) Franks,L.M. and Teich,N.M. 1991. An introduction to Cellular and Molecular Biology of cancer, 2nd Edition, Oxford University Press.
3) Vincent,T. et al., 2011. Principles and Practice of Oncology: Primer of the Molecular Biology of Cancer, 1st Edition, Lippincott Williams and Wilkins
4) Weinberg,R.A. 2013. The Biology of Cancer, 2nd Edition, Garland Science
5) R. Alison (2007) The Cancer Handbook, Nature Publ. Group
6) De Vita V.T. Jr., Hellman, S. and Rosenberg, S.A., J.B. Lippincott, (2008) Cancer Principles and Practice of Oncology Co., Philadelphia 8th edition.
7) Basic Science of Oncology. Tannock, I. and Hill, R.P., (2004) McGraw Hill Publication.

Supplementary Readings

1) McKinnell, R.G. et al., 2006. The Biological Basis of Cancer, 2nd Edition, Cambridge University Press.
2) Pelengaris,S. and Khan,M. 2002. The Molecular Biology of Cancer, 2nd Edition, Wiley Blackwell.
3) Hesketh,R. 2013. Introduction to Cancer Biology, Cambridge University Press.

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	3
CO2	2	3	2	3	2
CO3	3	3	3	3	2
CO4	3	2	3	3	3
CO5	3	2	3	2	2