

**ST. JOSEPH'S COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)
CUDDALORE-1**



PG & RESEARCH DEPARTMENT OF BIOCHEMISTRY

**PG SYLLABUS
(FROM THE ACADEMIC YEAR 2020 ONWARDS)**

M.Sc BIOCHEMISTRY
M.Sc DEGREE COURSE IN BIOCHEMISTRY
(With effect from 2019)

PROGRAMME OUTCOMES (PO)

1. The Students are groomed to acquire professional skills in their respective domains.
2. The Students are encouraged to climb the academic ladder by pursuing Research Programme.
3. The Inherent Skills of the Students are transformed into Employability and Entrepreneurial Opportunities.
4. Graduates are trained to keep in pace with the rapidly changing technological frontiers.
5. The Students evolve into intellectually, ethically and socially ideal citizens of the Nation.

PROGRAMME SPECIFIC OUTCOME (PSO)

1. Students are able to exhibit their knowledge and in depth understanding of fundamentals principles in biochemistry such as structure and functions of biomolecules, metabolism and regulation of biochemical process.
2. Students are trained to acquire skill in the biochemical techniques and able to demonstrate their scientific skill in both experimentation and in real life situations.
3. Students are instilled with ability to approach in each every biological process or research with moral, ethical and scientific reasoning.
4. Students are prepared to communicate their ideas and thoughts effectively and also apply their critical scientific approach in their knowledge development.
5. Students are encouraged to acquire knowledge and skill throughout their life in order to meet the ever changing scenario in the society/challenges in the society.
6. Students are prepared to articulately interpret and predict various cause and effect relationship in biological process or research.
7. Students are entrusted to work independently to enrich their skill & knowledge through various activities like Seminar, Assignment, Quiz etc..
8. Students are empowered to gain effective skill for their future growth with existing knowledge to identify their career in diverse fields.

M.Sc., BIOCHEMISTRY

M.Sc., DEGREE COURSE IN BIOCHEMISTRY

(With effect from 2019)

Semester	Sub. Code	Subject Title	Hrs	Cr	Exam hrs	
First	19PBC11	Main Paper – I(Bio organic chemistry)	5	4	3	
	19PBC12	Main Paper – II(Cell biology)	5	4	3	
	19PBC13	Main Paper–III(Intermediary Metabolism)	5	4	3	
	19EPB14A	Elective Paper–I	Medical lab Technology	5	4	3
	19EPB14B		Clinical Nutrition			
	PBCP101	Main Practical – I		8	6	6
		Seminar/paper presentation/library		2		
		Total		30	22	
Second	19PBC21	Main Paper – IV Molecular biology	5	4	3	
	19PBC22	Main Paper – V Enzymology	5	4	3	
	19PBC23	Main Paper – VI Analytical Biochemistry	5	4	3	
	19EPB24A	Elective Paper – II	Plant biochemistry	5	4	3
	19EPB24B		Endocrinology			
	PBCP202	Main Practical – II		8	6	6
		Seminar/paper presentation/library		2		
		Total		30	22	
Third	19PBC31	Main Paper –VII Clinical Biochemistry and Clinical Research.		5	4	3
	19PBC32	Main Paper –VIII Immunology		5	4	3
	19PBC33	Main Paper–IX Biotechnology		5	4	3
	19EPB34A	Elective Paper III	Developmental & Inheritance Biology	5	4	3
	19EPB34B		Bioinformatics & computational biology.			
	PBCP303	Main Practical – III		8	6	6
	ECHR901S	Human Rights		2	1	3
	19SPBC31 A	SSC	Nanotechnology		2*	3
	19SPBC31 B		Neutraceuticals& Functional Foods			
	19SPBC31 C		Any NPTEL Course			
Fourth	19PBC41	Main Paper – X Human physiology		5	4	3
	19PBC42	Main Paper – XI Research methodology and		5	4	3

		Biostatistics				
	19EPB43A	Elective	Pharmacology	5	4	3
	19EPB43B	Paper– IV	RecombinantDNA Technology			
	JPBC1016	Project work		15	11	
		Total		30	23	
		Total credits			90	

*- extra credits

YEAR-I	BIO-ORGANIC CHEMISTRY (75 hrs) For the students admitted from the year 2019	19PBC11
SEMESTER-I		HRS/WK-5
CORE-I		CREDIT-4

Learning objectives:

- To provide information about biochemically important aspects of the biomolecules.
- To understand the structure of biomolecules and its properties
- To know about the DNA-protein interactions and the techniques used to characterize it.

Course Outcomes:

CO1- To understand and acquire knowledge about the classification, structure, properties and biological importance of carbohydrates.

CO2- To gain knowledge about the different structural aspects of proteins and the allosteric nature of hemoglobin.

CO3- To acquire knowledge about the classification, structure and properties of lipids and its importance in physiological process.

CO4- To acquire the knowledge about the structure, types, properties and functions of DNA and RNA

CO5- Be familiar with important motifs involved in DNA-protein interaction and also gain technical skills in predicting the interactions.

SEMESTER II	SUB CODE: 19PBC11					BIO-ORGANIC CHEMISTRY								HOURS:4 CREDITS:3
COURSE OUTCOMES	PROGRAMME OUTCOMES(PO)					PROGRAMME SPECIFIC OUTCOMES(PSO)								MEAN SCORE OF CO'S
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
CO1	5	4	4	3	4	3	4	4	3	4	3	5	4	3.8
CO2	4	4	3	4	3	3	4	4	4	5	5	4	4	3.9
CO3	4	3	4	3	4	3	4	5	4	3	3	3	4	3.6
CO4	3	4	4	3	3	4	3	4	4	4	3	4	3	3.5
CO5	4	3	3	4	3	4	3	4	4	3	4	4	3	3.6
Mean overall score													3.7	

This Course is having **HIGH** association with Programme Outcome and Programme Specific Outcome

Association	1%-20%	21%-40%	41%-60%	61%-80%	81%-100%
Scale	1	2	3	4	5
Interval	0<=rating<=1	1.1<=rating<=2	2.1<=rating<=3	3.1<=rating<=4	4.1<=rating<=5
Rating	Very Poor	Poor	Moderate	High	Very High

UNIT-I CARBOHYDRATES [20 hrs]

Carbohydrates:classification-properties of monosaccharides and disaccharides. Polysaccharides—occurrence, structure and biological functions of cellulose, chitin, starch and glycogen.A brief account on fructans, arabinans and galactans, bacterial cell wall polysaccharides and blood group antigens.Glycosaminoglycans – structure and biological role of hyaluronic acid, chondroitinsulfate and heparin.Sialic acid – structure and significance, Proteoglycans and their biological importance.Receptor proteins.

UNIT-II PROTEINS [15 hrs]

Amino acids- classification, properties.Classification of protein.Orders of protein structure.Primary structure – determination of amino acid sequence of proteins.The peptide bond –Secondary structures – α -helix, β -sheet and β -turns. Pauling and Corey model for fibrous proteins. Reverse turns and super secondary structures. Tertiary structure.TheRamachandranplot.Collagen triple helix.Conformational properties of silk fibroin.Quaternary structure of proteins.The structure of hemoglobin.Models for hemoglobin allostery.Prions.

UNIT-III LIPIDS [10 hrs]

Lipids – Introduction, classification– structure and functions.Fatty acids – saturated, unsaturated and hydroxy fatty acids. PUFA, significance of omega 3and 6 fatty acids. Phospholipids and glycolipids – structure and functions. Structure and functions of cholesterol. DHA in memory function, lipids as signal, cofactor and pigments.Lipoproteins – classification and composition.

UNIT-IV NUCLEIC ACIDS [15 hrs]

DNA double helical structure – Watson and Crick model. A, B and Z forms of DNA.DNA supercoiling and linking number. Properties of DNA – buoyant density, viscosity, denaturation and renaturation – The cot curve. Major classes of RNA – mRNA, rRNA, tRNA, snRNA,micro RNA, Sno RNA – structure and biological functions.

UNIT-V DNA -PROTEIN INTERACTIONS [15 hrs]

Salient features of nucleic acid recognition by proteins. DNA binding motifs in proteins – the basic helix loop helix (bHLH) motif, zinc finger, the leucine zipper and helix-loop helix. RNA binding motifs in proteins. Techniques characterizing nucleic acid-protein complex – gel retardation assay, DNase I foot printing, CHIP.

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.

REFERENCES:

1. Victor W. Rodwell, Harpers Illustrated Biochemistry 30th Edition Paper back– Import, 1 Jan 2015.
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. Biochemistry. Freeman, 7th edn, 2011.
4. Text book of biochemistry (1997) 4th edition Thomas M devlin, A 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.

YEAR-I	CELL BIOLOGY(75 hrs) For the students admitted from the year 2019	19PBC12
SEMESTER-I		HRS/WK-5
CORE-II		CREDIT-4

Learning objectives:

- To understand the structure and purpose of the basic components of the Cell and its organelles
- To understand the vast networks of communication that occurs between and within each cell in our body.
- To acquire knowledge about microfilaments and microtubules and the components involved in cell- cell interaction
- To know the mechanism of cell cycle, cell death and genes to inhibit cancer.

Course Outcomes:

CO1: To gain in-depth knowledge about the structure and functions of various cell organelles, membrane and the techniques involved in visualization.

CO2: Able to understand the cell - cell interactions and the functional aspects of their components.

CO3: Able to understand the structure, functions and organization of microfilaments and microtubules.

CO4: To gain in-depth knowledge about the various mechanisms involved in cell signaling process.

CO5: To acquire knowledge and understand the different phases of cell cycle apart from types and tumorigenic properties of cancer.

SEMESTER II	SUB CODE: 19PBC12					CELL BIOLOGY								HOURS:4 CREDITS:3
COURSE OUTCOMES	PROGRAMME OUTCOMES(PO)					PROGRAMME SPECIFIC OUTCOMES(PSO)								MEAN SCORE OF CO'S
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
CO1	5	3	3	4	4	4	4	5	4	4	3	4	4	3.9
CO2	5	4	3	4	4	3	3	4	4	4	3	4	4	3.8
CO3	4	4	3	4	4	4	4	4	4	5	4	3	4	3.9
CO4	3	4	4	3	4	3	4	3	3	4	3	4	3	3.5
CO5	4	3	4	4	3	3	4	3	4	3	3	5	4	3.6
Mean overall score													3.7	

This Course is having **HIGH** association with Programme Outcome and Programme Specific Outcome

Association	1%-20%	21%-40%	41%-60%	61%-80%	81%-100%
Scale	1	2	3	4	5
Interval	0<=rating<=1	1.1<=rating<=2	2.1<=rating<=3	3.1<=rating<=4	4.1<=rating<=5
Rating	Very Poor	Poor	Moderate	High	Very High

UNIT I BIOMEMBRANE AND ORGANELLES

[25 hrs]

Structure and functions of organelles: nucleus, mitochondria, endoplasmic reticulum, Golgi apparatus, lysosomes, Ribosomes & peroxisomes. Membrane - Models, Membrane lipids - fluidity, asymmetry and phase transition. Membrane proteins - Types, proteins on RBC membrane, Purification of subcellular organelles, Bright field microscopy, phase contrast microscopy, SEM, TEM, AFM, FACS-Principle and applications. Marker enzyme for different organelles.

UNIT II: CELL – ADHESION AND CELL CELL INTERACTION

[15 hrs]

Cell-Cell interaction: - ECM; Collagen, hyaluronan & proteoglycans, laminin, integrins and fibronectins. Cell-Cell adhesion: Specialised junctions -- Desmosomes, Gap junctions, tight junctions Adhesion molecules - Cadherins - Connexins.

UNIT III CELL ORGANIZATION AND MOVEMENT

[10hrs]

Microfilaments - Actin – Structures, Assembly and disassembly. Microtubules – structure and composition. Microtubular associated proteins, MTOCs, Cilia and Flagella - Structure and functions, Intermediary filaments.

UNIT IV CELL SIGNALLING

[15hrs]

Cell surface receptor and signalling pathways – cell surface receptors, signal transduction and second messengers – adenylyl cyclase system, cAMP, G-protein coupled receptors. G-protein as cellular transducer, inositol triphosphate and calcium, DAG and NO, ion channels, Signal transmission via Ras proteins and MAP kinase pathways. Crosstalk in signalling pathways. mTOR pathways.

UNIT V CELL CYCLE & CELL DEATH

[10hrs]

Overview of cell cycle and its control. Checkpoints in cell cycle regulation. Apoptosis (Programmed cell death) - Pathways, regulators & effectors in apoptosis and necrosis. Cancer: types & properties of cancer cells. Tumor suppressor genes - functions .

TEXTBOOKS:

1. Harvey Lodish. W. H. Freeman; Sol edition (2007), Molecular cell Biology
2. Alberts 2002. Molecular Biology of the Cell 4th ed. Garland Sci.
3. Karp, G. Cell 2010, Molecular Biology: Concepts and Experiments, 6th edn, Wiley.

REFERENCES:

1. Robert Murray, Bender, (2012) Harper's Illustrated Biochemistry. McGraw Hill
2. De Robertis and De Robertis. Cell and Molecular Biology. Lea and Febiger 8th ed.
3. Nelson, D.L. and Cox, M.M (2008). Lehninger Principles of Biochemistry. 5th Edition, W.H. Freeman and Company, New York
4. Kelein Smith, and M Kish, (1995). Principles of cell biology, 2nd Edition, Harper and Row Publisher.

YEAR-I	INTERMEDIARY METABOLISM (75 hrs) For the students admitted from the year 2019	19PBC13
SEMESTER-I		HRS/WK-5
CORE-III		CREDIT-4

Learning objectives:

- ❖ To provide students with an appreciation and an understanding of key metabolic pathways of various biomolecules.
- ❖ To give insights to various pathways -how it generates energy and performs cellular work.
- ❖ To gain skills to interpret how the pathways are regulated by various metabolic and hormonal changes.

Course Outcomes:

CO1: To gain insights about the biological oxidation process, high energy compounds and key carbohydrate metabolic pathways such as glycolysis, TCA and ETC.

CO2: To understand the key metabolic steps involved in various pathways of carbohydrate metabolism.

CO3: To gain knowledge about the metabolic pathways of amino acid metabolism and its related inborn errors.

CO4: To gain knowledge about the metabolic pathways of lipid metabolism and its storage diseases.

CO5: Able to understand and interpret the metabolic pathways of nucleic acid metabolism and nucleotide coenzymes.

SEMESTER II	SUB CODE: 19PBC13					INTERMEDIARY METABOLISM								HOURS:4 CREDITS:3
COURSE OUTCOMES	PROGRAMME OUTCOMES(PO)					PROGRAMME SPECIFIC OUTCOMES(PSO)								MEAN SCORE OF CO'S
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
CO1	4	3	4	3	4	5	4	4	3	4	4	3	4	3.8
CO2	3	3	3	4	4	4	4	4	3	4	3	4	3	3.5
CO3	4	4	4	5	3	4	4	3	3	4	4	4	3	3.8
CO4	3	4	5	4	4	3	3	4	4	3	3	4	4	3.7
CO5	3	4	3	4	3	3	4	5	4	3	4	4	4	3.7
Mean overall score													3.7	

This Course is having **HIGH** association with Programme Outcome and Programme Specific Outcome

Association	1%-20%	21%-40%	41%-60%	61%-80%	81%-100%
Scale	1	2	3	4	5
Interval	0<=rating<=1	1.1<=rating<=2	2.1<=rating<=3	3.1<=rating<=4	4.1<=rating<=5
Rating	Very Poor	Poor	Moderate	High	Very High

UNIT I BIOENERGETICS**[15 hrs]**

Biological oxidation-reduction reactions, redox potentials, High energy phosphate compounds – phosphate group transfer, Glycolysis-regulation and energetic- PDH complex-citric acid cycle, regulation and energetic.ETC–oxidative phosphorylation-regulation and inhibition- uncouplers.

UNIT II CARBOHYDRATE METABOLISM**[15 hrs]**

Pentose phosphate pathway. Gluconeogenesis, glycogenesis &glycogenolysis metabolism - regulation, glyoxylate cycle and Gamma aminobutyrate shunt pathways, Cori cycle, anapleurotic reactions, glucuronate pathway. Hormonal regulation of carbohydrate metabolism.Glycogen storage diseases

UNIT III AMINO ACID METABOLISM**[15 hrs]**

Amino Acids – General reactions of amino acid metabolism - Transamination, decarboxylation, oxidative & non-oxidative deamination of amino acids.Catabolism of carbon skeletons of amino acids tyrosine and aliphatic amino acids.Urea cycle and its regulation. In born errors of metabolism-PKU,Alkaptonuria, Tyrosinosis.

UNIT IV LIPID METABOLISM**[15 hrs]**

Introduction, hydrolysis of tri-acylglycerols, α -, β -, ω - oxidation of fatty acids. Oxidation of odd numbered fatty acids ,PUFA– fate of propionate, role of carnitine, degradation of complex lipids. Fatty acid biosynthesis, Energetics of fatty acid cycle. Acetyl CoA carboxylase, fatty acid synthase, biosynthetic pathway for tri-acylglycerols, phosphoglycerides and sphingomyelin .Metabolism of cholesterol and its regulation.lipid storage diseases

UNIT V NUCLEIC ACID METABOLISM**[15 hrs]**

Nucleotides – Biosynthesis of Purines (de nova and salvage) and biosynthesis of Pyrimidines - catabolism and regulation of purine and pyrimidine biosynthesis. Biosynthesis of NAD^+ / NADP^+ and FAD^+ .

TEXT BOOKS:

1. Nelson, D. L. & Cox, M. M. Lehninger Principles of Biochemistry. Freeman, 5th edn, 2008

2. U.Sathayanarayana,(2006). Biochemistry. 3rd Edition by Books and Allied (P) Ltd., India.
3. Jain, J.L & Jain, (2005) Fundamentals of Biochemistry. Sixth Edition,S.Chand& Company, New Delhi.

REFERENCES:

1. Berg, J. M., Tymoczko, J. L. and Stryer, L, 2011. Biochemistry. Freeman, 7th edn,
2. Zubay, Biochemistry” 1998, 4th ed. William C. Brown Publication,
3. Voet, D. & Voet, 2010. J. G. Biochemistry. 4th edn,
4. Victor W. Rodwell, 2015. Harpers Illustrated Biochemistry 30th Edition Paper back— Import, 1 Jan
5. West, E.S. and Todd, W.R., 1985, Textbook of Biochemistry, MacMillan, Germany.

YEAR-I	MEDICAL LAB TECHNOLOGY (75hrs) For the students admitted from the year 2019	19EPB14A
SEMESTER-I		HRS/WK-5
ELECTIVE-I		CREDIT-4

Learning objectives:

- ❖ To impart basic knowledge of biochemistry, apparatus, units, equipment, and analysis in the Clinical Biochemistry.
- ❖ To discuss the laboratory test and diagnosis of various blood components
- ❖ To learn about various histotechniques, handling and processing of tissue specimens as well as staining procedures.
- ❖ To learn the different culturing techniques and its identification methods.

COURSE OUTCOMES:

CO1:To learn about the handling of the laboratory equipments and also know about how to collect and preserve the biological samples.

CO2:To gain the knowledge about to accessing various blood components and predict its clinical significance.

CO3:To acquire the knowledge and skill about various steps involved in the histopathological techniques.

CO4:To understand the importance of various biochemical parameters and its clinical significance.

CO5:To learn the basic skills of microbial culture and its safety measures.

SEMESTER II	SUB CODE: 19EPB14A					MEDICAL LAB TECHNOLOGY								HOURS:4 CREDITS:3
COURSE OUTCOMES	PROGRAMME OUTCOMES(PO)					PROGRAMME SPECIFIC OUTCOMES(PSO)								MEAN SCORE OF CO'S
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
CO1	5	4	3	5	4	3	5	4	4	5	5	4	3	4.2
CO2	4	4	5	4	3	5	3	5	4	3	4	3	4	3.9
CO3	4	3	4	3	4	4	5	4	3	5	3	4	3	3.8
CO4	4	5	3	4	3	4	4	3	3	5	4	5	4	3.9
CO5	3	5	4	4	3	4	4	5	4	5	4	3	5	4.2
Mean overall score													4.0	

This course is having **HIGH** association with programme outcome and programme specific outcome

Association	1%-20%	21%-40%	41%-60%	61%-80%	81%-100%
Scale	1	2	3	4	5
Interval	0<=rating<=1	1.1<=rating<=2	2.1<=rating<=3	3.1<=rating<=4	4.1<=rating<=5
Rating	Very Poor	Poor	Moderate	High	Very High

UNIT-I LABORATORY CARE AND INSTRUMENTATION [15 hrs]

Automation in clinical lab – Instrumental concept, selection of instrument, quality assurance, control of pre analytical and analytical variables. Internal and external quality control measurements . Collection and preservation of samples.

UNIT-II HEMATOLOGY [15 hrs]

Blood grouping and Rh factor, cross matching, clotting time,bleedingtime,hemoglobin estimation, total count-RBC count and WBC count, Differential WBC count, MCHC, MCH, MCV. Erythrocyte Sedimentation Rate (ESR),Hematocrit value (Packed Cell Volume).Screening test-HIV,HBs Ag, TPHA.Platelet and its significance, Coombs test.

UNIT-III CLINICAL PATHOLOGY [15 hrs]

Brief outline of histopathology: Tissue cutting,fixation,embedding,tissue slicing by microtome,slide mounting and staining techniques.

UNIT-IV CLINICAL BIOCHEMISTRY [15 hrs]

Biochemical parameters::Blood glucose,HbA1c, urea, uric acid, lipid profile, totalprotein,albumin test, A/G ratio, normal values and their significance. Enzymes: SGOT,SGPT,serum alkaline and acidic phosphates,amylase,lacticdehydrogenasetest, normal values and their significance.Electrolytes: sodium, potassium, calcium,phosphorous, - its role and abnormalities.

UNIT-V MICROBIOLOGY [15 hrs]

Culturing of organisms from various specimens, culture media and antibiotic sensitivity test (pus, urine, blood, sputum, throat swab).Gramstain,Ziehl-Neilson staining (TB,Lepra bacilli). Safety procedure in microbiological techniques.

TEXTBOOKS :

1. Kanai L. Mukherjee, Medical Laboratory Technology Vol. I.Tata McGraw Hill 1996,New Delhi.
2. Gradwohls, 2000. Clinical laboratory methods and diagnosis ed.Alex.C.
3. Sonnenwirth& Leonard Jarret.M.D.B.I.Publications, New Delhi,

REFERENCES

1. Henry, John Bernard, Todd Sanford and Davidson, 2002. Clinical diagnosis and management by laboratory methods. W.B. Saunders & Co.
2. Fischbach Francis A, 2003. Manual of laboratory and diagnostic tests. Philadelphia, J.B. Lippincott & Co, N.Y.
3. Philadelphia, J.B. Lippincott & Co, N.Y.
4. Sood, R, 2005, Medical Laboratory methods and interpretation, Jaypee Brothers Medical Publications, New Delhi.

YEAR-I	CLINICAL NUTRITION (75 hrs) For the students admitted from the year 2019	19EPB14B
SEMESTER-I		HRS/WK-5
ELECTIVE-I		CREDIT-4

Learning objectives

- ❖ To study the nutritional aspects of various foodstuffs and its measurement.
- ❖ To study the functional aspects of vitamins and minerals.
- ❖ To understand the nutritional management of diet in different age groups and diseases.
- ❖ To learn and gain knowledge about the functional foods.

Course Outcomes:

CO1: Students gain knowledge about diet and different nutritional disorders.

CO2: To understand and gain knowledge about different types of nutritional measurements.

CO3: Students are able to comprehend the daily requirements of vitamins & minerals.

CO4: Students are able to demonstrate and exhibit different dietary plan for different age groups & disease condition.

CO5: Students are able to gain knowledge about importance of nutraceuticals and antioxidants in human health.

SEMESTER II	SUB CODE: 19EPB14B					CLINICAL NUTRITION								HOURS:4 CREDITS:3
COURSE OUTCOMES	PROGRAMME OUTCOMES(PO)					PROGRAMME SPECIFIC OUTCOMES(PSO)								MEAN SCORE OF CO'S
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
CO1	4	4	3	5	2	2	3	3	5	5	3	5	4	3.7
CO2	5	4	4	3	2	2	3	4	5	3	4	3	3	3.5
CO3	4	3	3	2	2	5	3	3	3	3	5	5	3	3.4
CO4	3	3	4	5	2	2	5	4	4	2	5	5	4	3.7
CO5	4	3	4	5	2	5	3	4	3	5	5	3	3	3.8
Mean overall score													3.6	

This Course is having **HIGH** association with Programme Outcome and Programme Specific Outcome

Association	1%-20%	21%-40%	41%-60%	61%-80%	81%-100%
Scale	1	2	3	4	5
Interval	0<=rating<=1	1.1<=rating<=2	2.1<=rating<=3	3.1<=rating<=4	4.1<=rating<=5
Rating	Very Poor	Poor	Moderate	High	Very High

UNIT-1 NUTRITIONAL DISORDER [15 hrs]

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's disease, atherosclerosis, and fatty liver. Disorders of protein malnutrition.

UNIT II BASAL METABOLIC RATE [15 hrs]

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 on diabetes & renal disorders.

UNIT III VITAMINS & MINERALS [15 hrs]

Vitamins-Classification, fat soluble and water soluble vitamins-source, daily requirements, functions and deficiency manifestations. Micro, Macro and trace elements-daily requirements, functions and deficiency manifestations.

UNIT IV NUTRITIONAL MANAGEMENT [15 hrs]

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: obesity, cardiovascular diseases, Diabetes mellitus, Renal disorders and neurological disorders (Parkinson's disease, Alzheimer's disease). Nutrition at different stages of life-during infancy, adolescence, pregnancy, lactation and old age.

UNIT V Recent advances in clinical nutrition [15 hrs]

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 Phytochemicals such as polyphenols, flavonoids & terpenes).

TEXTBOOKS:

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.

REFERENCES:

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

YEAR-I	MOLECULAR BIOLOGY (75 hrs) For the students admitted from the year2019	19PBC21
SEMESTER-II		HRS/WK-5
CORE-IV		CREDIT-4

Learning objectives:

- ❖ To teach the life processes at the sub cellular and molecular level.
- ❖ To discuss central dogma of molecular biology in depth.
- ❖ To make them learn various repair processes involved in DNA damage.
- ❖ To explain various transposable elements, stress proteins and membrane fusion proteins and their function.

Course Outcomes:

CO1: To understand the basic concepts of molecular biology and its central dogma apart from gene transfer mechanism in microorganism

CO2: To acquire in-depth knowledge of the factors involved in prokaryotic and eukaryotic replication process.

CO3: To gain appropriate knowledge about transcription process and its modifications and also get cleared insight of operation/regulation of different operons.

CO4: To acquire sufficient knowledge and skill about the features and decoding of genetic code and also understand the translation process in prokaryotes and eukaryotes.

CO5: To understand the mechanism of DNA repair and its types and gain significant knowledge about protein targeting, HSPs and transposons.

SEMESTER II	SUB CODE: 19PBC21					MOLECULAR BIOLOGY								HOURS:4 CREDITS:3
COURSE OUTCOMES	PROGRAMME OUTCOMES(PO)					PROGRAMME SPECIFIC OUTCOMES(PSO)								MEAN SCORE OF CO'S
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
CO1	3	4	3	5	4	3	5	4	4	3	3	4	3	3.7
CO2	3	4	3	4	3	5	3	4	4	3	4	3	4	3.6
CO3	4	3	4	3	4	4	5	4	3	5	3	4	3	3.8
CO4	4	5	3	3	3	4	4	3	3	4	2	5	4	3.6
CO5	3	3	2	4	3	4	4	3	3	3	4	3	3	3.2
Mean overall score													3.6	

This Course is having **HIGH** association with Programme Outcome and Programme Specific Outcome

Association	1%-20%	21%-40%	41%-60%	61%-80%	81%-100%
Scale	1	2	3	4	5
Interval	0<=rating<=1	1.1<=rating<=2	2.1<=rating<=3	3.1<=rating<=4	4.1<=rating<=5
Rating	Very Poor	Poor	Moderate	High	Very High

UNIT-I CHROMOSOME [20 hrs]

DNA-genetic material-Griffith, Avery et al and Hershey and Chase experiment value ,C value paradox, Cot value, organization of chromosomes and nucleosomes, Euchromatin, heterochromatin, centromeres and telomeres,central dogma of molecular biology , mitochondria and chloroplast DNA-Gene transfer in microorganisms-conjugation-Hfrtransfer,chromosomal transfer and the mediation by F plasmids, transformation-competence, transduction .Repetitive DNA-Highly repetitive moderately repetitive and unique DNA sequences, Satellite DNA, Telomerase. Overlapping genes.

UNIT –II REPLICATION [15 hrs]

Replication-conservative and semiconservative- experimental proof for semiconservative replication-factors involved in prokaryotic and eukaryotic replication-DNA polymerases in prokaryotes and eukaryotes-inhibitors of replication-replication of circular DNA and linear DNA. Sigma & Theta replication. Mitochondrial replication.

UNIT-III TRANSCRIPTION AND GENE REGULATION [10 hrs]

Transcription-promoters, RNA polymerase in prokaryotes and eukaryotes-intiation, elongation and termination of transcription process -inhibitors of transcription, Group I& II introns, post transcriptional modification of mRNA, tRNA and rRNA, Antisense RNA . RNA editing. Operon concept- Lac, arabinose and trp operon.

UNIT-IV GENETIC CODE AND TRANSLATION [15 hrs]

Genetic code-features and deciphering of genetic code.wobblehypothesis.Translation- activation of amino acids, initiation, elongation and termination process in prokaryotes and eukaryotes. Inhibitors of protein synthesis in prokaryotes and eukaryotes, post translational modification.

UNIT-V DNA REPAIR& TRANSPOSONS [15 hrs]

DNA repair-photoreactivation, Excision repair, Post replication and mismatch repair, base and nucleotide excision recombination and SOS repair. Protein targeting-Heat shock proteins, glycosylation; SNAPs and SNAREs, transposons, retroposons.

TEXT BOOKS:

1. Lewin B(2004):Genes VIII ,Oxford University Press,New York
2. Watson. J. D, Baker. T. A, Bell. S. P, Gann. A, Levine. M,Lodish. R. Molecular Biology of Gene. 5th The Benjamin /Cummings Pub. Co. Inc, 2003
3. AjoyPaul. 2007. Text book of cell and molecular biology. Books and allied. Kolkata,
4. Krebs.J.E.et. al., 2011, lewin'sgenes X (Ed:10), Jones and Barrett publishers, US.
5. David Freifelder, 2008. Molecular Biology. (Ed: 2). Narosa Publications, New Delhi.
6. Twyman. 2003. Advanced Molecular Biology. Bios Scientific Publishers LTD. Oxford, UK.

REFERENCES:

1. Lodish, H., Berk, A., Zipursky, S. L., Matsudaira, P., Baltimore, D. and James Darnell, J, 2012.Molecular Cell Biology ,7th edn, Freeman.
2. Weaver. R. F. 2005. Molecular Biology. 3rd ed. McGraw Hill publication.
3. WeaverR.F and Philip.P.W(1989):Genetics,WMCBrwnPublishing,USA
4. Nelson, D. L. & Cox, M. M. Lehninger, 2008.Principles of Biochemistry. 5th edn, Freeman.
5. Primrose (2001) - Principles of gene manipulation. 6th Edition Blackwell Scientific Publishers. UK
6. Karp, 2010. Cell and Molecular Biology: Concepts and Experiments. 6th edn, Wiley.
7. Alberts B. 2002. Molecular Biology of the Cell, (Ed: 3) Garland Science, NY.

YEAR-I	ENZYMOLGY (75 hrs) For the students admitted from the year 2019	19PBC22
SEMESTER-II		HRS/WK-5
CORE-V		CREDIT-4

Learning objectives:

- ❖ To provide a deeper insight into the fundamentals of enzyme structure and function and kinetics of enzymes.
- ❖ To learn the regulation and inhibition of enzymes.
- ❖ It deals with current applications of enzymes and the methods of immobilization.

COURSE OUTCOMES (CO)

CO1-Students can able to gain knowledge about thermodynamic concepts involved in enzymatic reactions and classification of enzymes.

CO2-Able to understand the kinetics of the enzyme catalysed reaction using different plots.

CO3-To exhibit knowledge and understanding about the enzyme catalytic reactions in the active site with appropriate example

CO4-To understands the mechanisms of enzyme regulation and its allosteric effects with suitable examples.

CO5-Able to gain knowledge about the types of inhibition in enzyme catalysis, immobilization of enzymes and its applications.

SEMESTER II	SUB CODE: 19PBC22					ENZYMOLGY								HOURS:4 CREDITS:3
COURSE OUTCOMES	PROGRAMME OUTCOMES(PO)					PROGRAMME SPECIFIC OUTCOMES(PSO)								MEAN SCORE OF CO'S
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
CO1	3	4	3	5	4	3	4	2	4	3	3	4	3	3.5
CO2	5	4	3	4	3	5	3	4	4	3	4	3	4	3.8
CO3	4	3	2	3	4	4	5	4	3	5	3	4	3	3.6
CO4	5	3	4	3	3	5	4	3	3	4	2	3	4	3.5
CO5	4	3	2	4	3	4	4	3	4	3	4	3	3	3.2
Mean overall score													3.5	

This Course is having **HIGH** association with Programme Outcome and Programme Specific Outcome

Association	1%-20%	21%-40%	41%-60%	61%-80%	81%-100%
Scale	1	2	3	4	5
Interval	0<=rating<=1	1.1<=rating<=2	2.1<=rating<=3	3.1<=rating<=4	4.1<=rating<=5
Rating	Very Poor	Poor	Moderate	High	Very High

UNIT I ENZYMES [20 hrs]

Introduction, Classification and Nomenclature of enzymes - General characteristics of enzyme activity, Factors affecting enzyme activity. First Law & Second Law of thermodynamics. ΔG , characteristics of free energy, entropy and enthalpy. Law of mass action - Zero and first order reaction.

UNIT II KINETICS OF ENZYME ACTION [15hrs]

Concept of ES complex, collision, transition state theories and energy of activation, derivation of Michaelis-Menten equation for uni- substrate reactions. Different plots for the determination of K_m , V_{max} and their significance. Turn over number. The rate of expression for Bisubstrate reactions for Ping Pong, random & ordered Bi-Bi mechanisms. Multienzyme complex and its function with reference to PDH.

UNIT III MECHANISM OF ENZYME ACTION [10hrs]

Acid-base catalysis, covalent catalysis, metal ion catalysis, proximity, orientation effect. Active site – definition, common features of active site – Investigation of active site structure – trapping ES complex, Use of substrate analogue. Modification of amino acid side chain by single chemical procedure. Strain & distortion theory. Lock and Key and Chemical modification of active site groups. Site directed mutagenesis of enzymes. Mechanism of action of chymotrypsin and lysozyme.

UNIT IV ENZYME REGULATION [15hrs]

General mechanisms of enzyme regulation, product inhibition. Reversible and irreversible. Covalent modifications of enzymes. Allosteric enzymes - positive and negative cooperatively with special reference to aspartate transcarbamoylase & Phosphofructokinase.

UNIT V INHIBITION AND APPLICATION [15hrs]

Irreversible, reversible- competitive, noncompetitive, uncompetitive inhibition. Kinetic differentiation and Graphical analysis- Suicide inhibition. Immobilized enzymes - methods of immobilization - applications of immobilized enzymes K_i , IC_{50} . Industrial enzymes and its application. Purification of enzymes and characterization of enzymes.

TEXT BOOKS:

1. Trevor Palmer, (2004). Enzymes. 5th edition, Affiliated East –West press (P)Ltd. New Delhi.
2. Dixon, E.C.Webb , (1979). Enzymes. 3rd Edition, CJRthorne and K.F.Tipton, Longmans Green & Co , London and Academic Press, New York.
3. Nicholas, C. Price , (1998).Fundamentals of Enzymology. 2nd Edition, Oxford UniversityPress. UK

REFERENCES

1. Zubay,1998“ Principles of Biochemistry”, 4th ed.. William C.Brown Publ.
2. Berg, J. M., Tymoczko, J. L. and Stryer, L. Biochemistry. Freeman, 7th edn, 2011.
3. Uhlig H.1998. Industrial enzymes and their applications. John Wiley,
4. Balasubramanian. 1998. Concepts in Biotechnology Universities Press (India) Ltd.,
5. Chapline, Bucke,,1990. “Protein Biotechnology,”1st edition, Cambridge University Press,
6. Marangoni ,2002. Enzyme kinetics. A modern approach, John Wiley.
7. Bohinski, R.C, 1987, Modern concepts in Biochemistry, Alllyn and Bascon Inc., Boston

YEAR-I	ANALYTICAL BIOCHEMISTRY (75 hrs) For the students admitted from the year 2019	19PBC23
SEMESTER-II		HRS/WK-5
CORE-VI		CREDIT-4

Learning objectives:

- ❖ To understand the bio analytical techniques along with their theory, working principal, common instrumentation and possible applications
- ❖ To develop the skills to understand the theory and practice of bio analytical techniques.
- ❖ To provide scientific understanding of analytical techniques.

Course Outcomes:

CO1: To gain knowledge about the Principle instrumentation and application of various types of chromatography and its interpretation.

CO2: To acquire knowledge about the principle preparation, instrumentation and application of different kinds of electrophoretic techniques.

CO3: To get in-depth understanding about the basic principle: types of rotors instrumentation and application of different types of centrifugation process.

CO4: Able to exhibit their knowledge about the principle, instrumentation and application of spectroscopic techniques.

CO5: Able to demonstrate their skills in basic concepts of radioactivity, its measurement and application.

SEMESTER II	SUB CODE: :19PBC23					ANALYTICAL BIOCHEMISTRY								HOURS:4 CREDITS:3
COURSE OUTCOMES	PROGRAMME OUTCOMES(PO)					PROGRAMME SPECIFIC OUTCOMES(PSO)								MEAN SCORE OF CO'S
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
CO1	4	3	5	3	4	5	4	5	4	5	4	4	5	4.2
CO2	4	4	4	5	4	3	5	3	4	5	3	5	4	4.1
CO3	3	4	5	3	3	3	4	5	4	5	4	3	5	3.9
CO4	4	5	4	5	4	4	4	3	5	3	3	5	4	4.1
CO5	5	3	4	5	4	3	5	4	3	5	4	4	5	4.2
Mean overall score													4.1	

This Course is having **VERYHIGH** association with Programme Outcome and Programme Specific Outcome

Association	1%-20%	21%-40%	41%-60%	61%-80%	81%-100%
Scale	1	2	3	4	5
Interval	0<=rating<=1	1.1<=rating<=2	2.1<=rating<=3	3.1<=rating<=4	4.1<=rating<=5
Rating	Very Poor	Poor	Moderate	High	Very High

UNIT I CHROMATOGRAPHY [15 hrs]

Principle, instrumentation and applications of thin layer and gas chromatography. HPTLC, Column chromatography-packing, loading, elution and detection. Column chromatography 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, UPLC, UHPLC and software's used to interpret chromatogram.

UNIT II ELECTROPHORETIC AND ELECTROCHEMICAL TECHNIQUES [15 hrs]

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 gels.

UNIT III CENTRIFUGATION TECHNIQUES [10 hrs]

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 hrs]

Laws of absorption and absorption spectrum., UV-visible spectrophotometry and spectrofluorimetry. Flame spectroscopy- principle and applications of atomic absorption and flame emission. NMR, FTIR, mass spectroscopy-principle, instrumentation and application. LCMS, GCMS, ICPMS.

UNIT V RADIOISOTOPE TECHNIQUES [15 hrs]

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 radioisotopes in biology. Radiation hazards and safety aspects.

TEXTBOOKS:

1. Avinash Upadhyay, and Nirmalendranath, (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.

REFERENCES:

1. Boyer, R. 2000. Modern Experimental Biochemistry. 3rd ed. Addison Wesley Longman,
2. Simpson CFA & Whittaker, M. Electrophoretic techniques.
3. Sambrook, 2001. Molecular Cloning. Cold Spring Harbor Laboratory.
4. Friefelder and Friefelder, 1994. Physical Biochemistry – Applications to Biochemistry and Molecular Biology. WH Freeman & Co.
5. Pavia, 2000. Introduction to Spectroscopy. 3rd ed. Brooks/Cole Pub Co.

YEAR-I	PLANT BIOCHEMISTRY (75 hrs) For the students admitted from the year 2019	19EPB24A
SEMESTER-II		HRS/WK-5
ELECTIVE-II		CREDIT-4

Learning objectives:

- ❖ To acquire knowledge of the chemistry of important biological processes in plants.
- ❖ To acquire knowledge about photosynthesis, metabolism of nitrogen compounds and about molecular mechanisms of signalisation and regulation.
- ❖ To acquire knowledge about the importance of secondary metabolites and stress metabolism.

Course Outcomes (CO)

CO1- Able to gain knowledge about the different components of plant cells apart from mechanism of absorption by plants.

CO2- To get in-depth knowledge about the functions and mechanisms of different plant hormones.

CO3- To acquire knowledge about the steps and mechanisms involved in photosynthesis of plants.

CO4- To know and interpret the different secondary metabolites present in the plants and its stress adaptation.

CO5- To gain thorough understanding about the nitrogen fixing mechanisms adopted by the soil microbes.

SEMESTER II	SUB CODE: 19EPB24A					PLANT BIOCHEMISTRY								HOURS:4 CREDITS:3
	PROGRAMME OUTCOMES(PO)					PROGRAMME SPECIFIC OUTCOMES(PSO)								MEAN SCORE OF CO'S
COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
CO1	4	4	3	5	4	3	4	3	4	5	4	3	4	3.8
CO2	5	3	4	4	3	4	5	4	3	4	5	4	3	3.9
CO3	4	4	3	3	4	5	3	4	3	4	5	3	4	3.8
CO4	5	3	3	4	3	3	5	3	4	3	4	4	3	3.6
CO5	4	4	3	4	4	5	4	4	4	3	4	3	4	3.8
Mean overall score													3.8	

This Course is having **HIGH** association with Programme Outcome and Programme Specific Outcome

Association	1%-20%	21%-40%	41%-60%	61%-80%	81%-100%
Scale	1	2	3	4	5
Interval	0<=rating<=1	1.1<=rating<=2	2.1<=rating<=3	3.1<=rating<=4	4.1<=rating<=5
Rating	Very Poor	Poor	Moderate	High	Very High

UNIT I PLANT CELL & ABSORPTION [10 hrs]

Discovery and definition of plant cell – cell wall, plasmodesmata, meristematic cells, and secretory systems. Mechanism of absorption .Ion exchange passive absorption. Active absorption .The carrier concept.Donnan's equilibrium.

UNIT II PLANT HORMONES [10 hrs]

Structure, biosynthesis, mode of action & physiological effects of auxins, gibberellins, cytokinins and IAA. Biochemistry of seed dormancy, seed germination, fruit ripening and senescence. Synthetic seeds.

UNIT III PLANT PIGMENTS & PHOTOSYNTHESIS [20 hrs]

Structure & synthesis of chlorophyll, phycobilins and carotenoids. Photosynthesis photosystem –I & II-Light absorption, Hill reaction, Red drop & Emerson's enhancement effect. Cyclic and non-cyclic photophosphorylation, calvin cycle. Photosynthesis-factors and regulation. Chloroplast ATP synthase, complexes associated with thylakoid membranes, and light harvesting complexes. C₃, C₄ pathway and CAM.

UNIT IV SECONDARY METABOLITES & STRESS METABOLISM [15 hrs]

Secondary metabolites in plants –classification & function of alkaloids, terpenoids, tannins, polyphenols, flavanoids, saponins, lignin and pectin. Stress metabolism in plants - Environmental stresses, salinity, water stress, heat, chilling and their impact on plant growth. Heavy metals, radiations and their impact on plant growth, criteria of stress tolerance.

UNIT V NITROGEN FIXING ORGANISMS [20hrs]

Nitrogen fixing organisms: Structure and mechanism of action of nitrogenase: Rhizobium symbiosis .Leghaemoglobin; strategies for protection of nitrogenase against the inhibitory effect of oxygen; nif genes of klebsiella pneumoniae including their regulation. Nitrate Assimilation: Nitrate reductase; regulation of nitrate assimilation. Ammonia assimilation by glutamine synthetase- glutamine oxoglutarate amino transferase (GS-GOGAT). Nitrite and nitrate reductase.

TEXTBOOKS :

1. Jain.V.K., 2005. Fundamentals of Plant Physiology, revised 1st edition S.Chand and Co.
2. Pandey.S.N.,andSinha.B.K.,Plant Pysiology,1999,Vikas Publishing House.
3. Heldt, HW. (2005), Plant Biochemistry. 3rd Edition, Elseveir Academic Press Publication, USA.

REFERENCES:

1. Solisbury and Ross,Plant Physiology,3rd edition,CBS Publishers and Distributors.
2. Hans-Walter Held,Plant Biochemistry, 3rd edition,Elsevier India Pvt.Ltd.
3. Bonner and Varner, Plant Biochemistry, 3rd edition,Academic Press.
4. Bowsher, C, Steer, M. and Tobin, A (2008). Plant Biochemistry. Garland Science,Taylor and Francis Group, LLC. New York.
5. Verma,2001. Plant physiology, 7th Revised edition, Emkay Publications.
6. S. N. Pandey and B.K. Sinha, 1999.Vikas Publishing House Pvt. Ltd, 3rd edition, Plant Physiology.

YEAR-I	ENDOCRINOLOGY (75 hrs) For the students admitted from the year 2019	19EPB24B
SEMESTER-II		HRS/WK-5
ELECTIVE-II		CREDIT-4

Learning objectives:

- ❖ To provide students with a broad understanding of the major human endocrine glands and their hormones, together with understanding hormones action and their effect on target cells.
- ❖ To provide students with an understanding of the medical conditions resulted from abnormal hormone secretion and the laboratory tests that are used to diagnose these conditions

COURSE OUTCOMES:

CO1:To gain the knowledge about the functions of pituitary, hypothalamus and pineal gland hormones and its regulations.

CO2:To learn and understand the structure and functions of thyroid, parathyroid hormones and its regulations.

CO3:To understand the structure and functions of gastrointestinal and pancreatic hormones.

CO4:To acquire the knowledge about the structure and functions of adrenal hormones and its regulation.

CO5:To gain the knowledge about the structure and functions of male and female sex hormones and its regulation.

SEMESTER II	SUB CODE: :19EPB24B					ENDOCRINOLOGY								HOURS:4 CREDITS:3
	PROGRAMME OUTCOMES(PO)					PROGRAMME SPECIFIC OUTCOMES(PSO)								MEAN SCORE OF CO'S
COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
CO1	4	4	3	4	4	4	4	3	5	4	5	3	4	3.9
CO2	3	3	4	4	3	3	4	3	4	4	5	2	4	3.5
CO3	4	4	5	3	3	4	3	4	3	4	3	4	3	3.6
CO4	4	5	4	3	3	3	4	3	4	4	4	3	4	3.7
CO5	3	4	4	3	3	5	4	4	4	3	4	3	3	3.6
Mean overall score														3.7

This course is having **HIGH** association with programme outcome and programme specific outcome

Association	1%-20%	21%-40%	41%-60%	61%-80%	81%-100%
Scale	1	2	3	4	5
Interval	0<=rating<=1	1.1<=rating<=2	2.1<=rating<=3	3.1<=rating<=4	4.1<=rating<=5

Rating	Very Poor	Poor	Moderate	High	Very High
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UNIT I HYPOTHALAMIC, PITUITARY & PINEAL GLAND HORMONES [20hrs]

Definition & Classification - Mechanism of hormone action . Definition of signals, ligands and receptors, endocrine, paracrine and autocrine signalling. Pituitary Hormones: Anatomy of pituitary gland, hormones of the pituitary, Hypothalamic releasing factors, Anterior pituitary hormones: biological actions, regulation and disorders of growth hormones, ACTH, gonadotrophins prolactin and Leptin. Posterior pituitary hormones: vasopressin and Oxytocin- biological actions, regulation and disorders, MSH. Pineal gland - melatonin hypothesis, melatonin secretion and circulation, proposed role of pineal gland and mechanism of action.

UNIT II THYROID & PARATHYROID HORMONES [15 hrs]

Thyroid hormones – synthesis, secretion, regulation, transport, metabolic fate and biological actions. Antithyroid agents. Parathyroid hormone - Synthesis, Secretion and biological actions. Calcitonin and calcitriol - Hormonal regulation of calcium and phosphate metabolism. Hypercalcemia and hypocalcemia, Rickets and osteomalacia

UNIT III ADRENAL & GASTRO INTESTINAL HORMONES [15 hrs]

Adrenal gland structure. Adrenal cortical hormones - Synthesis, regulation, transport, metabolism and biological effects. Cushing's syndrome, aldosteronism, congenital adrenal hyperplasia, adrenal cortical insufficiency. Adrenal medullary hormones – synthesis, secretion, metabolism, regulation and biological effects of catecholamines. Pheochromocytoma .

G.I. Tract hormones – chemical nature & functions of Gastrin, Enterogastin, Secretin & Cholecystokinin

UNIT-IV PANCREATIC HORMONES [10 hrs]

Pancreatic hormones – cell types of islets of Langerhans -synthesis, regulation, biological effects and mechanism of action of glucagon and insulin. Somatostatin, leptin, Adiponectin, Pancreatic polypeptide and Ghrelin.

UNIT V SEX HORMONES [15 hrs]

Male sex hormones: Biosynthesis, regulation, transport, metabolism and biological actions of androgens. Hypogonadism and gynecomastia.

Female sex hormones: Biosynthesis, regulation, transport, metabolism and biological effects of oestrogen and progesterone. The menstrual cycle. Amenorrhoea.

TEXT BOOKS:

1. Robert Murray, Bender, (2012) Harper's Illustrated Biochemistry.
2. Williams Textbook of Endocrinology – Wilson and Foster 8th ed.
3. Devlin, 1997, Textbook of Biochemistry (with clinical correlation), John Wiley, USA.

REFERENCES:

1. Principles of Biochemistry – Mammalian Biochemistry – Smith. McGraw Hill 7th ed
2. Nelson, D. L. & Cox, M. M, 2008. Lehninger Principles of Biochemistry. 5th edn, Freeman.
3. Wilson and Foster, 1992, Textbook of Endocrinology, (8th edn), W.B. Saunders, USA.
4. Mac. E. Hadley and Jon. E. Levin, 2009, Endocrinology 6th ed., Darling Kindersly Pvt. Ltd., India
4. Guyton, A.C. and Hall, J.E (2006), Textbook of Medical Physiology, 11th Edition, Saunders Co. Pennsylvania.

YEAR-II	NANOTECHNOLOGY	19SPBC31A
SEMESTER-III		
SSC-I		For the students admitted from the year 2019

OBJECTIVES

To understand the various concepts of nanomaterials and its applications.

COURSE OUTCOMES

CO1: To understand the different types of nanomaterial.

CO2: To know the various aspects of synthesis of nanomaterials.

CO3: To know about the different types of biomaterials and its compatibility properties.

CO4: To get insights about protein and DNA based nanostructures.

CO5: To understand various applications of nanotechnology in food and agriculture field.

SEMESTER – III	COURSE CODE: 19SPBC31A					NANOTECHNOLOGY								HOURS:2 CREDITS
COURSE OUTCOMES	PROGRAMME OUTCOMES (PO)					PROGRAMME SPECIFIC OUTCOMES (PSO)								MEAN SCORE OF CO'S
	PO1	PO 2	PO 3	PO 4	PO5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	
CO1	3	4	2	4	3	5	3	5	5	4	3	2	2	3.4
CO2	3	3	5	4	3	4	5	3	4	3	5	4	4	3.8
CO3	4	4	4	3	4	4	4	3	4	3	4	4	3	3.6
CO4	5	2	4	5	3	3	4	5	3	4	4	3	2	3.6
CO5	3	4	4	3	4	3	3	4	5	4	3	2	4	3.5
Mean Overall Score													3.7	

This Course is having **HIGH** association with Programme Outcome and Programme Specific

Association	1%-20%	21%-40%	41%-60%	61%-80%	81%-100%
Scale	1	2	3	4	5
Interval	0<=rating<=1	1.1<=rating<=2	2.1<=rating<=3	3.1<=rating<=4	4.1<=rating<=5
Rating	Very Poor	Poor	Moderate	High	Very High

UNIT I: Classification and Nomenclature of Nanomaterials

Nanotechnology, Introduction to Nanostructures: Carbon Nanotubes (CNT), Graphenes, Fullerenes, Nano Peapods, Quantum Dots and Semiconductor Nanoparticles, Metal-based Nanostructures (Iron Oxide Nanoparticles), Nanowires, Polymer-based Nanostructures including dendrimers, Introduction to metal based nanostructures. Protein-based Nanostructures, Nanomotors: Bacterial (E.coli) and Mammalian (Myosin family) Nanobiosensors. Science of Selfassembly - From Natural to Artificial Structures. Nanoparticles in Biological Labeling and Cellular Imaging.

UNIT II: Synthesis of Nanomaterials

Nucleation and growth of nanosystems; self-assembly, mechanical milling, laser ablation, sputtering and microwave plasma, chemical reduction and oxidation, hydrothermal, micelles, sol-gel processes, photolysis and radiolysis.

Unit III: Nanobiomaterials And Biocompatibility

Surface and Bulk Properties of Bio materials – Nanobiomaterials, NanoCeramics, Nanopolymers, Nano Silica and Hydroxy apatite – Carbon Based nanomaterials.

Unit IV Protein And DNA Based Nanostructures

Nanocircuitry – S-layer proteins: structure, chemistry and assembly – lipid chips – S - Layers as Templates – engineered nanopores – DNA–Protein Nanostructures DNA-based Metallic Nanowires and Networks, DNA–Gold-Nanoparticle Conjugates.

Unit V Applications in food & agriculture

Enzyme Biosensors and Diagnostics - DNA-Based Biosensors and Diagnostics Radiofrequency. Food and New Ways of Food Production - Efficient Fractionation of Crops Efficient Product Structuring -Optimizing Nutritional Values - Applications of Nanotechnology in Foods : Sensing, Packaging, Encapsulation, Engineering Food Ingredients to Improve Bioavailability.

TEXT BOOKS

1. Molecular Cell Biology,HarveyLodish, Published by W.H. Freeman & Company
2. Biomaterials: A Nano Approach,S Ramakrishna, M Ramalingam, T.S. Sampath Kumar, Winston O. Soboyejo,Published by CRC Press
3. Bionanotechnology: Lessons from Nature, D S. Goodsell, by John Wiley & Sons, Inc.
4. Nanobiotechnology: Concepts, Applications and Perspectives,(edited by C. M. Niemeyer and C. A. Mirkin), Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim,
5. Nanobiotechnology: Concepts, Applications and Perspectives,Edited by Christof M. Niemeyer and Chad A. Mirkin, Wiley-VCH, 2004,ISBN 3527306587, 9783527306589

REFERENCE BOOKS

1. The structure and properties of materials by R.M.Rose, L.A.Shepard and J. Wulff, Wiley Eastern Ltd., 1966.
2. Semiconductor Devices – Physics and Technology by S.M. Sze, Wiley, 1985.
3. Semiconductor Material and Device Characterization by D. K. Schroder, John Wiley & Sons, New York, 1998.
4. Encyclopedia of Materials Characterization by C. Richard Brundle Charles A. Evans, Jr.ShaunWilson ,Butterworth-Heinemann, 1992.

YEAR-II	NEUTRACEUTICALS AND FUNCTIONAL FOODS	19SPBC31B
SEMESTER-III		
SSC-II		CREDIT-2

For the students admitted from the year 2019

OBJECTIVES

- To impart the concept of nutraceuticals and functional ingredients in foods and to determine their role in health and disease prevention.
- To learn about the various phytochemicals, their sources and functions.
- To understand the basics of phyto-chemicals and development of functional foods.
- To study the usefulness and effects of nutrigenomics foods.

COURSE OUTCOMES

CO1: Understand the basics, importance and applications of nutraceuticals

CO2: To acquire the knowledge about Nutraceuticals of plant and animal origin

CO3: understand the Nutraceutical remedies for common disorders

CO4: understand the basics for functional foods

CO5: Gain the Knowledge about foodomics.

SEMESTER III	COURSECODE: 19SPBC31B					NUTRACEUTICAL AND FUNCTIONAL FOODS								CREDITS:2
COURSE OUTCOMES	PROGRAMME OUTCOMES(PO)					PROGRAMME SPECIFIC OUTCOMES(PSO)								MEAN SCORE OF CO'S
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
CO1	3	3	4	4	3	4	3	4	3	4	4	3	3	3.46
CO2	5	3	4	5	3	3	3	3	4	5	3	3	4	3.69
CO3	4	4	3	3	4	4	4	3	2	3	3	4	3	3.38
CO4	3	5	2	4	3	3	3	4	3	2	4	2	4	3.23
CO5	3	4	3	3	2	3	4	3	4	3	4	3	4	3.30
Mean Overall Score													3.41	

This Course is having **HIGH** association with Programme Outcome and Programme Specific Outcome

Association	1%-20%	21%-40%	41%-60%	61%-80%	81%-100%
Scale	1	2	3	4	5
Interval	0<=rating<=1	1.1<=rating<=2	2.1<=rating<=3	3.1<=rating<=4	4.1<=rating<=5
Rating	Very Poor	Poor	Moderate	High	Very High

UNIT I NUTRACEUTICALS OF PLANT & ANIMAL ORIGIN

Nutraceuticals - Sources of Nutraceuticals. phytonutraceuticals - Alkaloids, phenols, Terpenoids. Animal metabolites: chitin, chitosan, glucosamine- uses and applications.

UNIT II CLASSIFICATION OF NUTRACEUTICALS

Nutraceuticals -. Dietary Fiber, Probiotics , Prebiotics, Polyunsaturated fatty acids,. Antioxidant ,vitamin, Polyphenols and. Spices and their importance.

UNIT III NUTRACEUTICAL REMEDIES

Nutraceutical remedies for common disorders like Arthritis, Bronchitis, hyperglycemia, Nephrological disorders, Liver disorders, Osteoporosis, Psoriasis and Ulcers. Nutraceutical rich supplements : Caffeine, Green tea, Mushroom extract and Spirulina.

UNIT IV FUNCTIONAL FOODS

Functional foods - Definition, development of functional foods, Applications of herbs to functional foods. Concept of free radicals and antioxidants; Health effects of common beans, *Capsicum annum*, mustards, Ginseng, garlic, grape, citrus fruits, fish oils, and sea foods. Use of nanotechnology in functional food industry.

UNIT V HEALTH BENEFITS OF NUTRACEUTICALS

Nutraceuticals: Carotenoids-lycopene,lutein,saponins,tocotrienol. Polyphenolic compounds: Flavanones,flavones,curcumin,glucosinolates. Phytoestrogens: isoflavones,lignans. Dietary fibre-soluble,insolublefibre and sulphides. Prebiotics, probiotics and omega3 and 6 fatty acids.

TEXT BOOKS

- 1.Taylor C, Wallace rebert E.C, Wildman, Robert Wildman (2016).Hand book of NutraceuticalsAnd Functional Foods. 2nd edition, CRC press.
- 2.MandalikaSubhadra (2014), Functional Foods And Nutrition, Daya Publishing House.

REFERENCES :

1. Israel Goldberg (Ed.) (1999) Functional foods, designer foods, pharma foods, Nutraceuticals, Aspen publishers Inc., USA .
2. L. Rapport and B. Lockwood (2002) Nutraceuticals, 2nd Edition, Pharmaceutical Press.
3. M. Maffei (Ed.) (2003) Dietary Supplements of Plant Origin, Taylor & Francis
1. Shahidi and Weerasinghe (Ed.) (2004) Nutraceutical beverages Chemistry, Nutrition and health Effects, , American Chemical Society.
2. Young, J. (1996) Functional Foods: Strategies for successful product development.

YEAR-II	HUMAN PHYSIOLOGY (75 hrs) For the students admitted from the year 2019	19PBC41
SEMESTER-IV		HRS/WK-5
CORE-X		CREDIT-4

OBJECTIVES

To learn the structure and functions of the different organs present in the human body

COURSE OUTCOMES

CO1: To learn about the digestion and absorption of various macromolecules.

CO2: To learn and gain knowledge about the blood cells and cardiac system.

CO3: To understand the mechanism of respiration and its types.

CO4: To acquire the knowledge about the structure and functions of kidney, nephron and mechanism of urine formation.

CO5: To gain the knowledge about the structure, types and functions of muscles and nervous system.

SEMESTER IV	COURSE CODE:19PBC41					TITLE OF THE PAPER:MOLECULAR PHYSIOLOGY					HOURS :5	CREDITS:4		
COURSE OUTCOMES	PROGRAMME OUTCOMES(PO)					PROGRAMME SPECIFIC OUTCOMES(PSO)					MEAN SCORE OF CO'S			
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5			PSO6	PSO7
CO1	5	5	2	3	2	5	4	4	3	2	4	5	5	49/13=4
CO2	4	5	2	2	2	5	4	5	2	2	4	5	3	45/13=3
CO3	4	5	2	2	2	5	3	4	2	2	3	5	3	41/13=3
CO4	4	5	2	2	2	5	3	4	3	2	4	5	4	45/13=3
CO5	5	5	2	4	3	5	5	5	4	2	4	5	5	54/13=4
Mean Overall Score													3.4	

This Course is having **HIGH** association with Programmed Outcome and Programmed Specific Outcome

Association	1%-20%	21%-40%	41%-60%	61%-80%	81%-100%
Scale	1	2	3	4	5
Interval	0<=rating<=1	1.1<=rating<=2	2.1<=rating<=3	3.1<=rating<=4	4.1<=rating<=5
Rating	Very Poor	Poor	Moderate	High	Very High

UNIT I DIGESTIVE SYSTEM**[15 hrs]**

Digestion-Digestive system of man, Digestive processes at various regions of digestive system- Liver, stomach, pancreas, gallbladder & 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 hrs]**

Renal system- structure of kidney & nephron- glomerular filtration, tubular reabsorption of glucose, water and electrolytes and tubular secretion. Mechanism of formation of urine- homeostatic regulation of water and electrolytes, countercurrent mechanism. Regulation of acid-base balance. Role of renin-angiotensin & ADH, renal failure.

UNIT III RESPIRATORY PHYSIOLOGY**[15 hrs]**

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, Bohr's effect and chloride shift, oxygen toxicity & therapy, artificial respiration.

UNIT IV CARDIO PHYSIOLOGY**[15 hrs]**

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

UNIT V MUSCLE & NERVE PHYSIOLOGY [15 hrs]

.Nervous system-structure of neuron and synapse-basic functions of synapses & neurotransmitters. Mechanism of transmission of impulse -synaptic transmission, neuromuscular junction. Central nervous system-Cerebrospinal fluid. Basis of EEG, sleep, learning & memory. Muscles - types of muscle -skeletal and smooth muscle- Molecular basis of muscle contraction.

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. Saunders Company.
3. Jain, J.L & Jain, (2005) Human physiology. Sixth Edition, S.Chand&Company, New Delhi.
4. DM.Vasudevan, 2008. Textbook of Biochemistry for medical students, 5th edition, Jaypee publishers.

REFERENCES:

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.
6. K..Sembulingam, PremaSembulingam, (2012) " Essentials of medical physiology" sixth edition, Jaypee publishers.

YEAR-II	RESEARCH METHODOLOGY & BIostatISTICS (75 hrs) For the students admitted from the year 2019	19PBC42
SEMESTER-IV		HRS/WK-5
CORE XI		CREDIT-4

OBJECTIVES

- To provide knowledge and skills to understand the role of statistics in research.
- To develop skill in scientific writing and recent techniques.
- To provide sufficient background to interpret statistical results in research papers

COURSE OUTCOME:

CO1: To understand the basic concepts of scientific research, objectives of various research, research process, research design and sampling.

CO2: To gain appropriate knowledge about sample collection, hypothesis testing analysis, tabulation of statistical data apart from measures of central tendency and averages.

CO3: To acquire in depth knowledge about the statistical analysis and hypothesis testing.

CO4: To understand and gain insight knowledge about bioethics and patenting.

CO5: To gain knowledge about the principle and application of various biochemical techniques.

SEMESTER IV	SUB CODE: 19PBC42					RESEARCH METHODOLOGY & BIostatISTICS								HOURS:5 CREDITS:4
COURSE OUTCOMES	PROGRAMME OUTCOMES(PO)					PROGRAMME SPECIFIC OUTCOMES(PSO)								MEAN SCORE OF CO'S
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
CO1	4	5	3	4	4	3	4	3	4	4	4	3	4	3.8
CO2	3	4	4	3	5	4	5	4	3	5	3	4	3	3.8
CO3	4	4	3	4	3	4	4	2	3	4	4	4	3	3.6
CO4	3	3	2	3	4	3	3	3	4	4	3	3	4	3.2
CO5	4	4	3	4	4	4	4	3	4	5	4	2	3	3.7
Mean overall score														3.6

This Course is having **HIGH** association with Programme Outcome and Programme Specific Outcome

Association	1%-20%	21%-40%	41%-60%	61%-80%	81%-100%
Scale	1	2	3	4	5
Interval	0<=rating<=1	1.1<=rating<=2	2.1<=rating<=3	3.1<=rating<=4	4.1<=rating<=5
Rating	Very Poor	Poor	Moderate	High	Very High

UNIT I SCIENTIFIC RESEARCH [15 hrs]

Research definition, importance & need for research ethics, selection of topic, review of literature, preparation of manuscript, scientific writing, features of abstract, mode of collection of literature, yearbooks, books & monograph, journals, conference proceedings, abstracting and indexing journals, notes & index cards, internet, magazines. Research design. References- Vancouver and Harvard system.

UNIT II DATA COLLECTION AND PRESENTATION [15 hrs]

Collection and classification of data - diagrammatic and graphical representation of data. Tabulation of statistical data-Frequency Distribution-Simple and Cumulative. Displaying data-Histogram, Bar chart, Frequency polygon, Pie chart, less than & more than Ogives. Measures of Central tendency. Mean (arithmetic, harmonic & geometric) median and mode. Measure of Averages – Mean, Median and mode.

UNIT III STATISTICAL ANALYSIS [15 hrs]

Measures of Dispersion for biological characters – Quartile Deviation, Mean Deviation and Standard deviation. Correlation & regression Co-efficient, levels of significance, Student t test, Chi square test. F test for equality of variances, Six sigma and Minitab, ANOVA –one way and two way classification.

UNIT IV BIOETHICS AND PATENTING [15hrs]

Ethics in animal experimentation and overview about other bioethics .CPCSEA guidelines - Animal care, feed, bedding, water, sanitation and cleanliness, waste disposal, anesthesia and euthanasia. Ethics in food and drug safety. Patenting - definition of patent. Product and process patent. Procedure for patent drafting.

. UNIT V BIOCHEMICAL TECHNIQUES [15 hrs]

FPLC, HPTLC, Capillary electrophoresis, Mass spectrometry, Circular dichroism - DNA sequencing, FISH - RFLP & RAPD -techniques & application. PCR Technique- Basic principle, Real time PCR & *in Situ* PCR. Applications of PCR.

TEXT BOOKS:

1. Green. R. H. 1979. 'Sampling Design and Statistical Methods for Environmental Biologists' .John Wiley & Sons.
2. Dr.A.WilsonAruni,Dr.P.Ramadass "Research and writing: Across the disciplines", MJP Publishers
3. Gupta.S.C&Kapoor. V.K. 1978. "Fundamental of Applied Statistics" (2nded) ,MJP Publishers,
4. Ethics and the use of alternatives to animals in research and education, ShiraneePereira, CPCSEA.
5. CPCSEA guidelines for laboratory animal facility (CPCSEA) - No.13 Seaward road, Valmiki Nagar, Chennai-41.
6. Ethical guidelines for biomedical research on human subjects.2000. ICMR, New Delhi.
7. Wayne W, Daniel 2006, biostatistics: a foundation for analysis in the health sciences (9th edition), John Willey and Sons Inc., USA.
8. Upadhyay, Upadhyay and Nath,1997. Biophysical Chemistry- Principles and Techniques' Himalaya Publ.

REFERENCES:

1. Dr.G.Vijayalashmi, Dr.C.Sivapragasam "Research methods: Tips and Techniques",MJP Publishers
2. Matthews,2001.Sucessful Scientific writing: A step-by step guide for Biomedical Scientists'. 2nd ed. Cambridge University Press
3. Thomas Glover, Kevin Mitchell.,2001. Introduction to Biostatistics', 1st ed. McGraw Hill Science
4. Dr N .Gurumani, "An Introduction to Biostatistics",MJP Publishers
5. Dr N .Gurumani, "Thesis writing and paper presentation", MJP Publishers
6. Pavia et al.2000. Introduction to Spectroscopy', 3rd ed. Brooks/Cole Pub Co.

YEAR-II	PHARMACOLOGY (75 hrs) For the students admitted from the year 2019	19EPB43A
SEMESTER-IV		HRS/WK-5
ELECTIVE VII		CREDIT-4

OBJECTIVES:

To understand the various route of drug administration, distribution, metabolism and excretion.

Course Outcomes:

CO1: To acquire the knowledge about the study of drugs particularly their metabolism and actions on living system.

CO2: To gain through the knowledge about the different drug receptors and their actions.

CO3: To get insight knowledge about the adverse effects of drug actions.

CO4: To gain in depth insights about the mode of action of drugs used in different diseases.

CO5: To acquire the knowledge about the study of different chemotherapeutic value of drugs.

SEMESTER – IV	COURSE CODE: 19EPB43A					PHARMACOLOGY								HOURS:5 CREDITS:
COURSE OUTCOMES	PROGRAMME OUTCOMES (PO)					PROGRAMME SPECIFIC OUTCOMES (PSO)								MEAN SCORE OF CO'S
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
CO1	3	4	2	4	3	5	3	5	5	4	3	2	2	3.4
CO2	3	3	5	4	3	4	5	3	4	3	5	4	4	3.8
CO3	4	4	4	3	4	4	4	3	4	3	4	4	3	3.6
CO4	5	2	4	5	3	3	4	5	3	4	4	3	2	3.6
CO5	3	4	4	3	4	3	3	4	5	4	3	2	4	3.5
Mean Overall Score														3.5

This Course is having **HIGH** association with Programme Outcome and Programme Specific Outcome

Association	1%-20%	21%-40%	41%-60%	61%-80%	81%-100%
Scale	1	2	3	4	5
Interval	$0 \leq \text{rating} \leq 1$	$1.1 \leq \text{rating} \leq 2$	$2.1 \leq \text{rating} \leq 3$	$3.1 \leq \text{rating} \leq 4$	$4.1 \leq \text{rating} \leq 5$
Rating	Very Poor	Poor	Moderate	High	Very High

UNIT I INTRODUCTION

[15 hrs]

Drug: Definition. Classification of drugs based on their sources (plant, animal, & synthetic). Dosages-single and multiple. Routes of administration & absorption. Factors modifying drug absorption. Distribution of Drugs – structural features and pharmacological activity, prodrug concept. Metabolism and excretion of drugs-phase-I, II reaction, action of cytochrome P₄₅₀. Microsomal & non-microsomal metabolism of drugs, drug metabolising enzymes.

UNIT II DRUG –RECEPTOR INTERACTIONS

[15hrs]

Drug receptor- localization, types and sub types, models and theories. Examples of drug – receptor interactions-G-protein coupled receptor, Acetylcholine receptor, Tyrosine kinase receptor, steroid hormone receptor. Agonist and Antagonist.

UNIT III PHARMACOKINETICS

[15 hrs]

Drug tolerance and dependence. Principles of basic pharmacokinetics. Adverse response to drugs, drug intolerance, pharmacogenetics, drug allergy, tachyphylaxis, drug abuse, factors modifying drug potency. Drug assay & types - chemical, bio assay and immunoassay.

UNIT IV DRUG THERAPY-I

[15hrs]

Mechanism of action of drugs used in therapy of respiratory system (cough- eg- chlorpheniramine, Diphenhydramine, bronchial-asthma-eg., salbutamol, methylxanthines, pulmonary tuberculosis), -General principles & mechanism involved in the chemotherapy of cancer (antimetabolites, alkylating agents, antibiotics. Anti-thyroid drugs eg. Carbimazole and oral Antidiabetic drugs eg-sulfonylurea, biguanide. Anti-BP drugs (adrenergic blockers).

UNIT V DRUG THERAPY-II

[15 hrs]

Antimalarial drugs –mode of action of chloroquine, quinine, antifungal drugs – mode of action of chlorphenesin, griseofulvin and candicidin. Antiviral drugs - mode of action of idoxuridine, acyclovir and amantadine hydrochloride. Anti-microbial drugs- sulfonamides, trimethoprim, penicillin, aminoglycosides.

TEXT BOOKS:

1. G.R.Chatwal, "Pharmaceutical Chemistry -vol-1&II",Himalaya Publishing House ,New Delhi
2. JayasreeGhosh "Text book of Pharmaceutical Chemistry", S.Chand& Company, Ltd., New Delhi
3. MantTimothy,G.K.Ritter,Jemes,M and Lewis Lionel,D:A Text Book of Clinical Pharamacology.

REFERENCES:

1. Joseph R.Palma,JohnDiGregorio"Basic Pharmacology in Medicine",McGraw Hill Publishing Company,New York
2. Good man, Gilman "The Pharmacology, volume I and II".
3. Katzung ,"Basic and Clinical Pharmacology", 7th edition- ,Prentice hall ,New Delhi.
4. M.Atherden ,"Text book of Pharmaceutical Chemistry", 8th edition.
5. Herfuidal and Gourley, 1996. Textbook of Therapeutics (Williams and Wilkins)
6. Essentials of medical pharmacology K.D Tripathi, Jaypee publications 5th edition.

YEAR-II	RECOMBINANT DNA TECHNOLOGY (75 hrs) For the students admitted from the year 2019	19EPB43B
SEMESTER-IV		HRS/WK-5
ELECTIVE VIII		CREDIT-4

OBJECTIVES

To equip the students to learn and apply the recent advances in the various techniques and concepts in Recombinant DNA technology.

Course Outcomes:

CO1: To acquire knowledge about the mechanism of action and the use of restriction enzymes in biotechnology research and recombinant protein production

CO2: To gain knowledge about the various steps involved in gene transfer and various selection processes for identifying transformants.

CO3: To get insight about the strategies involved in the expression of cloned genes.

CO4: To understand the site-Directed Mutagenesis (SDM) ,Protein Engineering and its applications in transgenic plants

CO5: To gain skill and knowledge about the techniques in recombinant DNA technology

SEMESTER IV	COURSE CODE: EPBC1016					TITLE OF THE PAPER: RECOMBINANT DNA TECHNOLOGY								HOUR S:5	CRE DITS: 4
COURSE OUTCOMES	PROGRAMME OUTCOMES(PO)					PROGRAMME SPECIFIC OUTCOMES(PSO)								MEAN SCORE OF CO'S	
	PO1	PO2	PO3	PO4	PO5	PSO 1	PSO2	PSO3	PSO 4	PS O5	PS O6	PSO 7	PSO 8		
CO1	5	5	2	3	2	5	4	4	3	2	4	5	5	3.8	
CO2	4	5	2	2	2	5	4	5	2	2	4	5	3	3.4	
CO3	4	5	2	2	2	5	3	4	2	2	3	5	3	3.2	
CO4	4	5	2	2	2	5	3	4	3	2	4	5	4	3.4	
CO5	5	5	2	4	3	5	5	5	4	2	4	5	5	4.1	
Mean Overall Score													3.58		

This Course is having **HIGH** association with Programme Outcome and Programme Specific Outcome

Association	1%-20%	21%-40%	41%-60%	61%-80%	81%-100%
Scale	1	2	3	4	5
Interval	0<=rating<=1	1.1<=rating<=2	2.1<=rating<=3	3.1<=rating<=4	4.1<=rating<=5
Rating	Very Poor	Poor	Moderate	High	Very High

UNIT- ICLONING STRATEGIES

[15 hrs]

Restriction endonucleases - nomenclature and action. DNA ligases. Recombinant DNA (rDNA). Basic steps in cloning. Cloning in plasmid (pBR322, pUC18), phage (λ and M13) Cosmids vectors. BACs and YACs.

Methods of splicing of DNA molecules- cohesive end method, homopolymeric tailing, blunt-end ligation. Linkers and adaptors. Construction of genomic and cDNA libraries.

UNIT- II GENE TRANSFER AND RDNA SCREENING

[15 hrs]

Gene transfer methods: calcium phosphate coprecipitation, electroporation, lipofection, viruses, microinjection. Host organisms for cloning- bacteria, yeast and mammalian cells.

Screening of recombinants: marker inactivation (antibiotic resistance, blue-white selection), colony PCR, colony hybridization and immunological screening.

UNIT- III EXPRESSION OF CLONED GENES

[15 hrs]

Expression vectors. Heterologous gene expression. Factors affecting expression of cloned genes. Prokaryotic expression of cloned genes - strong and weak promoter, Fusion proteins- staphylococcus protein A, glutathione-S-transferase, maltose-binding protein, cellulose-binding protein, chitin binding domain, polyhistidine, fluorescent protein tag and its uses.

UNIT- IV

SITE-DIRECTED MUTAGENESIS (SDM) AND PROTEIN ENGINEERING [15hrs]

SDM methods- cassette, oligonucleotide-directed, PCR-based. Protein engineering by directed evolution and DNA shuffling. Applications- increasing enzymes action, stability and specificity. Outline of metabolic engineering.

UNIT -V TECHNIQUESIN RDNA TECHNOLOGY

[15hrs]

Preparation of probes. DNA sequencing- enzymatic and automated methods. next generation sequencing - Lynx Therapeutics' Massively Parallel Signature Sequencing (MPSS).DNA fingerprinting - principle and applications. Basic principles of gene knock-in and knock-out

technology. Precise genome editing - CRISPR/Cas 9 system..Techniques involved in protein-protein interactions:*In vivo* techniques- Yeast two hybrid, Split ubiquitin system,Co-immunoprecipitation FRET and Bi-Fluorescence system.Hazards and safety aspects of genetic engineering

TEXT BOOKS

1. Dale and von Schantz. From Genes to Genomes: Concepts and Applications of DNA Technology. Wiley-Interscience. 3rd ed. 2011.
2. Glick and Pasternak. Molecular Biotechnology. ASM Press. 4th ed. 2010.
3. U.Sathayanarayana, 2006. Biotechnology. 3rd Edition by Books and Allied (P) Ltd., India

REFERENCES

1. T.A .Brown: Gene cloning and DNA analysis-An introduction: Wiley-Blackwell. 6th ed. 2010
2. James D. Watson et al. Recombinant DNA: Genes and Genomes-A Short Course. W. H. Freeman. 3rd ed. 2006
3. Sandy Primrose, Richard Twyman and Bob Old. Principles of Gene Manipulation. Wiley-Blackwell. 6th ed. 2002

