

ALAGAPPA UNIVERSITY, KARAIKUDI
NEW SYLLABUS FOR AFFILIATED COLLEGES
UNDER CBCS PATTERN WITH EFFECT FROM 2022-23 ONWARDS
B.Sc. BIOCHEMISTRY
Programme Structure

Sem.	Part	Course Code	Courses	Title of the Paper	T/P	Credit	Hours/Week	Max. Marks		
								Int.	Ext.	Total
I	I	2211T	T/OL	Tamil /Other Languages -I	T	3	6	25	75	100
	II	712CE	E	Communicative English - I	T	3	6	25	75	100
	III	22BBC1C1	CC	Biomolecules and Cell Biology	T	5	5	25	75	100
		22BBC1P1	CC	Biochemical Analysis and Cell Biology	P	4	4	40	60	100
		-	AL-IA	Chemistry/Botany/ Microbiology/ Home Science	T	3	3	25	75	100
	-	AL-IA	Practical - Respective Allied Theory Course	P	2	2	40	60	100	
	IV	22BVE1	SEC -I	Value Education	T	2	2	25	75	100
		-		Library	-	-	2	-	-	-
				Total		22	30	205	495	700
II	I	2221T	T/OL	Tamil/Other Languages-II	T	3	6	25	75	100
	II	722CE	E	Communicative English - II	T	3	6	25	75	100
	III	22BBC2C1	CC	Analytical Biochemistry	T	5	5	25	75	100
		22BBC2P1	CC	Analytical Biochemistry	P	4	4	40	60	100
		-	AL-IB	Chemistry/Botany/ Microbiology/ Home Science	T	3	3	25	75	100
	-	AL-IB	Practical - Respective Allied Theory Course	P	2	2	40	60	100	
	IV	22BES2	SEC -II	Environmental Studies	T	2	2	25	75	100
			Naan Mudhalvan Course	Language Proficiency for Employability(Effective English)	-	2	2	25	75	100
				Total		24	30	230	570	800
III	I	2231T	T/OL	Tamil/Other Languages-II	T	3	6	25	75	100
	II	2232E	E	English for Enrichment –I	T	3	6	25	75	100
	III	22BBC3C1	CC	Intermediary Metabolism and Clinical Biochemistry	T	3	3	25	75	100
		22BBC3C2	CC	Enzymology	T	3	3	25	75	100
		22BBC3P1	CC	Intermediary Metabolism, Clinical Biochemistry and Enzymology	P	3	3	40	60	100
	-	AL-IIA	Chemistry/Botany/ Microbiology/ Home Science	T	3	3	25	75	100	
	-	AL-IIA	Practical - Respective Allied Theory Course	P	2	2	40	60	100	
	IV	22BE3	SEC –III	Entrepreneurship	T	2	2	25	75	100
-		NME-I	Adipadai Tamil/ Advance Tamil/ IT Skills for Employment/ MOOC'S	T	2	2	25	75	100	
				Total		24	30	255	645	900
	I	2241T	T/OL	Tamil /Other Languages -IV	T	3	6	25	75	100
	II	2242E	E	English for Enrichment– II	T	3	3	25	75	100
		22BBC4C1	CC	Molecular Biology	T	4	4	25	75	100
		22BBC4C2	CC	Biotechnology	T	4	4	25	75	100

IV	III	22BBC4P1	CC	Molecular Biology and Biotechnology	P	3	3	40	60	100	
		-	AL-IIB	Chemistry/Botany/ Microbiology/ Home Science	T	3	3	25	75	100	
		-	AL-IIB	Practical - Respective Allied Theory Course	P	2	2	40	60	100	
	IV	-	NME-II	Adipadai Tamil/ Advance Tamil/ Small Business Management / MOOC'S	T	2	2	25	75	100	
		Naan Mudhalvan Course		Digital Skills for Employability – (Microsoft-Office Fundamentals)	T	2	3	25	75	100	
				Total		26	30	230	570	800	
V	III	22BBC5C1	CC	Human Genetics	T	4	4	25	75	100	
		22BBC5C2	CC	Microbiology	T	4	4	25	75	100	
		22BBC5C3	CC	Immunology	T	4	4	25	75	100	
		22BBC5C4	CC	Plant Biochemistry	T	4	4	25	75	100	
		22BBC5P1	CC	Basic Clinical Microbiology and Genetics	P	4	6	40	60	100	
		22BBC5P2	CC	Immunology and Plant Biochemistry	P	4	6	40	60	100	
		-		Career development/ employability skills	-	-	2	-	-	-	
				Total		24	30	180	420	600	
VI	III	22BBC6I	DSE	Internship		24	26	150	250	400	
	IV	Naan Mudhalvan Course		Employability Readiness* (Naandi/Unnati/Quest/IBM Skills build)	-	2	4	25	75	100	
					Total		26	30	175	325	500
	(Or)										
	III	22BBC6E1	DSE	Nutritional Biochemistry		T	6	6	25	75	100
				Human Physiology		T	6	6	25	75	100
				Diagnostic Biochemistry		T	6	6	25	75	100
				Biostatistics and Bioinformatics		T	6	6	25	75	100
	IV	-	-	Library / Yoga etc		-	-	2	-	-	-
		Naan Mudhalvan Scheme		Employability Readiness* (Naandi/Unnati/Quest/IBM Skills build)		-	2	4	25	75	100
						Total		26	30	125	375
(Or)											
III	22BBC6PR	DSE	Project			6	8	25	75	100	
			Nutritional Biochemistry		T	6	6	25	75	100	
			Human Physiology		T	6	6	25	75	100	
			Diagnostic Biochemistry		T	6	6	25	75	100	
IV	Naan Mudhalvan Course		Employability Readiness* (Naandi/Unnati/Quest/IBM Skills build)		-	2	4	25	75	100	
				Total		26	30	125	375	500	
				Grand Total		146	--	--	-	4300	

*Employability Readiness -Women's Colleges Naandi course and for all other Colleges IBM Skills build Course.

Sem.	Part	Course Code	Title of the Paper	Credit	Hours/Week	Marks		
						Int.	Ext.	Total
I	III	71BEPL	Professional English for Life Science -I	4	5	25	75	100
II		72BEPL	Professional English for Life -II	4	5	25	75	100
III		*	Professional English for Life Science -III	4	5	25	75	100
IV			Professional English for Life Science -IV	4	5	25	75	100

*The Syllabus of Professional English for III & IV Semester will be provided after Receiving the syllabus from TANSCHÉ.

As per TANSCHÉ, the Professional English book will be taught to all four streams apart from the existing hours of teaching/additional hours of teaching (1hour/day) as a 4 credit paper as an add on course on par with Major paper and completion of the paper is a must to continue his/her studies further.

- TOL-Tamil/Other Languages,
- E –English
- CC-Core course –Core competency, critical thinking, analytical reasoning, research skill & teamwork
- Allied -Exposure beyond the discipline
- AECC- -Ability Enhancement Compulsory Course (Professional English & Environmental Studies) - Additional academic knowledge, psychology and problem solving etc.,
- SEC-Skill Enhancement Course - Exposure beyond the discipline (Value Education , Entrepreneurship Course, Computer application for Science, etc.,
- NME -Non Major Elective – Exposure beyond the discipline
- DSE – Discipline specific elective – -Student choice – either or
 - Internship
 - If internship – Marks = Internal =150 (75+75) two midterm evaluation through Viva voce and External 250 marks (Report =150 +Viva Voce=100) =Total 400marks
 - Theory papers or
 - Project + 3 theory papers.
- MOOCs – Massive Open Online Courses
- T-Theory, P- Practical

Semester-I						
Course code: 22BBC1C1	Core Course-I			T/P	C	H/W
	Biomolecules and Cell Biology			T	5	5
Objectives	<ul style="list-style-type: none"> ➤ To elaborate the Molecular makeup behind the biological functioning of cell ➤ To understand about the role of biomolecules in the biological existence. ➤ To gain the knowledge about the structure, organization, of biological basic unit ➤ To study about the structural composition of cell. 					
Unit-I	<p>Carbohydrates:-Monosaccharides: Definition, Classification, Structure of Open – Chain, Haworth and Fischer formula, Stereoisomerism, Optical isomerism, Reactions of functional groups of sugars: Aldehyde, Keto and Hydroxyl groups. Di, Tri, and Oligosaccharides: Occurrence, Composition, Structure and Biological role of Sucrose, Lactose, Maltose, Raffinose. Polysaccharides: Occurrence, Composition, Structure and Biological role of Cellulose, Chitin, Inulin, Starch, Glycogen.</p>					
Unit-II	<p>Proteins:- Chemistry of monomeric units of proteins: Classification of Amino acids based on its side chains, Structure of Amino acids, Zwitterion, pKa and Optical properties of aminoacids. Essential aminoacids. Isoelectric pH , acid base properties of amino acids. Formation of peptide bond Structure: Hierarchical structure of proteins: Primary structure – peptide bond and its characteristics, Secondary structure – alpha-helix and Beta-pleated sheets, Tertiary structure: Myoglobin , Quaternary structure – Hemoglobin</p>					
Unit-III	<p>Lipids:-Lipids: Definition and classification. Fatty acids: introduction, classification, nomenclature, structure and properties of saturated and unsaturated fatty acids. Essential fatty acids. Triacylglycerols: nomenclature, physical properties, chemical properties and characterization of fats - hydrolysis, saponification value, acid value, rancidity of fats, Reichert-Meissel number. Glycerolipids, glycerophospholipids, sphingolipids, sterol lipids. Nucleic acids and vitamins:-Nucleic acids: Bases, nucleosides and nucleotides, polynucleotide. phosphodiester linkage Vitamins: Source, Structure, deficiency diseases and biochemical functions of water soluble and fat soluble vitamins and their coenzyme activity.</p>					
Unit-IV	<p>Structure and molecules of Cells: Characteristic features of prokaryote and eukaryotes, Structure of eukaryotic cells, Structure of Plasma membrane - phospholipid bilayer and Fluid mosaic model; Functions of plasma membrane- transport of small molecules - passive diffusion, facilitated diffusion and carrier proteins. Ion channels; Active transport driven by ATP and Ion gradients. Membrane lipids and membrane proteins; Composition of the Cell- Carbohydrate, Lipid, Nucleic acids and Proteins. Cytoplasmic matrix and chemical composition of cytosol.</p>					
Unit-V	<p>Structure and functions of cell organelles: Morphology; ultrastructure and functions of Endoplasmic Reticulum (ER), Golgi apparatus, Cytoskeleton, Vesicle, Ribosome, Lysosome, Microbodies, Peroxisomes and Glyoxysomes, centrioles, Cilia, flagella, Mitochondria, Nucleus and nucleolus. Cell cycle and mitosis - general events of interphase, prophase, metaphase, anaphase, telophase, Meiosis- kinds of meiosis, process of meiosis, heterotypic division or first meiotic division, homotypic or second meiotic division significance of mitosis; meiosis.</p>					
Reference and Textbooks:-						
Text Books:						
Alberts, B., Johnson, A., Lewis, J., Morgan, D., Raff, M., Roberts, K., & Walter, P. (2014). <i>Molecular Biology of the Cell</i> (6 th ed.). W. W. Norton & Company.						
Fatima, D., Narayanan, L.M., Arumugam, N., Meyyan, R.P., Prasanna kumar, S., Nallasingam, K.(2019). <i>Biochemistry</i> (7 th ed.). Saras publication.						
Freifelder, D.(2004). <i>Molecular Biology</i> (4 th ed.). Narosa Publishing House						

Rastogi, S.C. (2007). *Cell Biology* (3rd ed.) New Age International Publishers.

Sathyanarayana, U. (2007). *Biochemistry* (2nd ed.) Allied Books Publishers.

Books for Reference:

Berg, J.M., Tymoczko, J.L., Gatto, Jr. G.J., Stryer, L., *Biochemistry*. (9th ed.). W.H. Freeman, New York

Eliot W.H. (2007) *Biochemistry and Molecular Biology* (3rd ed.). Oxford University Press.

Kennelly, P., Botham, K., McGuinness, O., Rodwell, V., Anthony Weil, P. (2022). *Harper's Illustrated Biochemistry*. (32nd ed.). McGraw Hill / Medical.

Lodish, H., Berk, A., Zipursky, L., Matsudaira, P., Baltimore, D., Darnell, J. (2007). *Molecular cell biology*. W.H. Freeman, New York.

Nelson D.L., Cox, M.M. (2021). *Lehninger Principles of Biochemistry* (8th ed.). Macmillan Learning

Voet, D., & Voet, J. G. (2010). *Biochemistry* (4th ed.). Wiley.

Zubay, G. (1998). *Biochemistry*. (4th ed.). Wm.C. Brown Publishers.

Outcomes

- Students will gain knowledge in the structure and role of biomolecules
- Students will study about the chemistry behind the growth and development of living organism
- Understand the basic concepts and differences in prokaryotic and eukaryotic cells
- Gain knowledge about cell – division

Semester- I				
Course code:	Core Practical I	T/P	C	H/W
22BBC1P1	Biochemical Analysis and Cell Biology	P	4	4
Objectives	<ul style="list-style-type: none"> ➤ To understand the importance of cellular metabolism ➤ To get trained in observation of cells at different stages of division and isolation of cellular organelles 			
<u>Biomolecules</u>				
<ol style="list-style-type: none"> 1. Qualitative Analysis of Biomolecules <ol style="list-style-type: none"> i. Qualitative Analysis of Carbohydrates <ul style="list-style-type: none"> • Monosaccharide's :- Pentose, Glucose, Fructose, Mannose • Disaccharides :- Sucrose, Maltose, Lactose • Polysaccharides :- Starch, Dextrin and Glycogen ii. Qualitative Analysis of Lipids iii. Qualitative Analysis of Amino acids and Proteins <ul style="list-style-type: none"> • Aliphatic :- Histidine, Arginine, & Proline • Aromatic:- Tyrosine, Tryptophan, Phenylalanine • Sulphur containing aminoacids:- cystein, cysteine & methionine 2. Biochemical Preparation <ol style="list-style-type: none"> i. Starch from Potato ii. Casein from Milk 				
<u>Cell Biology</u>				
<ol style="list-style-type: none"> 3. Analysing different stages of cell division in roots of Onion. <ol style="list-style-type: none"> a. Stages of Mitosis b. Stages of Meiosis 4. Isolation of cell organelles – separation of chloroplast from leaves. 5. Subcellular fractionation of animal tissue 6. Staining of Mitochondria in buccal epithelial cells 7. Staining of nucleic acid using onion bulb 8. Observation of lampbrush chromosomes 				
<u>References</u>				
Text books:				
Chaitanya, K.V. (2013). <i>Cell and molecular biology-A lab manual</i> , PHI publishers.				
Gupta, A., Sati, B.K. (2019). <i>Practical laboratory manual- cell biology</i> . Lamber academic Publishing				
Jayaraman, J. (2011). <i>Laboratory manual in biochemistry</i> . New Age International Private Limited.				
Sadasivam, S., Manikam, A. (2018). <i>Biochemical Method</i> (3 rd ed.). New Age International Publisher				
Reference books:				
Majumdar, R., Sisodia, R. (2018). <i>Laboratory Manual of Cell Biology</i> . RUPA publications				
Pattabiraman, T.N. (2015). <i>Laboratory manual in biochemistry</i> (4 th ed.). All India Publishers & Distributors				
Plummer, D.T. (2017). <i>An introduction to practical biochemistry</i> (3 rd ed.). Mc GRAW-Hill Publishing company Ltd.				
Renu, G. Seema, M. (2018). <i>Cell Biology: Practical Manual Paperback</i> . Prestige Publishers				
Taylor, R.G.W. (2005). <i>Practical Cytology</i> , Academic Press, London.				
Outcomes	<ul style="list-style-type: none"> ➤ The students will be able to stain and visualize the organelles of cells ➤ Gain practical experience in analyzing the concentrations of cellular components ➤ Understand the various reactions of Biomolecules. 			

Semester-II				
Course code: 22BBC2C1	Core Course-II	T/P	C	H/W
	Analytical Biochemistry	T	5	5
Objectives	➤ To gain theoretical knowledge in the working principles behind analytical techniques.			
Unit-I	Centrifugation: Basic principles: Sedimentation principle, relative centrifugal force, revolutions per minute, RCF Vs RPM, G-force; types of rotors; Preparative and analytical centrifuges; — Density gradient centrifugation; Application of analytical ultra centrifuge; Swedbergvalue; safety aspects in the ultra centrifuge.			
Unit-II	Chromatography: General principles – column, paper and thin layer chromatography – Adsorption – Affinity – Ion exchange – Exclusion – Gas – Liquid Chromatography and HPLC. Application and selection of chromatography method for biology.			
Unit-III	Electrophoresis and Buffers: Theory of electrophoresis, types of electrophoresis: moving boundary and zone electrophoresis, paper electrophoresis, cellulose acetate strip and polyacrylamide gel electrophoresis. SDS-PAGE- vertical and horizontal electrophoresis and their applications. Agarose gel electrophoresis and its applications. Isoelectric focusing-theory and applications. Acid and bases-Lewis concept of acid and bases, titrable acidity, pH, pOH, buffer, pH of body fluids, buffer in body fluids. Measurement of pH by indicator and glass electrode.			
Unit-IV	Colorimetry and spectrophotometry: Beer-Lambert law and its limitations, Light absorption and transmission, Extinction coefficient. UV and visible absorption spectroscopy, Fourier Transform Infra red spectroscopy, Atomic absorption spectrophotometer. Biochemical applications of spectrophotometers. Principle and Application of fluorimetry.			
Unit-V	Nuclear chemistry: Radio isotopes, units of radio activity, half life, β and γ - emitters. Detection and measurement of radioactivity - Methods based upon ionization– GM counter, excitation– Scintillation counter. Autoradiography–Application of radio isotopes in the elucidation of metabolic pathways, clinical scanning and radio dating, radio immuno assay. Biological hazards of radiation and safety measures in handling radio isotopes.			
ReferenceandTextbooks:-				
Text Books:				
Asokan, P. (2006). <i>Basics of Analytical Biochemical Techniques</i> , Chinna Publications.				
Upathayay, A. (2020). <i>Biophysical chemistry – Principles and Techniques</i> (3 rd ed.). Himalaya Publishers.				
Books for Reference:				
Katoch R. (2011). <i>Analytical Techniques in Biochemistry and Molecular Biology</i> . Springer				
Lottspeich, F., Angels, J.W. (2018). <i>Bioanalytics Analytical Methods and Concepts in Biochemistry and Molecular Biology</i> . Wiley				
Robinson, J.W., Skelly Frame, E.M., Frame II, G.M. (2004). <i>Undergraduate Instrumental Analysis</i> . CRC Press.				
Vijayalakshmi, M.A. (2002). <i>Biochromatography Theory and Practice</i> . CRC Press				
Wilson K., Walker, J. (2000). <i>Practical Biochemistry</i> (5 th ed.) Cambridge University Press.				
Wilson K., Walker, J. (2010). <i>Principles and techniques of practical Biochemistry</i> (5 th ed.). University Press, Cambridge				
Wilson, K., Goudling, K.H. (1992). <i>A biologist's Guide to Priniciples and Techniques of Practical Biochemistry</i> . Cambridge University Press.				
Outcomes	➤ Creating a strong analytical background on techniques involving biomolecular identification and separation.			

Semester-II				
Course code: 22BBC2P1	Core Practical II	T/P	C	H/W
	Analytical Biochemistry	P	4	4
Objectives	➤ To analyze the biochemical components from the biological samples			
	<ol style="list-style-type: none"> 1. Preparation of Buffers- Phosphate, Acetate and Citrate 2. Determination of pH of Buffer Solution using Indicators and pH meter 3. Titration curve of Amino acids 4. Collection of blood and separation of serum by a centrifuge 5. Isolation of glycogen from goat liver 6. Separation of Amino Acids by Circular Chromatography 7. Separation of aminoacids by TLC method 8. Separation of serum protein by SDS PAGE 9. Verification of Beer – Lambert’s Law 10. Determination of absorption maxima of any three dyes by Spectrophotometer 11. Quantitative analysis of glucose by Anthrone method. 12. Quantitative analysis of aminoacids by Ninhydrin method. 13. Estimation of proteins from serum by Lowry Method 14. Determination of albumin and A/G ratio on Serum 15. Estimation of the following constituents in Blood and Serum <ol style="list-style-type: none"> a) Blood Urea b) Blood Sugar c) Blood Cholesterol d) Serum Creatinine e) Serum Inorganic Phosphorus 			
Text Books and Reference Books				
Text Books				
Damodaran, G.K. (2016). <i>Practical Biochemistry</i> . Jaypee Brothers Medical Publishers Pvt. Limited				
Jayaraman, J. (1981). <i>Laboratory Manual in Biochemistry</i> . New Delhi: New Age International (Pvt.) Ltd. Publishers				
Reference Books				
Bhowmik, G., Bose, S. (2011). <i>Analytical Techniques in Biotechnology</i> . Tata McGRaw-Hill education.				
Jain, A., Jain, R., Jain S. (2020). <i>Basic Techniques in Biochemistry, Microbiology and Molecular Biology Principles and Techniques</i> . Springer				
Rajan, S., Christy, R.S. (2018). <i>Experimental Procedures in Life Sciences</i> . CBS Publishers & Distributors Pvt Ltd.				
Sengar, R.S. (2014). <i>Laboratory Manual of Biochemistry Methods and Techniques</i> . New India Publishing Agency				
Outcomes	➤ To gain hands on experience in preparation of biological buffers ➤ To gain knowledge in handling biological samples			

Semester-III				
Course code:	Core Course-III	T/P	C	H/W
22BBC3C1	Intermediary Metabolism & Clinical Biochemistry	T	3	3
Objectives	<ul style="list-style-type: none"> ➤ To gain knowledge in basic biological pathways involving in inter-convention of nutritive materials to cellular metabolites ➤ To gain fundamental knowledge of clinical biochemistry related to health 			
Unit-I	Carbohydrate metabolism & Disorders : Glycolysis – aerobic and anaerobic, energetic of glycolysis and regulation; TCA cycle – amphibolic nature, energetics of TCA cycle; Glyoxalate cycle; Pentose phosphate pathway and its regulation; Glycogenesis; Glycogenolysis; Gluconeogenesis and cori cycle (in liver). Hypo and Hyperglycemia – Diabetes mellitus and Diabetes insipidus, Renal threshold, Glycosuria, Glucose tolerance test, Glycogen storage disease- types and characteristics			
Unit-II	Bioenergetics: Introduction to bioenergetics. High energy compounds (ATP, phosphocreatinine, phosphoenol pyruvate, glucose-6-phosphate). Exergonic and endergonic reactions. Role of ATP/ADP cycle in transfer of high-energy phosphate. Substrate-level phosphorylation Mitochondrion: Structure of mitochondrial membranes, Mitochondrial enzymes. Electron transport chain and oxidative phosphorylation – Theories of ATPase-Uncouplers of oxidative phosphorylation.			
Unit -III	Amino acid metabolism & Disorders: Biosynthesis and degradation of amino acid: Glucogenic and ketogenic amino acids -Deamination, Transamination. Metabolism of glucogenic (glycine, cysteine, proline), ketogenic (leucine, lysine) and both glucogenic and ketogenic amino acids (phenylalanine), Reactions of Urea cycle and its regulation; In-born errors of amino acid metabolism (Maple syrup urine disease, Phenylketonuria, homocystinuria, Tyrosinemia).			
Unit- IV	Lipid metabolism & Disorders: Biosynthesis of fatty acid, Triglycerides, phospholipids, sphingolipids, steroids; Oxidation of fatty acids: Even number carbon atoms, α , β and ω – oxidations, energetic of β -oxidation, Metabolism of ketone bodies, glycerol, chylomicrons, cholesterol, Disorders of lipid metabolism. (Steatorrhea, Gaucher's disease, Tay-sachs disease, Niemann-pick disease, Fabry's disease)			
Unit- V	Nucleic acid metabolism & Disorders: Biosynthesis and degradation of purine and pyrimidines – Denovo pathway and Salvage pathway, Regulation of nucleotide biosynthesis, biosynthesis of ribonucleotides, deoxyribonucleotides and polynucleotides, inhibitors of nucleic acid biosynthesis, disorders of nucleic acid metabolism (Gout, Lesch-Nyhan syndrome, Oroticaciduria, xanthinuria)			
Reference and Textbooks:-				
Text Books:				
Asokan, P. (2005) <i>Enzymes</i> . (2 nd ed.). Chinna publications.				
Bhagvan, N.V. (2001). <i>Medical Biochemistry</i> . (4 th ed.). Academic Press				
Chatterjee, M.D., Rana, S., Venkatesh, T., Kampli, V.B., Sita Devi, C. (2011). <i>Text book of medical biochemistry</i> , (8 th ed.). Jaypee Brothers medical publication.				
Gupta, S.K. (2019). <i>Text book of medical biochemistry</i> . (2 nd ed.). Avichal Publishing company.				
Kennelly, P., Botham, K., McGuinness, O., Rodwell, V., Anthony Weil, P. (2022). <i>Harper Illustrated Biochemistry</i> . (32 nd ed.). McGraw Hill / Medical.				
Palmer, T. (1997). <i>Understanding enzymes</i> . (4 th ed.). Prentice Hall.				
Satyanarayana, U., Chakrapani, U. (2021). <i>Biochemistry</i> (6 th ed.). Elsevier Publications.				
Books for Reference:				
Berg, J.M., Tymoczko, J.L., Gatto, Jr. G.J., Stryer, L., <i>Biochemistry</i> . (9 th ed.) W. H. Freeman and company, New York.				
Burtis C.A., Bruns, D.E. (2014). <i>Tietz Fundamentals of Clinical Chemistry and Molecular</i>				

Diagnostics (7th ed.). W.B. Saunders Publishers.

Devlin T.M. (2010). *Text book of biochemistry with clinical correlations* (7th ed.). Wiley-Liss.

Gaw, A. (2013). *Clinical biochemistry: An illustrated colour text*. (5th ed.). Churchill Livingstone/Elsevier.

Mukherjee, K.L. (2000). *Medical laboratory technique* (2nd ed.). Tata McGraw-Hill education.

Nelson D.L., Cox, M.M. (2021). *Lehninger Principles of Biochemistry* (8th ed.). Macmillan Learning

Ramadevi, K. (2016). *Ambika Shanmugam's Fundamentals of Biochemistry for Medical Students*. (8th ed.). Wolters Kluwer India Pvt. Ltd.

Varley, H. (2005). *Practical Clinical Biochemistry* (4th ed.). CBS Publishers.

Voet, D., Voet, J.G., Pratt, C.W. (2016). *Fundamentals of Biochemistry: Life at the molecular level* (5th ed.) Wiley.

Zubay G.L. (1998) *Biochemistry* (4th ed.) Wm.C Brown Publishers.

Outcomes	<ul style="list-style-type: none">➤ To provide insight on the biochemical and regulatory process in metabolism and its bioenergetics which will help the students to understand the metabolic disorders➤ Apply the key concepts of metabolic disorders when handling various clinical experiments.
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Semester-III				
Course code: 22BBC3C2	Core Course-IV	T/P	C	H/W
	Enzymology	T	3	3
Objectives	<ul style="list-style-type: none"> ➤ To understand the theories of enzyme kinetics ➤ To know about the various applications of enzymes in different fields 			
Unit-I	Introduction: History, general characteristics, nomenclature, IUB enzyme classification with examples, significance of numbering system. Definitions with examples of holoenzymes, oligomeric enzymes and multi enzyme complexes. Enzyme specificity.			
Unit-II	Enzyme catalysis: Role of co-factors in enzyme catalysis: NAD/NADP ⁺ , FMN/FAD, CoA, biotin, lipoamide, TPP, pyridoxal phosphate, THF and metal ions with special emphasis on co-enzyme functions. Acid-base catalysis, covalent catalysis, proximity and orientation effects, strain and distortion theory. Mechanism of actions of chymotrypsin, carboxypeptidase, Ribonuclease and lysozyme.			
Unit- III	Enzyme kinetics: Enzyme kinetics – MM equation, LB plot, Eadie and Hofstee plot, Factors affecting enzyme activity, Enzyme catalysis – covalent catalysis, acid base catalysis. Bisubstrate reactions. Enzyme inhibition. Allosteric regulation.			
Unit -IV	Enzyme purification: Importance of Enzyme purification. Strategies for purification-yield, catalytic activity and purity. Homogenization in enzyme purification; Techniques for separation- size based methods (centrifugation, size exclusion chromatography, dialysis, ultrafiltration), polarity based method (Ion-exchange chromatography), solubility based precipitation methods (change in pH, ionic strength, dielectric constant), ligand based method (ligand affinity chromatography)			
Unit- V	Industrial and clinical application of enzymes: Immobilization of enzymes and their industrial applications. Production of glucose from starch, cellulose and dextrin; use of lactase in dairy industry; production of glucose – fructose syrup from sucrose; use of proteases in food, detergent, leather and textile industry; medical application of enzymes; use of glucose oxidase in enzyme electrodes.			
Reference and Textbooks:-				
Text Books:				
Asokan, P. (2005). <i>Enzymes</i> . (2 nd ed.). Chinna publications.				
Dixon, M., Webb, E.C. (1982). <i>Enzymes</i> (2 nd ed.). Academic Press Inc., New York.				
Palmer, T. (1997). <i>Understanding enzymes</i> . (4 th ed.). Prentice Hall.				
Pandey, A., Webb, C., Socco, C.R., Larroche, C. (2008). <i>Enzyme technology</i> (2 nd ed.). Springer.				
Satyanarayana, U. (2014). <i>Enzymes</i> (4 th ed.). Elsevier health sciences.				
Books for Reference:				
Berg, J.M., Tymoczko, J.L., Gatto, Jr. G.J., Stryer, L., <i>Biochemistry</i> . (9 th ed.). WH Freeman. New York.				
Copeland, R.A. (2007). <i>Enzymes</i> (2 nd ed.). <i>A Practical introduction to structure, mechanism and data analysis</i> . Wiley.				
Palmer, T., Bonner, T.L. (2007). <i>Enzymes, Biochemistry, Biotechnology and clinical chemistry</i> . Elsevier health sciences.				
Price, N.C., Stevens, L. (2000). <i>Fundamentals of Enzymology: The cell and molecular biology of catalytic proteins</i> (3 rd ed.). Oxford University Press, 2000.				
Zubay G.L. (1998) <i>Biochemistry</i> (4 th ed.). Wm.C Brown Publishers.				
Outcomes	<ul style="list-style-type: none"> ➤ Understand the principle behind the role of enzymes in metabolic pathways. ➤ Understand the basic concepts and the mechanism of enzyme kinetics 			

Semester- III				
Course code:	Core Practical III	T/P	C	H/W
22BBC3P1	Intermediary Metabolism, Clinical Biochemistry and Enzymology	P	3	3
Objectives	<ul style="list-style-type: none"> ➤ To understand the importance of cellular metabolism ➤ To gain knowledge about handling clinical samples and to analyze various biochemical parameters. 			
<u>Intermediary metabolism</u>				
<ol style="list-style-type: none"> 1. Urine Quantitative Analysis / Normal / Abnormal Constituents <ol style="list-style-type: none"> a) Estimation of Urea in Urine b) Estimation of Creatinine in Urine c) Estimation of Chloride in Urine d) Determination of titrable acidity in Urine 				
<u>Clinical biochemistry</u>				
<ol style="list-style-type: none"> 2. Collection of clinical samples – Blood, Urine, Stool, Sputum, Pus, Throat swabs & Skin scrapings, transport & processing. 3. Detection of Albumin, sugars, ketone bodies and creatinine level in urine samples 4. Estimation of serum total cholesterol, albumin, bilirubin ,urea and creatinine level 				
<u>Enzymology</u>				
<ol style="list-style-type: none"> 5. Assay on the effect of pH on enzyme activity. 6. Assay on the effect of temperature on enzyme activity. 7. Assessing the activity of salivary amylase. 8. Estimation of specific activity of amylase. 9. Assessment of urease activity 10. Assessment of serum alkaline phosphatase activity. 11. Assessment of serum acid phosphatase activity. 12. Assessment of serum aspartate transaminase activity. 13. Assessment of serum alanine transaminase activity. 				
Reference and Text Books				
Clinical Biochemistry :				
Chatterjee, M.D., Rana, S., Venkatesh, T., Kambli, V.B., Sita Devi, C. (2011). <i>Text book of medical biochemistry</i> ,(8 th ed.). Jaypee Brothers medical publication.				
Mukherjee, K.L. (2000). <i>Medical laboratory technique</i> (2 nd ed.). Tata McGraw-Hill education.				
Satyanarayana, U., Chakrapani, U. (2021). <i>Biochemistry</i> (6 th ed.). Elsevier Publications				
Intermediary metabolism :				
Berg, J.M., Tymoczko, J.L., Gatto,Jr. G.J., Stryer, L., <i>Biochemistry</i> . (9 th ed.)W. H. Freeman and company, NewYork.				
Burtis C.A., Brun, D.E. (2014). <i>Tietz Fundamentals of Clinical Chemistry and Molecular Diagnostics</i> (7 th ed.). W.B. Saunders Publishers				
Devlin T.M. (2010). <i>Text book of biochemistry with clinical correlations</i> (7 th ed.). Wiley-Liss.				
Jayaraman, J. (2011). <i>Laboratory manual in biochemistry</i> . New Age International Private Limited.				
Nelson, D.L., Cox, M.M. (2021). <i>Lehninger Principles of Biochemistry</i> (8 th ed.). Macmillan Learning				

Plummer, D.T. (2017). *An introduction to practical biochemistry* (3rd ed.). Mc GRAW-Hill Publishing company Ltd.

Varley, H. (2005). *Practical Clinical Biochemistry* (4th ed.). CBS Publishers.

Voet, D., Voet, J.G., Pratt, C.W. (2016). *Fundamentals of Biochemistry: Life at the molecular level*(5th ed.) Wiley.

Zubay G.L. (1998) *Biochemistry* (4th ed.) Wm.C Brown Publishers.

Enzymology :

Asokan, P. (2005). *Enzymes*. (2nd ed.). Chinna publications.

Gray, N., Calvin, M., Bhatia, S.C. (2012). *Enzymes Biotechnology*, CBS Publishers.

Nicholas, C.P., Stevans, L. (Eds.) (2009). *Fundamentals of Enzymology*. Oxford University Press, Indian edition

Palmer, T. (1997). *Understanding enzymes*. (4th ed.). Prentice Hall.

Outcomes

- Demonstrate various methods to assess the parameters in clinical samples and to understand the basics of metabolism.
- Provides basic knowledge and expertise to the students to work in biochemical and diagnostic laboratories
- Understand the principle behind the mechanism of enzymes on human system

Semester- IV				
Course code:	Core Course-V	T/P	C	H/W
22BBC4C1	Molecular Biology	T	4	4
Objectives	<ul style="list-style-type: none"> ➤ To gain knowledge about the evolution of genetic material through various experiments ➤ To know about the regulation of genes in prokaryotes and eukaryotes. 			
Unit-I	Basics of molecular biology: Nucleic acids structure: DNA as genetic material, Watson-Crick model, A, B and Z forms of DNA; RNA types, distinctions between RNA and DNA. Experimental evidence – Griffith, McLeod, McCarty and Avery, Hershey-Chase experiments. Definition of gene, organization of genes and non-coding DNA in prokaryotes. Eukaryotes- unique, moderately repetitive and highly repetitive DNA sequence, satellite DNA, Cot value.			
Unit-II	DNA replication: DNA replication in prokaryotes, mode of replication, Semiconservative modes of replication. An overview of replication – replication eye, replication forks, semi discontinuous replication, Okazaki fragments, RNA primers – Enzymes of replication – DNA polymerases I, II, III, Topoisomerases, Helicases binding proteins and ligases. Role of Telomeres in eukaryotic DNA replication, Inhibitors of replication.			
Unit -III	Transcription: Steps in prokaryotic transcription: initiation, elongation, termination, and the factors involved in transcription. Difference between prokaryotic and eukaryotic transcription. Factors involved in eukaryotic transcription. Post transcriptional processes and its importance. Inhibitors of transcription.			
Unit -IV	Translation: Genetic code, degeneracy, codon usage, wobble hypothesis. Ribosome – Prokaryotic and Eukaryotic origin. Steps in translation – Initiation, elongation, termination, and the factors (both Prokaryotes and Eukaryotes) involved in translation, Inhibitors of Translation. Post translational modification: Formation of disulphide bonds, proteolytic cleavage, protein glycosylation – N linked oligosaccharides, O linked oligosaccharides Acetylation and Methylation.			
Unit- V	DNA Damage and repair: DNA damage by chemical and physical agents. Mutation – definition, type of mutations (spontaneous, induced and point mutation). Types of repair mechanisms: Base excision repair (BER), Nucleotide excision repair (NER), Mismatch repair (MMR), Double-strand break repair, Non-homologous end joining, Homologous recombination, and SOS repair. Gene regulation – Lac operon and Tryptophan operon.			
Reference and Textbooks:-				
Text Books:				
Freifelder, D. (1999). <i>Molecular Biology</i> (4 th ed.). Narosa Publishing House.				
Karp, G. (2006). <i>Cell and Molecular Biology Concepts and Experiments</i> (5 th ed.). John Wiley & Sons, Incorporated.				
Rastogi, S.C. (2005). <i>Concepts in Molecular Biology</i> (2 nd ed.). New Age International publishers.				
Watson, J.D., Tania, A.B., Stephen, P.B., Alexander, G., Michael, L., Richard, L. (2017). <i>Molecular Biology of the Gene</i> (7 th ed.). Pearson Education.				
Books for Reference:				
Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K., Watson, J.D. (2013). <i>Molecular cell biology</i> (4 th ed.). Garland Science Publisher, Taylor and Francis group.				
Ellicott, H., Ellicot, C. (2005). <i>Biochemistry and Molecular Biology</i> (4 th ed.). Oxford University Press.				
Lodish, H., Berk, A., Zipursky, L., Matsudaira, P., Baltimore, D., Darnell, J. (1997). <i>Molecular cell biology</i> (3 rd ed.). W.H.Freeman & Co Ltd.				
Malacinski, G.M. (2005). <i>Essentials of Molecular Biology</i> (4 th ed.). Jones and BartlettPublisher Whitehouse, D., Rapley, R. (2015). <i>Molecular Biology and Biotechnology</i> (6 th ed.).Royal society of chemist.				
Zubay G.L. (1998). <i>Biochemistry</i> (4 th ed.). Wm.C Brown Publishers.				
Outcomes	➤ The students will be clear on the concepts of molecular basis of living systems.			

Semester- IV				
Course code: 22BBC4C2	Core Course-VI	T/P	C	H/W
	Biotechnology	T	4	4
Objectives	<ul style="list-style-type: none"> ➤ To gain knowledge in various molecular techniques. ➤ To elaborate on vectors, gene transfer methods and GMOs 			
Unit-I	Vectors: Plasmids and Cosmids, Types of vectors – Bacterial, Viral, Yeast and Plant vectors, Yeast artificial chromosomes and Bacterial artificial chromosomes, Agrobacterium plasmids. Expression and Integration vectors, Enzymes involved in cloning.			
Unit-II	Recombinant DNA Technology: Cloning strategies, cDNA Synthesis and Genomic library, Restriction enzymes and Digestion, Gene mapping, Restriction fragment length polymorphism, SSCP, Polymerase chain reaction, Sequencing methods, Marker genes, site directed mutagenesis, Tag sequences (His tag)			
Unit -III	Gene Transfer Technology: Types of Gene transfer methods – Electroporation, Microinjection, Biolistic method, transformation using PEG & Calcium, Viral transfection, Protoplast fusion, Ti plasmid mediated gene-transformation			
Unit -IV	Analytical techniques: Qualitative and Quantitative analysis of DNA, RNA and Protein, Spectroscopy and Spectrophotometric analysis, Electrophoretic assay and Blotting techniques, DNA finger printing and RAPD			
Unit -V	Applications Of Genetically Modified Organisms: Production of Transgenic plants, animals and microorganisms, Blood products, Food products, Merits and Demerits of GMOs.			
Reference and Textbooks:-				
Text Books:				
Das, H.K. (2017). <i>Textbook of Biotechnology</i> (5 th ed.). Wiley.				
Dubey, R.C. (2006). <i>Text book of biotechnology</i> . (5 th ed.). S. Chand & company Pvt. Ltd.				
Kumaresan, V.K. (2009). <i>Animal Biotechnology</i> (1 st ed.). Saras Publications.				
Lohar, P.S. (2021). <i>Text book of Biotechnology</i> (1 st ed.). MJP Publisher.				
Sathyanarayana, U. (2006). <i>Biotechnology</i> (2 nd ed.). Allied Book publications.				
Books for Reference:				
Balasubramanian, D., Bryce, C.F.A., Jayaraman, K., Green, J. & Dharmalingam, K. (2004). <i>Concepts in biotechnology</i> . University Press				
Glick, B.R., Pasternack, J.J. (1998). <i>Molecular Biotechnology</i> (2 nd ed.). ASM press.				
Primrose, S. B., Primrose, S.B., Primrose, S., Twyman, R., Old, B., Old, R.W., Bertola, G. (2006). <i>Principles of Gene manipulation and Genomics</i> (7 th ed.). Blackwell scientific publications.				
Purohit, S.S. (2005). <i>Biotechnology: Fundamentals and Application</i> (4 th ed.). Agrobios (India).				
Watson, J.D., Zoller, M., Gilman, M., Witkowski, J., Che, W., Gilman, M., Witkowski, J.A., Zoller, M., Witkowski, J. (1992). <i>Recombinant DNA</i> (2 nd ed.). Scientific American Books.				
Outcomes	<ul style="list-style-type: none"> ➤ Understanding the basic principles of molecular techniques involved in rDNA technology, selection of vectors, basics of cloning and Genetically modified organisms. 			

Semester-IV				
Course code:	Core Practical IV	T/P	C	H/W
22BBC4P1	Molecular Biology & Biotechnology	P	3	3
Objectives	<p>➤ To gain knowledge in isolation of nucleic acids, proteins from tissue samples and bacterial samples.</p> <ol style="list-style-type: none"> 1. Isolation of DNA from liver samples. 2. Isolation of plasmids from bacterial cultures. 3. Plasmid DNA isolation 4. Estimation of DNA by Di-phenyl amine method 5. Separation of the quantified DNA through Agarose Gel Electrophoresis. 6. Estimation of RNA by Orcinol method 7. Isolation of proteins from bacterial cultures. 8. Estimation of proteins. 9. Separation of Proteins by SDS – PAGE. 10. Separation of biomolecules by Paper/Thin layer Chromatography . <ul style="list-style-type: none"> - Sugars - Lipids - Amino acids 11. Experiment on Bacterial gene expression 12. Experiment on gene cloning 13. Determination of Tm Value 			
Text and Reference books				
Text books				
Borah, D. (2015). <i>Biotechnology Lab Practices</i> . Global vision publishing house				
Gakhar, S.K., Miglani, M., Kumar, A. (2019). <i>Molecular Biology: A Laboratory</i> . Dreamtech Press				
Sarma. P.V.G.K. (2017). <i>Molecular Biology A Practical Manual</i> . (1 st ed.). MJP Publishers.				
Thirumurugan, G. (2020). <i>Molecular biotechnology: Techniques and tools made simple</i> (3 rd ed.). Independently Published				
Verma A.S., Das, S. (2014). <i>Laboratory Manual for Biotechnology</i> . S. Chand & company Ltd.				
Reference books				
Carson, S., Miller, H.B., Carson, S., Witherow, D.S. (2012). <i>Molecular Biology Techniques. Classroom Laboratory Manual</i> . (4 th ed.). Elsevier Science				
Hong, S.-B., Rashid, M.B., Santiago-Vázquez, L.Z. (2016). <i>Methods in Biotechnology</i> . Wiley.				
Masoodi, K.Z., Lone, S.M., Rasool, R.S. (2020). <i>Advanced Methods in Molecular Biology and Biotechnology A Practical Lab Manual</i> . Elsevier Science.				
Ram Singh, B., Kumar, R. (2021). <i>Practical Techniques in Molecular Biotechnology</i> . Cambridge University Press				
Thatoi S.K.D.H., Dash, S. (2020). <i>Practical Biotechnology: Principles and Protocols</i> . Dreamtech press, Wiley				
Outcomes	<p>➤ Hands on experience in isolation and estimation of nucleic acids and proteins along with the knowledge of chromatography.</p>			

Semester- V						
Course code: 22BBC5C1	Core Course - VII			T/P	C	H/W
	Human genetics			T	4	4
Objectives	<ul style="list-style-type: none"> ➤ To gain theoretical knowledge in understanding the mendelian principles ➤ Analyze the interaction of genes and their influence on the environment 					
Unit-I	Basics of genetics and gene expression: Introduction to genetics – Scope and significance of genetics, DNA – Types and structures, RNA – Types and functions, gene expression – Eukaryotic transcription - RNA splicing and processing, Overview of translation – mechanism - Post-translational modifications.					
Unit-II	Organization of chromosomes and chromosomal abnormalities: Chromosomes – Structure and Functions, Organization of chromosomes, Chromosome banding, Karyotyping, Chromosomal abnormalities, Sex linked inheritance – Hemophilia, color blindness, Lesch-Nyhan syndrome, Sex chromosome abnormalities – Trisomy X, Klinefelter syndrome, Turner syndrome.					
Unit- III	Mendelian principles and chromosome mapping: Principle of Genetic Transmission – Mendel’s Law of dominance, segregation and independent assortment, Chromosome mapping – Linkage and crossing over – molecular mechanism of crossing over, Mapping with molecular markers – Single nucleotide polymorphisms.					
Unit- IV	Transposons, mutation and repair mechanisms: Transposons – Eukaryotic transposable elements - mechanism of transposition - DNA transposons – retrotransposons - transposable elements in human genome (lines and sines), Mutation – mechanism (base analogs, intercalating agents) and types, DNA repair mechanisms – Photoreactivation - excision repair –SOS repair.					
Unit- V	Population genetics, cancer and human genome project: Population genetics – Genetic pool - Hardy-Weinberg law of equilibrium - genetic drift and population size, Pedigree analysis, allelic frequency, selection, Cancer genetics – Oncogenes, proto-oncogenes - tumor suppressor genes, Outline of Human genome project.					
Reference and Textbooks:-						
Text Books						
Gangane, S.D. (2017). <i>Human Genetics</i> (5 th ed.). Elsevier Science.						
Lewin, B. (2004). <i>Genes VIII</i> (1 st ed.). Pearson Publishing Pvt Ltd.						
Sarkar, A. (2001). <i>A Text Book of Genetics</i> (1 st ed.). Dominant Publishers & Distributors.						
Strachan T, Read A. (2003). <i>Human Molecular Genetics</i> (2 nd ed.). Garland Science.						
Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., Losick, R. (2005). <i>Molecular Biology of the Gene</i> (5 th ed.). Benjamin Cummings.						
Reference books						
Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2012). <i>Introduction to genetic analysis</i> (10 th ed.) W. H. Freeman & Company.						
Hartl, D.L., Ruvolo, M. (2011). <i>Genetics- Analysis of genes & genome</i> (8 th ed.). Lakshmi Publications.						
Pierce, B.A. (2012). <i>Genetics – A conceptual approach</i> (4 th ed.). W. H. Freeman and Company.						
Outcomes	➤ Students will gain knowledge about the concepts of Human genome and related genetic disorders.					

Semester- V						
Course code: 22BBC5C2	Core Course -VIII Microbiology			T/P	C	H/W
				T	4	4
Objectives	<ul style="list-style-type: none"> ➤ To gain knowledge in different categories of microorganisms ➤ To learn the beneficial uses of microorganisms and pathogenesis of various microbes in the environment 					
Unit-I	<p>Organization and structure of microorganisms: General characteristics of different groups: Acellular microorganisms (Viruses, Viroids, Prions) and Cellular microorganisms (Bacteria, Algae, Fungi and Protozoa) with emphasis on distribution and occurrence, morphology and mode of reproduction and economic importance.</p> <p>Prokaryotic organization – Cytoplasmic membrane and their functions – Mesosomes, cell wall – Gram positive and Gram negative bacteria and their reactions, capsule and slime layers– flagella and cilia – bacterial chromosome, plasmids, ribosomes, reserved food – endospore.</p>					
Unit-II	<p>Bacterial nutrition: Growth and reproduction – autotrophic and heterotrophic nutrition – bacteria photosynthesis – chemolithotrophy, bacterial metabolism – fermentation – homofermentative and heterofermentative types – binary fission – other modes of reproduction – conjugation – transformation – transduction – sporulation – kinetics of bacterial growth – normal growth curve.</p>					
Unit -III	<p>Morphology of virus: Classification and cultivation of viruses; plaque assay. Phages: - T4 Phages stages - lifecycle; synthesis and assembly of protein Lambda Phages - Life cycle; switch between lysogeny and lytic cycle. RNA viruses: - Influenza and Corona virus, HIV. DNA viruses: - Oncogenic viruses</p>					
Unit- IV	<p>Applied, food & industrial microbiology: Food spoilage, food poisoning and food borne infection. Use of microbes in industries, ethanol production, organic acid (lactic and citric acid) production, antibiotics (Pencillin and Streptomycin) production. Microorganism and milk: Sources of microorganism, fermentation of milk, specific fermentation of milk souring, gassiness, aroma and flavor, proteolysis, alkali production, ripeness, sweet curdling, bitter flavour and miscellaneous fermentations.</p>					
Unit -V	<p>Medical Microbiology: Pathogenesis and prevention of air and water borne diseases – Typhoid, Cholera, Dysentery, Diarrhea, hepatitis, amoebiosis, tuberculosis, pox diseases, diphtheria and poliomyelitis.</p>					
Reference and Textbooks:-						
Text Books:						
Ananthanarayanan, R., Panicker, C.K. J (2017). <i>Text Book of Microbiology</i> (11 th ed.) Universities Press (India) Pvt. Ltd.						
Arora, D.R. (2020). <i>Text book of microbiology</i> (6 th ed.) .CBS publishers						
Pelczer, J.R.E.C.S., Krieg, J.N.R. (2006). <i>Microbiology</i> MC Graw Hill Book Company						
Stainer. R.Y. (1985). <i>The Microbial World</i> (5 th ed.). Prentice Hall.						
Books for Reference:						
Levinson, W.E., Schwartz, B., Chin-Hong, P., Nussbaum, J., Joyce, E (2022). <i>Review Of Medical Microbiology and Immunology</i> (17 th ed.) McGraw Hill Medical						
Prescott, L.M., Harley, J.H., Klein, D.A. (2006). <i>Microbiology</i> (5 th ed.) C. Brown Publishers.						
Tortora, G.J. (2020). <i>Microbiology an Introduction</i> (6 th ed.). Pearson						
Willey, J.M., Sherwood, L., Woolverton, C.J. (2017). <i>Prescott's Microbiology</i> (10 th ed.). Tata McGraw Hill Publishing Company Ltd, New Delhi						
Outcomes	<p>On successful completion the students will</p> <ul style="list-style-type: none"> ➤ Understand the basic concepts related to relevant fields of microbiology which will enable them to analyze and develop solutions for microbiology related problems. ➤ Be familiarized with basic concepts in microscopy and sterilization procedures. ➤ Gain in-depth knowledge on pathogenesis of microbes in water, soil and food and prevention strategies 					

Semester- V						
Course code: 22BBC5C3	Core Course-IX			T/P	C	H/W
	Immunology			T	4	4
Objectives	<ul style="list-style-type: none"> ➤ To provide an insight on immune system including cells, organs, immunodiagnostic techniques ➤ To gain in depth knowledge on the molecular basis of complex cellular processes involved in inflammation and immunity, in states of health and disease. 					
Unit-I	The Immune system: Primary and Secondary Lymphoid organ, Lymphocytes- their origin and differentiation, NK cells. Antigen presenting cells-macrophages, dendritic cells, langerhans cell- their origin and function. Mechanism of phagocytosis. Complement – characteristic features- biological function-activation, types of immune responses, immune tolerance.					
Unit-II	Immunity: Types of immunity- Innate immunity- classification- mechanism of nonspecific immunity. Acquired immunity- active and passive, vaccine-active immunization, passive immunization. Immunity to infection- bacteria, virus and protozoa. Immune response. Humoral and cell mediated immunity –induction mechanism-cytokines -interleukins-Interferon-their role in immune response.					
Unit -III	Antigen-antibody reactions: Immunoglobulins – structure, classification and functions. Idiotype network hypothesis. Antigen- types of antigen, antigen V simmunogens, Haptens. Factors influencing immunogenicity- Affinity, avidity, epitope, paratope, Isotypes, allotypes and idiotype. Antigen-Antibody interaction –Precipitation, agglutination, complement fixation - opsonization, bacteriolysis and Antitoxins.					
Unit -IV	Immunity to infections: Hypersensitivity reactions- types and mechanism, Primary and secondary immunodeficiency disorders. Transplantation immunology- Structure and Functions of MHC I & II molecules, Types of graft – Autograft, Allograft, Xenograft. Graft rejection - Allograft rejection mechanism and prevention of graft rejection- immune-suppressive drugs. HLA-immune response genes- HLA molecules, Auto immune diseases-pathogenesis – treatment					
Unit -V	Immunochemical techniques: Production of antisera, Precipitation and agglutination reaction, immunodiffusion, immunoelectrophoresis, immunofluorescence, complement fixation test. Principle, technique and applications of RIA and ELISA. Hybridomas – monoclonal antibody production-uses. Flow Cytometry-Immunological Applications					

Reference and Textbooks:-

- Ananthanarayanan, R., Panicker, C.K. J (2017). Text Book of Microbiology (11th ed.) Universities Press (India) Pvt. Ltd.
- Abbas, A.K., Lichtman, A.H. (2017). *Cellular and Molecular Immunology* (9th ed.) Elsevier Science.
- Annaduri, B. (2014). *A Textbook of Immunology & Immuno Technology* (4th ed.). S. Chand & Company, Pvt. Ltd.
- Geha, R.S., Notarangelo, L. (2016). *Case Studies in Immunology A Clinical Companion* (7th ed.). Garland Science, Taylor & Francis Group, LLC.
- Goers, J. (1993). *Immunochemical Techniques Laboratory Manual* (1st ed.). Academic Press

Books for Refeence:

- Ivann, R., Brastoff, J., Male, D. (2017). *Immunology* (13th ed.) Mosby-Year Book
- Punt, J., Stranford, S. (2018). *Kuby Immunology*. (8th ed.). W.H. Freeman and Company, New York.
- Coico, R., Sunshine, G. (2015). *Immunology: A Short Course* (7th ed.). Wiley-Blackwell
- Hyde, R.M. (2000). *Immunology* (4th ed.). Lippincott Williams & Wilkins, Philadelphia.
- Goldsby, R., Kindt, T.J., Osborne, B.A., Kuby, A.J. (2002). *Immunology* (5th ed.).W.H. Freeman and Company, New York.

Paul, W.E. (2008). *Fundamentals of immunology* (6th ed.). Lippincott Williams & Wilkins, Philadelphia.

Outcomes

On successful completion of the course the students will

- Understand the key concepts of immune cells, immunity and applications of immunology
- Attain knowledge on immunological diseases and immunotherapy.
- Gain detailed knowledge on transplantation and immunization techniques

Semester - V						
Course code: 22BBC5C4	Core Course-X			T/P	C	H/W
	Plant Biochemistry			T	4	4
Objectives	<ul style="list-style-type: none"> ➤ To understand the major plant physiology and the crucial process involved (Photosynthesis, water and nutrient transport and key regulatory hormones) ➤ To understand the biochemistry of plant defense mechanism and identify the toxic compounds in plants 					
Unit-I	Plant cell physiology: Structure and biochemical aspects of plant cell membrane, primary and secondary cell walls, cell plate, plasmodesmata, vacuoles, meristematic cells. Water balance and transport in plants, osmosis and diffusion, water potential, measuring of water potential, osmotic potential, membrane potential, diffusion pressure deficit, solute transport, mass flow, transpiration.					
Unit-II	Plant Nutrition: Essential mineral nutrients – Absorption, translocation and function, effects of toxicity and deficiency, N ₂ cycle, Nitrogen fixation – symbiotic and a symbiotic nitrogen fixation – nitrogenase, nitrate assimilation, sulphur metabolism sulphate as a mineral nutrient, sulphate assimilation, Biofertilizer.					
Unit- III	Photosynthesis: Structure & function of chloroplast system. Photosynthetic pigments – Chlorophyll, plastocyanin, plastoquinone, carotenoids their functions, Photo system I & II. Photosynthetic electron transport and photophosphorylation . Calvin cycle (C ₃ plants), Hatch slack pathway (C ₄ plants) – regulation of photosynthesis, photorespiration.					
Unit -IV	Plant growth regulators: Introduction- Normal growth hormones – Auxins, Gibberlic acid, Cytokinins, Ethylene and Abscisic acid, synthetic growth hormones, senescence, abscission.					
Unit- V	Plant physiology and reproduction: Physiology and reproduction: Brief account on physiology of germination / dormancy / photoperiodism / Vernalization. Plant tissue culture (an elementary treatment). Biochemistry of disease resistance in plants.					
Reference and Textbooks:-						
Text Books:						
Barker, A.V., Pilbeam, D.J. (Eds.) (2015). <i>Handbook of Plant Nutrition</i> (2 nd ed.). CRC Press.						
Bowsher, C., Tobin A. (2021). <i>Plant Biochemistry</i> (2 nd ed.).CRC Press.						
Devlin, M. (1996). <i>Plant physiology</i> (3 rd ed.). John Wiley Publications						
Pandey, S.N. (2008). <i>Plant Physiology</i> (4 th ed.). Vikas publishing House						
Verma, S. K., Verma M. (2020). <i>A Textbook of Plant Physiology, Biochemistry and Biotechnology</i> (19 th ed.). S. Chand & Company						
Books for Reference:						
Bonner, J., Varner, J.E. (2016). <i>Plant Biochemistry</i> (1 st ed.). Academic Press, London						
Dashek, W.V. (2018). <i>Methods in Plant Biochemistry and Molecular Biology</i> (2 nd ed.). CRC Press.						
Heldt, H.W., Piechulla, B. (2021). <i>Plant Biochemistry</i> (5 th ed.). Academic Press, Elsevier.						
Jain, V.K. (2017). <i>Fundamentals of plant physiology</i> (19 th ed.). S. Chand and company limited.						
Mengel, K., Kirkby, E.A. (2012). <i>Principles of Plant Nutrition</i> (5 th ed.). Springer Netherlands						
Outcomes	<p>On successful completion of course students will</p> <ul style="list-style-type: none"> ➤ Understand the mechanism and pathways involved in the energy production in plants ➤ Gain insight to various stressful environmental conditions of the affecting plant growth and productivity as well as the defense mechanisms in plants due to which plants survive under stresses. 					

Semester-V				
Course code:	Core Practical V	T/P	C	H/W
22BBC5P1	Basic Clinical Microbiology And Genetics	P	4	6
Objectives	<ul style="list-style-type: none"> ➤ To gain knowledge in good laboratory practices to be followed in handling microbial and biological samples. ➤ To introduce various microorganisms present in the ecosystem and acquaint with Common equipment used in routine microbiology laboratory ➤ To attain practical knowledge of Mendelian genetic analysis 			
<u>Basic Clinical Microbiology</u>				
<ol style="list-style-type: none"> 1. Good Laboratory Practices and Biosafety. 2. Principle and applications of basic instruments used in microbiology lab (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter) 3. Preparation of culture media for bacterial cultivation. 4. Cleaning of Glassware and sterilization using Hot Air Oven 5. Sterilization of medium using Autoclave 6. Sterilization of heat sensitive material by membrane filtration 7. Preparation of different media: synthetic media BG-11, Complex media-Nutrient 8. agar, McConkey agar, EMB agar 9. Selection of Suitable Culture Media 10. Staining Techniques-Simple Staining, Grams Staining, Negative Staining and Spores Staining 11. Smear Preparation and Fixation 12. Determination of Bacterial Growth curve. 13. Isolation of Microbes:- Serial dilution technique and Streak plate technique 14. Estimation of CFU count 15. Biochemical Reactions of Bacteria- a) Starch Hydrolysis b) Casein Hydrolysis. 				
<u>Genetics</u>				
<ol style="list-style-type: none"> 1. Problem solving – Mendelian ratios <ul style="list-style-type: none"> - Test cross - Dihybrid cross 2. Analysis of Hardy Weinberg equilibrium. 				
Reference and Textbooks:-				
Text Books:				
Arumugam, N., Thangamani, A., Narayanan, L.M. (2005). <i>Microbiology</i> (5 th ed.). Saras Publications.				
Jain, A., Jain, R., Jain, S. (2021). <i>Basic Techniques in Biochemistry, Microbiology and Molecular Biology Principles and Techniques</i> (1 st ed.). Springer US.				
Pelczar, M. (2010). <i>Microbiology</i> (5 th ed.). Tata McGraw Hill Publications				
Rastogi, V.B. (2019). <i>Genetics</i> (4 th ed.) Medtech Publishers				
Senthilkumar, B., Zothansanga, Senbagam, D., Senthilkumar, N., Gurusubramanian, G. (2013). <i>Practical Microbiology - A Laboratory Manual.</i> (1 st ed.), Panima Publishing Corporation, New Delhi.				
Verma P.S. and Agarwal V.K.(2009). <i>Genetics</i> (9 th ed.). S. Chand publications				
Reference books				
Cappuccino, J.G., Welsh, C.T. (2017). <i>Microbiology: A Laboratory Manual</i> (11 ed.). Global Edition				
Klug, W.s., Cummings, M.R., Spencer, C.A. (2016). <i>Concepts of Genetics</i> (10 th ed.) Pearson.				
Madigan M.T., Martinko, J.M. Stahl, A.A. (2010). <i>Brock Biology of microorganisms</i> (10 th ed.) Benjamin-Cummings Pub Co				
Snustad, D.P., Simmons, M.J. (2015). <i>Principles of Genetics</i> (7 th ed.). Wiley				
Sulaiman, A., Saqr, A. (2012). <i>Laboratory Manual in General Microbiology For Undergraduate</i>				

Outcomes	On successful completion of the course, students will <ul style="list-style-type: none">➤ Be able to isolate and identify microorganisms relevant to healthcare and the pharmaceutical industries➤ Acquire knowledge and hands on experience in microbiological techniques and bioinstrumentation which make them competent to be placed in various Microbiological / Biotechnological industries➤ Understand the principles behind genetics through Mendelian ratios and hardy Weinberg equilibrium
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Semester-V				
Course code: 22BBC5P2	Core Practical VI	T/P	C	H/W
	Immunology and Plant Biochemistry	P	4	6
Objectives	<ul style="list-style-type: none"> ➤ To facilitate the students to understand the basic techniques in immunology, basis of antigen – antibody interactions and their applications in biotechnology. ➤ To provide insight on plant constituents, its extraction, isolation and estimation. 			
<u>Immunology</u>				
<ol style="list-style-type: none"> 1. ABO Blood Grouping, Rh factor typing, 2. Total and differential blood cell count by haemocytometer. 3. Determination of Erythrocyte sedimentation rate. 4. Estimation of Haemoglobin by Sahle’s Method. 5. Antigen Preparation 6. Antigen Antibody interaction 7. Double immunodiffusion 8. Immunoelectrophoresis 9. Radial immunodiffusion 10. Demonstration of ELISA 11. Demonstration of Widal test 				
<u>Plant Biochemistry</u>				
<ol style="list-style-type: none"> 12. Estimation of Cellulose. 13. Isolation of chloroplast. 14. Estimation of plant pigments <ol style="list-style-type: none"> a) Chlorophyll b) Carotenes c) Anthocyanin. 15. Preparation of plant extracts <ol style="list-style-type: none"> a) Decoction b) Maceration c) Soxhlet extraction. 16. Estimation of IAA and Proline. 17. Separation of plant pigments by circular chromatography 				
Reference and Textbooks:-				
Text Books:				
Anderson J.W., Brardall, J. (1994). <i>Molecular activities of plant cell – An Introduction to Plant Biochemistry</i> (1 st ed.) Black well Scientific Publications.				
Bowsher, C., Tobin A. (2021). <i>Plant Biochemistry</i> (2 nd ed.).CRC Press.				
Fathima, D., Narayanan, L.M., Mani, A., Selvaraj, A.M., Arumugam, N. (2022) <i>Immunology and Microbiology</i> (6 th ed.). Saras Publications				
Hay F.C., Westwood, O.M.R. (2008). <i>Practical Immunology</i> (4 th ed.). Wiley.				
Nigam A.(2007). <i>Lab Manual in Biochemistry, Immunology and Biotechnology</i> (1 st ed.). McGraw-Hill Education (India) Pvt Limited				
Verma, S. K., Verma M. (2020). <i>A Textbook of Plant Physiology, Biochemistry and Biotechnology</i> (19 th ed.). S. Chand & company				
Books for Reference:				
Bonner, J., Varner, J.E. (2016). <i>Plant Biochemistry</i> (1 st ed.) . Academic Press, London				
Deepak, D., Singh, V. (2013). <i>Laboratory Manual On Immunology and Molecular Biology: Step by Step Experimental Protocols, Concise and Easy to Follow</i> (1 st ed.) Lap Lambert Academic Publishing GmbH KG. Germany.				
Heldt, H.W., Piechulla, B. (2021). <i>Plant Biochemistry</i> (5 th ed.). Academic Press, Elsevier				

Paul, W.E. (2008). *Fundamentals of immunology* (6th ed.). Lippincott Williams & Wilkins, Philadelphia

Speshock J.(2019). *Immunology Lab Manual*,(2nd ed.). Kendall Hunt Publishing Company

Outcomes

- On successful completion of course the students will
- Understand the methods to analyze various immunological parameters
 - Acquire hands on experience on extraction, isolation and estimation of phytoconstituents

Semester- VI				
Course code:	DSE I	T/P	C	H/W
22BBC6E1	Nutritional Biochemistry	T	6	6
Objectives	<ul style="list-style-type: none"> ➤ To know the importance of balanced diet for health ➤ Understand about the deficiencies caused due to the insufficiency of nutrients from food sources and knowing the values of nutrition 			
Unit-I	Introduction to food science: Definition of foods and nutrition. Functions of food and its relation to nutritional and clinical health, Basic food groups: Energy giving foods, body building foods and protective foods. Essential nutrients, RDA for average Indian, analysis of food composition, food habits, food fads and fallacies. Carbohydrates, Fats and Proteins-Risks associated with deficiencies and overconsumption			
Unit-II	Energy: Definition and unit of energy – Kcal, RQ, SDA. Basal metabolism, measurement of BMR, factors affecting BMR, regulation of body temperature, energy needs, total energy requirements, estimation of energy requirements and energy value of foods. Water and Electrolytes: daily requirement of water, physiological functions of electrolytes (sodium, potassium, magnesium, calcium, phosphorus), nutritional support for preventing fluid and electrolyte imbalance			
Unit- III	Mineral and vitamin nutrition: Essential micro and macro nutrients, distribution, sources, functions and abnormalities. Vitamins: Definition, classification, sources, distribution, metabolism, function, abnormalities, minimum requirements and optimum allowances, assay of vitamins, deficiency and excess.			
Unit -IV	Balanced diet formulation: Assessment of nutritional status. Nutrition at various stages of growth and development: Diets for infants. Children, adolescent, pregnant women, lactating mothers and older persons. Nutritional therapy during stress, anemia, obesity, diabetes mellitus and allergy Protein nutritional Nitrogen balance, quality of food proteins and requirements, protein nutrition abnormalities, protein deficiency disorder, PEM			
Unit- V	Nutritional disorders: Nutritional challenges of the future: Food production and food storage, future foods, new protein foods, new fat foods and changing food habits			
Reference and Textbooks:-				
Text books:				
Shubhagini, A.J. (2021). <i>Nutrition and Dietetics</i> 5 th ed.), Tata McGraw Publishers.				
Srilakshmi, B. (2008). <i>Human Nutrition</i> (2 nd ed.) New Age Publishers.				
Srivastava, Y. (Ed.) (2013). <i>Advances In Food Science And Nutrition</i> (1 st ed.). Science And Education Development Institute, Nigeria				
Sumati, R.M., Shalini, M.R., Rajagopal. M.V. (2015). <i>Food Science</i> . New Age International (P) Limited, Publishers				
Books for Reference:				
Begum, R.M. (2008). <i>A Textbook of Foods, Nutrition & Dietetics</i> (3 rd ed.). Sterling Publisher pvt ltd, New Delhi				
Garrow, J.S., James, W.P.T. (1999). <i>Human Nutrition and Dietetics</i> (10 th ed.) Churchill Livingstone;				
Robinson, C. (1972). <i>Normal and Therapeutic Nutrition</i> . Macmillan publishers.				
Swaminathan, M.S. (1986). <i>Principles of Nutrition Determination Dietetics</i> . Bangalore printing and publishing company				
Toldra, F. (Ed.) (2017). <i>Advances in Food and Nutrition Research</i> (1 st ed.). Elsevier Science.				
Outcomes	<ul style="list-style-type: none"> ➤ Gaining knowledge in the nutritional values of food, its calorific value, role of each nutrient required for men and women at different stages and the disorders caused due to its deficiency. 			

Semester-VI					
Course code: 22BBC6E2	DSE 2		T/P	C	H/W
	Human Physiology		T	6	6
Objectives	<ul style="list-style-type: none"> ➤ To provide insight on the structure, function, regulation and integration of human body organ systems ➤ To understand the importance of hormonal and neuronal regulation of the body 				
Unit-I	Blood and body fluids: Extra cellular fluid – plasma, interstitial fluid and trancellular fluid: Lymph and blood composition, functions, osmolarity of the body fluids, ionic composition, electrolytes and body buffers. Blood cells, hemoglobin, haemoposis, and coagulation and blood groups.				
Unit-II	Digestive system: Structure of digestive system. Composition, function and regulation of saliva, gastric, pancreatic, intestinal and bile secretions – digestion and absorption of carbohydrates, lipids, proteins, nucleic acids, minerals and vitamins.				
Unit -III	Excretory system: Structure of nephron, formation of urine, glomerular filtration, tubular reabsorption of glucose, water and electrolyte balance – role of kidney and hormones in their maintenance.				
Unit -IV	Endocrine system: A brief outline of various endocrine glands and their physiological roles; Biosynthesis, storage and secretion of both peptide and steroid hormones. Amino acids as hormones. Feed back regulation of hormone secretion, hormone receptors and their activation, mechanisms of intracellular and extra cellular hormone action.				
Unit -V	Respiratory system: Anatomy and physiology of respiration, exchange of gases between lung and blood and between blood and tissues. Role of lung and kidney in acid base balance. Acidosis and alkalosis.				
Reference and Textbooks:-					
Text Books:					
Arumugam, N. (2008). <i>Animal Physiology</i> (2 nd ed.) Saras Publications.					
Chatterjee, C.C. (2004). <i>Human Physiology</i> (3 rd ed.). Medical Allied Publications. Distributors.					
Hall, J.E., Guyton, A.C. (2011). <i>Text book of medical physiology</i> (12 th ed.). Saunders Elsevier.					
Muthayya, N.M. (2008). <i>Human Physiology</i> . Jaypee Brothers Medical Publishers Pvt. Limited Publishers.					
Ratan, V. (2004). <i>Handbook Of Human Physiology</i> (7 th ed.). Jaypee Brothers Medical					
Subhash, S. (2000). <i>Human Physiology: Systemic & Applied</i> (1 st ed.). CBS Publishers &					
Books for Reference:					
Dua, A., Gupta, S.K. (2015). <i>Biochemistry and Human Physiology</i> (1 st ed.)Anmol Publications Pvt. Limited.					
Fox, S.I. (2015). <i>Human Physiology</i> . (14 th ed.). McGraw Hill					
R.A .Agarwal, S.Chand , Kumar K (1986). <i>Physiology and Biochemistry</i> (3 rd ed.). S. Chand					
Rhoades, R., Pflanzler, R.G. (2002). <i>Human Physiology</i> (4 th ed.). Brooks/Cole.					
Sherwood, L. (2015). <i>Human Physiology: From Cells to Systems</i> (9 th ed.). Cengage Learning					
Outcomes	<p>On successful completion of course the students will</p> <ul style="list-style-type: none"> ➤ Understand the role of different organ systems in maintaining homeostasis ➤ Understand the regulatory role of hormones in human health 				

Semester- VI				
Course code:	DSE-3	T/P	C	H/W
22BBC6E3	Diagnostic Biochemistry	T	6	6
Objectives	<ul style="list-style-type: none"> ➤ To develop basic skill in sample collection and handling of biological samples ➤ To understand the various diagnostic procedures and biochemical parameters 			
Unit-I	Specimen collection and processing (Blood, urine, feaces), use of anti-coagulants and preservatives for blood and urine. Transport of Clinical Samples. Units of measurements of solutes in solution, e.g. Normality, Molality, Molarity. SI Units. Clinical chemistry tests- Blood group, glycosylated haemoglobin, fructosamine, GTT, uric acid, Ca, P, Fe, Cu, CSF analysis			
Unit-II	Enzymes: Acid phosphatases, LDH, CPK, CPK_MB, Alpha amylase, Hormones- T3, TSH, LH. Immunoglobulins- IgA, IgM, IgE			
Unit- III	Serodiagnostic procedures- precipitation tests, VDRL test, Vidal test, (Slide and tube method) Brucella agglutination test, ASO test, RA test, CRP test. Complement fixation test, skin test- Montaux test, Lepramin test.			
Unit- IV	Complete haemogram, complete urine analysis, complete motion analysis, seman analysis.			
Unit -V	Blood bank, blood group and Rh factor, Coomb's test, Coagulation studies, Prothrombin test (PT), Partial PT, Plasma fibrinogen. Test for amino acidurias- Test for phenyl ketonuria, DNPH, Test for keto acids, sodium nitroprusside test for Cystinuria and homocysteine.			
Reference and Textbooks:-				
Text Books				
Baynes, J.W., Dominiczak, M.H. (2005). <i>Medical Biochemistry</i> (2 nd ed.). Elsevier Mosby Ltd. (Philadelphia).				
Mukherjee, K.L. (2010). <i>Medical Laboratory Technology - a Procedure Manual for Routine Diagnostic Tests</i> (3 rd ed.). Tata Mc Graw–Hill Publishing Company Limited (New Delhi).				
Tietz. N (1982), <i>Fundamentals of Clinical Chemistry and Molecular diagnostics</i> , (7 th ed.). W.B. Saunders Company.				
Varley, H., Gowenlick, A.H., McMurray, J.R., McLauchlan, D.M. (2005). <i>Varley's practical clinical biochemistry</i> (4 th ed.) Heinemann Medical Books, London, CBS, New Delhi (India).				
Wallach, J. (1982). <i>Interpretation of Diagnostic test – A Synopsis</i> . (5 th ed.) Little Brown and Company.				
Zilva, J., Pannall, P.R. (1994). <i>Clinical Chemistry, Diagnosis and treatment</i> (7 th ed.). PG Publishing Pvt. Ltd.				
Books for Reference				
Baynes, J.W, Dominiczak, M.H. (2005). <i>Medical Biochemistry</i> (2 nd ed.). Elsevier Mosby Ltd. (Philadelphia).				
Bishop, M.L., Fody, E.P., Schoeff, L.E. (2013). <i>Clinical Chemistry: Principles, Techniques and Correlations</i> (7 th ed.). Lippincott Williams and Wilkins.				
Marshall, W.J., Lapsley, M., Day, A., Ayling, R. (2014). <i>Clinical Biochemistry: Metabolic and Clinical Aspects</i> (3 rd ed.). Churchill Livingstone.				
Palmer, T., Bonner, P. (2008). <i>Enzymes: Biochemistry, Biotechnology, Clinical Chemistry</i> (2 nd ed.). EastWest Publisher.				
Swaminathan, R. (2011). <i>Handbook of clinical biochemistry</i> (2 nd ed.). World Scientific				

Publishing Co Pte Ltd.

Vasudevan, D.M., Sreekumari, S., Vaidyanthan, K, (2019). *Text book of biochemistry for medical students*. (9th ed.). Jaypee Brothers Medical Publishers.

Outcomes

- Gain knowledge on the analysis of different parameters in biological samples like blood & urine

Semester- VI				
Course code: 22BBC6E4	DSE-4	T/P	C	H/W
	Biostatistics and Bioinformatics	T	6	6
Objectives	<ul style="list-style-type: none"> ➤ To gain knowledge in basic statistical concepts in data collection and tabulation. ➤ To familiarize students in computer aided analysis of gene and protein sequences to understand the life process 			
Unit-I	Collection and organization of data: Collection of primary data and secondary data. Methods of data collection. Sampling and sampling designs – meaning and definition of random and non-random sampling. Editing of data, Definition for editing, objectives of editing, problems of accuracy, problems of approximation and errors.			
Unit-II	Representation of data: Classification of Data, Meaning and Definition, objectives of classification of data. <ul style="list-style-type: none"> a) Ungrouped data – continuous – discrete variation. b) Univariate frequency distribution, continuous frequency distribution, discrete frequency distribution. c) Cumulative frequency distribution Tabulation of data: Meaning and definition (a) parts of a table (b) Advantages. Diagrammatic and graphic representation of data.			
Unit- III	Measures of central tendency and dispersion: Mean, median, mode, standard deviation and variance, coefficient of variance, merits and demerits; Range - location of range in individual, discrete, continuous series, merits and demerits of Range. Correlation and Regression analysis; .F-test and its application, testing of hypothesis (Null and alternative hypothesis), Chi-square test, Analysis of variance			
Unit -IV	a) Basics of Computer <ul style="list-style-type: none"> ❖ Course introduction, MS Windows basics, Unix basics ❖ PC X windows (NCD PCXWARE) ❖ File management ❖ E-mail (PINE, EUDORA, METSCAPE MAIL) ❖ File transfer (ftp, wsftp) b) Review of key molecular genetic internet site and searching for similar sequences and multiple sequence alignment <ul style="list-style-type: none"> ❖ Internet world wide web resources (a list and description is provided in some useful sites on the internet) ❖ Similarity searching BLAST/FASTA ❖ Retrieving and installing a program (Tree Tool) ❖ Multiple sequence alignment (CLUSTLAW and bee) 			
Unit -V	a) The virtual library <ul style="list-style-type: none"> ❖ Searching MEDLINE on the pubmed system from the center for biotechnology information. ❖ Searching the Science Citation Index and current contents connect from the institute for scientific information. ❖ Using bibliographic databases and tables of content services to stay current of the biomedical literature. ❖ Accessing full – text journals on the internet and printing articles. b) Databases and search tools <ul style="list-style-type: none"> ❖ NCBI: http://www.ncbi.nlm.nih.gov/ ❖ EMBL SERVER: http://www.ebi.ac.uk/services.html ❖ Genom Navigator: S. cerevisiae Genome index ❖ http://www.mpimg-berlin-dahlem.mpg.de/andy/GN/S.cerevisiae 			

Reference and Textbooks:-**Text Books**

- Sharma, K. (2020). *Statistical methods*. ABD Publishers.
- Gupta, S. P. (2021). *Statistical methods* (46th ed.). Sultan Chand & Sons
- Rosner, B. (2017). *Fundamentals of Biostatistics* (8th ed.). Cengage Learning.
- Misener, S., Krawetz, S. A. (2000). *Bioinformatics methods and protocols*. Humana Press.
- Ignacimuthu, S. (2013). *Basic bioinformatics*. (2nd ed.). Alpha Science International.
- Harisha, S. (2019). *Fundamentals of Bioinformatics*. Wiley.

Books for reference

- Daniel, W. W., & Cross, C. L. (2019). *Biostatistics: A foundation for analysis in the Health Sciences*. Wiley.
- Healey, JF. (2012). *Statistics: A Tool for Social Research*. (9th ed.). Calif: Wadsworth Cengage Learning.
- Kalyanaraman, K., Ramanathan, H.N., Harikumar, P.N. (2021). *Statistical Methods for Research: A Step-by-Step Approach Using IBM SPSS*. Atlantic Publishers.
- Dwyer, R. A. (2005). *Genomic Perl: From bioinformatics basics to working code*. (2nd ed.). Cambridge University Press.
- Mount, D. W. (2006). *Bioinformatics: Sequence and Genome Analysis*. (2nd ed.). Cold Spring Harbor Laboratory Press.

Outcomes	Students will <ul style="list-style-type: none">➤ Gain knowledge in biological data analysis and its applications in biochemistry.➤ Understand the importance and basics of <i>In silico</i> tools and databases for retrieving and comparing biomolecular sequences
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