MARUDHAR KESARI JAIN COLLEGE FOR WOMEN

(AUTONOMOUS)

Vaniyambadi – 635 751

PG and Research Department of Biochemistry

for

Postgraduate Programme

Master of Science in Biochemistry

From the Academic Year 2024 - 25

LEARNING OUTCOMES BASED CURRICULUM FRAMEWORK FOR

UNDER GRADUATE AND POST GRADUATE EDUCATION

1. Preamble

Biochemistry, as a scientific field, delves into the chemical processes within living organisms, focusing on cellular and molecular levels. The Department of Biochemistry at MKJC aims to produce biochemists who can innovate, invent, and share knowledge for the betterment of humanity. It also seeks to provide students with comprehensive training in applying biochemical skills.

The Department of Biochemistry was established in 2004, the department initiated its Post Graduate course in 2007, followed by the M.Phil course in 2012 and the Research Course (Ph.D) in 2021. Biochemistry covers a wide array of scientific disciplines, including Genetics, Microbiology, Forensics, Plant Sciences, Medicine, and Nutrition. It's an ideal choice for students interested in healthcare delivery services and those who want to contribute innovative information to technological advancements in understanding life processes.

Equipped with advanced tools and instruments, the Biochemistry Department's laboratory conducts a variety of biochemical tests on blood and urine to understand health and disease.

The department organizes National and International Conferences, Health Awareness Programs, and Blood Grouping Programs for first-year students every academic year. These events provide valuable information and problem-solving skills to students in biology.

To foster academic and professional advancement, the department has signed Memorandums of Understanding (MoUs) with Microlab, Sacred Heart College, Vanni Tech, Saveetha Institute of Medical & Technical Science, and Xcellogen Biotech. Currently, the department comprises 10 faculty members and has a student strength of 158.

LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR POST GRADUATE EDUCATION	
Programme	**M.Sc., Biochemistry**
Programme Code	**PS03**
Duration	**2Years[PG]**
Programme Outcomes	**PO1:Disciplinary knowledge:** Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that forma part of an undergraduate Programme of study. **PO2:Communication Skills:** Ability to express thoughts and idea seffectively in writing and orally;Communicate with others using appropriate media;confidently shareone'sview s and express herself/himself; demonstrate the ability to listen carefully, read and write sanalytically,and present complex information in a clear and concise manner to different groups. **PO3:Critical thinking:** Capability to apply analytic thought to a body of knowledge; analyse and evaluate evidence, arguments, claims, be liefson the basis of empirical evidence;identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices,policies and theories by following scientific approach to knowledge development. **PO4:Problem solving: Capacity** to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge;and applyone's learning to real life situations. **PO5:Analytical reasoning**: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples and addressing opposing view points. **PO6:Research-related skills**: A sense of inquiry and capability for asking relevant/appropriate questions, problem arising, synthesising and articulating; Ability to recognise cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyse, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation. **PO7: Cooperation / Teamwork:** Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team **PO8: Scientific reasoning**: Ability to analyse, interpret and draw conclusions from quantitative/qualitative data;and critically evaluate ideas, evidence, and experiences from an open-minded and reasoned perspective.

	PO9 : Reflective thinking: Critical sensibility to lived experiences, withself-awareness and reflexivity of both self and society. **PO10 : Information/digital literacy:** Capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources; and use appropriate software foranalysisofdata. **PO 11: Self-directed learning**: Ability to work independently, identify appropriate resources required for a project, and manage a project through to completion. **PO 12: Multicultural competence:** Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully withdiverse groups. **PO13: Moral and ethical awareness/reasoning**: Ability to embrace moral/ethical values in conducting one's life, formulate a position/argument about anethical issue from multiple perspectives,and use ethical practices in all work. Capable of demonstrating the ability to identify ethical issues related to one's work, avoid unethical behavior such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights;appreciating environmental and sustainability issues; and adopting objective,unbiased and truthful actions in all aspects of work. **PO14: Leadership readiness/qualities:** Capability for mapping out the tasks of a team or an organization, and setting direction, formulating aninspiring vision, building a team who can help achieve the vision,motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way. **PO 15: Lifelong learning:** Ability to acquire knowledge and skills,including learning how to learn", that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.
Programme Specific Outcomes:	**PSO1– Placement:** To prepare the students who will demonstrate respectful engagementwith others' ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions. **PSO2-Entrepreneur:** To create effective entrepreneurs by enhancing their critical thinking,problem solving, decision making and leadership skills that will facilitate startups and high potential organizations. **PSO3 –Research and Development:** Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards Growth and development **PSO4–Contribution to Business World:** To produce employable,ethical,and innovative professionals to sustain in the dynamic business world. **PSO 5–Contribution to the Society:** To contribute to the development of the society by collaborating with stakeholders for mutual benefit.

PROGRAM OUTCOMES

PO1	Acquire knowledge in the field of Biological Sciences and to apply the knowledge in their day-to-day life for betterment of self and society.
PO2	Develop critical, analytical thinking and problem-solving skills
PO3	Develop research related skills in defining the problem, formulate and test the hypothesis, analyse, interpret, and draw conclusion from data.
PO4	Address and develop solutions for societal and environmental needs of local, regionaland national development.
PO5	Work independently and engage in lifelong learning and enduring proficient progress
PO6	Provoke employability and entrepreneurship among students along with ethics and communication skills.
PO7	Understand the importance of ethical behavior in business contexts and be able to recognize and address ethical dilemmas they may encounter in their professional careers.
PO8	Prepared for lifelong learning and professional development, including the ability to adapt to changes in technology, business practices, and economic conditions throughout their careers.

PROGRAM SPECIFIC OUTCOMES

PSO1	Students will be able to Competent in the principles, methods and applications of various techniques in Biochemistry, Immunology, Microbiology, Enzyme kinetics and Molecular Cell Biology for Placement and Entrepreneurial initiatives in relevant fields.
PSO2	Students will be capable of designing and executing experiments with relevant competencies for further research and development.
PSO3	Students will be able to acquire insight into the immune system and its responses, and use this knowledge in the processes of immunization, vaccine development, transplantation and organ rejection as required for a healthy society.

Eligibility for Admission:

Candidate for admission to the first year of M.Sc., Biochemistry shall be required to passed the UG with anyone of the followings - Biochemistry / Chemistry / Microbiology / Biotechnology / Life Sciences.

Methods of Evaluation and Assessment

Methods of Evaluation		
Internal Evaluation		25 Marks
External Evaluation	End Semester Examination	75 Marks
	Total	**100 Marks**
Methods of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
Understand / Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, short summary or overview	
Application (K3)	Suggest idea/concept with examples, suggest formulae, solve problems, Observe, Explain	
Analyze (K4)	Problem-solving questions, finish a procedure in many steps, Differentiate Between various ideas, Map knowledge	
Evaluate (K5)	Longer essay/Evaluation essay, Critique or justify with pros and cons	
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

Semester – III						
24PBCC31	CC – 8 Clinical Biochemistry	3	1	2	0	5
24PBCC32	CC – 9 Molecular Biology	3	1	2	0	5
24PBCC33P	CC - 10 Practical III - Laboratory Courses on Clinical Biochemistry	0	0	6	0	4
24PBCC34	CC – 11 Immunology and Immunotechnology	3	1	1	0	3
24PBCE31 24PBCE32	EC – 5 1. Nutritional Biochemistry 2. Microbiology	2	1	1	0	3
24PBCS31	SEC – 2 Pharmaceutical Biochemistry	1	1	0	0	2
					30	**24**

Semester – IV						
24PBCC41	CC – 12 Gene Editing, Cell and Gene Therapy	3	2	1	0	5
24PBCC42	CC – 13 – Advanced Molecular Endocrinology	3	1	2	0	5
24PBCC43P	CC - 14 Project	0	0	6	0	5
24PBCE41 24PBCE43	EC – 6 1. Research Methodology 2. Phytomedicine	2	1	1	0	4
24PBCF41	PEC – 1 Personality Development and leadership skills	1	1	0	0	2
24PBCL41	SLC – 1 Biotechnology	0	0	1	3	2
					30	**23**
	Total Credits	**90+2***				

Students must complete at least one online course (MOOC) from platforms like SWAYAM, NPTEL, or Nanmudalvan within the fifth semester. Additionally, engaging in a specified Self-learning Course is mandatory to qualify for the degree, and successful participation will be acknowledged with an extra credit of 2*.

L- Learning T- Tutorial P-Practice S-Seminar

CC	Core Course	14
EC	Elective Paper	6
SEC	Skill Enhancement Course	2
AEC	Ability Enhancement Compulsory Courses	1
VE	Value Educations	1
	Internship	1
PEC	Professional Enhancement Course	1
SLC	Self-Learning Course	1
NME	Non-Major Elective	
AECC	Ability Enhancement Compulsory courses	

II YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBCC31	**CC – 8: Clinical Biochemistry**	**Core**	**3**	**1**	**2**	**-**	**5**	**6**	**25**	**75**	**100**

Learning Objectives	
LO1	To gain knowledge on the role of biochemical investigations in diagnosing, prognosing, and monitoring diseases, while identifying and diagnosing blood cell disorders.
LO2	To discuss the Carbohydrate and lipid metabolic disorder disease
LO3	To explore the different organ function tests for liver and kidney.
LO4	To explore the Hormonal disorders free Radical and Diseases
LO5	To understand the clinical significance of diagnostic enzymes

Unit	Content	Hours
I	**Biochemical investigations in diagnosis, prognosis, monitoring, screening:** Specimen collection – blood, (primary /Secondary specimen)., urine and CSF. Preservation of biological specimens -blood, urine, CSF and amniotic fluid. ; . Biological reference ranges; **Disorders of blood cells:** Hemolytic, iron deficiency and aplasticanemia and diagnosis, sickle cell anaemia, thalassemia HBA1C variants. Porphyrias, Thrombocytopenia, Causes of leucopenia, leukemia and leucocytosis. Disorders of blood clotting mechanism - Von wille brands disease, Hemophilia A, B and C, diag	16
II	**Diabetes mellitus:** pathology and complications: Acute changes; Chronic complications: Diabetic nephropathy, neuropathy, retinopathy and Diabetic foot ulcers, Random/Fasting/PP glucose testing, Impaired glucose tolerance (IGT), Impaired fasting glucose (IFT), Diagnosis-by GTT, Pre-diabetes, Gestational DM ,Glycosylated Haemoglobin (HBA1c) ; Glycated albumin., Hypoglycaemia and critical alert value for glucose. Markers of complications of Diabetes mellitus: Metabolic syndrome. Lipid profile & lipoproteinemia, Atherosclerosis, Diabetic nephropathy, Micralbuminuira, eGFR, Diet and life style modifications	16

III	**Liver function tests.** Serum bilirubin, Serum albumin, Alanine transaminase (ALT), Aspartate transaminase (AST), Alkaline phosphatase (ALP), Gamma-glutamyl transpeptidase (GGT), Serum glucose test, Prothrombin time (PT), Van Ben Bergh reaction. **Renal function tests**. Clearance Tests: Creatinine clearance test, Urea clearance test, Inulin clearance test, Blood Urea Nitrogen	20
IV	**Hormonal disorders and diagnostics:** T3, T4 and TSH in the diagnosis of thyroid disorders; Diagnostic methods for disorders associated with adrenal, pituitary and sex hormones - Addison‟s disease, Cushing‟s syndrome, pituitary tumour, Hypopituitarism, Hypogonadism. **Free Radical and Diseases:** Free radicals - reactive oxygen species and reactive nitrogen species. Formation of free radicals- Oxidative stress- Free radical and diseases. Metabolism of iron, calcium and phosphorus, Trace elements and their deficiency. Applications of Artificial Intelligence in Medicine.	20
V	**Diagnostic Enzymology:** Clinically Important Enzymes and Isoezyme as diagnostic markers: Clinical significance of AST, ALT, ALP, ACP, CK, γ-GT, amylase, pseudocholinesterase and their pattern in .Myocardial infarction; Liver disease, Bone disease, Muscle disease, Cancer (tumor markers), GI tract pancreatitis); Enzymes as therapeutic agents. **Pre- and post-natal testing:** Amniocentesis, prenatal detection of inborn errors of metabolism in developing fetus-Autosomal recessive mode of inheritance- cystic fibrosis, X linked recessive inheritance-Duchenne muscular dystrophy. New born screening (NBS) for In born errors of metabolism, Tandem mass spectrometry application in NBS	18
	Course Outcomes **The student will be able to**	
CO1	Appreciate the basics of clinical biochemistry lab practices and biological sample analysis	
CO2	Access the disorders of Carbohydrates and lipids metabolism	
CO3	Analyze and implement the various organ function tests.	
CO4	Access the Hormonal disorders and free radical diseases	
CO5	Examine the Clinically Important Enzymes and Pre and Post-natal testing	

Textbooks:	
1	MN. Chatterjee - Text book of medical biochemistry - Fourth edition- Jaypee Publisher
2	U.Sathyanarayana& U. Chakrapani, Biochemistry - Third edition, Book and Allied (p) ltd.
se 3	Vasudevan DM, Sreekumari S, Vaidyanathan K. Biochemistry for Medical Students. 3rd ed. New Delhi: Jaypee Brothers Medical Publishers; 2020.
4	K.V. Krishna Das, Text Book of Medicine - Jaypee Brothers Medical Publishers (P) Ltd, 1996.
5	Ambika Shanmugam's Biochemistry for medical students, 8 th edition, published by Wolters Kluwer India Pvt. Ltd.
Reference Books:	
1	Philip. D. Mayne, Clinical Chemistry in diagnosis and treatment.ELBS Publication, 6 th edition, 1994.
2	Thomas M. Devlin (2014) Text book of Biochemistry with clinical correlations (7thed). John Wiley and sons.
3	Tietz Fundamentals of clinical chemistry and molecular Diagnostics (2014) (7thed) Saunders.
4	Crook MA. Clinical Biochemistry in Practical Medicine. 2nd ed. London: CRC Press; 2018
5	Ferrier DR. Lippincott's Illustrated Reviews: Biochemistry. 8th ed. Philadelphia, PA: Wolters Kluwer; 2022.

Webresources:	
1	https://labtestsonline.org.uk/articles/accuracy-precision-specificity-sensitivity https://www.inorganicventures.com/icp-guide/accuracy-precision-mean-and-standard-deviation
2	https://www.niddk.nih.gov/health-information/blood-diseases
3	https://www.britannica.com/science/metabolic-disease/Disorders-ofcarbohydrate metabolism https://medlineplus.gov/carbohydratemetabolismdisorders.html https://www.osmosis.org/learn/Disorders_of_carbohydrate_metabolism:_Pathology_review https://pmc.ncbi.nlm.nih.gov/articles/PMC8551734/
4	https://www.webmd.com/a-to-z-guides/inherited-metabolic-disorder-types-and-treatments
5	https://www.slideshare.net/MohitAdhikary/gastric-and-pancreatic-function-tests

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	3	2	3	3	3	2	3	3	3	3	3
CO4	3	2	3	3	3	2	3	3	3	3	3
CO5	3	2	3	3	3	3	3	3	3	3	3
Total	15	9	15	15	15	13	15	15	15	15	15
Average	3	2	3	3	3	2.6	3	3	3	3	3

3 – Strong, 2- Medium, 1- Low

II YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBCC32	**CC – 9 : Molecular Biology**	**Core**	**3**	**1**	**2**	**0**	**5**	**6**	**25**	**75**	**100**

Learning Objectives	
LO1	To provide an in-depth understanding of Gene Mapping and Genome Organization in Prokaryotes and Eukaryotes.
LO2	To impart knowledge on DNA replication and repair.
LO3	To provide a comprehensive understanding of the Mechanisms of Gene Expression: Transcription and Translation in Prokaryotes and Eukaryotes.
LO4	To explore the mechanisms of Regulation of gene expression.
LO5	To provide an in-depth understanding of Post-Transcriptional and Post-Translational Modifications and their mechanisms.

Unit	Content	Hours
I	**Gene Mapping and Genome Organization in Prokaryotes and Eukaryotes:**The bacterial chromosome, The eukaryotic genome-chromosome structure – Histones, Nucleosome, chromatin-heterochromatin, euchromatin, chromatin remodelling, DNAase hypersensitive sites, genome organization – the C-value paradox, reassociation kinetics, repetitive sequences, gene amplification, telomeres, organelle genomes – mitochondrial and chloroplast genome. Gene mapping in haploids and diploids, recombination mapping- restriction mapping.	16
II	**DNA replication and repair:** Enzymes of replication, prokaryotic replication mechanisms, primosome& replisomes, eukaryotic DNA replication, the role of topoisomerases and telomerase, regulation of replication. DNA repair mechanisms – Direct repair, excision repair, mismatch repair, recombination repair, SOS response, eukaryotic repair systems. Recombination and mobile genetic elements- the Holliday model, the general recombination in *E.coli*, site-specific recombination, transposons, and retroposons.	20
III	**Mechanisms of Gene Expression: Transcription and Translation in Prokaryotes and Eukaryotes:** **Transcription**: Prokaryotic transcription-subunits of RNA polymerase, E. coli promoters, sigma factor and promoter recognition, alternative sigma factors, initiation, elongation, Rho-dependent and independent termination of transcription. Eukaryotic transcription- Initiation, promoter elements, RNA polymerases,	20

	transcription factors, regulatory sequences in eukaryotic protein – coding genes, CpG islands, enhancers. Post transcriptional modifications in eukaryotes- RNA processing mRNA 5' capping and 3'poly-adenylation, introns and exons, RNA splicing,- spliceosome assembly, alternative splicing, processing of tRNA and rRNA, self-splicing, ribozymes, RNA editing- substitution and insertion/deletion editing, Genome editing-CRISPR- Cas technology **Translation**: Organization of the ribosome,The role of tRNA and rRNA, suppressor tRNAs the genetic code, evidencefor a triplet code, deciphering the genetic code, wobble hypothesis, deviation in the genetic code, unusual codons. Activation, initiation, elongation and termination of translation in E. coli and inhibitors of protein synthesis.	
IV	**Regulation of gene expression:** Regulation of gene expression in prokaryotes Positive and negative control, the lac operon, identification of operator and regulator sequences by mutations, induction and repression, Foot-printing and gel-shift assays for identification of protein-DNA interactions. Catabolite repression. *Trp* operon– Attenuation, alternative secondary structures of *trp*mRNA. Regulation of gene expression in eukaryotes- Response elements, DNA binding motifs, steroid receptors, association of methylation and histone acetylation with gene expression.	16
V	**Protein Sorting:**Post translational modification of proteins-Proteolytic cleavage, covalent modifications, glycosylation of proteins, disulfide bond formation, Protein sorting – signal peptides, transport of secretory proteins, Golgi and post-golgi sorting, coated vesicles, targeting of mitochondrial, lysosomal and nuclear proteins, Protein degradation-Ubiquitination of proteins, Protein folding-chaperones.	18

	Course Outcomes **The student will be able to**
CO1	Analyze and interpret Gene Mapping and Genome Organization in Prokaryotes and Eukaryotes.
CO2	Describe the fundamental processes of DNA replication and repair.
CO3	Explain the mechanisms of transcription and translation in prokaryotes and eukaryotes.
CO4	Compare and contrast gene regulation mechanisms in prokaryotes and eukaryotes.
CO5	Assess to explain the molecular processes involved in RNA and protein modifications.

Textbooks:	
1	Lewin's Genes XII: 12th edition, Krebs JE, Goldstein ES, Kilpatrick ST; Prentice Hall, Delhi
2	Molecular Cell Biology: 8th edition, Lodish H, Arnold Berk; W.H.Freeman& Co, New York
3	Karp's Cell and Molecular Biology: Concepts and Experiments, 8th Edition; Wiley, India
4	Essential Cell Biology :3rd edition, Alberts B, Bray D, Hopkin K, Johnson A, Lewis J, Raff M, Roberts K, Walter P; Garland Science, New York
5	Molecular Biology of the Gene: 6th edition, Watson JD, Baker TA, Bell S, Gann A, Levine M, Losick R; Cold Spring Harbor Laboratory Press, New York
Reference Books:	
1	Cox, M. M., Doudna, J. A., & O'Donnell, M. (2015). *Molecular biology: Principles and practice*. W.H. Freeman and Company.
2	Green, M. R., & Sambrook, J. (2012). *Molecular cloning: A laboratory manual* (4th ed.). Cold Spring Harbor Laboratory Press.
3	Goodman, M. F. (2007). *DNA repair and mutagenesis* (2nd ed.). ASM Press.
4	Berg, J. M., Tymoczko, J. L., &Stryer, L. (2007). *Biochemistry* (6th ed.). W.H. Freeman and Company.
5	Twyman, R. M. (2014). *Advanced molecular biology: A comprehensive review of molecular biology concepts and techniques*. Garland Science.

Webresources:	
1	https://mooc.es/course/molecular-biology/
2	https://onlinecourses.swayam2.ac.in/cec20_ma13/preview
3	https://lifescienceinteractive.com/category/molecular-biology/
4	https://learn.genetics.utah.edu/
5	https://www.cellbio.com/education.html

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	3	3	3	3	3
CO2	3	3	3	3	2	2	2	3	3	3	3
CO3	3	3	3	1	2	2	2	3	3	3	3
CO4	3	3	3	3	2	2	2	3	3	3	3
CO5	3	3	3	3	3	2	3	3	3	3	3
Total	15	15	15	12	11	10	12	15	15	15	15
Average	3	3	3	2.4	2.2	2.0	2.4	3	3	3	3

3 – Strong, 2- Medium, 1- Low

II YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBCC33P	**CC -10 Practical III - Laboratory Course on Clinical Biochemistry**	**Core**	**-**	**-**	**6**	**-**	**4**	**6**	**25**	**75**	**100**

Learning Objectives	
LO1	To learn how to measure RBC, WBC (both total and differential counts), ESR, Bleeding Time, and Clotting Time.
LO2	To explain the Measure plasma protein levels and determine the A/G ratio, indicating liver.
LO3	To illustrate the Perform estimations of key renal markers like blood urea, creatinine, and uric acid to evaluate kidney function.
LO4	To describe the procedure and clinical significance of estimating cholesterol levels using Zak's method.
LO5	To gain hands-on experience in various techniques for Antigen and Antibody reaction, venipuncture, blood collection and Automation in Clinical Biochemistry.

Unit	Content	Hours
1	**Haematology:** a) RBC count b) Total WBC count-total and differential count c) ESR d) Estimation of hemoglobin By Shali's method.	90
2	**Liver function test:** a) Estimation of Bilirubin direct and indirect. b) Estimation of Plasma protein, A/G ratio c) Estimation of Alanine Aminotransferase (ALT) d) Estimation of Aspartate Aminotransferase (AST) e) Estimation of Lactate Dehydrogenase (LDH)	
3	**Renal function test:** a) Collection and Preservation of Urine sample(pH, Specific Gravity, Color) b) Qualitative tests for normal and pathological components of urine. c) Estimation of blood Urea by DAM method d) Estimation of blood Creatinine by Alkaline picrate methods e) Estimation of blood uric acid by Phosphotungstic Acid Method	

4	a) Estimation of blood glucose by Ortho toluidine b) Lipid profile: Estimation of cholesterol by Zak's method	
5	**Group Experiments** a) Antigen-Antibody Reaction - HCG kit method b) Phlebotomy-Venipuncture, Different techniques of venipuncture c) Collection of blood, Serum or Plasma separation and Storage. **d)** Automation in Clinical Biochemistry Semi autoanalyzer -Demo	

CO	**The student will be able to Course Outcomes**
CO1	Accurately measure RBC, WBC (total and differential counts), ESR
CO2	Analyze and measure plasma protein levels and determine the A/G (albumin/globulin) ratio, which plays a critical role in assessing liver.
CO3	Perform estimations of key renal markers—blood urea, creatinine, and uric acid to evaluate kidney function.
CO4	Estimate cholesterol levels using Zak's colorimetric method.
CO5	Gain practical experience in various essential laboratory techniques.

Textbooks:	
1	Voet, Donald and Judith G. Voet, Book Name: Biochemistry, Edition Year: 4th Edition (2011), Publisher: John Wiley & Sons
2	J. JayaramanLaboratory Manual in Biochemistry, New Age International Pvt Ltd Publishers, 2011
3	S. K. SawhneyRandhir Singh, Introductory Practical Biochemistry, Alpha Science International, Ltd 2 edition, 2005.
4	Alan H GowenlockVarley's Practical Clinical Biochemistry, CBS Publishers and distributors, India Sixth Edition, 1988.
5	Practical Biochemistry - K. Wilson and I. Walker. 5th edition, Cambridge University press, 2000.
Reference Books:	
1	Medical laboratory Technology Volume I, II & III - KL Mukherjee
2	Biochemical Methods - S.Sadasivam&A.Manickam, New Age International
3	Practical Biochemistry – Shawney.
4	Gupta, Book Name: Practical Biochemistry, Edition Year: 3rd Edition (2017) Publisher: Tata McGraw-Hill
5	J. A. Berg and R. M. R. C. McKenzie, Book Name: Practical Biochemistry: Principles and Techniques, Edition Year: 2nd Edition (2018), Publisher: Springer
Webresources:	
1	https://courseware.cutm.ac.in/wp-content/uploads/2020/06/Practice-6.pdf
2	https://www.iitg.ac.in/biotech/BTechProtocols/Ascorbic.pdf
3	https://webstor.srmist.edu.in/web_assets/srm_mainsite/files/files/3%20ESTIMATION%20OF%20SUGAR.pdf
4	https://fssai.gov.in/upload/uploadfiles/files/Revised-method-acid-value_Oils_Fats_20_02_2018.pdf
5	https://egyankosh.ac.in/bitstream/123456789/43428/1/Experiment-24.pdf

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	3	1	2	2	3	2	2	2
CO2	3	3	2	2	2	3	2	2	2	2	3
CO3	3	3	3	3	2	2	2	3	2	2	2
CO4	3	3	3	3	2	3	2	3	2	2	3
CO5	3	3	2	2	2	3	2	2	2	2	3
Total	15	14	13	13	9	13	10	13	10	10	13
Average	3	2.8	2.6	2.6	1.8	2.6	2	2.6	2	2	2.6

3 – Strong, 2- Medium, 1- Low

II YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBCC34	CC – 11 Immunology and Immunotechnology	Core	3	1	1	0	3	5	25	75	100

Learning Objectives	
LO1	To understand the wide knowledge about Immunity and Lymphoid Organs and Immune Cells.
LO2	To explain the Structure and Properties of Antigens & Antibodies and acquire the knowledge on Major Histocompatibility Complex.
LO3	To analyze the clinical manifestations of various Autoimmune diseases and Hypersensitivity.
LO4	To evaluate clinical diagnostic applications of various Immunotechniques.
LO5	To create a vaccine chart and illustrate key characteristics and differences between vaccine types.

Unit	Content	Hours
I.	History of immunology - Types of immunity: Innate and acquired Immunity, Antibody Mediated Immunity and Cell Mediated Immunity-Lymphoid organs: primary & secondary – Hematopoiesis- Cells of the Immune System - T Lymphocytes, B Lymphocytes and Natural Killer Cells, Antigen Presenting Cells.	15
II.	Antigens and immunogens – Characteristics of ideal antigens – Properties and Types of Antigens - haptens and adjuvants. Antibody types – Domain structure and biological properties – Antibody diversity. Antigen antibody interactions –Agglutination assays and Precipitation assays. Major Histocompatibility Complex (MHC). Complement Pathways.	15
III.	Hypersensitivity: types – Clinical aspects of type I, Type II, III and IV - Autoimmune diseases – Addisons Disease, Rheumatoid Arthritis, Grave's Disease and Myasthenia Gravis. Transplantation – Types of Grafts, Graft Rejection and Graft Acceptance.	15
IV.	Principles of ELISA – types- direct, indirect and sandwich – clinical diagnostic applications - ELISpot assay. Principles and Applications – RIA, Immunohistochemistry, Immunoelectrophoresis, Isoelectric Focussing (IEF) Immunofluorescence and Western Blotting. Hybridoma Technology.	15

V.	Definition of Vaccine - Vaccination methods- History of Vaccine development -Types of Vaccines and their Characteristics – Whole Organism Vaccines (Killed Vaccines and Live Attenuated Vaccines) – Subunit Vaccines (Toxoid Vaccines and Polysaccharide Vaccines) and Nucleic Acid Vaccines (DNA Plasmid Vaccines and Recombinant Vector Vaccines). Vaccine Chart.	15

	Course Outcomes **The student will be able to**
CO1	Analyze the types of Immunity, Immune cells and Lymphoid Organs and its mechanism.
CO2	Apply knowledge of antigen-antibody interactions to understand the principles of immunological assays.
CO3	Evaluate the clinical manifestations and treatment options for autoimmune diseases and describe the clinical aspects of each type of hypersensitivity reaction
CO4	Identify the techniques and applications of immunohistochemistry, immunoelectrophoresis, isoelectric focusing (IEF), immunofluorescence, and Western blotting.
CO5	Assess the vaccine production, types and its applications.

Textbooks:	
1	J. Kuby, R.A. Goldsby, T.J. Kindt and B.A. Osborne, B.A. (2007), Immunology, 4th edition, W.H. Freeman and Company, New York, USA.
2	I. Roitt, J. Brostoff and DMale (2002), Essential Immunology, 8th edition, English Language Book Society, London.
3	J. Kuby (2002), Immunology, 5th edition, W.H. Freeman and Company, New York.
4	Annadurai. B (2008), A textbook of Immunology and Immunotechnology, 1st Edition. S.Chand& Co, Ltd,New York.
5	Rajasekaran Pandian (2007), Immunology and Immunotechnology, Panima Publishers, Chennai.
Reference Books:	
1	Benjamini E, Coico R and G. Sunskise (2008) Immunology a short course. IV edn. (Chapters 1–13) Wiley – Liss publication.
2	Peter J.Delves, Ivan Maurice Roitt,,Seamu J. Martin and Deninis Burton (2006), Roitt's Essential Immunology, 11th edition.
3	Immunology and Immunotechnology, Ashim K.Chakravarthy.
4	Murphy Kenneth (2008), Janeway's Immunobiology, Garland Science Publishers.
5	Ian R. Tizard (2000), Immunology: An Introduction., 4th edition, W.B.SaundersCo.,Philadelphia.

Webresources:	
1	https://ebooks.inflibnet.ac.in/biocp16/chapter/types-of-immunity-innate-and-acquired/
2	https://microbiologynotes.org/immunoglobulin-introduction-structure-and-function/
3	https://www.biologydiscussion.com/biochemistry/immunochemical-techniques/top-7-types-of-immunochemical-techniques-used-in-biochemistry/12525#google_vignette
4	https://microbenotes.com/hypersensitivity-introduction-causes-mechanism-and-types/
5	https://byjus.com/biology/vaccine-definition/

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	1	3	3	3	3	3	3	3	2
CO2	3	2	2	2	3	3	3	3	3	3	2
CO3	3	2	1	2	3	3	3	3	3	3	3
CO4	3	2	2	2	3	3	3	3	3	3	3
CO5	3	2	1	2	3	3	3	3	3	3	3
Total	15	10	7	11	15	15	15	15	15	15	13
Average	3	2	1.4	2.2	3	3	3	3	3	3	2.6

3 – Strong, 2- Medium, 1- Low

II YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBCE31	**EC – 1. Fundamentals of Nutritional Biochemistry**	**EC**	**2**	**1**	**1**	**0**	**3**	**4**	**25**	**75**	**100**

Learning Objectives	
LO1	To impart knowledge about basic concepts of nutrition.
LO2	To identify and understand the Role of Elements in Nutritional Biochemistry.
LO3	Tounderstand nutritional deficiency diseases.
LO4	To analyze the role of antioxidants.
LO5	To evaluate the diet therapy for various diseases.

Unit	Content	Hours
I.	**Concepts of Nutrition**: Food groups and balanced diet. Novel Foods. The calorific value of foods: Direct and indirect calorimetry. Empty calories. Basal metabolic rate: Factors affecting BMR. SDA and physical activity. Calculation of the day's energy requirement. Nutritional requirement and biochemical changes in different physiological states -infancy, childhood, pregnancy, lactation, and aging. Sports nutrition.	12
II.	**Role of Elements in Nutritional Biochemistry**: Plant and animal sources of simple and complex carbohydrates, fats, proteins, Vitamins, and Minerals and their requirement and biochemical functions Role of dietary fiber. Protein-sparing action of carbohydrates and fats. Essential amino acids. Essential fatty acids. Effects of naturally occurring food toxins, preservatives, additives, alcohol, and tobacco on health.	12
III.	**Nutritional Deficiency Diseases:** Diseases arise from Protein - Calorie Malnutrition, and undernutrition (Kwashiorkor and Marasmus). Prevention. Deficiency diseases associated with the vitamin B complex include Beri-Beri, Cheilosis, Glossitis, Pellagra, and Scurvy. Diseases associated with fat-soluble Vitamins A, D, E & K - Night Blindness, Rickets, Osteoporosis, Anemia, and Hemorrhagic diseases. Mineral deficiency diseases - symptoms and dietary supplementation. Enrichment and fortification (vitamins and minerals)	12
IV.	**Role of Antioxidants:** Concept of Antioxidants and free radicals. The effect of free radicals, Disease-fighting antioxidants, Sources of antioxidants, and antioxidants, Dietary recommendations for antioxidants- Sources and role of isoprenoids, isoflavones, flavonoids, carotenoids, tocotrienols, terpenoids,	12

	lycopene proanthocyanin, Concept of probiotic, prebiotic, and symbiotic, and its applications in human nutrition.	
V.	**Diet Therapy:** Diet for infection and fevers (typhoid, influenza, malaria), obesity and underweight, cardiovascular diseases, gastrointestinal diseases (Peptic ulcer, Constipation, Irritable bowel syndrome), diabetes, kidney diseases (Glomerular nephritis, Dialysis), food sensitivity and cancer.	12

CO	**The student will be able to Course Outcomes**
CO1	Appropriatelearn the basic concepts of Nutrition.
CO2	Examine the role of Elements in Nutritional Biochemistry.
CO3	Evaluate the Nutritional Deficiency Diseases.
CO4	Identify the Role of Antioxidants.
CO5	Create Diet Therapy for various diseases.

Text Books	
1	Srilakshmi. E .(2016) Nutrition Science, New Age International Publishers.
2	M. Swaminathan (1995) Principles of Nutrition and Dietetics. Bappco
3	Mahan, Kathleen L. (2004) Krause's Food, Nutrition and Diet Therapy, W.B.Saunder's 11th Edition
4	Tom Brody (1998) Nutritional Biochemistry (2nd ed). Academic Press, USA
5	Margaret Mc Williams (2012). Food Fundamentals (10th ed) Prentice Hall Press, USA
Reference Books:	
1	Andreas M. Papas (1998). Antioxidant Status, Diet, Nutrition, and Health (1st ed) CRC Press.
2	Weighley, E.S. 1997. Robinson's Basic Nutrition and Diet Therapy, 8th Edition, Macmillan Publishers.
3	Bamji,M.S.et al., 2009. Textbook of Human Nutrition, 3rd Edition, Oxford and IBH Publishers.
4	Insel, P. et al. 2013. Discovering Nutrition, 4th Edition, Jones and Bartlett Publishers.
5	Human Nutrition and Dietetics by Davidson and Passmore. Churchill Livingstone; 8th edition (1986)
6.	Modern Nutrition and Health Diseases by M.E. Skilis and V.R. Young

Web resources:

1. https://www.jmedscindmc.com/article.asp?issn=1011-4564;year=2014;volume=34;issue=5;spage=211;epage=213;aulast= Shrivastava
2. https://www.researchgate.net/figure/Relationship-between- malnutrition-infection-and-immunity-Malnutrition-is-considered- the_fig1_280722727
3. https://en.wikipedia.org/wiki/Novel_food
4. https://www.chemicalsafetyfacts.org/preservatives/
5. https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/food-enrichment

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	1	2	3	1	3	2	2	3
CO2	3	3	3	3	2	2	1	3	2	3	2
CO3	3	3	3	3	2	2	2	3	2	2	3
CO4	3	3	3	3	2	2	2	3	2	2	3
CO5	3	3	3	2	2	1	2	3	2	2	3
Total	15	14	15	12	10	10	08	15	10	11	14
Average	3	2.8	3	2.4	2	2	1.6	3	2	2.2	2.8

3 – Strong, 2- Medium, 1- Low

II YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBCE32	**EC 2: Microbiology**	**EC**	**2**	**1**	**1**	**0**	**3**	**4**	**25**	**75**	**100**

Learning Objectives	
LO1	To describe the ultra-structure of bacteria, fungi, algae, and protozoa. Classify microbes based on morphological and molecular taxonomy.
LO2	To illustrate microbial growth and explain its mathematical expression. the microbial growth curve and describe its different phases. Various methods for measuring microbial growth.
LO3	To understand the principles of microbial nutrition and the requirements for microbial growth. and different types of culture media based on microbial nutritional needs.
LO4	To classify viruses based on their host range (bacterial, plant, animal, and tumor viruses). the classification and structural characteristics of viruses.
LO5	To evaluate the mechanisms and impact of antibiotic resistance in microbial infections. antibiotics derived from prokaryotic sources and their applications.

Unit	Content	Hours
1	**MORPHOLOGY AND ULTRASTRUCTURE** Ultrastructure of bacteria, fungi, algae and protozoa. Classification of microbes, molecular taxonomy, cell walls of eubacteria - peptidoglycan and related molecules. Structure and synthesis of cell wall and cell membrane of gram-positive and negative bacteria. Flagella and motlility. Cell inclusion bodies. Blue and green bacteria. Budding and appendaged bacteria, spirilla, spirochaetes, gliding and sheathed bacteria, pseudomonads, lactic and propionic acid bacteria. Endospore-forming rods and cocci, mycobacteria, rickettsia and mycoplasma. Archaebacteria.	12
2	**MICROBIAL GROWTH AND METABOLISM** Microbial growth - definition. Mathematical expression of growth, growth curve, measurement of growth and factors affecting growth. Microbial metabolism - overview, photosynthesis in microbes. Role of chlorophylls, carotenoids and phycobilins, Calvin cycle. Chemolithotrophy: hydrogen - iron - nitrite-oxidizing bacteria: nitrate and sulfate reduction: methanogenesis and acetogenesis, fermentations - diversity, syntrophy - role of anoxic decompositions. Nitrogen metabolism, nitrogen fixation, hydrocarbon transformation	12

3	**MICROBIOLOGICAL TECHNIQUES** Methods in microbial identification. Pure culture techniques. Theory and practice of sterilization. Principles of microbial nutrition, construction of culture media. Enrichment culture techniques for isolation of chemoautotrophs, chemoheterotrophs and photosynthetic microbes.	12
4	**VIRUSES** Bacteria, plant, animal and tumor viruses. Classification and structure of viruses. Lytic cycle and lysogeny. DNA viruses: positive and negative strands. Double-stranded RNA viruses. Replication: example of herpes, pox, adenoviruses, retroviruses, viroids and prions	12
5	**MEDICAL MICROBIOLOGY** Disease reservoirs; Epidemiological terminologies. Infectious disease transmissions. Respiratory infections caused by bacteria and viruses; Tuberculosis, sexually transmitted diseases including AIDS; Vector bone diseases, water borne diseases, Public health and water quality. Pathogenic fungi, Antimicrobial agents, Antibiotics. Penicillins and cephalosporins, Broad spectrum antibiotics. Antibiotics from prokaryocytes, antifungal antibiotics - mode of action, Resistance to antibiotics.	12

CO	**Student will be able to Course Outcomes**
CO1	Demonstrate knowledge of microbial ultrastructure, morphology, and classification based on molecular taxonomy.
CO2	Analyze microbial growth and nutritional requirements for laboratory applications, and formulate suitable culture media for different microbial groups.
CO3	Implement enrichment culture techniques to investigate diverse microbial metabolic processes.
CO4	Compare and contrast the lytic and lysogenic replication cycles, and evaluate the replication strategies of DNA and RNA viruses, including the molecular mechanisms of herpes, pox, adenoviruses, and retroviruses.
CO5	Assess the effectiveness of antimicrobial agents, including antibiotics and antifungal drugs, by evaluating their mechanisms of action and clinical applications.

Textbooks:	
1	Brock Biology of Microorganisms (13th Edition) 13th Edition by Michael T. Madigan (Author),
2	Quantitative Aspects of Growth and Metabolism of Microorganisms" by A.H. Stouthamer
3	Handbook Of Techniques In Microbiology - A Laboratory Guide To Microbes, A.S. Karwa, M.K. Rai & H.B. Singh
4	Principles of Virology" by S.J. Flint, L.W. Enquist, V.R. Racaniello, and A.M. Skalka
5	Medical Microbiology" by Patrick R. Murray, Ken S. Rosenthal, and Michael A. Pfaller
Reference Books:	
1	**Prescott'Microbiology"**Joanne Willey, Linda Sherwood, and Christopher J. Woolverton
2	Microbial Growth and Metabolis General Microbiology - 1st Edition"LindaBruslin.
3	Microbiology by OpenStax Paperback – Import, 6 February 2023 by Nina Parker (Author), Mark Schneegurt (Author), Anh-Hue Thi Tu (Author) .
4	Medical Microbiology, 4th edition Samuel Baron.Galveston (TX): University of Texas Medical Branch at Galveston; 1996.ISBN-10: 0-9631172-1-1
5	The Short Textbook of Medical Microbiology: Including Parasitology 10th Edition by M.D. Gupte, Satish (Author), Dr. Sekhon, A. S.

Web resources:	
1	https://drive.google.com/drive/folders/17teC8hUgF7fkOVFn8bvGTRN28ayoEmXL?usp=drive_link– eBooks google drive
2	https://link.springer.com/book/10.1007/978-981-16-0723-3
3	https://asm.org/articles/2020/december/virtual-resources-to-teach-microbiology-techniques
4	https://openstax.org/books/microbiology/pages/6-2-the-viral-life-cycle
5	https://en.wikipedia.org/wiki/Antimicrobial_resistance

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	3	2	3	3	3	2	3	3	3	3	3
CO4	3	2	3	3	3	2	3	3	3	3	3
CO5	3	2	3	3	3	3	3	3	3	3	3
Total	15	9	15	15	15	13	15	15	15	15	15
Average	3	2	3	3	3	2.6	3	3	3	3	3

3 – Strong, 2- Medium, 1- Low

II YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBCS31	**Skill Enhancement Course: Pharmaceutical Biochemistry**	**SEC**	**1**	**1**	**-**	**-**	**2**	**2**	**25**	**75**	**100**

Learning Objectives	
LO1	Define the fundamental concepts of pharmacology, including drug classification, sources, and principles of drug action.
LO2	Explain the pharmacokinetics processes and analyze factors affecting drug bioavailability and dosage adjustments.
LO3	Illustrate the drug-receptor interactions and Dose-Response Relationship.
LO4	Describe the methods involved in new drug development and calculate LD50 and ED50 values in toxicity studies.
LO5	Evaluate the clinical trial phases and analyze the biochemical mode of action of antibiotics.

Unit	**Content**	**Hours**
I.	Definition, Scope, Importance and applications of Pharmacology. Drug - Sources and Classification. Routes of Drug Administration - Enteral Route - Oral, Sublingual, Buccal, Rectal. Parenteral Route - Intravenous, Intramuscular, Subcutaneous, Intradermal, Intraperitoneal, Intra-articular, Intra-arterial, Intrathecal. Topical Route- Inhalation, Nasal, Otic, Ophthalmic, Dermal.	6
II.	Pharmacokinetics – Drug Absorption- Factors Affecting Drug Absorption, Distribution- Bioavailability, Metabolism- Phase I, Phase II and Phase III Reactions, and Excretion. Half-Life and Dosage Adjustment.	6
III.	Pharmacodynamics – Mechanism of Drug Action. Drug-Receptor Interactions. Dose-Response Relationship- Potency, Efficacy, and Therapeutic Index. Agonists, Antagonists, and Enzyme Inhibitors	6
IV.	Methods involved in the development of new drugs. Drug safety, Preclinical studies. Calculation of LD50, ED50. Acute, subacute and chronic toxicity studies.	6
V.	Clinical trials (Phase-I, Phase-II, Phase-III and Phase-IV clinical trial). Biochemical mode of action of antibiotics- penicillin and chloramphenicol.	6

CO	The student will be able to Course Outcomes
CO1	Summarize the scope, classification, and general principles of pharmacology, along with different drug administration routes.
CO2	Analyze drug metabolism and excretion processes, apply knowledge to adjust drug dosages.
CO3	Analyze the different drug-receptor interactions and dose-response relationships in pharmacodynamics.
CO4	Interpret toxicological study data and evaluate the safety profile of drugs using LD50, and ED50 calculations.
CO5	Assess the significance of clinical trial phases and design a basic framework for understanding antibiotic mechanisms of action.

Textbooks:	
1	Ruchi Tiwari, Textbook of Pharmacology, Shashwat Publication, 1st Edition
2	Prasad Neerati, Textbook of Pharmacology, Shashwat Publication, 1st Edition
3	Joginder Singh Pathania, Rupendra Kumar Bharti, and Vikas Sood, Textbook of Pharmacology, Vision Health Sciences Publisher, 2nd Edition, 2022.
4	Thieme's Color Atlas of Pharmacology by Heinz Lullmannhttps://drive.google.com/file/d/17cobo-ZXQU1rdG5uZk4rX1Xc69nUZx7a/view?usp=drive_link
5	VN Sharma, Pharmacology for Health Professionals ANZ Book. By Kathleen Knights. CBSPD (2015)
Reference Books:	
1	Lippincott Illustrated Reviews: Pharmacology: Edited by Karen Whalen, 2nd South Asian Edition https://drive.google.com/file/d/1azL_Y0awUWdOGtMeSKpfE40hD8i9te-K/view?usp=drive_link
2	Goodman and Gilman's the Pharmacological Basis of Therapeutics, 14th Edition by Laurence Brunton; Bjorn Knollmann.
3	Katzung's Basic and Clinical Pharmacology, 16th Edition by Todd W. Vanderah 2024.https://drive.google.com/file/d/1p4kXZ8dkglof_uC6LyqRZH2xwXDML-yq/view?usp=drive_link
4	A Textbook of Clinical Pharmacology and Therapeutics, James M Ritter, fifth edition. https://drive.google.com/file/d/14l3Q8RnJOvo4sVdehpDhOJT5fk8ULuYo/view?usp=drive_link
5	Essentials Of Pharmacology Basic Principles and General Concepts (Fifth Edition)

Webresources:	
1	https://drive.google.com/drive/folders/17teC8hUgF7fkOVFn8bvGTRN28ayoEmXL?usp=drive_link – eBooks google drive
2	https://tvuni.academia.edu/mvinayagam - Educational networks to share research, knowledge, teaching documents, chapters, e-notes, e-books, thesis, materials.
3	https://ncert.nic.in/textbook.php
4	National Digital Library - https://ndl.iitkgp.ac.in/
5	https://efaidnbmnnnibpcajpcglclefindmkaj/https://www.cartercenter.org/resources/pdfs/health/ephti/library/lecture_notes/health_science_students/pharmacology.pdf

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	2	2	2	3	2	2
CO2	3	3	2	3	2	2	2	3	3	3	2
CO3	3	2	3	2	3	2	2	3	3	3	2
CO4	3	2	2	3	3	2	2	3	3	3	2
CO5	3	2	3	2	2	3	2	2	3	2	2
Total	15	11	13	12	13	11	10	13	15	13	10
Average	3	2.2	2.6	2.4	2.6	2.2	2	2.6	3	2.6	2

3 – Strong, 2- Medium, 1- Low

II YEAR: THIRD SEMESTER

Course Code	CourseName	Category	L	T	P	S	Credit	Hours	Marks	
									CIA	Total
24PBCIN31	Internship		0	0	3	0	2	1	25	100

Learning Objectives	
LO1	To understand the workflow of diagnostic laboratories, including sample collection, processing, analysis, reporting, and quality control.
LO2	To gain insight into research methodologies used in biochemistry, including hypothesis formation, data collection, and analysis.
LO3	To enhance problem-solving skills in experimental biochemistry and clinical diagnostics.
LO4	To develop professional ethics and discipline needed for laboratory and research work.
LO5	To strengthen communication skills required for documenting experiments, preparing reports, and collaborating in laboratory teams.

S.No	REGULATIONS	Hour
	1. Biochemistry students must complete a 15 - day's internship in any approved Hospital, Diagnostic Lab, Research Institute, Pharma/Biotech Company, or Food Industry during the Semester II vacation. 2. The candidates must demonstrate the ability to perform routine biochemical analyses, document laboratory procedures accurately, maintain an internship logbook, and monitor the outcomes or interpretations of the biochemical tests performed. 3. The candidates must develop skills in biochemical screening and assessment, including sample handling, preliminary diagnostic evaluation, and interpretation of laboratory results for patient or clinical samples. 4. During the Third Semester, candidates are required to refine the work completed during the internship by incorporating constructive feedback received from the Hospital/industry during reviews, and by further developing the project to meet Hospital/industry standards. 5. The Candidates have to prepare and submit the manuscript of the Internship experience as a Report as per the requirements of the Department for Evaluation. 6. The submission of the Internship Report will be done at the end of the Third Semester for Presentation and Viva-Voce during the Practical Examinations of the Semester. The Passing Minimum for Internship is 50%. 7. If the Candidate fails to score 50% in the Internship, the Candidate has to improve it during the next attempt. 8. A Faculty Member from the Department will act as a Guide to supervise/monitor the progress of the Candidates. 9. The Faculty Member will act as the Internal Examiner during the course of the Internship as well as at the time of conducting the Viva-Voce Examination. 10. The Internal Marks for the Internship will be awarded by the concerned Guide /Internal Examiner. 11. The Internal and External Examiners shall both evaluate the Internship Report, Presentation and conduct the Viva-Voce Examination.	

CO	Course Outcomes **Students will be able to**
CO1	Understand and describe the complete workflow of diagnostic laboratories, including sample collection, processing, biochemical analysis, reporting, and quality control procedures.
CO2	Apply basic research methodologies in biochemistry, including collecting experimental data and performing scientific analysis.
CO3	Enhance problem-solving skills in experimental biochemistry and clinical diagnostic situations.
CO4	Develop professional ethics, responsibility, and discipline required for laboratory and research environments.
CO5	Improve communication skills essential for documenting experiments, preparing scientific reports, and effectively collaborating with laboratory teams.

INTERNAL MARKS AWARDED FOR THE INTERNSHIP -25Marks
✓ Internship Review1 (During the beginning of the Semester)-5 Marks ✓ Internship Review2 (At the end of the Semester)-5 Marks ✓ Progress of the Internship by the Candidate's active Participation-15 Marks
EXTERNAL MARKS AWARDED FOR THE INTERNSHIP-75Marks
✓ Evaluation of the Internship Report -50 Marks ✓ Presentation & Viva-Voce Examination-25 Marks

II YEAR: IVth SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24PBCC41	CC – 12 Gene Editing, Cell and Gene Therapy	Core	3	2	1	-	5	6	25	75	100

Learning Objectives	
LO1	To train the student in techniques related to the molecular basis of genetic diseases and to incorporate skills essential for various types of sequencing.
LO2	To inculcate practical knowledge on comparing the animal models used to model genetic diseases.
LO3	To introduce and also elaborate knowledge about wide varieties of vectors and their features in addition to their applications and to identify the viral and nonviral gene transfer techniques.
LO4	To educate about the characteristics of cell culture, therapeutic strategies in gene therapy with relevant safety/ethics involved and patents as well.
LO5	To identify technological barriers in translating stem cell research into safe and effective clinical therapies.

Unit	Content	Hours
I	**Gene Editing**: Basis of gene editing, DNA repair mechanisms, Double strand DNA breaks, No homologous End-Joining (NHEJ), Homology directed repair, Programmable nucleases for gene editing, Mega nucleases, Zinc-Finger nucleases, Transcription Activator-Like Effectors Nucleases (TALEN), CRISPR-CASs systems, gene editing using a CRISPR-CASs, drawbacks and major challenges to present gene editing techniques, gene editing for human disease therapy.	18
II	**Gene and cell therapy:** Basics of Gene and cell therapy, types of gene therapy, gene therapy strategies, therapeutic targets for gene therapy, choice of the therapeutic target, administration routes, delivery systems, expression of transgenic, persistence of the gene therapy, cell targeting, immunological response to the therapy, ethical and legal issues, concerns about gene and cell therapy.	18
III	**Vectors for Gene therapy**: Non-viral and viral vectors for gene therapy, Physical methods of gene delivery, Polymer, Lipid and inorganic material based chemical systems for gene delivery,	18

	Viral vectors, Lent viral, Adenoviral, Adeno-associated virus, Herpes Simplex virus, vaccine, baculo viral vectors for gene delivery.	
IV	**Stem cells and tissue regeneration:** Adult and fetal stem cells, embryonic stem cells, cell reprogramming, induced pluripotent stem cells (iPSC), Chemically induced pluripotent stem cells (CiPSC), reprogramming factors, iPSC derived progenitors 'cells, Or ganoids, three dimensional (3D) bioprinting.	18
V	**Regulatory and Ethical Considerations**: Stem cell and Gene Therapy, pluripotent stem cell-based cell replacement therapies. Assessing Human Stem Cell Safety, Use of Genetically Modified Stem Cells in Experimental Gene Therapies.	18

CO	**Course Outcomes** The student will be able to
CO1	Explain the molecular basis of genetic diseases and demonstrate proficiency in techniques related to various sequencing methods.
CO2	Evaluate different animal models used to study genetic diseases
CO3	Identify various types of vectors, their structural features, and analyze their applications in viral and non-viral gene transfer techniques.
CO4	Understanding of cell culture characteristics and apply knowledge to design therapeutic gene therapy strategies while considering safety, ethical, and patent issues.
CO5	Assess the technological challenges in translating stem cell research into safe and effective clinical therapies.

Reference Books:	
1	An Introduction to Human Molecular Genetics (2nd Edition), J.J. Pasternak, 2005.
2	An Introduction to Molecular Medicine and Gene Therapy 1st Edition by Thomas F. Kresina Upadhyay, S. K. (Ed.). (2021).
3	Human Molecular Genetics (4th Edition), Tom Strachan & Andrew Read, 2010.
4	Stem Cells Handbook: Stewart Sell, Humana Press; Totowa NJ, USA; Oct. 2003,
Textbooks:	
1	Stem Cell Biology, Daniel Marshak, Richard L. Gardener and David Gottlieb, Cold Spring Harbour Laboratory Press.
2	Stem cell biology and gene therapy, Booth C., Cell Biology International, Academic Press
3	Stem Cell and Gene-Based Therapy: Frontiers in Regenerative Medicine, Alexander Battler.

Web resources:	
1	https://www.genome.gov/27569223/gene-editing
2	https://www.isscr.org
3	https://www.ema.europa.eu/en/human-regulatory/overview/advanced-therapy-medicinal-products-overview
4	https://www.fda.gov/vaccines-blood-biologics/cellular-gene-therapy-products
5	https://www.open.edu/openlearn/ocw/mod/oucontent/view.php?id=85915

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	1	2	3	2	2	2	2	2	2	2
CO2	3	3	3	3	2	2	2	2	2	2	3
CO3	3	2	3	3	2	3	3	3	3	3	1
CO4	3	1	2	2	2	3	3	2	2	3	3
CO5	3	3	3	3	3	3	3	3	3	3	2
Total	15	10	13	14	11	13	13	12	12	13	11
Average	3	2	2.6	2.8	2.2	2.6	2.6	2.4	2.4	2.6	2.2

3 – Strong, 2- Medium, 1- Low

II YEAR: IVth SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBCC42	Core – Advanced Molecular Endocrinology	Core	3	1	2	0	5	6	25	75	100

Learning Objectives	
LO1	To explore the genetic and biochemical basis of the synthesis and formation of polypeptide and glycoprotein hormones.
LO2	To study the fundamental principles of hormone signal transduction and second messenger systems.
LO3	To understand the chemistry, secretion, and physiological roles of pituitary, thyroid, and parathyroid hormones.
LO4	To analyze the interrelationships between pancreatic, adrenal, and renal endocrine functions in maintaining homeostasis.
LO5	To explain the functions of gonadal hormones in the development, maturation, and regulation of reproductive processes.

Unit	Content	Hours
I	**UNIT-I :** Hormones - definition, classification based on receptors, hormone cascade system involving CNS, hypothalamus, anterior pituitary, target gland, feedback mechanisms, classification of hormones (polypeptides, glycoproteins and POMC peptides), genes and formation of polypeptide hormones.	18
II	**UNIT-II :** Synthesis of amino acid derived hormones- epinephrine and thyroxine, inactivation and degradation of hormones, signal transduction and second messengers - adenylate cyclase system, cAMP, adrenalin and glycogen degradation. G-protein as cellular transducer, inositol triphosphate and calcium release, glycogen phosphorylase kinase, DAG and protein kinase C-pathway.	18
III	**Unit III:** Pituitary hormones- Chemistry, Secretion, Functions and Regulation. Anterior Pituitary hormones–GH, Pituitary tropic hormones (LH, TSH and ACTH) and Posterior Pituitary hormones (Vasopressin andOxytocin). Thyroid and Parathyroid Hormones–Chemistry, Synthesis, Secretion, Functions and Regulations.	18
IV	**Unit IV**: Pancreatic Hormones-Chemistry, Secretion, Functions and Regulations (Insulin and Glucagon). Adrenal gland hormones-Chemistry, Secretion, Functions and Regulations of Adrenal Cortex hormones (glucocorticoids and mineralocorticoids) and Adrenal Medullary hormones	18

	(Epinephrine and Nor-Epinephrine). Renin-angiotensin system.	
V	**Unit V**: Chemistry, Secretion, Functions and Regulations of Gonadal hormones– Testosterone, Estrogen and Progesterone. Ovarian cycle and its regulation. Pregnancy and Parturition,Placenta and its Functions, Pregnancy Tests, Mammary Glands and Lactation.	18
CO	**Course Outcomes** **The student will be able to**	
CO1	Interpret the genetic control and biosynthetic pathways responsible for the production of polypeptide hormones.	
CO2	Illustrate the steps involved in hormone signal transduction through the adenylate cyclase–cAMP pathway.	
CO3	Describe the chemical nature, secretion, and regulation of anterior and posterior pituitary hormones.	
CO4	Analyze the integration of endocrine pathways among pancreas, adrenal glands, and kidneys in maintaining metabolic equilibrium.	
CO5	Describe the chemistry, synthesis, secretion, and regulation of gonadal hormones—testosterone, estrogen, and progesterone.	

Textbooks:	
1	Textbook of biochemistry (with clinical correlation) by Devlin, Wiley-Liss; 6 edition (2005) .
2	Wilson and Foster," Endocrinology", 4th edition, W.B. Saunders Co, 2005.
3	Textbook of Endocrinology,1st edition,I.Niyas Ahamed, (Association of Indian Biologists publications.)
4	Textbook of endocrinology by Wilson and Foster, W.B. Saunders Co.
5	Lohar, S.Prakasa, Endocrinology- Hormones & human health, MJP Publishers, 2006.
Reference Books:	
1	Endocrinology – Mac E. Hadley and Jon E. Levine, 7th Edition, Pearson Education.
2	Medical Biochemistry – John W. Baynes and Marek H. Dominiczak, Elsevier.
3	Molecular Cell Biology – Harvey Lodish et al., W.H. Freeman and Company.
4	Human Reproductive Biology – Richard E. Jones and Kristin H. Lopez, Academic Press.
5	Textbook of Medical Physiology – A.K. Jain or Sembulingam&Sembulingam.

Webresources:	
1	https://www.ncbi.nlm.nih.gov/books/
2	https://www.khanacademy.org/science/biology/human-biology
3	https://openstax.org/books/anatomy-and-physiology/pages/1-introduction
4	https://medlineplus.gov/hormones.html
5	https://biologynotesonline.com/gonadal-hormones-secretion-functions-mechanism-regulation/

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	2	3	3	3	3	3	3	3	2	2
CO2	2	3	3	3	3	3	3	3	3	2	2
CO3	2	2	3	3	3	3	3	3	3	2	2
CO4	2	2	3	3	3	3	3	3	3	2	2
CO5	2	2	3	3	3	3	3	3	3	2	2
Total	10	9	15	15	15	15	15	15	15	10	10
Average	2	2	3	3	3	3	3	3	3	2	2

3 – Strong, 2- Medium, 1- Low

II YEAR: IVth SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBCE41	**EC – Research Methodology**	**Core**	**3**	**1**	**2**	**0**	**5**	**6**	**25**	**75**	**100**

Learning Objectives	
LO1	Understand the fundamentals of research design, types of research, and the importance of literature review in identifying research problems.
LO2	Identify major national and international funding agencies and outline the key components of a research proposal.
LO3	Apply knowledge of biological databases and sequence analysis tools such as BLAST and ClustalW for analyzing biological data.
LO4	Explain the ethical principles and CPCSEA guidelines governing animal and human experimentation.
LO5	Design a well-structured scientific paper with proper format and references.

Unit	Content	Hours
I	**Research Foundations and Literature Search** Types of research, Various Steps in Research Process, Postulating a hypothesis, developing a research question, "Choice of a problem; surveying, synthesizing, critically analyzing reading materials; reviewing, rethinking, critically evaluating and interpreting, reading materials, reviewing, rethinking, critical evaluation, interpretation, Research Purposes, Role of computers in biology. Useful search engines - Boolean searching, search engine algorithms. Finding scientific articles - PubMed.	20
II	**Research Project Funding and Proposal Preparation** Funding Agencies for R&D Projects: National funding agencies and international funding agencies. Preparation of R&D Projects for Funding: Steps in writing a research proposal – identifying the research problem and gap areas, defining aims and objectives, expected outcomes, review of literature, methodology, and timeline.	10
III	**Biological Databases and Sequence Analysis** Overview of biological databases, nucleotide databases (GenBank, DDBJ, ENA) Protein structure databases (PDB, SCOP, CATH), Organism specific databases, Bibliographic databases. Sequence analysis: pair wise alignment, multiple sequences alignment, scoring matrices, Phylogenetic trees. Sequence similarity search, BLAST, FASTA, ClustalW.	20

IV	**Ethics in Animal and Human Research** Ethics in animal experimentation. CPCSEA guidelines - Animal care and technical personnel environment, animal husbandry, feed, bedding, water, sanitation and cleanliness, waste disposal, anesthesia and euthanasia. Composition of (Human) institutional Ethical Committee (IEC) - General ethical issues. Specific principles for chemical evaluation of drugs, herbal remedies and human genetics research.	20
V	**Scientific Writing and Publication** Scientific writing - Characteristics - Logical format for writing thesis and papers. Essential features of abstract, introduction, review of literature, materials and methods, and discussion. Effective illustration - tables and figures. Reference styles - Harvard and Vancouver systems. Publication in Peer-reviewed journals.	20

CO	**Course Outcomes**
CO1	Explain the process of research design, hypothesis formulation, and the use of literature databases for effective research planning.
CO2	Develop a structured research proposal for submission to suitable funding agencies.
CO3	Utilize biological databases and sequence alignment tools to retrieve and interpret molecular data.
CO4	Apply ethical standards and regulatory guidelines in designing and conducting biomedical research involving animals and humans.
CO5	Students will be able to present research findings effectively following standard scientific writing and publication guidelines..

Textbooks:	
1	Kothari, C. R., & Garg, G. (2019). *Research methodology: Methods and techniques* (4th ed.). New Age International Publishers.
2	Glaser, A. N., & Natarajan, R. (2016). *High-yield biostatistics, epidemiology, and public health* (4th ed.). Wolters Kluwer India.
3	Rastogi, S. C. (2020). *Bioinformatics: Methods and applications* (4th ed.). PHI Learning Pvt. Ltd.
4	Ghosh, B. N. (2021). *Scientific methods and social research* (2nd ed.). Sterling Publishers Pvt. Ltd.
5	Day, R. A., & Gastel, B. (2012). *How to write and publish a scientific paper* (7th ed.). Cambridge University Press.
Reference Books:	
1	Subramanian, N. (2018). *Introduction to research methods and report writing*. Atlantic Publishers.
2	Lesk, A. M. (2019). *Introduction to bioinformatics* (5th ed.). Oxford University Press.
3	Beall, J. (Ed.). (2015). *Predatory publishing: What authors need to know*. Scholarly Open Access.
4	Smith, R. (2006). *Research misconduct: The poisoning of the well*. Journal of the Royal Society of Medicine, 99(5), 232–237.
5	National Research Council. (2011). *Guide for the care and use of laboratory animals* (8th ed.). The National Academies Press.

Webresources:	
1	PubMed – https://pubmed.ncbi.nlm.nih.gov
2	National Center for Biotechnology Information (NCBI) – https://www.ncbi.nlm.nih.gov
3	Council for Scientific and Industrial Research (CSIR) – https://www.csir.res.in
4	Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA) – https://cpcsea.nic.in
5	Directory of Open Access Journals (DOAJ) – https://www.doaj.org

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	3	3	3	3	3	3
CO2	3	3	2	3	3	3	2	3	3	3	3
CO3	3	2	3	2	3	3	2	3	3	2	3
CO4	3	3	3	3	3	3	3	3	3	2	3
CO5	3	3	2	3	3	3	3	3	3	3	3
Total	15	13	13	13	15	15	13	15	15	15	15
Average	3	2.6	2.6	2.6	3	3	2.6	3	3	2.6	3

3 – Strong, 2- Medium, 1- Low

II YEAR: IVth SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBCE43	**EC – Phytomedicine**	**EC**	**2**	**1**	**1**	**0**	**3**	**4**	**25**	**75**	**100**

Learning Objectives	
LO1	To gain knowledge of Indian systems of medicine
LO2	To understand morphological and histological characteristics of medicinal plants
LO3	To understand the source, morphology, and uses of flower drugs
LO4	To understand the clinical relevance and potential toxicities
LO5	To gain knowledge about the herbal drug industry

Unit	Content	Hours
I	**UNIT I: PHYTO PHARMACOLOGY** Definition and history, Indian systems of medicine - Siddha, ayurvedha, and Unani systems. Taxonomy of locally available medicinal plants, their chemical constituents and medicinal uses - Classification of Crude drugs - Chemistry of Drugs - Future of pharmacognosy	12
II	**UNIT II : CLASSIFICATION OF MEDICINAL PLANTS** Vernacular name and family - Geographical source, cultivation, collection, and processing for market and commerce in crude drugs. Morphological and histological studies, chemical constituents - Therapeutic and other pharmaceutical uses. Underground stem - ginger, Alpinia - Roots - Rauolfia - Belladona – Aerial parts - Bark - Cinchona.	12
III	**UNIT III: BIOMEDICAL IMPORTANCE OF MEDICINAL PLANTS** Leaves - Adathoda, Eucalyptus - Flower - Clove fruits seeds - Nux vomica Nutmegs, Gooseberry - unorganized drugs - Gum - Acacia - Resin - Turpentine, fixed oil - castor oil.	12
IV	**UNIT IV: HERBAL MEDICINES FOR HUMAN AILMENTS** Drugs Acting on Cardiac Diseases, Cerebral Diseases, Nasal diseases - Blood pressure Drugs acting on Nervous system – Depressants, Stimulants. Respiration and Drugs - Urogenital system and drugs - Psychoactive plants.	12
V	**UNIT V**: **PROPAGATION OF MEDICINAL PLANTS** Micro and macro propagation, conservation of rare medicinal plants, Role of biotechnology in medicinal plant's banks, cultivation of medicinal and aromatic plants. Drug adulteration - methods of Drug evaluation. Herbal food - Food processing - packaging - Herbal sale and Export of medicinal plants - marketing - Intellectual property rights - Export laws.	12

CO	The student will be able to Course Outcomes
CO1	Explain the fundamental concepts and therapeutic principles of Indian systems of medicine such as Siddha, Ayurveda, and Unani.
CO2	Identify and analyze the morphological and histological characteristics of medicinal plants for authentication and quality evaluation
CO3	Describe and differentiate the source, morphology, chemical constituents, and therapeutic uses of flower drugs
CO4	Evaluate the clinical relevance and potential toxicities of natural drugs and plant-derived compounds used in various disease conditions
CO5	Discuss and apply knowledge about the herbal drug industry.

Text Books	
1	George Edward Trease and W.C. Evans - Pharmacognosy 12th edition, English Language Books Society, Baelliere Tindall.
2	Handa, S.S. and Kapoor, V.K. Pharamcognosy - 2nd Edition, Vallabh Prakashan Publishers, New Delhi.
3	Indian Medicinal plants - Jain, S.K,1980.
4	Kokate, C.K., Durohit, A.P. and Gokhale, S.R., Pharmacognosy - 12th edition - Nirali Prakasham Publishers, Pune
5	Bioactive Compounds in Phytomedicine, edited by Iraj Rasooli. IntechOpen (2012)
Reference Books:	
1	An Introduction to Medical Botany and Pharmacognosy - Kumar N.C., 1993.
2	Indian Materia Medica – Nadkarni, 1981.
3	A text book of Pharmacognosy - Shah, S.C. and Qudary, 1990.
4	Text book of pharmacognosy , 5th edition -Wallis, T.E, CBS publishers and distributors, New Delhi

Web resources:

1.https://ccrum.res.in/writereaddata/UploadFile/The%20Science%20of%20Health%20and%20Healing01076_1861.p

2.**https://www.scribd.com/document/481786497/classificationsofmedicinalandaromaticplants-190722230043**

3. https://en.wikipedia.org/wiki/Medicinal_plants

4. https://www.healthline.com/nutrition/herbal-medicine

5. https://plantcelltechnology.com/blogs/blog/blog-seven-methods-of-plant-propagation?srsltid=AfmBOoq7Rpi2NEAJhA9owyQsIMs5ARoO94ykKHWa1-7V1u29Mnce0Bky

Mapping with Programme Outcomes and Programme Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	3	2	3	2	2	3
CO2	3	2	3	3	2	2	1	3	3	3	2
CO3	3	3	3	3	2	2	2	3	2	2	3
CO4	3	3	3	3	2	2	2	3	2	3	3
CO5	3	3	3	2	3	2	3	3	3	2	3
Total	15	14	15	13	12	11	10	15	12	12	14
Average	3.0	2.8	3.0	2.6	2.4	2.2	2.0	3.0	2.4	2..4	2.8

3– Strong, 2- Medium, 1- Low

II YEAR: IVth SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBCF41	PEC – 1 Personality Development and Leadership Skills	Core	1	1		-	2	2	25	75	100

Learning Objectives	
LO1	To enable students to develop a confident and dynamic personality.
LO2	To foster interpersonal and communication skills essential for leadership roles.
LO3	To inculcate leadership values, ethics, and team management skills.
LO4	To prepare students for professional success through self-awareness.
LO5	To prepare students for personal success through self-awareness.

Unit	Content	Hours
I	**Introduction to Personality Development** Definition and dimensions of personality, Self-concept, self-awareness, and self-esteem, SWOT analysis – self-assessment Goal setting and time management, Overcoming shyness, stage fear, and inertia	6
II	**Communication and Interpersonal Skills** Verbal and non-verbal communication, Active listening, assertive communication, Public speaking, group discussion, and debate skills, Conflict resolution and interpersonal harmony, Presentation skills and use of technology	6
III	**Leadership and Team Building** Types and traits of leaders, Leadership styles: visionary, Autocratic, coaching, transformational, transactional, democratic, laissez-Faire, situational etc. Role of motivation and inspiration, Team dynamics and collaboration	6
IV	**Emotional Intelligence and Stress Management** Components of Emotional Intelligence (EQ), Managing emotions and empathy in relationships, Stress and Anxiety- management techniques, Work-life balance and self-care practices, Mindfulness and meditation	6
V	**Professional and Social Etiquette** Workplace manners and ethics, Dress code, grooming, and hygiene, Interview preparation and resume building, Email, phone, and social media etiquette, Time and digital discipline.	6

CO	The student will be able to Course Outcomes
CO1	Identify and enhance key personality traits for self-development
CO2	Communicate effectively and confidently in various contexts.
CO3	Demonstrate leadership qualities and manage teams efficiently
CO4	Apply decision-making and problem-solving skills in real-life situations
CO5	Practice emotional intelligence and professional etiquette in personal and social life

Textbooks:	
1	Swami Vivekananda,Personality Development, Advaita Ashrama., New Delhi, 2002
2	Shiv Khera, You Can Win: A Step-by-Step Tool for Top Achievers, Bloomsbury Publishing India Pvt. Ltd., New Delhi, 2014
3	Daniel Goleman, Emotional Intelligence: Why It Can Matter More Than IQ, Bantam Books, New York (Reprint by Bloomsbury India)2006
4	Dr. Alex K. and S. Chandran Soft Skills: Know Yourself & Know the WorldS. Chand Publishing, New Delhi, 2011
5	Dale Carnegie, How to Win Friends and Influence PeopleSimon & Schuster, New York (India edition by Fingerprint Publishing), 2016
Reference Books:	
1	Stephen R. Covey, The 7 Habits of Highly Effective People: Powerful Lessons in Personal Chang,Simon & Schuster, New York (India edition by Pocket Books) 2020
2	Peter G. Northouse, Leadership: Theory and Practice, SAGE Publications, California, 2021.
3	John C. Maxwell, Developing the Leader Within You 2.0, HarperCollins Leadership, Nashville 2018
4	Barun K. MitraPersonality Development and Soft Skills, Oxford University Press, New Delhi, 2012
5	Suzanne C. de Janasz, Karen O. Dowd, and Beth Z. Schneider, Interpersonal Skills in Organizations, McGraw-Hill Education, New York, 2018

Webresources:	
1	https://www.7habits.com
2	https://www.mkgandhi.org/ebks/personality_development.pdf
3	https://www.golemanEI.com
4	https://opentextbc.ca/leadership/
5	https://www.open.edu/openlearn/ocw/mod/oucontent/view.php?id=85915

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	2	3	3	3	3	3	3	3	2	2
CO2	2	3	3	3	3	3	3	3	3	2	2
CO3	2	2	3	3	3	3	3	3	3	2	2
CO4	2	2	3	3	3	3	3	3	3	2	2
CO5	2	2	3	3	3	3	3	3	3	2	2
Total	10	9	15	15	15	15	15	15	15	10	10
Average	2	2	3	3	3	3	3	3	3	2	2

3 – Strong, 2- Medium, 1- Low

II YEAR: IVth SEMESTER

Course Code	CourseName	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBCL41	**SLC 1 Biotechnology**	**SLC**	**-**	**-**	**1**	**3**	**2**	**4**	**25**	**75**	**100**

Learning Objectives	
LO1	Understand the fundamental concepts, scope, and significance of biotechnology and identify the tools and enzymes used in genetic engineering.
LO2	Demonstrate knowledge of various cloning vectors used in genetic engineering
LO3	Able to demonstrate the principles and methodologies of DNA sequencing,
LO4	Apply the principles of constructions of vectors and gene transfer methods
LO5	Illustrate the use of Genetic Engineering for Human Welfare

Unit	Content	Hours
I	**Introduction to Biotechnology and Genetic Engineering Tools**– Biotechnology – definition, Scope, importance. Genetic engineering - Tools- enzymes used in genetic engineering – Endonucleases, Exonucleases, DNA ligase, Alkaline phosphatase, Reverse transcriptase, DNA polymerase, Terminal transferase, Use of linkers, adapters.	12
II	**Genetic Engineering Tools - Vectors** Vectors – Plasmid (pBR322, pUC), Bacteriophage Vector (Phage λ), Cosmid, Yeast artificial chromosome vector, bacterial artificial vector.	12
III	**Basic techniquesof Genetic Engineering and requirements**: DNA sequencing -Maxam and Gilbert method, Sanger and Coulson method. Chemical synthesis of oligonucleotides. Amplification of DNA - PCR.Sterilization techniques, laminar Air flow, CO2 incubator	12
IV	**Construction and expression of recombinant DNA molecules** Preparation of desired DNA - Genomic DNA library, cDNA library. Gene transfer methods – Transformation, Transfection, Electroporation, Microinjection, Particle Bombardment, Liposome fusion.	12
V	**Screening methods &Genetic Engineering for Human Welfare** Screening methods – insertional selection inactivation, Blue white	12

	selection, colony hybridization. Genetic Engineering for Human Welfare – production of tissue plasminogen activator, Insulin, somatropin	

CO	The student will be able to Course Outcomes
CO1	Explain the concepts, scope, and significance of biotechnology and describe the various enzymes used as tools in genetic engineering.
CO2	Illustrate the structure, types, and functions of different cloning vectors such as plasmids, bacteriophages, cosmids, and artificial chromosomes
CO3	Apply fundamental genetic engineering techniques such as DNA sequencing, PCR etc.
CO4	Analyze the strategies involved in the construction and expression of recombinant DNA, including gene transfer methods and library preparation.
CO5	Evaluate screening and selection techniques for recombinant clones and assess the applications of genetic engineering in human welfare

Textbooks:	
1	Biotechnology, U Satyanarayanan .U, (2008), Books and Allied (p)Ltd.
2	A Textbook of BiotechnologyR.C. Dubey S. Chand Publishing 6th Ed. 2014 / Latest
3	Plant Biotechnology, Dr. A. Arumugam, Saras Publication, Chennai
4	Molecular Biology and Genetic Engineering, P.K. Gupta,Rastogi Publications, 2020
5	Plant Biotechnology – B.D. Singh, Kalyani Publishers
Reference Books:	
1	Molecular Biology of the Gene. James D. Watson, Tania A. Baker, et al., Pearson Education, 2017 (7th Edition)
2	Genes XII, Benjamin Lewin, Jones & Bartlett Learning, 2017 (12th Edition)
3	Molecular Cloning: A Laboratory Manual, Michael R. Green and Joseph Sambrook, Cold Spring Harbor Laboratory Press, 2012 (4th Edition)
4	Genetic Engineering, Smita Rastogi and Neelam Pathak, Oxford University Press, 2009
5	Biotechnology: Fundamentals and Applications, S.S. Purohit, Agrobios (India), 2019

Webresources:	
1	https://drive.google.com/drive/folders/17teC8hUgF7fkOVFn8bvGTRN28ayoEmXL?usp=drive_link– eBooks google drive
2	https://tvuni.academia.edu/mvinayagam - Educational networks to share research, knowledge, teaching documents, chapters, e-notes, e-books, thesis, materials.
3	https://ncert.nic.in/textbook.php
4	National Digital Library -https://ndl.iitkgp.ac.in/
5	https://cec.nic.in/cec/ - e-Content courseware in UG/PG subjects

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	2	3	3	3	3
CO3	3	2	3	2	3	3	2	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3
Total	15	13	15	13	15	15	13	15	15	15	15
Average	3	2.6	3	2.6	3	3	2.6	3	3	3	3

3 – Strong, 2- Medium, 1- Low