MARUDHAR KESARI JAIN COLLEGE FOR WOMEN (AUTONOMOUS)

Vaniyambadi – 635 751

PG Department of Biotechnology

for

Post graduate Programme

Master of Science in Biotechnology

From the Academic Year 2024 - 25

CONTENT

LEARNING OUTCOMES BASED CURRICULUM FRAMEWORK FOR POSTGRADUATE EDUCATION

1. Preamble

The emergence of Biotechnology has made a contemporary advancement in the discipline of Science, embarking the venture of revolution for the enhancement of life and nature. This multidisciplinary subject has placed its foothold in different sectors like Pharmaceuticals, Food Industries, Textile Industries, Agriculture, Environment, Vaccine development to name a few, thereby opening a broad arena to widen job opportunities. The accelerated growth in newer hazards and the pressing need to address these issues has necessitated the requisite for radical strategies and pioneering research personnel to handle it with careful consideration. Cutting-edge technologies in Biotechnology therefore offer the hope to face emerging challenges with insightful approaches. With the advent of Biotechnology, there have been several astonishing inventions both in medicine and environment that has propelled it as one of the frontline subject of the 21st century at its prima facie. As a result the demand for subject experts has seen an inclined growth in all fields of science and technology. Encompassing different streams of science, Biotechnology contemplates to integrate industry and research for a constructive growth of the nation. Therefore an education that warrants both theoretical and practical expertise becomes an indispensible element to satiate the global requisite of an intellectually skilled person.

The Department of Biotechnology began its journey in the year 2007 with Bachelor's degree in a vision to empower students with adequate knowledge and skills on advancements in the field of science through Biotechnological concepts and principles. It then introduced its Post-Graduation program in the year 2014 and thereafter added the M.Phil and Pd.D research programs in the year 2018 and 2019 respectfully. The Department is endowed with highly skilled faculty members who work towards teaching, guiding and motivating the students to become successful career oriented personnel. The Department has taken up several collaborative activities with industries and research centers to provide the students with a real-time experience of a work environment. The Department has a never failed to produce University Rank Holders and also holds a commendable record in Placement. The Department is further enriched with sophisticated laboratory that is furnished with high-end instruments and equipment to deliver in-depth practical sessions for the students.

In adherence to the current needs and expectations of the industries, the curriculum and syllabi for Biotechnology were framed meticulously such that upon completion of the program, the learner will acquire commendable knowledge and skills to meet the expectancy of the industrial, educational and research sectors. The program is envisaged to impart deeper insights into radical and empowering technologies and concepts that refurbish scientific endeavors. It also seeks to mold and develop logical reasoning and solution providing potentiality to the leaners so as to become equally competent with their peers by increasing the credentials of their knowledge. The program also perpetuates the support of laying the path for building a self-sustaining ability and independency to stand out as a remarkable personality in this scientific era. The program of Biotechnology cultivates the sense of responsibility for the well-being of all life and instigates the curiosity into seeking opportunities to become a part of an impactful society. Biotechnology embodies such an ardent principality that makes this stream of science an unrelinquishable asset for the sustenance and betterment of life

PROGRAMME OUTCOMES (PO)

Programme	**M.Sc., Biotechnology**
Programme Code	**PS05**
Duration	**2 years [PG]**
Programme Outcomes	**PO1:Disciplinary knowledge:**Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that forma part of an postgraduate Programme of study. **PO2: Communication Skills:** Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically 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; analyses and evaluate evidence, arguments, claims, beliefs on 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 apply one'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 viewpoints. **PO6:Research-relatedskills**:Asenseofinquiry and capability for asking relevant/appropriate questions, problem arising, synthesizing and articulating; Ability to recognize cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyze, 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.

Programme Specific Outcomes:	**PSO1– Placement:** To prepare the students who will demonstrate respectful engagement with 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**.**

Eligibility for Admission:

Candidate for admission to the first year of M.Sc., Biotechnology, Department of Biotechnology shall be required to have passed the UG with any Life Science with 55% marks of a recognized Indian University or any other University

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 – I						
Code	**Course Title**	**Hours Distribution**				**C**
		L	**T**	**P**	**S**	
24PBTC11	Molecular Cell Biology	4	2	0	0	4
24PBTC12	Biochemistry	4	2	0	0	4
24PBTP13	Cell &Molecular Biology and Biochemistry Practicals	0	0	4	0	3
24PBTE11	Cancer Biology	4	1	0	0	3
24PBTE12	Bioinstrumentation	4	1	0	0	3
24PBTA11	MS- Office Fundamentals	1	1	0	0	2
TOTAL					**30**	**21**

Semester - II						
Code	**Course Title**	**Hours Distribution**				**C**
		L	**T**	**P**	**S**	
24PBTC21	Plant and Animal Biotechnology	3	1	2	0	4
24PBTC22	Microbiology	3	1	2	0	4
24PBTC23P	Plant and Animal Biotechnology, Microbiology Practical	0	0	4	0	3
24PBTC24	Bioprocess Technology	2	1	1	0	3
24PBTE21	Stem Cell Biology	2	1	1	0	3
24PBTE22	Aquaculture Biotechnology	3	1	0	0	3
24PBTS21	Organic Farming	1	1	0	0	2
TOTAL					**30**	**22**

L-Lecture **T-Tutorial** **P-Practical** **S-Seminar** **C-Credit**

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*.

1st YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBTC11	**Molecular Cell Biology**	CC-1	4	2	0	0	4	6	25	75	100

Learning Objectives

LO1	To understand the basics of cell organization
LO2	To understand the cell cycle and cell signalling
LO3	To learn the nucleus structure and organization
LO4	To understand the process of transcription
LO5	To know the mechanism on protein synthesis and transport

Unit	Content	Hours
1	Cells: Basic properties of cells-Cellular dimension-Size of cells and their composition. Cell origin and Evolution –Theory. Prokaryotic cells – Structural organization, Functions. Eukaryotic cells – Structural organization, Functions. Structural Organization: Cell membranes – Nucleus- organization of Chromatin– Golgi apparatus and vesicular transport – Lysosome – Endocytosis – Ectocytosis – mitochondria – peroxisomes- actin cytoskeleton and cell movement - Microtubules and intermediary filaments –Active and Passive transport across membranes	18
2	Molecular basis of eukaryotic cell – Cell cycle – regulation – check points. Cell to cell Adhesion, Cell Junctions - Extracellular matrix, Programmed cell death. Cell to cell signalling – Signalling molecules –Types of signalling – Signal transduction pathways-overview	18
3	Chromosome-structure, Nucleic Acids: Structure and Properties of DNA. Types of DNA, Functions of DNA. Structure and Properties of RNA – Types of RNA – Functions of RNA.DNA and RNA as Genetic Material, Non-coding RNA. Central Dogma of the Cell –Basic concepts of Gene. Regulatory regions-UTR, Promoter, Operator	18
4	Transcription – mechanism in Prokaryotes and Eukaryotes. Post transcriptional modifications- Regulation of Transcription Initiation, Elongation. Reverse transcription. Non coding regions of DNA & RNA. Operon-Lac, Trp	18
5	Genetic code - Mechanism of translation- post translational modification in RER – synthesis , sorting and trafficking of proteins- site of synthesis of membrane and organelle protein – transport of membrane protein across ER. Transport of protein to Mitochondria, nucleus, chloroplast, and peroxisomes Protein Glycosylation – mechanism and regulation of vesicular transport. Golgi and post golgi sorting and processing – Receptor mediated endocytosis	18

CO	Course Outcomes
CO1	To understand the structure and functional organization of cell and its components
CO2	To understand the different types of cell cell communications and process that drive cellular mechanism
CO3	The students will be able to understand the importance of DNA and its function in cell
CO4	The students will be able to understand the process of transcription and importance of RNA in cell functioning
CO5	The students will be able to understand the process of protein synthesis and its functional modifications
Textbooks:	
1	Paul A, 2001, Text Book Of Cell And Molecular Biology 2edition
2	T.Fleming. 2002. Cell interactions: A practical approach Second edition
3	Prakash S. Lohar , 2009. Cell and Molecular Biology
4	David E.Sadva., 2009. Cell biology organelles structure and function, CBS publishers and distributors, New Delhi.
5	Luiz Carlos Uchoa, Janqueira, Jose, Carneiro. 2005. Basic Histology Text and Atlas. McGraw-Hill Professional
Reference Books:	
1	Karp, G., 2009, Cell and Molecular Biology, Sixth edition, John Wiley Sons, New York.
2	Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, 2007., Molecular Biology of the Cell, Fifth edition. Garland Science
3	Geoffrey. M.Cooper, Robert.E.Hausman.2007.The Cell-A Molecular Approach, Fourth edition. Sinauer Associates
4	Alberts B, Molecular Cell Biology.
5	Pollard et al., Cell Biology. Sounders
Web resources:	
1	https://libguides.pcom.edu/cmbm/tools
2	https://frazer.uq.edu.au/files/3522/MolBiolWS08Immunofluorescence.pdf
3	https://www.uou.ac.in/sites/default/files/slm/BSCZO-102.pdf

Mapping with Programme Outcomes and Programme Specific Outcomes

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

3 – Strong, 2- Medium, 1- Low

1st YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBTC12	**Biochemistry**	CC-2	4	2	0	0	4	6	25	75	100

Learning Objectives	
LO1	To understand the basics of Biochemistry
LO2	To understand the concepts of energy flow
LO3	To understand the concepts of energy flow
LO4	To understand the functioning of nuclei acids and amino acids
LO5	To understand the transport system of a cell

Unit	Content	Hours
1	Introduction and scope of Biochemistry; classification of Biomolecules, Structure and significance of water in biochemistry; acid-base concept, buffers, pH and pK; hydrogen bonding; hydrophobic, electrostatic and Van der Waals forces; Classification and structure of Carbohydrate, Metabolism- Gluconeogenesis, Glycogenesis, Glycogenolysis, - Biochemistry of hyper and hypoglycaemia	18
2	Bioenergetics process, Thermodynamics principles of biological process, Oxidation and reduction reactions; Redox potentials; High energy compounds; Concept of free energy, conservation and utilization of energy in cell, Chemiosmosis; Cellular Respiration Glycolysis, Pyruvate decarboxylation, TCA cycle, Ketogenesis, ,Oxidative phosphorylation, Pentose Phosphate Pathway; Photosynthesis; Electron Transport Chain, ATP synthesis, Urea cycle	18
3	Lipids: Structure and classification, Chemical and physical propertied of fatty acids, Metabolism and biosynthesis of fatty acids, Triglycerides, phospholipids, glycolipids. Cholesterol biosynthesis, Bile acids and salt formation, Oxidation of fatty acids and ketone bodies. Biochemistry of lipid disorder; hypercholesterolemia;	18
4	Structure, Classification and properties of Nucleic acids, synthesis of purines and pyrimidines, catabolism of nucleic acids, Structure, Classification and properties of aminoacids, Biosynthesis of aminoacids. Metabolic diseases and disorders: Clinical significance of variations in blood glucose Enzyme kinetic (negative and positive cooperativity); Ordered and ping pong mechanism; Regulation of enzymatic activity; Active sites; Enzymes and coenzymes: Coenzymes interactions, activators and inhibitors, kinetics of enzyme inhibitors, isoenzymes, allosteric enzymes.	18
5	Principles of membrane transport; Membrane Structure and Function; Transport proteins and methods; Membrane fluidity; Membrane and cytosolic receptors; Ion channels- gated, ligand activated, Aquaporins; Role of pumps in transport; Membrane potential-transmission of nerve impulse, synapse, neurotransmitters	18

CO	Course Outcomes
CO1	The students will be able to understand the importance and functions of all the types of biomolecules
CO2	The students will be able to understand the different cellular process that drive cellular functions of an organism
CO3	The students will be able to understand how molecules are being transported across different cellular machinerys
CO4	The students will be able to understand the importance of molecular homeostasis and problems related to its imbalance
CO5	The students will gain understanding on the practical concepts in analyzing biomolecules
Textbooks:	
1	Cambell, M.K. and Farrell, S.O. (2018) Biochemistry, Ninth Edition, Cangage Learning
2	Voet, D., Voet, J.G. and Pratt, C.W. (2018) Principles of Biochemistry, John Wiley & Sons. Inc, New York.
3	Instrumental Methods of Analysis - Chatwal and Himalayan Publication
4	Principles And Techniques of Practical Biochemistry - Bryan L, Williams and Keith Wilson, Cambridge Univ, Press.
5	Medical Biochemistry (2005) 2nd ed., Baynes, J.W. And Dominiczak, M.H., Elsevier Mosby Ltd. (Philadelphia), ISBN: 0-7234-3341-0
Reference Books:	
1	Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN: 13:978-1-4641-0962-1 / ISBN: 10:1-4641- 0962-1.
2	Principles of Biochemistry (2008) 3rd ed., Voet, D.J., Voet, J.G. and Pratt, C.W., John Wiley Sons, Inc. (New York), ISBN:13: 978-0470-23396-2
3	Biochemistry (2010) 4th ed., Garret, R. H. and Grisham, C.M., Cengage Learning (Boston), ISBN-13:978-0-495-11464-2
4	Molecular Cell Biology (2013) 7th ed., Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A. and Scott, M.P., W.H. Freeman Company (New York), ISBN: 13:978-1-4641-0981-2.
5	Principles And Techniques of Practical Biochemistry- Keith Wilson And John Walker, Cambridge Press.
Web resources:	
1	https://pmc.ncbi.nlm.nih.gov/articles/PMC7182109/
2	https://www.britannica.com/science/lipid
3	https://www.geeksforgeeks.org/nucleic-acids-definition-structure-properties-types/

Mapping with Programme Outcomes and Programme Specific Outcomes

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

3 – Strong, 2- Medium, 1- Low

1st YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBTP13	**Cell & Molecular Biology and Biochemistry Practicals**	CC-3	0	0	4	0	3	4	25	75	100

Learning Objectives

LO1	To separate and identify cell organelles using separation techniques
LO2	To study stages of cell cycle
LO3	To quantify biomolecules using different methods
LO4	To separate biomolecules using chromatographic techniques
LO5	Use electrophoretic techniques to separate DNA and proteins

Unit	Content	Hours
1	Identification of cell organelles ,Histochemical staining to localize proteins/ carbohydrate/ lipids	12
2	Study of divisional stages in Mitosis, Mitotic index calculation ,Study of divisional stages in Meiosis. Basic calculations in Biochemistry - Normality, Molarity, Molality percent solutions (v/v, w/v) Preparation of biochemical solution with different concentrations	12
3	Estimation of RNA by orcinol method, Estimation of DNA by diphenylamine method Estimation of protein by Lowry's Method	12
4	Estimation of Carbohydrate by Anthrone method, Separation of amino acids by Paper Chromatograph, Separation of Sugar by Paper Chromatograph	12
5	Separation of /proteins by SDS PAGE,Separation of sugars by thin layer Chromatograph,Isolation of DNA from Plant/ Bacteria/ Animal cells and visualization of bands with Agarose Gel Electrophoresis	12

CO	Course Outcomes
CO1	To practically observe and analyse cell structure and organization
CO2	To observe the stages of cell division in somatic and germ cells
CO3	To understand and apply the principle of biochemical calculations
CO4	To extract, quantify and analyse functional biomolecules of a cell
CO5	Handle and experiment various methods in isolation of different biomolecules
Textbooks:	
1	Experimental Procedures in Lifescience - Dr.S.Rajan Mrs. R. Selvi Christy, Anjana Book House
2	Analytical Techniques in Biochemistry and Molecular Biology; Rajan Katoch; 2011; ISBN:9781441997852
3	Cell and Molecular Biology Lab Manual. 14 June 2011 by Cristina C Thompson
4	Practical Guide Of Cell Biology Molecular Genetics 6 February 2023by Dr. Kanak Saxena
5	A Cell Biology Lab Manual Spiral-bound –2022 by Joseph Francis
Reference Books:	
1	Cell and Molecular Biology: A Lab Manual.30 October 2013 by K. V. Chaitanya
2	Practical Handbook of Biochemistry: Lab Manual. 17 April 2020 by Deepak Shrivastava (Author)
3	Lab Manual of Biochemistry. 12 April 2020 by Deepika Bairagee (Author)
4	Cell and Molecular Biology Lab Manual. 14 June 2011. by Cristina C Thompson David
5	Lab in Cell Biology, Microbiology and Bioinstrumentation: Laboratory Manual Kindle Edition by Geethalakshmi Sundararaman ,Anitha Arumugam ; 2017
Web resources:	
1	https://www.researchgate.net/publication/343636082_Practical_manual_on_Techniques_in_Molecular_Biology
2	https://www.uou.ac.in/sites/default/files/slm/ZO(N)-102.pdf
3	https://www.deanza.edu/faculty/heyerbruce/b6b_pdf/Bio6B-Manual_W19.pdf

Mapping with Programme Outcomes and Programme Specific Outcomes

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

3 – Strong, 2- Medium, 1- Low

1st YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBTE11	**Cancer Biology**	EC-1	4	1	0	0	3	5	25	75	100

Learning Objectives	
LO1	To understand the molecular basis of cancer
LO2	To understand the signalling pathways associated with cancer
LO3	To understand the causes of cancer
LO4	To understand the different biomarkers in cancer diagnostics
LO5	To understand the novel approaches in cancer therapeutics

Unit	Content	Hours
1	Introduction to cancer biology-History and research; Stages in cancer progression; Cell cycle and regulation; Cell senescence, Autophagy and Necrosis, Hypoxia and Angiogenesis, Metastasis and Invasion; Cancer epigenetics; Oncogene and tumor suppressor genes, proto oncogenes Genomic instability in cancer; Somatic and germ cell mutations-Mutagen and infectious agents	15
2	Growth factors; Signal transduction pathways- RTK, Ras-MAPK, Wnt signalling, Notch signalling, TGF beta signalling, JAK-STAT pathway, PIK3/AKT pathway	15
3	MicroRNAs and Cancer; Bacteria and cancer; Viral Mechanisms in Carcinogenesis; Fungi and cancer; Hereditary cancer; Immune system and cancer-NK cells, B-cells, T-cells, APCs, Cancer cell receptors, Stem cells	15
4	Introduction to biomarkers; Types of biomarkers; Cancer biomarkers- DNA markers, RNA biomarkers, Protein biomarkers, Challenges in cancer biomarkers, Cancer detection and diagnosis, Biopsy, Imaging techniques; Molecular techniques-Cytogenetic analysis, Immunophenotyping	15
5	Cancer therapeutics- Surgical treatment in cancer, Chemotherapy in cancer, Mechanism of chemotherapeutic drugs, Immunotherapy, Personalized medicines, Targeted therapy, Stem cell therapy, Hormone therapy, Novel therapeutics in cancer, Current research trends in cancer; Cancer prevention- Gene therapy-CRISPR	15

CO	Course Outcomes
CO1	Understand the molecular basis of cancer biology
CO2	Understand different signalling events in cancer progression
CO3	Comprehend the different causes of cancer carcinogenesis
CO4	Understand the various biomarkers in cancer diagnostics
CO5	Understand the various methods of cancer treatments and research trends in cancer therapeutics
Textbooks:	
1	Cancer Biology, 3rd Edition, Roger J B King and Mike W Robins, 2006
2	Textbook of Cancer Biology, Francesco Pezzella, Mahvash Tavassoli, David J. Kerr, 2019
3	Cell Signalling, By John Hancock · 2010; ISBN: 9780199232109
4	Treatment of Cancer;2020; Karol Sikora, ISBN:9780429649004
5	Cancer Biomarkers: Clinical Aspects and Laboratory Determination; 2022; Lakshmi V. Ramanathan, Martin Fleisher, Michael J. Duffy; ISBN:9780128243039
Reference Books:	
1	Principles of Cancer Biology; Lewis J. Kleinsmith, Pearson Benjamin Cummings, 2006
2	Understanding Cancer An Introduction to the Biology, Medicine, and Societal Implications of this Disease- By J. Richard McIntosh
3	Molecular and Cell Biology of Cancer- Rita Fior, Rita Zilhao
4	Cancer Biology, Raymond W. Ruddon, Oxford University Press, USA, 2007
5	The Biology of Cancer by Robert A Weinberg, ISBN: 978-0-393-88764-8
Web resources:	
1	https://pmc.ncbi.nlm.nih.gov/articles/PMC8002322
2	https://www.khanacademy.org/science/ap-biology/cell-communication-and-cell-cycle/regulation-of-cell-cycle/a/cancer
3	https://www.pnas.org/doi/10.1073/pnas.1219651110

Mapping with Programme Outcomes and Programme Specific Outcomes

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

3 – Strong, 2- Medium, 1- Low

1st YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBTE12	**Bioinstrumentation**	EC-2	4	1	0	0	3	5	25	75	100

Learning Objectives	
LO1	To understand the concepts of Chromatography and electrophoresis
LO2	To understand the principles of GC-MS
LO3	To understand the concepts and working principles of Microscopy
LO4	To understand the working mechanism Spectroscopy
LO5	To understand the basic principle of radio isotopic techniques

Unit	Content	Hours
1	Chromatography-types, HPLC – History, Scope, Overview, Principle and Application, Parts and mechanism of HPLC – Mobile Phase, Solvent Delivery Pump, Injector, Column, Detector and Data System with LC-MS, HPTLC, Electrophoresis-AGE, PAGE, SDS-PAGE, 2D-PAGE, capillary	15
2	GCMS – History, Scope, Overview, Principle and Application, Parts and mechanism of GCMS – Carrier Gas, Pneumatic Controller, Injector, Oven, Column, Interface, Ion Source, Mass Analyzer, Detector, Vacuum System and Control Electronics; MALDI TOF	15
3	Microscopic techniques, Principles and applications, compound, light, stereo, phase contrast, fluorescent, atomic force microscopy, confocal, flow cytometry, SEM –, Scope, Overview, Principle and Application, Parts and mechanism of SEM; TEM – Scope, Overview, Principle and Application, Parts and Mechanism of TEM	15
4	Spectroscopic techniques-theory and application. Part and mechanism of UV- visible spectroscopy, fluorescence spectroscopy, Mass spectroscopy, IR, NMR, AAS, X-ray spectroscopy, Raman spectroscopy	15
5	Radio-isotopic techniques, Introduction of radio isotopes, Biological applications, Radioactive decay-types, Autoradiography, Health effects of radiations	15

CO	Course Outcomes
CO1	To understand the principle and working mechanism of HPLC
CO2	To understand the principle and working mechanism of GCMS
CO3	To understand the principle and working mechanism of SEM
CO4	To understand the principle and working mechanism of TEM
CO5	To understand the principle and working mechanism of NMR
Textbooks:	
1	Gas Chromatography and Mass Spectrometry: A Practical Guide; O. David Sparkman, Zelda Penton, Fulton G. Kitson; ISBN:9780080920153
2	HPLC: A Practical Guide; 2007; Toshihiko T Hanai, ISBN:9781847551078
3	A Beginners' Guide to Scanning Electron Microscopy; 2018; Anwar Ul-Hamid; ISBN:9783319984827
4	A Practical Guide to Transmission Electron Microscopy: Fundamentals; Zhiping Luo; 2016; ISBN-13: 978-1-60650-703-2
5	Nuclear Magnetic Resonance Spectroscopy: An Introduction to Principles, Applications, and Experimental Methods; Joseph B. Lambert , Eugene P. Mazzola , Clark D. Ridge ; 2018; SBN:9781119295280
Reference Books:	
1	Bioinstrumentation; L. VEERAKUMARI; 2019; MJP Publisher
2	Bioinstrumentation; 2016; M. J. Reilly; ISBN:9788123929132
3	Principles of Bioinstrumentation; Richard Normann ; 1988; ISBN:9780471605140
4	Introduction to Bioinstrumentation: With Biological, Environmental, and Medical Applications; Clifford D. Ferris ; 1979; ISBN:9780896030039
5	Analytical Techniques in Biosciences From Basics to Applications; Azhar Rasul, Jonathan C. Ifemeje, Kingsley C. Patrick-Iwuanyanwu, Muhammad Ajmal Shah; 2021; ISBN:9780128227992
Web resources:	
1	https://cbpbu.ac.in/userfiles/file/2020/STUDY_MAT/ZOO/PK%20(4).pdf
2	https://microbenotes.com/instruments-used-in-microbiology-lab/
3	https://www.scribd.com/doc/6846793/Bioinstrumentation
4	https://www.nature.com/articles/s41598-019-48815-9

Mapping with Programme Outcomes and Programme Specific Outcomes

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

3 – Strong, 2- Medium, 1- Low

1st YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBTA11	**MS- Office Fundamentals**	AEC C-1	1	1	0	0	2	2	25	75	100

Learning Objectives	
LO1	To understand the basics of MS-Word
LO2	To understand basic functions of MS-Word
LO3	To understand the basic functions of MS-PowerPoint
LO4	To comprehend basic functionalities of MS-PowerPoint
LO5	To understand and work with MS-Excel

Unit	Content	Hours
1	Introduction to MS-Word; Typing and editing text; Formatting Text: Font Size, Style; Color, Use the Bold, Italic, and Underline; Shading text and paragraph; Tabs and Indents; Spacing; Insert Shapes, Clipart and Picture, Word Art, Page Number; Insert Shapes, Clipart and Picture, Inserting Text boxes; Inserting symbols.	06
2	Inserting custom Header and Footer; Bullets and Numbering; Page formatting, Alignment; Creating and formatting tables; Shortcut keys; Grammar and Spell check	06
3	Introduction to MS PowerPoint; Typing the text, Alignment of text; Formatting text- Font style, Font color; Cut, Copy, Paste, Select All, Clear text; Find & Replace; Choosing slide formats; Inserting shapes, charts and symbols	06
4	Animations- custom animations; slide transition; Insert tables; formatting tables; Insert; Slide layouts; Slide formatting; Slide show settings; Side themes; Preparing professional presentation	06
5	Introduction to MS-Excel; Working with excel workbook and sheets; Data entry and editing; Cell properties; Inserting formula; Data analysis- Types of charts, Statistical analysis of data, AI in MS-Office	06

CO	Course Outcomes
CO1	To become practically skilled in working with MS-WORD
CO2	To become familiarized with functionalities of MS-WORD for thesis and manuscript preparation
CO3	To become practically skilled in working with MS-POWERPOINT
CO4	To become familiarized with functionalities in MS-POWERPOINT for oral and poster presentation
CO5	To become practically skilled in working with MS-EXCEL for research data analysis
Textbooks:	
1	Microsoft Office 2003: The Complete Reference by Jennifer Kettell
2	Office 2010 Visual Quick Tips (Paperback) by Sherry Willard Kinkoph Gunter
3	Microsoft Office PowerPoint 2007 Quick Steps (Paperback) by Carole Boggs Matthews
4	Microsoft Excel 2010 In Depth (Paperback) by Bill Jelen
5	Learn Microsoft Office for Windows 95: Comprehensive Tutorials for Word 7.0, Excel 7.0, Access 7.0, Power point 7.0, Schedule 7.0, Shortcut Bar, Binder, and Much More... (Paperback) by Russell A. Stultz
Reference Books:	
1	Microsoft Office 365 All-In-One for Beginners & Power Users: The Concise Microsoft Office 365 A-Z Mastery Guide for All Users (Word, Excel, PowerPoint, ... (Office 365 Mastery Guide 2022 Book 1) Kindle Edition by Tech Demystified
2	MS-Office, Dr. S.S. Srivastava
3	Microsoft Office Reference Guide by Tom Bunzel
4	Computer MS Office Book by Prof. Satish Jain, M.Geetha, Kratika
5	MS Office 2013 (Revised Edition**),** VISHNU P. SINGH, ISBN: 978-81-7317-705-7
Web resources:	
1	https://learn.microsoft.com/en-us/microsoft-365/enterprise/urls-and-ip-address-ranges?view=o365-worldwide
2	https://www.geeksforgeeks.org/how-to-add-a-hyperlink-in-ms-word/
3	https://be10x.in/blog/top-5-ai-features-in-ms-office-and-how-they-can-benefit-you/

Mapping with Programme Outcomes and Programme Specific Outcomes

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

3 – Strong, 2- Medium, 1- Low

1st YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBTC21	**PLANT AND ANIMAL BIOTECHNOLOGY**	CC-1	3	1	2	0	4	6	25	75	100

Learning Objectives

LO1	To Develop a strong theoretical foundation in plant biotechnology techniques, including tissue culture, plant genetic transformation, and their industrial applications.
LO2	To Understand the significance of secondary metabolites and their production in plants.
LO3	To Build a clear understanding of the concepts, principles, and processes involved in animal biotechnology.
LO4	To Explore the fundamentals of animal cell culture, including different types of cultures and cell lines.
LO5	To Apply molecular biology techniques to genetically engineer animals, enhancing their sustainability, productivity, and suitability for pharmaceutical and industrial applications.

Unit	Content	Hours
1	Definition, scope, and applications of plant tissue culture, Media preparation: MS medium, nutrient requirements, and hormone regulation. Micropropagation, organogenesis, somatic embryogenesis, haploid and triploid production, protoplast isolation and fusion, hybrid and cybrid,synthetic seed production. Secondary metabolites in plants – Classification– Alkaloids, Terpenoids (Isoprenoids), Phenolics - Flavonoids, Glycosides,Saponins, Volatile Oils (Essential Oils), therapeutic applications.	18
2	Transgenic plants: rDNA Technology; Gene transfer methods – Microinjection, electroporation and particle gun bombardment. Agrobacterium, Ti plasmid vector. Theory and techniques for the development of new genetic traits, conferring resistance to biotic and abiotic. Plant engineering towards the development of enriched food products, Molecular Marker aided breeding: RFLP maps, Linkage analysis. Applications of Transgenic Plants. Biosafety and Ethical Issues in Transgenic Plants.	18
3	Animal cell culture: Types (primary, secondary, continuous), Culture media: Essential nutrients, serum-free media, and growth factors. Animal health disease diagnosis, hybridoma technique, monoclonal antibodies, application of probes for disease diagnosis of existing and emerging animal diseases. Oral vaccines, DNA Vaccines in animal disease.	18
4	Disaggregation of tissue and primary culture; cell separation, cell synchronization, cryo preservation. Scaling up of animal cell culture, cell line and cloning micromanipulation . Somatic cell cloning. Karyotyping; measuring parameters for cell growth, measurement of cell death, apoptosis and its determination, cytotoxicity assays	18
5	Application of animal cell culture: in vitro testing of drugs, production of human and animal viral vaccines and pharmaceutical proteins. Transgenic animals: Production and application.Bioartificial organs: Skin substitutes, bioartificial pancreas, liver, and heart valves.Stem Cells- Properties, Types, Therapy, Prospects, and Ethics in stem cell research	18

CO	Course Outcomes
CO1	Students will gain knowledge about the concepts, scope, and applications of plant tissue culture.
CO2	Students will explore Agrobacterium Ti plasmid vectors for genetically modified plants
CO3	Students will be trained in scaling up cell cultures and performing cell culture techniques
CO4	Students will learn critical processes like tissue disaggregation, cell synchronization, and cryopreservation.
CO5	Students will be able to describe the production and use of transgenic animals for pharmaceutical and research purposes
Textbooks:	
1	Razdan. M. K., 2011. Plant tissue culture. Oxford and IBH publishing Company Pvt. Ltd, New Delhi.
2	Chawla. H. S., 2010. Introduction to plant biotechnology. Oxford and IBH publishing company pvt. Ltd, New delhi.
3	Ian Freshney, 2010. Culture of animal cells. 6th edition, Wiley-Blackwell publishers.
4	Slater, 2008. Plant Biotechnology: The Genetic manipulation of plants, Second Edition, Oxford University Press, USA.
5	J.D.Watson, Gillman, J.Witknowski and M.Zoller, 2006. Recombinant DNA. 3rd ed.
Reference Books:	
1	W.H.Freeman. 26 K. Dass. 2005, Text book of Biotechnology, Second Edition, Wiley Dreamtech, India (P) Ltd.
2	H.Kreuzer A.Massey. 2001. Recombinant DNA and Biotechnology: A guide for teachers Second Edition. ASM press, Washington.
3	M.Sudhir. 2000. Applied Biotechnology Plant Genetics. Dominant publishers Distributors.
4	Genetic Engineering of Animals by (Ed) A.Puhler, VCH Publishers, Weinheim, FRG, 1993. Animal Cell culture Practical approach. Ed. John R.W.Masters, Oxford.2004
5	Concepts in Biotechnology D. Balasubramaniam, Bryce, Dharmalingam, Green, Jayaraman Univ. Press, 1996
Web resources:	
1	https://www.isaaa.org/resources/publications/pocketk/14/default.asp
2	https://agritech.tnau.ac.in/bio-tech/biotech_tc_notes.html
3	https://www.corning.com/catalog/cls/documents/application-notes/CLS-AN-042.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	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	3	3	3	3	3	3
CO4	3	3	2	2	3	3	3	3	3	3	3
CO5	3	2	3	3	3	3	3	3	3	3	3
Total	15	12	12	14	15	15	15	15	15	15	15
Average	**3**	**2.4**	**2.4**	**2.8**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

3 – Strong, 2- Medium, 1- Low

1st YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBTC22	**MICROBIOLOGY**	Core 5	3	1	2	0	4	6	25	75	100

Learning Objectives	
LO1	To understand the major discoveries of microbiology and describe microbial diversity, Microbial growth and metabolism.
LO2	To provide basic knowledge about microbial culture, identification of microbes, principle and working of microscopes and sterilization techniques
LO3	To enlighten the students on host microbe interaction and Epidemiology of microbial disease
LO4	To update the knowledge on epidemic and pandemic diseases
LO5	To assess and appraise the role of novel microbes in environment and integrate them in specific innovative approaches

Unit	Content	Hours
1	History and microbial taxonomy: Major discoveries related to the field of microbiology: Antony Von Leeuwenhoek, Louis Pasteur, Robert Koch and Carl Woese. Microbial taxonomy: Bacteria, viruses, fungi, algae and protozoa, Microbial diversity: Biovars, Serovars and Prions, Role of Bacteria in Ecosystems. Applications of Microbial Diversity. Microbial growth: Growth curve, factors affecting growth, Microbial metabolism- Methanogenesis, acetogenesis and auxotrophs.	18
2	Microbial culture, identification, and control: Growth media and types – culturing techniques: Streaking method, Pure culture techniques: Serial dilution and plating methods. Identification of bacteria – Biochemical – IMViC. Microscopy: principles and applications of Bright field, florescent and Scanning electron microscopes. Microbial growth control: Physical Methods – Heat, Filtration, Low Temperatures, High Pressure, Osmotic Pressure, Radiation; Chemical Methods.	18
3	Host microbe interaction and Epidemiology: Human microbiome; Skin, Gastrointestinal tract, Oral cavity, Lung. Symbiotic relationship of microbes: Symbiosis, Mutualism, Parasitism,Commensalism and endophyte. Epidemiology of microbes: causes, types and transmission of epidemic, endemic and pandemic diseases.	18
4	Microbial Diseases: General characteristics, pathogenesis, laboratory diagnosis and control measures of Pandemic and Epidemic diseases: Leprosy, COVID-19, Yellow Fever, Flu, AIDS, Ebola, Zika Virus, Small Pox, Dengue, Chickungunya, filariasis, Candidiasis, superficial mycosis.	18
5	Agricultural and Environmental Microbiology: Biological nitrogen fixation, free living, symbiotic nitrogen fixation, mechanism of Nitrogen, Biofertilizers- types and applications; Rhizosphere effect. Biogeochemical cycles-Carbon, Nitrogen, Sulphur and Phosphorous;Methanogenic bacteria Extremphiles-Thermophiles, Acidophiles, Halophiles and alkalophiles.	18

CO	Course Outcomes
CO1	students familiarize with the major historical discoveries in microbiology by pioneers like Antony van Leeuwenhoek, Louis Pasteur, Robert Koch, and Carl Woese, and to provide knowledge of microbial taxonomy, including bacteria, viruses, fungi, algae, and protozoa.
CO2	Students can impart practical knowledge on culturing microorganisms, media preparation, and identification methods such as biochemical tests (e.g., IMViC) and microscopy, along with the physical and chemical control of microbial growth.
CO3	Students learn to provide insights into the human microbiome, microbial symbiosis, and the epidemiology of infectious diseases, focusing on their causes, transmission, and patterns of outbreaks (epidemic, endemic, and pandemic).
CO4	Students able to understand the characteristics, pathogenesis, diagnosis, and control of major microbial diseases, with a focus on pandemic and epidemic diseases like COVID-19, AIDS, dengue, and Ebola.
CO5	Students can understrand the microbial roles in nitrogen fixation, biofertilizers, rhizosphere interactions, biogeochemical cycles, and extremophiles, emphasizing their importance in agriculture and environmental sustainability.
Textbooks:	
1	Joanne Willey, Linda Sherwood, Christopher J. Woolverton, (2017). Microbiology, (10th edition), McGraw-Hill Education, ISBN: 978-1259281594.
2	Maheshwari D K, Dubey R C 2013. A Textbook of Microbiology.4th Edn S Chand Publishing India.
3	Ananthanarayan and Paniker's (2017) Textbook of Microbiology, (10th edition), The Orient Blackswan, ISBN: 978-9386235251.
4	Benson HJ. (1999). Microbiological Applications: A Laboratory manual in General Microbiology, 7th Edition, McGraw Hill.
Reference Books:	
1	Agriculture Microbiology 2016. E-Course Developed By TNAU (ICAR)
2	Prescott's Microbiology by Joanne Willey, Kathleen Sandman, and Dorothy Wood
3	Medical Microbiology by Patrick R. Murray, Ken S. Rosenthal, and Michael A. Pfaller
4	Textbook of Diagnostic Microbiology by Connie R. Mahon, Donald C. Lehman, and George Manuselis
5	Environmental Microbiology by Ian L. Pepper, Charles P. Gerba, and Terry J.Gentry
Web resources:	
1	https://www.britannica.com/science/microbiology
2	https://www.ncbi.nlm.nih.gov/books/NBK560448/

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	-	3	3	3	3	-
CO2	3	-	3	3	3	-	3	3	3	3	-
CO3	3	-	3	3	3	-	3	3	3	3	-
CO4	3	-	3	3	3	3	3	3	3	3	3
CO5	3	-	3	3	3	3	3	3	3	3	3
Total	15	3	15	15	15	6	15	15	15	15	6
Average	**3**	**0.6**	**3**	**3**	**3**	**1.2**	**3**	**3**	**3**	**3**	**1.2**

3 – Strong, 2- Medium, 1- Low

1st YEAR: SECOND SEMESTER CC-6

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBTC23P	Plant and Animal Biotechnology, Microbiology Practical	CC-6	0	0	4	0	3	4	25	75	100

Learning Objectives	
LO1	To Isolate organism from Different Environment
LO2	To develop proficiency in microbial identification and characterization
LO3	To gain hands-on expertise in plant tissue culture techniques
LO4	To Develop skills in isolating plant protoplasts, assessing their viability, and accurately localizing the nucleus using appropriate staining techniques for cellular analysis.
LO5	To acquire practical skills in animal cell culture techniques

Unit	Content	Hours
1	Isolation and Enumeration of bacteria from soil, Isolation and Enumeration of bacteria from water, Isolation and Enumeration of bacteria from air, Isolation and Enumeration of bacteria from plant surface, Isolation of bacteria from root nodules, Isolation of pure culture of Aspergillus niger, Isolation of pure culture of Streptomyces.	12
2	Gram staining and morphological characterization of microbes, Determination of growth curve of bacteria – E.coli, Biochemical characterization - catalase, oxidase, urease, coagulase, Starch Hydrolysis test, Lipid Hydrolysis test, Test for H2S production or TSI agar test, Antibiotic sensitivity test	12
3	Preparation of MS medium stock solution –Macro salt, Micro salt, Vitamin, growth regulator, Surface sterilization of various explants – leaf, shoot, root, seed, Generation of Callus from any two explants (leaf, root, bud and shoot apex), Maintenance of callus culture, Anther culture, Pollen culture, Embryo culture.	12
4	Isolation of plant protoplast 8. Protoplast viability test, Localization of nucleus using nuclear stain.	12
5	Introduction to Animal Cell culture: Procedure for handling cells and medium, Cleaning and sterilization of glassware and plastic tissue culture flasks, Preparation of tissue culture media, Trypsinization of established cell culture, Cell counting and viability - staining of cells (a) Vital Staining (Trypan blue).	12

CO	Course Outcomes
CO1	Demonstrate the ability to isolate and enumerate various microorganisms from different environmental sources, including soil, water, air, and plant surfaces, using appropriate microbiological techniques.
CO2	Perform biochemical characterization and morphological identification of bacteria, including the Gram staining technique and tests for enzymatic activity, to assess microbial diversity.
CO3	Conduct plant tissue culture techniques, including the preparation of MS medium, surface sterilization of explants, and generation of callus, to understand plant propagation methods.
CO4	Apply animal cell culture practices, including media preparation, sterilization, trypsinization, and viability testing using Trypan blue, to study cell behavior and growth dynamics.
CO5	Execute advanced techniques such as 16S rRNA sequencing and protoplast isolation, enhancing understanding of genetic identification and plant cellular biology.
Textbooks:	
1	Microbiology: A Laboratory Manual by James G. Cappuccino and Natalie R.Sherman
2	Bergeys Manual of Determinative Bacteriology by John G. Holt
3	Microbiology Laboratory Theory and Application by Michael J. Leboffe and Burton E. Pierce
4	Plant Tissue Culture: Techniques and Experiments by Roberta H. Smith
5	Animal Cell Culture: A Practical Approach by J. M. Davis
Reference Books:	
1	Laboratory Manual in General Microbiology by J. W. D. and E. T. K.
2	Plant Cell and Tissue Culture by A. M. M. P. G.
3	Animal Cell Culture and Technology by John C. D.
4	Handbook of Plant Cell Culture by R. A. Dixon
Web resources:	
1	https://jru.edu.in/studentcorner/lab-manual/agriculture/Lab%20Manual%20PPB.pdf
2	https://microbiologysociety.org/static/uploaded/23cbf9c5-f8c8-4f91-b092a4ad819e6357.pdf
3	https://faculty.washington.edu/korshin/Class-486/MicrobiolTechniques.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	2	3	3	3	3	2
CO2	3	3	3	-	3	2	3	3	3	3	2
CO3	3	3	3	-	3	2	3	3	3	3	2
CO4	3	2	3	-	3	2	3	3	3	3	2
CO5	3	2	3	-	3	2	3	3	3	3	2
Total	15	12	15	-	15	10	15	15	15	15	10
Average	**3**	**2.4**	**3**	**-**	**3**	**2**	**3**	**3**	**3**	**3**	**2**

3 – Strong, 2- Medium, 1- Low

1st YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBTC24	**Bioprocess Technology**	CC-7	2	1	1	0	3	4	25	75	100

Learning Objectives	
LO1	Explain the concept of fermentation and its importance
LO2	Learn about bioreactors and its types
LO3	Obtain a strong knowledge on product production and recovery
LO4	Perceive knowledge on seperation techniques of bioproducts
LO5	Understand the commercial importance of microbes in fermentation and bioprocessing

Unit	Content	Hours
1	Introduction to fermentation. General requirements of fermentation. Microbial growth kinetics of batch and continuous culture. Solid substrate, slurry fermentation and its application. Microbial cell culture. Immobilization of cells and enzymes.	12
2	Bioreactors: Submerged reactors, surface reactors, mechanically agitated reactors, non-mechanically agitated reactors. Design of fermenters. Production of citric acid, penicillin and insulin.	12
3	Introduction to bioproducts and bioseparation. Primary recovery process: Cell disruption methods. Cell lysis and Flocculation: Osmotic and mechanical methods of lysis. Flocculation by electrolysis; polymorphic flocculation. Precipitation methods. Filtration: Principles, Conventional, Crossflow filtration. Sedimentation: Principles, Sedimentation coefficients. Extraction Principles, Liquid liquid extraction, aqueous two phase extraction, supercritical fluid extraction.	12
4	Down Stream Processing: Chromatography Techniques, Membrane separation, ultrafiltration. Drying .Principles and operation of vacuum dryer, and its types	12
5	Aerobic and anaerobic fermentation processes and their application in the field of biotechnology industry. Production of commercially important primary and secondary metabolites.	12

CO	Course Outcomes
CO1	Students learn to Identify the major types, such as embryonic, adult, mesenchymal, and adipose-derived stem cells, and their unique properties.
CO2	Students learn to Compare the roles of embryonic and adult niches in maintaining stem cell populations, with examples like Drosophila germline stem cells.
CO3	Students can Understand the criteria used to validate stem cell properties, such as surface markers and molecular assays.
CO4	Students learn to Analyze key signaling pathways (e.g., JAK-STAT, PI3K, Ras/Raf) that regulate the cell cycle, self-renewal, and differentiation.
CO5	Students can able to Develop an awareness of the ethical considerations involved in human stem cell research, along with recent innovations in the field.
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 Biology and Gene Therapy. Quesenberry PJ, Stein GS, eds. (£65.00.) Wiley, 1998.
4	Progress in gene therapy, Volume 2,Pioneering stem cell/gene therapy trials, Roger Bertolotti, Keiya Ozawa and H. Kirk Hammond, VSP international science publishers
5	Stem Cells Handbook: Stewart Sell, Humana Press; Totowa NJ, USA; Oct. 2003
Reference Books:	
1	Human Embryonic Stem Cells: The Practical Handbook by Stephen Sullivan and Chad A Cowan
2	"Stem cell basics and application" Ed. By K. D. Deb and S. M. Totey, Tata McGraw Hill Pvt. Ltd, 2011.
3	"Hand book of Stem Cells" Edited by RoberLanza, Elsevier, Academic Press, 2011.
4	"Stem Cells Handbook", Edited by Stewart Sell, Human Press, 2010.
5	"Stem cell therapy for organ failures", Edited by S. Indumathi, Springer Verlag, 2015
Web resources:	
1	https://ipecgroup.com/wp-content/uploads/formidable/6/bioprocess-technology-lecture-notes.pdf
2	https://www.sciencedirect.com/journal/biotechnology-notes
3	https://bnmv.ac.in/images/uploads/2020%20Dr.%20Ruma%20Dutta%20Advances%20in%20Bioprocess%20Engineering%20and%20Technology2.pdf

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	-	3	2	3	3	3	3	3	3	3
CO2	3	-	3	2	3	3	3	3	3	3	3
CO3	3	3	3	2	3	3	3	3	3	3	3
CO4	3	2	3	3	3	3	3	3	3	3	3
CO5	3	2	3	3	3	3	3	3	3	3	3
Total	15	7	15	12	15	15	15	15	15	15	15
Average	**3**	**1.4**	**3**	**2.4**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

3 – Strong, 2- Medium, 1- Low

1st YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBTE23	**Aquaculture Biotechnology**	EC-4	3	1	0	0	3	4	25	75	100

Learning Objectives	
LO1	To understand the application of biotechnology in different aspects of aquaculture
LO2	To study about Feed Biotechnology
LO3	To understand environmental management
LO4	To study applications of Biotechnological tools
LO5	To study Molecular technique sin Aquaculture

Unit	Content	Hours
1	Introduction - Scope of biotechnology in fisheries and aquaculture research. Transgenics – Principles of transgenic technology and its application in fisheries, Synthetic hormones for induced breeding	12
2	Feed biotechnology: Probiotics, single cell proteins, nutraceuticals. Commercial Recombinant protein - enzymes, hormones, bioactive compounds, therapeutic proteins. Antimicrobial peptides and their applications. Marine toxins.	12
3	Biotechnological approaches in environmental management: Bioremediation, biosensors, biofouling, treatment of waste water. Vaccination in fishes- DNA vaccines, sub UNIT vaccines and Biofilm Vaccines	12
4	Applications of biotechnological tools - Recombinant DNA, Monoclonal antibodies, Cell lines, Stem cell culture, DNA markers and MAS. Application of tissue culture in sea weed and pearl production	12
5	Molecular diagnostic technology in aquaculture: PCR protocol for white spot syndrome virus WSSV, Infectious hypodermal and hematopoietic necrosis virus IHHNV, Yellowhead disease YHD, Taura syndrome virus TSV. Electron microscopy in advanced fisheries research. Cryomicroscopy in aquaculture research.	12

CO	Course Outcomes
CO1	Students will recall and describe the scope of aquatic biotechnology as an emerging field
CO2	Students will explain and apply the concepts of feed biotechnology, single-cell proteins (SCP), active compounds, and proteins in aquatic contexts
CO3	Students will utilize and assess various technologies in environmental management related to aquatic ecosystems
CO4	Students will interpret and analyze the applications of biotechnology in aquatic environments
CO5	Students will demonstrate the use of molecular diagnostic technologies in aquatic biotechnology to solve relevant problems
Textbooks:	
1	Ramesh RC. (Ed.). 2007. Microbial Biotechnology in Agriculture and Aquaculture. Vol.II. Science Publ.
2	Nagabhushanam R, Diwan AD, Zahurnec BJ ,Sarojini R. 2004.Biotechnology of Aquatic Animals. Science Publ
3	Felix S 2007. Molecular diagnostic technology in aquaculture, Narendra Publishing House, Delhi, India
4	Nair PR. 2008. Biotechnology and Genetics in Fisheries and Aquaculture. Dominant Publ.
5	Reddy PVGK, Ayyappan S, Thampy DM , Gopalakrishna. 2005. Text Book of Fish Genetics and Biotechnology. ICAR.
Reference Books:	
1	Pandian TJ, Strüssmann CA Marian MP. 2005. Fish Genetics and Aquaculture Biotechnology. Science Publ. Primrose SB. 1989. Modern Biotechnology. Blackwell
2	Applications of Recombinant DNA Technology. ASM Press.
3	Fingerman M, Nagabhushanam R Thompson MF. 1997. Recent Advances in Marine Biotechnology. Vols. I-III. Oxford & IBH.
4	Zhanjiang JL. 2007. Aquaculture Genome Technologies. Blackwell
5	Singh B. 2006. Marine Biotechnology and Aquculture Development. Daya Publ. House
Web resources:	
1	https://www.researchgate.net/publication/336982982_BIOTECHNOLOGY_AND_ITS_APPLICATIONS_IN_AQUACULTURE_AND_FISHERIES
2	https://extension.psu.edu/introduction-to-aquaculture
3	https://www.sciencedirect.com/science/article/abs/pii/S004484860100864X

Mapping with Programme Outcomes and Programme Specific Outcomes

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

3 – Strong, 2- Medium, 1- Low

1st YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PBTE21	**STEM CELL BIOLOGY**	EC 3	2	1	1	0	3	4	25	75	100

Learning Objectives

LO1	To understand the major discoveries of stem cell biology
LO2	To provide basic knowledge about stem cell niche and functions
LO3	To enlighten the students on Stem cell isolation and culture techniques
LO4	To update the knowledge on Stem cell cycle
LO5	To assess and appraise Applications of Embryonic stem cells.

Unit	Content	Hours
1	Stem cells - Definition, Characterization, Totipotent, pluripotent, multipotent and unipotent cells. Self-renewal and differentiation. Types of stem cells- Embryonic stem cells, Adult stem cells and mesenchymal stem Cells, Adipose stem cells	12
2	Stem cell niche, Niche specification - Drosophila germ line stem cells. Receptors, genes and markers of stem cells.Embryonic niche vs. adult niche.	12
3	Stem cell isolation and culture techniques. Characterization of stem cells. Culture of Stem Cells.	12
4	Stem cell cycle. Chromatin modification and transcriptional regulation, chromatin modifying factors, Chromosomal inactivation. JAK -STAT pathway, Ras\Raf pathway, PI3K cell signaling, p53 check points, Role of LIF pathway in cell cycle control	12
5	Applications of Embryonic stem cells, Bone marrow stem cells, Adipose derived stem cells and Hematopoietic stem cells. Ethics in human stem cell research. Stem Cells in Bioartificial Organs and Tissue Engineering. Recent Advances in Stem Cell Research.	12

CO	Course Outcomes
CO1	Students learn to Identify the major types, such as embryonic, adult, mesenchymal, and adipose-derived stem cells, and their unique properties.
CO2	Students learn to Compare the roles of embryonic and adult niches in maintaining stem cell populations, with examples like Drosophila germline stem cells.
CO3	Students can Understand the criteria used to validate stem cell properties, such as surface markers and molecular assays.
CO4	Students learn to Analyze key signaling pathways (e.g., JAK-STAT, PI3K, Ras/Raf) that regulate the cell cycle, self-renewal, and differentiation.
CO5	Students can able to Develop an awareness of the ethical considerations involved in human stem cell research, along with recent innovations in the field.
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 Biology and Gene Therapy. Quesenberry PJ, Stein GS, eds. (£65.00.) Wiley, 1998.
4	Progress in gene therapy, Volume 2,Pioneering stem cell/gene therapy trials, Roger Bertolotti, Keiya Ozawa and H. Kirk Hammond, VSP international science publishers
5	Stem Cells Handbook: Stewart Sell, Humana Press; Totowa NJ, USA; Oct. 2003
Reference Books:	
1	Human Embryonic Stem Cells: The Practical Handbook by Stephen Sullivan and Chad A Cowan
2	"Stem cell basics and application" Ed. By K. D. Deb and S. M. Totey, Tata McGraw Hill Pvt. Ltd, 2011.
3	"Hand book of Stem Cells" Edited by RoberLanza, Elsevier, Academic Press, 2011.
4	"Stem Cells Handbook", Edited by Stewart Sell, Human Press, 2010.
5	"Stem cell therapy for organ failures", Edited by S. Indumathi, Springer Verlag, 2015
Web resources:	
1	https://www.medicalnewstoday.com/articles/323343
2	https://www.jto.org/article/S1556-0864(15)31506-9/fulltext
3	https://www.dvcstem.com/post/benefits-of-stem-cells

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	-	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	3	-	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	2	3	3	3	3	3	3	3	3	3
Total	15	7	15	15	15	15	15	15	15	15	15
Average	**3**	**1.4**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

3 – Strong, 2- Medium, 1- Low