



MARUDHAR KESARI JAIN COLLEGE FOR WOMEN (AUTONOMOUS)

Vaniyambadi – 635 751

PG & Research Department of Biotechnology

for

Undergraduate Programme

Bachelor of Science in Biotechnology

From the Academic Year 2024-25

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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 indispensable element to satiate the global requisite of an intellectually skilled person.

The Department of Biotechnology began its journey in the year 2007 with a 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 Ph.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 learners 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 on earth.

PROGRAMME OUTCOMES (PO)

Programme	B.Sc., Biotechnology
Programme Code	US05
Duration	3 years [UG]
Programme Outcomes	PO1: Disciplinary knowledge: Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate 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-related skills: A sense of inquiry 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.
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Eligibility for Admission:

Candidates for admission to the first year of the Bachelor of Biotechnology course shall be required to have passed the Higher Secondary Examination with **50%** marks in the aggregate in the Academic Stream of any Science group

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	
24UFTA11	Tamil – I	4	1	0	0	3
24UFEN11	English – I	4	1	0	0	3
24UBTC11	CC – 1 – Cell and Molecular Developmental Biology	3	1	2	0	5
24UBTC12P	CC - 2 Practical I –Cell Biology and Biological Chemistry Practical	0	0	4	0	3
24UBTA11	EC - 1 AL – Biological Chemistry	3	1	0	0	3
24UBTS11	SEC – 1 Human Physiology and Disease (NME)	2	0	0	0	2
24UBTS12P	SEC – 2 – Practical –MS – Office Fundamentals Practicals	0	0	2	0	2
24UBTF11	FC – Concepts in Biotechnology	1	1	0	0	2
					30	23

Semester – III						
24UFTA31	Tamil – III	4	1	0	0	3
24UFEN31	English – III	4	1	0	0	3
24UBTC31	CC – 5 – Immunology and Immunotechnology	3	1	2	0	5
24UBTC32P	CC - 6 Practical III – Immunology and Immunotechnology Practical	0	0	3	0	2
24UBTA31	EC - 4 AL – Bioinstrumentation	3	1	0	0	4
24UBTA32P	EC - 5 AL Practical – Bioinstrumentation Practical	0	0	3	0	2
24UBTS31	SEC -4 – Medical Lab Technology	1	0	1	0	2
24UAEC31	AEC – 2 Human Values and Professional Ethics	1	1	0	0	2
					30	23

Semester – V						
24UBTC51	CC -9 – Environmental and Industrial Biotechnology	4	1	0	0	5
24UBTC52P	CC- 10 Practical V – Environmental and Industrial Biotechnology	0	0	3	0	2
24UBTC53	CC – 11 – Plant and Animal Biotechnology	4	1	0	0	5
24UBTC54P	CC - 12 Practical VI – Plant and Animal Biotechnology	0	0	3	0	2
24UBTE51/ 24UBTE52/ 24UBTE53	EC – 8 – Nanotechnology / Bioethics & Biosafety/ Research Methodology	4	1	0	0	4

Semester - II						
Code	Course Title	Hours Distribution				C
		L	T	P	S	
24UFTA21	Tamil – II	4	1	0	0	3
24UFEN21	English – II	4	1	0	0	3
24UBTC21	CC – 3 – Genetics and Molecular Biology	3	1	2	0	5
24UBTC22P	CC - 4 Practical II – Genetics and Molecular Biology Practical	0	0	4	0	2
24UBTA21	EC - 2 AL – Fundamentals of Microbiology	3	1	0	0	4
24UBTA22P	EC - 3 AL Practical – Fundamentals of Microbiology Practical	0	0	2	0	2
24UBTS21	SEC – 3 Good Laboratory Practice (GLP)	1	0	1	0	2
24UAEC21	AEC – 1 LIFE SKILLS THROUGH YOGA	1	1	0	0	2
					30	23

Semester – IV						
24UFTA41	Tamil – IV	4	1	0	0	3
24UFEN41	English – IV	4	1	0	0	3
24UBTC41	CC – 7 – Genetic Engineering & rDNA Technology	3	1	2	0	5
24UBTC42P	CC - 8 Practical IV – Genetic Engineering and rDNA Technology Practical	0	0	3	0	2
24UBTA41 24UBTA42	EC - 6 AL – Bioinformatics & Biostatistics EC - 6 AL – Botany	3	1	0	0	4
24UBTA42P 24UBTA42P	EC - 7 AL Practical – Bioinformatics & Biostatistics Practical EC - 7 AL Practical – Botany	0	0	3	0	2
24UBTS41	SEC – 5 – Disease Diagnosis and Prevention	1	0	1	0	2
24UAEC41	AEC – 3 Environmental Studies & Disaster Management	1	1	0	0	2
					30	23

Semester - VI						
24UBTC61	CC – 13 - Enzymology	5	1	0	0	5
24UBTC62P	CC - 14 Practical VII – Enzymology	0	0	4	0	2
24UBTC63P	CC - 15 – Project (Group/ Individual)	0	0	0	5	4
24UBTE61/ 24UBTE62	EC – 10 –Marine Biotechnology / Food Technology	4	1	0	0	4
24UBTE63/ 24UBTE64	EC – 11 – Vermicompost / Pharmaceutical Biotechnology	4	1	0	0	4

24UBTE54/ 24UBTE55	EC – 9 – Biotechnology in Forensic Science/ Bioentrepreneurship	4	1	0	0	4	24UBTP61	PEC – 1 – Research Ethics	1	1	0	0	2
24UAEC51	AEC – 4 Gender Equality and Social Inclusion	1	1	0	0	2	24UBTL61	SLC – 1 – Life span Psychology				3	2
24UBTIN51	Internship	0	0	0	0	2							
24UBTIK51	IKS- Introduction to Indian Science and Technology	2	0	0	0	0						30	23
						30	26					141+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*.

Part – 1 & 2	Tamil & English	4	SEC	Skill Elective Course	5
CC	Core Course	15	FC	Foundation Course	1
EC-AL	Elective Course – Applied	7	AEC	Ability Enhancement Course	4
EC	Elective Course – Major	4	SLC	Self-Learning Course	1

1st YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UBTC11	CELL AND MOLECULAR DEVELOPMENTAL BIOLOGY	CC-1	3	1	2	0	5	6	25	75	100
Learning Objectives											
LO1	To Have an insight of the cell as the fundamental unit of life and to compare the structure of the Eukaryotic cell with the primitive prokaryotic cell										
LO2	To obtain a strong foundation about the functional aspects of cell organelles										
LO3	To Study the structure and functions of Nucleic acid										
LO4	To understand Cell Cycle and Cell to Cell Signalling										
LO5	To Understand the principles and molecular mechanisms involved in cellular differentiation										
Unit	Content										Hours
1	Cells-Introduction & Discovery and Diversity of cells – Cell theory - Cell death, growth and developments – Cell origin and Evolution – Basic Properties of cell – Size, shape, Composition. Types and Structure of cells – Prokaryotes , Eukaryotes.										18
2	Cell Organelles: Structure and Function of Cell Organelles - Cell Wall & Cell Membrane, Cytoplasm, Nucleus, Chromosomes, Endoplasmic reticulum, Ribosomes, Golgi bodies, plastids, Vacuoles, lysosomes, Mitochondria, Microbodies – Flagella, Cilia, Centrosomes and Centrioles, Cytoskeleton.										18
3	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. Central Dogma of the Cell – Basic concepts of Gene. Regulatory regions- UTRs										18
4	Cell Cycle (Prokaryotes and Eukaryotes) Cell Cycle – Cell Cycle Check points – Cell death and Senescence. Cell division – Phases- mitosis – meiosis. Cell to cell communication- signal transduction – signalling molecules – cell junction – cell adhesion and cleavage. Extracellular matrix – cell differentiation.										18
5	Gametogenesis- Basic Concepts of Gametogenesis - Spermatogenesis in Mammals –Oogenesis in mammals – Stem cells and types – Fertilization – types of cleavage – Germ layers – Blastula formation – gastrulation – Neurulation – organogenesis – parthenogenesis – Invitrofertilization										18

CO	Course Outcomes
CO1	The students will be able to gain knowledge on cellular organization
CO2	The students will be able to understand the membrane system of cells
CO3	The students will gain knowledge on the genetic material
CO4	The students will be able to understand the regulation of cell cycle
CO5	The students will be able to understand the process of gametogenesis
Textbooks:	
1	Cell and Developmental Biology Hardcover – 1 January 2020 by KarrunaSantoshasing& A K DubeyPardeshi (Author)
2	Cell and Developmental Biology Hardcover – 1 January 2022 by Dr.KapilKishor (Editor)
3	Cell and Development Biology Paperback – 1 December 2004by K.V. Sastry (Author), S. P. Singh (Author), B.S. Tomar (Author)
4	Developmental Biology by Reddy EcSurendranatha L NirmalaJyothi, SbwPublishersJanuary 2016
5	Developmental Biology Michael Barresi and Scott Gilbert; Publication Date - 01 March 2023. ISBN: 9780197574591
Reference Books:	
1	Karp's Cell and Molecular Biology: Concepts and Experiments. 8th Edition (2015). WileyPublications.
2	James D. Watson, 7th Edition (2014), Molecular Biology of the Gene, Pearson Publications
3	Geoffrey M. Cooper, 7th Edition (2015). The Cell: A Molecular Approach, Sinauer Associates, Qxford University Press
4	LodishHarvey, 6th Edition (2016), Molecular Cell Biology, W. H. Freeman Publications
5	Wolpert L, Tickle C, 2015. Principles of Development, 5th edition, Oxford University Press.
Web resources:	
1	https://byjus.com/biology/cells/
2	https://ncert.nic.in/textbook/pdf/kebt102.pdf
3	https://pmc.ncbi.nlm.nih.gov/articles/PMC6822018/
4	https://www.khanacademy.org/science/ap-biology/cell-communication-and-cell-cycle/cell-cycle/a/cell-cycle-phases
5	https://byjus.com/biology/gametogenesis-spermatogenesis-oogenesis/

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	2	3	3	2	3	3	3	3	2
CO2	3	3	2	3	3	2	3	3	3	3	2
CO3	3	3	3	3	3	2	3	3	3	3	2
CO4	3	2	3	3	3	2	3	3	3	3	2
CO5	3	2	3	3	3	2	3	3	3	3	2
Total	15	12	13	15	15	10	15	15	15	15	10
Average	3	2.4	2.6	3	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
24UBTC12 P	CELL BIOLOGY AND BIOLOGICAL CHEMISTRY PRACTICAL	CC-2	0	0	4	0	3	4	25	75	100
Learning Objectives											
LO1	To Demonstrate the operation of Light Microscope& to identify different cells										
LO2	To identify cell & Organelles										
LO3	To understand cell division										
LO4	To understand the cell division in germ cells										
LO5	To understand staining procedure										
Unit	Content										Hours
1	Components of a Light/Compound Microscope										2
2	Measurement of cell size by ocular and stage micrometer										4
3	Identification of animal cell and plant cells										4
4	Cell fractionation of organelles										4
5	Observation of buccal cells										8
6	Mitosis from Onion root tip										4
7	Meiosis from Flower Bud										8
8	Preparation of Buffer Solution, pH meter calibration										8
9	Blood Smear preparation										2
10	Identification of Bacterial Cell (Simple Staining)										4
11	Cell Types - Microbial And Plant Morphometric Measurements of Chick embryo-24hrs, 48hrs, 72hrs, 96hrs										4
12	Systematic analysis of organic compounds- Functional group test										4
13	Volumetric analysis- - Estimation of Glycine - Determination of Ascorbic acids										4

CO	Course Outcomes
CO1	The students will be able to understand the basic components of microscope
CO2	The students will be able to understand the cell fractionation and organelle identification
CO3	The students will be able to understand the process of cell division in somatic cells
CO4	The students will be able to understand the process of cell division in germ cells
CO5	The students will be able to understand the different staining procedures
Textbooks:	
1	Experimental Procedures in Lifescience - Dr.S.Rajan&Mrs. R. Selvi Christy, Anjana Book House
2	Analytical Techniques in Biochemistry and Molecular Biology; RajanKatoch; 2011; ISBN:9781441997852
3	Cell and Molecular Biology Lab Manual. 14 June 2011 by Cristina C Thompson &David a Thompson
4	Practical Guide Of Cell Biology & Molecular Genetics 6 February 2023by Dr.KanakSaxena
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 DeepikaBairagee (Author)
4	Cell and Molecular Biology Lab Manual. 14 June 2011. by Cristina C Thompson &David a Thompson
5	Lab in Cell Biology, Microbiology and Bioinstrumentation: Laboratory Manual Kindle Edition by GeethalakshmiSundararaman & AnithaArumugam; 2017
Web resources:	
1	https://byjus.com/biology/study-of-the-parts-of-a-compound-microscope/
2	https://ncert.nic.in/pdf/publication/sciencelaboratorymanuals/classXII/biology/Ielm204.pdf
3	https://egyankosh.ac.in/bitstream/123456789/101661/1/Unit-3.pdf
4	https://abhedanandamahavidyalaya.ac.in/wp-content/uploads/2019/06/Detection_of_Organic_Compounds.pdf
5	https://www.iitg.ac.in/biotech/BTechProtocols/Ascorbic.pdf

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	2	3	3	3	3	2
CO2	3	3	3	3	3	2	3	3	3	3	2
CO3	3	3	3	3	3	3	3	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	15	15	15	15	13	15	15	15	15	13
Average	3	3	3	3	3	2.6	3	3	3	3	2.6

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
24UBTA11	BIOLOGICAL CHEMISTRY	Allied-1	3	1	0	0	3	4	25	75	100
Learning Objectives											
LO1	To understand the acid-base concept and principle of chemical bonding										
LO2	To understand the importance and preparation of buffer solutions										
LO3	To understand the importance of carbohydrate and its biological significance										
LO4	To understand the importance and functioning of amino acids, vitamins and minerals										
LO5	To understand the Biological significance of lipids and nucleic acids										
Unit	Content										Hours
1	Atomic theory, Formation of molecules, Electronic configuration of atoms, s&p atomic orbitals, Periodic table and periodic classification, valency types and chemical bonds, Organic compounds-electrophiles, nucleophiles, free radicals, Types of reactions-addition, substitution, elimination, condensation and polymerization										12
2	Acid and base properties and differences, concentration of solution, Ways of expressing concentration of solution/percent/weight, normality, molarity, molality, mole fraction. pH of solution, pH scale, measurement of pH, buffer solution and properties, Henderson-Hasselbalch equation, mechanism of buffer action of acidic buffer and basic buffer										12
3	Carbohydrate- Types, Classification and sub-classification, Structure, Function and Properties of carbohydrates. Metabolic pathways- Glycolysis, Glycogenesis, Glycogenolysis, Gluconeogenesis, TCA Cycle, Electron Transport Chain, Biological importance of carbohydrates										12
4	Aminoacids- Classification, Structure and Function of aminoacids, Zwitter ionic states; Biological significance of aminoacids. Proteins-Primary, Secondary and Tertiary structures; Protein classification, Physiochemical properties of protein, Isoelectric point and significance, Vitamins and Minerals- Fat and water soluble vitamins, Minerals- Macro and microelements- Cofactors and CoEnzymes-Biological importance of Vitamins and Minerals.										12
5	Lipids- Classification- Function and Properties of lipids; Lipids in biological membrane, Lipid metabolism, Biological significance; Sterols- Classification, Cholesterol biosynthesis, Hormones- function; Triglycerides- Function, Nucleotides- Structure and function, Biosynthesis of Nucleic acids, Biological significance of nucleic acids, 16s rRNA and its significance.										12

CO	Course Outcomes
CO1	The students will gain understanding in the structure and functioning of biomolecules
CO2	The students will be able to understand the importance of biomolecules
CO3	The students will be able to understand the regulation of biomolecules
CO4	The students will be able to understand the different metabolic process
CO5	The students will be able to logically reason the coordinated functioning of biomolecules
Textbooks:	
1	Cambell, M.K. and Farrell, S.O. (2018) Biochemistry, Ninth Edition, Cengage 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://byjus.com/chemistry/atomic/
2	https://www.khanacademy.org/science/biology/water-acids-and-bases/acids-bases-and-ph/a/acids-bases-ph-and-buffers
3	https://www.chem.purdue.edu/gchelp/https://pmc.ncbi.nlm.nih.gov/articles/PMC7778149/#:~:text=Carbohydrates%20are%20divided%20into%20three,glucose%20molecules%3B%20and%20(3)
4	https://www.britannica.com/science/lipid/Digestion-of-dietary-fatty-acids
5	https://www.ncbi.nlm.nih.gov/books/NBK525952/

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	2	3	3	3	2	2
CO2	3	3	3	3	3	3	3	3	3	2	2
CO3	3	3	3	3	3	3	3	3	3	2	2
CO4	3	3	3	3	3	3	3	3	3	2	2
CO5	3	3	3	3	3	3	3	3	3	2	2
Total	15	15	15	15	15	14	15	15	15	10	10
Average	3	3	3	3	3	2.8	3	3	3	2	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
24UBTS11	Human Physiology and Diseases	SEC-1	2	0	0	0	2	2	25	75	100
Learning Objectives											
LO1	To understand the biological concept of Physiology										
LO2	To understand the different biological system										
LO3	To understand the mechanism of infection and infectious diseases										
LO4	To understand the concepts of most common diseases										
LO5	To understand different types of therapeutics										
Unit	Content										Hours
1	Introduction to Human Biology, Overview of human physiology, Cells and tissues: Structure and function, Composition and Function of Blood, Types of Disease in Human- Blood related diseases.										06
2	The nervous system: Anatomy, function and common disorders, The cardiovascular system: Heart function, blood vessels, common cardiovascular diseases, The respiratory system: Mechanisms of breathing, Respiratory disorders, The digestive system: Digestion, absorption, gastrointestinal diseases.										06
3	Common endocrine disorders (e.g., diabetes, thyroid diseases), Autoimmune diseases, allergies, and immune deficiencies, Genetic disorders and their inheritance patterns, Mechanisms of infection, Impact of environment on health.										06
4	Lifestyle diseases: Obesity, Diabetes: Types, treatment strategies, Cellular basis of cancer, Types of cancer, diagnostics and treatments, AIDS : Causes, Treatment and Prevention.										06
5	Recent advances in biomedical research, Antibiotics, antivirals, antifungals, and antiparasitic Drugs, Role of surgery in treating diseases, Lifestyle modifications as a treatment approach, Ethics in medical treatment Policy and public health considerations, Vaccine development										06

CO	Course Outcomes
CO1	The students will be able to understand the biology of diseases
CO2	The students will be able to understand the different biological systems in human
CO3	The students will be able to understand the basics of different types of infectious reactions
CO4	The student will be able to gain understanding on the most common diseases and disorders
CO5	The students will be educated in the different kind of therapeutics
Textbooks:	
1	Textbook of Pathology for Allied Health Sciences Paperback – 1 June 2017 by Armada's (Author)
2	Textbook of Medical Physiology, 2ed Paperback – 12 July 2018 by D. Venkatesh (Author), H. H. Sudhakar (Author)
3	Textbook of Anatomy and Physiology for Health Professionals Paperback – Import, 30 January 2022 by InduKhurana (Author)
4	Ganong's Review of Medical Physiology [Paperback] Barrett Paperback – 13 August 2019 by BARRETT (Author)
5	Textbook of Pathology for Allied Health Sciences Paperback – 1 June 2017 by RamadasNayak (Author)
Reference Books:	
1	Basics of Medical Physiology, 5ed Paperback – 31 May 2023 by Dr Venkatesh and Sudhakar HH (Author)
2	Ganong's Review Of Medical Physiology [Paperback] Barrett Paperback – 13 August 2019 by BARRETT (Author)
3	Human Anatomy and Physiology Paperback – 1 December 2008 by Rahul Phate (Author)
4	Ross and Wilson Anatomy and Physiology in Health and Illness, International Edition, 14e Paperback – 1 July 2022 by Waugh (Author)
5	Human anatomy and physiology Paperback – 1 February 2017, by SatishMandave (Author)
Web resources:	
1	https://www.medicalnewstoday.com/articles/196001
2	https://www.kenhub.com/en/library/anatomy/human-body-systems
3	https://pmc.ncbi.nlm.nih.gov/articles/PMC7988207/
4	https://www.healthline.com/health/cancer#how-cancer-grows
5	https://pmc.ncbi.nlm.nih.gov/articles/PMC11434382/

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	3
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	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	15	15	15	15	15	15	15	15	15	15
Average	3	3	3	3	3	3	3	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
24UBTS12P	MS-OFFICE FUNDAMENTALS	SEC-2	0	0	2	0	2	2	25	75	100
Learning Objectives											
LO1	To become practically expertise in MS-WORD										
LO2	To understand the advance functioning in WORD										
LO3	To gain practical experience in MS-PowerPoint										
LO4	To gain practical experience in MS-PowerPoint										
LO5	To gain practical experience in MS-EXCEL										
Unit	Content										Hours
1	Basic functions of WORD; Menu bar and Tool bar; Typing and editing; Formatting text; Indent and spacing; Bullets and numbering.										06
2	Inserting symbols, objects and pictures; Inserting tables and Formatting tables; Borders and Shading; Page setup; Thesaurus, Autocorrect										06
3	Basic functioning of PowerPoint; Menu and tools; Slide templates; Slide themes and colours; Adding text and formatting; Bullets and numbering										06
4	Inserting tables and images; Working with charts, Slide animation- Properties; Custom animation- Properties; Slide show and navigation										06
5	Basics of Excel-Uses; Menus of Excel; Data entry- rows, columns; Working with charts; Working with formula, AI in MS-Office										06

CO	Course Outcomes
CO1	The students will be able to understand and gain practical knowledge in MS-WORD
CO2	The students gain practical skills in preparing documents professionally
CO3	The students will become practically skilled in the concepts of PowerPoint
CO4	The students will become skilled in preparing professional presentations
CO5	The students will gain practically experience in analysing research data
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 QuickSteps (Paperback)by Carole Boggs Matthews
4	Microsoft Excel 2010 In Depth (Paperback)by <u>Bill Jelen</u>
5	Learn Microsoft Office for Windows 95: Comprehensive Tutorials for Word 7.0, Excel 7.0, Access 7.0, Powerpoint 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, <u>Dr. S.S. Srivastava</u>
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://www.egyankosh.ac.in/bitstream/123456789/28486/1/Unit-3.pdf
2	https://support.microsoft.com/en-us/office/format-a-table-e6e77bc6-1f4e-467e-b818-
3	https://support.microsoft.com/en-us/office/basic-tasks-for-creating-a-powerpoint-presentation-efbbc1cd-c5f1-4264-b48e-c8a7b0334e36
4	https://opentextbc.ca/learningpowerpoint/chapter/slide-transitions-and-animations/
5	https://support.microsoft.com/en-us/office/present-your-data-in-a-column-chart-d89050ba-e6b6-47de-b090-e9ab353c4c00

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	3	3	3	3	3	2	2	3
Total	10	15	15	11	15	15	15	15	10	10	15
Average	2	3	3	2.2	3	3	3	3	2	2	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
24UBTF11	CONCEPTS IN BIOTECHNOLOGY	FC	1	1	0	0	2	2	25	75	100
Learning Objectives											
LO1	To understand the scope of Biotechnology										
LO2	To understand the diverse applications of Biotechnology										
LO3	To understand the importance of biotechnology in daily life										
LO4	To understand the basic principles of biotechnology										
LO5	To understand the advanced application of Biotechnology										
Unit	Content										Hours
1	Biotechnology – Introduction, Overview, Importance, Scope and Application, History of Biotechnology, Biotechnology in India and Global, Biotech Industries in India and Job Opportunities.										6
2	Green Biotechnology - Agricultural biotechnology and application, Red Biotechnology – Pharmaceutical Biotechnology and its applications, Yellow Biotechnology – Food and nutrition and its application, White Biotechnology – Industry and manufacturing applications, Grey Biotechnology – Environmental Biotechnology and application, Blue Biotechnology – Marine Biotechnology and application Gold Biotechnology – Computation Biology and Nanotechnology										6
3	Dairy Products, Bakery Products, Beverages, Cosmetics, Detergent, Genetically Modified Crops, Antibiotics, Vaccines, Bio-fuels.										6
4	Diversity of Plant and Animal cell size and shape, Cellular organelles, Chloroplast; Nucleus, DNA, Overview of Recombinant DNA Technology, restriction enzymes, plasmids, vectors										6
5	Advancements of Biotechnology- Applied Biotechnology, Genetically modified organisms, BT cotton, BT-brinjal, Golden Rice, Cloning, Pharmaceutical products										6

CO	Course Outcomes
CO1	The students will be able to understand the scope and opportunities in Biotechnology
CO2	The students will be able to understand the organization of cells and cell components
CO3	The students will be able to understand the different fields of biotechnology
CO4	The students will be able to understand the applications of biotechnology in daily life
CO5	The students will be able to understand the basic principle of biotechnological application
Textbooks:	
1	Basic Biotechnology International Student Edition Paperback – Student Edition, 31 January 2007, by Colin Ratledge (Editor), Bjorn Kristiansen (Editor)
2	Basics of Biotechnology Paperback – 1 January 2004; by A.J. Nair
3	Textbook of Basic Biotechnology Hardcover – 1 January 2012, by BirendraBahadur Singh (Author), Vinod Singh (Author)
4	Textbook of Biotechnology, 4ed Paperback – 1 January 2010 by H.K.Das (Author)
5	A Textbook of Biotechnology Paperback – 1 January 2009 by RashmiTyagi (Author)
Reference Books:	
1	Cell Biology Paperback – 1 January 2020 by Dr.Tripurari Mishra (Author), Dr. B.D. Singh (Author)
2	A Text Book of Biotechnology Paperback – 1 January 2007 by PradeepParihar (Author)
3	Molecular Biotechnology: Principles and Applications of Recombinant DNA Hardcover – Import, 1 December 2002 by Bernard R. Glick (Editor), Jack J. Pasternak (Editor)
4	A Textbook of Biotechnology 4th Rev. Edn. 2006 Edition, Kindle Edition by R C Dubey (Author)
5	Textbook of Biotechnology Paperback – 27 February 2012 by Patnaik (Author)
Web resources:	
1	https://www.techtarget.com/whatis/definition/biotechnology
2	https://www.upscprep.com/biotechnology-blue-green-red-grey-applications-upsc/
3	https://www.nios.ac.in/media/documents/SrSec314NewE/Lesson-30.pdf
4	https://bio.libretexts.org/Bookshelves/Genetics/Genetics_Agriculture_and_Biotechnology_(Suza_and_Lee)/01%3A_Chapters/1.11%3A_Recombinant_DNA_Technology
5	https://www.drishtiias.com/to-the-points/paper3/genetically-modified-organism-gmo

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	3
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	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	15	15	15	15	15	15	15	15	15	15
Average	3	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
24UBTC21	Genetics and Molecular Biology	CC-3	3	1	2	0	5	6	25	75	100
Learning Objectives											
LO1	Explain the properties of genetic materials and storage and processing of genetic information.										
LO2	Learn about the classical genetics and transmission of characters from one generation to the next.										
LO3	Obtain a strong foundation for the advanced genetics										
LO4	Acquire knowledge about the Mutagens, Mutations, DNA Repairs and Genetic disorders in human.										
LO5	Categories Eugenics, Euphenics and Euthenics and indepth Knowledge on population Genetics.										
Unit	Content										Hours
1	Basic Concept – Gene, Chromosome, DNA and RNA. DNA as the Genetic Material: Griffith’s experiment, Hershey-Chase Experiment, Experimental Proof by Avery, McLeod and McCarty. RNA as genetic material. DNA Replication: Semi conservative, Rolling circle. Mechanism of replication. Genetics of Bacteria and viruses: Transformation, Conjugation, F+, Hfr, Transduction- generalized and specialized. Viral DNA Replication- lytic and lysogenic										18
2	Mendelian Inheritance- Birth of Genetics, Mendelian principles –Mendel’s experiments, Monohybrid cross, Dihybrid cross, Backcross or Testcross, Mendel’s laws. Incomplete dominance, Co-dominance. Interaction of Genes- Epistasis -lethal genes. Multiple alleles. Blood group inheritance in man.										18
3	Linkage - linkage in Drosophila- Morgan’s experiments, factors affecting linkage. Crossing over- types, mechanism, significance of crossing over. Mapping of Chromosomes, interference and coincidence. Sex –Linked Inheritance and Sex-Determination in Man.										18
4	Mutation – types of mutation, mutagens, DNA damage and Repair Mechanism. Chromosomal aberrations- Numerical and Structural, Pedigree Analysis- Mendelian inheritance in human. (Cystic Fibrosis, Muscular Dystrophy), Karyotyping.										18
5	Population Genetics– Hardy Weinberg principle, gene frequency, genotype frequency and factors affecting gene frequency. Eugenics, Euphenics and Euthenics. Penetrance and Expressivity. Allelic variation, Genetic diversity										18

CO	Course Outcomes
CO1	Students will Explore DNA as the genetic material through experiments like Griffith's, Hershey-Chase, and Avery's proof
CO2	Students will Apply Mendelian principles to inheritance, including monohybrid and dihybrid crosses.
CO3	Students will Understand linkage, crossing over, chromosome mapping, and sex-linked inheritance
CO4	Students will Understand chromosomal aberrations, pedigree analysis, and their inheritance patterns.
CO5	Students will Study population genetics, including Hardy-Weinberg equilibrium and factors affecting gene frequency
Textbooks:	
1	Dr. Veer Bala Rastogi, 2020, Elements of Genetics, 11 th Revised & Enlarged Edition, Kedar Nath Ram
2	Nath Publications, Meerut, 250001. www.knrnpublishations.com, ISBN-978-81-907011-2-9
3	Verma, P.S. and Agarwal, V.K., 1995. Genetics, 8 th edition, S.Chand & Co., New Delhi – 10055.
4	Molecular Biology of Genes. 4th edition by Watson, Hopkins, Roberts, Steitz, Weiner.
5	Dr. Veer Bala Rastogi, 2020, Elements of Genetics, 11 th Revised & Enlarged Edition, Kedar Nath Ram
Reference Books:	
1	Talaro K.P. and Chess B. (2012) Foundations in Microbiology, 8 th Edn. The McGraw-Hill Companies
2	Tortora G.J., Funke B.R. and Chase C.L. (2013) Microbiology: An Introduction, 11 th Edn. Pearson-Benjamin Cummings
3	Brown A. and Smith H. (2015) Benson's Microbiological Applications: Laboratory Manual in General Microbiology, 13 th Edn. McGraw-Hill Companies
Web resources:	
1	https://byjus.com/biology/griffith-experiment-genetic-material/
2	https://www.khanacademy.org/science/ap-biology/heredity/mendelian-genetics-ap/a/the-law-of-segregation
3	https://byjus.com/biology/linkage-recombination/
4	https://bio.libretexts.org/Bookshelves/Biochemistry/Fundamentals_of_Biochemistry_(Jakubowski_and_Flatt)/03%3A_Unit_III-_Information_Pathway/24%3A_DNA_Metabolism/24.02%3A_DNA_Mutations_Damage_and_Repair

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	2	-	3	-	3	3	3	3	-
CO2	3	3	2	-	3	2	3	3	3	3	2
CO3	3	3	2	1	3	-	3	3	3	3	-
CO4	3	3	2	3	3	2	3	3	3	3	2
CO5	3	2	2	3	3	-	3	3	3	3	-
Total	15	13	10	7	15	4	15	15	15	15	4
Average	3	2.6	2	1.4	3	0.8	3	3	3	3	0.8

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
24UBTC22P	Genetics and Molecular Biology Practicals	CC-4	0	0	4	0	2	4	25	75	100
Learning Objectives											
LO1	To observe the cell division stages in plant cells										
LO2	To identify and observe barr bodies for sex determination										
LO3	To isolate DNA from plant material										
LO4	To quantify the amount of DNA present in the sample										
LO5	To understand practical concepts in human karyotyping										
Unit	Content										Hours
1	Verification of Monohybrid ratio by beads/ Coin tossing Experiment Verification of Dihybrid ratio by beads/ Coin tossing Experiment										12
2	Bacterial Transformation Observation of Blood Group Inheritance in Man / Observation of Sex Linked Inheritance in Man										12
3	Isolation of plant DNA by CTAB method										12
4	Estimation of DNA by diphenylamine method										12
5	Human karyotyping (Demo)										12

CO	Course Outcomes
CO1	Students will gain knowledge of proper handling techniques for laboratory instruments and safety protocols
CO2	Students will acquire an understanding of how to handle and maintain a compound microscope
CO3	Students will learn various staining techniques used in laboratory practices
CO4	Students will develop skills in the proper handling of laboratory instruments
CO5	Students will understand the procedures for preparing different types of media in the laboratory
Textbooks:	
1	Practical Manual on "Fundamentals of Genetics" (PBG-121). 2019, Edition: First Publisher: Odisha University of Agriculture & Technology. Editor: Kaushik Kumar Panigrahi
2	Cell And Molecular Biology-A Lab Manual, K. V. Chaitanya, 2013, PHI Learning
3	Practical Manual on Plant Cytogenetics, <u>Ram J. Singh</u> , 2017, CRC Press
Reference Books:	
1	Molecular Biology Techniques, A Classroom Laboratory Manual, Heather B. Miller, D. Scott Witherow, Sue Carson, 2011, Academic Press
2	Essential Practical Handbook Of Cell Biology & Genetics, Biometry & Microbiology- A Laboratory Manual, Debarati Das, 2017, Academic Publishers
3	Laboratory Manual of Genetics, A. M. Winchester, Peter J. Wejksnora, 2010 McGraw-Hill Higher Education
Web resources:	
1	https://www.hrmrajgurunagar.ac.in/uploads/student_corner/Practical_1.pdf
2	https://www.ncbi.nlm.nih.gov/books/NBK2267/
3	https://opsdiagnostics.com/notes/protocols/ctab_protocol_for_plants.htm

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	2	3	3	3	3	2
CO2	3	2	3	3	3	2	3	3	3	3	2
CO3	3	2	3	3	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	12	15	15	15	13	15	15	15	15	13
Average	3	2.4	3	3	3	2.6	3	3	3	3	2.6

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
24UBTA21	FUNDAMENTALS OF MICROBIOLOGY	EC-2	3	1	0	0	4	4	25	75	100
Learning Objectives											
LO1	To understand the historical development of microbiology and the contributions of key figures like Leeuwenhoek, Pasteur, Koch, Jenner, Ehrlich, and Fleming.										
LO2	To apply staining techniques to visualize different bacterial structures and characteristics.										
LO3	To describe the components and functions of the bacterial cell envelope (cell wall, cytoplasmic membrane, periplasmic space).										
LO4	To understand the mode of action of different chemical agents.										
LO5	To classify media based on their composition (synthetic, semi-synthetic, enriched, enrichment, selective, differential)										
Unit	Content										Hours
1	History and scope of microbiology, spontaneous generation – biogenesis theory – contributions of Leeuwenhoek, Louis Pasteur, Robert Koch, Edward Jenner, Paul Ehrlich and Fleming.										12
2	Microscope–principles and application–simple and compound microscope–dark field– phase contrast, fluorescent microscope, SEM and TEM. Types of staining – simple, differential (Gram’s, AFB), special – capsular staining (negative), spore, LPCB, KOH mount.										12
3	Ultra structure and Classification of bacteria, cell envelope, cell wall – Gram positive and Gram negative bacterial cell wall, slime, flagella, capsule, pili.										12
4	Sterilization and disinfection – principles – methods of sterilization – physical methods – dryheat–moistheat–radiation–filtration(membraneandHEPA)–chemicalsterilization – chemical agents – mode of action. Preservation and maintenance of culture										12
5	Culture and media preparation – solid and liquid. Types of media – semi synthetic, synthetic, enriched, enrichment, selective and differential media.Pure culture techniques – tube dilution, pour, spread, streak plate. Serial Dilution Technique. Anaerobic cultivation of bacteria.										12

CO	Course Outcomes
CO1	Students will gain an understanding of the historical development of microbiology and the contributions of prominent figures in the field.
CO2	Students will learn the principles and applications of various types of microscopes
CO3	Students will acquire knowledge of the components and functions of the bacterial cell envelope.
CO4	Students will understand different sterilization methods, both physical and chemical
CO5	Students will learn about the various types of culture media used to support microbial growth
Textbooks:	
1	Willey J.M., Sherwood L.M. and Woolverton C.J. (2013) Prescott's Microbiology, 9 th Edn. McGraw-Hill Higher Education.
2	Madigan M.T., Bender K.S., Buckley D.H., Sattley W.M. and Stahl D.A. (2017) Brock Biology of Microorganisms, 15 th Edn. (Global Edn.) Pearson Education.
Reference Books:	
1	Talaro K.P. and Chess B. (2012) Foundations in Microbiology, 8 th Edn. The McGraw Hill Companies
2	Tortora G.J., Funke B.R. and Chase C.L. (2013) Microbiology: An Introduction, 11 th Edn. Pearson-Benjamin Cummings
3	Brown A. and Smith H. (2015) Benson's Microbiological Applications: Laboratory Manual in General Microbiology, 13 th Edn. McGraw-Hill Companies
Web resources:	
1	https://egyankosh.ac.in/bitstream/123456789/93476/1/Unit-1.pdf
2	https://www.ncbi.nlm.nih.gov/books/NBK8477/
3	https://byjus.com/biology/classification-of-culture-media/

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	3	2	-
CO2	3	-	2	-	3	-	3	3	3	3	-
CO3	3	-	2	-	2	-	3	3	3	3	-
CO4	3	-	3	-	3	-	3	3	3	3	-
CO5	3	-	3	-	3	-	3	3	3	3	-
Total	15	-	12	-	13	-	14	15	15	14	-
Average	3	-	2.4	-	2.6	-	2.8	3	3	2.8	-

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
24UBTA22P	FUNDAMENTALS OF MICROBIOLOGY PRACTICALS	EC-2 AL	0	0	2	0	2	2	25	75	100
Learning Objectives											
LO1	To understand Laboratory safety and Instrument Operation										
LO2	To understand Sterilization techniques										
LO3	To understand Media Preparation										
LO4	To understand Staining Techniques										
LO5	To understand Culture Techniques										
Unit	Content										Hours
1	Handling of instruments and laboratory safety measures. Handling and maintenance of compound microscope Handling of laboratory instruments a. autoclave b. hot air oven c. laminar air flow d. pH meter										06
2	Cleaning of glasswares and preparation of cleaning solutions.										04
3	Media preparation: a. liquid media – peptone water, nutrient broth; b. solid media – nutrient agar (agar slant, agar plate); c. enriched medium – blood agar; d. differential medium – Mac Conkey agar; e. enrichment medium – selenite F broth; f. selective medium – EMB, MSA										08
4	Staining techniques a. simple, b. differential staining (Gram's and Ziehl-Neelsen), c. special staining (spore and capsular staining methods) and wet-mount. Hanging drop technique– motility										06
5	Culture Techniques – Streak Plate, Pour Plate & Spread Plate. Serial Dilution Technique										06

CO	Course Outcomes
CO1	Students will acquire knowledge of laboratory safety protocols and proper instrument operation
CO2	Students will gain an understanding of various sterilization techniques
CO3	Students will learn the procedures for preparing different types of media
CO4	Students will understand the principles and applications of staining techniques
CO5	Students will develop an understanding of culture techniques used in microbiology
Textbooks:	
1	Laboratory Methods in Microbiology by Gerald E. Carter and Patricia E. Carter
2	Bailey & Scott's Diagnostic Microbiology (15th edition) by Patricia M. Murray, Ken S. Rosenthal, Michael A. Pfaller, and Linda S. Kobayashi
3	Manual of Clinical Microbiology (12th edition) edited by Patrick R. Murray, Ellen J. Baron, James H. Jorgensen, Michael A. Pfaller, and Roger P. Gilbert
Reference Books:	
1	Prescott, Harley, and Klein's Microbiology (9th edition) by Joanne M. Willey, Linda Sherwood, and Christopher J. Woolverton
2	Brock Biology of Microorganisms (15th edition) by Michael T. Madigan, John M. Martinko, Kelly B. Bender, Brock A. Stahl, and David H. Boone
3	Tortora, Funke, and Case's Microbiology: An Introduction (14th edition) by Gerard J. Tortora, Berdell R. Funke, and Christine L. Case
Web resources:	
1	https://microbenotes.com/instruments-used-in-microbiology-lab/
2	https://milnepublishing.geneseo.edu/suny-microbiology-lab/chapter/differential-staining-techniques/
3	https://pmc.ncbi.nlm.nih.gov/articles/PMC4846335/

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	3
CO3	3	-	3	-	3	3	3	3	3	3	3
CO4	3	-	3	-	3	3	3	3	3	3	3
CO5	3	-	3	-	3	3	3	3	3	3	3
Total	15	-	15	-	15	15	15	15	15	15	15
Average	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
24UBTS21	Good Laboratory Practices (GLP)	SEC-3	1	0	1	0	2	2	25	75	100
Learning Objectives											
LO1	To know the types of labs associated with Biotechnology										
LO2	To understand how to use and maintain lab Instruments										
LO3	To understand basic calculations needed in a laboratory experiments.										
LO4	To become aware of good lab Guidelines										
LO5	To know and practice safety disposal of bio waste										
Unit	Content										Hours
1	Types of labs associated with Biotechnology (General lab, microbial culture lab, plant tissue culture lab, Fermentation lab, computational stimulation lab), Types of Chemicals (Analytical grade, molecular grade) and its various arrangement (Arrangement of basic chemicals, solvent, acid and base, fine chemicals like dyes, protein and enzyme storage units)- Health hazards, Fumigation technique.										06
2	Methods and types of documentation (pre-lab writes, result recording and post lab report: interpretation of result), Dilution factor calculation, Molarity, percentage, dilution of concentrated solution, metric units (kg to gms and vice -versa).										06
3	Principles, use and maintenance of laboratory instruments - Autoclave, hot air oven, Incubators, Water bath, Centrifuge, Colorimeter, pH meter, Haemocytometer, Electronic balances.										06
4	Good Laboratory guidelines, Elements of GLP, Standard Operating Procedures and its importance, Quality Assurance & Quality control										06
5	Definition of waste, types of waste: Biological and chemical waste, methods of Safe Disposal of biological and chemical waste: treatment methods of Ethidium Bromide solutions, Electrophoresis Gels, Contaminated Gloves, debris, Wastes containing sodium azide, Silver staining solutions, Perchloric acid, Nanoparticle wastes, Spill management.										06

CO	Course Outcomes
CO1	Students will gain knowledge about the various types of laboratories used in biotechnology and the associated chemicals
CO2	Students will develop practical skills in fundamental laboratory calculations and proper documentation of results
CO3	Students will understand the functionality and proper handling of laboratory instruments
CO4	Students will acquire theoretical knowledge about the guidelines and protocols to be followed in research laboratories
CO5	Students will recognize the importance of safely disposing of different types of laboratory waste and practice safe disposal methods.
Textbooks:	
1	WHO training manual on Good Laboratory Practices, 2 nd Edition.
2	Milton A. Anderson GLP Essentials: A Concise Guide to Good Laboratory Practice, Second Edition 2nd Edition, Published by CRC press.
Reference Books:	
1	"Handbook of Laboratory Safety" by A. Keith Furr
2	"Practical Skills in Biomolecular Sciences" by Allan Jones, Jonathan Weyers, and Reed Holmes
3	"Laboratory Instrumentation" by Leslie Cromwell, Fred J. Weibell, and Erich A. Pfeiffer
4	"Handbook of Chemical Health and Safety" by Robert J. Alaimo
Web resources:	
1	https://pmc.ncbi.nlm.nih.gov/articles/PMC10982607/
2	https://bio.libretexts.org/Bookshelves/Biotechnology/Lab_Manual%3A_Introduction_to_Biotechnology/01%3A_Techniques/1.08%3A_Serial_Dilutions_and_Standard_Curve
3	https://smartfoodsafety.com/good-laboratory-practices/
4	https://ehs.yale.edu/sites/default/files/files/hazardous-waste-management.pdf

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	3	3	3	3	3	3
CO2	3	3	3	-	2	-	3	3	3	3	-
CO3	3	3	3	-	2	-	3	3	3	3	-
CO4	3	3	3	-	2	-	3	3	3	3	-
CO5	3	2	3	3	3	-	3	3	3	3	-
Total	15	14	15	6	10	3	15	15	15	15	3
Average	3	2.8	3	1.2	2	0.6	3	3	3	3	0.6

3 – Strong, 2- Medium, 1- Low

SECOND YEAR THIRD SEMESTER

CC- 5 -IMMUNOLOGY AND IMMUNOTECHNOLOGY

Course Code	Course name	Category	L	T	P	S	Credit	Hours	Marks	
									CIA	External
24UBTC31	Immunology and Immunotechnology	CC-5	3	1	2	0	5	6	25	75
Learning Objectives										
LO1	To Understand the role of immune cells and their mechanism in body defense mechanism.									
LO2	To study the characteristics of antigen & antibody									
LO3	To gain new insights into Antigen - Antibody interactions and to demonstrate immunological techniques.									
LO4	To gain knowledge on complement System & production of vaccines.									
LO5	To explain hypersensitivity reactions & MHC									
Unit	Contents									No. of Hours
I	Introduction to Immunology: Cells involved in immune response. Strucutre and function of Primary and Secondary lymphoid organs – Thymus, Bone marrow, Lymph nodes and Spleen. Hematopoiesis – development of B and T lymphocytes. Types of immunity – Innate and acquired.									15
II	Antigen & Antibody: Characteristics and types. Antibody – Structure, Types, Properties and their Biological Function. Production of antibodies- Hybridoma technology: Applications of Monoclonal antibodies in biomedical research.									15
III	Antigen – Antibody Interactions: Immunodiffusion-Single and double, Immuno electrophoresis. Principle and application of ELISA and RIA and Flourescent antibody technique and Western Blotting. Purification of antibodies.									20
IV	The complement system - activation and regulation: Types – Classical, alternative and Lectin pathway. Biological function of C’ proteins. Cytokines- Structure and Function. Vaccines – Introductory review of Vaccines, Types, Production and application. I									20
V	Hypersensitivity: Hypersensitivity Reactions and Types. Major Histocompatability Complex – MHC genes, MHC in immune responsiveness, Structure and function of Class I and Class II MHC molecules. HLA tissue typing									20

Course Outcomes	
The students will be able to	
CO1	Explain the mechanism of Immune cells and their defense activity
CO2	Describe the characteristics of antigens and antibodies
CO3	Outline and compare various antigen-antibody interactions
CO4	Describe Complement system and cytokines
CO5	Illustrate Hypersensitivity reactions and MHC
Textbooks	
1	Junith A. Owen, Jenny Punt, Sharon A. Stanford, Patrica P. Jones 2013. Kuby Immunology. 7th edition, W. H . Freeman and Company.
2	Kannan, I., 2010. Immunology. MJP Publishers, Chennai
3	Bharat Singh, 2006. Immunology, Pointer Publishers.
4	Ashim K. Chakravarty, 2015. Immunology and Immunotechnology. Oxford University Press
5	Dulsy Fathima, N Arumugam, 2006. Immunology. Saras Publication.
Reference Books	
1	Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt, 2011. Roitt.s Essential Immunology, 13th edition, Wiley- Blackwell. USA.
2	Ian R. Tizard, 2004. Immunology an Introduction, 4 th Edition. Saunders College Publishing.
3	David Male, jonathan Brostoff, David B Roth, Ivan Roitt, 2006. Immunology 7 th Edition. Elsevier.
4	Abbas, A.K., A.H.L. Lichtman and S.Pillai, 2010. Cellular and Molecular Immunology. 6th Edition. Saunders Elsevier Publications, Philadelphia.
5	Charles A. Janeway, Paul Travers, Mark Walport, Mark J Shlomchik. (2005). Immunobiology- the immune system in health and disease. Garland Science Publishing. 6rd Edition.

Web Resources

1	https://www.ncbi.nlm.nih.gov/books/NBK279395/
2	https://med.stanford.edu/immunol/phd-program/ebook.html
3	https://ocw.mit.edu/courses/hst-176-cellular-and-molecular-immunology-fall-2005/pages/lecture-notes/
4	https://www.ncbi.nlm.nih.gov/books/NBK7795/

Mapping Programme Outcomes and Programme Specific Outcomes with Course Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	1	1	2	2	1	1	3	3	1	1
CO2	3	1	2	2	2	2	2	3	3	2	3
CO3	3	1	2	2	2	3	2	3	3	3	3
CO4	3	1	2	2	2	3	1	3	3	3	3
CO5	3	2	1	2	2	1	1	3	3	2	2
Total	15	6	8	10	10	10	7	15	15	11	12
Average	3	1.2	1.6	2	2	2	1.4	3	3	2.2	2.4

3 – Strong, 2- Medium, 1- Low

CC – 6 – IMMUNOLOGY AND IMMUNOTECHNOLOGY PRACTICALS

Course Code	Course name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBTC32P	Immunology and Immunotechnology Practicals	CC-6	0	0	3	0	2	3	25	75	100
Learning Objectives											
LO1	To learn to Perform blood grouping and determine blood type										
LO2	To learn count WBC and RBC										
LO3	To conduct serological diagnostic tests such as ASO and Widal test.										
LO4	To acquire technical skills required for immunodiffusion and know the principle behind the techniques.										
LO5	To demonstrate ELISA & Western blot										
Unit	Contents										No.of Hours
I	Separation of Serum and Plasma. Blood grouping										9
II	WBC counting RBC counting Differential blood count										9
III	WIDAL Slide test ASO test										9
IV	Double Immunodiffusion Single Radial Immunodifusion										9
V	ELISA – Demonstration Western Blotting – Demonstration										9

Course Outcomes The students will be able to	
CO1	Perform Blood group and identify Blood groups
CO2	Demonstrate Procedure to count RBC & WBC
CO3	Conduct diagnostic test such as WIDAL and ASO tests
CO4	Demonstrate immunodiffusion technique
CO5	Demonstrate ELISA & Western blotting tests
Textbooks	
1	Talwar. (2006). Hand Book of Practical and Clinical Immunology, Vol. I, 2nd edition, CBS.
2	Asim Kumar Roy. (2019). Immunology Theory and Practical, Kalyani Publications.
3	V H Talib, H R Khurana, 1999. A Handbook of Medical Laboratory Technology, 2 nd Edition. CBS Publishers and Distributors Pvt. Ltd
Reference Books	
1	Frank C. Hay, Olwyn M. R. Westwood. (2008). Practical Immunology, 4th Edition, Wiley-Blackwell.
2	Rose. (1992). Manual of Clinical Lab Immunology, ASM.
3	Wilmore Webley. (2016). Immunology Lab Manual, LAD Custom Publishing.
4	Janeway Travers. (1997). Immunobiology- the immune system in health and disease. Current Biology Ltd. London, New York. 3 rd Edition.

Web Resources

1	https://www.urmc.rochester.edu/MediaLibraries/URMCMedia/labs/frelinger-lab/documents/Immunology-Lab-Manual.pdf
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Mapping Programme Outcomes and Programme Specific Outcomes with Course Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	1	3	3	3	2	1	3	3	3	2
CO2	3	1	3	3	3	2	1	3	3	3	2
CO3	3	1	3	3	3	2	1	3	3	3	3
CO4	3	1	3	3	3	2	1	3	3	3	3
CO5	3	1	3	3	3	2	1	3	3	3	3
Total	15	5	15	15	15	10	5	15	15	15	13
Average	3	1	3	3	3	2	1	3	3	3	2.6

3 – Strong, 2- Medium, 1- Low

SECOND YEAR THIRD SEMESTER
EC – 4 AL – BIOINSTRUMENTATION

Course Code	Course name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBTA31	Bioinstrumentation	EC-4	3	1	0	0	4	4	25	75	100
Learning Objectives											
LO1	To Practice, experiment with and apply the basic instruments in the laboratory.										
LO2	To Predict the functionality of Beer – Lambert’s law in identifying and quantifying a biomolecule.										
LO3	To Employ the separation techniques for separating biomolecules based on chromatography and electrophoretic techniques.										
LO4	To Understand the clinical important isotopes and detection of isotopes										
LO5	To Employ the separation techniques for separating biomolecules based on centrifugal force by centrifugation.										
Unit	Contents										No. of Hours
I	pH – Definition – pH meter. Measurement of pH and calibration of pH meter - Buffers – Preparation of Buffers. Microscopy: Principle and applications of Compound, Bright field, Phase contrast and Fluorescence Microscope.										15
II	Centrifugation – Principles - RCF, Sedimentation concept - - Different types of centrifuge – Types of rotors – Centrifugation types: Differential and Density gradient centrifugation – Ultra Centrifuge.										15
III	Chromatography - Principles – Paper Chromatography, TLC, Gel filtration, Ion-Exchange, Affinity Chromatography, Liquid Chromatography and Gas Chromatography. Electrophoresis: Principle, Paper Electrophoresis. Agarose Gel Electrophoresis – SDS- PAGE.										10
IV	Spectra – Absorption and Emission Spectra – Beer Lambert’s law – Colorimeter, UV-Visible Spectrophotometer. Mass spectroscopy - Atomic absorption spectrometer (AAS) - Nuclear magnetic resonance Spectrometer (NMR).										10
V	Radioactivity – Isotopes – Clinically important isotopes – Measurement of Radioactivity – GM Counters, Scintillation Counters – Autoradiography – Applications. SOPs for Radioactive materials.										10

Course Outcomes	
The Students will able to understand	
CO1	the principles of pH, buffer preparation, and the operation and calibration of a pH meter, along with gaining knowledge of microscopy techniques and their applications in biological and chemical analysis.
CO2	the principles of centrifugation, including RCF and sedimentation concepts, different types of centrifuges and rotors, and the applications of differential, density gradient, and ultracentrifugation techniques in biological and chemical analysis.
CO3	the principles and applications of chromatography techniques, including paper chromatography, TLC, gel filtration, ion-exchange, affinity, liquid, and gas chromatography, along with electrophoresis methods such as paper electrophoresis, agarose gel electrophoresis, and SDS-PAGE for biomolecular separation and analysis.
CO4	the principles of absorption and emission spectra, Beer-Lambert's law, and the working of colorimeters, UV-Visible spectrophotometers, mass spectrometry, AAS, and NMR. Gain knowledge of their applications in qualitative and quantitative analysis of biological and chemical substances.
CO5	the principles of radioactivity, isotopes, and their clinical significance, along with radioactivity measurement techniques like GM counters, scintillation counters, and autoradiography. Learn the applications of radioisotopes and SOPs for safe handling of radioactive materials.
Textbooks	
1	Keith Wilson, John Walker, (2010).Principles and techniques of Biochemistry and Molecular Biology”(7th edition).Cambridge University Press
2	David L .Nelson, Michael M Cox.Lehninger (2008).”Principles of Biochemistry”,Fifth edition W.H.Freeman,Newyork.
3	Khandpur R S, 2014. Handbook of Biomedical Instrumentation, 3rd edition, McGraw Hill Education (India).
Reference Books	
1	L.Veerakumari, (2006) “Bioinstrumentation” MJP publishers , Kindle Edition.
2	Upadhyay and UpadhyayNath. (2009). “Biophysical Chemistry”, Principles and Techniques. Himalaya Publishing House.
Web Resources	
1	<u>Centrifuge: Principle, Parts, Types, and Applications</u>
2	<u>Chromatography Definition, Types, C Facts Britannica</u>

Mapping Programme Outcomes and Programme Specific Outcomes with Course Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	1	1	2	2	1	1	3	3	1	1
CO2	3	1	2	2	2	2	2	3	3	2	3
CO3	3	1	2	2	2	3	2	3	3	3	3
CO4	3	1	2	2	2	3	1	3	3	3	3
CO5	3	2	1	2	2	1	1	3	3	2	2
Total	15	6	8	10	10	10	7	15	15	11	12
Average	3	1.2	1.6	2	2	2	1.4	3	3	2.2	2.4

3 – Strong, 2- Medium, 1- Low

EC – 5 AL – PRACTICALS - BIOINSTRUMENTATION

Course Code	Course name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBTA32P	Bioinstrumentation Practicals	EC-4	0	0	3	0	2	3	25	75	100
Learning Objectives											
LO1	To Practice, experiment with and apply the basic instruments in the laboratory such as weighing balance, pH meter, shaker, incubator etc. in various research processes.										
LO2	To Employ the separation techniques for separating biomolecules based on Agarose Gel Electrophoresis										
LO3	To Employ the separation techniques for separating biomolecules based on paper chromatography.										
LO4	To Employ the separation techniques for separating biomolecules based on Thin layer chromatography.										
LO5	To Employ the separation techniques for separating biomolecules based on centrifugal force by centrifugation.										
Unit	Contents										No. of Hours
I	Preparation of Buffer (Phosphate Buffer) Calibration of pH Determination of pH of biological samples using pH meter.										9
II	Agarose gel electrophoresis of DNA Verification of Beer's Lamberts law by colorimetry										9
III	Chromatography analysis of sugar, amino acids by paper Chromatography Chromatography analysis of sugar, amino acids by Thin Layer Chromatography										9
IV	Separation of Proteins by SDS-PAGE										9
V	Fractionation of cellular components by differential Centrifugation.										9

Course Outcomes The Students will able to	
CO1	Understand the preparation of phosphate buffer and the principles of pH measurement. Gain hands-on experience in determining the pH of biological samples using a pH meter.
CO2	Understand the principles and techniques of agarose gel electrophoresis for DNA analysis. Verify Beer-Lambert's law using colorimetry for quantitative analysis of absorbance and concentration relationships.
CO3	Perform chromatography analysis of sugars and amino acids using paper chromatography for separation and identification.
CO4	Perform chromatography analysis of sugars and amino acids using thin-layer chromatography for separation and identification.
CO5	Perform chromatography analysis of sugars and amino acids using thin-layer chromatography for separation and identification.
Textbooks	
1	Sharda University Abstract Laboratory Manual for Bio-instrumentation, Biochemistry, Microbiology, Cell Biology and Enzyme Technology.2018
2	Bhomwik (2011), Analytical techniques in Biotechnology – A complete laboratory manual, MGH Publisher, ISBN-13 : 978-0070700130
3	P. Palanivelu (2017), Analytical Biochemistry and Separation techniques – A laboratory manual, (5th Edition), Twentyfirst century publishers, ISBN: 978-81-908489-0-9
Reference Books	
1	L.Veerakumari, (2006) “Bioinstrumentation” MJP publishers , Kindle Edition.
2	Upadhyay and UpadhyayNath. (2009). “Biophysical Chemistry”, Principles and Techniques. Himalaya Publishing House.

Web Resources

1	https://webstor.srmist.edu.in/web_assets/srm_mainsite/files/files/BI501%20Advanced%20Biochemistry%20and%20Immunology.pdf
2	https://egyankosh.ac.in/bitstream/123456789/68525/1/Exercise-3.pdf
3	Agarose Gel Electrophoresis: Principle, Parts, Steps, Uses
4	https://chem.libretexts.org/Ancillary_Materials/Laboratory_Experiments/Wet_Lab_Experiments/Chemistry_410%3A_Chemistry_for_Health_Sciences_Laboratory_Manual/15%3A_Paper_Chromatography_of_Amino_Acids/15.01%3A_New_Page

Mapping Program Outcomes and Program specific outcomes with course Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	1	1	2	2	1	1	3	3	1	1
CO2	3	1	2	2	2	2	2	3	3	2	3
CO3	3	1	2	2	2	3	2	3	3	3	3
CO4	3	1	2	2	2	3	1	3	3	3	3
CO5	3	2	1	2	2	1	1	3	3	2	2
Total	15	6	8	10	10	10	7	15	15	11	12
Average	3	1.2	1.6	2	2	2	1.4	3	3	2.2	2.4

3 – Strong, 2- Medium, 1- Low

SECOND YEAR THIRD SEMESTER
SEC – 4 MEDICAL LAB TECHNOLOGY

Course Code	Course name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBTS31	Medical Lab Technology	SEC-4	1	0	1	0	2	2	25	75	100
24UAEC31											
LO1	To Understand the structural organization of cell and physiological system										
LO2	To Understand microbial diseases and its biochemical tests										
LO3	To Understand the blood components and evaluation										
LO4	To Understand clinical aspects of physiological system.										
LO5	To Understand processing of tissue in histopathological tests										
Unit	Contents										No. of Hours
I	General Anatomy - Cell-structure & function. Tissue - Epithelium, Connective, Sclerous muscle. Systemic anatomy - Basic features of Cardio vascular system, Respiratory system, Digestive system, Excretory system, Reproductive (Male & Female) system, Nervous system.										7
II	Microbiology- Microbial diseases -Cholera, TB, Leprosy & Typhoid. Biochemical tests, Bacteriological examination of pus, wounds, Abscess, Microbial Parasites, Serological tests										7
III	Blood -Blood cells, Haemoglobin, Blood grouping, Coagulation Factors. Anticoagulation, MCV, MCH & MCHC & its Importance, Haematological Disorders-Classification of Anaemia-Iron Deficiency anaemia, Megaloblastic anaemia, Haemolytic anaemia.										3
IV	Cardio vascular system-Heart rate, cardiac cycle, cardiac output, blood pressure, hypertension, radial pulse. Respiratory System-Ventilation, functions, Lungs- Volumes and capacities. Endocrinology - Endocrine Glands- Description. Hormones-their secretion and functions. Excretory system, Urine formation, Urinary Sediments, Glucose Tolerance test (G.T.T.), Liver Function test										10
V	Histopathology -Introduction. Basic steps for tissue processing- Fixing, Embedding, Microtomy, Staining- PAS & PAP staining principal and uses, Mounting, methods of decalcifications..										3

Course Outcomes The student will be able to understand the	
CO1	Funtions of various physiological system
CO2	Mechanism of microbial diseases and their diagnosis
CO3	Concepts in blood profiling and its inference
CO4	Features in clinical examination of physiological responses
CO5	Processing of clinical samples involving tissues
Textbooks	
1	Kanai L Mukharjee, Swarajit Ghosh, Medical Laboratory Technology-Procedure Manual for Routine Diagnostic Test, Vol II, 2 nd Edition, Tata McGraw Hill Publishers, 2010, Pages 818.
2	Ramnik Sood, Medical Lab Technology-Method and Interpretation, 5 th Edition, JayPee Publications, 1999, Pages 732
Reference Books	
1	V. H. Talib, Handbook Medical Laboratory Technology, CBS Publishers C Distributors, 2019, Pages 246
2	F. J. Baker, R. E. Silvertown, Eveline D. Luckcock, An Introduction to Medical Laboratory Technology, Elsevier Science, 2014, Pages 342

Web Resources

1	https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S001174BS/P001209/M014177/ET/1526979793P14_M1_ET.pdf
2	https://library.fiveable.me/bioinformatics/unit-3/pairwise-sequence-alignment/study-guide/X75d1KtnnunHWZyJ
3	https://booksite.elsevier.com/9780123749796/Chapter_13.pdf
4	https://pmc.ncbi.nlm.nih.gov/articles/PMC10819513/
5	https://www.e3s-conferences.org/articles/e3sconf/pdf/2023/36/e3sconf_iconnect2023_04042.pdf

Mapping Programme Outcomes and Programme Specific Outcomes with Course Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	1	1	2	2	1	1	3	3	1	1
CO2	3	1	2	2	2	2	2	3	3	2	3
CO3	3	1	2	2	2	3	2	3	3	3	3
CO4	3	1	2	2	2	3	1	3	3	3	3
CO5	3	2	1	2	2	1	1	3	3	2	2
Total	15	6	8	10	10	10	7	15	15	11	12
Average	3	1.2	1.6	2	2	2	1.4	3	3	2.2	2.4

3 – Strong, 2- Medium, 1- Low

Second Year Fourth Semester

Core Paper 7 - Genetic Engineering and rDNA Technology

Course Code	Course name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBTC41	Genetic Engineering and rDNA Technology	CC - 7	3	1	2	-	5	6	25	75	100
Learning Objectives											
LO1	Demonstrate the basic principles of genetic engineering techniques and illustrate the specificity of vectors for cloning and advantages.										
LO2	Exhibit knowledge in sequencing technologies and Sequencing method employed in Human Genome Project										
LO3	Understand Gene transfer techniques by direct and indirect mechanisms.										
LO4	Comprehend the mechanism of Gene Expression, DNA Amplification and Fragmentation.										
LO5	Explore the strategies of Recombinant DNA Technology in medicine, Industry and agriculture.										
UNIT	Contents										No. of Hours
1	Genetic Engineering – Introduction. Tools in recombinant DNA technology – recombinant DNA – cloning strategies (Restriction enzymes; Vectors-Expression, cloning, shuttle; host) – Introduction of rDNA into host cells.										15
II	Identification of recombinants, selection and screening for Recombinants. DNA sequencing methods: Sangers (Chain Termination Method), Maxam Gilbert (Chemical Degradation Method), BAC to BAC, Whole Genome Shotgun Method and NGS: Next Generation Sequencing method). Human Genome Project.										20
III	Gene transfer techniques – Direct (Physical & Chemical): Physical methods: Microinjection - Electroporation - Particle Bombardment, Chemical methods: Calcium phosphate - DEAE dextran - Liposomes. Indirect Method: Viral mediated gene transfer, Selectable markers and reporter genes - Non viral mediated gene transfer										20
IV	Gene Expression: Expression system and their applications										20

	Gene Amplification: Polymerase Chain reaction- Methodology and its Types. DNA Fragmentation: RAPD – Randomly Amplified Polymorphic DNA and RFLP – Restriction Fragment Length Polymorphism.	
V	Application of Recombinant DNA technology in Industries: Pharmaceutical, Food, and Agricultural Industries. Merits and Demerits of r-DNA technology.	15
Total		90
COURSE OUTCOME		
Students will be able		
CO1	To demonstrate the basic principles of genetic engineering techniques and illustrate the specificity of vectors for cloning and advantages.	
CO2	To exhibit knowledge in sequencing technologies and Sequencing method employed in Human Genome Project	
CO3	To understand Gene transfer techniques by direct and indirect mechanisms.	
CO4	To comprehend the mechanism of Gene Expression, DNA Amplification and Fragmentation.	
CO5	To explore the strategies of Recombinant DNA Technology in medicine, Industry and agriculture.	
Text Books		
1	Brown T.A, 2015. Gene Cloning and DNA Analysis: An Introduction, 7th edition, Wiley - Blackwell.	
2	Desmond S.T. Nicholl, 2008. An Introduction to Genetic Engineering, 3rd edition, Cambridge university press.	
3	R.W. Old & S.B. Primrose, Principles of Gene Manipulation, Fifth Edition, Blackwell Science.	
4	Genetic Engineering Principles and Methods by Setlow, Jane K. (Volume 24).	
5	Keya Chaudhuri, 2012. Recombinant DNA Technology.	
Reference Books		
1	David Clark Nanette Pazdernik Michelle McGehee (2018), <i>Molecular Biology techniques</i> ,(3 rd edition).	
2	<u>Anton Byron</u> (2019), <i>Introduction to Gene Cloning</i> , Publisher: Oxford Book Company	
3	Monika Jain (2012), <i>Recombinant DNA technology</i> , (I edition), Alpha Science International. ISBN-13 : 978-1842656679.	

4	Primrose.S.B (2014), <i>Principles of gene manipulation</i> , (7th edition), Blackwell Scientific limited, Germany. ISBN: 978-1-405-13544-3
Web Resource	
1	https://www.britannica.com/recombinant-DNA-technology
2	https://www.le.ac.uk/recombinant-dna-and-genetic-techniques
3	https://www..ncbi.nlm.nih.gov

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	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	2	3	2	3	3	3	3
CO4	3	3	3	2	3	2	3	2	3	3	2
CO5	3	3	3	3	3	3	3	3	3	2	3
TOTAL	15	15	15	14	14	14	14	14	15	15	14
AVERAGE	3	3	3	2.8	2.8	2.8	2.8	2.8	3	3	2.8

3-Strong, 2-Medium, 1-Low

Core Course VIII- PRACTICAL IV - LAB IN GENETIC ENGINEERING & RDNA TECHNOLOGY

Course Code	Course name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBTC42P	Lab in Genetic Engineering & rDNA Technology	CC - 8	0	0	3	0	2	3	25	75	100

Learning Objectives

LO1	Isolate the Plasmid DNA and Genomic DNA and predict the molecular weight of DNA by Agarose gel electrophoresis.
LO2	Isolate the RNA and predict the molecular weight of RNA by Agarose gel electrophoresis.
LO3	Prepare the competent cells and perform bacterial transformation.
LO4	Demonstrate working principles of PCR and RAPD
LO5	Exhibit the restriction fragment length polymorphism.

UNIT	Contents	No. of Hours
1	Isolation of genomic DNA- Bacteria Isolation of bacterial plasmid DNA	12
II	Isolation of RNA from bacteria by trizol method Detection of molecular weight by Agarose Gel Electrophoresis	7
III	Production of competent cells for transformation Bacterial transformation	6
IV	PCR – Polymerase Chain Reaction RAPD – Randomly Amplified Polymorphic DNA	14
V	Analyzes the differences in DNA fragment sizes created by cutting DNA with restriction enzymes using RFLP – Restriction Fragment Length Polymorphism	6
Total		45

Course Outcome	
Students will be able	
CO1	To isolate the Plasmid DNA and Genomic DNA and predict the molecular weight of DNA by Agarose gel electrophoresis.
CO2	To isolate the RNA and predict the molecular weight of RNA by Agarose gel electrophoresis.
CO3	To prepare the competent cells and perform bacterial transformation.
CO4	To demonstrate working principles of PCR and RAPD
CO5	To exhibit the restriction fragment length polymorphism.
Text Books	
1	Laboratory Manual for GENETIC ENGINEERING 1st Edition, Kindle Edition by S. JOHN VENNISON (Author) 2009.
2	Understanding Bioinstrumentation, Discovery Publishing House Pvt Limited by M. Prakash(Author) 2009

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CLO1	3	3	3	3	3	3	3	3	3	3	3
CLO2	3	3	3	3	3	3	3	3	3	3	3
CLO3	3	3	3	3	2	3	2	3	3	3	3
CLO4	3	3	3	2	3	2	3	2	3	3	2
CLO5	3	3	3	3	3	3	3	3	3	2	3
TOTAL	15	15	15	14	14	14	14	14	15	14	14
AVERAGE	3	3	3	2.8	2.8	2.8	2.8	2.8	3	2.8	2.8

3-Strong, 2-Medium,1-Low

SECOND YEAR FOURTH SEMESTER

EC- 6 AL -BIOINFORMATICS AND BIOSTATISTICS

Course Code	Course name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBT A41	BIOINFORMATICS AND BIOSTATISTICS	EC-6 AL	3	1	0	0	4	4	25	75	100
Learning Objectives											
LO1	Acquire knowledge about the Developments and Applications of Bioinformatics.										
LO2	Gain knowledge about the importance of the bioinformatics, databases, tools and software of bioinformatics and explain different types of Biological Databases.										
LO3	Understand the basics of sequence alignment, sequence analysis and Protein structure prediction method.										
LO4	Demonstrate the basic methods of data collection, graph construction and sampling techniques and Calculate measures of central tendency										
LO5	Correlate and analyze biological data through various statistical methods and interpret biological data via various probabilistic distribution methods.										
Unit	Contents									No. of Hours	
I	Introduction to Bioinformatics–History,Scope and applications, Biological Databases, Importance of Databases, Nucleic acid sequence databases, Protein Databases and Structure Databases									12	
II	Sequence analysis (Proteins and Nucleic acids), Pairwise Sequence alignment– BLAST. Multiple Sequences alignment – method of multiple sequences alignment- clustering methods									12	
III	Homology modeling of proteins methods for protein structure prediction - visualization tools (RASMOL), History of Drug Discovery, Steps in Drug design - Chemical libraries –(Pubchem)- Role of molecular docking in drug design.									12	
IV	Introduction to Biostatistics, Application of Biostatistics in biotechnology, Statistics – collection, classification, tabulations of Statistical Data – Diagrammatic representation – Graphs – Sampling method and standard error. Measures of central tendency (Mean, Median and Mode) – measures of dispersion.									12	

V	Correlations and regression. Probability distribution-Binomial, Negative binomial, multinomial distribution, Poisson distribution. Tests of significance – t tests – F tests – Chi square test. Analysis of variance – Statistical Soft wares (SPSS).	12
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Course Outcomes		
CO1	Understand the basic concepts of genome, transcriptome, and proteome, and learn gene prediction methods and tools.	
CO2	Gain knowledge of biological databases and perform sequence analysis using tools like BLAST and FASTA.	
CO3	Compare protein sequences, predict protein structures, and visualize them using tools such as RasMol	
CO4	Understand multiple sequence alignment, phylogenetic tree construction, and the basics of drug discovery and molecular docking.	
CO5	Apply statistical methods to analyze biological data, including probability, correlation, regression, and significance tests.	
Textbooks		
1	Pennington, S.R. and Punna, M.J. 2002. Proteomics: from protein sequence to function. Viva books Pvt. Ltd.	
2	Shuba G., 2010. Bioinformatics., Tata McGraw Hill publishing. India.	
3	Rastogi, S.C, Mendiratta, N, Rastogi, P., 2004. Bioinformatics methods and application. Prentice-Hall of India private limited, New Delhi.	
4	N.Gurumani (2011) "An Introduction to Biostatistics" MJP Publishers	
5	Verbala Rastogi .(2011). "Fundamentals of Biostatistics", Ane books Pvt Ltd Publishers, Chennai.	
Reference Books		
1	Attwood, T.K. and Parry-Smith, D.J. 2008. Introduction to Bioinformatics. Pearson Education.	
2	David Mount., Bioinformatics: sequence and genome analysis, second edition., Taylor & Francis, UK; 2009.	
3	D.R. Westhead. Instant Notes in Bioinformatics., second edition., Taylor & Francis, UK; 2009.	
4	Zar, (J.H. 2010). "Biostatistical Analysis" Fifth Edition, Pearson Education Pvt Ltd, Indian Branch, New Delhi.	
5	P.N. Arora and P.K. Malhan. (2013) "Biostatistics" Himalaya publishing House.	

Web Resources

1	https://www.lkouniv.ac.in/site/writereaddata/siteContent/202003291612341467kuaum_yadav_Bioinformatics.pdf
2	https://www.slideshare.net/6263234147/protein-and-nucleic-acid-sequencing
3	https://www.slideshare.net/slideshow/multiple-sequence-alignment-81493182/81493182
4	https://microbenotes.com/phylogenetic-tree/
5	https://www.lkouniv.ac.in/site/writereaddata/siteContent/202004241216240370priyamka_DS_COLLECTION_OF_DATA.pdf

Mapping Programme Outcomes and Programme Specific Outcomes with Course Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	1	1	2	2	1	1	3	3	1	1
CO2	3	1	2	2	2	2	2	3	3	2	3
CO3	3	1	2	2	2	3	2	3	3	3	3
CO4	3	1	2	2	2	3	1	3	3	3	3
CO5	3	2	1	2	2	1	1	3	3	2	2
Total	15	6	8	10	10	10	7	15	15	11	12
Average	3	1.2	1.6	2	2	2	1.4	3	3	2.2	2.4

3 – Strong, 2- Medium, 1- Low

SECOND YEAR FOURTH SEMESTER

EC - 7 AL (Practical) – Lab in Bioinformatics and Biostatistics

Course Code	Course name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBTA42P	Lab in Bioinformatics and Biostatistics	EC-7 (AL)	0	0	3	0	2	3	25	75	100

Learning Objectives

LO1	Analyse the Biological databases
LO2	Able to perform BLAST and FASTA
LO3	Represent data in to graphical form
LO4	Test the level of significance of biological data and interpret the results.
LO5	Determine Correlation Coefficient

Unit	Contents	No.of Hours
I	Retrieval of Nucleotide, Protein sequence from Database (GenBank, etc.,)	9
II	Sequence similarity search using BLAST & FASTA	9
III	Molecular Visualization using RasMol Measurement of bond length, angle in protein Structure using RasMol	9
IV	Preparation of bar diagram, line diagram and pie diagram using MS EXCEL. Calculation of Central tendency- mean, geometric mean, median using MS EXCEL Calculation of dispersion – Mean deviation, quartile deviation and standard deviation using MS EXCEL	9
V	Calculation of r value using Correlation Coefficient Calculation of student's t test using MS EXCEL	9

Course Outcomes

The students will be able to

CO1	Use biological databases such as NCBI, Swiss-Prot, and PDB to retrieve and interpret sequence and structure data.
CO2	Perform sequence similarity searches using BLAST and FASTA tools for functional analysis of biomolecules.
CO3	Identify functional domains in proteins using domain analysis tools like SMART .
CO4	Create and interpret bar diagrams, line diagrams, and pie charts using MS Excel for data visualization.

CO5	Calculate correlation coefficient and t-tests using MS Excel .
Textbooks	
1	Pennington, S.R. and Pun, M.J. 2002. Proteomics: from protein sequence to function. Viva books Pri. Ltd.
2	Maleolm and Goosfship. J. 2001. Genotype to phenotype, 2nd edition. Bios Scientific Publishers Ltd
3	Misener, S. and Krawetz. S.A. 2000. Bioinformatics: Methods and Protocols. Humana press.
4	Attwood, T.K. and Parry-Smith, D.J. 1999. Introduction to Bioinformatics. Pearson Education Asia.
5	Primrose, S.B. 1998. Principle of genome analysis. 2nd edition. Blackwell Science.
Reference Books	
1	Durbin, R., Eddy, S., Krogh, A. and Mitchison, G. 1998. Biological sequence analysis. Cambridge University Press.
2	Friedman, C.P. and Wyatt. J.C. 1997. Computers and Machine: Evaluation methods in medicinal information. Springer-verlag, New York.

Web Resources

1	Bishop, M.J. and Rawhings. C.J. 1997. DNA and protein sequence analysis: A practical approach. Oxford University press. New press. Kolodne
2	Kolodner, R.M. 1997. Computer in Health care: Computerizing large integrated health networks. Springer – Verlag, New York

Mapping Programme Outcomes and Programme Specific Outcomes with Course Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	1	3	3	3	2	1	3	3	3	2
CO2	3	1	3	3	3	2	1	3	3	3	2
CO3	3	1	3	3	3	2	1	3	3	3	3
CO4	3	1	3	3	3	2	1	3	3	3	3
CO5	3	1	3	3	3	2	1	3	3	3	3
Total	15	5	15	15	15	10	5	15	15	15	13
Average	3	1	3	3	3	2	1	3	3	3	2.6

3 – Strong, 2- Medium, 1- Low

SEC – 5 - Disease diagnosis and prevention

Course Code	Course name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBTS41	Disease diagnosis and prevention	SEC – 5	2	-	-	-	2	2	25	75	100
Learning Objectives											
LO1	To acquire a basic knowledge on human health and diseases										
LO2	To understand the pathogenesis of infectious diseases										
LO3	To understand the mechanism of development non-infectious diseases										
LO4	To obtain knowledge on the various diagnostics procedures										
LO5	To perceive the methods of prevention and control of diseases										
Unit	Contents										No. of Hours
I	Human Health and Disease Introduction to human health and diseases. Infectious and Non-infectious diseases. Modes of transmission- direct and indirect; Epidemic, pandemic and endemic diseases										5
II	Pathogenesis of infectious diseases Bacterial diseases- signs and symptoms-typhoid, tuberculosis, syphilis; steps in bacterial pathogenesis; Steps in viral pathogenesis; viral diseases- signs and symptoms-Influenza, covid, dengue; Steps in fungal infection, signs and symptoms-yeast infection, ringworm; Parasitic infections -malaria, lymphatic filariasis, steps in pathogenesis										7
III	Non-infectious diseases Causes, symptoms and mechanism-Cancer, diabetes, cardiovascular diseases, Cystic fibrosis, alzheimer's disease, anxiety disorders, autoimmune diseases										5
IV	Diagnosis and treatment Sample types, collection and preparation; Diagnostic tests- Biochemical tests, Antibiotic sensitivity test, Widal test, Serological tests- CBC, ELISA, Immunoassays, CSF analysis, Molecular tests, Histopathological assay										10
V	Prevention and control of diseases Immunity; Vaccination; Healthy lifestyle, Exercise, Yoga and Meditation, Rehabilitation, Screening tests-markers, Social distancing., Antibiotics										3

Course Outcomes	
The student will be able to	
CO1	Understand the various types of diseases and its transmission
CO2	Obtain knowledge on the mode of pathogenesis of infectious diseases
CO3	Gain knowledge on the development of non-infectious diseases
CO4	Comprehend deeper insights into the different diagnostics methods of infectious and non-infectious diseases
CO5	Understand the various preventive measures in controlling diseases
Textbooks	
1	Roy M. Anderson, Robert M. May, Infectious Diseases of Humans Dynamics and Control, 2003, OUP Oxford, 757 pages
2	Molecular Diagnostics: Promises and Possibilities, Mousumi Debnath, Godavarthi B.K.S. Prasad, Prakash S. Bisen, Springer Netherlands, 520 pages
3	Andrej Spec, Bethany Davies, Courtney Chrisler, Gerome Escota, Comprehensive Review of Infectious Diseases, Elsevier publishers, 2025, 831 pages
Reference Books	
1	John H. Dirckx, Human Diseases, Health Professions Institute Publishers, 1997, 370 pages
2	Neelam Sharma, Sandeep Arora, Saurabh Gupta, Sukhbir Singh, Tapan Behl, Metastatic Diseases, Apple Academic Press, 2021, 294 pages
3	Jean-Luc Benoit, Michael David, The Infectious Disease Diagnosis, 2017, 272 pages, Springer International Publishing
4	<u>J. S. Thakur</u> , Public Health Approaches to Non-Communicable Diseases, <u>Lippincott Williams & Wilkins</u> , 2015, pages 448
Web Resources	
1	https://pmc.ncbi.nlm.nih.gov/articles/PMC7150340/
2	https://www.msmanuals.com/professional/infectious-diseases/laboratory-diagnosis-of-infectious-disease/susceptibility-testing
3	https://accessmedicine.mhmedical.com/content.aspx?bookid=2129&sectionid=192510478
4	https://libguides.mskcc.org/infectiousdiseases/Transmission
5	https://egyankosh.ac.in/bitstream/123456789/101249/1/Unit-4.pdf

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC

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

3-Strong, 2-Medium, 1-Low

SECOND YEAR FOURTH SEMESTER

EC- 6 AL - BOTANY

Course Code	Course name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UB TA41	BOTANY	EC-6 AL	3	1	0	0	4	4	25	75	100
Learning Objectives											
LO1	To be familiar with the basic concepts and principles of plant systematics.										
LO2	Learn the importance of plant anatomy in plant production systems										
LO3	Understand the mechanism underling the shift from vegetative to reproductive phase										
LO4	To learn about the physiological processes that underlie plant metabolism										
LO5	To know the application of plant growth hormones										
Unit	Contents									No. of Hours	
I	MORPHOLOGY Leaf types- simple and compound. Phyllotaxy and types. Inflorescence - Racemose, Cymose and Special types. Terminology with reference to flower description.									12	
II	TAXONOMY: Study of the range of characters and plants of economic importance in the following families: Rutaceae, Caesalpiniaceae, Asclepiadaceae, Euphorbiaceae and Cannaceae									12	
III	ANATOMY Tissue and tissue systems: Simple and complex tissues. Anatomy of monocot and dicot stem and leaves									12	
IV	EMBRYOLOGY Structure of mature anther and ovule - Types of ovules, structure of embryo sac, pollination -double fertilization, structure of dicotyledonous and monocotyledonous seeds.									12	
V	PLANT PHYSIOLOGY Absorption of water, photosynthesis - light reaction - Calvin cycle; respiration - Glycolysis - Krebs cycle - electron transport system. Growth hormones - auxins and cytokinins and their applications.									12	

Course Outcomes	
CO1	Classify plant systematics and recognize the importance of herbarium and virtual herbarium
CO2	Understand the fundamental concepts of plant anatomy and embryology.
CO3	Analyze and recognize the different organs of plants and secondary growth.
CO4	Understand water relation of plants with respect to various physiological processes
CO5	Classify aerobic and anaerobic respiration.
Textbooks	
1	Sharma, O.P. 2017. Plant Taxonomy. (II Edition).The McGraw Hill Companies.

2	Maheshwari, P. 1963. Recent Advances in Embryology of Angiosperms. Intl. Soc. Plant Morphologists, New Delhi.
3	Salisbury, F. B.C.W. Ross.1991. Plant Physiology. Wassworth Pub. Co. Belmont
4	Ting, I.P. 1982. Plant Physiology. Addison Wesley Pb. Philippines.
Reference Books	
1	Lawrence.G.H.M. 1985. An Introduction to Plant Taxonomy, Central Book Depot, Allahabad
2	Bhojwani, S.S and Bhatnagar, S.P. 2000. The Embryology of Angiosperms (4th revised and enlarged edition). Vikas Publishing House, New Delhi.
3	Pandey, B.P. 2012. Plant Anatomy. S Chand Publishing.
4	Jain, VK. 2006. Fundamentals of Plant Physiology, S. Chand and Company Ltd.
5	Rajni Gupta. 2012. Plant Taxonomy: Past, Present and Future. Vedams (P) Ltd. New Delhi.

Web Resources

1	https://archive.org/EXPERIMENTS/plantanatomy031773mbp_4 .
2	https://books.google.co.in/books/about/PLANT_TAXONOMY_2E.html?id=Roi0lwSXFuUC&redir_esc=y_3 .
3	https://www.crcpress.com/Plant-Physiology/StewartGlobig/p/book/9781926692692
4	https://www.amazon.in/Embryology-Angiosperms-6th-S-P-Bhatnagarebook/dp/B00UN5KPQG

Mapping Programme Outcomes and Programme Specific Outcomes with Course Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	1	1	2	2	1	1	3	3	1	1
CO2	3	1	2	2	2	2	2	3	3	2	3
CO3	3	1	2	2	2	3	2	3	3	3	3
CO4	3	1	2	2	2	3	1	3	3	3	3
CO5	3	2	1	2	2	1	1	3	3	2	2
Total	15	6	8	10	10	10	7	15	15	11	12
Average	3	1.2	1.6	2	2	2	1.4	3	3	2.2	2.4

3 – Strong, 2- Medium, 1- Low

SECOND YEAR FOURTH SEMESTER
EC - 7 AL (Practical) – BOTANY

Course Code	Course name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBTA42P	BOTANY	EC-7 (AL)	0	0	3	0	2	3	25	75	100

Learning Objectives		
LO1	To be familiar with the basic concepts and principles of plant systematics	
LO2	To understand the basic structure and functions of cell organelles	
LO3	To learn about the physiological processes that underlie plant metabolism	
LO4	To study the development embryology	
LO5	To study the primary and secondary structure of stem and root	
Unit	Contents	No.of Hours
I	To describe in technical terms, plants belonging to any of the family prescribes and to identify the family. To dissect a flower, construct floral diagram and write floral formula.	9
II	To dissect a flower, construct floral diagram and write floral formula. Demonstration experiments Ganong's Light screen Ganong's respiro	9
III	Study the Growth hormones - auxins and cytokinins	9
IV	Dissect and display the T.S of (young and mature) anther - Datura or Cassia flower and any one stage of embryo - Tridax	9
V	Study the types of ovules- Anatropous, Orthotropous, Circinotropous, Amphitropous, Campylotropous. (Permanent slides)	9

Course Outcomes The students will be able to	
CO1	To study the classical taxonomy with reference to different parameters.
CO2	To study the morphology characters of plants
CO3	Develop critical understanding on Growth Hormones
CO4	Understand the fundamental concepts of Anther
CO5	Understand the fundamental concepts of Ovule
Textbooks	
1	Porter, C.L. 1982. Taxonomy of Flowering Plants, Eurasia Publications House, New Delhi
2	Noggle G.R and G.J. Fritz. 2002. Introductory Plant Physiology. Prentice Hall of India, New Delhi

3	Sundara, R. S. 2000. Practical manual of plant anatomy and embryology. Anmol Publ. PVT LTD, New Delhi
4	Sharma, H.P. 2009. Plant Embryology: Classical and Experimental, Bombay Popular Prakashan, ISBN-8173199698, 9788173199691
5	Pandey, B.P.2015. Plant Anatomy S. Chand Publ. New Delhi
Reference Books	
1	Hutchinson, J. 1973. The Families of Flowering plants , Oxford University press, London
2	Steward, F.C. 2012. Plant Physiology Academic Press, US

Web Resources

1	https://www.amazon.in/Practical-Taxonomy-Angiosperms-RSinha/dp/9380578210
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Mapping Programme Outcomes and Programme Specific Outcomes with Course Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	1	3	3	3	2	1	3	3	3	2
CO2	3	1	3	3	3	2	1	3	3	3	2
CO3	3	1	3	3	3	2	1	3	3	3	3
CO4	3	1	3	3	3	2	1	3	3	3	3
CO5	3	1	3	3	3	2	1	3	3	3	3
Total	15	5	15	15	15	10	5	15	15	15	13
Average	3	1	3	3	3	2	1	3	3	3	2.6

3 – Strong, 2- Medium, 1- Low

SECOND YEAR FOURTH SEMESTER
AEC – 3 – ENVIRONMENTAL STUDIES & DISASTER MANAGEMENT

Course Code	Course name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UAEC41	ENVIRONMENTAL STUDIES & DISASTER MANAGEMENT	AEC - 3	2	0	0	0	2	2	25	75	100
Learning Objectives											
LO1	To provide basic knowledge of Environmental Science and Sustainability										
LO2	To understand the Fundamentals of Disaster Management										
LO3	To create awareness about Natural Disaster and Management										
LO4	To familiarize students with Manmade Disaster and Management										
LO5	To promote community participation and technological applications in disaster risk reduction										
Unit	Contents										Hour
I	Environmental Science and Sustainability Ecosystem: structure, types, and functions - Biodiversity: importance and conservation strategies - Environmental pollution: types (Air & Water), causes, effects, and control measures - Climate change and global warming										5
II	Fundamentals of Disaster Management Concepts: disaster, hazard, vulnerability, risk, resilience - Types of disasters: natural and man-made - Disaster management cycle: prevention, mitigation, preparedness, response, recovery.										5
III	Natural Disasters and Management Earthquakes, floods, Oil spill disaster, cyclones, Tsunami, droughts, landslides, Heat wave - Causes, consequences, and case studies - Community and government measures for preparedness and mitigation. Role of Government in Disaster Management – NDMA, SDMA & DDMA. Community Based Disaster Management										8
IV	Man-Made Disasters and Management Industrial accidents, fires, chemical and nuclear hazards, Biological hazards, transport accidents - Impacts on society, economy, and environment - Disaster preparedness and management strategies - Case studies: Bhopal Gas Tragedy, Vizag Gas Leak, urban disasters.										7
V	Sustainable Development and Disaster Risk Reduction Principles of sustainable development and Sustainable Development Goals (SDGs) -										5

	Climate change and disaster interlinkages - Disaster risk reduction strategies: early warning systems, resilient infrastructure, policy framework. Role of technology, education, and media in environmental sustainability and disaster management	
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Course Outcomes	
The students will be able to	
CO1	Describe the importance of ecosystems, biodiversity, and methods of controlling pollution.
CO2	Understand the basic concepts of disaster management, hazards, risks, and resilience.
CO3	Explain the causes, effects, and control measures of major natural disasters.
CO4	Identify different types of man-made disasters and suggest safety and preparedness measures.
CO5	Recognize the role of sustainable development and disaster risk reduction strategies in protecting environment and society.
Textbooks	
1	Government of India – Disaster Management Act, 2005
2	P.C. Mishra – Disaster Management and Mitigation
Reference Book	
1	Erach Bharucha – Textbook of Environmental Studies
2	IGNOU Study Material – Disaster Management

Web Resources:

1	https://ndma.gov.in/
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Mapping Programme Outcomes and Programme Specific Outcomes with Course Outcomes

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

3 – Strong, 2- Medium, 1- Low

3rd YEAR: FIFTH SEMESTER

CC -9 – Environmental and Industrial Biotechnology

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UBTC51	Environmental and Industrial Biotechnology	CC-9	4	1	0	0	5	5	25	75	100
LO1	To understand environmental changes, pollution, and biotech-based sustainability.										
LO2	To understand wastewater treatment, waste management, and biotechnological approaches for pollution										
LO3	To Illustrate the significance of bioreactors in bioprocess engineering and culture methods.										
LO4	To Understand microbial processes for producing bioproducts with quality control.										
LO5	To comprehend downstream processing for product purification.										
Unit	Content									Hours	
1	Environmental pollution-sources and types- water, Air, soil and industrial. Global environmental changes – Pollution, Global warming, Greenhouse effect, acid rain, ozone depletion, and photochemical smog. Environmental issues, management strategies and safety, Biotechnological approaches for management.									15	
2	Waste water treatment: Aerobic and anaerobic methods (Primary, Secondary and Tertiary) –Use of aquatic plants in waste water treatment. Solid waste management and Bioenergy. Bioremediation of Heavy Metals. Drinking water treatment. Biotechnological approach to industrial effluent (Paper, Tannery, Textile) Pesticide waste disposal.									15	
3	Bioreactors / Fermentor: Types, features, operation: sterilization (Batch and Continuous Microbial growth and media formulation. Microbial culture - batch, fed batch, semi-continuous, continuous. Growth kinetics of microorganisms.									15	
4	Production of antibiotics (Penicillin, Streptomycin); production of vitamins and organic acids; alcoholic beverages (Wine, Beer); microbial enzymes (Amylase, Protease) and enzyme immobilization; biopesticides (Bacillus thuringiensis) and microbial toxins with applications; fermented foods; quality control in bioproducts; dairy products (Cheese, Yoghurt).									15	
5	Downstream processing: Solid-liquid separation, flotation, flocculation, filtration, centrifugation, cell disruption, concentration, evaporation, liquid-liquid extraction, membrane filtration, precipitation, adsorption. Product purification by chromatography.									15	
	Total									75	

CO	Course Outcomes
	Students will be able to
CO1	Understand environmental pollution, global changes, and biotechnological management.
CO2	Understand waste management, bioremediation, and water treatment.
CO3	Analyze bioprocesses, bioreactors, and fermentation systems.
CO4	Apply downstream processing, fermented foods, microbial products, enzymes, and biosensors.
CO5	Evaluate antibiotics, alcoholic beverages, biofertilizers, biopesticides, and microbial products.
Textbooks:	
1	Chatterji, A.K., 2002. Introduction to Environmental Biotechnology, Prentice-Hall of India, New Delhi.
2	Anil Kumar De., 2000. Environmental Chemistry, 4th Edition. New Age International, New Delhi.
3	Murugesan, A G., Rajakumari, C., 2005. Environmental Science and Biotechnology Theory and Techniques., MJP publishers, Chennai.
4	T.Satyanarayana, Bhavdish Narain Johri, Anil Prakash(2012), Microorganisms in Sustainable Agriculture and Biotechnology.
5	Madigan, Michael and Martinko, John, Brock biology of microorganism, 11th edition, (2005).
Reference Books:	
1	Alan Scragg, 1999. Environmental Biotechnology, Pearson Education Limited, England,
2	Peter F. Stanbury, Allan Whitaker, Stephen J. Hall (2013). Principles of Fermentation Technology Second Edition, Elsevier Science Ltd
3	Michael J. Waites, Neil L. Morgan, John S. Rockey Gary Higton (2001.), Industrial Microbiology: An Introduction. . Blackwell Science Ltd
4	Nduka Okafor, Modern Industrial Biotechnology & Microbiology ((2017, Science Publishers, Edenbridge Ltd.
5	Waites, Morgan, Rockey and Higton, Industrial Microbiology: An Introduction, Blackwell Science (2001).
Web Resources:	
1	https://nptel.ac.in/courses/120/108/120108004/
2	Notes-Sem-IV-Microbiology-PII-U2.pdf
3	https://mlsu.ac.in/econtents/1815_microbial%20culture%20types.pdf
4	IEM Unit3-Fermentation- Downstream Processing

Mapping Programme Outcomes and Programme Specific Outcomes with Course Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	3	3	2	2	2	3
CO2	3	3	2	3	2	3	3	2	3	3	3
CO3	3	2	3	2	3	1	2	1	3	3	2
CO4	3	3	3	2	3	1	2	1	3	3	2
CO5	3	3	2	3	3	1	2	1	3	3	2
Total	15	13	11	12	12	9	12	7	14	14	12
Average	3	2.6	2.2	2.4	2.4	1.8	2.4	1.4	2.8	2.8	2.4

3 – Strong, 2- Medium, 1- Low

CC-10 Practical V - Environmental and Industrial Biotechnology Practical

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UBTC52P	Environmental and Industrial Biotechnology practical	CC-10	-	-	3	0	2	3	25	75	100
Learning Objectives											
LO1	To study airborne pathogens, water quality, and heavy metal contamination.										
LO2	To enumerate microbial load and screen biodegrading microbes capable of starch and cellulose degradation.										
LO3	To study batch fermentation for alcohol and citric acid production using microorganisms.										
LO4	To isolate and identify microorganisms from idli batter, curd, soil, and sewage samples.										
LO5	To study immobilization of yeast cells or enzymes using alginate beads.										
Unit	Content									Hours	
1	Isolation of Air borne Pathogens Water analysis – BOD & COD Heavy metal contamination analysis (Lead, Cadmium)									9	
2	Enumeration of microbial load (CFU count) Screening for biodegrading microbes (starch/cellulose)									9	
3	Batch fermentation (alcohol production using yeast) Organic acid production (citric acid)									9	
4	Isolation and identification of starter organisms from Idli batter/ curd Isolation of microorganisms from soil/sewage									9	
5	Immobilization of whole yeast cells/ enzyme by Alginate beads.									9	
	TOTAL									45	
CO	Course Outcomes										
CO1	Ability to isolate and study airborne pathogens from environmental samples.										
CO2	Skill in enumerating microbial load and screening biodegrading microorganisms.										
CO3	Understanding of fermentation processes for alcohol and citric acid production.										
CO4	Ability to isolate and identify microorganisms from food and environmental samples.										
CO5	Knowledge of immobilization techniques using alginate beads for cells or enzymes.										

Textbooks:	
1	Aneja K R, Laboratory Manual of Microbiology and Biotechnology, MEDTECH, 2014.ISBN-13 : 978-9381714553
2	Vijaya Ramesh, (2007), Food Microbiology, MJP Publishers, Chennai, ISBN-13 : 978-8180940194
3	<i>Sharma, D. & Saini, A., Lignocellulosic Ethanol Production from a Biorefinery Perspective, Springer, 2020. ISBN-13: 978-9811545733</i>
4	<i>Faraco, V. (Ed.), Lignocellulose Conversion: Enzymatic and Microbial Tools for Bioethanol Production, Springer, 2013. ISBN-13: 978-3642378614</i>
5	<i>Prasad, S. et al., Sustainable Bioethanol Production from Lignocellulosic Biomass, Springer, 2026. ISBN-13: 978-9819596898</i>
Reference Books:	
1	Raghuramulu, N., Madhavan Nair, K., and Kalyanasundaram, S. Ed., (1983), A Manual of Laboratory Techniques, National Institute of Nutrition, ICMR, Hyderabad
2	<i>Aneja, K.R., (2014), Laboratory Manual of Microbiology and Biotechnology, MEDTECH, New Delhi. ISBN-13: 978-9381714553</i>
3	APHA, AWWA, WEF, (2017), Standard Methods for the Examination of Water and Wastewater, American Public Health Association, Washington, D.C. ISBN-13: 978-0875532875
4	Patel, A.H., (2015), Industrial Microbiology, Macmillan Publishers India Ltd., New Delhi. ISBN-13: 978-9350593790
5	Dubey, R.C., and Maheshwari, D.K., (2013), <i>Practical Microbiology</i> , S. Chand & Company Ltd., New Delhi. ISBN-13: 978-8121926200
Web Resources:	
1	(PDF) Isolation of toxic metal-tolerant bacteria from soil and examination of their bioaugmentation potentiality by pot studies in cadmium- and lead-contaminated soil
2	Microsoft Word - Lab7 BOD,COD.doc
3	(Pdf) Bioethanol Production from Agricultural Waste
4	(PDF) Isolation and Enumeration of Probiotic Microorganisms from Fermented Idli Batter
5	Industrial Biotechnology: A Lab Manual By Arshan, M. L. Mohammed Kaleem - Amazon.Ae

Mapping Programme Outcomes and Programme Specific Outcomes with Course Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	1	3	2	3	1	2	2	1	3
CO2	3	2	2	3	2	1	1	2	3	2	1
CO3	3	2	3	2	2	1	1	2	2	3	1
CO4	3	2	3	2	2	1	1	2	2	3	1
CO5	3	3	2	3	2	3	1	2	2	3	3
Total	15	12	11	13	10	9	5	10	11	12	9
Average	3	2.4	2.2	2.6	2	1.8	1.0	2.0	2.2	2.4	1.8

3 – Strong, 2- Medium, 1- Low

CC-11 Plant and Animal Biotechnology

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UBTC53	Plant and Animal Biotechnology	CC-11	4	1	0	0	5	5	25	75	100

Learning Objective		
LO1	To provide basic knowledge on plant genome organization and plant hormones.	
LO2	To understand different micropropagation techniques and secondary metabolite production.	
LO3	To study gene transfer methods and their applications.	
LO4	To gain knowledge of animal cell culture techniques.	
LO5	To apply animal cell culture techniques in the production of transgenics.	
UNIT	Contents	No. of Hours
I	An introduction to Plant Biotechnology, its scope History of Plant Biotechnology, Plant genome organization- Plant hormones: (Auxins, cytokinin, gibberlins, ABA, Ethylene) Phytochrome and Fruit Ripening: Introduction to plant genomics and epigenetics.	15
II	Media: Types, Media composition (MS media) – Anther culture, Pollen Culture and Embryo culture. Micro propagation techniques - direct and indirect organogenesis - somatic embryogenesis - haploid and triploid - Protoplast culture - hybrid and cybrid production, Synthetic seed production. Secondary metabolite production: Metabolic engineering and CRISPR in plants.	15
III	Agrobacterium and crown gall tumors – Mechanism of T-DNA transfer to plants, Ti and Ri Plasmid vectors and their utility – Plant viral vectors. Genome editing (CRISPR-Cas9) gene. RNA interference; Transgenic plants, plant vaccines, genetically modified food - future perspectives & ecological impact of transgenic plants.	15
IV	Introduction to Animal Cell culture - Media and components; Equipment; Types of culture (primary, secondary, cell lines)- Cell separation, synchronization, counting methods, cryopreservation, Cell banking procedures. 3D culture and organoids.	15
V	Transfection of cells in culture- Animal viral vectors for transfection, selectable markers - Gene targeting, gene silencing and Gene knockout and their applications - Stem cells and their applications - Transgenic Animals. Collection and preservation of embryos, Semen banking, AI, IVF and ICSI. - Common animal diseases and its molecular diagnostic methods. (PCR, ELISA); AI applications in biotech.	15
	Total	75

Course Outcome	
CO1	Understand Plant Biotechnology fundamentals, including scope, history, genome organization, and hormone roles in growth and ripening.
CO2	Analyze plant tissue culture techniques, media (MS), micropropagation, protoplast culture, and applications like synthetic seeds and secondary metabolites.
CO3	Describe gene transfer in plants using <i>Agrobacterium</i> , vectors, nif gene, and applications of transgenic plants and GM foods with their impacts.
CO4	Describe animal cell culture basics, media, equipment, cell types, and techniques including separation, counting, cryopreservation, and cell banking.
CO5	Understand cell transfection, gene modification techniques, stem cells, transgenic animals, reproductive technologies, and molecular diagnostics of animal diseases.
Text Books	
1	Sudhir, M. 2000. Applied Biotechnology and plant Genetics. Dominant publishers and distributors.
2	Trivedi, P.C.2000. Applied Biotechnology: Recent Advances. PANIMA Publishing corporation.
3	Ignacimuthu. 1996. Applied Plant Biotechnology. Tata McGraw – Hill.
4	Narayanaswamy S. 1994. Plant cell and tissue culture. Tata McGraw Hill Publishing Company limited, New Delhi.
5	Chawla, H.S., “Introduction to Plant Biotechnology”, 3rd Edition, Science Publishers, 2009.
Reference Books	
1	Ramasamy.P. 2002.Trends in Biotechnology, University of Madras of Publications, Pearl Press
2	Ignacimuthu. 1996. Basic Biotechnology. Tata McGraw-Hill.
3	R. Ian Freshney, Culture of Animal cells – A Manual of Basic Technique Fourth Edition, WILEY LISS & Publications.
4	Glick, B.R. and Pasternark. 2002. Molecular Biotechnology: Principle and applications of recombinant DNA.
5	Kreuzer, H. and Massey, A. 2001. Recombinant DNA and Biotechnology: A guide for teachers, 2nd edition. ASM Press Washington.
6	Traven. 2001. Biotechnology. Tata McGraw – Hill.
Web Resources	
1	https://nptel.ac.in/courses/102103016
2	https://science.umd.edu/classroom/bsci124/lec41.html
3	https://www.nifa.usda.gov/grants/programs/biotechnology-programs/plant-biotechnology
4	http://mydunotes.blogspot.com/p/plant-biotechnology.html
5	https://nptel.ac.in/courses/102103016
6	http://ecoursesonline.iasri.res.in/course/view.php?id=350

Mapping Programme Outcomes and Programme Specific Outcomes with Course Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CLO1	3	2	3	1	1	2	1	3	3	3	3
CLO2	3	3	3	2	1	3	1	3	3	3	3
CLO3	3	3	3	3	2	2	1	3	3	3	3
CLO4	3	2	2	1	3	2	1	3	3	3	2
CLO5	3	3	3	2	3	3	1	2	3	2	3
TOTAL	15	13	14	9	10	12	5	14	15	14	14
AVER AG E	3	2.6	2.8	1.8	2	2.4	1	2.8	3	2.8	2.8

3 – Strong, 2- Medium, 1- Low

CC – 12 Practical VI- Plant and Animal Biotechnology practical

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UBTC54P	Plant and Animal Biotechnology Practical	CC-12	0	0	3	0	2	3	25	75	100

Learning Objective		
LO1	To Learn plant tissue culture techniques and procedures.	
LO2	To Comprehend root initiation, anther, pollen, embryo culture, protoplast isolation, and synthetic seed techniques	
LO3	To study synthetic seed production by entrapment method and plant DNA isolation using CTAB method.	
LO4	To Apply animal cell culture techniques including media preparation, cell suspension, counting, and viability testing.	
LO5	To isolate DNA from buccal and blood cells for molecular and genetic analysis.	
UNIT	Contents	No. of Hours
I	Plant tissue culture media preparation & sterilization techniques, Explant Preparation, callus culture & Shoot tip initiation	9
II	Root initiation using MS media, Anther culture/Pollen Culture/Embryo culture. Isolation of plant protoplast & viability test	9
III	Synthetic seeds (Entrapment method) Production. Isolation of plant DNA using CTAB.	9
IV	Preparation of Animal Tissue culture medium Preparation of Single Cell Suspension & Cell counting Cell viability Test-MTT Assay	9
V	Isolation of DNA from buccal cell Isolation of DNA From blood cells	9
	Total	45

Course Outcome	
CO1	Apply aseptic tissue culture techniques for plant propagation.
CO2	Apply advanced tissue culture methods for effective plant regeneration.
CO3	Utilize DNA isolation techniques for basic plant molecular analysis.
CO4	Employ animal cell culture methods to evaluate cell growth and viability.
CO5	Integrate animal cell culture and molecular techniques for cell maintenance and analysis.
Text Book	
1	Madhavi Adhav, 2009, Practical Biotechnology and Plant Tissue Culture, S.Chand & Company Ltd.
2	C. C. Giri, Archana Giri, 2007, Plant Biotechnology: Practical Manual, I.K. International Pvt Ltd.
3	Karl-Hermann Neumann, Ashwani Kumar, Jafargholi Imani, 2009, Plant Cell and Tissue Culture - A Tool in Biotechnology: Basics and Application, Springer.
Reference Book	
1	S. Lal, Vikas. (2018), Public Health Management Principles And Practice, (2nd Edition), CBS Publishers and Distributors Pvt Ltd, ISBN 13: 9789387742932
2	S. Harisha. (2012), Biotechnology procedures and experiments handbook, ISBN13 9781934015117
3	Debajit Borah (2018), Environmental Biotechnology Theory and Lab Practices, (2nd edition), Hardcover – Global Vision Publishing House, ISBN: 9788182205840
Web reference	
1	https://www.plantcelltechnology.com/pct-blog/different-types-of-tissueculture-processes/
2	https://www.thermofisher.com/in/en/home/references/gibco-cell-culturebasics.Html

Mapping Programme Outcomes and Programme Specific Outcomes with Course Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	1	2	2	3	3	3	3
CO2	3	3	3	3	1	3	2	3	3	3	3
CO3	3	3	3	3	2	2	2	3	3	3	3
CO4	3	3	3	3	3	2	2	3	3	3	2
CO5	3	3	3	3	3	3	2	3	3	2	3
TOTAL	15	15	15	15	10	12	10	15	15	14	14
AVERAGE	3	3	3	3	2	2.4	2	3	3	2.8	2.8

3 – Strong, 2- Medium, 1- Low

EC-8- NANOTECHNOLOGY

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UBTE51	Nanotechnology	EC-8	4	1	0	0	4	5	25	75	100
Learning Objectives											
LO1	To provide an overview of nanobiotechnology and its research developments in India.										
LO2	To understand nanoparticles and their analysis using advanced instrumentation techniques.										
LO3	To gain knowledge about nanodevices and their functions.										
LO4	To understand the applications of nanobiotechnology in various fields.										
LO5	To study nanobiosensors and their applications.										
UNIT	Contents									No. of Hours	
1	Introduction to Nanotechnology-Nano particles, size, shape, bulk and nano material. Glimpse of Nanotechnology based material in ancient India: Wootz steel (iron carbide) and the Delhi iron pillar (anticorrosive nanomaterial), Bhasma (nanomaterial as medicine). Contributions of Indian Research Institutes in the field of nanobiotechnology.									15	
II	Metals: Silver nanoparticle, Green synthesis of silver and Zinc oxide nanoparticles and its Characterization by UV-spectroscopy, XRD, FTIR., SEM and TEM.									15	
III	Nano-thin films: Chitosan thin film, Nanodevices (nanorobots), Nanotubes: Microtubules assembly and its importance, Nano shells- Dendrimers: Liposomes, Nanofibers: Collagen, Fibronectin & elastin, nano fluidics: Extracellular matrix assembly and its importance.									15	
IV	Agriculture: Crop production- Nano fertilizers technology, Biomaterial to improve shelf life of vegetables. Medicine: Collagen thin films in wound healing mechanism, Nanoscale devices – DNA microarray for disease diagnosis, Antibodies and Targeted drug delivery system.									15	

V	Nano biosensors (Firefly-luciferase) and its applications, Introduction to Biomimetics (Gecko foot effect, Lotus leaf effect: Paint and fabrics, Box fish based Car).	15
Total		75
Course Outcome		
CO1	Students will understand nanotechnology basics, ancient nanomaterials (Wootz steel, Delhi Iron Pillar, Bhasma), and Indian contributions to nanobiotechnology.	
CO2	Learn silver nanoparticles, green synthesis, and analysis using UV, FTIR, SEM, and TEM.	
CO3	Analyze nano-thin films, nanodevices, nanotubes, nanocarriers, nanofibers, and nanofluidics in extracellular matrix assembly.	
CO4	Understand nanotechnology applications in agriculture and medicine.	
CO5	Analyze nanobiosensors and biomimetics.	
Text Books		
1	Vasantha Pattabhi and N. Gautham (2009), Biophysics, Narosa Publishing House, New Delhi.	
2	Narayanan.P (2010), Essentials of Biophysics, New Age International (P) Ltd. Publishers, New Delhi.	
3	Rai, Mahendra, and Clemens Posten (2013). Green biosynthesis of nanoparticles: Mechanisms and applications, CABI, ISBN: 9781780642246.	
4	Shanmugam.S, "Nanotechnology", MJP publishers, 2010.	
5	Pradeep T (2012). Textbook of Nanoscience and Nanotechnology, McGraw Hill publications, ISBN: 9781259007323.	
Reference Books		
1	D.Voet & J.G.Voet (2010), Biochemistry, John Wiley & Sons, New York.	
2	Biochemistry by Lubert Stryer, 4 th Ed., WH.Freeman, 1995.	
3	David S. Goodsell, "Bionanotechnology", John Wiley & Sons Inc., publications, 2004.	
4	Guozhong Cao (2004). Nanostructures and Nanomaterials, synthesis, properties and applications, Imperial College Press, ISBN: 978-1860944802.	
5	C.M.Niemeyer, C.A. Mirkin (2007). Nanobiotechnology, WILEY-VCH Verlag GmbH & Co. KG, Weinheim, ISBN: 9783527306589.	

Web Resources	
1	https://www.jabonline.in/admin/php/uploads/16_pdf.pdf
2	https://web.pdx.edu/~pmoeck/phy381/intro-nanotech.pdf
3	https://etp-nanomedicine.eu/wp-content/uploads/2018/10/nano-hands-on-activities_en.pdf

Mapping Programme Outcomes and Programme Specific Outcomes with Course Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	P07	P08	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	2	1	3	3	3	3
CO2	3	3	3	2	3	3	1	3	3	3	3
CO3	3	3	3	3	2	3	1	3	3	3	3
CO4	3	2	2	1	1	2	1	3	3	2	3
CO5	3	3	3	2	3	3	1	2	3	3	3
TOTAL	15	13	13	10	11	13	5	14	15	14	15
AVERAGE	3	2.6	2.6	2	2.2	2.6	1	2.8	3	2.8	3

3 – Strong, 2- Medium, 1- Low

EC-8-Bioethics and Biosafety

Course Code	Course name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBTE52	Bioethics and Biosafety	EC -8	4	1	0	0	4	5	25	75	100
Learning Objectives											
LO1	To understand the concepts of bioethics and biosafety.										
LO2	To understand bioethics, ethical issues in biotechnology, and clinical ethics.										
LO3	To gain knowledge about the importance of ethical clearance in research.										
LO4	To understand patent rights in the field of research.										
LO5	To study biosafety measures and Good Laboratory Practices (GLP).										
Unit	Contents										No. of Hours
I	Human Rights: Definition, Classification and Scope of Human Rights. Universal Declaration of Human Rights (UDHR); Article 21 of Indian Constitution; United Nations Commission for Human Rights Council, National and State Human Rights Commission. Social issues of Human rights.										15
II	Bioethics: Principles and significance; Ethical issue in biotechnology related to reproduction, Birth, life and Death (Artificial insemination, egg donation, IVF, embryo transplants, Prenatal diagnosis and sex selection & Abortion). Introduction to clinical ethics and consent										15
III	Advanced bioethics and regulatory frameworks: Animal ethics and CPCSEA guidelines; Licensing of animal house; Human cloning and ethical concerns; Ethical clearance norms for research involving human subjects (ICMR guidelines); Institutional Ethics Committees (IEC/IRB)										15
IV	Intellectual Property Rights: Introduction; Types of IPR – Patents, Copyrights, Trademarks, Industrial designs, Farmer’s rights; Patent treaties and conventions (PCT, TRIPS); Criteria for patentability and non-patentable inventions; Patent application procedure in India; Patenting in biotechnology; Regulatory bodies (WHO, FDA) – role in approval of biotech products.										15
V	Biosafety: Principles and guidelines; DBT biosafety guidelines; Risk assessment and biosafety levels; Handling and disposal of hazardous biological materials; Good Laboratory Practices (GLP) and Good Manufacturing Practices (GMP); Containment strategies; Regulations on GMOs – field trials, release and labeling; Guidelines for transgenic plants and animals; Introduction to biosecurity										15
	Total										75

Course Outcomes	
The student will be able to	
CO1	Understand the need and importance of Bioethics and Biosafety
CO2	Gain knowledge of bioethical principles and informed consent in biotechnology.
CO3	Acquire information on the ethical practice and Clearance
CO4	Attain knowledge on WHO in Bioethics and Biosafety
CO5	Acquire knowledge on DBT standards
Reference Books	
1	Trayer, P.C, Fredrick.R., and Koch, M. (2002), <i>Biosafety</i> . Michigan State University
2	Biosafety, Traylor, Fredric & Koch, 2002. Michigan state University pub., USA.
3	Contemporary issues in Bioethics, Beauchamp & Leroy, 1999. Wardsworth Pub. Co. Belmont, California.
Textbooks	
1	Ignacimuthu, S (2009), <i>Bioethics</i> , Narosa Publication house, ISBN:978-81-7319-966-0
2	V. Sree Krishna . V (2007), <i>Bioethics and Biosafety in Biotechnology</i> , (1st ed.), New Age International Private Limited.
3	Rhona Smith. (2003), <i>International Human rights</i> , Blackstone Press.
Web resources	
1	www.ipr-helpdesk.org/
2	www.patentoffice.nic.in/ipr/patent/patents.htm
3	www.bangalorebio.com/GovtInfo/ipr.htm

Mapping Programme Outcomes and Programme Specific Outcomes with Course Outcomes

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

High – 3 Moderate – 1 Low – 1

EC-8-Research Methodology

Course Code	Course name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBTE53	Research Methodology	EC-8	4	1	0	0	4	5	25	75	100
Learning Objectives											
LO1	To know the basics of Research Methodology										
LO2	To gain knowledge on Data Preparation, Analysis and Statistical Analysis										
LO3	To learn different types of Research Studies										
LO4	To comprehend the importance of Research Publications										
LO5	To develop skill on Reference formatting and Manuscript formatting										
Unit	Contents										No. of Hours
I	Objectives and motivation for research; Types of research (descriptive, analytical, applied, fundamental, quantitative, qualitative, conceptual, empirical); Research methods vs methodology; Literature review – sources, organization and consolidation; Library, field and laboratory research										15
II	Sampling methods: probability and non-probability sampling; Sample size, sampling frame, sampling error; Characteristics of a good sample; Data preparation and analysis – univariate analysis (frequency tables, bar charts, pie charts, percentages); Introduction to basic biostatistics (mean, median, standard deviation)										15
III	Research problem formulation: Research questions and investigation questions; Hypothesis – types and qualities; Research design – features of a good design; Exploratory and descriptive research designs; Experimental design – independent and dependent variables, controls and replication; Basics of statistical testing (t-test, chi-square – concept only)										15
IV	Scientific writing: Structure of a research paper (IMRaD format); Journals in life sciences and impact factor; Ethical issues in publishing – plagiarism, self-plagiarism; Use of reference sources (encyclopedias, handbooks); Life science databases (PubMed, Scopus, Web of Science, NCBI)										15
V	Information retrieval strategies; Reference management tools (Zotero, Mendeley); Tools for scientific writing (MS Office, LaTeX basics); Plagiarism detection tools; Introduction to data visualization and basic tools (Excel/GraphPad); reproducibility and research data management (basic concepts)										15
	Total										75

Course Outcomes	
The student will be able to	
CO1	Understand the basics of Research Methodology
CO2	Obtain knowledge on Data Preparation, Analysis and Statistical Analysis
CO3	Differentiate and classify the Research types
CO4	Attain the importance of Research Publication
CO5	Understand different Reference style and Manuscript formats
Reference Books	
1	Experimental Design for the Life Sciences. Ruxton & Colegrave. Oxford University Press
2	Robert A. Day (1998), How to Write & Publish a Scientific Paper. Oryx Press; 5 editions
3	Judith Bell. Doing your research, A guide for first-time researchers in education, health, and social science. 4 th edition. Open University press. McGraw Hill education (2005).
Textbooks	
1	C.R.Kothari Research methodology.
2	Robert A. Day (1998), How to Write & Publish a Scientific Paper. Oryx Press; 5 editions
3	Research Methods for the Biosciences. Holmes, Moody & Dine. Oxford University Press.
Web resources	
1	https://www.drnishikantjha.com/papersCollection/Research%20Methodology%20.pdf
2	https://ijoeear.com/what-is-research-methodology-types-importance-and-examples
3	http://ndl.ethernet.edu.et/bitstream/123456789/79439/5/Research%20Methodology%20-%20Methods%20and%20Techniques%202004.pdf

Mapping Programme Outcomes and Programme Specific Outcomes with Course Outcomes

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

High – 3 Moderate – 1 Low – 1

EC-9 Biotechnology in Forensic science

Course Code	Course name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBTE54	Biotechnology in Forensic science	EC-9	4	1	0	0	4	5	25	75	100
Learning Objectives											
LO1	To provide insight into forensic biotechnology and its applications.										
LO2	To understand various investigation protocols used in forensic analysis.										
LO3	To gain knowledge about blood-related forensic investigations.										
LO4	To study molecular approaches used in forensic investigations.										
LO5	To understand the principles and applications of DNA fingerprinting.										
Unit	Contents										No.of Hours
I	Definition and scope of Forensic Biotechnology; History and development; Forensic genetics and forensic agriculture; Introduction to forensic science disciplines; Digital forensics – types of cybercrimes and basic investigation concepts										15
II	Crime scene investigation: Principles and procedures; Collection, preservation, packing and forwarding of physical and trace evidence; Chain of custody; Questioned documents – handwriting, signature analysis and forgery detection; Agencies involved in crime detection (India)										15
III	Forensic biology: Forensic botany (palynology, limnology); Forensic entomology and estimation of post mortem interval (PMI); Forensic serology – blood grouping, identification of blood stains, analysis of body fluids (semen, saliva, blood); Case studies										15
IV	Molecular and analytical techniques in forensics: PCR, Real-time PCR (intro); RFLP, AFLP; STR/VNTR analysis; Microscopy (electron, fluorescence); Chromatography (paper, TLC, HPLC); Basic introduction to electrophoresis										15
V	DNA profiling and applications: Principles and methods; Isolation of DNA from biological samples; DNA fingerprinting in paternity and forensic cases; Forensic databases (CODIS concept); Ethical and legal issues in forensic DNA analysis										15
	Total										75

Course Outcomes	
CO1	Understand the definition, scope, history, and development of forensic biotechnology.
CO2	Demonstrate knowledge of crime scene investigation procedures.
CO3	Apply forensic serology principles for blood grouping and typing.
CO4	Interpret forensic evidence using molecular and analytical techniques.
CO5	Evaluate the application of DNA-based techniques in legal investigations.
Textbooks	
1	Nageshkumar G Rao, Textbook of Forensic Medicine & Toxicology, Jaypee, 2013.
2	K.S. Narayan reddy and O.P. Murty, The Essentials of Forensic Medicine & Toxicology, 35th Edition, Jaypee, 2017.
3	Nanda, B.B. and Tiwari R. K. (2014). Forensic Science in India: A Vision for the Twenty First Century, (2 nd edition), Select Publishers, New Delhi, ISBN: 9788190113526.
4	Barbara H. Stuart (2013). Forensic Analytical Techniques (Analytical Techniques in the Sciences (AnTs), (1 st edition), UK, Wiley, ISBN: 978-0-470-68727-7.
5	C. Champod, C. Lennard, C. Margot, P. and Stoilovic (2015). Fingerprints and other Ridge Skin Impressions, (7 th edition), Boca Raton, CRC Press, ISBN: 9781498728959.
Reference Books	
1	Jim Fraser, " Forensic Science: A very short introduction", Oxford university press, 2010.
2	William Goodwin, Adrian Linacre, SibteHadi, "An introduction to Forensic Genetics", John Wiley & Sons Ltd 2007.
3	Harralson H. and Miller S. (2017). <i>Huber and Headrick's Handwriting Identification: Facts and Fundamentals</i> , (2nd Edition), Boca Raton, CRC Press, ISBN: 9781498751308.
4	Ghosal S. and Avasthi A.S. (2018). <i>Fundamentals of Bioanalytical Techniques and Instrumentation</i> , (2nd Edition), Delhi, PHI, ISBN: 9789387472396.
Web Resources	
1	http://www.forensicsciencesimplified.org
2	www.nfstc.org

Mapping Programme Outcomes and Programme Specific Outcomes with Course Outcomes

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

3 – Strong, 2- Medium, 1- Low

EC 9 - Bioentreprenurship

Course Code	Course name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBTE55	Bioentrepreneurship	EC – 9	4	1	-	-	4	5	25	75	100
Learning Objectives											
LO1	To identify the challenges of being a Bioentrepreneur										
LO2	To prepare business proposal for starting a company										
LO3	To understand Vermicomposting and Sericulture										
LO4	To setup mushroom cultivation										
LO5	To explore Spirulina and SCP cultivation										
UNIT	Contents										No. of Hours
I	Basics of bioentrepreneurship; Scope and importance; Types of bio-industries (biopharma, industrial biotech, agri biotech, diagnostics); Innovation opportunities and market trends; Startup ecosystem in India; Public and private funding agencies (MSME, DBT, BIRAC, Start-up India, Make in India); Introduction to biotech product development pipeline										15
II	Business plan preparation; Feasibility analysis (SWOT); Market analysis and business models; Preparation of business plan for a biotech startup; Statutory and legal requirements (company registration, licensing); Introduction to IPR, regulatory approvals (CDSCO/FDA basics)										15
III	Bio-based enterprise case studies (Agri-biotech): Vermicomposting and vermiculture; Sericulture – mulberry cultivation, silkworm rearing; Economic aspects and commercialization; Business model and cost–benefit analysis (instead of repeated budget plans)										15
IV	Food & allied biotech enterprises: Mushroom cultivation – production, diseases, nutritional importance; Aquaponics – system design, nutrient cycling, advantages and limitations; Commercial scalability and market potential										15
V	Industrial & microbial biotech enterprises: Single Cell Protein (SCP) – sources and production; Spirulina cultivation – process and applications; Emerging areas: probiotics, biofertilizers, bioplastics, AI in biotech startups (intro); Business planning and commercialization strategies										15
	Total										75

COURSE OUTCOME	
Students will be able to	
CO1	Identify the challenges and opportunities in bioentrepreneurship.
CO2	Prepare business proposals for establishing biotechnology-based companies.
CO3	Understand the principles and applications of vermicomposting and sericulture.
CO4	Develop skills in mushroom cultivation techniques.
CO5	Explore the cultivation and applications of Spirulina and Single Cell Protein (SCP).
Text Books	
1	Shimasaki, C. D. (2014). Biotechnology entrepreneurship: Starting, managing, and leading biotech companies. Amsterdam: Elsevier. Academic Press is an imprint of Elsevier
2	Onetti, A., & Zucchella, A. (n.d.). Business modeling for life science and biotech companies: Creating value and competitive advantage with the milestone bridge. Routledge
3	The Earthworm book, Ismail, S.A., other India Press, Goa
4	An Introduction to sericulture by G.Ganga, J.Sulochana Chetty
5	Silk: Processing, Properties and Applications Book by K. Murugesh Babu
Reference Books	
1	Adams, D. J., & Sparrow, J. C. Enterprise for life scientists: Developing innovation and entrepreneurship in the biosciences. Bloxham: Scion.
2	Jordan, J. F. (2014). Innovation, Commercialization, and Start-Ups in Life Sciences. London: CRC Press.
3	Desai, V. The Dynamics of Entrepreneurial Development and Management. New Delhi: Himalaya Pub. House.
4	The Essential Guide to Cultivating Mushrooms: Simple and Advanced Techniques for Growing Shiitake, Oyster, Lion's Mane, and Maitake Mushrooms at Home by Stephen Russell
5	Neutraceutical spirulina: Commercial cultivation using rural technology in india by Pushpa Srivastava
Web Resource	
1	https://biotech.co.in/sites/default/files/2020-01/BioentrepreneurshipDevelopment.pdf
2	https://archive.india.gov.in/citizen/agriculture
3	http://www.recirculatingfarms.org/resources/
4	https://academy.vertical-farming.net/intro-to-mushroom-growing/

Mapping Programme Outcomes and Programme Specific Outcomes with Course Outcomes

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

3-Strong, 2-Medium, 1-Low

AEC-4 Gender Equality and Social Inclusion

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UAEC51	GENDER EQUALITY AND SOCIAL INCLUSION	AEC	2	-	-	-	2	2	25	75	100
Learning Objectives											
LO1	To understand the introduction to Gender and Social Inclusion										
LO2	To acquire knowledge on Gender inequality in society										
LO3	To equip Social Exclusion and Marginalized Group										
LO4	To understand Legal Frameworks and Policies										
LO5	To assimilate knowledge about Strategies for Promoting Equality and Inclusion										
Unit	Content										Hours
1	Introduction to Gender and Social Inclusion: Concepts Gender-Gender roles, stereotypes, and socialization Meaning and importance of social inclusion- Intersectionality (gender, caste, class, disability, etc.) - Historical perspectives on gender inequality.										6
2	Gender Inequality in Society: Forms of gender discrimination (education, health, employment) - Gender-based violence and its types - Wage gap and economic inequality - Representation of gender in media and culture - Case studies on gender inequality (local and global).										6
3	Social Exclusion and Marginalized Groups: Understanding social exclusion - Marginalized communities (women, LGBTQ+ individuals, persons with disabilities, minorities) - Barriers to inclusion (social, economic, political) - Role of culture, tradition, and norms in exclusion - Impact of exclusion on development.										6
4	Legal Frameworks and Policies: National and international laws promoting gender equality - Human rights perspective on inclusion - Government policies and welfare programs - Role of institutions (NGOs, UN, civil society).										6
5	Strategies for Promoting Equality and Inclusion: Gender mainstreaming and inclusive development - Education and awareness programs - Role of media and technology - Empowerment approaches (economic, social, political) - Community participation and leadership - Measuring progress (indicators like SDGs)										6
Total										30	

CO	Course Outcomes
CO1	Understand the introduction to Gender and Social Inclusion
CO2	Acquire knowledge on Gender inequality in society
CO3	Equip the knowledge on Social Exclusion and Marginalized Group
CO4	Understand Legal Frameworks and Policies towards gender Equality
CO5	Gain knowledge about Strategies for Promoting Equality and Inclusion
Textbooks:	
1	Development as Freedom, Amartya Sen, Publisher: Oxford University Press (1999).
Reference Books:	
1	Gender Trouble: Feminism and the Subversion of Identity, 2 nd Edition (1999 revised edition) Publisher: Routledge, London & New York.
2	David E. Newton, Gender Inequality: A Reference Handbook, Bloomsbury Academic, 2019.
3	Gender Inequality: A Reference Handbook, by David E. Newton ABC-CLIO, 2019.
Web resources:	
1	GESI-Traning-Module.pdf
2	Gender Equality_and_Social_Inclusion WV.pdf
3	integrity-action-gesi-strategy-version-2.pdf
4	Major Marginalized Groups: A Closer Look - Urban Studies
5	UNOPS GESI Mainstreaming in Projects Strategy (Final)

Mapping Programme Outcomes and Programme Specific Outcomes with Course outcome

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

3–Strong,2-Medium,1-Low

IKS Introduction to Indian Science and Technology

Subject Code	CourseName	L	T	P	S	Credits	Instructional Hours	Marks		
								CIA	External	Total
24UBTIK51	IKS-Introduction to Indian Science and Technology	2	0	0	0	0	2	25	75	100

Learning Objective		
LO1	To understand Indian science philosophy: unity of science–spirituality, knowledge types, and epistemology.	
LO2	To Understand key contributions of Indian astronomy, metallurgy, and medicine.	
LO3	To Understand traditional Indian practices in agriculture, water management, and textile science.	
LO4	To knowledge transmission, daily-life science, colonial impact, and NEP2020 revival.	
LO5	To Understand integration of Ayurveda, Vastu Shastra, and Jyotisha with modern fields, and related digitization, standardization, and global challenges.	
UNIT	Contents	No. of Hours
I	Philosophical Foundations of Indian Science-Unity of science and spirituality - Śāstra, Kalā, Vidyā: categories of knowledge - Epistemology: Pratyakṣa (perception), Anumāna (inference), Śabda (testimony).	6
II	Astronomy: Jyotiṣa, planetary motion, eclipse theory, Āryabhaṭa, Varāhamihira Metallurgy: Iron pillar, zinc distillation, wootz steel. Medicine: Āyurveda (Caraka, Suśruta), health systems, surgery.	6
III	Agriculture and irrigation :canal systems, crop rotation, organic methods Water management: step wells, tanks, dams. Textile science: dyeing, spinning, weaving, cotton technology	6
IV	Role of guilds, hereditary knowledge, community transmission-Science in rituals, festivals, and daily life-Colonial disruption and documentation - NEP2020 and revival of traditional knowledge systems.	6
V	Integrative models :Ayurveda+modern medicine, Vāstu+ architecture, Jyotiṣa+data science-Challenges and possibilities in digitization, standardization, and global relevance.	6

Course Outcome	
CO1	Understand Indian scientific philosophy, its knowledge systems, and core epistemological methods.
CO2	Understand key contributions of Indian science in astronomy, metallurgy, and medicine.
CO3	Understand traditional Indian practices in agriculture, irrigation, water management, and textile science.
CO4	Understand knowledge transmission, daily-life science, colonial impacts, and revival of traditional systems under NEP 2020.
CO4	Understand integration of Ayurveda, Vāstu, and Jyotiṣa with modern fields and related challenges.
Text Books	
1	Dharampal. Indian Science and Technology in the Eighteenth Century.
2	Rajaram, N.S., and Frawley, D. Vedic Aryans and the Origins of Civilization.
3	Balasubramanian, R. (Ed.). History of Science, Philosophy and Culture in Indian Civilization (PHISPC Series).
4	Kak, S. The Astronomical Code of the Ṛgveda.
5	Pingree, D. The Logic of Science in Indian Mathematics and Astronomy.
Reference Books	
1	Salomon, R. Indian Epigraphy and Scientific Inscriptions.
2	Sharma, R.S. Irrigation and State in Ancient India.
Web Resources	
1	https://philosophy.institute/epistemology/pramanas-indian-philosophy-foundations/?utm_
2	Pramanas: The Foundations of Knowledge in Indian Philosophy • Philosophy Institute

MAPPING WITH PROGRAMME OUTCOME AND PROGRAMME SPECIFIC OUTCOME

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	1	1	2	1	3	3	3	3
CO2	3	3	3	2	1	3	1	3	3	3	3
CO3	3	3	3	3	2	2	1	3	3	3	3
CO4	3	3	2	1	3	2	1	3	3	3	2
CO5	3	3	3	2	3	3	1	3	3	3	3
TOTAL	15	15	14	9	10	12	5	15	15	15	14
AVERAGE	3	3	2.8	1.8	2	2.4	1	3	3	3	2.8

3–Strong, 2–Medium, 1–Low

3rd YEAR SIXTH SEMESTER

CC-13-ENZYMOLGY

Course Code	Course name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBTC61	Enzymology	CC-13	5	1	0	0	5	6	25	75	100
Learning Objectives											
LO1	To understand enzyme classification, properties, and factors affecting enzyme activity.										
LO2	To study enzyme structure, active site, specificity, and basic enzyme concepts.										
LO3	To understand enzyme kinetics, inhibition, and allosteric regulation.										
LO4	To gain knowledge on enzyme isolation, purification, and localization.										
LO5	To understand enzyme immobilization, enzyme engineering, and applications.										
Unit	Contents										No. of Hours
I	Nomenclature and classification of enzymes according to IUBMB; Properties of enzymes; Factors affecting enzyme activity (pH, temperature, substrate concentration, enzyme concentration, activators and inhibitors); Definitions – Apoenzyme, holoenzyme, zymogens; Coenzymes (vitamin-derived and non-vitamin); Transition state theory; Free energy and activation energy in enzyme-catalyzed reactions										18
II	Active site – definition and characteristics; Enzyme specificity; Bisubstrate and multisubstrate reactions; ES complex formation; Lock-and-key and induced fit models; Enzyme units (IU and katal); Turnover number; Isoenzymes (LDH, CPK); Ribozymes and abzymes										18
III	Enzyme kinetics: Michaelis–Menten equation (derivation), Km and Vmax significance; Lineweaver–Burk, Eadie–Hofstee, Hanes–Wolf plots; Enzyme inhibition – competitive, non-competitive, uncompetitive (no derivations); Allosteric enzymes – sequential and concerted models; Feedback inhibition										18
IV	Enzyme isolation and purification: Extraction methods (chemical and physical – homogenization, ultrasonication, French press); Nature of extraction medium; Subcellular fractionation and differential centrifugation; Enzyme purification techniques – dialysis, chromatography, electrophoresis; Intracellular localization and marker enzymes; Introduction to enzyme immobilization and applications										18
V	Enzyme immobilization – principles; Physical and chemical methods; Advantages and limitations; Enzyme engineering and designer enzymes (basic concepts); Applications of										18

	enzymes in pharmaceutical, clinical diagnostics and industrial processes (including immobilized enzymes)	
	Total	90

Course Outcomes

The student will be able to

CO1	Understand enzyme classification, properties, and factors affecting enzyme activity.
CO2	Gain knowledge of enzyme structure, active site, specificity, and basic concepts.
CO3	Understand enzyme kinetics, inhibition, and allosteric regulation.
CO4	Develop knowledge on enzyme isolation, purification, and localization techniques.
CO5	Understand enzyme immobilization, enzyme engineering, and their applications.

Reference Books

1	Ralph A. Messing (2012) Immobilised Enzymes Academic Press, NY.
2	Jeremy M Berg, Stryer, L. 2015. Biochemistry, 8th edition. Macmillan Learning.
3	Enzyme – Palmer, 18th edition, 2004.London: Portland Press

Textbooks

1	Satyanarayana. U. 2013. Biochemistry.4th edition, Elsevier India.
2	Voet, D. and Voet, J.G. 2016. Biochemistry, 5th edition. John Wiley and Sons, Inc.,
3	Jain J L, 2014, Fundamentals of Biochemistry, 7th edition, S.Chand publishing.

Web resources

1	https://www.youtube.com/watch?v=AD3-v1oKjSk
2	https://www.youtube.com/watch?v=tPCOEUo6J8s
3	https://www.youtube.com/watch?v=ALwziZSRiqM

Mapping Programme Outcomes and Programme Specific Outcomes with Course Outcomes

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

High – 3 Moderate – 2 Low – 1

CC – 14 PRACTICAL VII – ENZYMOLOGY PRACTICAL

Course Code	Course name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBTC62P	Enzymology Practical	CC-14	0	0	4	0	2	4	25	75	100

Learning Objective

LO1	To study enzyme assay techniques using salivary amylase and alkaline phosphatase.
LO2	To study the assay methods of acid phosphatase and urease from plant sources.
LO3	To study the effect of substrate concentration and pH on enzyme activity.
LO4	To study the estimation of SGPT and SGOT levels in serum.
LO5	To study the effect of temperature on enzyme activity and understand enzyme immobilization

UNIT	Contents	No. of Hours
I	Enzyme assay – Salivary amylase using starch; Assay of alkaline phosphatase activity	12
II	Assay of acid phosphatase (plant source); Assay of urease (horse gram)	12
III	Effect of substrate concentration on enzyme activity and determination of Km; Effect of pH on enzyme activity (optimum pH)	12
IV	Clinical enzymology: Estimation of SGPT and SGOT in serum.	12
V	Effect of temperature on enzyme activity and determination of activation energy; Introduction to enzyme immobilization.	12
Total		60

Course Outcomes

CO1	Gain practical knowledge in performing enzyme assay techniques.
CO2	Understand the assay and activity of enzymes from different biological sources.
CO3	Analyze the effects of substrate concentration and pH on enzyme activity.
CO4	Develop skills in clinical enzymology through SGPT and SGOT estimation.
CO5	Understand the influence of temperature on enzymes and the principles of enzyme immobilization.

Text Books	
1	Plummer, D.T. (1979) An Introduction to Practical Biochemistry, Tata MC Graw Hill Book Co., Bombay.
2	Oser B.L.(1961) Hawk's Physiological Chemistry, Tata MC Graw Hill Book Co. Bombay.
Reference Books	
1	Burtis, C.A & Ashwood, E.R (Eds)(V Edn) Tietz Fundamentals of clinical Biochemistry . WBSaunders & Co. New York.
Web Resources	
1	Protocols - Creative Enzymes
2	https://studylib.net/doc/26071841/enzymepurification
3	Tissue Homogenization and Assay Protocols PDF Enzyme Assay Buffer Solution

Mapping Programme Outcomes and Programme Specific Outcomes with Course Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	2	2	3	3	3	3
CO2	3	2	3	2	2	2	2	3	3	3	3
CO3	3	2	3	2	2	2	2	3	3	3	3
CO4	3	2	3	1	2	2	2	3	3	3	3
CO5	3	2	3	1	2	2	2	3	3	3	3
TOTAL	15	10	15	8	10	10	10	15	15	15	15
Average	3	2	3	1.6	2	2	2	3	3	3	3

3 – Strong, 2- Medium, 1- Low

EC – 10 - Marine Biotechnology

Course Code	Course name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBTE61	Marine Biotechnology	EC-10	4	1	0	0	4	5	25	75	100

Learning Objective

LO1	To provide knowledge about marine ecosystems and marine resources.
LO2	To study bioactive compounds obtained from marine sources.
LO3	To understand the medicinal importance of seaweeds.
LO4	To gain knowledge of seaweed culture and aquaculture techniques.
LO5	To study marine biotechnology products and their applications.

UNIT	Contents	No. of Hours
1	Marine ecosystems and their functioning; Ocean currents; Physical and chemical properties of seawater; Ecological divisions – Euphotic, Mesopelagic, Bathopelagic, Benthic, Intertidal; Estuarine systems, salt marshes, mangroves, coral reefs; Impact of climate change on marine ecosystems	15
II	Marine bioprospecting: Screening of secondary metabolites from marine microorganisms (bacteria, fungi, actinomycetes, microalgae); Biofilms, biofouling and antifouling strategies; Anticorrosion; Probiotic bacteria and their role in aquaculture	15
III	Marine natural products and applications: Bioactive compounds from marine flora (seaweeds, seagrass, mangroves) and fauna (sponges, ascidians, corals); Marine toxins; Antiviral, antimicrobial and anticancer agents; Introduction to marine drug discovery	15
IV	Marine biotechnology in aquaculture: Seaweed cultivation (<i>Kappaphycus alvarezii</i>); Fish genetic improvement – hybridization, gynogenesis, androgenesis, polyploidy; Artificial insemination; Eyestalk ablation; Transgenesis and cryopreservation; Basics of sustainable aquaculture practices	15
V	Marine bioproducts: Agar, agarose, alginate, carrageenan, chitin, chitosan; Heparin; Omega-3 fatty acids; Astaxanthin; Industrial and pharmaceutical applications of marine products	15
Total		75

Course Outcome The students will able to	
CO1	Understand marine ecosystems and their resources.
CO2	Gain knowledge of marine bioactive compounds and their significance.
CO3	Understand the medicinal value of seaweeds.
CO4	Develop knowledge of seaweed culture and aquaculture techniques.
CO5	Understand marine biotechnology products and their applications.

Text Book	
1	Italy, E (Eds). 1998, New Developments in Marine Biotechnology, Plenum Pub. Corp.
2	Milton Fingerman and Rachakonda Nagabhushanam, 1996, Molecular Genetics of Marine Organisms, Science Pub Inc.
3	Y. Le Gal and H.O.Halvorsen 1998, New Developments in Marine Biotechnology. Springer.
4	David H. Attaway, 2001. Marine Biotechnology, Volume 1, Pharmaceutical and Bioactive Natural Products.
5	Rita R. Colwell 1984. Biotechnology in the Marine Sciences (Advances in Marine Science & Biotechnology) Wiley Interscience

Reference Books	
1	Scheupr, P.J. (Ed.), 1984. Chemistry of Marine Natural Products, ,Chemical and Biological Perspectives. Vol. I III, Academic Press, New York
2	Marine Biology- Lalli C.M. and T.R. Parsons., 1997. Biological Oceanography - An Introduction, Elsevier, 314 pp
3	Marine Pollution- Clark, R. B. 2001. Marine pollution, Fifth edition. Oxford University press, New York Inc., 231pp
4	Gloria Sanchez, Elizabeth Hernandez,(2019), <i>Environmental Biotechnology and cleaner Bioprocess</i> , (1 st edition), CRC Press, ISBN 9780367455552
5	Kirchman, D.L.Gasol, J.M. (2018), Microbial ecology of the oceans, (3 rd edition), Wiley – Blackwell.

Web Resources	
1	http://coe.genomics.org.cn/
2	http://www.bcb.iastate.edu/
3	http://www.nwfsc.noaa.gov/protocols/bioinformatics.html
4	http://www.ebi.ac.uk/ ExPASy.org/
5	http://www.expasy.org/

Mapping Programme Outcomes and Programme Specific Outcomes with Course Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	1	2	3	3	3	3	3	3
CO2	3	3	3	1	2	3	3	3	3	3	3
CO3	3	3	2	1	2	3	2	3	3	3	3
CO4	3	3	2	1	2	3	2	3	3	3	3
CO5	3	3	3	1	2	3	3	3	3	3	3
TOTAL	15	15	13	5	10	15	13	15	15	15	15
Average	3	3	2.6	1	2	3	2.6	3	3	3	3

3 – Strong, 2- Medium, 1- Low

EC-10-Food Technology

Course Code	Course name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBTE62	Food Technology	EC-10	4	1	-	-	4	5	25	75	100

Learning Objectives

LO1	To understand the basic concepts of the food industry.
LO2	To study the classification of food products.
LO3	To gain knowledge about fruits, vegetables, and horticulture.
LO4	To understand Animal food products and their importance.
LO5	To study food adulteration and the use of biosensors for detection.

Unit	Contents	No. of Hours
I	Introduction to food biotechnology: Role of biotechnology and bioprocess engineering in food industry; Historical evolution of food processing; Genetically modified foods – concept, applications and concerns; Regulatory and social aspects; Biotechnology in food waste treatment and valorization	15
II	Cereals and millets – structure, composition and processing (wheat: types; rice: parboiling); Pulses – structure, anti-nutritional factors and processing (soaking, cooking, fermentation); Food chemistry basics – starch gelatinization, Maillard reaction, caramelization; Fats and oils – refining processes (steam, alkali, bleaching, deodorization, hydrogenation)	15
III	Fruits and vegetables – classification, general composition, pigments, enzymatic browning; Dietary fibre; Post-harvest physiology – climacteric changes, maturity indices, storage changes (physical, chemical, pathological)	15
IV	Animal foods: Meat – composition and post-mortem changes (rigor mortis, ageing); Fish – composition, freshness and spoilage; Egg – composition and quality; Milk and milk products – composition and processing (pasteurization, homogenization); Introduction to fermented foods and probiotics	15
V	Food safety and quality control: Food adulterants and detection methods; Metal and processing contaminants; Food additives and regulations (FSSAI); Food fortification and enrichment; Biosensors in food analysis; Rapid detection techniques and introduction to smart/AI-based food quality monitoring	15
	Total	75

Course Outcomes	
The student will be able to	
CO1	Understand biotechnology applications in the food industry.
CO2	Analyze processing and quality of cereals, pulses, fats, and oils.
CO3	Evaluate composition and post-harvest changes of fruits and vegetables.
CO4	Understand processing and spoilage of animal-based foods.
CO5	Identify food safety issues including adulterants, additives, and biosensors.
Textbooks	
1	Bawa. A.S, O.P Chauhan et al. Food Science. New India Publishing agency, 2013
2	B. Srilakshmi, Food science, New Age Publishers,2002
Reference Books	
1	Roday,S. Food Science, Oxford publication, 2011
2	Foster, G.N., (2020), Food Biotechnology, (First edition), CBS Publishers & Distributors Pvt Ltd, ISBN 9789389396348.
Web resources	
1	https://ifst.onlinelibrary.wiley.com/journal/13652621
2	https://app.knovel.com/web/browse-a-subject-area.v/catid:216/cat_slug:food-science/subcatid:27

Mapping Programme Outcomes and Programme Specific Outcomes with Course Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	P07	P08	PSO1	PSO2	PSO3
CO1	3	2	1	3	2	3	1	3	3	3	3
CO2	3	2	1	3	2	3	1	2	3	3	3
CO3	3	2	1	3	2	3	1	3	3	3	3
CO4	3	2	1	3	2	3	1	3	3	3	3
CO5	3	2	1	3	2	3	1	3	3	3	3
TOTAL	15	10	5	15	10	15	5	14	15	15	15
Average	3	2	1	3	2	3	1	2.8	3	3	3

3 – Strong, 2- Medium, 1- Low

EC- 11 VERMICOMPOST

Course Code	Course name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBTE63	Vermicompost	EC-11	4	1	0	0	4	5	25	75	100
Learning Objectives											
LO1	To understand the types, biology, and role of earthworms in soil fertility.										
LO2	To study culturing techniques and factors affecting vermicomposting.										
LO3	To apply small-scale vermicomposting methods and utilization of vermicompost.										
LO4	To understand large-scale vermicomposting for waste management.										
LO5	To study vermiwash production and its economic importance										
Unit	Contents										No. of Hours
I	Types, Collection and Preservation of earthworms – Types and basic characteristics of species suitable for vermicomposting; Role of earthworms in soil fertility; Biology of Lampito mauritii; Collection and Preservation of Earthworms; Flow sheet for vermitechnology; basic concept of soil microbiome and role of earthworms in nutrient cycling.										15
II	Culturing techniques of earthworms and composting materials – General method; Pot method; Wooden box method; Propagation; Factors affecting culturing of earthworms; Vermicomposting materials; Preliminary treatment of composting materials; basic compost quality parameters (pH, moisture, temperature – introductory level).										15
III	Small scale techniques of Vermicomposting – Indoor dual bin method; Bed method; Pit method; Heap method; Expandable worm tower assembly method; Hanging basket method; Physical, chemical and biological properties of vermicompost; simple nutrient analysis and field application of vermicompost.										15
IV	Large scale techniques of Vermicomposting – Outdoor dual bin; Raised cage; Dual pit; Commercial model; Trickling filter vermicomposting; Keep it simple and save plan; overview of sustainable waste management practices and environmental impact.										15
V	Vermiwash and Economics – Chemical composition of vermiwash; Techniques of vermiwash production; Advantages of Vermicomposting; Prospects of vermiculture as a self-employment venture; applications of vermiwash in sustainable agriculture and basic economic significance.										15
										Total	75

Course Outcomes	
CO1	Understand the types, biology, and contribution of earthworms to soil fertility.
CO2	Describe techniques and factors affecting vermicomposting.
CO3	Apply small-scale vermicomposting methods and evaluate compost quality.
CO4	Understand large-scale vermicomposting and its role in waste management.
CO5	Understand vermiwash production and assess its economic significance in vermiculture
Textbooks	
1	The Earthworm book, Ismail, S.A., other India Press, Goa
2	Somani, L.L. 2008. Vermicomposting and vermiwash. Agrotech Publishing Academy, Udaipur.
3	Talashilkar and Dosani, 2005. Earthworm in Agriculture. Agrobios (India), Jodhpur.
4	Ranganathan, L.S. 2006. Vermibiotechnology from soil health to human health – Agrobios, India.
5	Vermitechnology – M. Seetha Lekshmy & R. Santhi
Reference Books	
1	Earthworms and Vermicomposting – S.S. Walia & T. Kaur
2	Vermiculture Technology – Clive A. Edwards et al.
3	Worms Eat My Garbage – Mary Appelhof
Web Resources	
1	https://teca.apps.fao.org/en/technologies/4301/
2	https://www.ijfmr.com/papers/2024/3/58384.pdf
3	https://www.vedantu.com/biology/vermiculture
4	https://agriwelfare.gov.in/Documents/Vermicompost%20Production%20Unit.pdf
5	https://justagriculture.in/files/magazine/dec/012%20VERMIWASH.pdf

Mapping Programme Outcomes and Programme Specific Outcomes with Course Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	2	2	2	3	3	3
CO2	3	2	1	1	2	2	2	2	3	3	3
CO3	3	2	1	1	2	2	2	2	3	3	3
CO4	3	2	1	1	2	2	2	2	3	3	3
CO5	3	2	1	1	2	2	2	2	3	3	3
Total	15	10	5	5	10	10	10	10	15	15	15
Average	3	2	1	1	2	2	2	2	3	3	3

3 – Strong, 2- Medium, 1- Low

EC- 11 PHARMACEUTICAL BIOTECHNOLOGY

Course Code	Course name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBTE64	Pharmaceutical Biotechnology	EC-11	4	1	0	0	4	5	25	75	100
Learning Objectives											
LO1	To understand pharmaceutical biotechnology basics and drug development process.										
LO2	To study biopharmaceutical production, gene therapies, and drug delivery systems.										
LO3	To learn major biopharmaceutical products and their applications.										
LO4	To understand drug safety, toxicity testing, and pharmacovigilance.										
LO5	To study regulatory systems, GMP, and pharmaceutical industry trends.										
Unit	Contents								No. of Hours		
I	Introduction to Pharmaceutical Biotechnology: Objectives; Generic and biosimilar drugs; Drug development pipeline – discovery, design, preclinical and clinical trials (Phases I–IV); Patenting and drug approval process; Drug marketing and pharmacovigilance								15		
II	Production of biopharmaceuticals: Recombinant protein production systems; Nucleic acid-based therapies (gene therapy, RNA-based drugs – intro); Biopharmaceutical considerations; Drug formulation and delivery systems; Overview of regulatory guidelines (CDSCO, FDA)								15		
III	Major biopharmaceutical products: Insulin, growth hormone, erythropoietin, monoclonal antibodies, vaccines; Blood factors and cytokines; Applications in diseases (diabetes, cancer, anaemia, immune disorders); Concept of biosimilars								15		
IV	Drug safety and evaluation: Drug toxicity testing (acute, chronic); Adverse drug reactions and pharmacovigilance; Clinical data interpretation; Ethical issues in clinical trials								15		
V	Regulatory and industrial aspects: National and international regulatory agencies (CDSCO, FDA, EMA); Structure of pharmaceutical industry; GMP and quality control; Scope and career opportunities in pharmaceutical biotechnology; Introduction to emerging trends (biologics, personalized medicine)								15		
	Total								75		

Course Outcomes	
The students will be able	
CO1	Understand the basics of pharmaceutical biotechnology and the drug development process..
CO2	Gain knowledge of biopharmaceutical production, gene therapies, and drug delivery systems.
CO3	Understand major biopharmaceutical products and their applications.
CO4	Develop knowledge of drug safety, toxicity testing, and pharmacovigilance.
CO5	Understand regulatory systems, GMP, and pharmaceutical industry trends
Textbooks	
1	Chandrakant Kokate and Pramod H.J 1st Edition (2011), Text Book of Pharmaceutical Biotechnology, Elsevier
2	Crommelin, Dean J. A., Sindelar, Robert, Meobohm, Bernd (Eds.) (2019), Pharmaceutical Biotechnology: Fundamentals and Applications, Springer.
3	Ashish Dixit, Pawan Tiwari and Vivekanand Kishan Chatap (2015), Textbook of Pharmaceutical Biotechnology, Studium Press (India) Pvt. Ltd.
4	John F. Corpenner, Mark C. Manning (2012). Rational Design of stable formulation Theory and Practice, (1st edition), US: Springer Science, ISBN: 9781461351313
Reference Books	
1	Gary Walsh (2003), Biopharmaceuticals ; biochemistry and Biotechnology, John Wiley & Sons Ltd.
2	Oliver Kayser and Heribert Warzecha (2012), Pharmaceutical Biotechnology: Drug Discovery and Clinical Applications, Wiley - Blackwell.
3	Simon Wills, 2nd Edition (2005), Drugs of abuse, Pharmaceutical Press
4	Hiten J. Gutka, Harry Yang, Shefali Kakar (2018). Biosimilars: Regulatory, Clinical, and Biopharmaceutical Development, (1st ed), USA: Springer, ISBN: 978-3-319- 99679-0.
5	Yui-Wing F. L. and Stuart S. (2019). Pharmacogenomics: Challenges and Opportunities in Therapeutic Implementation, (2nd Ed), TX, USA: Academic Press, ISBN: 9780128126264.
Web Resources	
1	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5178364/
2	https://www.pharmamanufacturing.com/

Mapping Programme Outcomes and Programme Specific Outcomes with Course Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	1	1	2	2	1	1	3	3	1	1
CO2	3	1	2	2	2	2	2	3	3	2	3
CO3	3	1	2	2	2	3	2	3	3	3	3
CO4	3	1	2	2	2	3	1	3	3	3	3
CO5	3	2	1	2	2	1	1	3	3	2	2
Total	15	6	8	10	10	10	7	15	15	11	12
Average	3	1.2	1.6	2	2	2	1.4	3	3	2.2	2.4

3 – Strong, 2- Medium, 1-Low

Course Code	Course name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBTP61	Research Ethics	PEC-1	1	1	0	0	2	2	25	75	100

Learning Objectives	
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LO1	To understand the basic concepts of philosophy, ethics, and moral judgment.
LO2	To study scientific conduct, research integrity, and ethical issues in research.
LO3	To learn publication ethics, guidelines, and open-access publishing practices.
LO4	To identify publication misconduct, conflicts of interest, and unethical practices in research.
LO5	To understand research databases, metrics, and data management for reproducible research.

Unit	Contents	No. of Hours
I	Philosophy and Ethics: Introduction to philosophy – definition, nature and scope; Branches of philosophy; Ethics – definition, moral philosophy, nature of moral judgement; Introduction to research ethics and responsible conduct of research.	6
II	Scientific Conduct: Ethics in science and research; Intellectual honesty and research integrity; Scientific misconduct – falsification, fabrication and plagiarism (FFP); Redundant publications (duplicate, overlapping, salami slicing); Selective reporting and misrepresentation of data	6
III	Publication Ethics: Definition, importance and principles; Best practices and guidelines (COPE, WAME, ICMJE); Open access publishing and copyright issues	6
IV	Publication Misconduct and Ethics Issues: Conflicts of interest; Authorship and contributorship; Types of publication misconduct; Identification of unethical practices; Complaints and appeal mechanisms; Predatory journals and publishers	6
V	Databases and Research Metrics: Indexing and citation databases (Web of Science, Scopus, PubMed); Research metrics – Impact factor, SNIP, SJR, CiteScore; Author metrics – h-index, g-index, i10-index; Altmetrics; Introduction to research data management and reproducibility	6
	Total	30

Course Outcomes	
The student will be able to	
CO1	Understand the concepts of philosophy, ethics, and moral judgment.
CO2	Gain knowledge of scientific conduct, research integrity, and ethical issues in research.
CO3	Understand publication ethics, guidelines, and open-access publishing practices.
CO4	Identify publication misconduct, conflicts of interest, and unethical research practices.
CO5	Understand research databases, metrics, and data management for reproducible research.

Text Book

1	The book <i>Responsible Conduct of Research</i> by Adil E. Shamoo and David B. Resnik.Fourth Edition 2022.
2	National Academy of Science, National academy of Engineering and Institute of Medicine (2009) On Being a Scientist: A guide to Responsible Conduct in Research, National Academies Press.

Reference Books

1	Anderson B.H., Dursaton, and Poole M. (1997) Thesis and assignment writing, Wiley Eastern
2	Bordens K.S. and Abbott, B.b. (2008) Research Design and Methods, Mc Graw Hill

Web resources

1	(PDF) Research and Publication Ethics: A Textbook
2	Resethics-hb.pdf

Mapping Programme Outcomes and Programme Specific Outcomes with Course Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	2	2	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	2	3	3	2	3	3	3
CO4	3	3	3	2	3	2	3	3	3	3	2
CO5	3	3	3	3	3	3	2	3	3	2	3
TOTAL	15	15	15	14	14	14	13	13	15	14	14
AVERAGE	3	3	3	2.8	2.8	2.8	2.6	2.6	3	2.8	2.8

SLC-1- LIFE SPAN PSYCHOLOGY

Course Code	Course name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBTL61	Life Span Psychology	SLC	0	0	0	3	2	3	25	75	100
Learning Objectives											
LO1	To understand the basic concepts and principles of human development across the life span.										
LO2	To study physical, cognitive, emotional, and social development at different life stages.										
LO3	To learn major theories of development and their applications.										
LO4	To understand adult development, ageing, and related adjustment issues.										
LO5	To develop awareness of psychological and social changes across life span stages.										
Unit	Contents									No.of Hours	
I	Basic concepts of human development: Aspects and principles of development; Methods of study (experimental and non-experimental); Overview of life-span stages – prenatal, infancy, childhood, adolescence, adulthood and old age									09	
II	Physical and cognitive development: Growth and motor development; Physical health across life span; Cognitive development (Piaget's theory – basic concepts); Language development; Memory and intelligence; Introduction to moral development (Kohlberg)									09	
III	Personality and social development: Emotional development; Emergence of self; Role of family, parents, siblings and peers; Theoretical perspectives (Freud, Erikson, social learning); Adolescent issues – identity crisis, peer pressure, emotional and behavioural problems									09	
IV	Adult development: Career development and work life; Parenthood; Intimate relationships and lifestyle; Work-life balance; Stress and coping in adulthood									09	
V	Ageing and adjustment: Physical and psychological changes in old age; Memory and cognitive changes; Health and fitness; Retirement and adjustment; Personal relationships; Death, bereavement and meaning of life									09	
	Total									45	
Course Outcomes											
CO1	Understand the concepts and principles of human development across the life span.										
CO2	Gain knowledge of physical, cognitive, emotional, and social development.										
CO3	Apply developmental theories in understanding human behaviour.										
CO4	Understand adult development, work-life balance, and stress management.										

CO5	Develop awareness of ageing, adjustment, and end-of-life issues.
Textbooks	
1	Cicarelli, K. S., Meyer, E. G. & Misra, G. (2008). General psychology. New Delhi, India: Pearson India Education Services Pvt Ltd.
2	Baron, R. A. (2010). Psychology. New Delhi, India: Pearson India Education Services Pvt Ltd.
3	Mangal, S. K. (2019). <i>General psychology</i> (3rd ed.). PHI Learning Pvt. Ltd..
4	Atkinson, R. L., Atkinson, R. C., Smith, E. E., Bem, D. J., & Nolen-Hoeksema, S. (2012). <i>Atkinson & Hilgard's introduction to psychology</i> (16th ed.). Cengage Learning.
Reference Books	
1	Cicarelli, S. K., & White, J. N. (2021). <i>Psychology</i> (6th ed.). Pearson Education.
2	Morgan, C. T., King, R. A., Weisz, J. R., & Schopler, J. (2013). <i>Introduction to psychology</i> (7th ed.). McGraw-Hill Education..
3	Myers, D. G., & DeWall, C. N. (2020). <i>Psychology</i> (13th ed.). Worth Publishers.
4	Feldman, R. S. (2018). <i>Understanding psychology</i> (14th ed.). McGraw-Hill Education.
Web Resources	
1	https://online.maryville.edu/online-bachelors-degrees/human-development-and-family-studies/resources/stages-of-human-development/
2	https://pressbooks.online.ucf.edu/lumenpsychology/chapter/reading-childhood/
3	https://nobaproject.com/modules/social-and-personalitydevelopment-in-childhood
4	https://www.who.int/news-room/fact-sheets/detail/ageing-andhealth

Mapping Programme Outcomes and Programme Specific Outcomes with Course Outcomes

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

3 – Strong, 2- Medium, 1- Low