CAUVERY COLLEGE FOR WOMEN (AUTONOMOUS)

NATIONALLY ACCREDITED (III CYCLE) WITH "A" GRADE BY NAAC

TIRUCHIRAPPALLI – 620 018

DEPARTMENT OF BIOTECHNOLOGY

B.Sc., BIOTECHNOLOGY SYLLABUS

2023 – 2024 and Onwards

CAUVERY COLLEGE FOR WOMEN (AUTONOMOUS)

DEPARTMENT OF BIOTECHNOLOGY

VISION

- To educate a broad range of basic lab skills applicable to biology and biotechnology.
- Make the students know and understand broad range of basic biological concepts and can apply and analyse these in at least one specialty area.
- Make the students generate a hypothesis, design approaches to test them and interpret the data from those tests to reach valid conclusions.
- To develop the ability to place their own works in a broader scientific context.

MISSION

- To produce ambitious, creative graduates who are interested in continuing their education in biosciences.
- Make the students to read and critically evaluate the original scientific literature.
- To produce responsible biotechnology professionals to fulfill the employment and research needs in the biotechnology industry.
- Enhance the student's ability to integrate their acquired computer and biosciences knowledge and skills to investigate and solve the biological problems.
- To create opportunities for placement in leading industries through Internships.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEOs	Statements
PEO 1	**LEARNING ENVIRONMENT** To facilitate value-based holistic and comprehensive learning by integrating innovative learning practices to match the highest quality standards and train the students to be effective leaders in their chosen fields.
PEO 2	**ACADEMIC EXCELLENCE** To provide a conducive environment to unleash students hidden talents and to nurture the spirit of critical thinking and encourage them to achieve their goal.
PEO 3	**EMPLOYABILITY** To equip students with the required skills in order to adapt to the changing global scenario and gain access to versatile career opportunities in multidisciplinary domains.
PEO 4	**PROFESSIONAL ETHICS AND SOCIAL RESPONSIBILITY** To develop a sense of social responsibility by formulating ethics and equity to transform students into committed professionals with a strong attitude towards the development of the nation.
PEO 5	**GREEN SUSTAINABILITY** To understand the impact of professional solutions in societal and environmental contexts and demonstrate the knowledge for overall sustainable development.

PROGRAMME OUTCOMES FOR B.Sc., BIOTECHNOLOGY PROGRAMMES

PO NO	On completion of B.Sc., Biotechnology Programme, the students will be able to
PO 1	**Academic Excellence and Competence**: Elicit firm fundamental knowledge in theory as well as practical for coherent understanding of academic field to pursue multi and interdisciplinary science careers in the future.
PO 2	**Holistic and Social approach:** Create novel ideas related to the scientific research concepts through advanced technology and sensitivity towards sustainable environmental practices as well as social issues.
PO 3	**Professional ethics and Teamwork:** Explore professional responsibility through projects, internships, field trips/industrial visits and mentorship programmes to transmit communication skills.
PO 4	**Critical and Scientific thinking:** Equip training skills in Internships, Research Projects to do higher studies in multidisciplinary paths with a higher level of specialization to become professionals of high - quality standards.
PO 5	**Social Responsibility with ethical values:** Ensure ethical, social and holistic values in the minds of learners and attain gender parity for building a healthy nation.

PROGRAMME SPECIFIC OUTCOMES FOR B.Sc., BIOTECHNOLOGY

PSO NO	The students of B.Sc., Biotechnology will be able to	POs Addressed
PSO 1	Acquire knowledge of biological sciences with the implementation of technology on different living systems like plants, animals and microbes.	**PO1** **PO 2**
PSO 2	Explain the fundamental concepts and develop skills in Immunology, Developmental biology, Nanobiotechnology, Genomics, Proteomics, Bioinformatics, Agriculture and Medicine	**PO 1** **PO 2**
PSO 3	Apply the technical aspects related to the improvement of microbes, plants and live-stocks for the welfare of human and environment.	**PO 2** **PO 4**
PSO 4	Impart hands-on techniques in various thrust areas of biotechnology to meet the emerging demands in industry, academia and research.	**PO 2** **PO 4**
PSO 5	Gaining knowledge to transform theoretical concepts to practical products/process to move ahead in entrepreneurship and apply the laws concerning to IPR and bioethics	**PO 2** **PO 3** **PO 5**

Cauvery College for Women (Autonomous), Trichy -18

Department of Biotechnology

B.Sc., Biotechnology

Learning Outcome Based Curriculum Framework (CBCS - LOCF)

(For the Candidates admitted from the Academic year 2023-2024 and onwards)

Semester	Part	Course	Course Title	Course Code	Inst. Hrs	Credits	Exam			Total
							Hrs.	Marks		
								Int	Ext	
I	I	Language Course-I (LC)	Podhu Tamil –I	23ULT1	6	3	3	25	75	100
			Hindi ka Samanya Gyan aur Nibandh	23ULH1						
			Poetry, Grammar and History of Sanskrit Literature	23ULS1						
			Foundation Course: Paper I - French I	23ULF1						
	II	English Language Course -I (ELC)	General English -I	23UE1	6	3	3	25	75	100
	III	Core Course – I (CC)	Cell and Molecular Biology	23UBT1CC1	5	5	3	25	75	100
		Core Practical - I (CP)	Cell and Molecular Biology (P)	23UBT1CC1P	3	3	3	40	60	100
		First Allied Course- I (AC)	BiologicalChemistry	23UBT1AC1	4	3	3	25	75	100
		First Allied Course- II (AP)	Biological Chemistry (P)	23UBT1AC2P	4	3	3	40	60	100
	IV	Ability Enhancement Compulsory Course-I (AECC)	Value Education	23UGVE	2	2	-	100	-	100
	Total				**30**	**22**				**700**
II	I	Language Course - II(LC)	Podhu Tamil -II	23ULT2	6	3	3	25	75	100
			Hindi Literature & Grammar – II	22ULH2						
			Prose, Grammar and History of Sanskrit literature	23ULS2						
			Basic French – II	22ULF2						
	II	English Language Course -II (ELC)	General English -II	23UE2	6	3	3	25	75	100
	III	Core Course – II (CC)	Genetics	23UBT2CC2	5	5	3	25	75	100
		Core Practical - II (CP)	Genetics (P)	23UBT2CC2P	3	3	3	40	60	100
		Core Course - III (CC)	Biomolecular Techniques	23UBT2CC3	2	2	3	25	75	100
		First Allied Course – III(AC)	General Microbiology	23UBT2AC3	4	3	3	25	75	100
	IV	Ability Enhancement Compulsory Course-II(AECC)	Environmental Studies	22UGEVS	2	2	-	100	-	100
		Ability Enhancement Compulsory Course-III(AECC)	Innovation and Entrepreneurship	22UGIE	2	1	-	100	-	100
	Extra Credit Course		SWAYAM	As per UGC Recommendation						
				Total	**30**	**22**				**800**

III	I	Language Course-III(LC)	Podhu Tamil – III	23ULT3	6	3	3	25	75	100
			Hindi Literature & Grammar – III	22ULH3						
			Drama, Grammar and History of Sanskrit Literature	23ULS3						
			Intermediate French-I	22ULF3						
	II	English Language Course-III (ELC)	Learning Grammar Through Literature-I	23UE3	6	3	3	25	75	100
	III	Core Course– IV(CC)	rDNA Technology	23UBT3CC4	5	5	3	25	75	100
		Core Practical - III(CP)	rDNATechnology(P)	22UBT3CC3P	3	3	3	40	60	100
		Second Allied Course-I (AC)	Bioinformatics	22UBT3AC4	4	3	3	25	75	100
		Second Allied Course-II(AP)	Bioinformatics (P)	22UBT3AC5P	4	3	3	40	60	100
	IV	Generic Elective Course- I(GEC)	Basics of Biotechnology	22UBT3GEC1	2	2	3	25	75	100
			Basic Tamil -I	22ULC3BT1						
			Special Tamil – I	22ULC3ST1						
		Extra Credit Course	SWAYAM	As per UGC Recommendation						
		Total			**30**	**22**				**700**

15 Days INTERNSHIP during Semester Holidays*

IV	I	Language Course – IV (LC)	Podhu Tamil – IV	23ULT4	6	3	3	25	75	100
			Hindi Literature & Functional Hindi	22ULH4						
			Alankara, Didactic and Modern Literatures and Translation	23ULS4						
			Intermediate French – II	22ULF4						
	II	English Language Course –IV (ELC)	Learning Grammar Through Literature – II	23UE4	6	3	3	25	75	100
	III	Core Course – V(CC)	Immunology	23UBT4CC5	6	5	3	25	75	100
		Core Practical - IV(CP)	Immunology (P)	22UBT4CC4P	4	4	3	40	60	100
		Second Allied Course - III(AC)	Basics of Forensic Biology	22UBT4AC6	4	3	3	25	75	100
		Internship*	Internship	22UBT4INT	-	2	-	-	-	100
	I V	Generic Elective Course-II(GEC)	Applied Biotechnology	22UBT4GEC2	2	2	3	25	75	100
			Basic Tamil – II	22ULC4BT2						
			Special Tamil – II	22ULC4ST2						
		Skill Enhancement Course –I (SEC)	Medical Lab Technology - I (P)	22UBT4SEC1P	2	2	3	40	60	100
		Extra Credit Course	SWAYAM	As per UGC Recommendation						
		Total			**30**	**24**				**800**

V	III	Core Course – VI(CC)	Plant Biotechnology	23UBT5CC6	6	5	3	25	75	100
		Core Practical – V(CP)	Plant & Animal Biotechnology(P)	22UBT5CC5P	3	3	3	40	60	100
		Core Course - VII(CC)	Animal Biotechnology	23UBT5CC7	6	5	3	25	75	100
		Core Course – VIII(CC)	Biostatistics	23UBT5CC8	6	5	3	25	75	100
		Discipline Specific Elective – I (DSE)	A. Cancer Biology	23UBT5DSE1A	5	3	3	25	75	100
			B. Human Anatomy and Physiology	23UBT5DSE1B						
			C. Pharmacognosy	23UBT5DSE1C						
	I V	Ability Enhancement Compulsory Course – IV (AECC)	UGC Jeevan Kaushal -Professional Skills	22UGPS	2	2	-	100	-	100
		Skill Enhancement Course –II (SEC)	Medical Lab Technology -II (P)	22UBT5SEC2P	2	2	3	40	60	100
		Extra Credit Course	SWAYAM	As per UGC Recommendation						
		Total			**30**	**25**				**700**
VI	III	Core Course – IX (CC)	Microbial & Environmental Biotechnology	23UBT6CC9	6	5	3	25	75	100
		Core Practical –VI (CP)	Microbial & Environmental Biotechnology(P)	22UBT6CC6P	3	3	3	40	60	100
		Core Course – X (CC)	IPR, Biosafety and Bioethics	23UBT6CC10	5	4	3	25	75	100
		Core Course – XI (CC)	Cyber Security	22UGCS	5	4	3	25	75	100
		Discipline Specific Elective – II (DSE)	A. Developmental Biology	23UBT6DSE2A	5	3	3	25	75	100
			B. Stem CellBiology	23UBT6DSE2B						
			C. Bioentrepreneurship	23UBT6DSE2C						
		Project	Project Work	22UBT6PW	5	4	-	-	100	100
	IV	Ability Enhancement Compulsory Course – V (AECC)	Gender Studies	22UGGS	1	1	-	100	-	100
	V	Extension activity		22UGEA	0	1	0	-	-	-
		Total			**30**	**25**				**700**
				Grand Total	**180**	**140**				**4400**

Semester – I	Internal Marks: 25			External Marks: 75
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HOURS/WEEK**	**CREDITS**
23UBT1CC1	**CELL AND MOLECULAR BIOLOGY**	**CORE**	**5**	**5**

Course Objectives

- To learn about the fundamentals of cell and its structure.
- To study the cellular organelles and membrane
- To understand the molecular structure and functions of DNA and RNA
- To evaluate the mechanism of transcription and translational process

Course Outcome and Cognitive Level Mapping

Upon successful completion of the course, the students will be able to

CO Number	CO Statement	Cognitive Level
CO1	Understand the basic knowledge about cell and to compare the structure of prokaryotic cell with eukaryotic cell	K1, K2
CO2	Illustrate the fundamentals about the structural and functional aspects of cell organelles and cell membrane	K2
CO3	Categorize the importance of cells to the intra and extracellular environment by discussing about the intracellular signaling pathways	K3
CO4	Analyze the structure and functions of nucleic acid and acquire knowledge about the molecular mechanism of DNA and RNA	K4
CO5	Analyze the molecular mechanism of transcription, translation and post translational modifications of proteins	K4

Mapping of CO with PO and PSOs

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	2	1	3	2	2	2	1
CO2	3	3	3	2	1	3	3	2	2	1
CO3	3	3	3	3	2	3	3	3	3	2
CO4	3	3	3	3	2	3	3	3	2	1
CO5	3	3	3	2	2	3	3	3	2	1

"1" – Slight (Low) Correlation, "2" – Moderate (Medium) Correlation,
"3" – Substantial (High) Correlation, "-" indicates there is no Correlation.

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	**Cell Structure:** Discovery and diversity of cells - Cell theory - Structure of prokaryotic (bacteria) and eukaryotic cells (plant and animal cells).	10	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
II	**Introduction to Cellular Organelles:** Biomacromolecules and Biomicromolecules (Primary functions in the cell). Structure and Functions of Cell Organelles: Cell wall - Cell membrane - Cytoplasm - Nucleus - Endoplasmic reticulum - Ribosomes - Golgi bodies - Plastids - Vacuoles - Lysosomes - Mitochondria - Flagella - Cilia - Centrosome and Centrioles - Cytoskeleton.	17	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
III	**Cell Division and Cell Signalling:** Cell cycle - Cell cycle check points - Cell division - Mitosis and Meiosis - Cellular differentiation - Cell junctions - Cell Adhesion - Extra Cellular Matrix - Cell to cell communications - Signal transduction - G - Protein Coupled Receptors Signal transduction pathways.	16	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
IV	**Structure and Functions of DNA and RNA:** Structure and functions of DNA- Types of RNA - Central Dogma of the cell: DNA - Replication in prokaryotes and eukaryotes - Enzymes and Proteins involved in Replication - Inhibitors of DNA Replication.	16	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
V	**Introduction to Transcription and Translation:** Transcription - Transcription in prokaryotes and eukaryotes - initiation, elongation, termination and Post Transcriptional Modifications. Translation in prokaryotes and eukaryotes - Similarities and differences in prokaryotic and eukaryotic translation - Post Translational Modifications - Protein Sorting - Protein degradation	16	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
VI	**Self-Study for Enrichment** **(Not Included for End Semester Examination)** Eukaryotic rRNA genes, formation of eukaryotic tRNA molecules.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4

Text books

1. Harvey, L., Arnold, B., Lawrence, Z., Paul, M., David, B., James, D. (2020). *Molecular Cell biology*. 5th Edition.W. H. Freeman Publishers.
2. Bruce, A. (2014). *Molecular Biology of the cell.* 6th Edition. W. W. Norton Publishing Company.
3. Devasena, T. (2012). *Cell Biology, Oxford University Press.*
4. Robert, W. (2012). *Molecular Biology.* 5th Edition. McGraw Hill.
5. James Watson, D. (2011). *The Double Helix: A personal account of the Discovery of the Structure of DNA*. Touchstone Publishers.

Reference books

1. Brown, T. A. (2021). *Gene Cloning and DNA Analysis: An Introduction.* 8th Edition. Wiley and Sons.
2. Cooper, G. (2018). *The Cell: A Molecular Approach,* 8th Edition. Oxford University Press.
3. Thomas Pollard, D., William Earnshaw, C., Jennifer Lippincott, S., Graham Johnson, T. (2017). *Cell Biology.* 3rd Edition. Elsevier publishers.
4. James Watson, D., Baker Tania, A., Bell Stephen, P., Alexander, G., Michael, L., Losick, R. (2016). *Molecular Biology of the gene.* 7th Edition. Pearson Publishers.
5. Walker John, M. & Ralph, R. (2015). *Molecular Biology and Biotechnology.* 6th Edition. RSC Publishing.

E – Books

1. https://www.pdfdrive.com/molecular-cell-biology-molecular-cell-biology-e7302545.html
2. https://www.pdfdrive.com/cell-division-genetics-and-molecular-biology-cell-division-genetics and-molecular-biology-e22406140.html
3. https://www.pdfdrive.com/molecular-cell-biology-e187264624.html
4. https://www.pdfdrive.com/dna-replication-recombination-and-repair-molecular-mechanisms-and pathology-e187695166.html
5. https://www.pdfdrive.com/a-characterization-of-the-role-of-post-translational-modifications-in-transcriptional-regulation-by-e74315851.html

Web References

1. https://www.lehigh.edu/~inbios21/PDF/Fall2008/Lopresti_11142008.pdf
2. https://www.genome.gov/geneticsglossary/Organelle.pdf
3. http://kea.kar.nic.in/vikasana/bridge/biology/chap_14.pdf
4. http://ncbr.muni.cz/~martinp/C3210/StructBioinf3.pdf
5. https://sites.engineering.ucsb.edu/~shell/che170/DNA-notes.pdf

Pedagogy

Chalk and Talk, PPT, Animation and Videos

Course Designer

Dr. R. RAMESHWARI

Semester – I	Internal Marks: 25			External Marks: 75
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HOURS/WEEK**	**CREDITS**
23UBT1CC1P	**CELL AND MOLECULAR BIOLOGY (P)**	**CORE**	**3**	**3**

Course Objectives

- To perform experiments using microscopes and micrometry.
- To study about cells and their morphology by appropriate techniques.
- To gain knowledge in cell division and their stages.
- To develop skills related to the Isolation and Separation Techniques of Nucleic acids.

Course Outcome and Cognitive Level Mapping

Upon the successful completion of the course, students will be able to

CO Number	CO Statement	Cognitive Level
CO 1	Define and describe the basic instruments involved in Biology.	K1, K2
CO 2	Discuss and differentiate the morphology of various types of cells.	K2
CO 3	Classify and illustrate the different cellular organelles.	K3
CO 4	Categorize the different types and stages of cell division.	K4
CO 5	Illustrate the techniques involved in size analysis of macromolecules.	K4

Mapping of CO with PO and PSO

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	2	3	2	3	3	1
CO2	3	3	3	3	2	3	2	3	3	1
CO3	3	2	3	3	2	3	2	3	3	1
CO4	3	2	3	3	1	3	2	2	3	1
CO5	3	3	3	3	1	3	2	2	3	2

"1" – Slight (Low) Correlation, "2" – Moderate (Medium) Correlation, "3" – Substantial (High) Correlation, "-" indicates there is no correlation.

Syllabus

1. Laboratory rules, regulations and safety measures.
2. Components of a Compound / Light Microscope.
3. Blood smear preparation and Identification of Blood cells.
4. Measurement of Cell Size by Micrometry.
5. Morphological Characterization of various types of Plant tissue cells.
6. Cell fractionation and Identification of cell organelles (Demo)
7. Barr body identification from Buccal Smear.
8. Observation of Mitosis in Onion root tip cells.
9. Observation of Binary fission in Yeast Cells.
10. Cell Counting and viability in Yeast Cells
11. Enumeration of Eukaryotic Cells - Red Blood Cells
12. Enumeration of Eukaryotic Cells - White Blood Cells
13. Isolation and purification of Genomic DNA from Human Cheek Cells.
14. Separation of DNA by using AGE
15. Separation of Protein by using SDS – PAGE

Reference Books

1. Trigunayat, M. M., Trigunayat, K. (2019). *A Manual of Practical Zoology: Biodiversity, Cell Biology, Genetics & Developmental Biology Part-1*. Scientific Publishers.
2. Amit, G., Bipin Kumar, S. (2019). *Practical Laboratory Manual – Cell Biology.* Lambert Academic Publishing.
3. Hubel, A. (2018). *Preservation of cells: a practical manual*. John Wiley & Sons.
4. Das, D. (2017). *ESSENTIAL PRACTICAL HANDBOOK OF CELL BIOLOGY & GENETICS, BIOMETRY & MICROBIOLOGY: A LABORATORY MANUAL*. Academic Publishers.
5. Rybicki, E. (2014). *A Manual of Online Molecular Biology Techniques*. University of Cape Town.

E - Books

1. https://www.google.co.in/books/edition/CELL_AND_MOLECULAR_BIOLOGY/Qy7IoupYJacC?hl=en&gbpv=1&printsec=frontcover
2. https://www.academia.edu/71052580/Techniques_in_Molecular_Biology_Lab_Manual_2
3. https://www.deanza.edu/faculty/heyerbruce/b6b_pdf/Bio6B-Manual_W19.pdf
4. https://www.researchgate.net/publication/330654692_Cell_Biology_Practical_Manual
5. https://onlinelibrary.wiley.com/doi/book/10.1002/0470033487
6. https://www.bioscience.com.pk/topics/zoology/item/614-chick-embryo-at-24-hours

Pedagogy

Practical Observation, Video and Demo

Course Designer

Ms. P. ILAMATHY

Semester – I	Internal Marks: 25			External Marks: 75
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HOURS/WEEK**	**CREDITS**
23UBT1AC1	**BIOLOGICAL CHEMISTRY**	**ALLIED**	**4**	**3**

Course Objectives

- To learn about the fundamentals of atoms and periodic table classification.
- To study the concepts of acids and bases.
- To understand the fundamentals of carbohydrates, lipids, fatty acids and nucleic acids.
- To evaluate the structural properties of proteins, amino acids, vitamins and hormones.

Course Outcome and Cognitive Level Mapping

Upon successful completion of the course, the students will be able to

CO Number	CO Statement	Cognitive Level
CO1	Understand the basic knowledge about structure of atoms, periodic properties of elements and differentiate the properties of chemical substances	K1, K2
CO2	Illustrate the types of chemical reactions and to calculate the stoichiometry and rate	K2
CO3	Categorize the importance of classification, properties, structure of carbohydrates and various biochemical cycles involved in carbohydrate metabolism	K3
CO4	Analyze the classification and structural properties of lipids, fatty acids and nucleic acids	K4
CO5	Determine the chemistry, classification, structural properties of proteins, amino acids, vitamins and hormones	K4

Mapping of CO with PO and PSOs

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	2	1	3	3	2	2	1
CO2	3	3	3	2	2	3	3	3	2	2
CO3	3	3	3	2	1	3	3	3	2	1
CO4	3	3	3	3	2	3	3	3	3	3
CO5	3	3	3	3	2	3	3	3	3	3

"1" – Slight (Low) Correlation, "2" – Moderate (Medium) Correlation,
"3" – Substantial (High) Correlation, "-" indicates there is no Correlation.

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	**Basics of Biological Chemistry:** Acids & Bases properties and differences, Concepts of acids and bases. pH of solution, pH scale, measurement of pH. Buffer solutions, properties of buffers, Henderson - Hasselbalch equation. The chemical foundation of life. Water: its unique properties, ionization of water, buffering action in biological system, properties and characteristics of water.	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
II	**Fundamentals of Carbohydrates and Biochemical Cycles:** Classification of carbohydrates. Properties of carbohydrates. Ring structure of sugars and conformation of sugars. Metabolism of Carbohydrates – Glycogenesis, Glycolysis, Glycogenolysis, TCA cycle.	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
III	**Classification of Lipids and Nucleic acids**: Classification of Lipids. Properties and Biological importance of lipids. Metabolism of Fatty acids, triglycerides, phospholipids, cholesterol. β -oxidation of fatty acids. Classification of nucleic acids. Classification of DNA & RNA.	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
IV	**Introduction to Proteins and Amino acids:** Classification and structure of amino acids. Structural conformation of proteins. Classification of proteins. Properties and biological importance of amino acids and proteins. Degradation of Amino acids and Urea Cycle. ATP production. Oxidative phosphorylation, Electron transport chain and Photophosphorylation.	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
V	**Vitamins and Minerals:** Vitamins: Definition, Classification. Fat soluble vitamins-sources, structure and physiological functions; Water soluble vitamins-sources, structure and physiological functions. Vitamin deficiency diseases. Minerals: Macro minerals and micro minerals - sources and functions	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
VI	**Self-Study for Enrichment** **(Not Included for End Semester Examination)** Weak interactions in aqueous systems, water as a reactant and fitness of the aqueous environment. Lipids as signals, cofactors and pigments.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4

Text books

1. Singh, S. P., Singh, A. N. (2021). *Textbook of Biochemistry*. CBS Publishers.
2. Gupta, S. N. (2020). *Concepts of Biochemistry*. Rastogi Publications.
3. Sathyanarayana, U., Chakrapani, U. (2020). *Biochemistry*, 5th Edition. Elsevier Publishers.
4. Seema Pavgi, U. (2020). *Textbook of Biochemistry*.1st Edition. Dreamtech Press.
5. Padmaja Agarkar, H., Yogesh, K. & Rammohan, R. (2020). *Biochemistry*. Nirali Prakashan Publishers.

Reference books

1. Manzoor Malik, M. (2021). *Fundamentals of Biochemistry*. LAP Lambert Academic Publishing.
2. Vikrant, V. (2021). *Biochemistry*. Discovery Publishing House Pvt Ltd.
3. Brailsford Robertson, T. (2020). *Principles of Biochemistry*. MJP Publishers.
4. Jeremy Berg, M., Stryer, L., Tymoczko, J., Gatto, G. (2019). *Biochemistry*. Freeman and Company.
5. Dean Appling, R., Spencer Anthony, J., Cohill, C., Christopher Mathews, K. (2017). *Biochemistry Concepts and Connections*. Pearson Education.

E – Books

1. https://www.pdfdrive.com/lehninger-principles-of-biochemistry-d158404366.html
2. https://www.pdfdrive.com/biochemistry-d196362531.html
3. https://www.pdfdrive.com/biochemistry-genetics-molecular-biology-d18198970.html
4. https://www.pdfdrive.com/marks-basic-medical-biochemistry-a-clinical-approach-5th-edition-e158491166.html
5. https://www.pdfdrive.com/biochemistrystrayer-e25312085.html

Web References

1. http://ecoursesonline.iasri.res.in/course/view.php?id=422
2. https://nptel.ac.in/courses/102105034/
3. https://youtu.be/DhwAp6yQHQI
4. https://agrimoon.com/fundamentals-of-biochemistry-pdf-book/
5. http://courseware.cutm.ac.in/courses/fundamentals-of-biochemistry/

Pedagogy

Chalk and Talk, PPT, Animation and Videos

Course Designer

Ms.P. ILAMATHY

Semester–III	Internal Marks: 25			External Marks: 75
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HOURS/ WEEK**	**CREDITS**
23UBT1AC2P	**BIOLOGICAL CHEMISTRY (P)**	**ALLIED**	**4**	**3**

Course Objectives

- To acquire skills about the various techniques in Biochemical Analysis
- To understand the basic concepts of Chemical preparations.
- To study about the qualitative and quantitative analysis of various chemical compounds.
- To perform experiments on detection of chemicals present in unknown solutions.

Course Outcome and Cognitive Level Mapping

Upon successful completion of the course, students will be able to

CO Number	CO Statement	Cognitive Level
CO 1	Demonstrate and discuss the genomic DNA and protein isolation method from different sources	K1, K2
CO 2	Describe and outline the method of qualitative and quantitative analysis of organic compounds.	K2, K3
CO 3	Classify and categorize the organic compound according to the experimental analysis	K3, K4
CO 4	Analyse and estimate the quantity of compounds in unknown given Sample	K4, K5
CO 5	Analyze, compare and distinguish the nature of various organic classes of compounds qualitatively.	K4, K5

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	2	3	2	3	3	1
CO2	3	3	3	3	2	3	3	3	3	1
CO3	3	2	3	3	2	3	2	3	3	1
CO4	3	2	3	3	2	3	2	2	3	3
CO5	3	3	3	3	2	3	3	2	3	2

"1" – Slight (Low) Correlation, "2" – Moderate (Medium) Correlation,
"3"–Substantial (High) Correlation, "-" indicates there is no Correlation.

Syllabus

1. Units and Measurements.
2. Preparation of Molarity, Normality solutions and Buffers.
3. Determination of pH and use of pH meter.

Qualitative Analysis

4. Qualitative analysis of carbohydrates - Glucose, sucrose and starch.
5. Qualitative analysis of amino acids - Tyrosine, Tryptophan, Arginine, Proline and Cysteine.

Quantitative Analysis

6. Analyse Blood Glucose Level

Volumetric Analysis

7. Estimation of Glycine- Formal Titration.
8. Determination of Ascorbic acid – DCPIP method.
9. Estimation of Ferrous sulphate using standard Mohr's salt.

Colorimetric Analysis

10. Estimation of glucose - DNS method.
11. Estimation of Cholesterol- Zak's method
12. Estimation of proteins – Bradford's method

Chromatographic Analysis

13. Separation of plant pigments using Paper chromatography

Reference Books

1. Evangeline, J. (2022). *Manual of Practical Medical Biochemistry*. 3rd edition. Jaypee Brothers Medical Publishers.
2. Chawla, R. (2020). *Practical Clinical Biochemistry: Methods and Interpretations*. JP Medical Ltd.
3. Kaushik, G.G., Neha, S., Sabira, D., Ruchi, J. (2020). *Practical Manual of Biochemistry*. CBS Publishers and Distributors
4. Gupta, R.C., Bhargava, S. (2018). *Practical Biochemistry*. 5th Edition. CBS Publishers.
5. Plummer, D. T. (2017). *An Introduction to Practical Biochemistry*. 3rd Edition. Tata McGraw-Hill Education.
6. Jayaraman, J. (2011). *Laboratory Manual in Biochemistry*, New Age International Pvt Ltd Publishers.

E-Books

1. https://skyfox.co/wp-content/uploads/2020/12/Practical-Manual-of-Biochemistry.pdf
2. https://www.pdfdrive.com/practical-biochemistry-e187196416.html
3. https://www.pdfdrive.com/practical-clinical-biochemistry-e187182591.html
4. https://www.pdfdrive.com/marks-basic-medical-biochemistry-a-clinical-approach-5th-edition-e158491166.html
5. https://www.researchgate.net/publication/313745155_Practical_Biochemistry_A_Student_Companion

Web References

1. https://biotech01.vlabs.ac.in/List%20of%20experiments.html
2. https://vlab.amrita.edu/?sub=3&brch=63&sim=156&cnt=1
3. https://www.vrlabacademy.com/Experiments/501/Medical-Biochemistry-Laboratory.html
4. https://www.asbmb.org/education/online-teaching/online-lab-work

Pedagogy

Practical Observation and Demo

Course Designer

Dr. M. KEERTHIGA

Semester II	Internal Marks: 25		External Marks: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HOURS/WEEK**	**CREDITS**
23UBT2CC2	**GENETICS**	**CORE COURSE-II**	**5**	**5**

Course Objectives

- To predict and analyze the inheritance of traits in various genetic scenarios.
- To apply the concepts of genetics, inheritance patterns and genetic disorders in various organisms including humans.
- To conduct pedigree analysis to determine the inheritance patterns of genetic traits within families.
- To apply the knowledge of chromosomal disorders and chromosomal aberrations into genetic research, genetic counselling and the diagnosis of chromosomal disorders.
- To identify scenarios and conditions where genetic drift and genetic shift are most likely to occur.

Course outcome and Cognitive Level Mapping

Upon successful completion of the course, the students will be able to

CO Number	CO Statement	Cognitive Level
CO1	Understand the historical milestones in molecular biology and genetics, the structure and functions of nucleic acids and their significance in the field of biology and genetics.	K1, K2
CO2	Illustrate about the structural organization of chromosome, chromosomal aberrations, chromosomal disorders.	K2
CO3	Understand the fundamental principles of inheritance as elucidated by Mendel, as well as subsequent developments in genetics related to gene linkage and independent assortment.	K3
CO4	Analyse pedigrees to determine the inheritance patterns of sex-linked traits and predict the probabilities of inheritance.	K4
CO5	Apply the knowledge of gene frequency, genetic drift and shift, pedigree analysis into study of evolution, genetic disorders.	K4

Mapping of CO with PO and PSO

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	1	2	2	1	3	1	2	3	1
CO2	3	2	2	2	1	3	1	2	2	1
CO3	3	3	2	2	1	3	3	2	2	1
CO4	3	3	2	2	1	3	3	2	3	1
CO5	3	3	3	3	1	3	3	3	3	2

"1" – Slight (Low) correlation **"2" - Moderate (Medium) correlation**
"3" – Substantial (High) correlation **"_" indicates there is no correlation**

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	Historical developments of molecular biology and Genetics; DNA as genetic material - Griffith's, Hershey - chase Experiments; Avery Macleod Mccarty Experiment. Structure and functions of Nucleic acids: Nucleosides and Nucleotides, Purines and Pyrimidines. Watson and Crick model of DNA. A, B & Z forms of DNA. Structure of RNA and its Types.	15	CO1, CO2, CO3	KI, K2, K3, K4
II	Chromosome's structural organization – Chromatin and chromatids; Special types of Chromosomes: Polytene and Lampbrush chromosomes. Chromosomal variation in number, Changes in Chromosomal structure, Chromosomal disorders - Transposable elements in prokaryotes and eukaryotes.	15	CO1, CO2, CO4	KI, K2, K3, K4
III	Early concepts of inheritance; Discussion on Mendel's Laws of inheritance - Law of Dominance and Uniformity – Incomplete dominance and codominance; Law of Segregation of genes - Morgan's work on Drosophila; Law of Independent Assortment – Dihybrid cross. Test cross and Back Cross	15	CO2, CO3, CO4	KI, K2, K3, K4
IV	Sex determination, differentiation and sex-linkage, Sex – linked inheritance, Sex-influenced and sex-limited traits; Linkage Analysis – Fruit Fly. Recombination and genetic mapping in eukaryotes, Multiple Alleles – ABO Blood Grouping.	16	CO3, CO4, CO5	KI, K2, K3, K4
V	Genetic control of Development in Drosophila and Arabidopsis. Population genetics, calculating gene frequency, factors affecting gene frequency. Genetic drift, Shift, Pedigree analysis and genetic counselling.	14	CO3, CO4, CO5	KI, K2, K3, K4
VI	**Self-Study for Enrichment** RNA as genetic material – Fraenkel - Conrat Experiment- Chromosomal aberrations, Somatic cell genetics. **(Not Included for End Semester Examination)**	-	CO1, CO2, CO4	KI, K2, K3, K4

Text Books

1. Vishnu Shankar, S. (2021). Fundamentals of Genetics and Molecular Biology. Red'shine Publication Pvt. Ltd.
2. Pierce, B. A. (2018). *Genetics essentials: concepts and connections* (p. 488). WH Freeman.
3. Brown, T. A. (2012). *Introduction to genetics: a molecular approach*. Garland Science.
4. Vega, L. (2019). *Fundamentals of genetics*. Scientific e-Resources.
5. Panchal, S. (2022). Fundamentals of Genetics. In *Genetics Fundamentals Notes* (pp. 3-51). Singapore: Springer Nature Singapore.

Reference Books

1. Pierce, B. A. (2012). *Genetics: a conceptual approach*. Macmillan.
2. Brooker, R. J. (2015). Genetics: analysis and principles. *(No Title)*.
3. Goldberg, M. L., Fischer, J. A., Hood, L., & Hartwell, L. (2021). Genetics: from genes to genomes. *(No Title)*.
4. Russell, P. J., & Gordey, K. (2002). *IGenetics* (No. QH430 R87). San Francisco: Benjamin Cummings.
5. Watson, J. D. (2004). *Molecular biology of the gene*. Pearson Education India.

E - books

1. https://www.pdfdrive.com/lewins-genes-xii-e185848559.html
2. https://www.pdfdrive.com/introduction-to-genetics-a-molecular-approach-e187102063.html
3. https://www.pdfdrive.com/the-cell-a-molecular-approach-e186369576.html
4. https://www.pdfdrive.com/genetics-a-conceptual-approach-e186741220.html

Web References

1. https://microbenotes.com/category/molecular-biology/
2. https://www.easybiologyclass.com/topic-genetics/
3. https://ocw.mit.edu/courses/7-03-genetics-fall-2004/pages/lecture-notes/
4. http://ndl.iitkgp.ac.in/document/bnZnR2hPaUVqRU9TbFc2Rmp1MVJzN0dyTCs3OGxyRzdaUWpPTzdRV2pBTT0

Pedagogy

Blackboard, PPT, Videos, Animations, Group Discussion and Quiz.

Course Designer

Dr. R. RAMESHWARI

Semester–II	Internal Marks: 40		External Marks: 60	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HOURS/ WEEK**	**CREDITS**
23UBT2CC2P	**GENETICS (P)**	**CORE PRACTICAL-II**	**3**	**3**

Course Objectives

- To learn and execute various techniques in genome analysis.
- To study the basic concepts of mendelian laws and its deviations using simple problems.
- To study effects of mutations and molecular markers.
- To learn Cultural handling technique of *Drosophila melanogaster*.
- To prepare permanent slides of polytene chromosome.

Course outcome and Cognitive Level Mapping

On successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO 1	Demonstrate the basic principles of important techniques in Genetics.	K1
CO 2	Analyze the Polytene chromosome of the organisms. Identify Barr bodies from Buccal smear	K2
CO 3	Perform basic genetics problem based on Mendel's laws	K2
CO 4	Apply the effects of mutation and appraise the applications of molecular markers.	K3
CO 5	Identify and analyze chromosomal aberrations using karyotyping methods	K3

Mapping with Programme Outcomes

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	2	1	3	3	2	3	1
CO2	3	3	3	2	1	3	2	2	3	1
CO3	3	3	2	2	1	3	2	2	2	2
CO4	3	3	3	3	1	3	2	2	3	1
CO5	3	3	2	3	1	3	2	2	2	1

"1" – Slight (Low) Correlation, **"2" – Moderate (Medium) Correlation,**
"3"–Substantial (High) Correlation, **"-"indicates there is no Correlation.**

Syllabus

1. Mendel's law of genetics - Mono and Dihybrid crosses.
2. Rearing morphology of Drosophila (mutant eye identification)
3. Observation of Genetic model organisms (*Arabidopsis thaliana* and *Coenorrabditis elegans*)- Permanent slides
4. Isolation of spontaneous mutant cells.
5. Isolation of petite mutant yeast cell.
6. Study the effect of physical mutagens on bacterial characteristics.
7. Karyotype analysis- Human (Normal and Abnormal) and onion.
8. Identification of Barr body (Buccal epithelium smear)
9. Preparation of polytene chromosomes (Chironomous larvae salivary gland)- squash preparation.
10. Pedigree charts of some common characters like blood group and color blindness.
11. Determination the ABO blood groups in a random sample and calculation of the allele frequency using Hardy Weinberg's law.

Reference books

1. Kaushik Kumar Panigrahi. (2019), *Practical Manual on "Fundamentals of Genetics" (PBG-121).* First Publisher: Odisha University of Agriculture & Technology.
2. Amita J, Jyotsna A and Vimala V (2018). *Microbiology Practical Manual.* (1st Edition). Elsevier India.
3. Talib VH (2019). *Handbook Medical Laboratory Technology*. (2nd Edition). CBS.
4. Snustad, D.P., Simmons, M.J. (2009). *Principles of Genetics.* V Edition. John Wiley and Sons Inc.
5. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). *Concepts of Genetics. IX* Edition. Benjamin Cummings.

E-Books:

1. https://www.pdfdrive.com/a-manual-of-laboratory-and-diagnostic-tests-e157742334.html
2. https://www.pdfdrive.com/lippincott-manual-of-nursing-practice-e189815788.html
3. https://www.pdfdrive.com/introduction-to-genetic-analysis-solutions-megamanual-e158762003.html

Web links:

1. https://egyankosh.ac.in/bitstream/123456789/16314/1/Experiment-8.pdf
2. https://uou.ac.in/sites/default/files/slm/MSCBOT-510(L).pdf
3. https://vlab.amrita.edu/?sub=3&brch=76&sim=1089&cnt=1
4. https://webstor.srmist.edu.in/web_assets/srm_mainsite/files/files/BT0213%20-%20CELL%20BIOLOGY%20PRACTICAL%20MANUAL.pdf
5. https://www.iitg.ac.in/cseweb/vlab/anthropology/procedure_mendels.html

Pedagogy

Practical Observation and Demo

Course Designer

Dr. M. KEERTHIGA

Semester – II	Internal Marks: 25			External Marks: 75
COURSE CODE	COURSE TITLE	CATEGORY	HOURS/ WEEK	CREDITS
23UBT2CC3	BIOMOLECULAR TECHNIQUES	CORE COURSE	2	2

Course Objectives

- ➢ To understand the working principles of different instruments used in the biological field
- ➢ To provide a better understanding of various analytical techniques
- ➢ To operate and maintain common bio instruments effectively and safely.
- ➢ To understanding of biomedical instrumentation principles in aspects of device design and applications.
- ➢ An ability to analyze contemporary bioinstrumentation studies to make connections and decisions based on their scientific merit.

Course Outcome and Cognitive Level Mapping

Upon the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Define and Express the principle of Microscopy, Electrophoresis, Chromatography, Colorimeter and tracing Techniques	K1, K2
CO2	Demonstrate and analyze of the economic and environmental aspects of bioinstrumentation, including cost-effective instrument selection, maintenance, and sustainable practices	K2, K4
CO3	Interpret the types and applications of microscopy, Electrophoresis, Chromatography, Colorimeter and Centrifugation techniques	K3
CO4	Appraise the advantages of advanced techniques like HR_TEM,2D-GEL, LC-MS, FTIR and NMR	K5
CO5	Elaborate the role of Bioinstrumentation techniques in advancing healthcare, scientific discovery, and the understanding of biological systems	K6

Mapping of CO with PO and PSO

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	1	2	2	1	3	1	2	3	1
CO2	3	2	2	2	1	3	1	2	2	1
CO3	3	3	2	2	1	3	3	2	2	1
CO4	3	3	2	2	1	3	3	2	3	1
CO5	3	3	3	3	1	3	3	3	3	2

"1" – Slight (Low) Correlation, "2" – Moderate (Medium) Correlation,
"3" – Substantial (High) Correlation, "-" indicates there is no correlation.

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	**Microscopy:** Light Microscopy, Bright and Dark field Microscopy, Fluorescence Microscopy, Confocal Microscope, Electron microscopy	5	CO1, CO2, CO3	K1, K2, K3, K4
II	**pH Meter & Spectrophotometer:** pH Meter: Principle and Operation of pH meter, Calomel Electrode, Glass Electrode, Combined Electrode, Methods of determining pH. Colorimeter – Principle and its applications, Beer Lambert's Law, Spectrophotometer- Principle and its applications, Types of Spectrophotometer- UV – Visible	4	CO1, CO2, CO3	K1, K2, K3, K4
III	**Centrifugation and Imagining Techniques:** Centrifugation – Principle, Types – Zonal, Differential, Density gradient centrifugation and ultracentrifugation its applications. Imaging Techniques- X-ray and NMR. Tracer Techniques - Radioactive isotope –Half life, GM Counter, Liquid Scintillation Counter.	5	CO2, CO3, CO4	K1, K2, K3, K4
IV	**Electrophoresis:** Principle and Applicationsof Electrophoresis – Types of electrophoresis- Pulsed Field Gel Electrophoresis, SDS-PAGE and 2 D gel; Immunoelectrophoresis; Blotting Techniques; Gel documentation	8	CO3, CO4, CO5	K1, K2, K3, K4
V	**Chromatography:** Fundamentals of Chromatography - Principle and its applications, Types –TLC, Column, Affinity, Ion –exchange, HPLC.	8	CO3, CO4, CO5	K1, K2, K3, K4
VI	**Self-Study for Enrichment** Introduction to Instrumentation, AGE **(Not Included for End Semester Examination)**	-	CO1, CO2	K1, K2, K3, K4

Text Books

1. Agarwal, P.K., Baqri, S.R & Gau, K. (2022). Molecular Biology, Bioinstrumentation and Biotechniques. Pragati Prakashan Publishers.
2. Vitha, M. F. (2018). *Spectroscopy: Principles and instrumentation*. John Wiley & Sons.
3. Ohlendieck, K., & Harding, S. E. (2018). Centrifugation and ultracentrifugation. *Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology*, *1*(2), 424-453.
4. Skoog, D. A., Holler, F. J., & Crouch, S. R. (2017). *Principles of instrumental analysis*. Cengage learning.

5. Ismail, B., & Nielsen, S. S. (2010). Basic principles of chromatography. *Food analysis*, *27*, 473-498.
6. Enderle, J., & Bronzino, J. (Eds.). (2012). *Introduction to biomedical engineering*. Academic press.

Reference Books

1. Bogusław, B & Irena B (2022). Handbook of Bioanalytics. Springer InternationalPublishing.
2. Webster, J. G. (Ed.). (2003). *Bioinstrumentation*. John Wiley & Sons.
3. Khandpur, R. S. (2005). *Biomedical instrumentation: Technology and applications* (Vol. 1). New York: Mcgraw-hill.
4. Upadhyay, A., Upadhyay, K., & Nath, N. (1993). Biophysical chemistry principles and techniques.
5. Chatterjee, S., & Miller, A. (2012). *Biomedical instrumentation systems*. Cengage Learning.

E books

1. https://www.academia.edu/30824186/6846793_Bioinstrumentation_pdf
2. https://files.eric.ed.gov/fulltext/ED407284.pdf
3. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SMB2103.pdf
4. https://www.pdfdrive.com/bioanalytical-chemistry-e185517690.html
5. https://www.pdfdrive.com/bioanalytical-chemistry-e180345635.html

Web links

1. https://nptel.ac.in/courses/102103044
2. https://kamarajcollege.ac.in/wp-content/uploads/Allied-I-Bioinstrumentation.pdf
3. https://www.youtube.com/watch?v=MvkFWmzFqNM
4. https://www.nature.com/scitable/definition/gel-electrophoresis-286/
5. https://www.khanacademy.org/science/class-11-chemistry-india/xfbb6cb8fc2bd00c8:in-inorganic-chemistry-some-basic-principles-and-techniques/xfbb6cb8fc2bd00c8:in-in-methodsof-purification-of-organic-compounds/a/principles-of-chromatography

Pedagogy

Power point presentation, Group Discussion, Seminar, Assignment, Animations.

Course Designer

Ms. R. NEVETHA

Semester – II	Internal Marks: 25		External Marks: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HOURS/ WEEK**	**CREDITS**
23UBT2AC3	**GENERAL MICROBIOLOGY**	**FIRST ALLIED COURSE-III**	**4**	**3**

Course Objectives

- To study about the classification of microorganisms.
- To study about the media composition and their types
- To study about the structure and characteristics of bacteria, algae, fungi, protozoa and virus.
- To study the characteristics, properties and biological significance of the different organism.
- To obtain the knowledge in health care for prevention of diseases, diagnosis, sterilization methods and drug production.

Course Outcome and Cognitive Level Mapping

Upon the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Recall the history of Microbiology and list out the scopes.	K1
CO2	Outline the methods involved in media preparation and sterilization.	K2
CO3	Summarize the structural organization of Bacteria.	K2
CO4	Explain the general characteristic features of Algae and Fungi.	K2
CO5	Describe the Diversity, Ecology and Characteristics of different Protozoa and Viruses.	K3

Mapping of CO with PO and PSO

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	1	2	2	1	3	1	2	3	1
CO2	3	2	2	2	1	3	1	2	2	1
CO3	3	3	2	2	1	3	3	2	2	1
CO4	3	3	2	2	1	3	3	2	3	1
CO5	3	3	3	3	1	3	3	3	3	2

"1" – Slight (Low) Correlation, "2" – Moderate (Medium) Correlation,
"3" – Substantial (High) Correlation, "-" indicates there is no correlation.

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	**History and Classification:** Historical development of Microbiology - Theories of Spontaneous generation – Biogenesis The scope of Microbiology; General principles and nomenclature – Haeckel's three kingdom concept, Whittaker's five kingdom concept- Carl Woese's three domain classification. Cavalier – Smith's Eight kingdom classification.	13	CO1, CO2, CO3	K1, K2, K3, K4
II	**Media Preparation and Sterilization:** Media Composition and their types based on physical state & ingredients. Microbial Growth- Factors influencing the growth of Microorganisms – Growth Curve.	11	CO1, CO2, CO3	K1, K2, K3, K4
III	**Bacteria:** Structural organization of bacteria – Size, shape and arrangement of bacterial cells – Ultrastructure of a bacterial cell – cell wall, cell membrane, ribosomes, nucleoid, slime, capsule, flagella, fimbriae, spores, cysts, plasmid, mesosomes and cytoplasmic inclusions.	11	CO1, CO2, CO3	K1, K2, K3, K4
IV	**Diversity of Microbial world**: General characteristics of Algae (Chlamydomonas sp) including occurrence, thallus organization, Ultra structure, pigments, flagella, eyespot, food reserves. Reproduction – Sexual and Asexual reproduction. Fungi (*Aspergillus* sp) – General characteristics of fungi including habitat, distribution, nutritional requirements, Ultrastructure, thallus organization and aggregation.	13	CO1, CO2, CO3,	K1, K2, K3, K4
V	**Protozoa & Viruses:** Protozoa: General characteristics with special reference to Amoeba, *Paramecium* and *Giardia*. Viruses: Viruses, viroids and prions - A general introduction with special reference to the structure of the following: TMV, poliovirus. Lytic and lysogenic cycle.	12	CO3, CO4, CO5	K1, K2, K3, K4
VI	**Self-Study for Enrichment** Types of Sterilization and Disinfection. **(Not Included for End Semester Examination)**	-	CO1, CO2	K1, K2, K3, K4

Text Books

1. Tortora, G. J., Case, C. L., Bair III, W. B., Weber, D., & Funke, B. R. (2008). Microbiology:an introduction. *(11th Edition)*.
2. Baveja, D. C. (2005). Textbook of Microbiology, (2017). *Published by Arya Publication, Page*, (592).
3. Rathoure, A. K. (2017). Brillion Publishing, Essentials of Microbiology.
4. Tortora, G. J., Funke, B. R., & Case, C. L. (2015). *Microbiology: An Introduction, Books a la Carte Edition*. Benjamin-Cummings.
5. Madigan, M. T., Martinko, J. M., & Parker, J. (1997). *Brock biology of microorganisms* (Vol.11). Upper Saddle River, NJ: Prentice hall.

Reference Books

1. Madigan, M. T., Bender, K. S., Buckley, D. H., Sattley, W. M., & Stahl, D. A. (2018). Brock Biology of Microorganisms. 15th Global Edition. *Boston, US: Benjamin Cummins*, *1*, 1391- 1407.
2. Prescott, Harley andKlein (2016). McGraw Hill. *Microbiology. 10thEdition.*
3. Pelczar, Chan and Kreig (2016). McGraw-Hill. *Microbiology 9thEdition.*
4. Madigan, M. T., Martinko, J. M., Bender, K. S., Buckley, D. H., & Stahl, D. A. (2016). *Microbiologia de Brock-14ª Edição*. Artmed Editora.
5. Cowan, M. K., & Talaro, K. P. (2009). *Microbiology: a systems approach*. McGraw-Hill Higher Education.

E books

1. https://rlmc.edu.pk/themes/images/gallery/library/books/Microbiology/Text_Book_of_Microbiology.pdf
2. https://www.academia.edu/40368024/Textbook_of_MICROBIOLOGY
3. http://www.grsmu.by/files/file/university/cafedry/microbiologii-virysologii-immynologii/files/essential_microbiology.pdf
4. https://worldofmedicalsaviours.com/microbiology-books-pdf/

Web links

1. https://archive.nptel.ac.in/courses/102/103/102103015/
2. https://www.youtube.com/watch?v=Bhe6Tj2Ebys
3. https://microbiologynotes.com/category/basic-microbiology/
4. https://byjus.com/biology/microbiology/

Pedagogy

Power point presentation, Group Discussion, Seminar, Assignment, Animations.

Course Designer

DR R. RAMESHWARI

Semester – III	Internal Marks: 25			External Marks: 75
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HOURS/WEEK**	**CREDITS**
23UBT3CC4	**rDNA TECHNOLOGY**	**CORE**	**5**	**5**

Course Objectives

- To upskill students in rDNA technology and their application in the field of genetic engineering
- To illustrate the use of modern tools and techniques for gene manipulation and gene expressional analysis for further studies in the area of genetic engineering.
- To expose students to the applications of rDNA technology inbiotechnological research.

Course Outcome and Cognitive Level Mapping

Upon the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Utilize and infer the knowledge on principles of Genetic Engineering in application of biotechnological research	K1, K2
CO2	Illustrate the knowledge on various tools and the genetic engineering strategies for transgenic products and its applications.	K2
CO3	Develop the Genomic and cDNA libraries and compare the tools such as Enzymes, Vectors, Gene transfer and selection techniques in the rDNA Technology.	K3, K4
CO4	Classify the versatile techniques in rDNA Technology and to explain the concepts of genetic transformation, gene sequencing, gene manipulation and genetically modified organisms.	K4, K5
CO5	Elaborate the applications of Genetic engineering in basic and applied biology, proficiency in designing and conducting experiments involving genetic manipulation for societal applications.	K6

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	2	1	3	2	2	2	1
CO2	2	3	3	3	2	3	2	2	1	1
CO3	3	2	3	2	2	3	2	2	2	1
CO4	3	2	3	2	2	3	2	2	1	1
CO5	2	2	3	3	3	2	2	3	3	3

1" – Slight (Low) Correlation, "2" – Moderate (Medium) Correlation,
"3" – Substantial (High) Correlation, "-" indicates there is no correlation.

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	Introduction to recombinant DNA (rDNA) technology: Milestones in genetic engineering, Basic tools and applications – isolation and purification of nucleic acids, Enzymes used in cloning - Restriction endonucleases: Type I & II properties and its applications. DNA modifying enzymes and their applications: DNA & RNA polymerase, reverse transcriptase, terminal transferase; nucleases (S1 nucleases) T_4 polynucleotide kinase, Alkaline Phosphatase and ligase (*E.coli* & T_4).	14	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
II	Vectors - Definition and properties. Plasmid vectors- pBR and pUC series, Bacteriophage vectors - lambda and M13, Viral vectors- Animal viral vectors - SV40 and Retrovirus. Plant viral vectors - CaMV vector and TMV vector. Cosmids, Shuttle vectors. BACs, YACs, MACs.	13	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
III	Molecular Cloning: Cloning strategies. Cloning System for amplifying different sized fragments, Cloning System for producing single-stranded and mutagenized DNA. Methods of Gene transfer Microinjection, Electroporation, gene gun, CaCl2 mediated and Polyethylene Glycol Mediated.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
IV	Construction of Genomic and cDNA libraries. Recombinant selection and Screening: Selection methods - Antibiotics, GUS expression, Blue White Selection and colony hybridization. Principle of Nucleic acid hybridization assays, microarrays, Altered expression and engineering genes and Site Directed Mutagenesis	16	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
V	DNA amplification using PCR – principle, types and Applications. Gene shuffling, production of chimeric proteins, Protein engineering concepts and examples. DNA Fingerprinting. Principles and applications of RFLP, AFLP and RAPD. Principles of Southern, Northern and Western blotting technique. DNA Sequencing - Chemical degradation, Chain termination, Automated sequence and Next Generation Sequencing.	17	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
VI	**Self-Study for Enrichment** **(Not Included for End Semester Examination)** Nick translation – Klenow enzyme, Ti Plasmid, lipofection, Probe construction, Chromosome walking and jumping,	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

Text Books

1. Bernard R. Glick and Cheryl L. Patten (2022) *Molecular Biotechnology: Principles and Applications of Recombinant DNA, 6th Edition,* ASM Press,WashingtonDC
2. Robert Brooker (2021) Genetics: Analysis and principles.7th edition, Mc Graw Hill.
3. T. A. Brown (2020). *Gene Cloning and DNA Analysis: An Introduction 8th Edition*, Wiley-Blackwell book
4. Jogdand, S.N, (2019). Gene biotechnology, Fourth edition, Himalaya Publishing House.
5. Jocelyn E. Krebs, Elliott S. Goldstein, Stephen T. Kilpatrick. (2018), *Lewin's Genes XII*, Jones & Bartlett Learning.
6. David Irvine (2018), *An Introduction to GeneticEngineering,* Syrawood Publishing House

Reference Books

1. Vineet Kumar, Muhammad Bilal, Luiz Fernando R. Ferreira , Hafiz M. Iqbal (2023). *Genomics Approach to Bioremediation: Principles, Tools, and Emerging Technologies*. Wiley-Blackwell book
2. Santosh Kumar Upadhyay, (2021), *Genome Engineering for Crop Improvement*, Wiley-Blackwell book
3. Muhammad Sarwar Khan iqrar Ahmad Khan debmalya Barh, (2016), *Applied Molecular Biotechnology The Next Generation of Genetic Engineering*, CRC Press, Taylor and Francis Group.
4. Old, R. W., Primrose, S. B., & Twyman, R. M. (2006). Principles of Gene Manipulation: an Introduction to Genetic Engineering. Oxford: Blackwell Scientific Publications.
5. Green, M. R., & Sambrook, J. (2012). *Molecular Cloning: a Laboratory Manual*. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.

Web Links

1. https://youtube.be/Yh9w_fyvpUk
2. https://www.bx.psu.edu/~ross/workmg/Isolat_analyz_genes_Chpt3.htm
3. www.biologydiscussion.com/essay/tools-of-recombinant-dna-technology-essay-_tools-biotechnology/75954
4. https://youtube.be/D3If9ycpyXM
5. https://bio.libretexts.org/Bookshelves/Biochemistry/Supplemental_Modules_(Biochemistry)/3._Biotechnology_1/3.6%3A_cDNA_and_Genomic_Libraries

E-Books

1. https://www.pdfdrive.com/molecular-biotechnology-principles-and-applications-of-recombinant-dna-4th-edition-d162050162.html
2. https://www.pdfdrive.com/modern-tools-for-genetic-engineering-d187396945.html
3. https://www.pdfdrive.com/biotechnology-molecular-biology-and-genetic-engineering-of-plants-d50502615.html
4. https://www.pdfdrive.com/applied-molecular-biotechnology-the-next-generation-of-genetic-engineering-d42102084.html
5. https://www.pdfdrive.com/gene-cloning-and-dna-analysis-d33417027.html

Pedagogy

Power point presentation, Group Discussion, Seminar, Assignment, Animations.

Course Designer

Dr. M. KEERTHIGA

Semester–III	Internal Marks: 40			External Marks: 60
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HOURS / WEEK**	**CREDITS**
22UBT3CC3P	**rDNA TECHNOLOGY (P)**	**CORE**	**3**	**3**

Course Objectives

- To acquire skills about the various techniques in recombinantDNA technology.
- To understand the types of enzymes used to produce recombinants.
- To study about the experiments involving genetic manipulation.
- To perform experiments on crime detection.

Course Outcome and Cognitive Level Mapping

Upon the successful completion of the course, students will be able to

CO Number	CO Statement	Cognitive Level
CO 1	Demonstrate and discuss the genomic DNA and protein isolation method from different sources	K1, K2
CO 2	Describe and outline the method of Agarose Gel Electrophoresis and SDS PAGE for DNA and Protein identification	K2, K3
CO 3	Classify and categorize the restriction digestion and ligation of DNA	K3, K4
CO 4	Analyse the working principles of PCR, RFLP and other important Genetic Engineering techniques.	K4
CO 5	Analyze, compare and distinguish the recombinant DNA products.	K4, K5

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	2	3	2	3	3	1
CO2	3	3	3	3	2	3	2	3	3	1
CO3	3	2	3	3	2	3	2	3	3	1
CO4	3	2	3	3	1	3	2	2	3	1
CO5	3	3	3	3	1	3	2	2	3	2

"1" – Slight (Low) Correlation, "2" – Moderate (Medium) Correlation, "3"– Substantial (High) Correlation, "-" indicates there is no Correlation.

Syllabus

1. Isolation of genomic DNA from plant tissue.
2. Isolation of genomic DNA from Animal cells.
3. Isolation of genomic DNA from Bacteria.
4. Isolation of Plasmid DNA.
5. Protein Precipitation.
6. Protein Quantification by Spectrophotometer Method.
7. Size analysis of protein by SDS PAGE.
8. Size analysis of DNA by Agarose Gel Electrophoresis.
9. RFLP.
10. DNA Restriction Digestion and Ligation.
11. PCR amplification.
12. RAPD.
13. Preparation of competent cells E. *coli* cells.
14. Transformation of *E. coli* with Plasmid DNA using CaCl2.

Reference Books

1. Siddra, I., Imran, U.L.H. (2019). *Recombinant DNA Technology*. 1st Edition. Cambridge Scholar.
2. Tiwari, S., Sharma, M. (2018). *Recombinant DNA Technology in the synthesis of Human Insulin*.LAP LAMBERT Academic Publishing.
3. Roebbe, W. (2021). *Genetic Engineering*. Springer Nature B.V.
4. Punia, M.S. (2018). *A Laboratory Manual of Plant Biotechnology and Molecular Biology "PlantBiotechnology and Molecular Biology : A Laboratory Manual*. Scientific Publishers.
5. Khalid, Z. M., Sameena, M.L, Rovidh Saba, R. (2020). *Advanced Methods in Molecular Biologyand Biotechnology*. *A Practical Lab Manual*. Elsevier, Science Publishers.

E-Books

1. https://books.google.co.in/books?id=WTv5Bte1R7YC&pg=PP9&source=gbs_selected_pages&cad =3#v=onepage&q&f=false_onepage&q&f=false
2. https://www.google.co.in/books/edition/Genetic_Engineering_of_Horticultural_Cro/fSk0DwAAQBAJ?hl=en&gbpv=1&dq=genetic+engineering&printsec=frontcover
3. https://www.google.co.in/books/edition/An_Introduction_to_Genetic_Engineering/5qixMSCEAhAC?hl =en&gbpv=1&dq=genetic+engineering&printsec=frontcover
4. https://www.google.co.in/books/edition/Genetic_Engineering/8DFlDwAAQBAJ?hl=en&gbpv=1&dq=genetic+engineering&printsec=frontcover
5. https://www.cshlpress.com/pdf/sample/2013/MC4/MC4FM.pdf

Web Links

1. https://www.idosi.org/wjms/16(3)19/8.pdf
2. https://www.ndvsu.org/images/StudyMaterials/Biotech/Recombinant-DNA-Technology.pdf
3. https://chaudhary.kau.edu.sa/files/0030235/files/19046_lect%20recombinant%20dna%20tech molecular %20genetics%20lect%202nd%20yr%20mt-1st%20semester.pdf
4. https://bio.libretexts.org/Bookshelves/Genetics/Genetics_Agriculture_and_Biotechnology_(Suza_and_Lee)/01%3A_Chapters/1.11%3A_Recombinant_NA_Technology

Pedagogy

Practical Observation and Demo

Course Designer

Dr. R. UMA MAHESWARI

Semester – III	Internal Marks: 25			External Marks: 75
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HOURS/WEEK**	**CREDITS**
22UBT3AC4	**BIOINFORMATICS**	**ALLIED**	**4**	**3**

Course Objectives

- To learn about the fundamentals of Bioinformatics
- To become familiarize with the databases for structure prediction and sequence analysis of macromolecules.
- To understand the usage of basic online bioinformatics tools and techniques
- To apply bioinformatics concepts and tools in various fields

Course Outcome and Cognitive Level Mapping

Upon successful completion of the course, the students will be able to

CO Number	CO Statement	Cognitive Level
CO1	Acquire knowledge about the developments and applications of Bioinformatics	K1, K2
CO2	Gain knowledge about the importance of bioinformatics, databases, tools, software of bioinformatics and different types of biological Databases	K2
CO3	Understand the basics of sequence alignment, sequence analysis and protein structure prediction method.	K2
CO4	Introduce the importance of drug designing and apply the bioinformatics tools in medicine for drug discovery and identification of novel drugs	K3
CO5	Analyze the different applications of bioinformatics in various fields and explore upcoming areas of interest in bioinformatics	K4

Mapping of CO with PO and PSOs

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	2	1	3	3	2	2	1
CO2	3	3	3	3	1	3	3	3	3	1
CO3	3	3	3	3	1	3	2	2	2	2
CO4	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	2	3	3	2	3	2

"1" – Slight (Low) Correlation, "2" – Moderate (Medium) Correlation,
"3" – Substantial (High) Correlation, "-" indicates there is no Correlation.

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	**Bioinformatics:** Fundamentals of Bioinformatics - Introduction to concepts and terminology of Internet, Search engines, Databases and Softwares	10	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
II	**Introduction to Tools and Databases:** Review of basics about structure of macromolecules - DNA, RNA and Proteins. Online resources for Bioinformatics – Biological Databases – NCBI, Genbank, Swissprot. Sequence alignment – Multiple sequence alignment – CLUSTALW – Pairwise alignment – BLAST	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
III	**Sequence Analysis and Alignment**: Bioinformatics in genomics and proteomics – gene sequencing tools traditional methods – Maxam and Gilbert's method, Sanger's sequencing – structure prediction tools – Gene and protein expression analysis – similarity search databases – FASTA. Analysis of Phylogeny – Phylogenetic tree construction, computational analysis tools (SCHRODINGER) and visualization tools (RASMOL).	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
IV	**Introduction to Drug Discovery**: History of drug discovery, Steps in drug design - Role of molecular docking in drug design. Introduction to Simulation softwares in biology – High throughput screening, AutoDock, ChemDraw, ADMET, PubMed and MEDLINE.	13	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
V	**Applications of Bioinformatics in various fields:** Applications of Bioinformatics in different fields – Genomics, Proteomics, Molecular medicine, Drug development, Forensic analysis, Evolutionary studies, Crop improvement and Environmental monitoring.	10	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
VI	**Self-Study for Enrichment** **(Not Included for End Semester Examination)** Bioinformatics in India, Emerging areas in bioinformatics, Importance of Quantitative Structure Activity Relationship (QSAR).	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4

Text Books

1. Manoj, K. (2020). *Introduction to Bioinformatics*. Notion Press.
2. Noor, A.S., Khalid, R.H., Babajan, B., Ramu E. (2019). *Essentials of Bioinformatics, Volume I:Understanding Bioinformatics: Genes to Proteins*. MJP Publisher.
3. Shuba, G. (2010). *Bioinformatics*. Tata McGraw Hill publishing. India.
4. Rastogi, S.C., Mendiratta, N.R.P. (2004). *Bioinformatics methods and application*. Prentice-Hall ofIndia private limited, New Delhi.
5. Pennington, S.R., Punn, M.J. (2002). *Proteomics: from protein sequence to function.* Viva books Pvt.Ltd.

Reference Books

1. Attwood, T.K., Parry - Smith, D.J. (2008). *Introduction to Bioinformatics*. Pearson Education.
2. Arthur, L. (2019). *Introduction to Bioinformatics*. Oxford University Press
3. Paola, L. (2011). *Systemic Approaches in Bioinformatics and Computational Systems Biology:Recent Advances*. Business Science Reference.
4. David, M. (2009). *Bioinformatics: sequence and genome analysis*. second edition., Taylor & Francis,UK;
5. Westhead, D.R. *Instant Notes in Bioinformatics., second edition.* Taylor & Francis, UK; 2009.

E Books

1. https://www.pdfdrive.com/introduction-to-bioinformatics-oxford-university-press-inc-e33405190.html
2. https://www.pdfdrive.com/essential-bioinformatics-e156837150.html
3. https://www.pdfdrive.com/bioinformatics-sequence-and-genome-analysis-e158336165.html
4. https://www.pdfdrive.com/bioinformatics-sequence-and-genome-analysis-e158336165.html
5. **https**://www.pdfdrive.com/bioinformatics-algorithms-techniques-and-applications-wiley-series-in-bioinformatics-e185077187.html

Web Links

1. https://www.lehigh.edu/~inbios21/PDF/Fall2008/Lopresti_11142008.pdf
2. https://pages.cs.wisc.edu/~bsettles/ibs08/lectures/01-intro.pdf
3. https://www.eurl-ar.eu/CustomerData/Files/Folders/34-wgs/534_6-engage-list-of-online- bioinformatics-tools-and-software.pdf
4. https://www.ks.uiuc.edu/Training/Tutorials/science/bioinformatics-tutorial/bioinformatics.pdf
5. https://www.imsc.res.in/~kabru/parapp/bioinformatics_notes.pdf

Pedagogy

Chalk and Talk, PPT, Videos and Animations

Course Designer

Dr. M. AZEERA

Semester–III	Internal Marks: 40			External Marks: 60
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HOURS/ WEEK**	**CREDITS**
22UBT3AC5P	**BIOINFORMATICS (P)**	**ALLIED**	**4**	**3**

Course Objectives

- To learn and execute various molecular analysis using bioinformatics tools.
- To study the basic concepts of Bioinformatics and its significance in Biological data analysis.
- To study about the different types of Biological databases.

Course Outcome and Cognitive Level Mapping

Upon successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO 1	Demonstrate nucleotide analysis from various databases	K1
CO 2	Analyze various sequence format from different database	K2
CO 3	Perform basic phylogenic analysis for species identification	K2
CO 4	Apply the sequencing skills in various molecular analysis	K3
CO 5	Identify and analyze Structural classifications of Proteins	K3

Mapping of CO with PO and PSOs

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	2	3	2	3	3	2
CO2	3	3	3	3	2	3	2	3	3	2
CO3	3	2	3	3	2	3	2	3	3	1
CO4	3	2	3	3	1	3	2	2	3	1
CO5	3	3	3	3	2	3	2	1	3	2

"1" – Slight (Low) Correlation, "2" – Moderate (Medium) Correlation, "3"– Substantial (High) Correlation, "-" indicates there is no Correlation.

Syllabus

1. Retrieval of Nucleotide Sequence from GenBank, EMBL, DDBJ database.
2. Retrieval of Protein Sequences from PIR, Swissprot/ Uniprot database.
3. Sequence file formats GenBank, FASTA and PIR.
4. Structure database –PDB and Pubchem.
5. Motif and domain analysis using PROSITE and SMART Motif database.
6. Pairwise Sequence analysis using BLAST.
7. Multiple Sequence analysis using ClustalW.
8. Construction of Phylogenetic tree.
9. Structural Databases of Proteins-SCOP and CATH
10. Pathway search using KEGG database.
11. Molecular visualization using Rasmol.
12. Homology Modeling using SWISS – MODEL Workspace.

Reference Books

1. Sofi, M. Y., Shafi, A., Masoodi, K. Z. (2021). *Bioinformatics for everyone*. Academic Press.
2. Shaik, N. A., Hakeem, K. R., Banaganapalli, B., Elango, R. (2019). *Essentials of Bioinformatics,Volume II.* Springer International Publishing.
3. Lassez, J. L., Rossi, R., Sheel, S. (2016). *Introduction to Bioinformatics using Action Labs*. Lulu.com.
4. Ranganathan, S., Nakai, K., Schonbach, C. (2018). *Encyclopedia of bioinformatics andcomputational biology: ABC of bioinformatics*. Elsevier.
5. Su, C. (2006). *Bioinformatics: A Practical Guide to the Analysis of Genes & Proteins.*Third edition.John Wiley & Sons.

E- Books

1. https://books.google.co.in/books?hl=en&lr=&id=RQcPBAAAQBAJ&oi=fnd&pg=PP1&dq=bioinformatics+practical+&ots=ShaasZise2&sig=l-M9XZr8TWA5zHy5o3YY2C420nQ&redir_esc=y#v=onepage&q=bioinformatics%20practical&f=false
2. https://link.springer.com/book/10.1007/978-3-540-74268-5
3. https://link.springer.com/article/10.1385/MB:23:2:139

Web Links

1. https://www.youtube.com/watch?v=rhCGy2ZndYo
2. https://www.youtube.com/watch?v=cq5lpR2Hqgw
3. https://www.youtube.com/watch?v=CBi0mXsG70s
4. https://www.youtube.com/watch?v=LokO-iFJdqc

Pedagogy

Practical Observation and Demo

Course Designer

Ms. R. NEVETHA

Semester – III	Internal Marks: 25			External Marks: 75
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HOURS/WEEK**	**CREDITS**
22UBT3GEC1	**BASICS OF BIOTECHNOLOGY**	**GENERIC ELECTIVE**	**2**	**2**

Course Objectives

- To study the basic concepts of Biotechnology
- To familiarize with the basic tools and techniques employed in Biotechnology
- To understand the applications of biotechnological aspects in various fields

Course Outcome and Cognitive Level Mapping

Upon successful completion of the course, the students will be able to

CO Number	CO Statement	Cognitive Level
CO1	Understand and explain the basic concepts and significant findings in the field of biotechnology.	K1, K2
CO2	Illustrate the structure and function of cells and their organelles.	K2
CO3	Classify the basic structure of DNA, RNA the flow of genetic information.	K2
CO4	Apply the knowledge of rDNA technique in creating genetic modified organisms.	K3
CO5	Analyze the different applications of biotechnology in various field.	K4

Mapping of CO with PO and PSOs

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	2	1	3	3	3	3	1
CO2	3	3	2	2	1	3	3	2	2	2
CO3	3	3	3	2	2	3	3	3	2	1
CO4	3	3	3	3	3	3	3	2	2	1
CO5	3	2	3	3	3	3	3	2	3	3

"1" – Slight (Low) Correlation, "2" – Moderate (Medium) Correlation,
"3" – Substantial (High) Correlation, "-" indicates there is no correlation.

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	**Biotechnology:** Definition, Brief history, Scope and branches of biotechnology – Ancient and Modern Biotechnology.	6	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
II	**Introduction to cells:** Discovery of cells - Types of cells -Structure of prokaryotic (Bacteria – *E. coli*) eukaryotic cells - Plant and Animal cell and their organelles.	6	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
III	**Structure and components of nucleic acids**: DNA Structure, RNA – Structure and its types. DNA as genetic material – Griffith's experiment and Chase Experiment. RNA as genetic material- Fraenkel experiment.	6	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
IV	**Introduction to recombinant DNA (rDNA) technology**: Steps involved in rDNA technology. Enzymes in rDNA technology - Restriction Enzymes -Types of Endonucleases and Exonucleases.	6	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
V	**Applications of biotechnology invarious fields:** Food, Agriculture, Therapeutics, Molecular Diagnostics, Waste treatment and Energy Production.	6	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
VI	**Self-Study for Enrichment (Not Included for End Semester Examination)** Biotechnology in India, Cell theory, Forms of DNA, Different types of vectors used in rDNA technology.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4

Text Books

1. Dubey, R. C. (2022). *A text book of Biotechnology*. 2022 Edition. S Chand Publication.
2. Thieman, W. J. & Palladino, M. A. (2021). *Introduction to Biotechnology*. 4th Edition. PearsonPublishers.
3. Satyanarayana, U. (2020). *Biotechnology*. Books and Allied Ltd. Publishers.
4. Karp, G., Iwasa, J., Marshall, W. (2019). *Karp's Cell and Molecular Biology*. 9th Edition. WilleyPublishers.
5. Das, H. K. (2017). *Textbook of Biotechnology*. 5th Edition. Willey Publisher

Reference Books

1. Khan, F. A., Taylor, F. (2020). *Biotechnology Fundamentals.* 3rd Edition. Taylor and FrancisPublishers.
2. Lal, R. (2020). *An Introduction to Biotechnology*. Dreamtech Press Publishers.
3. Irvine, D. (2018). *An Introduction to Genetic Engineering.* Syrawood Publishing House.
4. Glick, B. R. (2018). *Molecular Biotechnology: Principles and Applications of Recombinant DNA.* 5th Edition Indian Reprint. ASM Press Publishers.
5. Griffith, R. (2017). *Cell biology (Meiosis & Mitosis).* Larsen and Keller Education Publishers.

Web Links

1. https://thunderbooks.files.wordpress.com/2009/05/introduction-to-biotechnology-and-genetic-engineering-infinity-2008.pdf
2. https://www.sciencedirect.com/book/9780128012246/biotechnology-for-beginners
3. https://www.medicosrepublic.com/biotechnology-2nd-edition-pdf-free-download/
4. https://www.academia.edu/36555620/Biotechnology_Book
5. https://www.ncbi.nlm.nih.gov/pubmed/

E Books

1. https://www.pdfdrive.com/molecular-biotechnology-principles-and-applications-of-recombinant-dna-d33452385.html
2. https://www.infobooks.org/free-pdf-books/biology/biotechnology/
3. https://www.sciencedirect.com/book/9781907568282/an-introduction-to-biotechnology
4. https://vulms.vu.edu.pk/Courses/BT301/Downloads/Basic%20Biotechnology-Third%20Edition.pdf
5. https://ncert.nic.in/textbook/pdf/lebo111.pdf

Pedagogy

Chalk and Talk, PPT, Videos and Animations

Course Designer

Dr. G. GOMATHI

Semester – IV	Internal Marks: 25			External Marks: 75
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HOURS/WEEK**	**CREDITS**
23UBT4CC5	**IMMUNOLOGY**	**CORE COURSE – V**	**6**	**5**

Course Objectives

- To know about the immune system and their functions.
- To learn about humoral and cell mediated immunity.
- To acquire knowledge about the vaccines and its types.
- To study about Principle, Methodology and applications of various Immunological techniques
- To know the significance of various immunological disorders and their remedies

Course Outcome and Cognitive Level Mapping

Upon successful completion of the course, the students will be able to

CO Number	CO Statement	Cognitive Level
CO 1	Demonstrate and distinguish the types of lymphoid organ involved in immune system.	K1, K2
CO 2	Describe and Differentiate humoral and Cell mediated immunity	K2, K3
CO 3	Illustrate and justify the Principle, Methodology and applications ELISA, Fluorescent antibody techniques and Monoclonal antibody production	K3, K4
CO 4	Infer the structure and explain the functions of MHC Molecules and different types of Vaccines and clinical transplantation	K5, K6
CO 5	Explain the causes of Immunological Disorders and Tumor Immunity	K6

Mapping of CO with PO and PSOs

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	2	2	3	3	2	2	2
CO2	3	3	3	2	2	3	3	3	2	2
CO3	3	3	3	2	2	3	3	3	2	3
CO4	3	3	3	3	2	3	3	3	3	3
CO5	3	3	3	3	2	3	3	3	3	3

"1" – Slight (Low) Correlation, "2" – Moderate (Medium) Correlation,
"3" – Substantial (High) Correlation, "-" indicates there is no Correlation.

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	**Unit I - Basics of Immunology** Scope of Immunology, Historical background of Immunology, Biological aspects of Immunology, Essential features of Ag. Classification of Immunoglobulins: Types –IgG, IgM, IgA, IgD and IgE (Origin, structural functions). T- Cells and B-Cells Development, Maturation and activation.	18	CO1, CO2, CO3,	K1, K2, K3, K4
II	**Unit II-Types of Immunity** Types: Active and passive immunity. Cell mediated immunity and humoral immunity. Natural built in barriers – skin, semen, saliva, tears, enzymes.. Complement components, natural killer cells, macrophages, phagocytosis, pinocytosis. Inflammatory response. Mucosal and Gut associated lymphoid tissue (MALT and GALT) and mucosal immunity.	18	CO1, CO2, CO5	K1, K2, K3, K4
III	**Unit III - Immunological techniques** Immunodiffusion, one and two dimensional, single radial immunodiffusion, Ouchterlony immunodiffusion. Immuno-electrophoresis: Rocket immunoelectrophoresis; Agglutination: Direct and Indirect - Widal test. ELISA – Principle, Methodology and applications.	18	CO3, CO4, CO5	K1, K2, K3, K4
IV	**Unit IV - Vaccines and Transplantation** Inactivated, attenuated Recombinant vaccines, Peptide, DNA vaccines and RNA vaccine - Covid vaccine. Synthetic vaccines, plant-based vaccine. Transplantation: Mechanism, Types of Grafts, Graft rejection, General and specific immunosuppressive therapy; Clinical transplantation	18	CO3, CO4, CO5	K1, K2, K3, K4
V	**Unit V - Hypersensitivity and Tumor Immunity** Hypersensitivity Reaction Type I and II with examples. Autoimmune disease. Types of tumors, tumor Antigens, causes and therapy for cancers. Monoclonal antibody production.	18	CO4, CO5	K1, K2, K3, K4
VI	**Self-Study for Enrichment** **(Not Included for End Semester Examination)** MHC I & II	-	CO1, CO2,	K1, K2, K3, K4

Text Books

1. A.B. Singh. (2021). *Allergy and Allergen Immunotherapy Unknown Binding.*Apple Academic Press Inc.; 1st edition
2. Lauren M.Sompayrac (2019).*How the Immune system works. 6th Edition.*Wiley Blackwell.
3. Dr.P.Madhavee Latha (2018). *A Textbook of Immunology.* S.Chand Publishing.
4. Abul K.Abbas, Andrew H.Lichtman Shiv Pillai.(2017).*Cellular and Molecular Immunology.* 9th Edition Elsevier
5. Warren Levinson *Review of Medical Microbiology and Immunology*.(2016). Mc Graw Hill Education .
6. Louis Hawley Richard J Ziegler Benjamin L Clarke BRS.(2015). *Immnology and Microbiology (6th Edition)*. Lippincott Williams and Wilkins

Reference Books

1. David Male, R. Stokes Pebbles, Victoria Male. (2020). *Immunology*. Elsevier Health Sciences Publishers.
2. Abul K.Abbas, AndrewH.Lichtman Shiv Pillai.(2019).*Basic Immunology.* Edition.Elseiver
3. Jenni Punt, Sharon Stranford, Patrica Jones,Judith Owen. (2018). *Kuby Immunology.* 8th Edition. ML IE PRNT
4. Peter,J.Delves,Seamus,J.Martin, Dennis R.Burton, Ivan M.RoitRoitt's.(2017).*Essential Immunology.1st Edition*.Wiley Blackwell
5. Kenneth Murphy. (2016). *Casey Weaver Janeway's Immunobiology*. *9th Edition* Garland Science.
6. Kathy M.Durkin(2010).*Understanding the Vaccines and the Immune system.1st Edition* Nova Science.Pub.Inc

E-Books

1. https://archive.org/details/cellular-and-molecular-immunology-10th-edition
2. https://www.frontiersin.org/research-topics/463/emerging-immune-functions-of-non-hematopoietic-stromal-cells
3. https://assets.cambridge.org/97805217/04892/frontmatter/9780521704892_frontmatter.pdf
4. https://drive.google.com/file/d/18n7FAu3MzWqwUZPblrKWtiA_nBM5STTd/view?pli=1
5. https://www.ncbi.nlm.nih.gov/books/NBK10779/

Web Links

1. https://microbenotes.com/immunity/
2. https://www.coursera.org/learn/immunology-innate-immune-system
3. https://www.bing.com/videos/riverview/relatedvideo?&q=Immune+System+Notes%3a+Diagrams+%26+Illustrations+%7c+Osmosis&qpvt=Immune+System+Notes%3a+Diagrams+%26+Illustrations+%7c+Osmosis&mid=55E74851E85FF7ED932255E74851E85FF7ED9322&&FORM=VRDGAR
4. https://www.osmosis.org/notes/Immune_System
5. https://geekymedics.com/category/medicine/immunology/

Pedagogy

Lecture, Power point presentation, Seminar, Assignment, Quiz, Group Discussion, Video/Animation

Course Designer

Dr. R. UMA MAHESWARI

Semester – IV	InternalMarks:40		External Marks: 60	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HOURS/ WEEK**	**CREDITS**
22UBT4CC4P	**IMMUNOLOGY (P)**	**CORE PRACTICAL –IV**	**4**	**4**

Course Objectives

- To study about the Identification of Blood Group.
- To enumerate the Blood Cells
- To studyabout the Immunoelectrophoresis Techniques
- Enable the students with diagnostic skills for identification of certain diseases andimmunological techniques.
- To examine viral fever by agglutination test

Course Outcome and Cognitive Level Mapping

Upon successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO 1	Define and Demonstrate the methods to identify the Blood Cells	K1, K2
CO 2	Elaborate and determine the experiments for Enumeration of Blood Cells	K2, K3
CO 3	Apply the techniques for Plasma and Serum Separation and examine the Blood Group types	K3, K4
CO 4	Criticize the diagnostic skills for different types of Immunoelectrophoresis techniques.	K5
CO 5	Explain how the detection of viral fever by slide agglutination tests.	K6

Mapping of CO with PO and PSOs

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	2	2	3	3	2	2	3
CO2	3	3	3	2	2	3	3	3	2	3
CO3	3	3	3	2	2	3	3	3	2	3
CO4	3	3	3	3	2	3	3	3	3	3
CO5	3	3	3	3	2	3	3	3	3	3

"1" – Slight (Low) Correlation, "2" – Moderate (Medium) Correlation,
"3" –Substantial (High) Correlation, "-" indicates there is no Correlation.

Syllabus

1. Identification of Cells in a Blood Smear.
2. Blood Cell Counting using Haemocytometer
3. Separation of Serum and Plasma
4. Identification of Blood Group
5. Erythrocyte Sedimentation Rate (ESR).
6. Latex Agglutination Test
7. Single Radial Immunodiffusion
8. Precipitation Reaction – AGD
9. Rocket Immunoelectrophoresis.
10. Testing for Typhoid Antigens - Widal Test
11. AMES TEST
12. DOT ELISA
13. Pregnancy Test – HCG
14. Detection of viral fever by slide agglutination tests.

Reference books

1. Dr. Preeti Sharma, Dr. Pradeep Kumar.(2021).*Basics of Immunology.* FirstEdition. IP Innovative Publication Pvt. Ltd.
2. Senthilkumar Balakrishnan, Karthik Kaliaperumal, Senbagam Duraisamy.(2017).*Practical Immunology A Laboratory Manual*.LAP LAMBERT AcademicPublishing, Germany.
3. Wilmore C.Webley.(2017).*Immunology LaboratoryManual*.LAD CustomPublishing, Georgia.
4. Barbara Detrick, John L Schmitz, Robert G Hamilton(2016).*Manual of Molecular and ClinicalLaboratory Immunology*. 8th Edition.ASM Press, Washington, DC.
5. Christine Dorresteyn Stevens.(2016).*Clinical Immunology and Serology*: A Laboratory Perspective.F.A. DavisCompany, Philadelphia.

E – Books

1. https://www.avit.ac.in/lab/biomedical_instrumentation_lab/download/17BMES81/lab_manual._pdf
2. https://www.avit.ac.in/lab/biomedical_instrumentation_lab/download/17BMES81/lab_manual._pdf
3. https://www.avit.ac.in/lab/biomedical_instrumentation_lab/download/17BMES81/lab_ manual.pdf
4. https://www.avit.ac.in/lab/biomedical_instrumentation_lab/download/17BMES81/lab_manual._pdf
5. https://www.avit.ac.in/lab/biomedical_instrumentation_lab/download/17BMES81/lab_manual._pdf
6. https://www.avit.ac.in/lab/biomedical_instrumentation_lab/download/17BMES81/lab_manual._pdf

Weblinks

1. https://faculty.ksu.edu.sa/sites/default/files/immuno-_lecture-1_0.pdf
2. https://www.academia.edu/23738538/Immunology_Lecture_Notes_Immune_Responses
3. https://archive.nptel.ac.in/courses/102/105/102105083/
4. https://microbenotes.com/category/immunology/
5. https://www.bing.com/videos/riverview/relatedvideo?&q=Immunology+lab+notes&qpvt=Immunology+lab+notes&mid=5EEC54E35D3C5584F7025EEC54E35D3C5584F702&&FORM=VRDGAR

Pedagogy

Practical Observation, Video and Demo

Course Designer

Dr. R. UMA MAHESWARI

Semester IV	Internal Marks: 25		External Marks: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HOURS/ WEEK**	**CREDITS**
22UBT4AC6	**BASICS OF FORENSIC BIOLOGY**	**SECOND ALLIED COURSE**	**4**	**3**

Course Objectives

- To develop a comprehensive understanding of the field of forensic biology, including itshistorical development, various branches, and ethical responsibilities.
- To Gain proficiency in physical evidence identification and crime scene investigation,To acquire mastery in Foot, Finger and tyre prints Analysis
- To develop expertise in Fundamental of DNA typing and biological fluid identificationexaminations.
- To develop knowledge about entomology and forensic anthropology and contribute to criminalinvestigations effectively.

Course outcome and Cognitive Level Mapping

Upon successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO 1	Analyze the multifaceted field of forensic biology and ethical considerations to gain a comprehensive understanding.	K1, K2
CO 2	Utilize course knowledge and evidence-based techniques to address intricate forensic challenges.	K2
CO 3	Evaluate the ethical obligations in forensic biology demand impartiality, meticulous chain of custody, and unwavering commitment topreserving evidence integrity.	K3, K4
CO 4	Apply acquired skills to actively contribute to forensic investigations, aiding in crime scene reconstruction, suspect identification, and victim analysis.	K4. K5
CO 5	Utilize forensic methods, like DNA profiling, serology, and entomology for interpreting biological evidence in diverse criminal cases	K6

Mapping of CO with PO and PSOs

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	**3**	**1**	**3**	**3**	**2**	**3**	**1**	**1**	**2**	**3**
CO2	**3**	**1**	**3**	**2**	**3**	**2**	**2**	**1**	**1**	**3**
CO3	**2**	**1**	**2**	**2**	**1**	**2**	**2**	**2**	**3**	**3**
CO4	**2**	**1**	**2**	**2**	**2**	**1**	**1**	**2**	**2**	**3**
CO5	**3**	**1**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

"1" – Slight (Low) Correlation, "2" – Moderate (Medium) Correlation,"3" – Substantial (High) Correlation, "-" indicates there is no Correlation.

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	**Introduction to Forensic Biology:** Forensic Science - Definition - Development of Forensic science in India - Organization and functions of Forensic laboratory. **Documents identification:** Questioned documents, identification of hand writing, type writer and forged signatures- Erasures and alterations on documents and their detection	11	CO1, CO2, CO3	K1, K2, K3, K4
II	**Physical evidences and Crime Scene examinations** **Physical evidences:** classification and significance - Locard's Principle of exchange class and individual characteristics. **Crime Scene examinations** - documentation of crime scene- recognition, collection, preservation and transportation of physical evidence for laboratory examinations. **Fundamentals of photography** - crime scene photography.	13	CO1, CO2, CO3	K1, K2, K3, K4
III	**Foot and Finger prints Analysis** **Foot and tyre impressions** - Walking pattern - Recording and examination of foot prints and tyre prints. **Finger prints -** Fundamental principles - Finger print patterns - classification of finger prints -methods of developments of latent finger prints. .	12	CO1, CO4, CO5	K1, K2, K3, K4
IV	**Examination of biological fluid:** Examination of biological fluids - blood, seminal and saliva stains - forensic characterization of the above stains - stain patterns of the blood, Examination of fibres, hair, bones, teeth and skull - Fundamental of DNA typing.	12	CO1, CO2, CO5	K1, K2, K3, K4
V	**Entomology and Skeletal Analysis:** Role of Entomology in Forensic Investigations: Insect Succession: Forensic Anthropology and its role in the criminal investigations. **Skeletal Analysis**: Techniques for age, sex, and ancestry determination from skeletal remains.	12	CO1, CO2, CO3	K1, K2, K3, K4
VI	**Self-Study for Enrichment** Satellite DNA **(Not Included for End Semester Examination)**	-	CO1, CO2, CO3	K1, K2, K3

TEXT BOOKS

1. James, S. H., & Nordby, J. J. (2002). *Forensic science: an introduction to scientific and investigative techniques*. CRC press.
2. Hall, A. B., & Saferstein, R. (2020). *Forensic Science Handbook, Volume I*. CRC Press.
3. Saferstein, R. (2004). Criminalistics: An introduction to forensic science.
4. Li, R. (2015). *Forensic biology*. CRC press.
5. Amankwaa, A. O. (2019). *Forensic DNA databasing: retention regimes and efficacy*. University of Northumbria at Newcastle (United Kingdom).

REFERENCE BOOKS

1. Carroll, K. (2020). Forensic Science: Fundamentals and Investigations.
2. Butler, J. M. (2005). *Forensic DNA typing: biology, technology, and genetics of STR markers*. Elsevier.
3. Christensen, A. M., Passalacqua, N. V., & Bartelink, E. J. (2019). *Forensic anthropology: current methods and practice*. Academic Press.
4. Sharma B.R., (2020). *Forensic Science in Criminal Investigation and Trials*.6th Edition. Lexis Nexis.
5. Pande.B.B (2022). *Criminal Law and Criminal Justice: Advanced Legal Writings.* Eastern Book Company.

E-BOOKS

1. https://www.pdfdrive.com/forensic-science-an-introduction-to-scientific-and-investigative- techniques-fourth-edition-e158235953.html
2. https://www.pdfdrive.com/scientific-method-applications-in-failure-investigation-and-forensic- science-international-e160960612.html
3. https://www.pdfdrive.com/forensic-science-fundamentals-and-investigations-1st-edition- e26447548.html
4. https://www.pdfdrive.com/introduction-to-forensic-sciences-cnqzu-e17458427.html

PEDAGOGY

Chalk and talk, PPT, Group Discussion, Assignment, Demo, Quiz, Seminar

COURSE DESIGNER

Dr. R. RAMESHWARI

Semester – IV	Internal Marks: 25			External Marks: 75
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HOURS/WEEK**	**CREDITS**
22UBT4GEC2	**APPLIED BIOTECHNOLOGY**	**GENERIC ELECTIVE COURSE**	**2**	**2**

Course Objectives

- To appreciate the role of biotechnology which increase the productivity and protect crops from damage or infestation.
- To impart knowledge about the application of biotechnology to improve the edibility, texture and nutritional composition of food.
- To understand how biotechnology is applied to address environmental problems such as removal of pollution and maintain quality standards.
- To familiarize with the basic concepts of innovative techniques for diagnosing, treating and preventing diseases.
- To understand the policies, rules, and procedures related to biosafety.

Course Outcome and Cognitive Level Mapping

Upon successful completion of the course, the students will be able to

CO Number	CO Statement	Cognitive Level
CO1	Define and outline the significant applications of biotechnology in improving human health.	K1, K2
CO2	Relate the role of biotechnology in monitoring and controlling pollution for sustainable environment.	K2
CO3	Summarize and utilize several molecular techniques for disease diagnosis, treatment and prevention for the betterment of human health.	K2, K3
CO4	Identify potential hazards pertaining to biosafety for the protection of laboratory workers, public, and the environment.	K3
CO5	Infer biotechnological applications that facilitate healthier lives & positively impact society.	K4

Mapping of CO with PO and PSOs

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	2	1	3	3	1	1	1
CO2	3	1	3	1	1	3	3	1	1	2
CO3	1	3	3	1	1	3	2	1	1	1
CO4	3	2	3	3	2	3	3	1	1	2
CO5	3	3	3	2	1	3	3	1	1	2

"1" – Slight (Low) Correlation, "2" – Moderate (Medium) Correlation,
"3" – Substantial (High) Correlation, "-" indicates there is no correlation.

UNIT	CONTENT	HOURS	Cos	COGNITIVE LEVEL
I	**Biotechnology in Agriculture:** History, Genetically modified Crops – Advantages and Applications - Bt Cotton, Bt Brinjal (Pest resistant), GM Mustards (Herbicide Tolerant), Flavr Savr Tomato (Shelf life improvement), Golden Rice (Rich in Vitamin A), Soybean (Rich in oleic acid content).	6	CO1, CO2	K1, K2, K3, K4
II	**Biotechnology in Food:** Principle of Fermentation process. Production of food products – Bread, Dairy, Confectionery and Beverages, Meat, Poultry and Fish products. Food processing and preservation.	7	CO2, CO3	K1, K2, K3, K4
III	**Biotechnology in Environment**: Pollution – Source & types. Health hazards due to pollution. Xenobiotics. Detection of Environmental pollutant - Biosensors. GMOs in Environmental clean-up. Health and Hygiene. Environmental standards and Quality Monitoring	5	CO2, CO4	K1, K2, K3, K4
IV	**Biotechnology in Medicine:** Molecular diagnosis – PCR, ELISA, monoclonal antibodies; Gene therapy – Somatic & Germline; Genetically engineeredproduct - recombinant insulin, Tissue plasminogen activator & Vaccine.	7	CO1, CO3	K1, K2, K3, K4
V	**Biosafety guidelines and regulations** - Importance and Operation. Role of Biosafety Committees - IBSC, RDAC, RCGM, GEAC. Environmental release of GMOs, Risk assessment and management.	5	CO4, CO5	K1, K2, K3, K4
VI	**Self-Study for Enrichment (Not Included for End Semester Examination)** ELSI - Ethical Legal & Social Implications of Biotechnology	-	CO4, CO5	K1, K2, K3, K4

Text Books

1. Dubey, R. C. (2022). *A text book of Biotechnology*. 2022 Edition. S Chand Publication.
2. Thieman, W. J. & Palladino, M. A. (2021). *Introduction to Biotechnology*. 4th Edition. Pearson Publishers.
3. Satyanarayana, U. (2020). *Biotechnology.* Books and Allied Ltd. Publishers.
4. Karp, G., Iwasa, J., Marshall, W. (2019). *Karp's Cell and Molecular Biology*. 9th Edition. Willey Publishers.
5. Das, H. K. (2017). *Textbook of Biotechnology*. 5th Edition. Willey Publishers.

Reference Books

1. Khan, F. A., Taylor, F. (2020). *Biotechnology Fundamentals.* 3rd Edition. Taylor and Francis Publishers.
2. Lal, R. (2020). *An Introduction to Biotechnology.* Dreamtech Press Publishers.
3. Irvine, D. (2018). *An Introduction to Genetic Engineering.* Syrawood Publishing House.
4. Glick, B. R. (2018). *Molecular Biotechnology: Principles and Applications of Recombinant DNA.* 5th Edition Indian Reprint. ASM Press Publishers.
5. Griffith, R. (2017). *Cell biology (Meiosis & Mitosis).* Larsen and Keller Education Publishers.

E Books

1. https://www.pdfdrive.com/basic-and-applied-aspects-of-biotechnology-e158085236.html
2. https://www.pdfdrive.com/molecular-biotechnology-principles-and-applications-of-recombinant- dna-d33452385.html
3. https://www.infobooks.org/free-pdf-books/biology/biotechnology/
4. https://www.sciencedirect.com/book/9781907568282/an-introduction-to-biotechnology
5. https://vulms.vu.edu.pk/Courses/BT301/Downloads/Basic%20Biotechnology- Third%20Edition.pdf
6. https://ncert.nic.in/textbook/pdf/lebo111.pdf

Web Links

1. https://thunderbooks.files.wordpress.com/2009/05/introduction-to-biotechnology-and-genetic- engineering-infinity-2008.pdf
2. https://www.sciencedirect.com/book/9780128012246/biotechnology-for-beginners
3. https://www.medicosrepublic.com/biotechnology-2nd-edition-pdf-free-download/
4. https://www.academia.edu/36555620/Biotechnology_Book
5. https://www.ncbi.nlm.nih.gov/pubmed/

Pedagogy

Chalk and Talk, PPT, Videos and Animations

Course Designer

Ms. P. JENIFER

Semester – IV	Internal Marks: 40			External Marks: 60
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HOURS/ WEEK**	**CREDITS**
22UBT4SEC1P	**MEDICAL LAB TECHNOLOGY - I (P)**	**SKILL ENHANCEMENT COURSE –I**	**2**	**2**

Course Objectives

- To learn and execute various techniques in medical lab techniques.
- To perform hands on training on various immunotechniques, biochemical parameters of urine, various body fluid.
- To study hematological parameters, analysis of various parameters of Immunology involved in the normal health of human.

Course Outcome and Cognitive Level Mapping

Upon the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Demonstrate the basic principles of important techniques in hematology	K1
CO2	Analyze and determine the constituents of blood samples	K2
CO3	Perform basic blood cell counting using various methods	K2
CO4	Apply the knowledge on serological parameters.	K3
CO5	Identify and analyze the parameters for pathological conditions	K3

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	2	1	3	3	2	3	1
CO2	3	3	3	2	1	3	2	2	3	1
CO3	3	3	2	2	1	3	2	2	2	2
CO4	3	3	3	3	1	3	2	2	3	1
CO5	3	3	2	3	1	3	2	2	2	1

"1" – Slight (Low) Correlation, **"2" – Moderate (Medium) Correlation,**
"3" – Substantial (High) Correlation, **"-" indicates there is no correlation.**

Syllabus

1. Anticoagulant vial preparation.
2. Complete Blood Counts.
3. Determination of Hemoglobin.
4. TRBC Count by Hemocytometers.
5. Differential Leukocyte count.
6. Determination of Platelet Count.
7. Determination of ESR by Wintrobe's.
8. Determination of ESR by Westergreen's method.
9. Determination of PCV by Wintrobe's.
10. Erythrocyte Indices- MCV, MCH, MCHC.
11. Absolute Eosinophil Count.

Reference Books

1. Sainani G. S., Rajesh G Sainani. (2018). *A Manual of Clinical and Practical Medicine. SecondEdition*. Jaypee Publishers, Chennai.
2. Gupta. Talwar. (2006). *A Handbook of Practical and Clinical Immunology*.CBS publishers, India.
3. Hannah D.Zane. (2001). *Immunology, Theoretical and Practical Concepts in Laboratory Medicine* .Saunders Publishers, UK.
4. Krishna Das.KV.(2013). *Clinical Medicine, A Text Book of Clinical Methods and Laboratory Investigations*. Jaypee publishers, Chennai.
5. Baker.F.J, Selverton.R.E. *Introduction To Medical Laboratory Technology. Seventh Edition*.Elsievier, USA.

E-books

1. https://www.pdfdrive.com/a-manual-of-laboratory-and-diagnostic-tests-e157742334.html
2. https://www.pdfdrive.com/lippincott-manual-of-nursing-practice-e189815788.html
3. \https://www.pdfdrive.com/introduction-to-genetic-analysis-solutions-megamanual- e158762003.html

Web links

1. https://egyankosh.ac.in/bitstream/123456789/16314/1/Experiment-8.pdf
2. https://uou.ac.in/sites/default/files/slm/MSCBOT-510(L).pdf
3. https://vlab.amrita.edu/?sub=3&brch=76&sim=1089&cnt=1
4. https://webstor.srmist.edu.in/web_assets/srm_mainsite/files/files/BT0213%20-
5. %20CELL%20BIOLOGY%20PRACTICAL%20MANUAL.pdf
6. https://www.iitg.ac.in/cseweb/vlab/anthropology/procedure_mendels.html

Pedagogy

Practical Observation, Video and Demo

Course Designer

Dr. M. KEERTHIGA

Course Objectives

Semester V	Internal Marks : 25		External Marks : 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HOURS/ WEEK**	**CREDITS**
23UBT5CC6	**PLANT BIOTECHNOLOGY**	**CORE COURSE-VI**	**6**	**5**

- To know the basic principles and techniques involved in plant tissue culture.
- To study the importance of plant models.
- To acquire knowledge about the concepts of transformation in Plant Biotechnology.
- To understand the achievements of biotechnology in plant system.
- To explore and understand the diverse applications of molecular markers in plant breeding.

Course outcome and Cognitive Level Mapping

Upon successful completion of the course, the students will be able to

CO Number	CO Statement	Cognitive Level
CO1	Demonstrate a comprehensive understanding of plant biotechnology, encompassing plant tissue culture, genome organization, transgenic plant technology, biofertilizers, and molecular breeding techniques.	K1, K2
CO2	Develop practical skills in establishing and maintaining plant tissue cultures, including media preparation, explant selection, and regeneration techniques for plant propagation.	K2
CO3	Gain proficiency in analyzing plant genome organization, including nuclear, chloroplast, and mitochondrial genomes, and apply this knowledge to genetic studies and plant breeding.	K3
CO4	Evaluate the principles and applications of transgenic plants, including their role in biotic and abiotic stress resistance, crop improvement, and biosafety considerations.	K4
CO5	Acquire the ability to apply molecular techniques, such as DNA markers, linkage analysis, and QTL mapping, in modern plant breeding practices, while adhering to ethical and biosafety standards.	K4

Mapping of CO with PO and PSO

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	2	1	3	3	1	1	1
CO2	3	1	3	1	1	3	3	1	1	2
CO3	1	3	3	1	1	3	2	1	1	1
CO4	3	2	3	3	2	3	3	1	1	2
CO5	3	3	3	2	1	3	3	1	1	2

"1" – Slight (Low) correlation **"2" - Moderate (Medium) correlation**
"3" – Substantial (High) correlation **"_" indicates there is no correlation**

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	**Plant Tissue Culture and Regeneration Techniques** Introduction to Plant Tissue Culture and Culture Media: History and significance of plant tissue culture. Types of culture media: solid vs. liquid, basal vs. specialized. Composition and preparation of culture media. Sterilization techniques for culture media and equipment. Explant selection criteria and preparation.	17	CO1, CO2, CO3	KI, K2, K3, K4, K5
II	**Plant Tissue Culture and Somaclonal Variations:** Types of culture (Callus, Suspension, Meristem, Embryo, Anther and Root). **Regeneration Methods and Somaclonal Variations:** Organogenesis: Shoot and Root formation. Somatic embryogenesis. Somaclonal variations: Production of Haploids. Nurturing and manipulating protoplasts: Culture and regeneration strategies. Fusion of protoplasts: Techniques, significance.	19	CO1, CO2, CO3,	KI, K2, K3, K4, K5
III	**Deciphering *Arabidopsis thaliana* Genome Organization** Introduction to Arabidopsis thaliana as a premier model plant species : Landscape of the nuclear genome in Arabidopsis thaliana - Structure and functions of the chloroplast genome - Mitochondrion and its Genome. Cytoplasmic Male Sterility in plants: Mechanisms, applications, and implications.	18	CO1, CO2, CO3,	KI, K2, K3, K4, K5
IV	**Introduction to Transgenic Plants** Genetic engineering and crop improvement – Agrobacterium-mediated transformation: Transgenic plants: Biotic stress resistance (Insect) BT Cotton, BT Mustard, BT Bringal), Virus, Bacteria). Abiotic stress resistance (Herbicide, Drought). Applications of Plant genetic Engineering Improvement : (Flavr savr tamato, Golden Rice. Transformation techniques: GUS assay, Neomycin resistance assay).	20	CO3, CO4, CO5	KI, K2, K3, K4, K5
V	**Applications of Molecular Markers in Plant Breeding** DNA Hybridization-Based Molecular Markers (RFLP) – PCR-Based Molecular Markers (RAPD, AFLP, STS, SNPs, Microsatellites) Genomic enabled breeding methods.	16	CO3, CO4, CO5	KI, K2, K3, K4, K5
VI	**Self-Study for Enrichment (Not Included for End Semester Examination)** Thermosensitive genic Male sterility (TGMS), Production of Organic food, Linkage analysis and Quantitative Trait Loci.	-	CO2, CO3, CO4	KI, K2, K3, K4, K5

Text Books

1. Smith, R. H. (2012). Plant tissue culture: techniques and experiments. academic press. recent reprint of this book
2. Stewart Jr, C. N. (Ed.). (2016). *Plant biotechnology and genetics: principles, techniques, and applications*. John Wiley & Sons.
3. Abdin, M. Z., Kiran, U., & Ali, A. (Eds.). (2017). *Plant biotechnology: principles and applications*. Springer Singapore.
4. Altman, A., & Hasegawa, P. M. (Eds.). (2011). *Plant biotechnology and agriculture: prospects for the 21st century*. Academic press.
5 Singh, B. D., & Singh, A. K. (2015). Marker-assisted plant breeding: principles and practices.

Reference Books

1. Bhojwani, S. S., & Razdan, M. K. (1996). Plant tissue culture: theory and practice. *(No Title)*.
2. Janick, J. (Ed.). (2010). *Plant Breeding Reviews, Volume 23* (Vol. 23). John Wiley & Sons.
3. Nelson, G. C. (2001). *Genetically modified organisms in agriculture: economics and politics*. Elsevier.
4. Gahlawat, S. K., Salar, R. K., Siwach, P., Duhan, J. S., Kumar, S., & Kaur, P. (Eds.). (2017). *Plant biotechnology: recent advancements and developments* (pp. 1-390). Singapore:: Springer.
5. Primrose, S. B., & Twyman, R. (2009). *Principles of genome analysis and genomics*. John Wiley & Sons.

E - books

1. https://www.pdfdrive.com/plant-tissue-culture-third-edition-techniques-and-experiments-e189228999.html
2. https://www.pdfdrive.com/plant-tissue-culture-an-introductory-text-e157392516.html
3. https://www.pdfdrive.com/plant-biotechnology-and-genetics-principles-techniques-e15853574.html
4. https://www.pdfdrive.com/plant-biotechnology-volume-1-principles-techniques-and-applications-e158415461.html
5. https://www.pdfdrive.com/plant-biology-and-biotechnology-volume-ii-plant-genomics-and-biotechnology-e176062706.html

Web References

1. https://r.search.yahoo.com/_ylt=AwrKAluRmB9lCrYGyy3nHgx.;_ylu=Y29sbwMEcG9zAzUEdnRpZAMEc2VjA3Ny/RV=2/RE=1696598289/RO=10/RU=https%3a%2f%2fonlinecourses.nptel.ac.in%2fnoc20_bt36%2fpreview/RK=2/RS=uV1eGcoCnfbF4aAAhBpmHWdAv0U-
2. https://r.search.yahoo.com/_ylt=Awr1TcjWmB9lTA8EdArnHgx.;_ylu=Y29sbwMEcG9zAzMEdnRpZAMEc2VjA3Ny/RV=2/RE=1696598358/RO=10/RU=https%3a%2f%2fnipb.icar.gov.in%2f/RK=2/RS=Nk74kvGCmXV1VpTJfggqTjY_G0o-

Pedagogy

Blackboard, PPT, Videos, Animations, Group Discussion and Quiz.

Course Designer

Dr. R. RAMESHWARI

Semester – V	Internal Marks: 40			External Marks: 60
COURSE CODE	COURSE TITLE	CATEGORY	HOURS/ WEEK	CREDITS
22UBT5CC5P	PLANT & ANIMAL BIOTECHNOLOGY (P)	CORE PRACTICAL	3	3

Course Objectives

➢ To get trained in maintaining aseptic conditions in animal cell culture.

➢ To provide a better understanding of various analytical techniques

➢ To operate and maintain common bio instruments effectively and safely.

Course Outcome and Cognitive Level Mapping

Upon the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Enumerate the cells using hemocytometer	K1
CO2	Explain to maintain aseptic conditions in tissue culture lab	K2
CO3	Demonstrate the method of DNA isolation from various sources and identification in agarose gel electrophoresis.	K2
CO4	Illustrate to culture and maintain animal cell cultures, various method of preservation and counting of viable cells	K3
CO5	Analyze the skills and basic techniques in culturing cells using primary and secondary methods	K4

Mapping of CO with PO and PSO

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	1	2	2	1	3	1	2	3	1
CO2	3	2	2	2	1	3	2	2	2	1
CO3	3	3	2	2	2	3	3	2	2	1
CO4	3	3	2	3	1	3	3	2	3	1
CO5	3	3	3	3	1	3	3	3	3	2

"1" – Slight (Low) Correlation, "2" – Moderate (Medium) Correlation,
"3" – Substantial (High) Correlation, "-" indicates there is no correlation.

Syllabus

1. Introduction to safety and aseptic maintenance of tissue culture laboratory.
2. Isolation of Plant genomic DNA.
3. Isolation of protoplast from spinach leaves by mechanical and enzymatic methods.
4. Protoplast fusion by using polyethylene glycol.
5. Isolation of genomic DNA from animal liver tissue.
6. Quantification of DNA by Spectrophotometric method.
7. Identification of stages during chick embryo development.
8. Assessment of cell viability by cell counting in Haemocytometer.
9. Preparation of animal tissue culture media.
10. Establishment of Primary cell culture *
11. Establishment of Secondary cell culture *
12. Cryopreservation and thawing of cells*

Reference Books

1. Freshney, R. I. (2015). *Culture of animal cells: a manual of basic technique and specialized applications*. John Wiley & Sons.
2. Kasper, C., Charwat, V., & Lavrentieva, A. (Eds.). (2018). *Cell culture technology*. Berlin/Heidelberg, Germany: Springer International Publishing.
3. Thatoi, H., Dash, S., & Das, S. K. (2017). *Practical Biotechnology: Principles and Protocols*. IK International Publishing House.
4. Wilkie, S., Clark, M. S., Leroy, P., Merlino, M., Nègre, S., Caissard, J. C., ... & Bernard, M. (1997). Genomic DNA isolation, southern blotting and hybridization. In *Plant Molecular biology—a laboratory manual* (pp. 3-53). Berlin, Heidelberg: Springer Berlin Heidelberg.
5. Stewart Jr, C. N. (Ed.). (2016). Plant biotechnology and genetics: principles, techniques, and applications. John Wiley & Sons.

E books

1. https://www.academia.edu/21781061/Lab_in_Industrial_Plant_and_Animal_Biotechnology_Students_Manual
2. https://kau.in/sites/default/files/documents/a_plant_biotechnology_laboratory_manual.pdf
3. https://www.bio.org
4. https://www.asas.org
5. https://www.asas.org

Pedagogy

Practical Observation, Video and Demo

Course Designer

Ms. R. NEVETHA

Semester – V	Internal Marks: 25			External Marks: 75
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HOURS/ WEEK**	**CREDITS**
23UBT5CC7	**ANIMAL BIOTECHNOLOGY**	**CORE COURSE**	**6**	**5**

Course Objectives

- ➢ To understand the basic requirements and techniques about Animal Cell Culture.
- ➢ To provide the knowledge about the manipulation of Embryo.
- ➢ To provide basic concepts about Cloning.
- ➢ To provide an overview and current developments in different areas of animal biotechnology.
- ➢ To learn propagation of embryonic stem cells, nuclear transfer technology, animal cloning and stem cell differentiation

Course Outcome and Cognitive Level Mapping

Upon the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Explain the fundamental scientific principles that underlie cell culture and its importance	K1
CO2	Acquire knowledge for isolation, maintain and growth of cells.	K2
CO3	Develop techniques for the production of Growth Hormones, monoclonal antibodies etc.	K3
CO4	Explain proficiency in establishing and maintaining of cell lines.	K3
CO5	Analyze principles and applications of animal cloning and gene therapy along with ethical concerns.	K1

Mapping of CO with PO and PSO

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	1	2	2	1	3	1	2	3	1
CO2	3	2	2	2	1	3	1	2	2	1
CO3	3	3	2	2	1	3	3	2	2	1
CO4	3	3	2	2	1	3	3	2	3	1
CO5	3	3	3	3	1	3	3	3	3	2

"1" – Slight (Low) Correlation, "2" – Moderate (Medium) Correlation,
"3" – Substantial (High) Correlation, "-" indicates there is no correlation.

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	**Animal Cell Culture:** Animal cell culture - Lab Facilities – Infrastructure- Equipment – Culture Vessels. Media Composition – Types – Natural – Synthetic – Semisynthetic – Freezing Media. Reagents – Antibiotics – Trypsin – Indicators.	17	CO1, CO2	K1, K2, K3, K4
II	**Types of Animal Cell Culture:** Types of Cultures – Primary – Secondary – Established Cultures. Culture – Finite – Continuous Culture - Histotypic – Organotypic. Biology of Cultured Cells – Cell Synchronization – Cell Viability – Cytotoxicity.	17	CO1, CO2, CO3	K1, K2, K3, K4
III	**Gene transfer and Developmental Biology:** Gene transfer methods in Animals –Physical - Chemical - Biological methods. Hybridoma technology. Gametogenesis. Stages of embryonic development – Morula, Blastulation, Gastrulation and Organogenesis. Cryopreservation - Sperm - Ova - Embryo of livestock. Artificial Insemination - Super ovulation - In vitro Fertilization- Culture of Embryos - Embryo transfer- Embryo Splitting- Embryo Sexing.	20	CO3, CO4, CO5	K1, K2, K3, K4
IV	**Trangenesis:** Animal Cloning - Basic Concepts. Cloning from Embryonic Cells - Adult cells. Cloning of different Animals - Transgenic Animals – Mice – Sheep - Fish. Products from Transgenic Animals – Insulin – Growth Hormones – Blood Clotting Factors. Merits - demerits. Global Ethical Challenges in Animal Biotechnology	19	CO3, CO4, CO5	K1, K2, K3, K4
V	**Gene Therapy:** Gene Therapy - Types of Gene Therapy- Somatic – Germline Gene Therapy. Approaches – Ex vivo – In vivo Gene Therapy. Gene knock out technology.	17	CO3, CO4, CO5	K1, K2, K3, K4
VI	**Self-Study for Enrichment** Introduction and History of Animal Biotechnology **(Not Included for End Semester Examination)**	-	CO1, CO2	K1, K2, K3

Text Books

1. Verma, A. S., & Singh, A. (Eds.). (2020). *Animal biotechnology: models in discovery and translation 2nd edition*. Academic Press.
2. Singh, B., Mal, G., Gautam, S. K., & Mukesh, M. (2019). *Advances in animal biotechnology*. Springer International Publishing.
3. Scherman, D. (Ed.). (2019). *Advanced textbook on gene transfer, gene therapy and genetic pharmacology: principles, delivery and pharmacological and biomedical applications of nucleotide-based therapies*. World Scientific.
4. Niemann, H., & Wrenzycki, C. (Eds.). (2018). *Animal Biotechnology*. Springer.
5. Gwiasda, K. E., Allender-Hagedorn, S., Chang, Y. Y., Eun, J. Y., Marino, P., Swales, J. M., ... & Dalrymple, L. (2000). Bibliography: Relations of Science to Literature and the Arts 1998. *Configurations*, *8*(3), 429-562.

Reference Books

1. Thieman, W. J., & Palladino, M. A. (2009). Introduction to Biotechnology. 2nd.
2. Lakshmipathy, U., & Thyagarajan, B. (2011). *Primary and stem cells: gene transfer technolo applications*. John Wiley & Sons.
3. Ranga, M. M. (2017). *Animal biotechnology*. Student Edition.
4. Verma, A. S., & Singh, A. (Eds.). (2013). *Animal biotechnology: models in discovery and translation*. Academic Press.
5. van Zutphen, L. F. M. (1998). Animal Biotechnology and Ethics. Edited by Alan Holland and Johnson (1998). Chapman and Hall: London. 352pp. Hardback. Obtainable from the publishe Row, London SE1 8HN, UK (ISBN 0412756803). Price£ 49.00. *Animal Welfare*, *7*(4), 465-4

E - books

1. https://mis.alagappauniversity.ac.in/siteAdmin/dde-admin/uploads/4/ PG_M.Sc._Zoology_350%2042_Animal%20Biotechnology_MSC%20ZOOLOGY_6335.pdf
2. https://nap.nationalacademies.org/read/10418/chapter/1
3. https://www.vet-ebooks.com/biotechnology-in-animals-husbandry/
4. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SBT1305.pdf
5. https://www.kobo.com/in/en/ebook/animal-biotechnology

Web links

1. https://onlinecourses.swayam2.ac.in/cec22_bt07/preview
2. https://nptel.ac.in/courses/102104059
3. https://www.khanacademy.org/science/ap-biology/gene-expression-and-regulation/biotechnology/v/dna-cloning-and-recombinant-dna
4. https://www.khanacademy.org/science/in-in-class-12-biology-india/xc09ed98f7a9e671b:biotechnology-and-its-applications/xc09ed98f7a9e671b:introduction/a/transgenic-animals
5. https://byjus.com/biology/transgenic-animals/

Pedagogy

Power point presentation, Group Discussion, Seminar, Assignment, Animations.

Course Designer

Ms. R. NEVETHA

Semester – V	Internal Marks: 25			External Marks: 75
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HOURS/ WEEK**	**CREDITS**
23UBT5DSE1A	**CANCER BIOLOGY**	**DISCIPLINE SPECIFIC ELECTIVE – I**	**5**	**3**

Course Objectives

- To identify mutations in signal molecules and receptors for cancer Proliferations.
- To learn the risks of cancer treatment (experimental and non-experimental)
- To prevent the occurrence of cancer and to get awareness about prevalence of cancer
- To analyze the genetic and environmental factors which causes cancer
- To enhance the skills in clinical examination techniques biopsy, blood tests for cancer detection.

Course Outcome and Cognitive Level Mapping

Upon the successful completion of the course, students will be able to

CO NUMBER	CO Statement	Knowledge Level
CO1	Demonstrate a comprehensive understanding of the hallmarks of cancer, the regulation of the cell cycle, and the role of mutations in signal molecules and receptors in cancer development.	K1, K2
CO2	Compare and Contrast the genetic and environmental factors that contribute to the development of cancer, and assess their relative impacts.	K2, K3
CO3	Examine and Interpret two intricate mechanisms of cell cycle regulation, including the role of cyclin-dependent protein kinases (CDKs) and CDK inhibitors in cancer, and how these can be targeted in therapy.	K3, K4
CO4	Analyse and Examine the proficiency in the diverse treatment modalities for cancer, including chemotherapy, radiotherapy, immunotherapy, gene therapy, stem cell therapy, and surgical interventions, and understand their applications in different cancer types and stages.	K4, K5
CO5	Explain the skills in clinical examination techniques biopsy, blood tests, etc. and diagnostic imaging (X-rays) for cancer detection. They will also comprehend advances in cancer detection methods, enhancing their ability to assess and adopt emerging technologies in cancer diagnosis.	K6

Mapping of CO with PO and PSOs

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	2	2	3	2	2	2	2
CO2	3	3	2	3	2	3	2	2	2	2
CO3	3	3	2	2	2	3	2	2	2	2
CO4	3	3	3	2	2	2	2	2	2	2
CO5	3	3	3	2	3	1	3	2	3	2

"1" – Slight (Low) Correlation, "2" – Moderate (Medium) Correlation,
"3" – Substantial (High) Correlation, "-" indicates there is no correlation.

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	**Unit I-Fundamentals of cancer biology**Hallmarks of cancer. Regulation of Cell cycle, Mutations that cause changes in signal molecules, effects on receptor, signal switches, tumour suppressor genes, Modulation of cell cycle-in cancer, Different forms of cancers.	15	CO1, CO2, CO3	K1, K2, K3, K4, K5, K6
II	**Unit II- Causative Agents of Cancer** Biology - Genetic Factor, Viruses, Hormones. Lifestyle and Dietary factors, Alcohol consumption and smoking. Environmental and occupational Exposure - Chemical carcinogens and Mutagens.	13	CO1, CO2, CO3	K1, K2, K3, K4, K5, K6
III	**Unit III- Biology of Cancer Cells** Cell Cycle Regulation in Cancer Cell. Cyclin Dependent Protein Kinase, CDK inhibitors. Apoptosis. Molecular Mechanism-Intrinsic and Extrinsic pathway. Oncogene and Tumorsuppressor gene-p53.Metastasis and Angiogenesis.	16	CO2, CO3, CO4	K1, K2, K3, K4, K5, K6
IV	**Unit IV- Cancer Diagnosis** Clinical Examination by Biopsy: Bone marrow Biopsy, Skin Biopsy-Shave biopsy, Punch biopsy, Incisional biopsy, Excisional biopsy. Blood Test-RBC, WBC, Platelets Count, Pap Test. Imaging-X-ray, Endoscopy, Mammography.	16	CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
V	**Unit V- Cancer therapy** Different forms of therapy Chemotherapy, Radiotherapy, Immunotherapy, Gene therapy, Stem Cell Therapy and Surgery Advances in Cancer detection.	15	CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
VI	**Self - Study for Enrichment** **(Not included for End Semester Examination)** Prediction of aggressiveness of Cancer	-	CO1, CO2, CO3	K1, K2, K3, K4, K5, K6

Text Books

1. Gibbons, J. P. (2020). *Khans the Physics of Radiation Therapy with Access Code 6ed.* LWW US Reprint.
2. Edward Chu, Vincent T. Devita Jr. (2019). *Physicians' Cancer Chemotherapy Drug Manual*. Jones and Bartlett Publishers, Inc; 19th edition.
3. Philip J. DiSaia MD William T. Creasman MD, Robert S MannelMD (2017) *Clinical GynecologicOncology*. Elsevier; 9th edition.
4. Clifford L. K. Pang. (2015) *Hyperthermia in Oncology,1st Edition.* CRC Press
5. Robert, E. Bristow, BethY.Karlan, Dennis S. Chi (2015). *Surgery for Ovarian Cancer*, 3rd Edition. CRC Press

Reference Books

1. Sayan Paul (2020). *The Bethesda Handbook of Clinical Oncology* - Wolters Kluwer IndiaPvt. Ltd.
2. Devita V. T. (2019). *Evita hellman and Rosenbergs cancer principles and Practice of oncology 11ED (HB 2019)*. LWW; 11th edition.
3. Dr. Pradeep Kumar (2022). *The Textbook of Cancer Biology*.Prachi Digital Publication.
4. Anjali Susan John Elizabeth John. (2021). *An Overview on Cancer*. Bluerose Publishers Pvt. Ltd.
5. Lakshmi Kalpana, V., Anuradha, A. (2021). *A Textbook of Medical Genetics and Cancer Genetics.* IP Innovative Publication Pvt. Ltd
6. Lauren Pecorino., *MOLECULAR BIOLOGY OF CANCER 5E: Mechanisms, Targets, and Therapeutics.* (2021). OUP Oxford; 5th edition.

Web Links

1. https://www.onlinebiologynotes.com/cancer-etiology-pathophysiology-types-diagnosis-and-treatment/
2. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SBT1606.pdf
3. https://archive.nptel.ac.in/courses/108/108/108108124/
4. https://www.cancer.gov/about-cancer/understanding/what-is-cancer
5. https://www.mayoclinic.org/diseases-conditions/cancer/symptoms-causes/syc-20370588
6. https://my.clevelandclinic.org/health/diseases/12194-cancer

E-Books

1. https://ia801205.us.archive.org/14/items/CancerBiology_201607/cancer%20biologpf
2. https://link.springer.com/book/10.1007/978-3-030-57254-9
3. https://ia801205.us.archive.org/14/items/CancerBiology_201607/cancer%20biology.pf
4. https://mis.kp.ac.rw/admin/admin_panel/kp_lms/files/digital/Core%20Books/Biology/Cancer%20Biology.pdf
5. https://redir.booklibrary.website/library/cancer-biology-and-therapy.pdf

Pedagogy

Lecture, Power point presentation, Seminar, Assignment, Quiz, Group Discussion, Video/Animation

Course Designer

Dr. R. UMA MAHESWARI

Semester – V	Internal Marks: 25			External Marks: 75
COURSECODE	**COURSE TITLE**	**CATEGORY**	**HOURS/ WEEK**	**CREDITS**
23UBT5DSE1B	**HUMAN ANATOMY AND PHYSIOLOGY**	**DISCIPLINE SPECIFIC ELECTIVE**	**5**	**3**

Course Objectives

- To study the levels of structural organization and classification of tissues and organs of human body.
- To familiarize with the working pattern of integumentary and respiratory system of human.
- To know the anatomy and working function of human nervous and cardiovascular system.
- To understand the structure, types and functions of muscular and skeletal system.
- To learn about the basic anatomy and function of urinary and reproductive system.

Course Outcome and Cognitive Level Mapping

Upon successful completion of the course, the students will be able to

CO Number	CO Statement	Cognitive Level
CO1	Define the internal and external structures of the body and their physical relationships.	K1
CO2	Understand the structure and organization of tissues, organs, and systems of human body.	K2
CO3	Classify and explain the types of various systems of human body	K2
CO4	Identify and analyze how different systems work together to maintain health and perform various activities.	K3, K4
CO5	Examine the interaction of chemicals with human system that affect functioning of body.	K4

Mapping of CO with PO and PSOs

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	2	3	1	2	1	3	1	1	1	1
CO2	1	3	1	1	1	3	1	1	1	1
CO3	1	3	1	2	1	3	2	1	1	1
CO4	2	3	2	1	1	3	2	1	1	1
CO5	2	3	3	2	1	3	2	1	1	1

"1" – Slight (Low) Correlation, "2" – Moderate (Medium) Correlation,"3" – Substantial (High) Correlation, "-" indicates there is no correlation.

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	**Introduction to anatomy and physiology:** Levels of structural organization and body systems. General principles of cell communication, intracellular signalling - Contact-dependent, Paracrine, Synaptic & Endocrine. Classification of tissues, structure, location and functions of epithelial, muscular and nervous and connective tissues.	12	CO1, CO2	K1, K2, K3, K4
II	**Integumentary & Respiratory System:** Structure and functions of skin. Receptors: touch, pressure, nociceptors, chemoreceptors, mechanoreceptors. Anatomy of respiratory system with special reference to anatomy of lungs, mechanism of respiration, regulation of respiration.	15	CO2, CO3	K1, K2, K3, K4
III	**Nervous & Cardiovascular system:** Classification of peripheral nervous system: Structure and functions of sympathetic and parasympathetic nervous system. Origin and functions of spinal and cranial nerves. Heart – anatomy of heart, blood vessels. Structure and functions of artery, vein and capillaries, elements of conduction system of heart and its regulation by autonomic nervous system.	17	CO3, CO4	K1, K2, K3, K4
IV	**Endocrine, Skeletal & Muscular System:** Classification of hormones, mechanism of hormone action, structure and functions of pituitary gland, thyroid gland, parathyroid gland, adrenal gland, pancreas, pineal gland, thymus. Skeletal system - types of bone, salient features and functions. Organization of skeletal muscle. Structure, Types and function of muscles. physiology of muscle contraction, neuromuscular junction.	18	CO4, CO5	K1, K2, K3, K4
V	**Reproductive & Urinary system:** Anatomy of male and female reproductive system, Functions of male and femalereproductive system. Anatomy of urinary tract with special reference to anatomy of kidney and nephrons, functions of kidney and urinary tract.	13	CO3, CO5	K1, K2, K3, K4

VI	**Self-Study for Enrichment (Not Included for End Semester Examination)** Cell junctions - Occluding junction, Adhering junction, Desmosome & Gap junction.	-	CO1, CO2	K1, K2, K3, K4

Text Books

1. Shaeena, M.H. & Dr. Baharul Islam, H. (2023). *Textbook of Human Anatomy And Physiology*. PritamPublications.
2. Murugesh, N. (2021). *Human Anatomy And Physiology*. 1st Edition. Sathya Publishers.
3. Venkatesh, D. & Sudhakar H.H. (2020). *Textbook of Medical Physiology*. 3rd Edition. Wolters Kluwer(India) Pvt. Ltd
4. Yalayyaswamy, N.N. (2020). *Human anatomy and physiology for courses in nursing and allied healthsciences*. 4th Edition. CBS Publishers & Distributors Pvt. Ltd.
5. John, E.H. & Michael, E.H. (2020). *Guyton and Hall Textbook of Medical Physiology*, 14th Edition.Elsevier Publisher.

Reference Books

1. Krishna, A.P. (2021). *Fundamentals of Medical Physiology*. 1st Edition. IP Innovative Publication Pvt.Ltd.
2. Bhise, S.B. & Yadav, A. V. (2021). *Human Anatomy and Physiology*. Nirali Prakashan Publisher.
3. Chaudhary, S. & Chaudhary, A. (2021). *Human Anatomy and Physiology*. S Vikas and Company.
4. Comstock, J.L. (2022). *Outlines of Physiology, Both Comparative And Human*. Legare Street Press.
5. Vishram, S. (2020). *Textbook of Clinical Neuroanatomy*. 4th Edition. Elsevier Health Science Publisher.

E Books

1. https://www.pdfdrive.com/principles-of-anatomy-and-physiology-with-a-brief-atlas-of-the-skeleton-surface-anatomy-e184863666.html
2. https://www.pdfdrive.com/essentials-of-anatomy-and-physiology-e25774384.html
3. https://www.pdfdrive.com/fundamentals-of-anatomy-and-physiology-for-nursing-and-healthcare-students-e176005292.html
4. https://www.pdfdrive.com/basic-clinical-pharmacology-e34443843.html
5. https://www.pdfdrive.com/essentials-of-medical-pharmacology-6th-edition-e33763519.html

Web Links

1. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=WR+tSjp4YS3g7BIFEffOcw==
2. https://openstax.org/books/anatomy-and-physiology-2e/pages/1-1-overview-of-anatomy-and_physiology
3. https://www.cartercenter.org/resources/pdfs/health/ephti/library/lecture_notes/nursing_students/ln_human
4. _anat_final.pdf
5. https://medictests.com/units/introduction-to-a-p
6. https://explorehealthcareers.org/field/pharmacology/

Pedagogy

Lecture, Power point presentation, Seminar, Assignment, Quiz, Group Discussion, Video/Animation

Course Designer

Ms P. JENIFER

Semester – V	Internal Marks: 25			External Marks: 75
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HOURS/ WEEK**	**CREDITS**
23UBT5DSE1C	**PHARMACOGNOSY**	**DISCIPLINE SPECIFIC ELECTIVE – I (DSE)**	**5**	**3**

Course Objectives

- To know the fundamentals of Pharmacognosy like scope, classification of crude drugs, their identification and evaluation.
- To study phytochemicals present in the medicinal plants and its properties.
- To know the techniques in the cultivation and production of crude drugs
- To analyse the crude drugs, their uses and chemical nature
- To evaluate the techniques for the herbal drugs.

Course Outcome and Cognitive Level Mapping

Upon the successful completion of the course, students will be able to

CO NUMBER	CO STATEMENT	KNOWLEDGE LEVEL
CO1	Recall and infer the basic concepts for understanding of importance of drugs in the treatment of diseases.	K1, K2
CO2	Illustrate the physical, chemical and medical characters of crude drugs ofplant and mineral origin.	K2
CO3	Design the drug preparation method and explain the characteristic featuresof various drug compounds.	K3. K4
CO4	Classify the drugs and explain the role, method of extraction and its applications.	K4, K5
CO5	Elaborate the effects of drugs in allopathy with traditional systems of Medicine.	K6

Mapping of CO with PO and PSO

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	2	2	3	2	2	1	1
CO2	3	3	2	3	1	3	3	2	2	1
CO3	3	3	2	2	2	3	2	3	3	2
CO4	3	3	3	2	2	2	2	2	2	2
CO5	3	3	3	2	3	3	3	2	3	2

"1" – Slight (Low) Correlation, "2" – Moderate (Medium) Correlation,
"3" – Substantial (High) Correlation, "-" indicates there is no correlation.

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	**Introduction to Pharmacognosy** Definition, #History and Scope of Pharmacogonosy Sources of drugs: Biological, marine, mineral and plants, Classification of drugs: Alphabetical, morphological, taxonomical, chemical and pharmacological basis, Quality control of crude drugs: Adulteration of curde drugs and their detection by organoleptic, microscopic, physical, chemical and biological methods, significance of pharmacopoeial standards.	15	CO1, CO2	K1, K2, K3, K4, K5, K6
II	**Phytochemical screening of Drugs** Phytochemicals: Preparation of extracts, Screening of alkaloids, saponins, cardenolides and bufadienolides, flavonoids and leucoanthocyanidins, tannins and polyphenols, anthraquinones, cynogenetic glycosides, amino acids in plant extracts. Pharmaceutical aids: Study of pharmaceutical aids like talc, diatomite, kaolin, bentonite, gelatin and natural colors.	17	CO1, CO2, CO3	K1, K2, K3, K4, K5, K6
III	**Sources of Natural drugs** Study of the biological sources, cultivation, collection, commercial varieties, chemical constituents, substitutes, adulterants, uses, and specific chemical tests of following groups of drugs containing glycosides: Saponins: ginseng, Dioscorea; Cardioactive sterols: Digitalis; Anthraquinone cathartics: Senna Others: saffron.	16	CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
IV	**Modern pharmacognosy** The development of modern pharmacognosy in organic chemistry - structure prediction using analytic chemistry techniques, including paper, HPTLC and Gas chromatography Mass spectrophotometry for pharmacologically bio-synthesized substances from the plants - Quinine, Nicotine and Vinca alkaloids-vincristine.	14	CO3, CO4	K1, K2, K3, K4, K5, K6
V	**Uses of Secondary Metabolites** Pharmaceutical applications of secondary metabolites like Alkaloids: Rauwolfia; Flavonoids: Lignans, Tea; Triterpenoids: Dioscorea. Volatile oils: Mentha; Tannins: Catechu; Resins: Asafoetida; Glycosides: Bitter Almond.	13	CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

VI	**Self - Study for Enrichment (Not included for End Semester Examination)** Indigenious system of medicine, Fibers used in pharmacy, Drug administration, Extraction methods, Drugs of Marine source.	-	CO4, CO5	K1, K2, K3, K4, K5, K6

Text Books

1. Veronika Butterweck and Robert furst. (2020). *Planta Medica Journal of Medicinal Plant and Natural Product Research.* Thieme.de publishers.
2. Pathania JS. (2020). *Text Book of Pharmacology for Paramedical students*. CBS Publishers and Distributors
3. Dr.Kuntal Das. (2019). *Pharmacognosy and Phytochemistry -II.* Nirali Publishers
4. Tripathy K. D, (2018). *Essentials of Medical Pharmacology (6th edition)*, Jaypee publishers
5. Satoskar R.S, Nirmala N. Rege, and Bhandarkar S. D, (2017). *Pharmacology and Pharmacotherapeutics (Revised 23rd Edition)*, Popular Prakashan, Mumbai.

Reference Books

1. J. S. Qadry. (2018). *Pharmacognosy.* CBS Publishers and Distributors
2. Simone Badal McCreath and Rupika Delgoda. (2016). *Pharmacognosy: Fundamentals, Applications and Strategies* Academic Press.
3. M. A. Iyengar and S.G.K. Nayak. (2018). *Pharmacognosy Lab Manual* Pharma Med press.
4. M.S. Krishnamurthy and JV Hebbar. (2018). *Easy Ayurveda Home Remedies: Based On Authentic, Traditional Ayurveda Practice.* Hand Cover
5. Dr.Kuntal Das (2019). *Pharmacognosy and Phytochemistry –II.* Nirali Publishers.

E-Books

1. https://libguides.tulane.edu/pharmacology/ebooks
2. https://www.pharmaresearchlibrary.com/wp-content/uploads/2013/03/A-Textbook-of-Clinical-Pharmacology-and-Therapeutics-5th-edition.pdf
3. https://www.cartercenter.org/resources/pdfs/health/ephti/library/lecture_notes/health_science_students/pharmacology.pdf
4. https://medicostimes.com/kd-tripathi-pharmacology/
5. https://core.ac.uk/download/pdf/200104466.pdf

Web Links

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5178364/
2. https://www.patentdocs.org/biotech_news/
3. https://www.pharmamanufacturing.com/
4. https://www.parexel.com/
5. https://nptel.ac.in/courses/102/103/102103013/

Pedagogy

Power point presentation, Group Discussion, Seminar, Assignment, Animations

Course Designer

Dr. M. KEERTHIGA

Semester – V	Internal Marks: 40		External Marks: 60	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HOURS/ WEEK**	**CREDITS**
22UBT5SEC2P	**MEDICAL LAB TECHNOLOGY - II (P)**	**SKILL ENHANCEMENT COURSE – II**	**2**	**2**

Course Objectives

- To learn and execute various techniques in medical lab techniques.
- To perform hands on training on various immunotechniques, clinical biochemical parameters of body fluids.
- To study serological parameters for normal and abnormal persons.

Course Outcome and Cognitive Level Mapping

Upon the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Demonstrate the basic principles of important techniques in clinical pathology	K1
CO2	Analyze and determine the glucose, urea, uric acid in body fluid	K2
CO3	Perform basic diagnosis tests for infectious agents	K2
CO4	Apply the knowledge on serological parameters for normal and abnormal persons.	K3
CO5	Identify and analyze body fluids and excretory products	K3

Mapping of CO with PO and PSO

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	2	1	3	3	2	3	1
CO2	3	3	3	2	1	3	2	2	3	1
CO3	3	3	2	2	1	3	2	2	2	2
CO4	3	3	3	3	1	3	2	2	3	1
CO5	3	3	2	3	1	3	2	2	2	1

"1" – Slight (Low) Correlation, "2" – Moderate (Medium) Correlation, "3" – Substantial (High) Correlation, "-" indicates there is no correlation.

Syllabus

1. Qualitative analysis - Identification of Carbohydrates of biochemical importance in biological fluid.
2. Qualitative analysis - Identification of Proteins of biochemical importance in biologicalfluid.
3. Urine analysis – normal & abnormal constituents of urine.
4. Estimation of Glucose in Urine and Blood.
5. Estimation of serum bilirubin.
6. Estimation of serum calcium.
7. Estimation of Total cholesterol in blood.
8. Culture analysis of Urine and blood
9. Microscopic examination of urine for crystals
10. Demonstration of VDRL Test*
11. Demonstration of CRP Test*

* Practical by demonstration only

Reference Books

1. Nanda Maheshwari. (2022). *Clinical Microbiology & Parasitology for DMLT Students*. Fourthedition, Jaypee Brothers Medical Publishers;
2. Henry Harvin. (2021). *Medical Laboratory Technician Handbook.* Henry Harvin Education.
3. Sainani G. S., Rajesh G Sainani. (2018). *A Manual of Clinical and Practical Medicine*. SecondEdition. Jaypee Publishers, Chennai.
4. Krishna Das.KV.(2013). *Clinical Medicine, A Text Book of Clinical Methods and Laboratory Investigations*. Jaypee publishers, Chennai.
5. Baker.F.J, Selverton.R.E. (2012). *Introduction To Medical Laboratory Technology*. SeventhEdition. Elsievier, USA.

E books

1. https://www.pdfdrive.com/a-manual-of-laboratory-and-diagnostic-tests-e157742334.html
2. https://www.pdfdrive.com/lippincott-manual-of-nursing-practice-e189815788.html
3. https://www.pdfdrive.com/introduction-to-genetic-analysis-solutions-megamanual-e158762003.html
4. https://www.jaypeedigital.com/book/9789350908518
5. https://bookpdf.co.in/vmc-lab-technician-notes-2021-download-vmc-lab-technician- study-materials/

Web links:

1. https://egyankosh.ac.in/bitstream/123456789/16314/1/Experiment-8.pdf
2. https://uou.ac.in/sites/default/files/slm/MSCBOT-510(L).pdf
3. https://vlab .amrita.edu/?sub=3&brch=76&sim=1089&cnt=1
4. https://webstor.srmist.edu.in/web_assets/srm_mainsite/files/files/BT0213%20-%20CELL%20BIOLOGY%20PRACTICAL%20MANUAL.pdf
5. https://www.iitg.ac.in/cseweb/vlab/anthropology/procedure_mendels.html

Pedagogy

Practical Observation, Video and Demo

Course Designer

Dr. M. KEERTHIGA

Semester – VI	Internal Marks: 25		External Marks: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HOURS / WEEK**	**CREDITS**
23UBT6CC9	**MICROBIAL & ENVIRONMENTAL BIOTECHNOLOGY**	**CORE**	**6**	**5**

Course Objectives

- To know the industrially important microbes and their metabolic pathways.
- To study the microbial fermentation processes and its types.
- To acquire knowledge about the types of bioreactors and recovery of fermentation product.
- To study the concepts of pollution management.
- To provide the knowledge about Biodegradation and Bioremediation.

Course Outcome and Cognitive Level Mapping

Upon successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO 1	Demonstrate the isolation of industrially important microorganisms and their preservation	K1
CO 2	Outline a clear and concise idea about concepts and basic methods in fermentation process	K2
CO 3	Discuss the design and types of Bioreactor and upstream and Downstream processing	K3
CO 4	Illustrate the utilization of microbial processes in waste.	K4
CO 5	Analyse the Process of Biodegradation and Bioremediation.	K5

Mapping of CO with PO and PSOs

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	2	2	3	3	2	2	2
CO2	3	3	3	2	2	3	3	3	2	2
CO3	3	3	3	2	2	3	3	3	2	3
CO4	3	3	3	3	2	3	3	3	3	3
CO5	3	3	3	3	2	3	3	3	3	3

"1" – Slight (Low) Correlation, "2" – Moderate (Medium) Correlation, "3" – Substantial (High) Correlation, "-" indicates there is no Correlation.

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	**Unit I - Basic principles of Biochemical Engineering** Introduction and historical developments in industrial microbiology, industrially important microbes and metabolic pathways- various microbial metabolites and their overproduction – Isolation and selection of industrially important microorganisms preservation and maintenance of microbial culture.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
II	**Unit II - Concepts of basic mode of fermentation processes** Components of microbial fermentation process; Types of fermentation processes- Solid state, static and submerged fermentation. Fermenter design - mechanically agitated, pneumatic and hydrodynamic fermenters. Design of laboratory bioreactor; Types of Bioreactor: Continous, semi continuous and fed batch bioreactors; Continuous Stirred tank bioreactors, Bubble column bioreactors, Air lift bioreactors, Fluidized bed bioreactors, Packed bed bioreactors and Photobioreactors.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
III	**Unit III – Upstream and Downstream Processing** **Upstream Processing:** Media formulation, sterilization, aeration, agitation and air sterilization. Measurement and control of bioprocess parameters,scale up and scale down process. **Downstream Processing:** Bioseparation - filtration, centrifugation, sedimentation, flocculation, microfiltration, sonication. Cell disruption – enzymatic lysis and liquid-liquid extraction. Purification by precipitation (ammonium sulfate), electrophoresis and crystallization. Extraction - Reverse osmosis and ultra filtration. Drying, crystallization, storage and packaging. Industrial Production of Wine and Penicillin.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4

IV	**Unit IV: Introduction to Environmental Biotechnology** Basic components of environment. Definition – concept and scope of ecosystem, abiotic and biotic components. Environmental pollution: Air - Types of Air Pollutants: Sources, Effects and control of Air pollution. Water pollution- Sources, Basic Components of Environment. Definition -Concept and Scope of Ecosystem, Abiotic and Biotic components. Environmental pollution: Air-Types of Air pollutants: Sources effects and Control of air pollution. Water pollution – Sources, Effects and control of Water pollution. Soil Pollution- Sources, Effects and control of soil pollution. Liquid Waste management. Sewage water treatment – Process of Waste water treatment. Effluent Treatment - Mechanical treatments, Biological treatments, Chemical treatments.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
V	**Unit V: Biodegradation and Bioremediation** Principle and mechanism of biodegradation, Biodegradation of xenobiotic compounds (Lignin, Hydrocarbons, Detergents, Dyes and pesticides). Biodegradation of agro chemicals and other organic compounds – Biotransformation of xenobiotic compound; Bioremediation- Principles - Phytoremediation: Use of plants for removal of organic and metallic pollutants.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
VI	**Self-Study for Enrichment** **(Not Included for End Semester Examination)** Oxidation Ponds, Bioscrubbers and Biofertilizer	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4

Text Books

1. Bhat, R.A. (2022). Environmental Biotechnology. 1st Edition. Taylor and Francis Ltd
2. Bharani. A, Senthilraja. K. (2022). *An Introduction to Environmental Biotechnology: An insight into it's latest Advancements*. Scientific Publishers,India.
3. Arvind .K.(2021). *Environmental Biotechnology*. Daya Publication House.
4. Joginder Singh, AshishVyas, Shanquanwang, Ram Prasad. (2020). *Microbial Biotechnology: Basic Research and Applications.* Springer Nature Singapore pvt.Ltd.
5. Bruce E. R, Perry L. M. (2020). *Environmental Biotechnology: Principles and Applications.* 2nd Edition. McGraw-Hill Education.

Reference Books

1. Debabrata. D, Soumya. P. (2021). *Industrial Biotechnology*. CRC Press.
2. Bernard R.G, JackJ.P. (2017). *Molecular Biotechnology Principles and Applicationsof Recombinant DNA.* Wiley Publication.
3. Clarke, W. (2016). *A Textbook of Industrial Microbiology.* 1st Edition. CBS Publishers.
4. Allen.K.(2016). *Environmental Biotechnology*. CBS Publishers.
5. Jogdand. S.N. (2010). *Environmental Biotechnology*. Himalaya Publishing House**.**

E Books

1. https://www2.hcmuaf.edu.vn/data/quoctuan/Environmental%20Biotechnology%20-%20Theory%20and%20Application,%20G%20M%20Evans%20&%20J%20C%20Furlong.pdf
2. https://portal.abuad.edu.ng/lecturer/documents/1585662755MICROBIAL_BIOTECHNOLOGY___Fundamentals_of_Applied_Microbiology,_Second_Edition.pdf
3. https://biblioseb.wordpress.com/wp-content/uploads/2018/03/environmental-biotechnology-jordening-and-winter.pdf
4. file:///C:/Users/hp/Downloads/textbook-of-environmental-biotechnology-9385059874-9789385059872_compress.pdf

Web Reference

1. https://mis.alagappauniversity.ac.in/siteAdmin/ddeadmin/uploads/4/PG_M.Sc._Microbiology_36442%20Microbial%20Biotechnology.pdf
2. https://www.scribd.com/document/378006391/Environmental-Biotechnology-Lecture-Notes-Study-Material-and-Important-Questions-Answers
3. https://egyankosh.ac.in/bitstream/123456789/95582/1/Block-1.pdf
4. https://unaab.edu.ng/funaab-ocw/opencourseware/Environmental%20Biotechnology.pdf
5. https://egyankosh.ac.in/bitstream/123456789/95583/1/Unit-1.pdf

Pedagogy

Lecture (Chalk and Talk) & Power Point Presentation, Quiz, Seminar, Assignment & Group Discussion. Videos and Animations

Course Designer

Ms. P. ILAMATHY

Semester – VI	Internal Marks: 40		External Marks: 60	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HOURS / WEEK**	**CREDITS**
22UBT6CC6P	**MICROBIAL & ENVIRONMENTAL BIOTECHNOLOGY (P)**	**CORE PRACTICAL –VI (CP)**	**3**	**3**

Course Objectives

- To equip the students with skills pertaining to immobilization and genetic engineering techniques.
- To acquire hands-on exposure to fermentation techniques.
- To get skilled in the production techniques of Single Cell Protein, Biofertilizer and Bio- Enzymes.
- To get hands on training in isolation of industrial important microbes and production of various products such as azolla, mushroom, vermicompost and enzyme.
- To understand and learn the concepts of Water quality analysis techniques.

Course Outcome and Cognitive Level Mapping

Upon successful completion of the course, the students will be able to

CO Number	CO Statement	Cognitive Level
CO 1	Demonstrate and Enumerate the industrially important microorganisms.	K1,K2
CO 2	Describe Handle and establish the techniques of Immobilization.	K2, K3
CO 3	Illustrate the principle and production of Single Cell Protein, Biofertilizer and Bio -Enzymes.	K3, K4
CO 4	Explain the methods of isolation and culture of industrially important microorganisms, mushroom, vermiculture and product production	K5, K6
CO 5	Analyse the physical and chemical parameters of water sample	K6

Mapping of CO with PO and PSOs

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	2	2	3	3	2	2	2
CO2	3	3	3	2	2	3	3	3	2	2
CO3	3	3	3	2	2	3	3	3	2	3
CO4	3	3	3	3	2	3	3	3	3	3
CO5	3	3	3	3	2	3	3	3	3	3

"1" – Slight (Low) Correlation, "2" – Moderate (Medium) Correlation, "3" – Substantial (High) Correlation, "-" indicates there is no Correlation.

Syllabus

1. Isolation of industrially important microorganisms from soil
2. Isolation of Lactic acid bacteria.
3. Immobilization of yeast cells by Sodium Alginate method.
4. Isolation of amylase producing organisms.
5. Wine production by yeast.
6. Production of Bio-Enzyme from Food waste.
7. Isolation of Arbuscular mycorrhizal fungi from plant roots
8. Cultivation of Azolla
9. Process of Mushroom Cultivation
10. Process of Vermicomposting
11. Degradation of the organic wastes using the isolated soil microbes and enzymes.
12. Determination of Total alkalinity of water sample
13. Determination of the Acidity of the given water
14. Bioassay techniques for antibiotics by Disc method.
15. Test for Antibiotic sensitivity of microorganisms by Agar well diffusion method.

Reference Books

1. Sibi G.*(2023). Environmental Biotechnology Fundamentals to Modern Techniques. CRC Press.*
2. Farshad Darvishi Harzevili, Hongzhang Chen (2014). *Microbial Biotechnology –Progress and Trends.* Taylor & Francis/ Routledge,UK.
3. Surajit Das, Hirak Ranjan Dash (2014). *Microbial Biotechnology – ALaboratory Manual for Bacterial System.* Springer India.
4. Ratna Trivedi. *Practical Manual of Environmental, Microbiology and Biotechnology*. (2020). SSDN Publishers &Distributors
5. Jayanta Kumar Patra,Gitishree Das. (2020). *A Practical Guide to Environmental Biotechnology (Learning Materials in Biosciences*). First edition
6. Adkins (2021). *Environmental Biotechnology.* Ed Tech Press

E-Books

6. https://www.pdfdrive.com/environmental-microbiology-a-laboratory-manual-e184055362.html
7. https://www.pdfdrive.com/water-quality-procedures-and-practices-manual-e49686765.html
8. https://www.scientificpubonline.com/bookdetail/microbiology-laboratory-manual-4th-ed/9789394645516/0
9. https://www.taylorfrancis.com/books/9781003070153
10. https://www.taylorfrancis.com/books/9781315173351
11. https://www.taylorfrancis.com/books/9780429442902

Web Links

1. https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering
2. http://icv-au.vlabs.ac.in/inorganic-chemistry/Water_Analysis_Determination_of_Physical_Parameters/
3. https://mis.alagappauniversity.ac.in/siteAdmin/dde-admin/uploads/4/PG_M.Sc._Microbiology_36444%20Lab%20IV%20Industrial%20Microbiology%20&%20Microbial%20biotechnology.pdf
4. https://microbiologysociety.org/static/uploaded/23cbf9c5-f8c8-4f91-b092a4ad819e6357.pdf

Pedagogy

Lecture, Power point presentation, Seminar, Assignment, Quiz, Group Discussion, Video/Animation

Course Designer
Dr. R. UMA MAHESWARI

Semester – VI	Internal Marks: 25		External Marks: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HOURS/WEEK**	**CREDITS**
23UBT6CC10	**IPR, BIOSAFETY AND BIOETHICS**	**CORE**	**5**	**4**

Course Objectives

- To understand various aspects of IPR, biosafety regulations and bioethics concerns arising from the commercialization of biotech products.
- To give an idea about IPR, registration and its enforcement.
- To sensitize about the importance of Personnel Protective Equipment (PPE), general biosafety rules and different biosafety levels

Course Outcome and Cognitive Level Mapping

Upon successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Define the fundamental aspects of Intellectual Property Rights for development and management of innovative projects in industries	K1
CO2	Outline the current trends in IPR and Govt. steps in fostering IPR	K2
CO3	Explain about the ethical issues involving biological material	K3
CO4	Utilize adequate knowledge in the use of genetically modified organisms and its effect on human health	K3
CO5	Make use of critical thinking skills to analyse information and situations in order to respond and act ethically with regard to scientific research, practice, and technology	K3

Mapping of CO with PO and PSOs

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	2	1	3	2	2	2	1
CO2	3	3	3	2	1	3	3	2	2	1
CO3	3	3	3	3	2	3	3	3	3	2
CO4	3	3	3	3	2	3	3	3	2	1
CO5	3	3	3	2	2	3	3	3	2	1

"1" – Slight (Low) Correlation, "2" – Moderate (Medium) Correlation, "3" – Substantial (High) Correlation, "-" indicates there is no Correlation.

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	**Introduction to Intellectual Property and Types of IPs:** Introduction to IPR, Basic concepts and need for Intellectual Property, types - Patents, Trademarks, Trade Secrete, Copyright, Geographical Indications- History of GATT and TRIPS Agreement. – World Intellectual Property Rights Organization (WIPO). IP rights in India and abroad (USA & Europe) - few Case Studies-patent-Turmeric Patent, GI- Kolli Hills Pepper	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
II	**Patent Filing Procedures and Agreements:** Patent- Elements of Patentability: Novelty, Non Obviousness, patentable and non-patentable – patenting life, Registration Procedure, Rights and Duties of Patentee, Assignment and license, Patent infringement. IPR Agreements and Treaties: Madrid Agreement; Hague Agreement; Budapest Treaty; PCT; PPV & FR Act.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
III	**Biosafety:** Introduction, biosafety issues in biotechnology - historical background; Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
IV	**Biosafety Guidelines:** Biosafety guidelines and regulations (National and International) – operation of biosafety guidelines and regulations of Government of India; Roles of Institutional Biosafety Committee, GEAC, for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; Overview of National Regulations and relevant International Agreements including Cartagena Protocol, Guidelines	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4

	for Safety Assessment of Genome Edited plants			
V	**Bioethics:** Introduction to ethics/ bioethics – purpose and principles of bioethics, Bioethics in medical – human cloning, Biotechnology and ethics, Benefits and risks of genetic engineering- ethical aspects of genetic testing –genetic engineering and bio warfare; Ethical implications of cloning: Reproductive cloning, therapeutic cloning; Ethical, legal and socioeconomic aspects of gene therapy, germ line, somatic, embryonic and adult stem cell research-GM crops and GMO's – biotechnology and biopiracy –ICMR Guidelines- Ethical implications of human genome project.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
VI	**Self-Study for Enrichment** **(Not Included for End Semester Examination)** Definition of GMOs and LMOs, Biosafety Levels;	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3,K4

Text books

1. **Raybould, A. (2021). New frontiers in biosafety and biosecurity.** ***Frontiers in Bioengineering and Biotechnology*****, 9, 727386.**
2. **Sople, V. V. (2016).** ***Managing intellectual property: The strategic imperative*****. PHI Learning Pvt. Ltd..**
3. **Nambisan, P. (2017).** ***An introduction to ethical, safety and intellectual property rights issues in biotechnology*****. Academic Press.**
4. **Ahuja, V. K. (2019). Law Relating to Intellectual Property Rights. Lexis Nexis.**
5. **Campbell, A. (2017).** ***Bioethics: the basics*****. Routledge.**
6. **Bayot, M. L., & Limaiem, F. (2019). Biosafety guidelines.**

Reference books

1. Gassmann, O., Bader, M. A., Thompson, M. J., Gassmann, O., Bader, M. A., & Thompson, M. J. (2021). Fundamentals of Intellectual Property Rights. *Patent Management: Protecting Intellectual Property and Innovation*, 1-25.
2. Reddy, S. D. (2019). *Intellectual Property Rights: Law and Practice*. Asia Law House.
3. Wooley, D. P., & Byers, K. B. (Eds.). (2020). *Biological safety: principles and practices*. John Wiley & Sons.

4. Ramakrishna, B., & HS, A. K. (2017). *Fundamentals of intellectual property rights: for students, industrialist and patent lawyers*. Notion Press.

5. Singh, M., & Khosla, B. Intellectual Property Rights (IPR), Biosafety and Bioethics. *Handbook of Biotechnology*, 523.

Web links

1. http://www.cbd.int/biosafety/backgrounds.html
2. http://web.princeton.edu/sites/ehs/biosafety/biosafetypage/section
3. http://www.cbd.int/biosafety/background.shtml
4. http://web.princeton.edu/sites/ehs/biosafety/biosafetypage/section 3.html
5. http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf
6. https://www.wipo.int/about-ip/en/

Pedagogy

Lecture (Chalk and Talk) & Power Point Presentation, Quiz, Seminar, Assignment & Group Discussion. Videos and Animations

Course Designer

Ms. R. NEVETHA

Semester – VI	Internal Marks: 25		External Marks: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HOURS / WEEK**	**CREDITS**
23UBT6DSE2A	**DEVELOPMENTAL BIOLOGY**	**DISCIPLINE SPECIFIC ELECTIVE – II (DSE)**	**5**	**3**

Course Objectives

- To understand how an organism develops.
- To acquire knowledge about a single cell becomes an organized grouping of cells.
- To explain the processes of growth and development in individuals.
- To study the processes involved in the embryonic development.

Course Outcome and Cognitive Level Mapping

Upon successful completion of the course, the students will be able to

CO Number	CO Statement	Cognitive Level
CO 1	Utilize and infer the knowledge of historical perspective of development Biology,	K1,K2
CO 2	Describe and Discuss the morphological processes that transform a fertilised egg into a multicellular organism	K2, K3
CO 3	Illustrate the Cell commitment, determination and control of differentiation at the level of genome.	K3, K4

Mapping of CO with PO and PSOs

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	2	2	3	3	2	2	2
CO2	3	3	3	2	2	3	3	3	2	2
CO3	3	3	3	2	2	3	3	3	2	3
CO4	3	3	3	3	2	3	3	3	3	3
CO5	3	3	3	3	2	3	3	3	3	3

"1" – Slight (Low) Correlation, "2" – Moderate (Medium) Correlation, "3" – Substantial (High) Correlation, "-" indicates there is no Correlation.

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	**UNIT I: Gametogenesis and Fertilization** Definition, scope & historical perspective of development Biology, Gametogenesis – Spermatogenesis, Oogenesis Fertilization - Definition, mechanism, types of fertilization. Different types of eggs on the basis of yolk.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
II	**UNIT II: Early embryonic development** **Cleavage: Definition, types, patterns & mechanism Blastulation: Process, types & mechanism Gastrulation: Morphogenetic movements– epiboly, emboly, extension, invagination, convergence, de-lamination. Formation & differentiation of primary germ layers.**	16	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
III	**UNIT III: Embryonic Differentiation** Differentiation: Cell commitment and determination- the epigenetic landscape: a model of determination and differentiation, control of differentiation at the level of genome.	14	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
IV	**UNIT IV: Organogenesis** Neurulation, development of vertebrate eye. Fate of different primary germlayers. Development of behaviour: constancy & plasticity, Extra embryonic membranes. placenta in Mammals	14	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
V	**UNIT V:** Development of Microsporangium and Megasporangium, Pollination, Embryo -Embryo sac development and double fertilization in plants, seed formation and germination. Outline of experimental embryology. Organization of shoot and root apical meristem, and development. Leaf development.	16	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
VI	**Self-Study for Enrichment** **(Not Included for End Semester Examination)** Fate Maps in early embryos. Notogenesis. Phyllotaxy.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4

Text Books

1. Michael Barresi, Scott Gilbert (2023). *Developmental Biology*: 13th edition. OUP USA.
2. Madhavan. K S. (2023). *Developmental Biology*. Raj Publications, India

3. Müller. (2019). *Developmental Biology.* **Springer /MBS.**

4. Verma, P. S. & Agarwal, V. K. (2016). *Cell Biology*. S. Chand Publication.

Reference Books

1. Gilbert, Scott's. (2014). *Developmental biology:* 10 edition. Sinauer Association, Inc., Publishers.
2. Chattopadhyay.S. (2016). An Introduction to Developmental Biology, Books and Allied (P) Ltd, Kolkata. First Edition.
3. Bruce M Carlson, Patten's Foundation of Embryology,. Tata McGraw Hill Co.
4. Balinsky, B.I., 1981. 5 edition. An Introduction to Embryology, W. B. Saunders Co., Philadelphia
5. Verma , P.S., Agarwal, V.K., and Tyagi., 1995. Chordate embryology, S. Chand & Co., New Delhi.
6. Berril, N.T., Karp, G., 1988. Development. Tata McGraw Hill Co., New York

E-Books

1. https://bgc.ac.in/pdf/study-material/developmental-biology-7th-ed-sf-gilbert.pdf
2. https://www.academia.edu/43276516/Developmental_Biology_Tenth_Edition_by_Scott_F_Gilbert_Hard cover
3. https://www.pdfdrive.com/human-embryology-and-developmental-biology-5th-edition-d194549769.html
4. https://www.pdfdrive.com/essential-developmental-biology-d186855236.html

Web Reference

1. https://dhingcollegeonline.co.in/attendence/classnotes/files/1605724307.pdf
2. https://nou.edu.ng/coursewarecontent/BIO%20413%20MAIN%20TEXT_0.pdf
3. https://mcb.berkeley.edu/courses/mcb141/lecturetopics/Levine/MCB%20141%202015-01-29.pdf
4. https://www.ncbi.nlm.nih.gov/books/NBK9983/

Pedagogy

Lecture, Power point presentation, Seminar, Assignment, Quiz, Group Discussion, deo/Animation

Course Designer

Ms. P. ILAMATHY

Semester – IV	Internal Marks: 25		External Marks: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HOURS/WEEK**	**CREDITS**
23UBT6DSE2B	**STEM CELL BIOLOGY**	**DISCIPLINE SPECIFIC ELECTIVE-II (B)**	**5**	**3**

Course Objectives

- To understand the basic concepts of Stem cell biology.
- To afford the knowledge about stem cell epigenetics.
- To provide an overview of potential clinical use of stem cells.

Course Outcome and Cognitive Level Mapping

Upon successful completion of the course, the students will be able to

CO Number	CO Statement	Cognitive Level
CO1	Define the fundamental of scientific principles of embryonic and adult stem cells.	K1, K2
CO2	Explain the techniques involved in isolation, maintain and growth of stem cells	K2, K3
CO3	Outline the basic concepts in stem cell epigenetics.	K3, K4
CO4	Make use of the potential benefits and clinical applications of stem cells.	K5, K6
CO5	Utilize the clinical significance and ethical issues pertaining to stem cell research	K6

Mapping of CO with PO and PSOs

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	2	2	3	3	2	2	2
CO2	3	3	3	2	2	3	3	3	2	2
CO3	3	3	3	2	2	3	3	3	2	3
CO4	3	3	3	3	2	3	3	3	3	3
CO5	3	3	3	3	2	3	3	3	3	3

"1" – Slight (Low) Correlation, "2" – Moderate (Medium) Correlation, "3" – Substantial (High) Correlation, "-" indicates there is no Correlation.

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	**Unit I- Introduction to Stem cells** Stem cell – Introduction, History, Properties, Potency – Totipotent, Pluripotent, Multipotent, Oligopotent, Unipotent; Types – Embryonic and Adult Stem cells. Stem cell niche - Components and function. Cell cycle regulation in stem cells.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
II	**Unit II- Stem cell culture** **Isolation of Embryonic stem cell and Adult stem cell – Blastocyst from IVF, Umbilical Cord, Somatic Cell Nuclear Transfer, Bone marrow. Culture Media – Feeder cell layers, Serum and feeder free media, growth factors. Stem cell expansion and differentiation. Cryopreservation and storage techniques of stem cells. Stem cell bank.**	16	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
III	**Unit III - Stem Cell Epigenetics** Epigenetic mechanisms in normal development - DNA Methylation, histone modifications and Micro-RNAs. Cell Reprogramming – Induction and Maintenance of pluripotency and differentiation of pluripotency into various cell lineages.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
IV	**Unit IV- Application of Stem Cells** Stem Cells in Regenerative Medicine: Tissue regeneration and repair, Organ transplantation and tissue engineering; Stem Cell Therapy for Degenerative Diseases - Parkinson's, sickle cell anemia, spinal cord injuries; Stem Cells in Autoimmune Disorders and Immunomodulation - Rheumatoid arthritis; Stem Cells in Drug Discovery and Personalized Medicine - Drug screening and toxicity testing.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
V	**Unit V- Stem Cell Ethics** Ethical and legal issues in stem cell research and therapy. Regulatory Guidelines from ISSCR (International Society for Stem Cell Research), CLAA (Central Licensing Approving Authority); FDA, National Guidelines for Stem Cell Research (NGSCR) and NAC-SCRT (National Apex Committee for Stem Cell Research and Therapy).	14	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4

VI	**Self-Study for Enrichment** **(Not Included for End Semester Examination)** Chediak- Higashi syndrome, Leukocyte adhesion deficiency.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4

Text Books

7. A.B. Singh. (2021). *Allergy and Allergen Immunotherapy Unknown Binding.*Apple Academic Press Inc.; 1st edition
8. Lauren M.Sompayrac (2019).*How the Immune system works. 6th Edition.*Wiley Blackwell.
9. Dr.P.Madhavee Latha (2018). *A Textbook of Immunology.* S.Chand Publishing.
10. Abul K.Abbas, Andrew H.Lichtman Shiv Pillai.(2017).*Cellular and Molecular Immunology.* 9th Edition Elsevier
11. Warren Levinson Review of Medical Microbiology and Immunology.(2016). Mc Graw Hill Education .
12. Louis Hawley Richard J Ziegler Benjamin L Clarke BRS.(2015).*Immnology and Microbiology (6th Edition).*Lippincott Williams and Wilkins

Reference Books

1. David Male, R. Stokes Pebbles, Victoria Male.(2020).*Immunology*. Elsevier Health Sciences Publishers.
2. Abul K.Abbas, AndrewH.Lichtman Shiv Pillai.(2019).*Basic Immunology.* Edition. Elseiver
3. Jenni Punt, Sharon Stranford, Patrica Jones,Judith Owen.(2018). *Kuby Immunology.*
4. 8th Edition.ML IE PRNT
5. Peter,J.Delves,Seamus,J.Martin, Dennis R.Burton, Ivan
6. M.RoitRoitt's.(2017).Essential Immunology.1st Edition.Wiley Blackwell
7. Kenneth Murphy. *Casey Weaver Janeway's Immunobiology*.(2016) 9th Edition Garland Science.
8. Kathy M.Durkin(2010).*Understanding the Vaccines and the Immune system*.(2010)1st Edition Nova Science.Pub.Inc

E-Books

1. https://archive.org/details/cellular-and-molecular-immunology-10th-edition
2. https://www.frontiersin.org/research-topics/463/emerging-immune-functions-of-non-hematopoietic-stromal-cells
3. file:///C:/Users/my%20pc/Downloads/Emerging%20immune%20functions%20of%20non-hematopoietic%20stromal%20cells.PDF
4. https://assets.cambridge.org/97805217/04892/frontmatter/9780521704892_frontmatter.pdf
5. file:///C:/Users/my%20pc/Downloads/PrefaceandcontentsTextBookofImmunology-ArvindKumar.pdf

Web References

1. https://microbenotes.com/immunity/
2. https://www.coursera.org/learn/immunology-innate-immune-system
3. https://www.bing.com/videos/riverview/relatedvideo?&q=Immune+System+Notes%3a+Diagrams+%26+Illustrations+%7c+Osmosis&qpvt=Immune+System+Notes%3a+Diagrams+%26+Illustrations+%7c+Osmosis&mid=55E74851E85FF7ED932255E74851E85FF7ED9322&&FORM=VRDGAR
4. https://www.bing.com/videos/riverview/relatedvideo?&q=Immune+System+Notes%3a+Diagrams+%26+Illustrations+%7c+Osmosis&qpvt=Immune+System+Notes%3a+Diagrams+%26+Illustrations+%7c+Osmosis&mid=55E74851E85FF7ED932255E74851E85F F7ED9322&&FORM=VRDGAR

Pedagogy

Lecture, Power point presentation, Seminar, Assignment, Quiz, Group Discussion, Video/Animation

Course Designer

Dr. R. RAMESHWARI

Semester – VI	Internal Marks: 25			External Marks: 75
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HOURS/ WEEK**	**CREDITS**
23UBT6DSE2C	**BIOENTREPRENEURSHIP**	**DISCIPLINE SPECIFIC ELECTIVE**	**5**	**3**

Course Objectives

- To motivate students towards bioentrepreneurship and skill development
- To understand the basic marketing strategies from lab to store
- To expose the students to various technology and their commercialization
- To gain technological and financial knowledge for related to biotechnology

Course Outcomes

Upon the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Utilize and infer the knowledge on concepts in entrepreneurship and marketing strategies related to biotechnology.	K1, K2
CO2	Illustrate the knowledge on the development of entrepreneurship, from classic to contemporary topics, in different contexts and disciplines.	K2
CO3	Develop the entrepreneurial process and approach and critically analyse its core concepts and theories.	K3, K4
CO4	Classify the versatile techniques for understanding of the emerging research of entrepreneurship within life science, i.e. bioentrepreneurship, in a responsible manner supported by relevant literature.	K4, K5
CO5	Apply reflective and reflexive practices to learning in intercultural and interdisciplinary contexts.	K6

Mapping of CO with PO and PSO

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	2	1	3	2	2	2	1
CO2	2	3	3	3	2	3	2	2	1	1
CO3	3	2	3	2	2	3	2	2	2	1
CO4	3	2	3	2	2	3	2	2	1	1
CO5	2	2	3	3	3	2	2	3	3	3

"1" – Slight (Low) Correlation, "2" – Moderate (Medium}

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	**Introduction:** Entrepreneur, Creativity & Entrepreneurial personality and Entrepreneurship in Biotechnology, pillars of bioentrepreneurship and major start-ups in Biotechnology, Concepts and theories of Entrepreneurship, Entrepreneurial traits and motivation, Nature and importance of Entrepreneurs, Government schemes for commercialization of technology (eg. Biotech Consortium India Limited)	14	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
II	**Project management:** Search for a business idea, concept of project and classification, project identification, project formulation, project design and network analysis, project report, project appraisal. Biotech enterprises: Desirables in start-up, Setting up Small, Medium & Large scale industry, Quality control in Biotech industries, Location of an enterprise, steps for starting a small industry, incentives and subsidies, exploring export possibilities	14	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
III	**Compost and Vermicompost:** Compost - Purpose of Composting. Decomposition of organics - Aerobic and Anaerobic Digestion. Factors Affecting Composting Process – Carbon – Nitrogen ratio – Moisture - Temperature – Aeration – Surface area – pH. Advantages of application of Organic Fertilizer. Limitations of Composting, Applications. Vermicompost – Earthworm – Biology of Earthworm – Life cycle – Classification – Species Suitable for processing organic wastes. Microbial biomass responsible during the vermicomposting.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
IV	**Mushroom cultivation:** Mushroom culture – historical background, current status of mushroom culture in India. Nutritional values – cultivation methods; Obtaining a pure culture preparation of spawn; formulation and preparation of composts; spawning, spawn running and cropping; cultivation of paddy straw mushrooms - cultivation of Dhingri (*Pleurotus sajor caju*) medicinal value of mushrooms – Ganoderma, antiviral value, antibacterial, antifungal and antitumour effect. Preservation and packaging of mushrooms – Market, Technical and Financial Feasibility study of mushroom production.	16	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
V	**Integrated Farming System:** Integrated Farming System - introduction, principles, Components of IFS, advantages of IFS, Farming System Research, IFS for Different Agroclimatic Zones, Production and Economics of IFS, Resource Flow – Wet land – Garden land – Dry land.	16	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
VI	**Self-Study for Enrichment** **(Not Included for End Semester Examination)** Recipes of Mushroom (Mushroom Soup, Pulav), Budget preparation for composting unit, Mushroom cultivation and integrated farming technique.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

Text Books

1. Arvind Kumar Bhatt, Ravi Kant Bhatia, Tek Chand Bhalla, (2023), *Basic Biotechniques for Bioprocess and Bioentrepreneurship,* Academic Press
2. Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, Sabyasachi Sinha (2020) *Entrepreneurship, 11th Edition, McGraw Hill Education (India) Private Limited, Uttar Pradesh*
3. Dr. Ashok K. Rathour, Dr. Pawan Kumar 'Bharti', Dr. Jaswant Ray,, (2020). *Vermitechnology Farm and Fertilizer,* Discovery publishing House Pvt, Ltd, New Delhi.
4. Matei, Florentina, Zirra, Daniela (2019) *Introduction to Biotech Entrepreneurship: From Idea to Business: A European Perspective,* Springer.
5. R. Gogoi, Y. Rathaiah, T.R. Borah (2019). *Mushroom Cultivation Technology*, Scientific Publishers.
6. A. Zaman. (2019), *Integrated Farming System and Agricultural Sustainability*, New India Publishing Agency.

Reference Books

1. Heidrun Flaadt Cervini, Jörg Dogwiler (2020). *Bio- and MedTech Entrepreneurship From Start-up to Exit*. Stämpfli Verlag
2. Tavis Lynch, (2018), *Mushroom Cultivation An Illustrated Guide to Growing Your Own Mushrooms at Home*, Quarry books
3. John Tyler, (2019), *Essential Guide to Mushroom Cultivation A Definite Guide to Cultivation and Self Use,* Independently Published.
4. Rhonda Sherman. (2018). *The Worm Farmer's Handbook Mid- to Large-Scale Vermicomposting for Farms, Businesses, Municipalities, Schools, and Institutions,* Chelsea Green Publishing.
5. Shawn Jadrnicek, Stephanie Jadrnicek (2016). *The Bio-integrated Farm A Revolutionary Permaculture-based System Using Greenhouses, Ponds, Compost Piles, Aquaponics, Chickens, and More*, Chelsea Green Publishing.

Web Links

1. https://www.nationalbioentrepreneurship.in/
2. https://www.acs.edu.au/courses/mushroom-production-86.aspx
3. https://onlinecourses.swayam2.ac.in/nos20_ge07/preview
4. https://www.youtube.com/watch?v=4nNQEO8ZQR0
5. https://agritech.tnau.ac.in/agriculture/agri_majorareas_smmf03.html

E-Books

1. https://www.biotech.co.in/sites/default/files/2020-01/Bioentrepreneurship-Development.pdf
2. https://archive.org/details/handbookofbioent0000unse
3. https://depintegraluniversity.in/userfiles/Entrepreneurship%20Development.pdf
4. https://content.kopykitab.com/ebooks/2013/11/2269/sample/sample_2269.pdf
5. https://naip.icar.gov.in/download/77735/gvt-naip-c3.pdf/gvt-naip-c3.pdf

Pedagogy

Power point presentation, Group Discussion, Seminar, Assignment, Animations.

Course Designer

Dr. M. KEERTHIGA