

CAUVERY COLLEGE FOR WOMEN (AUTONOMOUS)
NATIONALLY ACCREDITED (III CYCLE) WITH “A” GRADE BY NAAC
TIRUCHIRAPPALLI – 620 018

DEPARTMENT OF BIOTECHNOLOGY



B.Sc., BIOTECHNOLOGY SYLLABUS
2024 – 2025 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 Projectsto 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.

Cancer Biology 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 PO2
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 2024-2025 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 Biology	22UBT1CC1	5	5	3	25	75	100		
				Core Practical - I (CP)	Cell Biology (P)	22UBT1CC1P	3	3	3	40	60	100
				First Allied Course- I (AC)	General Microbiology	22UBT1AC1	4	3	3	25	75	100
				First Allied Course- II	Biochemistry	22UBT1AC2	4	3	3	25	75	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)	Molecular Biology & Genetics	22UBT2CC2	5	5	3	25	75	100		
				Core Practical - II (CP)	Molecular Biology & Genetics (P)	22UBT2CC2P	3	3	3	40	60	100
				Core Course - III (CC)	Biomolecular Techniques	23UBT2CC3	2	2	3	25	75	100
				First Allied Course – III(AP)	Microbiology & Biochemistry (P)	23UBT2AC3P	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	Ability Enhancement Compulsory Course – IV (AECC)	Health and Wellness	24UGHW	2	1	-	100	-	100	
			Generic Elective Course- I(GEC)	Introduction to NCC@	24UNC3GEC1	2	2	2	-	100	100
				Basics of Biotechnology	22UBT3GEC1			3	25	75	
				Basic Tamil -I	22ULC3BT1						
	Special Tamil – I	22ULC3ST1									
Extra Credit Course SWAYAM				As per UGC Recommendation							
Total				30	23					800	

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)	24UBT4CC4P	4	3	3	40	60	100
			Second Allied Course - III(AC)	Basics of Forensic Biology	22UBT4AC6	4	3	3	25	75	100
	Generic Elective Course-II(GEC)	Specialization in Army@	24UNC4GEC2	2	2	2	-	100	100		
		Applied Biotechnology	22UBT4GEC2			3	25	75			
		Basic Tamil – II	22ULC4BT2								
		Special Tamil – II	22ULC4ST2								

	I V	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	21				700

30 Days INTERNSHIP during Semester Holidays*

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
		Internship	Internship	24UBT5INT	-	2	-	-	-	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
Total					30	27				800
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	24UBT6CC10	6	5	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 Cell Biology	23UBT6DSE2B						
			C. Bioentrepreneurship	23UBT6DSE2C						
	Project	Project Work	24UBT6PW	4	3	-	-	100	100	
	IV	Ability Enhancement Compulsory Course – V (AECC)	Gender Studies	22UGGS	1	1	-	100	-	100
	V	Extension activity		22UGEA	-	1	-	-	-	-
Total					30	25				700
Grand Total					180	140				4500

Semester – I	Internal Marks: 25		External Marks: 75	
COURSE CODE	COURSE TITLE	CATEGORY	HOURS/WEEK	CREDITS
22UBT1CC1	CELL BIOLOGY	CORE	5	5

Course Objectives

- To study about the basic concepts of cells and their cellular organelles and their functions.
- To study the specialized cells.
- To study about cell cycle and its regulations.
- To study cell signaling pathways

Course Outcome and Cognitive Level Mapping

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

CO Number	CO Statement	Cognitive Level
CO1	Relate and explain the basics of cell biology, types, structure, and properties of cells.	K1, K2
CO2	Apply the knowledge of cell biology in diverse research areas.	K3
CO3	Illustrate the Ultra structure and list the functions of cellular organelles in various types of cells	K2, K4
CO4	Explain the significance of cells and specialized cells	K5
CO5	Interpret the concepts of cell, cell division, compartmentalization, transport of nutrients and cell signalling in different types of cells.	K5

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	1	3	1
CO2	3	2	2	2	1	3	1	1	2	2
CO3	3	1	1	3	1	3	3	2	1	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	Fundamentals of cell structure: Cell as basic unit of life: Basic properties of cells, cell theory, cell morphology, Ultrastructure - Prokaryotic and Eukaryotic cells.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
II	Cellular membranes and matrices: Cell Membrane: Plasma Membrane – Fluid Mosaic Model and Sandwich Model; Chemical composition and fluidity of membranes; transport of nutrients - diffusion, facilitated diffusion and osmosis. Cell wall: Structural organization; Cytoskeleton: Microtubules and intermediate filaments; Cell Motility – Flagella.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
III	Endomembrane System: Ultrastructure and functions: Nucleus; Endoplasmic Reticulum - Rough and Smooth; Golgi Complex, Ribosomes - Types and functions; Mitochondria - Ultrastructure, Chemical Composition and functions; Chloroplast - Ultrastructure, Chemical Composition and functions; Microbodies: Types - Peroxisomes, Glyoxisomes and Lysosomes - Types, structure and function.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
IV	Cell Division and Signaling: Cell division in prokaryotes and eukaryotes: Cell cycle, mitosis, meiosis, crossing over; Apoptosis; Signal transduction - Cell to cell recognition.	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
V	Specialized cells: Motile cells (amoeboid and Sperm cells), nerve cells and nerve impulse conduction, muscle cells and muscle contraction and Egg cells.	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
VI	Self Study for Enrichment (Not included for End Semester Examination) Discovery of Cells, Cytoskeleton - Microfilaments, Types of Microbodies, Cell adhesion and Red Blood Cells.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

Text Books

1. Veer Bala, R. (2021). *Cell Biology*. Latest edition. Med tech.
2. Rastogi, S. C. (2020). *Cell and Molecular Biology*. New Age International Private Ltd.
3. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., Karen, H., Dennis, B., & Walter, P. (2019). *Essential Cell Biology*. 5th International Student Edition. Garland Science.
4. De Robertis, E.D.D. & De Robertis, E.M.F. (2017). *Cell & Molecular Biology*. 8th Edition. Waverly.
5. Verma, P. S. & Agarwal, V. K. (2016). *Cell Biology*. S. Chand Publication.

Reference Books

1. Cooper, G.M. & Hausman, R.E. (2018 Reprint). *The Cell A Molecular Approach*. 6th Edition. Ingram Publication.
2. Griffith, R. (2017). *Cell biology (Meiosis & Mitosis)*. Larsen and Keller Education.
3. Thomas, D. P., William, C. E., Jennifer, L. S. & Graham, J. (2017). *Cell Biology*. 3rd Edition. Elsevier IE (short Disc).
4. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., Karen, H., Dennis, B. & Walter, P. (2017). *Molecular Biology of Cell*. 6th Edition. Garland Science, Taylor & Francis group.
5. Hardin, J., Bertoni, G.P. & Kleinsmith, L.J. (2017). *Becker's World of the Cell*. Pearson Education.

E - Books

1. <https://open.umn.edu/opentextbooks/textbooks/244>
2. <http://standing.weebly.com/uploads/2/3/3/5/23356120/8 - unit 30c.pdf>
3. <https://www.infobooks.org/free-pdf-books/biology/cell-biology/>
4. <http://www.freebookcentre.net/Biology/Cell-Biology-Books.html>;
5. https://tripurauniv.ac.in/Page/SubjectWiseOnline_EBooks_Cell_Molecular_Biology

Web Reference

1. <https://ocw.mit.edu/courses/7-06-cell-biology-spring-2007/>
2. <https://sciencewiz.com/portals/cells/tour-inside-the-cell/a-tour-of-the-cell-more-advanced/>
3. <http://naturedocumentaries.org/17217/virtual-tour-cell-xvivo-scientific-animation-2018/>
4. <https://nptel.ac.in/courses/102103012>

Pedagogy

Chalk and Talk, PPT, Videos and Animations

Course Designers

1. Ms. P. ILAMATHY
2. Dr. S. ABINAYA

Semester – I	Internal Marks: 40		External Marks: 60	
COURSE CODE	COURSE TITLE	CATEGORY	HOURS/WEEK	CREDITS
22UBT1CC1P	CELL 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 perform experiments on cell counting and viability.

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 cell organelles.	K3
CO 4	Categorize the different types and stages of cell division.	K4
CO 5	Illustrate and conclude cell viability and counting.	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. Demonstration of Principles and working mechanism of Light Microscope.
3. Principles and working mechanism of rotary Microtome (Demo).
4. Measurement of Cell Size by Micrometry.
5. Prokaryotic Cell Observation – *E. coli*.
6. Eukaryotic Cell Observation – Yeast and Onion.
7. Morphological Characterization of various types of Plant tissue cells.
8. Separation of cell organelles by centrifugation method.
9. Barr body identification from Buccal Smear.
10. Cell Division - Mitotic stages.
11. Cell Division - Meiotic stages.
12. Cell Division - Binary fission of Yeast Cells.
13. Enumeration of Eukaryotic Cells (Yeast), Red Blood Cells and White Blood Cells.
14. Assessment of Cell Viability by trypan blue staining.
15. Experiment on Osmosis.

Reference Books

1. Gupta, R., Seema, M. & Ravi, T. (2018). *Cell Biology: Practical Manual*. Prestige Publishers.
2. William, H. H. (2017). *Cell Biology: Laboratory Manual*, Pearson Education.
3. Amit, G. & Bipin Kumar, S. (2019). *Practical Laboratory Manual – Cell Biology*. Lambert Academic Publishing.
4. Thompson, D. A. (2011). *Cell and Molecular Biology Lab. Manual*. Create Space Independent Publishing Platform.
5. Mary, L. L. (1993). *Cell Biology: Laboratory Manual*. Ron Jon Publishing Incorporated.

E - Books

1. https://www.bjcancer.org/Sites_OldFiles/Library/UserFiles/pdf/Cell_Biology_Laboratory_Manual.pdf
2. http://www.ihcworld.com/protocols/lab_protocols/cell-biology-lab-manual-heidcamp.htm
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://www.pdfdrive.com/cell-biology-protocols-d13735633.html>

Pedagogy

Practical Observation and Demo

Course Designers

1. Dr. R. UMA MAHESWARI
2. Dr. G. GOMATHI

Semester – I	Internal Marks: 25		External Marks: 75	
COURSE CODE	COURSE TITLE	CATEGORY	HOURS/WEEK	CREDITS
22UBT1AC1	GENERAL MICROBIOLOGY	ALLIED	4	3

Course Objective

- To create basic knowledge on the History and classification of Microorganisms.
- To study the structure and characteristics of microorganisms like bacteria, algae, fungi, protozoa and virus.
- To study the media composition and their types.
- To study the microbial diseases, pathogenesis, diagnosis and preventive measures.

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	Recall and infer the factual and conceptual information required for understanding microbiology.	K1, K2
CO 2	Illustrate the different structural organization of bacteria, Algae, Fungi, protozoa and virus.	K2
CO 3	Develop the different microbial culture media for isolation of microbes and Compare the lifecycle of bacteria, algae, fungi, protozoa and virus.	K3, K4
CO 4	Classify the different kind of microbes (Classification) and explain the general characteristic features of the Algae, Fungi, protozoa and virus.	K4, K5
CO 5	Elaborate the diagnostic methods and controlling measures of various pathogenic microbial diseases for the human welfare.	K6

Mapping of CO with PO and PSO

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 no Correlation

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	History and Classification: Historical development of Microbiology – Theories of Spontaneous generation – Biogenesis. General principles and nomenclature – Bergey’s Manual of Determinative Bacteriology, Whittaker’s five kingdom concept- Carl Woese’s three domain classification. Cavalier – Smith’s Eight kingdom classification.	12	CO1, CO2, CO3, CO4, CO5	K1, K2 K3, K4, K5, K6
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.	10	CO1, CO2, CO3, CO4, CO5	K1, K2 K3, K4, K5, K6
III	Bacteria, Virus and Protozoa: Structural organization of bacteria – Size, shape and arrangement of bacterial cells – Ultrastructure of a bacterial cell. Size & Morphology of Virus; Viroids. Lifecycle – Lytic & Lysogenic. Morphology & Anatomy of Protozoa - Amoeba & Paramecium.	12	CO1, CO2, CO3, CO4, CO5	K1, K2 K3, K4, K5, K6
IV	Algae and Fungi: General characteristics of Algae (<i>Chlamydomonas sp.</i>) including occurrence, thallus organization, Ultra structure, pigments, eyespot, food reserves. Reproduction – Sexual and Asexual reproduction. Fungi (<i>Aspergillus sp.</i>) – General characteristics of fungi including habitat, distribution, nutritional requirements, Ultrastructure, thallus organization and aggregation.	13	CO1, CO2, CO3, CO4, CO5	K1, K2 K3, K4, K5, K6
V	Microbial Diseases: General account on Microbial diseases - Causative Organism, Pathogenesis, Epidemiology, Diagnosis, Prevention & Control. Bacterial Diseases: Typhoid & Tuberculosis. Fungal diseases: Candidiasis & Aspergillosis. Viral Diseases: Hepatitis, AIDS. Protozoan Diseases: Malaria & Amoebiasis.	13	CO1, CO2, CO3, CO4, CO5	K1, K2 K3, K4, K5, K6
VI	Self - Study for Enrichment (Not included for End Semester Examination) Scope of Microbiology, Types of Sterilization, Size and morphology of Virus – Prions, Ultrastructure of Flagella and Corona Virus	-	CO1, CO2, CO3, CO4, CO5	K1, K2 K3, K4, K5, K6

Text Books

1. Barry, C. (2020). *Talaro's Foundations in Microbiology*. 11th Edition. Mc Graw Hill.
2. Rajan, S. & Selvi Christy, R. (2020). *Essentials of Microbiology*. CBS Publishers Pvt. Ltd.
3. Ananthanarayan, R. & Paniker, C.K.J. (2020). *Textbook of Microbiology*. 11th Edition. Orient Blackswan Pvt. Ltd.
4. Gerarad, J.T., Berdell, R.F. & Christine, L.C. (2018). *Microbiology - An Introduction*. 11th Edition. Pearson.
5. Robert, W. B. (2017). *Microbiology with Diseases by taxanomy*. 4th Edition. Pearson.
6. Dr. Baveja, C. P. (2017). *Text Book of Microbiology*. Anja Publications.

Reference Books

1. Apurba, S. S. & Sandhya, B. (2021). *Essentials of Medical Microbiology*. 3rd Edition. Jaypee Brothers.
2. Willey, J.M., Kathleen, M.S. & Dorothy, H.W. (2019). *Prescott's Microbiology*. Mc GrawHill.
3. Gerarad, J.T., Berdell, R.F. & Christine, L.C. (2018). *Microbiology: An Introduction*. 13th Edition. Pearson.
4. Madigam, M.T., Bender, K.S., Buckley, D.H., Sattley, W.M. & Stahl, D.A. (2017). *Brock Biology of Microorganism*. 15th Edition. Pearson Education.
5. Rathoure, A.K. (2017). *Essentials of Microbiology*. Brillion Publishing.

E – Books

1. <https://www.pdfdrive.com/essentials-of-medical-microbiology-e33538815.html>
2. <https://www.pdfdrive.com/medical-microbiology-e18737002.html>
3. <https://www.pdfdrive.com/textbook-of-microbiology-and-immunology-e175896260.html>
4. <https://www.pdfdrive.com/sherris-medical-microbiology-d193153850.html>
5. <https://www.pdfdrive.com/oxford-handbook-of-infectious-diseases-and-microbiology-d158084200.html>
6. <https://www.pdfdrive.com/microbiology-with-diseases-by-body-system-d185840565.html>

Web References

1. <https://nptel.ac.in/courses/102103015>
2. <http://ecoursesonline.iasri.res.in/course/view.php?id=108>
3. <https://www.digimat.in/nptel/courses/medical/microbiology/MB11.html>
4. <https://www.iaritoppers.com/2019/06/fundamentals-of-microbiology-icar-ecourse-pdf-book-download.html>
5. <https://microbiologysociety.org/why-microbiology-matters/what-is-microbiology/microbes-and-the-human-body/microbes-and-disease.html>

Pedagogy

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

Course Designers

1. Ms. P. JENIFER
2. Dr. M. KEERTHIGA

Semester – I	Internal Marks: 25		External Marks: 75	
COURSE CODE	COURSE TITLE	CATEGORY	HOURS/WEEK	CREDITS
22UBT1AC2	BIOCHEMISTRY	ALLIED	4	3

Course Objectives

- To study the basics of biomolecules.
- To study classification, structure and functional properties of carbohydrates, proteins, lipids, vitamins and minerals.
- To study the impact of proteins and enzymes.
- To study vitamin deficiency diseases.

Course Outcome and Cognitive Level Mapping

Upon the Successful completion of the course the student would be able to

CO Number	CO Statement	Cognitive Level
CO1	Understand and remember the chemistry and salient features of Macromolecules	K1, K2
CO2	In depth knowledge about the properties and significance of the Biomolecules	K2
CO3	Explain and differentiate the relationship between different kinds of biomolecules such as carbohydrates, lipids, nucleic acid and proteins.	K2, K4
CO4	Classify and demonstrate the various sources and functions of the nutrients. Calorific value of food.	K3, K4
CO5	Evaluate and analyze the concept of nutrition in health and disease, with metabolism and functions of a living system	K4, K5

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	1	2	1
CO2	3	2	2	1	1	3	2	1	1	1
CO3	3	2	2	1	1	3	2	2	2	1
CO4	3	2	3	2	2	3	3	2	2	2
CO5	3	2	3	2	2	3	3	3	2	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	Carbohydrates: Definition, structure, classification and functions of carbohydrates - Monosaccharides: Glucose and Fructose. Disaccharides: Sucrose and Maltose, Oligosaccharides: Raffin. Polysaccharides: Starch and Glycogen. Physical and chemical properties of carbohydrates.	12	CO1, CO2, CO3, CO4, CO5	KI, K2, K3, K4, K5
II	Lipids: Definition, classification and importance of lipids - Simple lipids: Triglycerides, Compound lipids: Phosphatides and Derived lipids: Cholesterol. Structure and functions of glycerol, phospholipids, glycolipids and lipoproteins. Physical and chemical properties of lipids.	12	CO1, CO2, CO3, CO4, CO5	KI, K2, K3, K4, K5
III	Amino acids: Introduction, structure and classification of amino acids - Essential amino acids, Semi - essential amino acids, non-essential amino acids and carboxyl groups of amino acids. Physico-chemical properties of amino acids. Functions of amino acids.	12	CO1, CO2, CO3, CO4, CO5	KI, K2, K3, K4, K5
IV	Proteins: Definition and classification based on shape, composition, solubility and functions of proteins. Structure of proteins - Primary, secondary, tertiary and quaternary structure - protein folding. Structure, classification and properties of enzymes. Mechanism of enzyme activity. Enzyme inhibition - Competitive, non-competitive and uncompetitive inhibition.	12	CO1, CO2, CO3, CO4, CO5	KI, K2, K3, K4, K5
V	Vitamins and Minerals: Vitamins: Definition and Classification. Fat soluble vitamins - sources, structure and physiological functions; Water soluble vitamins - sources, structure and physiological functions. Vitamin deficiency diseases (Scurvy and Rickets). Minerals: Macro minerals and micro minerals - sources and functions.	12	CO1, CO2, CO3, CO4, CO5	KI, K2, K3, K4, K5
VI	Self-Study for Enrichment: (Not Included for End Semester Examination) Oligosaccharides – Stachyose, Structure and functions of– sphingolipids, importance of amino acids, Protein – denaturation and Vitamin deficiency diseases - Anemia.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5

Text Books

1. Singh, S. P., & Singh, A. N. (2021). *Textbook of Biochemistry*. CBS Publications.
2. Gupta, S. N. (2020). *Concepts of Biochemistry*. Rastogi Publications.
3. Sathyanarayana, U., and Chakrapani, U. (2020). *Biochemistry*. 5th Edition. Elsevier India.
4. Seema, P. U. (2020). *Textbook of Biochemistry*. 1st Edition. Dreamtech Press.
5. Padmaja H. A., Dr. Yogesh, K. & Dr. Rammohan R. (2019). *Biochemistry*. Nirali Prakashan Publications.
6. Denise, R.F. (2017). *South Asian Edition of Lippincott Illustrated Reviews Biochemistry*. 7th Edition. Wolters Kluwer Publications.

Reference Books

1. Manzoor, M. M. (2021). *Fundamentals of Biochemistry*. Lambert Academic Publishing(LAP).
2. Voet, D. & Voet, J.G.(2021). *Voet's Biochemistry*. Adapted Edition 2021. Wiley India.
3. Brailsford, R. T. (2020). *Principles of Biochemistry*. MJP Publisher.
4. Jeremy M., Berg, Lubert, S., John, T., Gregory, G. (2019). *Biochemistry*. Freeman and Company publications.
5. Appling D.R., Anthony-Cahill, S. J., Mathews, C. K. (2017). *Biochemistry: Concepts and Connections*. Pearson Education.
6. Vikrant, V. (2021). *Biochemistry*. Discovery Publishing House Pvt Ltd.

E-Books

1. <https://www.pdfdrive.com/lehniger-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/biochemistry-biochemistry-e19576202.html>
5. <https://www.pdfdrive.com/marks-basic-medical-biochemistry-a-clinical-approach-5th-edition-e158491166.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://sites.google.com/a/uasd.in/ecourse/biochemistry> <https://youtu.be/f7jRpniCsaw>
5. <https://agrimoon.com/fundamentals-of-biochemistry-pdf-book/>

Pedagogy

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

Course Designer Ms.

M. AZEERA

Semester – II	Internal Marks: 25		External Marks: 75	
COURSE CODE	COURSE TITLE	CATEGORY	HOURS/WEEK	CREDITS
22UBT2CC2	MOLECULAR BIOLOGY & GENETICS	CORE	5	5

Course Objectives

- To study the basics of Genetics and molecular biology.
- To study about laws and concepts of Mendelian inheritance.
- To study the process of DNA replication, transcription, and translation process.
- To study Gene expression, post-transcriptional and post-translational modifications

Course Outcome and Cognitive Level Mapping

Upon the Successful completion of the course the student would be able to

CO Number	CO Statement	Cognitive Level
CO1	Understand and remember chemistry and salient features of DNA and the concepts of inheritance.	K1, K2
CO2	In-depth knowledge of the mendelian laws, sex determination, replication, transcription and translation.	K2
CO3	Explain and differentiate the process of DNA replication, transcription and translation between prokaryotes and Eukaryotes.	K2, K4
CO4	Compare and distinguish the laws of segregation, law of independent assortment, linkage, multiple alleles, and Eukaryotic and prokaryotic gene expression.	K3, K4
CO5	Evaluate and analyze the basic concepts of classical and molecular genetics	K4, K5

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	2	1
CO2	3	3	2	1	1	3	3	2	2	1
CO3	3	3	3	2	1	3	3	2	2	1
CO4	3	3	3	2	1	3	3	2	3	1
CO5	3	3	2	2	1	3	3	2	2	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 and RNA as genetic material - Griffith's, Hershey - chase Experiments and Fraenkel-Conrat 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.	13	CO1, CO2, CO3, CO4, CO5	KI, K2, K3, K4, K5
II	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 <i>Drosophila</i> ; Law of Independent Assortment – Dihybrid. Test cross and Back Cross.	14	CO1, CO2, CO3, CO4, CO5	KI, K2, K3, K4, K5
III	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. Somatic cell genetics.	14	CO1, CO2, CO3, CO4, CO5	KI, K2, K3, K4, K5
IV	Chromosome structural organization – Chromatin and chromatids; Special types of Chromosomes: Polytene and Lampbrush chromosomes. DNA Replication- Prokaryotic and Eukaryotic DNA replication, enzymes and proteins involved in DNA replication. Models of replication – Semi-conservative, Unidirectional, Bidirectional, Rolling circle mechanism. Inhibitors of DNA replication. DNA repair mechanisms.	16	CO1, CO2, CO3, CO4, CO5	KI, K2, K3, K4, K5
V	Transcription – Prokaryotic and Eukaryotic transcription, Enzymes involved in transcription. Post transcriptional modifications – 5' – CAP formation, 3' processing and polyadenylation, splicing. Regulation of Transcription - Prokaryotes: lac operon and trp operon. Translation – Prokaryotic and Eukaryotic translation, Mechanisms of initiation, elongation and termination. Post-translational modifications - Importance of Glycosylation and Phosphorylation.	18	CO1, CO2, CO3, CO4, CO5	KI, K2, K3, K4, K5
VI	Self-Study for Enrichment (Not Included for End Semester Examination) Extra Nuclear inheritance, Crossing over, Replisomes and Primosomes, Wobble hypothesis, hormonal control of gene expression, Regulation of transcription.	-	CO1, CO2, CO3, CO4, CO5	KI, K2, K3, K4, K5

Text Books

1. Verma, P.S & Agarwal, V.K. (2022). *Cell Biology, Genetics, Molecular Biology, Evolution and Ecology*. S Chand and Company Ltd.
2. Vishnu Shankar, S. (2021). *Fundamentals of Genetics and Molecular Biology*. Red'shine Publication Pvt. Ltd.
3. Pragya, K. (2020). *Essentials of Genetics*. Dream tech Press.
4. Veer Bala, R. (2019). *Genetics*, 4th edition. Med tech.
5. Andreas, H & Samuel, C. (2018). *Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology 8th Edition*. Cambridge University Press.

Reference Books

1. Poonam, A. (2022). *Lippincott Illustrated Reviews: Cell and Molecular Biology*. Wolters Kluwer India Pvt Ltd.
2. Harvey, L., Arnold B., Chris, A. K & Monty, K. (2021). *Molecular Cell Biology Ninth edition*. W. H. Freeman
3. Nancy, L.C., Rachel, R.G., Carol, C.G., Gisela, G.S & Cynthia, W. (2020). *Molecular Biology: Principles of Genome Function 3rd Edition*. Oxford University Press.
4. Lieberman. (2020). *BRS Biochemistry, Molecular Biology, and Genetics*. 7th edition. Wolters Kluwer India Pvt Ltd.
5. Jocelyn, E.K., Elliott, S.G & Stephen, T.K. (2017). *Lewin's GENES XII 12th edition*. Jones and Bartlett Publishers, Inc

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>
5. <https://www.pdfdrive.com/cell-biology-genetics-molecular-biology-evolution-and-ecology-e157248372.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>
5. <http://ndl.iitkgp.ac.in/document/Qkh4R2FGUkRNZjFicFUvWmpzQ2loU1NPaeI6eWpVaXpnNGUwc21iQzZKbUdaczdobHlyeWNpditXM2hpaFNOS1F6dVc4NGltYWZEQ09YbEVlWjJtelE9PQ>

Pedagogy

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

Course Designers

1. Ms. P. ILAMATHY
2. Dr. M. KEERTHIGA

Semester-II	Internal Marks: 40		External Marks: 60	
COURSE CODE	COURSE TITLE	CATEGORY	HOURS/ WEEK	CREDITS
22UBT2CC2P	MOLECULAR BIOLOGY & GENETICS (P)	CORE	3	3

Course Objectives

- To develop skills related to DNA Isolation Techniques.
- To study about the Quantification of Nucleic acids.
- To gain knowledge in mutagenesis.
- To perform experiments on *Drosophila* and observe their genetic variations.
- To gain knowledge about simple traits in man.

Course Outcome and Cognitive Level Mapping

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

CO Number	CO Statement	Cognitive Level
CO1	Demonstrate and analyze the DNA isolation methods.	K3, K4
CO2	Infer the separation techniques for DNA and protein and their quantification methods.	K4
CO3	Illustrate and interpret the different mutagenesis techniques.	K3
CO4	Explain the Mendelian traits and distinguish the male and female <i>Drosophila</i> cultures.	K4
CO5	Categorize the different genetic disorders in man using the Pedigree Chart.	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. Isolation and purification of Genomic DNA from Prokaryotes
2. Isolation and purification of Genomic DNA from Eukaryotes
3. Isolation and purification of Plasmid DNA
4. Separation of DNA by using AGE
5. Separation of Protein by using NATIVE - PAGE
6. Separation of Protein by using SDS - PAGE
7. Quantification of Nucleic Acids – DNA by chemical method
8. Quantification of Nucleic Acids – RNA by chemical method
9. Bacterial mutagenesis using Physical Method
10. Transformation
11. Observation of simple Mendelian traits among humans.
12. Drosophila – male and female Identification and Culture.
13. Karyotyping with the help of photographs
14. Pedigree charts of some common characters like blood group and color blindness.
15. Determination the ABO blood groups in a random sample and calculation of the allele frequency using Hardy Weinberg's law.

Reference Books

1. Taneri, B., Asilmaz, E., Delikurt, T., Savas, P., Targen, S., & Esemem, Y. (2020). *Human Genetics and Genomics: A Practical Guide*, John Wiley & Sons.
2. Hofmann, A.C., Willson, S & Walker's. (2017). *Principles and Techniques of Biochemistry and Molecular Biology*, Cambridge University Press.
3. Joshi, S., & Dhamij, N., (2015). *Rediscovering Genetics: A Laboratory Manual*, Wiley India.
4. Malacinski, G.M., & Freifeder's. (2013). *Essentials of Molecular Biology*, Norosa Publishing House.
5. Thompson, D. (2011). *Cell and Molecular Biology Lab Manual*, Norosa Publishing House.

E-Books

1. <https://jru.edu.in/studentcorner/lab-manual/agriculture/Fundamentals%20of%20Genetics.pdf>
2. https://academicworks.cuny.edu/cgi/viewcontent.cgi?article=1008&context=ny_oers
3. <https://sjce.ac.in/wp-content/uploads/2018/04/Cell-Biology-Genetics-Laboratory-Manual-17-18.pdf>

4. https://www.academia.edu/27721547/LABORATORY_MANUAL_BTY108_BASIC_GENETICS_LABORATORY
5. <https://www2.umbc.edu/summerstem/documents/biology/BIOL302L-SU14-Caruso.pdf>

Web References

1. <https://www.jove.com/v/5058/separating-protein-with-sds-page>
2. http://www.uwyo.edu/molb2021/virtual-edge/lab13/exp_13a.html
3. <https://www.youtube.com/watch?v=oBwtxdI1zvk>
4. <https://www.jove.com/v/5082/an-introduction-to-drosophila-melanogaster>

Pedagogy

Practical Observation and Demo

Course Designers

1. **Ms. R. NEVETHA**
2. **Dr. G. GOMATHI**

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 Imaging 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 Applications of 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. Boguslaw, B & Irena B (2022). Handbook of Bioanalytics. Springer International Publishing.
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: 40		External Marks: 60	
COURSE CODE	COURSE TITLE	CATEGORY	HOURS/ WEEK	CREDITS
22UBT2AC3P	MICROBIOLOGY AND BIOCHEMISTRY (P)	ALLIED	4	3

Course Objectives

- To impart the students with hands on skills related to biochemical techniques.
- To enable the students to perform qualitative analysis of biomolecules.
- To make the students to maintain aseptic and pure culture techniques of microorganisms.
- To enhance the students with knowledge about biochemical characterization of microorganisms.

Course Outcome and Cognitive Level Mapping

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

CO Number	CO Statement	Knowledge Level
CO 1	Define and Demonstrate aseptic and pure culture techniques in isolation and culture of microorganisms	K1, K2
CO 2	Identify and Classify the type of microorganism using staining techniques & biochemical tests.	K2, K3
CO 3	Make use of various tests for examination of urine & enzymes.	K3
CO 4	Apply various qualitative tests to identify the biomolecules.	K3
CO 5	Identify and Examine the biomolecules present in the given sample.	K3, K4

Mapping of CO with PO and PSO

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

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

Syllabus

1. Preparation of Molarity, Normality solutions and Buffers.
2. Qualitative analysis of Carbohydrates
3. Qualitative analysis of proteins
4. Qualitative analysis of Lipids.
5. Estimation of Glucose by DNS method.
6. Qualitative chemical examination of Urine.
7. Determination of salivary amylase activity.
8. Separation of plant pigments using Paper chromatography.
9. Media Preparation & Sterilization.
10. Isolation and Enumeration of Microorganisms from Water and Soil.
11. Pure Culture Techniques – Spread plate, Streak plate, Pour plate and Slant preparation.
12. Measurement of Bacterial Growth – Turbidometric method
13. Staining Techniques – Simple staining, Gram's staining & Capsule Staining.
14. Cell Motility – Hanging drop technique.
15. Biochemical Characterization of microorganisms – IMViC tests.

Reference Books

1. Arora, B., & Arora, D. R. (2020). *Practical Microbiology (2nd Edition)*. CBS Publishers & Distributors.
2. Chawla, R. (2020). *Practical Clinical Biochemistry: Methods and Interpretations*. JP Medical Ltd.
3. Aneja, K.R. (2018). *Laboratory Manual of Microbiology and Biotechnology (2nd Edition)*. ED-TECH.
4. Gupta, R.C., Bhargava, S. (2018). *Practical Biochemistry (5th Edition)*. CBS Publishers.
5. Cappucino, J. G. (2017). *Microbiology - Laboratory Manual*. Pearson.
6. Plummer, D. T. (2017). *An Introduction to Practical Biochemistry (3rd Edition)*. Tata McGraw-Hill Education.

E- Books

1. <https://www.pdfdrive.com/bensons-microbiological-applications-laboratory-manual-in-general-microbiology-short-version-d185416575.html>

2. <https://www.pdfdrive.com/laboratory-manual-for-general-microbiology-e33507828.html>
3. <https://www.pdfdrive.com/microbiology-laboratory-exercises-justmedeu-d15396585.html>
4. <https://www.pdfdrive.com/laboratory-manual-of-biochemistry-d44169898.html>
5. <https://www.pdfdrive.com/biochemistry-laboratory-manual-e33724502.html>

Web References

1. <https://vlab.amrita.edu/?sub=3&brch=63>
2. <https://vlab.amrita.edu/?sub=3&brch=73>
3. https://profiles.uonbi.ac.ke/jamesmuthomi/files/acp101_microbiology_practical_exercises.pdf
4. <https://nptel.ac.in/courses/102103015>
5. <https://jru.edu.in/studentcorner/lab-manual/bpharm/Lab%20Manual%20-%20Biochemistry.pdf>

Pedagogy

Practical Observation and Demo

Course Designers

1. **DR. R. RAMESHWARI**
2. **MS. P. JENIFER**

Semester: II	Internal Marks: 100			
COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
22UGEVS	ENVIRONMENTAL STUDIES	ABILITY ENHANCEMENT COMPULSORY COURSE	2	2

Course Objective

- To train the students to get awareness about total environment and its related problems and to make them to participate in the improvement and protection of the environment.

Course Outcome and Cognitive Level Mapping

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

CO Number	CO Statement	Cognitive Level
CO1	Outline the nature and scope of environmental studies	K1, K2
CO2	Illustrate the various types of natural resources and its importance.	K2
CO3	Classify various types of ecosystem with its structure and function.	K2, K3
CO4	Develop an understanding of various types of pollution and biodiversity.	K3
CO5	List out the various types of social issues related with environment and explain protection acts	K4, K5

Mapping of CO with PO and PSO

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	2	2	2	3	3	2	2	3	2	3
CO2	3	3	2	3	3	3	2	3	3	3
CO3	2	3	3	2	3	3	3	3	3	2
CO4	2	3	3	3	2	3	2	3	3	3
CO5	3	3	2	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	Introduction to environmental studies Definition, scope and importance. Need for public awareness	06	CO1, CO2, CO3, CO4	K1, K2, K3,
II	<p>Natural Resources: Renewable and non-renewable resources:</p> <p>a. Forest resources: use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.</p> <p>b. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams benefits and problems.</p> <p>c. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources.</p> <p>d. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity.</p> <p>e. Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies.</p> <p>f. Land resources: Land as resources, land degradation, man induced Landslides, soil erosion and desertification.</p> <p>g. Role of an individual in conservation of natural resources.</p>	06	CO1, CO2, CO3, CO4	K1, K2, K3
III	<p>Ecosystems</p> <p>Concept, Structure and function of an ecosystem.</p> <p>Producers, consumers and decomposers</p> <p>Energy flow in the ecosystem and Ecological succession.</p> <p>Food chains, food webs and ecological pyramids</p> <p>Introduction, types, characteristic features, structure and function of the following ecosystem:-Forest ecosystem, Grassland ecosystem and Desert ecosystem, Aquatic ecosystems, (ponds, streams, lakes, rivers, oceans, estuaries)</p>	06	CO1, CO2, CO3, CO4	K1, K2, K3
IV	<p>Biodiversity and Environmental Pollution</p> <p>Introduction, types and value of biodiversity.</p> <p>India as a mega diversity nation. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts.</p> <p>Endangered and endemic species of India.</p> <p>Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity. Definition, Causes, effects and control measures of:</p>	06	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5

	<p>a) Air Pollution b) Water Pollution c) Soil Pollution d) Noise pollution e) Nuclear hazards</p> <p>Solid waste Management: Causes, effects and control measures of urban and industrial wastes. E-Waste Management: Sources and Types of E-waste. Effect of E-waste on environment and human body. Disposal of E-waste, Advantages of Recycling E-waste. Role of an individual in prevention of pollution. Disaster management: floods, earthquake, cyclone and landslides.</p>			
V	<p>Social Issues and the Environment Water conservation, rain water harvesting, watershed management. Climate change, global warming, acid rain, ozone layer depletion, Wasteland reclamation. Environment Protection Act Wildlife Protection Act. Forest Conservation Act. Population explosion – Family Welfare Programmes Human Rights - Value Education. HIV/ AIDS - Women and Child Welfare. Role of Information Technology in Environment and human health.</p>	06	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
VI	<p>Self-Study for Enrichment (Not to be included for End Semester Examination) Global warming – climate change – importance of ozone – Effects of ozone depletion. Biogeography – history, ecology and conservation. International laws and policy</p>	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5

References

1. Beard, J.M. 2013. Environmental Chemistry in Society (2nd edition). CRC Press.
2. Girard, J. 2013. Principles of Environmental Chemistry (3rd edition). Jones & Bartlett.
3. Brebbia, C.A. 2013. Water Resources Management VII. WIT Press.
4. Pandit, M.K. & Kumar, V. 2013. Land use and conservation challenges in Himalaya: Past, present and future. In: Sodhi, N.S., Gibson, L. & Raven, P.H. Conservation Biology: Voices from the Tropics. pp. 123-133. Wiley-Blackwell, Oxford, UK (file:///Users/mkpanidit/ Downloads /Raven%20et%20al.%202013.%20CB%20Voices %20from %20Tropics%20(2).pdf) .
5. Hites, R.A. 2012. Elements of Environmental Chemistry (2nd edition). Wiley & Sons.
6. Harnung, S.E. & Johnson, M.S. 2012. Chemistry and the Environment. Cambridge University Press.
7. Boeker, E. & Grondelle, R. 2011. Environmental Physics: Sustainable Energy and Climate Change. Wiley.
8. Forinash, K. 2010. Foundation of Environmental Physics. Island Press.
9. Evans, G.G. & Furlong, J. 2010. Environmental Biotechnology: Theory and Application (2nd edition). Wiley-Blackwell Publications.
10. Williams, D. M., Ebach, M.C. 2008. Foundations of Systematics and Biogeography. Springer
11. Pani, B. 2007. Textbook of Environmental Chemistry. IK international Publishing House.
12. Agarwal, K.C. 2001 Environmental Biology, Nidi Public Ltd Bikaner.

Pedagogy

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

Course Designer

Dr.B.Thamilmaraiselvi

Ability Enhancement Compulsory Course II (AECC) : Environmental Studies (22UGEV5)

Assessment Rubrics for 100 Marks

1. Documentary (or) Poster Presentation (or) Elocution-25 Marks
2. Quiz (or) MCQ Test-25 Marks
3. Album Making (or) Case study on a topic (or) Field Visit -25 Marks
4. Essay Writing (or) Assignment (Minimum 10 pages) -25 Marks

There will be no End Semester Examination for this course. However, the subject teacher will evaluate the above mentioned components based on the performance of the students and submit the marks out of 100 (in the format to be supplied by the COE) with the approval of the concerned Head of the Department to the COE along with CIA marks of other courses.

Semester: II	Internal marks:40		External marks: 60	
COURSE CODE	COURSE TITLE	CATEGORY	Hrs/ week	CREDITS
22UGIE	INNOVATION & ENTREPRENEURSHIP	Ability Enhancement Compulsory Course -III	2	1

Course Objective

- The course is designed to motivate the students in Entrepreneurship with innovative ideas and build interest in Venture Creation.

Course Outcome and Cognitive Level Mapping

The students will be able to

CO	CO Statement	Knowledge Level
CO 1	Identify Self-Entrepreneurial traits and passion leads.	K3
CO 2	Discover problem solving opportunities and generate ideas	K3
CO 3	Analyse the process of design thinking	K4
CO 4	Develop Business Model canvas for the idea generated	K5
CO 5	Validate the business idea by creating Capstone project	K6

Mapping of CO with PO and PSO

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

“1” – Slight (Low) Correlation □ “2” – Moderate (Medium) Correlation □

“3” – Substantial (High) Correlation □ “-” indicates there is no correlation.

SYLLABUS

UNIT	CONTENT	HOURS	CO'S	COGNITIVE LEVELS
I	<p><u>Entrepreneurship & Intrapreneurship</u></p> <p>Importance of Entrepreneurship Development-The entrepreneurial mind set – Attributes and Characteristics of a successful entrepreneur.</p> <p>Intrapreneurship- Importance- Attributes, Contribution and Characteristics of a successful Intrapreneur- Types of Intrapreneurs.</p> <p>Self-Discovery- Learnings from famous company cases that promote entrepreneurship and Intrapreneurship. (Activity)</p>	6	<p>CO1</p> <p>CO2</p> <p>CO3</p> <p>CO4</p> <p>CO5</p>	<p>K3</p> <p>K4</p> <p>K5</p>
II	<p><u>Entrepreneurial Skill Sets</u></p> <p>Significance of Entrepreneurship skills- Business Management Skill- Decision making skills- Principles of Effectuation- Analytical & Problem-solving skill- Critical thinking skill- Lateral thinking skill- Factors associated with lateral thinking along with examples.</p> <p>Opportunity Discovery- Identify problems worth solving through JTBD method (Activity)</p>	6	<p>CO1</p> <p>CO2</p> <p>CO3</p> <p>CO4</p> <p>CO5</p>	<p>K3</p> <p>K4</p> <p>K5</p>

III	Design Thinking & Innovation Innovation & Creativity- Role in Industry and Organizations- Dynamics of Creative Thinking-Process of Design Thinking- Implementing the Process in Driving Innovation through scientific technologies and Non technology process. Business Idea Generation – Build your own Idea Bank with Innovative Approaches (Activity)	6	CO1 CO2 CO3 CO4 CO5	K3 K4 K5
IV	Crystallising the business Idea Customer Discovery- Identification of customer segments-Drafting of Value Proposition Canvas with a venture creation Idea. Basics of Business Model and LEAN Approach, Blue Ocean Strategy Approach. Crafting business model for a venture using the Lean Canvas – (Activity)	6	CO1 CO2 CO3 CO4 CO5	K3 K4 K5
V	Start-up Business Plan Presentation of Capstone project; Validation Analysis; Pre-incubation and Incubation stages to develop a start-up ecosystem.	6	CO1 CO2 CO3 CO4 CO5	K3 K4 K5 K6
VI	Self study for enrichment: (Not to be included for External examination) Case study analysis on Entrepreneurship		CO1 CO2 CO3 CO4 CO5	K3 K4 K5

Textbooks:

1. Elias G.Carayannis, Elbida.D.Samra (2015), Innovation and Entrepreneurship,
2. Peter.F. Drucker (2006), Innovation and Entrepreneurship, Harper Publications

Reference books:

1. John R.Bessant, Joe Tidd (2015), Innovation and Entrepreneurship, Wiley Publictaions
2. Mike Kennard (2021), Innovation and Entrepreneurship, Routledge, Taylor and Frnacis

Web References:

1. <https://innovation-entrepreneurship.springeropen.com/>
2. <https://www.worldcat.org/title/innovation-and-entrepreneurship-practice-and-principles/oclc/11549089/lists>

Pedagogy:

e- Content modules, Activity worksheet, Case Studies

Course Designer:

Dr.R.Subha, Assistant Professor, Innovation ambassador, Department of Chemistry

Dr.S.Sowmya,Assistant Professor, Innovation ambassador, Department of Commerce

**ABILITY ENHANCEMENT COMPULSORY COURSE III-INNOVATION
AND ENTREPRENEURSHIP**

Assessment Rubrics for 100marks

S.No	Particulars	Marks
1	Self Analysis / Preparation of Self Identification Report / Case study presentation	20
2	Identification of Problem / Innovative practice/ Business plan report	20
3	Lean Canvas / Value Proposition Model / Prototype	20
4	VIVA VOCE a. Novelty of Business Idea b. Commercial Scalability c. Pitching Presentation	20 10 10
	TOTAL	100

There will be no End Semester Examination for this Course. The subject teacher will make the assessment of student's performance based on the above-mentioned components and an internal VIVA VOCE will be conducted by the Institution Innovation Ambassadors of Institution Innovation Council, Ministry of Education. Marks will be awarded and submitted to CoE in the Prescribed format specified by the Controller of the examination approved by the Head of respective Departments.

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 expression analysis for further studies in the area of genetic engineering.
- To expose students to the applications of rDNA technology in biotechnological 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 (<i>E.coli</i> & 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, CaCl ₂ 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, Washington DC
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 Genetic Engineering*, 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](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 CaCl_2 .

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 "Plant Biotechnology and Molecular Biology : A Laboratory Manual*. Scientific Publishers.
5. Khalid, Z. M., Sameena, M.L, Rovidh Saba, R. (2020). *Advanced Methods in Molecular Biology and 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
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/8DFIDwAAQBAJ?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](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%20molecular%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](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 of India 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. Pathwaysearch 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 and computational 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-iFJdq>

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 – <i>E. coli</i>) 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 in various 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. 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 Publisher

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.

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, Genera and specific immunosuppressive therapy; Clinica 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.Madhav 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). *Immunology 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, Andrew H.Lichtman Shiv Pillai.(2019). *Basic Immunology*. Edition.Elsevier
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.Roitt'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&qv=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	Internal Marks: 40		External Marks: 60	
COURSE CODE	COURSE TITLE	CATEGORY	HOURS/ WEEK	CREDITS
24UBT4CC4P	IMMUNOLOGY (P)	CORE PRACTICAL –IV	4	4

Course Objectives

- To study about the Identification of Blood Group.
- To enumerate the Blood Cells
- To study about the Immunoelectrophoresis Techniques
- Enable the students with diagnostic skills for identification of certain diseases and immunological 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*. First Edition. IP Innovative Publication Pvt. Ltd.
2. Senthilkumar Balakrishnan, Karthik Kaliaperumal, Senbagam Duraisamy.(2017).*Practical Immunology A Laboratory Manual*. LAP LAMBERT Academic Publishing, Germany.
3. Wilmore C. Webley.(2017).*Immunology Laboratory Manual*. LAD Custom Publishing, Georgia.
4. Barbara Detrick, John L Schmitz, Robert G Hamilton(2016).*Manual of Molecular and Clinical Laboratory Immunology*. 8th Edition. ASM Press, Washington, DC.
5. Christine Dorresteyn Stevens.(2016).*Clinical Immunology and Serology: A Laboratory Perspective*. F.A. Davis Company, 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&qpv=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 its historical 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 identification examinations.
- To develop knowledge about entomology and forensic anthropology and contribute to criminal investigations 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 to preserving 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	<p>Introduction to Forensic Biology: Forensic Science - Definition - Development of Forensic science in India - Organization and functions of Forensic laboratory.</p> <p>Documents identification: Questioned documents, identification of hand writing, type writer and forged signatures- Erasures and alterations on documents and their detection</p>	11	CO1, CO2, CO3	K1, K2, K3, K4
II	<p>Physical evidences and Crime Scene examinations Physical evidences: classification and significance - Locard's Principle of exchange class and individual characteristics.</p> <p>Crime Scene examinations - documentation of crime scene- recognition, collection, preservation and transportation of physical evidence for laboratory examinations.</p> <p>Fundamentals of photography - crime scene photography.</p>	13	CO1, CO2, CO3	K1, K2, K3, K4
III	<p>Foot and Finger prints Analysis Foot and tyre impressions - Walking pattern - Recording and examination of foot prints and tyre prints.</p> <p>Finger prints - Fundamental principles - Finger print patterns - classification of finger prints -methods of developments of latent finger prints. .</p>	12	CO1, CO4, CO5	K1, K2, K3, K4
IV	<p>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 fibre hair, bones, teeth and skull - Fundamental of DNA typing.</p>	12	CO1, CO2, CO5	K1, K2, K3, K4
V	<p>Entomology and Skeletal Analysis: Role of Entomology in Forensic Investigations: Insect Succession: Forensic Anthropology and its role in the criminal investigations.</p> <p>Skeletal Analysis: Techniques for age, sex, and ancestry determination from skeletal remains.</p>	12	CO1, CO2, CO3	K1, K2, K3, K4
VI	<p>Self-Study for Enrichment Satellite DNA (Not Included for End Semester Examination)</p>	-	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 engineered product - 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,

“3” – Substantial (High) Correlation,

“2” – Moderate (Medium) 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. Second Edition.* 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](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 V	Internal Marks : 25		External Marks : 75	
COURSE CODE	COURSE TITLE	CATEGORY	HOURS/ WEEK	CREDITS
23UBT5CC6	PLANT BIOTECHNOLOGY	CORE COURSE-VI	6	5

Course Objectives

- 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	K1, 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,	K1, K2, K3, K4, K5
III	Deciphering <i>Arabidopsis thaliana</i> Genome Organization Introduction to <i>Arabidopsis thaliana</i> as a premier model plant species : Landscape of the nuclear genome in <i>Arabidopsis thaliana</i> - Structure and functions of the chloroplast genome - Mitochondrion and its Genome. Cytoplasmic Male Sterility in plants: Mechanisms, applications, and implications.	18	CO1, CO2, CO3,	K1, 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 Brinjal), 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	K1, 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	K1, 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	K1, 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	Trangensis: 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 technology 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 publisher 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/x09ed98f7a9e671b:biotechnology-and-its-applications/x09ed98f7a9e671b: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 India Pvt. 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 female reproductive 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
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Text Books

1. Shaeena, M.H. & Dr. Baharul Islam, H. (2023). *Textbook of Human Anatomy And Physiology*. Pritam Publications.
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/in-human-anat-final.pdf>
4. <https://medicests.com/units/introduction-to-a-p>
5. <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 of plant and mineral origin.	K2
CO3	Design the drug preparation method and explain the characteristic features of 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,
“3” – Substantial (High) Correlation,

“2” – Moderate (Medium) Correlation,
“-” indicates there is no correlation.

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	Introduction to Pharmacognosy Definition, #History and Scope of Pharmacognosy 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) Indigenous system of medicine, Fibers used in pharmacy, Drug administration, Extraction methods, Drugs of Marine source.	-	CO4, CO5	K1, K2, K3, K4, K5, K6
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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](https://www.cartercenter.org/resources/pdfs/health/ephti/library/lecture%20notes/health%20science%20students/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 biological fluid.
 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*. Fourth edition, 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*. Second Edition. 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*. Seventh Edition. Elsevier, 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](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	<p>Unit I - Basic principles of Biochemical Engineering</p> <p>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.</p>	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
II	<p>Unit II - Concepts of basic mode of fermentation processes</p> <p>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.</p>	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
III	<p>Unit III – Upstream and Downstream Processing</p> <p>Upstream Processing: Media formulation, sterilization, aeration, agitation and air sterilization. Measurement and control of bioprocess parameters, scale up and scale down process.</p> <p>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.</p>	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4

IV	<p>Unit IV: Introduction to Environmental Biotechnology</p> <p>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.</p>	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
V	<p>Unit V: Biodegradation and Bioremediation</p> <p>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.</p>	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
VI	<p>Self-Study for Enrichment (Not Included for End Semester Examination)</p> <p>Oxidation Ponds, Bioscrubbers and Biofertilizer</p>	-	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, PerryL. 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 – A Laboratory 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, BIOETHICS AND BIOSAFETY	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 Secret, 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	<p>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.</p>	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
VI	<p>Self-Study for Enrichment (Not Included for End Semester Examination) Definition of GMOs and LMOs, Biosafety Levels;</p>	-	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	DISCIPLINESPECIFIC 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 germ layers. 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/attendance/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
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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.Madhav 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). *Immunology 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, Andrew H.Lichtman Shiv Pillai.(2019). *Basic Immunology*. Edition. Elsevier
3. Jenni Punt, Sharon Stranford, Patricia 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. Roitt'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&qvpt=Immune+System+Notes%3a+Diagrams+%26+Illustrations+%7c+Osmosis&mid=55E74851E85FF7ED93225E74851E85FF7ED9322&&FORM=VRDGAR>
4. <https://www.bing.com/videos/riverview/relatedvideo?&q=Immune+System+Notes%3a+Diagrams+%26+Illustrations+%7c+Osmosis&qvpt=Immune+System+Notes%3a+Diagrams+%26+Illustrations+%7c+Osmosis&mid=55E74851E85FF7ED93225E74851E85FF7ED9322&&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 (<i>Pleurotus sajor caju</i>) 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