CAUVERY COLLEGE FOR WOMEN (AUTONOMOUS)

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

TIRUCHIRAPPALLI – 620 018

DEPARTMENT OF BIOTECHNOLOGY

B.Sc.,BIOTECHNOLOGY

SYLLABUS

2025 – 2026 and Onwards

CAUVERY COLLEGE FOR WOMEN (AUTONOMOUS)
DEPARTMENT OF BIOTECHNOLOGY

VISION

- To educate a broad range ofbasic lab skills applicable to biologyand biotechnology.
- Make the students know and understand broad range ofbasic biological concepts and can apply and analyse these in at least one specialty area.
- Make the students generate a hypothesis, design approaches to test themand interpret the data from those tests to reach valid conclusions.
- To develop the abilityto 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 biotechnologyprofessionals to fulfill the employment and research needs in the biotechnology industry.
- Enhance the student's abilityto integrate their acquired computer and biosciences knowledge and skills to investigate and solve the biological problems.
- To createopportunities for placement in leading industries through Internships.

PROGRAMMEEDUCATIONAL 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 equityto transform students into committed professionals with a strong attitude towards the development of the nation.
PEO 5	**GREENSUSTAINABILITY** 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 multidisciplinarypaths 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.

PROGRAMMESPECIFIC OUTCOMES FOR B.Sc., BIOTECHNOLOGY

PSO NO	The students of B.Sc., Biotechnology will be able to	POs Addressed
PSO 1	Acquire knowledge ofbiological sciences with the implementation of technology on different living systems like plants, animals and microbes.	PO1 PO 2
PSO 2	Explain the fundamental concepts and develop skills in Immunology, Developmental biology, Nanobiotechnology, Genomics, Proteomics, Bioinformatics, Agriculture and Medicine	PO 1 PO 2
PSO 3	Applythe 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-ontechniques in various thrust areas of biotechnologyto 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 2025-2026 and onwards)

Semester	Part	Course	Course Title	Course Code	Inst Hrs.	Credits	Exam			Total
							Hrs.	Marks		
								Int	Ext	
I	I	Language Course-I (LC)	Tamil Ilakkiya varalaru –I	25ULT1	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 (AC)	Biochemistry	22UBT1AC2	4	3	3	25	75	100
	IV	Ability Enhancement Compulsory Course-I (AECC)	UGC Jeevan Kaushal-Universal Human Values	25UGVE	2	2	-	100	-	100
		Total			**30**	**22**				**700**
II	I	Language Course - II (LC)	Podhu Tamil – II	25ULT2	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	40	60	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*

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 studyabout the basic concepts ofcells and their cellular organelles and their functions.
- To studythe specialized cells.
- To studyabout cell cycle and its regulations.
- To studycell signaling pathways

Course Outcome and Cognitive Level Mapping

Uponthe successful completion ofthe course, students will be able to

CO Number	CO Statement	Cognitive Level
CO1	Relate and explain the basics ofcell 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 ofcells and specialized cells	K5
CO5	Interpret the conceptsofcell, cell division, compartmentalization, transport of nutrients and cell signalling in different types ofcells.	K5

Mapping of CO withPO 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)** Discoveryof 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,
4. P. (2019). *Essential Cell Biology*. 5th International Student Edition. Garland Science.
5. De Robertis, E.D.D. & De Robertis, E.M.F. (2017). *Cell &Molecular Biology*. 8th Edition. Waverly.
6. 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.* 6thEdition. 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://standring.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 performexperiments using microscopes and micrometry.
- To studyabout cells and their morphology byappropriate techniques.
- To gain knowledge in cell division and their stages.
- To performexperiments on cell counting and viability.

Course Outcome and Cognitive Level Mapping

Uponthe successful completion ofthe 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 morphologyof various types ofcells.	K2
CO 3	Classifyand illustrate the different cellorganelles.	K3
CO 4	Categorize the different types and stages ofcell division.	K4
CO 5	Illustrate and conclude cell viabilityand 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. Laboratoryrules, regulations and safety measures.
2. DemonstrationofPrinciples and working mechanismofLight Microscope.
3. Principles and working mechanism ofrotaryMicrotome (Demo).
4. Measurement ofCell Size byMicrometry.
5. Prokaryotic Cell Observation – *E. coli.*
6. Eukaryotic Cell Observation – Yeast and Onion.
7. Morphological Characterization of various types ofPlant tissue cells.
8. Separation of cell organelles bycentrifugation method.
9. Barr body identification fromBuccal Smear.
10. Cell Division - Mitotic stages.
11. Cell Division - Meiotic stages.
12. Cell Division - Binary fission ofYeast Cells.
13. Enumeration ofEukaryotic Cells (Yeast), Red Blood Cells and White Blood Cells.
14. Assessment ofCell Viability bytrypan 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. UMAMAHESWARI**
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 Historyand classification ofMicroorganisms.
- To studythe structure and characteristics of microorganisms like bacteria, algae, fungi, protozoa and virus.
- To studythe media composition and their types.
- To studythe microbial diseases, pathogenesis, diagnosis and preventive measures.

Course Outcome and Cognitive Level Mapping

Uponthe successful completion ofthe course, students will be able to

CO Number	CO Statement	Cognitive Level
CO 1	Recalland infer the factualand 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	Classifythe different kind of microbes (Classification) and explain the general characteristic features ofthe Algae, Fungi, protozoa and virus.	K4, K5
CO 5	Elaboratethediagnostic 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'sEight 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 (*Chlamydomonas sp.*) including occurrence, thallus organization, Ultra structure, pigments, eyespot, food reserves. Reproduction – Sexual and Asexual reproduction. Fungi (*Aspergillus sp.*) – General characteristics of fungi including habitat, distribution, nutritional requirements, Ultrastructure, thallus organization and aggregation.	13	CO1, CO2, CO3, 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 studythe basics ofbiomolecules.
- To studyclassification, structure and functional properties of carbohydrates, proteins, lipids, vitamins and minerals.
- To studythe impact ofproteins and enzymes.
- To studyvitamin deficiency diseases.

Course Outcome and Cognitive Level Mapping

Uponthe Successful completion ofthe 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	Indepth knowledge about the properties and significance ofthe Biomolecules	K2
CO3	Explain and differentiate the relationship between different kinds of biomolecules such as carbohydrates, lipids, nucleic acid and proteins.	K2, K4
CO4	Classifyand demonstratethe various sources and functions ofthe nutrients. Calorific value of food.	K3, K4
CO5	Evaluate and analyze the concept ofnutrition 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 ofamino 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 ofamino 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*. NiraliPrakashan 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*. DiscoveryPublishing House Pvt Ltd.

E-Books

1. https://www.pdfdrive.com/lehninger-principles-of-biochemistry-d158404366.html
2. https://www.pdfdrive.com/biochemistry-d196362531.html
3. https://www.pdfdrive.com/biochemistry-genetics-molecular-biology-d18198970.html
4. https://www.pdfdrive.com/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 studythe basics ofGenetics and molecular biology.
- To study about laws and concepts of Mendelian inheritance.
- To studythe process of DNA replication, transcription, and translation process.
- To study Gene expression, post-transcriptional and post-translational modifications

Course Outcome and Cognitive Level Mapping

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

CO Number	CO Statement	Cognitive Level
CO1	Understand and remember chemistryand salient features ofDNA and the concepts of inheritance.	K1, K2
CO2	In-depth knowledge of the mendelian laws, sex determination, replication, transcription and translation.	K2
CO3	Explainand differentiatethe processofDNA replication, transcription and translation between prokaryotes and Eukaryotes.	K2, K4
CO4	Compare and distinguish the laws ofsegregation, 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 *Drosophila*; 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.* Dreamtech 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). *MolecularBiology: Principles of Genome Function 3rd Edition.* Oxford University Press.
4. Lieberman. (2020). *BRSBiochemistry, 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/Qkh4R2FGUkRNZjFicFUvWmpzQ2loU1NPaEl6eWpVaXpnNGUwc21iQzZKbUdaczdobHlyeWNpditXM2hpaFNOS1F6dVc4NGltYWZEQ09YbEVlWjJtelE9PQ

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	**MOLECULARBIOLOGY & GENETICS (P)**	**CORE**	**3**	**3**

Course Objectives

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

Course Outcome and Cognitive Level Mapping

Uponthe successful completion ofthe 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 them quantification methods.	K4
CO3	Illustrate and interpret the different mutagenesis techniques.	K3
CO4	Explain the Mendelian traits and distinguish the male and female *Drosophila* 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. Isolationand 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 byusing AGE
5. Separation of Protein by using NATIVE - PAGE
6. Separation of Protein by using SDS - PAGE
7. Quantificationof Nucleic Acids – DNA bychemical method
8. Quantificationof Nucleic Acids – RNA bychemical 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 ofphotographs
14. Pedigree charts ofsome common characters like blood group and color blindness.
15. Determination the ABO blood groups in a random sample and calculation ofthe allele frequency using Hardy Weinberg's law.

Reference Books

1. Taneri, B., Asilmaz, E., Delikurt, T., Savas, P., Targen, S., & Esemen, 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 ofdifferent instruments used in the biological field
- To provide a better understanding of various analytical techniques
- Tooperate and maintain common bio instruments effectivelyand safely.
- To understanding ofbiomedical instrumentation principles in aspects ofdevice design and applications.
- An abilityto analyze contemporarybioinstrumentation studies to make connections and decisions based on their scientific merit.

Course Outcome and Cognitive Level Mapping

Uponthe successful completion ofthe course, students will be able to

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

Mapping of CO with PO and PSO

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

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

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	**Microscopy:** Light Microscopy, Bright and Dark field Microscopy, Fluorescence Microscopy, Confocal Microscope, Electron microscopy	5	CO1, CO2, CO3	K1, K2, K3, K4
II	**pH Meter & Spectrophotometer:** pH Meter: Principle and Operation of pH meter, Calomel Electrode, Glass Electrode, Combined Electrode, Methods of determining pH. Colorimeter – Principle and its applications, Beer Lambert's Law, Spectrophotometer- Principle and its applications, Types of Spectrophotometer- UV – Visible	4	CO1, CO2, CO3	K1, K2, K3, K4
III	**Centrifugation and Imagining Techniques:** Centrifugation – Principle, Types – Zonal, Differential, Density gradient centrifugation and ultracentrifugation its applications. Imaging Techniques- X-ray and NMR. Tracer Techniques - Radioactive isotope –Half life, GM Counter, Liquid Scintillation Counter.	5	CO2, CO3, CO4	K1, K2, K3, K4
IV	**Electrophoresis:** Principle and Applicationsof Electrophoresis – Types of electrophoresis- Pulsed Field Gel Electrophoresis, SDS-PAGE and 2 D gel; Immunoelectrophoresis; Blotting Techniques; Gel documentation	8	CO3, CO4, CO5	K1, K2, K3, K4
V	**Chromatography:** Fundamentals of Chromatography - Principle and its applications, Types –TLC, Column, Affinity, Ion –exchange, HPLC.	8	CO3, CO4, CO5	K1, K2, K3, K4
VI	**Self-Study for Enrichment** Introductionto 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 ofchromatography. *Food analysis*, *27*, 473-498.
6. Enderle, J., & Bronzino, J. (Eds.). (2012). *Introduction to biomedical engineering*. Academic press.

Reference Books

1. Bogusław, B & Irena B (2022). Handbookof Bioanalytics. Springer InternationalPublishing.
2. Webster, J. G. (Ed.). (2003). *Bioinstrumentation*. John Wiley & Sons.
3. Khandpur, R. S. (2005). *Biomedical instrumentation: Technology and applications* (Vol. 1). New York: Mcgraw-hill.
4. Upadhyay, A., Upadhyay, K., & Nath, N. (1993). Biophysicalchemistryprinciples 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**
23UBT2AC3P	**MICROBIOLOGYAND BIOCHEMISTRY (P)**	**ALLIED**	**4**	**3**

Course Objectives

- To impart the students with hands onskills related to biochemical techniques.
- To enable the students to performqualitative analysis ofbiomolecules.
- 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

Uponsuccessful completion ofthe 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 examinationofurine& enzymes.	K3
CO 4	Apply various qualitative tests to identify the biomolecules.	K3
CO 5	Identifyand Examine the biomolecules present inthe 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. Preparationof 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 ofplant pigments using Paper chromatography.
9. Media Preparation & Sterilization.
10. Isolation and Enumeration ofMicroorganisms from Water and Soil.
11. Pure Culture Techniques – Spread plate, Streak plate, Pour plate and Slant preparation.
12. Measurement ofBacterial Growth – Turbidometric method
13. Staining Techniques –Simple staining, Gram's staining & Capsule Staining.
14. Cell Motility – Hanging droptechnique.
15. BiochemicalCharacterization 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 beable to

CO Number	CO Statement	Cognitive Level
CO1	Outline the nature and scope of environmental studies	K1, K2
CO2	Illustrate the various types of naturalresources 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	Introductionto environmental studies Definition, scope and importance. Need for public awareness	06	CO1, CO2, CO3, CO4	K1, K2, K3,
II	**Natural Resources: Renewable and non-renewable resources:** a. Forest resources: use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests andtribal people. b. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams benefits and problems. c. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources. d. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity. e. Energy resources: Growing energy needs, renewable and non-renewable energy sources,use of alternate energy sources. Case studies. f. Land resources: Land as resources, land degradation, man induced Landslides, soil erosion and desertification. g. Role of an individual in conservation of natural resources.	06	CO1, CO2, CO3, CO4	K1, K2, K3
III	**Ecosystems** Concept, Structure and function of an ecosystem. Producers, consumers and decomposers Energy flow in the ecosystem and Ecological succession. Food chains, food webs and ecological pyramids 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)	06	CO1, CO2, CO3, CO4	K1, K2, K3
IV	**Biodiversity and Environmental Pollution** Introduction, types and value of biodiversity. India as a mega diversity nation. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity. Definition, Causes, effects and control measures of:	06	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5

	a) Air Pollution b) Water Pollution c) Soil Pollution d) Noise pollution e) Nuclear hazards 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.			
V	**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.	06	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
VI	**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	-	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/mkpandit/ 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 (22UGEVS)

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 studyon 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 Modelcanvas 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	COGINITIVE LEVELS
I	**Entrepreneurship & Intrapreneurship** Importance of Entrepreneurship Development-The entrepreneurial mind set – Attributes and Characteristics of a successful entrepreneur. Intrapreneurship- Importance- Attributes, Contribution and Characteristics of a successful Intrapreneur- Types of Intrapreneurs. **Self-Discovery- Learnings from famous company cases that promote entrepreneurship and Intrapreneurship. (Activity)**	**6**	**CO1** **CO2** **CO3** **CO4** **CO5**	**K3** **K4** **K5**
II	**Entrepreneurial Skill Sets** 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. **Opportunity Discovery- Identify problems worth solving through JTBD method (Activity)**	**6**	**CO1** **CO2** **CO3** **CO4** **CO5**	**K3** **K4** **K5**

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 eexamination) Case study analysis on Entrepreneurship		**CO1** **CO2** **CO3** **CO4** **CO5**	**K3** **K4** **K5**

Textbooks:

1. Elias G.Carayannis, Elbida.D.Samra (2015), Innovation and Entreprenurship,

2. Peter.F. Drucker (2006), Innovation and Entreprenurship, Harper Publications

Refrence books:

1. John R.Bessant, Joe Tidd (2015), Innovation and Entreprenurship, Wiley Publictaions

2. Mike Kennard (2021), Innovation and Entreprenurship, 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 expressional analysis for further studies in the area of genetic engineering.
- To expose students to the applications of rDNA technology inbiotechnological research.

Course Outcome and Cognitive Level Mapping

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

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

Mapping of CO with PO and PSO

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

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

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

Text Books

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

Reference Books

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

Web Links

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

E-Books

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

Pedagogy

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

Course Designer

Dr. M. KEERTHIGA

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

Course Objectives

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

Course Outcome and Cognitive Level Mapping

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

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

Mapping of CO with PO and PSO

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

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

Syllabus

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

Reference Books

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

E-Books

1. https://books.google.co.in/books?id=WTv5Bte1R7YC&pg=PP9&source=gbs_selected_pages&cad
2. https://www.google.co.in/books/edition/Genetic_Engineering_of_Horticultural_Cro/fSk0DwA
3. https://www.google.co.in/books/edition/An_Introduction_to_Genetic_Engineering/5qixMSCEAh
4. https://www.google.co.in/books/edition/Genetic_Engineering/8DFlDw
5. https://www.cshlpress.com/pdf/sample/2013/MC4/MC4FM.pdf

Web Links

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

Pedagogy

Practical Observation and Demo

Course Designer

Dr. R. UMA MAHESWARI

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

Course Objectives

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

Course Outcome and Cognitive Level Mapping

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

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

Mapping of CO with PO and PSOs

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

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

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

Text Books

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

Reference Books

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

E Books

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

Web Links

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

Pedagogy

Chalk and Talk, PPT, Videos and Animations

Course Designer

Dr. M. AZEERA

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

Course Objectives

- To learn and execute various molecular analysis using bioinformatics tools.
- To studythe 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	Applythe 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 andcomputational biology: ABC of bioinformatics.* Elsevier.
5. Su, C. (2006). *Bioinformatics: A Practical Guide to the Analysis of Genes & Proteins.*Third edition.John Wiley & Sons.

E- Books

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

Web Links

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

Pedagogy

Practical Observation and Demo

Course Designer

Ms. R. NEVETHA

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

Course Objectives

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

Course Outcome and Cognitive Level Mapping

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

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

Mapping of CO with PO and PSOs

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

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

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

Text Books

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

Reference Books

1. Khan, F. A., Taylor, F. (2020). *Biotechnology Fundamentals.* 3rd Edition. Taylor and FrancisPublishers.
2. Lal, R. (2020). *An Introduction to Biotechnology*. Dreamtech Press Publishers.
3. Irvine, D. (2018). *An Introduction to Genetic Engineering.* Syrawood Publishing House.
4. Glick, B. R. (2018). *Molecular Biotechnology: Principles and Applications of Recombinant DNA.*
5. 5th Edition Indian Reprint. ASM Press Publishers.
6. 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 oftumors, 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).*Howthe Immune system works. 6th Edition.*Wiley Blackwell.
3. Dr.P.Madhavee Latha (2018). *A Textbook of Immunology.* S.Chand Publishing.
4. Abul K.Abbas, Andrew H.Lichtman Shiv Pillai.(2017).*Cellular and Molecular Immunology.* 9th Edition Elsevier
5. Warren Levinson *Review of Medical Microbiology and Immunology*.(2016). Mc Graw Hill Education .
6. Louis Hawley Richard J Ziegler Benjamin L Clarke BRS.(2015). *Immnology and Microbiology (6th Edition)*. Lippincott Williams and Wilkins

Reference Books

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

E-Books

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

Web Links

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

Pedagogy

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

Course Designer

Dr. R. UMA MAHESWARI

Semester – IV	InternalMarks:40		External Marks: 60	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HOURS/ WEEK**	**CREDITS**
24UBT4CC4P	**IMMUNOLOGY (P)**	**CORE PRACTICAL –IV**	**4**	**4**

Course Objectives

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

Course Outcome and Cognitive Level Mapping

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

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

Mapping of CO with PO and PSOs

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

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

Syllabus

1. Identification ofCells in a Blood Smear.
2. Blood CellCounting using Haemocytometer
3. Separation ofSerumand Plasma
4. Identification ofBlood 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 - WidalTest
11. AMES TEST
12. DOT ELISA
13. PregnancyTest – HCG
14. Detection of viral fever by slide agglutination tests.

Reference books

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

E – Books

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

Weblinks

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

Pedagogy

Practical Observation, Video and Demo

Course Designer

Dr. R. UMA MAHESWARI

Semester IV	Internal Marks: 25		External Marks: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HOURS/ WEEK**	**CREDITS**
22UBT4AC6	**BASICS OF FORENSIC BIOLOGY**	**SECONDALLIED 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 topreserving evidence integrity.	K3, K4
CO 4	Apply acquired skills to actively contribute to forensic investigations, aiding in crime scene reconstruction, suspect identification, and victim analysis.	K4. K5
CO 5	Utilize forensic methods, like DNA profiling, serology, and entomology for interpreting biological evidence in diverse criminal cases	K6

Mapping of CO with PO and PSOs

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

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

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

TEXT BOOKS

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

REFERENCE BOOKS

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

E-BOOKS

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

PEDAGOGY

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

COURSE DESIGNER Dr. R.

RAMESHWARI

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

Course Objectives

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

Course Outcome and Cognitive Level Mapping

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

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

Mapping of CO with PO and PSOs

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

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

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

Text Books

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

Reference Books

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

E Books

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

Web Links

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

Pedagogy

Chalk and Talk, PPT, Videos and Animations

Course Designer

Ms. P. JENIFER

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

Course Objectives

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

Course Outcome and Cognitive Level Mapping

Uponthe 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	Applythe knowledge on serological parameters.	K3
CO5	Identify and analyze the parameters for pathological conditions	K3

Mapping of CO with PO and PSO

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

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

Syllabus

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

Reference Books

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

E-books

1. https://www.pdfdrive.com/a-manual-of-laboratory-and-diagnostic-tests-e157742334.html
2. https://www.pdfdrive.com/lippincott-manual-of-nursing-practice-e189815788.html
3. \https://www.pdfdrive.com/introduction-to-genetic-analysis-solutions-megamanual-_____e158762003.html

Web links

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

Pedagogy

Practical Observation, Video and Demo

Course Designer

Dr. M. KEERTHIGA