CAUVERY COLLEGE FOR WOMEN

(AUTONOMOUS)

DEPARTMENT OF BIOTECHNOLOGY

UG SYLLABUS

(For the candidates admitted from the academic year 2021 -22 onwards)

B.Sc., BIOTECHNOLOGY

PROGRAMME EDUCATIONAL OBJECTIVES

THE PROGRAMME AIMS

1. To make our student competent in various areas of biotechnology.
2. To inculcate the capability to work as entrepreneurs with strong ethics and communication skills.
3. To equip the students to pursue higher education and research in reputed institutes at national and international levels.
4. To develop a working knowledge of biotechnological product and processes.

PROGRAMME OUTCOMES

1. Apply ethical principles and commit to professional ethics and responsibilities in technology usages.
2. Function effectively as an individual and as a member in multidisciplinary settings.
3. Demonstrate knowledge in various environment with respect to sustainable development.
4. Recognize the need for and have the preparation & ability to engage independent and lifelong learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES

1. Acquire knowledge on the fundamentals of biotechnology for sound and solid base which enables them to understand the emerging and advance concepts in life sciences.
2. Acquire knowledge in domain of biotechnology enabling their applications in industry and research.
3. Empower the students to acquire technological knowhow by connecting disciplinary and interdisciplinary aspects of biotechnology.
4. Recognize the importance of biotechnological applications as to usher next generation entrepreneurship

CAUVERY COLLEGE FOR WOMEN (AUTONOMOUS)

DEPARTMENT OF BIOTECHNOLOGY

B.Sc., BIOTECHNOLOGY PROGRAMME STRUCTURE

(For the candidates admitted from the academic year 2021 -2022 onwards)

Semester	*Part*	**Course**	**Title**	**Subject Code**	**Inst. Hour / Week**	*Credit*	**Exam Hours**	**Marks**		*Total*
								Int	*Ext*	
I	I	Language Course–I (LC) –Tamil/Other Languages	இக்கால இலக்கியம்	19ULT1	6	3	3	25	75	100
			Story, Novel, Hindi, Literature & Grammar – I	19ULH1						
			History of Popular Tales, Literature and Sanskrit Story	19ULS1						
			Communication in French – I	19ULF1						
	II	English Language Course – I (ELC)	Functional Grammar for Effective Communication – I	19UE1	6	3	3	25	75	100
	III	Core Course–I (CC)	Cell Biology	19UBT1CC1	6	4	3	25	75	100
		Core Practical – I (CP)	Lab in Cell Biology	19UBT1CC1P	3	3	3	40	60	100
		First Allied Course– I (AC)	General Microbiology	19UBT1AC1	4	4	3	25	75	100
		First Allied Course– II (AP)	Lab in Microbiology	19UBT1AC1P	3	-	-	-	-	-
	IV	The Universal Human Values	The Universal Human Values	20UGVE	2	2	3	25	75	100
	Total				**30**	**19**				**600**
II	I	Language Course– II (LC)–Tamil /Other Languages	இடைக்கால இலக்கியமும் புதினமும்	19ULT2	6	3	3	25	75	100
			Prose, Drama, Hindi Literature – 2 & Grammar – II	19ULH2						
			Poetry, Textual Grammar and Alakara	19ULS2						
			Communication in French – II	19ULF2						
	II	English Language Course–II (ELC)	Functional Grammar for Effective Communication – II	19UE2	6	3	3	25	75	100
	III	Core Course–II (CC)	Molecular Biology	19UBT2CC2	6	4	3	25	75	100
		Core Practical – II (CP)	Lab in Molecular Biology	19UBT2CC2P	3	3	3	40	60	100
		First Allied Course– II (AP)	Lab in Microbiology	19UBT1AC1P	4	2	3	40	60	100
		First Allied Course– III(AC)	Bioinstrumentation	19UBT2AC2	3	3	3	25	75	100
	IV	Part –IV	Environmental Studies	21UGES	2	2	3	25	75	100
	V	Extra Credit Course	Swayam Online Course	To be fixed later	-	-	As per UGC Recommendation			
	Total				**30**	**20**				**700**

III	I	Language Course – III (LC)–Tamil/Other Languages	காப்பியமும் நாடகமும்	19ULT3	6	3	3	25	75	100
			Medieval, Modern Poetry & History of Hindi Literature – 3	19ULH3						
			Prose, Textual Grammar and Vakyarachana	19ULS3						
			Communication in French – III	19ULF3						
	II	English Language Course-III(ELC)	Reading and Writing for Effective Communication – I	19UE3	6	3	3	25	75	100
	III	Core Course – III (CC)	rDNA Technology	19UBT3CC3	6	4	3	25	75	100
		Core Practical – III (CP)	Lab in rDNA Technology	19UBT3CC3P	3	3	3	40	60	100
		Second Allied Course – I (AC)	Biomolecules & Basics of Nanotechnology	21UBT3AC3	4	4	3	25	75	100
		Second Allied Course-II (AP)	Lab in Biomolecules & Nanotechnology	21UBT3AC2P	3	-	-	-	-	-
	IV	Non Major Elective I-for those who studied Tamil under Part-I a) Basic Tamil for other language students b) Special Tamil for those who studied Tamil upto +2 but optfor other languages in degree programme	Basics of Biotechnology	19UBT3NME1	2	2	3	25	75	100
			Basic Tamil	19ULC3BT1						
			Special Tamil	19ULC3ST1						
	V	Extra Credit Course	Swayam Online Course	To be fixed later	-	-	As per UGC Recommendation			
	Total				**30**	**19**				**600**
IV	I	Language Course –IV (LC) -Tamil/Other Languages	பண் டைய இலகக்கியமம்	19ULT4	6	3	3	25	75	100
			Letter writing, General essays, Technical Terms, Proverbs, Idioms& Phrases, Hindi Literature – 4	19ULH4						
			Drama, History of Drama Literature	19ULS4						
			Communication in French – IV	19ULF4						
	II	English Language Course – IV(ELC)	Reading and Writing for Effective Communication – II	19UE4	6	3	3	25	75	100
	III	Core Course – IV (CC)	Immunology	19UBT4CC4	5	4	3	25	75	100
		Core Practical – IV (CP)	Lab in Immunology	19UBT4CC4P	3	3	3	40	60	100
		Second Allied Course - II (AP)	Lab in Biomolecules & Nanotechnology	21UBT3AC2P	3	2	3	40	60	100
		Second Allied Course – III(AC)	Plant Anatomy and Physiology	19UBT4AC4	3	3	3	25	75	100

	IV	Non Major Elective II- for those who studied Tamil under Part-I a) Basic Tamil for other language students b) Special Tamil for those who studied Tamil upto +2 but opt for other languages in degree programme	Applied Biotechnology Basic Tamil Special Tamil	19UBT4NME2 19ULC4BT2 19ULC4ST2	2	2	3	25	75	100
		Skill Based Elective -I	A) Information in Omics and Applications	19UBT4SBE1A	2	2	3	25	75	100
			B) Bioinformatics	19UBT4SBE1B						
	V	Extra Credit Course	Swayam Online Course	To be fixed later	-	-	As per UGC recommendations			
	Total				**30**	**22**				**800**
	15 Days INTERNSHIP during Semester Holidays*									
V	III	Core Course – V (CC)	Plant Biotechnology	19UBT5CC5	5	5	3	25	75	100
		Core Course – VI (CC)	Animal Biotechnology	19UBT5CC6	5	5	3	25	75	100
		Core Course – VII (CC)	Biostatistics	19UBT5CC7	5	5	3	25	75	100
		Core Practical – V (CP)	Lab in Plant and Animal Biotechnology	19UBT5CC5P	4	4	3	40	60	100
		Major Based Elective – I	A) Pharmacognosy	19UBT5MBE1A	5	5	3	25	75	100
			B) Cancer Biology	19UBT5MBE1B						
	IV	Skill Based Elective – II	A) Molecular Diagnostics and Therapeutics	19UBT5SBE2A	2	2	3	25	75	100
			B) Lab in Bioinformatics	19UBT5SBE2BP				40	60	
		Skill Based Elective – III	A)DNA Fingerprinting	19UBT5SBE3A	2	2	3	25	75	100
			B) Lab in Plant Tissue Culture & Environmental Biotechnology	21UBT5SBE3BP				40	60	
		UGC Jeevan Kaushal Life Skills	Professional Skills	19UGPS	2	2	3	25	75	100
	V	Extra Credit Course	Swayam Online Course	To be Fixed Later	-	-	As per UGC Recommendation			
	Total				**30**	**30**				**800**
VI	III	Core Course – VIII (CC)	Microbial Biotechnology	19UBT6CC8	6	6	3	25	75	100
		Core Course – IX (CC)	IPR, Bioethics and Biosafety	19UBT6CC9	6	6	3	25	75	100
		Core Practical – VI (CP)	Lab in Microbial Biotechnology	19UBT6CC6P	5	4	3	40	60	100
		Major Based Elective – II	A) Environmental Biotechnology	19UBT6MBE2A	6	6	3	25	75	100
			B) Stem Cell Biology	19UBT6MBE2B						

		Major Based Elective – III	A) Bioentrepreneurship	19UBT6MBE3A	6	6	3	25	75	100
			B) Drug Discovery and Development	19UBT6MBE3B						
	V	Extension Activities	Extension Activities	19UGEA	-	1	-	-	-	-
		Gender Studies	Gender Studies	19UGGS	1	1	3	25	75	100
	Total				**30**	**30**				**600**
Grand Total					**180**	**140**				**4100**

***Internship – 2 Credits (Extra Credit Course)**

Evaluation Based on the following component

Internship Component

Component	**Marks**
Attendance	10
Performance	30
Presentation	20
Report	20
Review	20
Total	100

CORE COURSE – I

CELL BIOLOGY

Semester – I	CELL BIOLOGY	Hours/Week - 6	
Core Course – I		Credits - 4	
Course Code - 19UBT1CC1		Internal 25	External 75

Preamble

- To study about cell, its types, cellular organelles and their functions.
- To study about cell cycle and its regulations.
- To study about cell signaling pathways

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO 1	Exhibit a knowledge base in classes of cells, types of cell division.	K1
CO 2	Outline a clear and concise idea about cell membrane and cytoskeleton	K2
CO 3	Discuss the properties and functions of the cytoplasmic organelles.	K2
CO 4	Illustrate the reactions that comprise energy metabolism.	K2
CO 5	Explain about cell cycle and its regulations.	K2

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4
CO1	M	S	S	M
CO2	M	M	S	M
CO3	S	M	M	M
CO4	S	S	S	S
CO5	M	M	S	S

S-Strong, M-Medium, L-Low

CORE COURSE – I
CELL BIOLOGY

Unit I - Fundamentals of cell structure **18 Hours**

Discovery of Cells - Basic properties of cells, cell size and shape, cell theory, cell morphology, Different classes of cells – Prokaryotic and Eukaryotic cells. Cell cycle, cell division – Mitosis and Meiosis.

Unit II - Cellular membranes and matrices **18 Hours**

Cell Membrane – Plasma Membrane - Chemical composition and fluidity of membranes; transport of nutrients, ions and macromolecules across the membranes; structural organization of cell wall ; Extracellular matrices – structure and function; Cytoskeleton and cell motility: Microtubules, Microfilaments and Intermediate filaments.

Unit III - Endomembrane System **18 Hours**

Structure and functions of Nucleus - Endoplasmic Reticulum – Smooth and Rough; Functions of Endoplasmic Reticulum; Golgi Complex – Structure and functions; Ribosomes- Types, structure and functions; Types of Microbodies; Peroxisomes; Glyoxysomes; Lysosomes - Types, structure and functions.

Unit IV- Cellular Organelles in Energy Metabolism **18 Hours**

Mitochondria – Morphology; Chemical Composition; Enzyme System of Mitochondria; functions- Oxidation of Carbohydrates. Chloroplast – Morphology; Chemical Composition; functions- Photosynthesis and Protein Synthesis.

Unit V- Applications of Cell Biology **18 Hours**

Apoptosis analysis, Cytotoxicity, Cell viability, signal transduction – Cell to cell recognition and adhesion, Cell signalling pathways.

Text Books

S. No.	Author name	Title of the book	Publishers name	Year of publication
1	Geoffrey M.Cooper and Robert E.Hausman	The Cell A Molecular Approach (Sixth Edition)	Ingram Publishers	2018 (Reprint)
2	Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter.	Molecular Biology of Cell. 6th Edition.	Garland Science, Taylor & Francis group Publishers	2017
3	Anne Wanjie	The Basics of Cell biology	Rosen Publishers	2013

Reference Books

S. No.	Author name	Title of the book	Publishers name	Year of publication
1	Griffith Reid	Cell biology(Meiosis & Mitosis)	Harsen and keller Education	2017
2	Jeff Hardin, Gregory Bertoni and Lewis J. Klein Smith	Becker's World of the Cell – Technology Update – 8th Edition	Pearson Education Ltd.	2015
3	Bruce Alberts, Dennis Bray, Karen Hopkin, Alexander D. Johnson, Julian Lewis, Martin Raff, Keith Roberts and Peter Walter.	Essential Cell Biology	Garland Science, Taylor & Francis group Publishers	2013
4	T.A. Brown.	Introduction to genetics: A molecular approach. 1st Edition.	Garland Science.	2011
5	Benjamin Lewin	Genes XI. 9th Edition.	Jones & Bartlett Learning.	2008
6	Lewin B	Genes IX.	Oxford University Press, London.	2007

CORE PRACTICAL – I

LAB IN CELL BIOLOGY

Semester – I	LAB IN CELL BIOLOGY	Hours/Week - 3	
Core Practical – I		Credits - 3	
Course Code - 19UBT1CC1P		Internal 40	External 60

Preamble

- To study about cells and their enumeration by appropriate techniques
- To study about the cell division and development.
- To study about the embryonic development

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO 1	Describe the basic instruments involved in Cell Biology	K1
CO 2	Demonstrate the morphology of various types of cells and their enumeration.	K1
CO 3	Illustrate the different types of cell division.	K2
CO 4	Outline a clear and concise idea about embryogenesis.	K2
CO 5	Identify the Barr body from Buccal Cells.	K2

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4
CO1	M	L	M	M
CO2	M	M	M	L
CO3	M	L	L	M
CO4	S	M	L	M
CO5	L	L	L	L

S- Strong, M-Medium, L-Low

CORE PRACTICAL – I

LAB IN CELL BIOLOGY

1. Demonstration of Principles and working mechanism of Microscope and Microtome.
2. Morphological Characterization of various types of Plant tissue cells.
3. Structure observation of Prokaryotic cells.
4. Structure observation of Eukaryotic cells.
5. Enumeration of Eukaryotic cells (Yeast).
6. Enumeration of Red Blood Cells.
7. Enumeration of White Blood Cells.
8. Cell organelle separation by centrifugation methods.
9. Cell Division - Mitotic stages
10. Cell Division - Meiotic stages
11. Cell Division – Binary fission of yeast cells
12. Osmosis and Tonicity
13. Grading the stages of chick embryo development (demo only).
14. Barr body Identification in cells of Buccal Smear.

Reference Books

S. No.	Author name	Title of the book	Publishers name	Year of publication
1	Dr. William H. Heidcamp	Cell Biology Laboratory manual	Pearson Education	2017
2	David A. Thompson	Cell and Molecular Biology Lab. Manual.	Create Space Independent Publishing Platform	2011
3	P. Gunasekaran.	Laboratory Mannual in Microbiology.	New Age International.	2007
4	Mary L. Ledbetter.	Cell Biology: Laboratory Manual.	RonJon Publishing. Incorporated.	1993

FIRST ALLIED COURSE – I

GENERAL MICROBIOLOGY

Semester – I	**GENERAL MICROBIOLOGY**	**Hours/Week – 4**	
First Allied Course – I		**Credits - 4**	
Course Code - 19UBT1AC1		**Internal 25**	**External 75**

Preamble

- To study about the classification of microorganisms.
- To study about the media composition and their types
- To study about the structure and characteristics of bacteria, algae, fungi, protozoa and virus.

Course Outcomes

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

CO Number	**CO Statement**	**Knowledge Level**
CO 1	Recall the history of Microbiology and list out the scopes.	K1
CO 2	Outline the methods involved in media preparation and sterilization.	K2
CO 3	Summarize the structural organization of Bacteria.	K2
CO 4	Explain the general characteristic features of Algae and Fungi.	K2
CO 5	Describe the Diversity, Ecology and Characteristics of different Protozoa and Viruses.	K3

Mapping with Programme Outcomes

Cos	**PO1**	**PO2**	**PO3**	**PO4**
CO1	M	S	S	S
CO2	L	L	L	M
CO3	M	M	M	M
CO4	M	M	S	M
CO5	M	M	S	S

S-Strong, M-Medium, L-Low

FIRST ALLIED COURSE – I
GENERAL MICROBIOLOGY

Unit I - History and Classification **12 Hours**

Historical development of Microbiology - Theories of Spontaneous generation – Biogenesis The scope of Microbiology; General principles and nomenclature – Haeckel's three kingdom concept, Whittaker's five kingdom concept- Carl Woese's three domain classification. Cavalier – Smith's Eight kingdom classification.

Unit II - Media Preparation and Sterilization **10 Hours**

Media Composition and their types based on physical state & ingredients. Microbial Growth- Factors influencing the growth of Microorganisms – Growth Curve. Types of Sterilization and Disinfection.

Unit III – Bacteria **12 Hours**

Structural organization of bacteria – Size, shape and arrangement of bacterial cells – Ultrastructure of a bacterial cell – cell wall, cell membrane, ribosomes, nucleoid, slime, capsule, flagella, fimbriae, spores , cysts, plasmid, mesosomes and cytoplasmic inclusions.

Unit IV – Diversity of Microbial world **13 Hours**

General characteristics of Algae (*Chlamydomonas* sp) including occurrence, thallus organization, Ultra structure, pigments, flagella, eyespot, food reserves. Reproduction – Sexual and Asexual reproduction. Fungi (*Aspergillus* sp) – General characteristics of fungi including habitat, distribution, nutritional requirements, Ultrastructure, thallus organization and aggregation.

Unit V – Protozoa & Viruses **13 Hours**

Protozoa: General characteristics with special reference to *Amoeba, Paramecium* and *Giardia.* Viruses: Viruses, viroids and prions - A general introduction with special reference to the structure of the following: TMV, poliovirus. Lytic and lysogenic cycle.

Text Books

S. No.	Author name	Title of the book	Publishers name	Year of publication
1	Gerarad J.Tortora Berdell R.Funke and Christine L.Case	Microbiology An Introduction (11th Edition)	Pearson Education	2018
2	Dr. C. P. Baveja	Text Book of Microbiology	Anja Publications	2017
3	A.K. Rathoure	Essentials of Microbiology	Brillion Publishing	2017

Reference Books

S. No.	Author name	Title of the book	Publishers name	Year of publication
1	Tortora, Funke and Case	Microbiology: An Introduction – 13th Edition	Pearson	2018
2	Madigam M.T. Bender K.S. Buckley D.H Sattley W.M and Stahl D.A	Brock Biology of Microorganism(15th Edition)	Pearson Education	2017
3	Prescott, Harley and Klein.	Microbiology. 10th Edition.	McGraw Hill	2016
4	Pelczar, Chan and Kreig	Microbiology 9th Edition.	McGraw-Hill.	2016
5	Michael T. Madigan, John M. Martinko and Kelley S Bender	Brock Biology of microorganisms	Pearson	2014

FIRST ALLIED COURSE- II

LAB IN MICROBIOLOGY

Semester – I	**LAB IN MICROBIOLOGY**	**Hours/Week – 4**	
First Allied Course – II		**Credits - 2**	
Course Code - 19UBT1AC1P		**Internal 40**	**External 60**

Preamble

- To acquire knowledge about aseptic techniques.
- To comprehend the various methods for identification of unknown microorganisms.
- To study about the Biochemical Characterization

Course Outcomes

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

CO Number	**CO Statement**	**Knowledge Level**
CO 1	Illustrate the techniques involved in sterilization of media and glasswares.	K1
CO 2	Outline the methods for isolation and enumeration of microorganisms from different samples.	K2
CO 3	Demonstrate the various pure culture techniques and to measure the bacterial growth.	K2
CO 4	Identify the organisms by various staining techniques.	K3
CO 5	Apply various biochemical tests to characterize microorganisms.	K3

Mapping with Programme Outcomes

Cos	**PO1**	**PO2**	**PO3**	**PO4**
CO1	M	S	L	M
CO2	M	S	S	S
CO3	S	S	M	M
CO4	L	L	M	M
CO5	M	S	M	M

S- Strong, M-Medium, L-Low

FIRST ALLIED COURSE- II

LAB IN MICROBIOLOGY

1. Laboratory Rules and Regulations.
2. Sterilization Techniques – Media and Glasswares.
3. Media Preparation.
4. Isolation and Enumeration of Microorganisms from Water and Soil.
5. Pure Culture Techniques – Spread plate, Streak plate, Pour plate, Stab and Slant preparation.
6. Measurement of Bacterial Growth – Turbidometric method
7. Staining Techniques –Simple staining, Gram's staining, Capsule Staining,
8. Lactophenol Cotton Blue Staining.
9. Cell Motility – Hanging drop technique.
10. Biochemical Characterization of microorganisms – IMViC tests.
11. Counting of Microbial colonies using colony counter.
12. Micrometry (Ocular and Stage).

Reference Books

S. No	Author name	Title of the book	Publishers name	Year of Publication
1	Joanne Willey, Linda Sherwood and Christpher J. Woolverton	Prescott's Microbiology	Mc Graw Hill Education	2017
2	James G. Cappuccino	Microbiology - Laboratory Manual	Pearson	2017
3	Michael J. Leboffe & Burton E. Pierce	Microbiology: Laboratory Theory and Application, Brief.	Morton	2016
4	Mark Gladwin, William Trattler and C. Scott Mahan	Clinical Microbiology made Ridiculously simple – 6th Edition	Medmaster	2016
5	Brown A and Smith	Benson's Microbiological Application; Laboratory Manual in General Microbiology (13th Edition)	Mc Graw Hill Companies	2015

CORE COURSE – II

MOLECULAR BIOLOGY

Semester – II	MOLECULAR BIOLOGY	Hours/Week – 6	
Core Course – II		Credits - 4	
Course Code - 19UBT2CC2		Internal 25	External 75

Preamble

- To study about the chromosomes, genes and their functions
- To study about the DNA damage and repair mechanism
- To study about the central dogma of molecular biology

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO 1	Describe the organisation and development of the genetic makeup on cellular, chromosomal and gene level.	K1
CO 2	Recall basic concepts of hereditary and population genetics.	K1
CO 3	Explain DNA replication and repair mechanism.	K2
CO 4	Summarise the mechanisms of transcription and translation	K2
CO 5	Outline the gene regulatory mechanisms.	K2

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4
CO1	M	M	M	M
CO2	S	S	S	M
CO3	S	M	M	M
CO4	L	L	L	L
CO5	S	M	M	M

S-Strong, M-Medium, L-Low

CORE COURSE – II
MOLECULAR BIOLOGY

Unit I – Genetic Material **18 Hours**

Structural organization of Chromatin and chromosome. Basic structure of Chromosomes; Chromosomal Proteins – Histones and Protamines. Special types of Chromosomes: Polytene and Lampbrush chromosomes. Experiments to prove DNA and RNA as the Genetic Material; Components, types & Structure of nucleic acids

Unit II – Classical Genetics **18 Hours**

Mendelein Inheritance, Laws of inheritance – single and dihybrid ratio. Linkage analysis – Fruit fly. Population Genetics – Hardy Weinberg Law, Developmental Genetics using *Drosophila melanogaster* as model system.

Unit III – DNA Replication and Repair **18 Hours**

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 Damage and repair.

Unit IV – Transcription and Translation **18 Hours**

Transcription – Prokaryotic and Eukaryotic transcription, Enzymes involved in transcription. Post transcriptional modifications – 5' – CAP formation, 3' processing and polyadenylation, splicing. Translation – Prokaryotic and Eukaryotic translation, the translational machinery, mechanisms of initiation, elongation and termination, regulation of translation, Co-translational and post-translational modifications - Importance of Glycosylation and Phosphorylation.

Unit V – Gene Regulation **18 Hours**

Prokaryotes: *lac* operon, *gal* operon and *trp* operon. Eukaryotes: Gene loss, gene amplification, gene rearrangement.

Text Books

S.No.	Author name	Title of the book	Publishers name	Year of publication
1	David Clark, Nanette Pazdernik, Michaelle and Mc. Gehee	Molecular Biology – 3rd Edition	Elsevier	2018
2	William S. Klug, Michael R. Cummings, Charlotte A. Spencer and Michael A. Palladino	Concepts of Genetics	Pearson Education India	2016
3	George M. Malacinski	Freifelder's Essentials of Molecular Biology	Viva	2015

Reference Books

S.No.	Author name	Title of the book	Publishers name	Year of publication
1	James D. Watson	Molecular Biology of the gene – 7th Edition	Pearson	2017
2	Michael M. Cox, Jennifer Doudna and Michael O' Donnell	Molecular Biology – Principles and Practice	W.H. Freeman	2015
3	Bruce Alberts, Alexander Johnson. Julian Lewis, David Morgan, Martin Raff, Keith Roberts and Peter Walter.	Molecular Biology of Cell.	Garland Science publication	2014
4	Stanely R. Maloy, Jhon E Cornan Jr and David Freifelder.	Freifeder's Essentials of Molecular Biology.	Norosa Publishing House.	2013
5	George M. Malacinski and Burton E. Tropp.	Molecular Biology – Genes to Proteins.	Jones and Bartlett Publishers.	2012

CORE PRACTICAL – II

LAB IN MOLECULAR BIOLOGY

Semester – II	LAB IN MOLECULAR BIOLOGY	Hours/Week – 3	
Core Practical – II		Credits – 3	
Course Code - 19UBT2CC2P		Internal 40	External 60

Preamble

- To develop skills pertaining to Molecular Biology
- To study about the Quantification of Nucleic acids
- To study about Bacterial mutagenesis

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO 1	Demonstrate the methods for the isolation and purification of genomic DNA and plasmid DNA.	K1
CO 2	Outline the process of separation of DNA and protein by electrophoresis.	K2
CO 3	Apply the various methods for the quantification of nucleic acids.	K3
CO 4	Experiment with various gene transfer methods.	K3

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4
CO1	S	S	S	S
CO2	M	M	M	M
CO3	L	L	M	M
CO4	S	S	S	S

S- Strong, M-Medium, L-Low

CORE PRACTICAL – II

LAB IN MOLECULAR BIOLOGY

1. Isolation and purification of Genomic DNA from Prokaryotes
2. Isolation and purification of Genomic DNA from Eukaryotes
3. Isolation and purification of Plasmid DNA
4. Separation of DNA by using AGE
5. Separation of Protein by using SDS- PAGE
6. Quantification of Nucleic Acids – DNA by chemical method
7. Quantification of Nucleic Acids – RNA by chemical method
8. Bacterial mutagenesis using Physical Method
9. Transformation
10. Conjugation
11. Transduction

Reference Books

S.No.	Author name	Title of the book	Publishers name	Year of publication
1	Andreas Hofmann and Samuel Clokie	Willson and Walker's Principles and Techniques of Biochemistry and Molecular Biology	Cambridge University Press	2017
2	George M. Malacinski	Freifeder's Essentials of Molecular Biology	Norosa Publishing House	2013
3	Dr. David Thompson	Cell and Molecular Biology Lab Manual	Norosa Publishing House	2011
4	J Sambrook and D. W. Russell	Molecular cloning: a laboratory manual Vol 1, 2 & 3	CSHL Press	2001

FIRST ALLIED COURSE- III

BIOINSTRUMENTATION

Semester – II	**BIOINSTRUMENTATION**	**Hours/Week - 3**	
First Allied Course – III		**Credits – 3**	
Course Code - 19UBT2AC2		**Internal 25**	**External 75**

Preamble

- To understand the working principles of different bioinstruments.
- To provide a better understanding of various analytical techniques
- To apply the principle of instruments in different fields.

Course Outcomes

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

CO Number	**CO Statement**	**Knowledge Level**
CO 1	Define the principle of microscope and its various types	K1
CO 2	Demonstrate the various Electrophoretic techniques and its applications	K2
CO 3	Explain the principle, types and applications of Chromatographic techniques.	K2
CO 4	Outline the principle, types and applications of Colorimetry.	K2
CO 5	Summarize the principle, types and applications of Centrifugation.	K2

Mapping with Programme Outcomes

Cos	**PO1**	**PO2**	**PO3**	**PO4**
CO1	M	S	M	S
CO2	S	M	M	S
CO3	S	M	M	S
CO4	S	S	M	S
CO5	M	S	S	M

S-Strong, M-Medium, L-Low

FIRST ALLIED COURSE- III

BIOINSTRUMENTATION

Unit I – Microscopy **10 Hours**

Introduction to Instrumentation, Microscope – Light Microscopy, Bright and Dark field Microscopy, Fluorescence Microscopy, Phase Contrast Microscopy, TEM, SEM.

Unit II – Electrophoresis **10 Hours**

Principle and Applications of Electrophoresis –Types of electrophoresis- AGE, SDS-PAGE and 2 D gel; Blotting Techniques; Gel documentation.

Unit III – Chromatography **7 Hours**

Fundamentals of Chromatography. Principle and its applications, Types – Paper, TLC, Column, Affinity, Ion –exchange, HPLC, GC-MS Chromatography.

Unit IV- Colorimeter **7 Hours**

Colorimeter – Principle and its applications, Beer Lambert's Law, Spectrophotometer-Principle and its applications, Types of Spectrophotometer-UV – Visible & IR.

UNIT V – Centrifugation and Tracer Techniques **11 Hours**

Centrifugation – Principle, Types – Zonal, Differential and Density gradient centrifugation and its applications, Imaging Techniques- X-ray and NMR.

Tracer Techniques - Radioactive isotope – Half life, GM Counter, Liquid Scintillation Counter, Autoradiography.

Text Books

S.No.	Author name	Title of the book	Publishersname	Year of Publication
1	M. J. Reilly	Bioinstrumentation	CDS Publishers	2016
2	L. Veerakumari	Bioinstrumentation	MJP Publishers	2015
3	R. S. Khandpur	Handbook of Bio-Medical Instrumentation	Tata McGraw Hill.	2014
4	Carr and Brown	Introduction to Biomedical Equipment Technology	Pearson Education,	2001
5	J. Webster	Bioinstrumentation	Wiley and Sons	2000

Reference Books

S.No.	Author name	Title of the book	Publishers name	Year of Publication
1	Avinash Upadhyay, Niramalendu Nath and Kakoli Upadhyay	Biochemical Chemistry Principles and Techniques	Himalaya Publication	2009
2	P. Narayanan	Essentials of Biophysics	New Age International	2007
3	Vasantha Pattabhi and N. Gautham	Biophysics	Narosa	2004
4	Wilson and Walkar	A Biologist guide to principles and techniques of practical biochemistry	Cambrige University press	2000

PART– IV

ENVIRONMENTAL STUDIES

Semester – II	ENVIRONMENTAL STUDIES	Hours/Week - 2	
Part– IV		Credits – 2	
Course Code - 19UGES		Internal 25	External 75

PREAMBLE

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

CO	CO Statement	Knowledge Level
CO1	Outline the nature and scope of environmental studies	K2
CO2	Illustrate the various types of natural resources and its importance.	K2
CO3	Classification of various types of ecosystem with its structure and function.	K2
CO4	Develop an understanding of various types of pollution and biodiversity.	K3
CO5	List out the various types of social issues related with environment.	K4

PART– IV

ENVIRONMENTAL STUDIES

Unit: 1 Introduction to environmental studies**,** Definition, scope and importance. Need for public awareness

Unit: 2 **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 and tribal 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 a resource, land degradation, man induced Landslides, soil erosion and desertification.
Role of an individual in conservation of natural resources.

Unit: 3 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:-
  a. Forest ecosystem
  b. Grassland ecosystem
  c. Desert ecosystem
  d. Aquatic ecosystems, (ponds, streams, lakes, rivers, oceans, estuaries)

Unit: 4 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 :
  a. Air Pollution
  b. Water Pollution
  c. Soil Pollution
  d. Noise pollution
  e. Nuclear hazards
- Solid, Liquid Management: Causes, effects and control measures of 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.

Unit: 5 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

References:

1. Agarwal, K.C. 2001 Environmental Biology, Nidi Public Ltd Bikaner.
2. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt ltd, Ahamedabad – 380013, India, E-mail: mapin@icenet.net(R)
3. Brunner R.C. 1989, Hazardous Waste Incineration, McGraw Hill Inc 480 p
4. Clark R.S. Marine Pollution, Clanderson Press Oxford (TB)
5. Cunningham, W.P.Cooper, T.H.Gorhani E & Hepworth, M.T. 2001.
6. De A.K. Environmental Chemistry, Wiley Eastern Ltd
7. Down to Earth, Centre for Science and Environment (R)
8. Gleick, H.P. 1993. Water in crisis, Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute Oxford University, Press 473p.
9. Hawkins, R.E. Encyclopedia of India Natural History, Bombay Natural History Society, Bombay (R)
10. Heywood, V.H & Watson, R.T. 1995. Global Biodiversity Assessment. Cambridge University Press 1140 p.
11. Jadhav, H & Bhosale, V.M. 1995. Environmental Protection and Laws Himalaya Pub. House, Delhi 284 p.
12. Mckinney, M.L. & Schoch R.M. 1996. Environmental Science systems & Solutions, Web enhanced edition 639 p.
13. Mhaskar A.K. Matter Hazardous, Techno-Science Publications (TB)
14. Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. (TB)
15. Odum, E.P. 1971 Fundamentals of Ecology. W.B. Saunders Co. USA. 574 p
16. Rao MN & Datta, A.K. 1987 Waste Water treatment, Oxford & IBH Publication Co. Pvt Ltd 345 p.
17. Sharma B.K. 2001 Environmental chemistry Goel Publ House, Meerut.
18. Survey of the Environment, The Hindu (M).
19. Townsend C. Harper, J and Michael Begon, Essentials of Ecology, Blackwell science (TB)
20. Trivedi R.K. Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol. I and II, Enviro Media (R).
21. Trivedi R.K. and P.K. Goel, Introduction to air pollution, Techno-Science Publications (TB).
22. Wagner K.D. 1998 Environmental Management. W.B. Saunders Co. Philadelphia USA 499 p

CORE COURSE – III

rDNA TECHNOLOGY

Semester – III	**rDNA TECHNOLOGY**	**Hours/Week - 6**	
Core Course – III		**Credits – 4**	
Course Code - 19UBT3CC3		**Internal 25**	**External 75**

Objectives

- To illustrate the use of modern tools and techniques for manipulation and analysis of genomic sequences.
- To train students in strategizing research methodologies employing genetic engineering techniques.
- To expose students to the applications of recombinant DNA technology in biotechnological research.

Course Outcomes

On the Successful completion of the course the students would be able to

CO No.	CO Statement	Knowledge Level
CO1	Utilize Knowledge on various tools & principles in Genetic Engineering	K1
CO2	Recall the knowledge on creation of genomic libraries & explain the strategies in generating transgenics.	K2
CO3	Contrast the methods of gene cloning using different vectors & assessing a recombinant plasmid	K2
CO4	Technical knowhow on versatile techniques in Recombinant DNA Technology and to employ them in isolation procedures.	K3
CO5	Outline the applications of Genetic engineering in basic and applied biology, proficiency in designing and conducting experiments involving genetic manipulation for societal applications.	K3

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4
CO1	S	S	S	S
CO2	M	M	S	S
CO3	S	S	S	S
CO4	S	S	M	S
CO5	S	L	**S**	S

S-Strong, M-Medium, L-Low

CORE COURSE – III
rDNA TECHNOLOGY

Unit I **18 Hours**

Introduction to recombinant DNA (rDNA) technology. Steps involved in rDNA technology. Enzymes in rDNA technology. Restriction Enzymes -Types of Endonuclease and Exonuclease. DNA modifying enzymes - Polymerase, Transferase, Kinase, Ligase

Unit II **16 Hours**

Vectors; Cloning vectors - Plasmids, Cosmids, Phagemids. Viral vectors- Animal viral vectors - SV40 and Retrovirus. Plant viral vectors - CaMV vector and TMV vector. Shuttle vectors and Expression vectors - YAC, BAC - *S.cerevisiae* system as model.

Unit III **20 Hours**

Gene transfer techniques - Physical methods – Microinjection, Electroporation and gene gun. Chemical methods- CaCl2 mediated and Polyethylene Glycol Mediated. Construction of Genomic libraries and cDNA libraries. Probe construction. DNA amplification using PCR - Concepts, Analysis of amplified products and Applications of PCR. Principles and applications of RFLP and RAPD.

Unit IV **18 Hours**

Recombinant selection and Screening. Selection methods - Antibiotics, Expression basis, GUS expression, Blue White Selection. DNA Sequencing - Chemical degradation, Chain termination, Automated sequence and Next Generation Sequencing - New sequencing methods. Site Directed Mutagenesis.

Unit V **18 Hours**

Applications of Genetic Engineering- Transgenic products - Bt Cotton, Golden rice, Flavr savr tomato, Humulin, Factor VIII, Trangenic mouse, Transgenic Fish. Xenotransplantation. Gene therapy - Types - Applications - SCID and Sickle cell anemia. Metagenomics.

Text Books

S.No	Author	Title	Publisher	Year of Publication
1	David Irvine	An Introduction to Genetic Engineering	Syrawood Publishing House	2018
2	Bernard R. Glick and Cheryl L. Patten	Molecular Biotechnology: Principles and Applications of Recombinant DNA. 5th Edition	ASM Press, Washington DC	2017
3	Nessa carey	Junk DNA: A Journey through the Dark Matter of the Genome	Columbia University Press	2017
4	T. A. Brown	Gene Cloning and DNA Analysis: An Introduction.7th Edition	Wiley Blackwell	2016
5	Dr. Arun Dev Sharma	rDNA Technology.2nd Edition	Himalaya Publishing House	2014

Reference Books

S.No	Author	Title	Publisher	Year of Publication
1	Munis Dundar	Current Applications of Biotechnology	European Biotechnology Thematic Network Association	2015
2	Keya Chaudhuri	Recombinant DNA Technology	The Energy Resources Institute, TERI	2013
3	K. Rajagopal	Recombinant DNA Technology and Genetic Engineering	Tata Mc Graw Hill education Private Ltd.	2012
4	Jane K. Setlow	Genetic Engineering : Principles and Methods	Springer	2012
5	M.Wink	An Introduction to Molecular Biotechnology : Molecular Fundamentals Methods and Applications in Modern Biotechnology	Wiley Blackwell	2011

Pedagogy

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

Web Links

1. https://youtube.be/Yh9w_fyvpUk
2. 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

CORE PRACTICAL - III

LAB IN rDNA TECHNOLOGY

Semester – III	LAB IN rDNA TECHNOLOGY	Hours/Week - 3	
Core practical – III		Credits – 3	
Course Code - 19UBT3CC3P		Internal 40	External 60

Objectives

- ❖ To acquire a skills about the various techniques in recombinant DNA technology.
- ❖ To understand the types of enzymes used to produce recombinants.
- ❖ To study about the experiments involving genetic manipulation.

Course Outcomes

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

CO No.	CO Statement	Knowledge Level
CO1	Demonstrate the genomic DNA isolation method from different sources.	K1
CO2	Describe the method of Agarose Gel Electrophoresis.	K2
CO3	Illustrate about the restriction digestion and ligation of DNA.	K2
CO4	Outline a clear and concise idea about transformation.	K3
CO5	Identify the recombinant DNA products.	K3

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4
CO1	S	S	S	S
CO2	M	M	S	S
CO3	S	S	S	S
CO4	S	S	M	S
CO5	S	L	**S**	S

S-Strong, M-Medium, L-Low

CORE PRACTICAL - III
LAB IN rDNA TECHNOLOGY

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. Size analysis of DNA by Agarose Gel Electrophoresis.
6. Restriction digestion of DNA.
7. Ligation.
8. PCR amplification*.
9. Preparation of competent cells *E.coli* cells*.
10. Transformation of *E.coli* with Plasmid DNA using $CaCl_2$ *.
11. Southern blotting*.

* Practical by demonstration only

Reference Books

S. No	Author	Title	Publisher	Year of Publication
1	Siddra I, Imran ULH	Recombinant DNA Technology. 1st Edition	Cambridge Scholar	2019
2	Tiwari S, Sharma M.	Recombinat DNA Technology in the synthesis of Human Insulin	LAP LAMBERT Academic Publishing	2018
3	Rajalakshmi AG	Manual on Plant Biotechnology and Recombinanat DNA Technology	LAP LAMBERT Academic Publishing	2017
4	Sambrook, J and Russel DW	Molecular Cloning : A laboratory Manual – 4th Edition	Cold Spring Harbor, N.Y. : Cold Spring Harbor Laboratory Press.	2012
5	Ashok Kumar	Molecular Biology and Recombinant DNA Technology : Practical Manual Series (Volume II)	Narendra Publishing House	2011

Pedagogy

Power point presentation, Group Discussion, Seminar, Assignment.

Web Links

1. http://www.biology.arizona.edu/molecular_bio/problem_sets/Recombinant_DNA_Technology/recombinant_dna.html.
2. http://www.genome.ou.edu/protocol_book/protocol_index.html.
3. http://www.biology.arizona.edu/molecular_bio/problem_sets/Recombinant_DNA_Technology/recombinant_dna.html

SECOND ALLIED COURSE – I

BIOMOLECULES AND BASICS OF NANOTECHNOLOGY

Semester – III	BIOMOLECULES AND BASICS OF NANOTECHNOLOGY	Hours/Week – 4	
Second Allied Course – I		Credits – 4	
Course Code – 21UBT3AC2		Internal 25	External 75

Objectives

- To make the students understand the basics of biomolecules.
- To study structural and functional properties of carbohydrates, proteins and lipids
- Acquire knowledge about fundamentals of nanotechnology.
- To study nanomaterial synthesis and characterization by various methods.

Course Outcome

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

CO No.	CO Statement	Knowledge Level
CO1	Understand the structures and functions of biomolecules- Carbohydrate, proteins and Lipids	K1
CO2	Summarize the fundamentals of nanotechnology	K2
CO3	Illustrate the different classes of nanomaterials	K3
CO4	Apply their knowledge on various methods of synthesis and characterization of nanomaterials.	K3
CO5	Infer the application of nano capsules in agriculture	K4

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4
CO1	M	S	S	S
CO2	M	S	M	M
CO3	M	M	M	M
CO4	M	M	M	M
CO5	S	S	S	S

S-Strong, M-Medium, L-Low

SECOND ALLIED COURSE – I

BIOMOLECULES AND BASICS OF NANOTECHNOLOGY

Unit I – Carbohydrates and proteins **12 Hours**

Carbohydrates: Definition, Classification and properties of carbohydrates. Structure and function of Monosaccharides, Disaccharides, Polysaccharides, Nano lignocellulosic material.

Proteins: Amino acids –Essential and Non - Essential Amino acids. Proteins - Classification of Proteins, Properties - solubility, Denaturation, Renaturation, Structural organization of Proteins - Primary, secondary, tertiary & quaternary structure.

Unit II - Lipids and Nucleic acids **12 Hours**

Lipids: Introduction to Lipids. Classification of lipids - Simple lipids, Compound lipids and Derived lipids. Structure and function of phospholipids, Triacylglycerols, Glycerophospholipids, Sphingolipids and Cholesterol.

Nucleic acids: Purines, Pyrimidines - Structure & function, Nucleosides, Nucleotides. Nucleic acids - DNA - Double helical structure and Biological importance, RNA - Structure, Types & ***Biological Importance#*.**

Unit III- Introduction to Nanotechnology **12 Hours**

Definition and historical development of nanomaterials. Different Classes of Nanomaterials- Classification based on dimensionality - Quantum dots, Carbon-based nano materials, Carbon nanotubes, Metal based nano materials, Metal oxide based nano materials, Nanocomposites and Nanopolymers, Biological nanomaterials.

Unit IV - Synthesis of Nanomaterials **12 Hours**

Physical methods: Ball milling and Electrodeposition techniques. Chemical methods: Metal nanocrystals by reduction and Solvothermal synthesis. Biological Methods: Synthesis, Mechanism of Microbial mediated nanomaterials-Bacteria, Fungi; Plant mediated nanomaterials. Advantages of Microbial and ***Plant Mediated nanomaterials#*.**

Unit-V- Characterization and Applications of nanomaterials. **12 Hours**

Characterization of Nanomaterials - UV-VIS, FTIR, DLS, Field emission scanning electron microscopy (FESEM). High resolution transmission electron microscope (HRTEM).

Applications of nanomaterials in Food, Agriculture, Medicine and Environmental protection.

 # Self Study Topics

Course Designer: Dr.R. UMA MAHESWARI

Text Books

S.No.	Authors Name	Title of the Book	Publishers Name	Year of Publication
1	Thomas Varghese and K.M. Balakrishna	Nanotechnology: An Introduction to Synthesis, Properties and Applications of Nanomaterials	Atlantic	2021
2	T. Pradeep	A Textbook of Nanoscience and Nanotechnology	McGraw Hill Education	2017
3	Asim K Das and Mahua Das	An Introduction To Nanomaterials And Nanoscience	CBS	2020
4	Naik Pankaja	Essentials Of Biochemistry	Jaypee Brothers Medical Publishers(P) Ltd	2017
5	U. Sathyanarayana and U Chakrapani	Biochemistry-5th edition	Generic	2019
6	Dr. Mrs Padmaja H. Agarkar, Dr Yogesh kulkarni and Dr Rammohan Rao	Biochemistry	Nirali Prakashan	2019

Reference Books

S.No.	Authors Name	Title of the Book	Publishers Name	Year of Publication
1	M. A. Shah and K. A. Shah	Nanotechnology	Wiley	2019
2	Charles P. Poole, Jr. Frank and J. Owens	Introduction to Nanoscience and Nanotechnology, An Indian Adaptation	Wiley	2020
3	Dr. Swapnil Yadav	Biomolecules and Cell Biology	Mahaveer Publications	2020
4	R. Appling Dean, J. Anthony-Cahill Spencer, K. Mathews Christopher	Biochemistry: Concepts and Connections	Pearson Education	2017
5	Nelson, D. L.; Cox, M. M.; Lehninger	Principles of Biochemistry, 7th Edition.	Pearson Education	2017
6	Jeremy M. Berg, Lubert Stryer, John Tymoczko , Gregory Gatto	Biochemistry	Freeman and Company	2019

Web links

1. https://nptel.ac.in/courses/102105034/
2. https://youtu.be/DhwAp6yQHQI
3. https://youtu.be/YWEiQlEUFak
4. https://youtu.be/f7jRpniCsaw
5. https://youtu.be/ZqoX2W1N6l0

Pedagogy

Chalk and Talk, Power point presentation, Group Discussion, Seminar, Video class, Quiz, Assignment.

SECOND ALLIED COURSE – II

LAB IN BIOMOLECULES AND NANOTECHNOLOGY

2021 – 2022 Onwards

Semester – III	**LAB IN BIOMOLECULES AND NANOTECHNOLOGY**	**Hours/Week – 3**	
Second Allied Course – II		**Credits – 2**	
Course Code – 21UBT3AC2P		**Internal 40**	**External 60**

Objectives

- To impart the students with hands on skills related to biochemical techniques.
- To enable the students to perform qualitative and quantitative analysis of biomolecules.
- To make the students separate plant pigments using chromatographic techniques.
- To gain knowledge of structure, properties, manufacturing of metal nanoparticles.

Course Outcome

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

Co Number	CO STATEMENT	Knowledge Level
CO 1	Outline the qualitative analysis of Biomolecules.	K1
CO 2	Understand the methods for the estimation of Glucose.	K2
CO 3	Describe the process of separation of plant pigments by chromatographic techniques.	K3
CO 4	Demonstrate the synthesis, characterization and analysis of antibacterial activity of metal nanoparticles.	K3

Mapping with Programme Outcomes

Cos	PO 1	PO 2	PO 3	PO 4
CO 1	**S**	**S**	**S**	**S**
CO 2	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**S**	**S**
CO 4	**M**	**M**	**M**	**M**

S – Strong, M – Medium, L- Low

SECOND ALLIED COURSE – II

LAB IN BIOMOLECULES AND NANOTECHNOLOGY

2021 – 2022 Onwards

1. Units and Measurements
2. Preparation of Molarity, Normality solutions and Buffers.
3. Determination of p^H and use of p^H meter.
4. Qualitative analysis of Carbohydrates
5. Qualitative analysis of proteins
6. Qualitative analysis of Lipids.
7. Estimation of Glucose by DNS method.
8. Experiment on plotting calibration curve with standards
9. Separation of plant pigments using Chromatographic techniques – TLC, Paper chromatography
10. Separation of Blood, plasma and Serum.
11. Synthesis of silver nanoparticles (AgNP) using plant extract
12. Synthesis of sol - gel Nanoparticles.
13. Biocompatibility of Nanoparticles – Hemolytic assay.
14. Characterization of nanoparticles – FTIR, UV-VIS, TEM, SEM, DLS. (Demo).
15. Antibacterial activity of metal nanoparticles.

Course Designer

Dr. R. RAMESHWARI

Reference Books

S.No	Authors	Title of Book	Publishers Name	Year of Publication
1	Koch C.C	Nanostructured Materials: Processing, Properties and Applications	Imperial College Press	2018
2	Ghuzang G, Cao	Nanostructures and Nanomaterials: Synthesis, properties and applications	Imperial College Press	2014
3	Sergeev GB.	Nanochemistry	Elseivier	2014
4	Rao CNR, Muller A Cheentham AK.	Chemistry of Nanomaterials	Wiley VCH	2013
5	Brechignac C, Hody P, Lahamani M	Nano materials and Nano chemistry	Springer Publications	2013
6	Edelstein AS and Cammarata RC.	Nanomaterials: Synthesis, properties and applications	Taylor and Francis	2012

E- Books

- https://www.pdfdrive.com/introduction-to-nanomaterials-and-nanotechnology-e7096944.html
- https://www.pdfdrive.com/nanomaterials-and-nanotechnology-e25902292.html
- https://www.pdfdrive.com/introduction-to-nano-basics-to-nanoscience-and-nanotechnology-e176037191.html
- https://www.pdfdrive.com/nanotechnology-principles-and-practices-e36381054.html
- https://www.pdfdrive.com/handbook-of-research-on-nanoscience-nanotechnology-and-advanced-materials-e186744468.html

Web Links

- https://www.youtube.com/watch?v=IFYs3XDu4fQ
- https://www.youtube.com/watch?v=GZWGWEYWdyw
- https://www.youtube.com/watch?v=W11HYiJMvYg
- https://www.youtube.com/watch?v=wK7ue8Uesbw
- https://www.youtube.com/watch?v=fISqlOjoxRs

Pedagogy

Practical Observation and Demo

NON MAJOR ELECTIVE – I

BASICS OF BIOTECHNOLOGY

Semester – III	**BASICS OF BIOTECHNOLOGY**	**Hours/Week – 2**	
Non Major Elective – I		**Credits – 2**	
Course Code – 19UBT3NME1		**Internal 25**	**External 75**

Objectives

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

Course Outcomes

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

CO Number	CO Statement	Knowledge level
CO1	Understand the basic concepts and significant findings in the field of biotechnology.	K1
CO2	Understand the structure and function of cells and organelles	K2
CO3	Learn the basic structure of DNA, RNA and understand the flow of genetic information	K2
CO4	Apply the existing techniques in waste management	K3
CO5	Explore more advanced application based aspects in biotechnology	K3

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4
CO1	M	M	S	M
CO2	L	M	M	M
CO3	S	M	S	M
CO4	S	S	S	M
CO5	S	S	M	M

S – Strong, M – Medium, L - Low

NON MAJOR ELECTIVE – I

BASICS OF BIOTECHNOLOGY

Unit I **4 Hours**

Biotechnology: Definition, Brief history of biotechnology, Scope and branches of biotechnology.

Unit II **7 Hours**

Introduction to cells - Discovery of cells and cell theory- Types of cells -Structure of prokaryotic (Bacteria) and eukaryotic cells (Plant and Animal).

Unit III **6 Hours**

Structure and components of nucleic acids, Forms of DNA and types of RNA, DNA as genetic material – Hershey and Chase and Griffith's experiment. RNA as genetic material- TMV.

Unit IV **6 Hours**

Biotechnology for solid and liquid waste management - Bioremediation, Biodegradation, Bioleaching and waste water treatment. Degradation of xenobiotics, Oil spills – Superbugs.

Unit V **7 Hours**

Applications of biotechnology in various fields — Food – Algae (SCP) and Fungi (Mushroom), Pharmaceutical– probiotics *(Lactobacillus).* Biofertilizers – Rhizobium, Biofuel - Ethanol.

Text books

S. No	Name of the Author(s)	Title of the book	Publishers name	Year of publication
1	William J Thieman and Micheal A. Palladino	Introduction to Biotechnology	Pearson	2014
2	R. C. Dubey	A text book of Biotechnology	S Chand	2014
3	U. Satyanarayana	Biotechnology	Books and Allied (P) Ltd.	2008
4	Gerald Karp, Janet Iwasa, Wallace Marshall	Karp's Cell Biology, 8th Edition	Willey – Blackwell	2018
5	Michael Pelczar, E.C.S. Chan, Noel R. Krieg	Microbiology	Tata McGraw – Hill	2001

Reference books

S. No	Name of the Author(s)	Title of the book	Publishers name	Year of publication
1	David L. Nelson and Michael M. Cox	Lehninger Principles of Biochemistry	W. H. Freeman	2017
2	Jeremy W Dale and Malcolm Von Schantz	From genes to genome	Willey - Blackwell	2011
3	Alberts, Johnson, Lewis, Morgan, Raff, Roberts and Walter	Molecular biology of the cell	W.W. Norton & Co	2014
4	Peter Stanbury, Allan Whitaker and Steve Hall	Principles of fermentation technology	Butterworth - Heinemann	2016
5.	Keith Wilson and John Walker	Principles and techniques of biochemistry and Molecular Biology	Cambridge University Press	2010

Pedagogy

Powerpoint presentation, Simulation, Animated videos, Lab and industrial visits, Group Discussion, Seminar and Assignment.

Web links

1. www.sciencedirect.com
2. https://www.ncbi.nlm.nih.gov/pubmed/
3. https://nptel.ac.in/courses/102103045/
4. http://www.nih.gov
5. http://www.nas.edu

CORE COURSE – IV

IMMUNOLOGY

Semester – IV	IMMUNOLOGY	Hours/Week – 5	
Core Course – IV		Credits – 4	
Course Code – 19UBT4CC4		Internal 25	External 75

Objectives

- To know about the immune system and their functions.
- To acquire knowledge about the vaccines and its types.
- To study about the cellular responses in immune system.
- To know the significance of various immunological disorders and their remedies

Course Outcomes

CO Number	CO Statement	Knowledge Level
CO 1	Demonstrate the types of cells involved in immune system.	K1
CO 2	Describe the agents of nonspecific immunity.	K2
CO 3	Illustrate about the structure and functions of immunoglobulins and monoclonal antibodies.	K2
CO 4	Outline the clear and concise idea about Vaccines	K3
CO 5	Obtain Knowledge in transplantation and tumor immunology.	K3

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4
CO1	S	S	S	S
CO2	M	M	S	S
CO3	S	S	S	S
CO4	S	S	M	S
CO5	S	L	S	S

S- Strong, M- Medium, L-Low

CORE COURSE – IV

IMMUNOLOGY

Unit I - Fundamental Concepts and Anatomy of the Immune system 12 Hours

Basics of Immunology - Terminology - antigen, immunogen, hapten, super antigen, allergen, antigenecity, immunogenicity, immunoglobulin, antibody, epitope, paratope, tolerogen. Organs of immune system, tissues of immune system, cells of immune system and mediators of immune system. Lymphoid organs: Primary lymphoid organs (Thymus, Bone marrow), Secondary lymphoid organs (Spleen, Lymph node, MALT). Haematopoiesis and differentiation; Haematopoietic stem cells, T-cells, B-cells, Macrophages, Monocytes, Polymorphs, Platelets and Null cells. Immunity: Innate and acquired immunity. Theory of clonal selection.

Unit II - Cellular Responses 12 Hours

T- Cells and B- Cells: Development, maturation, activation and differentiation. Antigen: Properties and Biology. Factors affecting antigenicity – Super antigens, epitopes, haptens, adjuvants and vaccines; Antigen –antibody binding; Immunoglobulin: Structure, functions and Classifications. Monoclonal antibodies - Principles and applications; APC's, MHC, antigen processing and presentation, regulation of T and B cell responses.

Unit III - Non specific Immunity 12 Hours

Natural built in barriers – skin, semen, saliva, tears, enzymes. Mediators of immune system - lymphokines, cytokines, interferon, tumor necrosis factor. Complement components, natural killer cells, macrophages, phagocytosis, pinocytosis. Inflammatory response. Mucosal and Gut associated lymphoid tissue (MALT and GALT) and mucosal immunity.

Unit IV - Vaccinology 12 Hours

Active, passive and combined immunization. Live, killed, attenuated, plasma derived, sub unit, recombinant DNA, protein based, plant-based, peptide, anti-idiotypic and conjugate vaccines – production and applications. Role and properties of adjuvants and ISCOMS.

Unit V - Transplantation and Tumor Immunology 12 Hours

Transplantation: Mechanism, Types of Grafts[#], Graft rejection, General and specific immunosuppressive therapy; Clinical transplantation; - Hypersensitivity - Type I-IV; Tumor immunology; Autoimmunity: Autoimmune diseases, diagnosis and treatment.

 # Self Study Topics

Text Books

S.No	Author	Title	Publisher	Year of Publication
1	Lauren M.Sompayrac	How the Immune system works. 6th Edition	Wiley Blackwell	2019
2	Dr.P.Madhavee Latha	A Textbook of Immunology	S.Chand Publishing	2018
3	Abul K.Abbas, Andrew H.Lichtman Shiv Pillai	Cellular and Molecular Immunology. 9th Edition	Elsevier	2017
4	Warren Levinson	Review of Medical Microbiology and Immunology	Mc Graw Hill Education	2016
5	Paul	Fundamental Immunology. 7th Edition	Lippincott Williams and Wilkins	2012
6	Louis Hawley Richard J Ziegler Benjamin L Clarke	BRS Immnology and Microbiology (6th Edition)	Lippincott Williams and Wilkins	2015

Reference Books

S. No	Author	Title	Publisher	Year of Publication
1	Abul K.Abbas, Andrew H.Lichtman Shiv Pillai	Basic Immunology. 6th Edition	Elseiver	2019
2	Jenni Punt, Sharon Stranford, Patrica Jones, Judith Owen	Kuby Immunology. 8th Edition	ML IE PRNT	2018
3	Peter , J.Delves,Seamus J.Martin, Dennis R.Burton, Ivan M.Roitt	Roitt's Essential Immunology. 1st Edition	Wiley Blackwell	2017
4	Kenneth Murphy, Casey Weaver	Janeway's Immunobiology. 9th Edition	Garland Science	2016
5	Kathy M.Durkin	Understanding the Vaccines and the Immune system.1st Edition	Nova Science.Pub.Inc	2010

Pedagogy

Power point presentation, Group Discussion, Seminar, Assignment

Weblinks

- https://youtu.be/Ktry4gGC2nA
- https://youtu.be/GY87mHuuwok
- https://youtu.be/edIPKRAKa-Y
- Immunology Link Home Page.

CORE PRACTICAL – IV

LAB IN IMMUNOLOGY

Semester – IV	**LAB IN IMMUNOLOGY**	**Hours / Week – 03**	
Core Practical – IV		**Credits – 03**	
Course Code - 19UBT4CC4P		**Internal 40**	**External 60**

Preamble

- To Study about the Identification of Blood Group.
- To Enumerate the Blood Cells
- To Study about the Immunoelectrophoresis Techniques
- Enable the students with diagnostic skills for identification of certain diseases and immunological techniques.

Course Outcomes

On Successful Completion of the Course, Students will be able to

CO Number	CO Statement	Knowledge Level
CO 1	Demonstrate the methods to Identify the Blood Cells	**K1**
CO 2	Experiments for Enumeration of Blood Cells	**K3**
CO 3	Techniques for Plasma and Serum Separation and Identify the Blood Groups	**K3**
CO 4	Apply the diagnostic skills for identification of certain diseases, immunological techniques.	**K3**

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4
CO1	S	M	S	S
CO2	S	S	M	L
CO3	M	S	M	S
CO4	S	M	L	M

S – Strong, M – Medium, L - Low

CORE PRACTICAL – IV

LAB IN IMMUNOLOGY

1. Identification of Cells in a Blood Smear.
2. Blood Cell Counting using Haemocytometer
3. Separation of Serum and Plasma
4. Identification of Blood Group
5. Latex Agglutination Test
6. Single Radial Immunodiffusion
7. Precipitation Reaction – AGD
8. Rocket Immunoelectrophoresis.
9. Testing for Typhoid Antigens - Widal Test
10. AMES TEST
11. DOT ELISA
12. Pregnancy Test – HCG
13. Rapid Plasma Reagin Test
14. Route of Immunization by Virtual
15. Breeding and Maintenance of Laboratory Animals by Virtual

Reference books

S. No.	Authors Name	Title of the Book	Publishers Name	Year of Publication
1	Senthilkumar Balakrishnan, Karthik Kaliaperumal, Senbagam Duraisamy	Practical Immunology A Laboratory Manual	LAP LAMBERT Academic Publishing, Germany	2017
2	Wilmore C.Webley	Immunology Laboratory Manual	LAD Custom Publishing, Georgia.	2017
3	Barbara Detrick, John L Schmitz, Robert G Hamilton	Manual of Moleclar and Clinical Laboratory Immunology – 8th Edition	ASM Press, Washington, DC.	2016
4	Christine Dorresteyn Stevens	Clinical Immunology and Serology: A Laboratory Perspective	F.A.Davis Company, Philadelphia	2016
5	G.P.Talwar and S.K.Gupta	A Handbook of Practical and Clinical Immunology	CBS, Publications, Delhi, India	2012

SECOND ALLIED COURSE- III

PLANT ANATOMY AND PHYSIOLOGY

Semester – IV	PLANT ANATOMY AND PHYSIOLOGY	Hours/Week – 3	
Second Allied Course- III		Credits – 3	
Course Code –19UBT4AC4		Internal 25	External 75

Objectives

- To acquire knowledge about anatomical structure of plants
- To comprehend the biochemistry of plant metabolism
- To study about the application of plant growth regulators in agriculture
- To acquire complete knowledge about the biochemical pathways in plants

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO 1	Compare the account of anatomy of Dicot stem and Monocot stem	K2
CO 2	Classify the internal structure of Dicot root and Monocot root	K2
CO 3	Sketch the various pathway for translocation of minerals in plants	K3
CO 4	Analyse the utilization of plant hormones in agriculture	K4
CO 5	Design various biochemical pathways to characterize C3 and C4 plants	K6

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4
CO1	M	S	L	M
CO2	M	S	S	S
CO3	S	S	S	S
CO4	L	L	M	M
CO5	M	S	M	M

S- Strong, M-Medium, L-Low

SECOND ALLIED COURSE- III

PLANT ANATOMY AND PHYSIOLOGY

Unit I - Plant anatomy **9 Hours**

Meristems: Characteristics, classification and theories of root - shoot apical meristem. The cambium: Types and functions. Simple Plant tissues: Types, Structure and functions. Comparative account of anatomy of Dicot stem (Sunflower) and Monocot stem (Maize), Dicot root (Sunflower) and Monocot root (Maize). Dicot Leaf and Monocot leaf

Unit II - Transportation in Plants **9 Hours**

Translocation of water in xylem and Translocation of food in Phloem. Water uptake: imbibitions, diffusion, osmosis, water potential and its components. Ascent of sap - Transpiration - Guttation. Stomatal physiology. Plant responses to Stress- biotic Stress-unwanted weeds, insects, bacteria, fungus, virus and abiotic Stress-Drought, high salinity, cold and heat.

Unit III - Plant Growth Development **9 Hours**

MS Medium and its composition in Plant tissue Culture for Plant Growth Development. Measurement of plant growth- growth curve. Plant growth regulators (PGR) - Auxins, Gibberellins, Cytokinins, Ethylene and Abscisic acid. Plant growth regulators in agriculture – Merits and demerits of PGR in agriculture.

Unit IV - Morphogenesis **9 Hours**

Photomorphogenesis- Photoperiodism, Vernalisation, Phytochrome, Biological clock. Physiology of germination. Dormancy – causes and types of dormancy. Seed dormancy-Causes of Seed dormancy, Types of Seed dormancy-Innate, Enforced and Induced dormancy. Methods of Breaking Seed Dormancy. Importance of seed dormancy.

Unit V - Photosynthesis and Respiration **9 Hours**

Photosynthesis: Photosynthetic pigment systems - radiant energy - cyclic and noncyclic electron transport - C3 and C4 pathways - factors affecting photosynthesis - photorespiration Respiration: Aerobic - anaerobic, Glycolysis, Kreb's cycle, oxidation - reduction potential, ATP synthesis, Factors affecting respiration[#].

 # Self Study Topic

Text books

S.No.	Author	Title	Publisher	Year of Publication
1	Lincoln Taiz, Eduardo Zeiger , Ian Max Moller , Angus Murphy	Fundamentals of Plant Physiology-1 edition	Sinauer Associates is an imprint of Oxford University Press	2018
2	Crang, Richard, Lyons-Sobaski, Sheila, Wise, Rober	Plant Anatomy A Concept-Based Approach to the Structure of Seed Plants	Springer International Publishing	2018
3	Bhatla, Satish C, Lal, Manju A.	Plant Physiology, Development and Metabolism	Springer Singapore	2018
4	Ava Metcalfe	Integrative Plant Anatomy	Tritech Digital Media	2019
5	Alexander James	Plant Physiology, Biochemistry And Biotechnology	Tritech Digital Media	2019

Reference Books

S.No.	Author	Title	Publisher	Year of Publication
1	Neil Willey	Environmental Plant Physiology	Taylor and Francis Inc	2016
2	Clive Koelling	Plant Anatomy, Morphology and Physiology	Syrawood Publishing House	2016
3	Taiz.L, Zeiger.E, Moller.M and Murphy.A	Plant Physiology and Development (VI Edition)	Sinauer Associates,Inc.Publishers ,Massachusetts,USA	2015
4	Taylor A. Steeves and Vipen K. Sawhney	Essentials of Developmental Plant Anatomy	OUP USA	2017
5	Taiz.L, Zeiger.E, Moller.M and Murphy.A	Fundamentals of plant Physiology	Sinauer Associates, Inc	2018
6	Bob B.Buchanan, Wilhelm Gruissem, and Russell L.Jones	Biochemistry & molecular Biology ofplants	John Wiley & Sons, Ltd	2015

Pedagogy
PowerPoint presentation, Video lectures, Group discussion, Seminar, Assignment

Web links

- https://swayam.gov.in/nd2_cec19_bt01/preview
- https://www.askiitians.com/biology/plant-physiology/
- https://biology.ufl.edu
- https://labs.eemb.ucsb.edu
- https://employees.csbsju..edu

NON MAJOR ELECTIVE – II

APPLIED BIOTECHNOLOGY

Semester – IV	APPLIED BIOTECHNOLOGY	Hours/Week – 2	
Non Major Elective – II		Credits – 2	
Course Code – 19UBT4NME2		Internal 25	External 75

Preamble

- To understand the fundamental principles of biotechnology
- To appreciate the techniques involved in the field of biotechnology
- To recognize the application of genetically modified organisms in various fields like agriculture, livestock, medicine and environment.
- To familiarize with the basic principles of biotechnology employed in forensic science and medicine.

Course Outcomes

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

CO Number	CO Statement	Knowledge level
CO1	Define the importance of biotechnology in the field of life science	K1
CO2	Outline the principle and application of biotechnology in food industry	K2
CO3	Explain the efficiency of microbes in waste treatment and pollution control	K2
CO4	Apply the concept of DNA fingerprinting in forensic science	K3
CO5	Interpret regulations and guidelines for ensuring biosafety measures for protection of public health and environment.	K3

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4
CO1	M	L	M	M
CO2	M	M	L	M
CO3	S	M	S	M
CO4	M	L	L	M
CO5	L	M	L	M

S – Strong, M – Medium, L - Low

NON MAJOR ELECTIVE – II
APPLIED BIOTECHNOLOGY

Unit I **6 Hours**

Biotechnology in the field of Agriculture – History of Genetic modification in Agriculture - Genetically modified Crops – Advantages and Applications - Bt Cotton (Pest resistant), Flavr Savr Tomato (Shelf life improvement), Golden Rice (Rich in Vitamin A), Soybean (Rich in oleic acid content).

Unit II **6 Hours**

Introduction to Food Biotechnology, Principle of Fermentation process. Production of food products – Bread, Dairy, Confectionery and Beverages, Meat, Poultry and Fish products. Food processing and preservation.

Unit III **6 Hours**

Introduction to Environmental Biotechnology. 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.

Unit IV **6 Hours**

Importance of Biotechnology in Forensic science. Principle of DNA fingerprinting. Application of DNA profiling in forensic medicine - Solving violent crimes such as murder and rape – Blood & Semen Sample; solving maternal & paternal disputes. Forensic Science Laboratories in India.

Unit V **6 Hours**

Biosafety guidelines and regulations - Importance and Operation. Role of Biosafety Committees - IBSC, RDAC, RCGM, GEAC. Environmental release of GMOs, Risk assessment and management.

[#] **Self Study Portion**

Text books

S. No	Name of the Author(s)	Title of the book	Publishers name	Year of publication
1	Varsha Gupta, Manjistha Sengupta, Jaya Prakash and Baishnab Charan Tripathy	Basic and Applied aspects of Biotechnology	Springer	2017
2	Malik Zainul Abdin, Usha Kiran, Kamaluddin and Athar Ali	Plant Biotechnology: Principles and Applications	Springer	2017
3	Firdos Alam Khan	Biotechnology Fundamentals	CRC Press	2016
4	Ashish S. Verma, Anchal and Singh	Animal Biotechnology –Models in Discovery and Translation	Elsevier	2014
5	A. K. Chakravarthy	Introduction to Environmental Biotechnology – Second Edition	OUP, India	2013

Reference books

S. No	Name of the Author(s)	Title of the book	Publishers name	Year of publication
1	Pessarakli M	Handbook Of Plant And Crop Stress	Taylor and Francis	2020
2	Foster G. N.	Food Biotechnology	CBS Publishers	2020
3	Chawla H. S.	Introduction to Plant Biotechnology	Oxford and IBH Publishing	2017
4	Allen K	Environmental Biotechnology	CBS Publishers	2016
5	Petre M	Advances In Applied Biotechnology	INTECH	2016
6	Daniel Vallero	Environmental Biotechnology – A Biosystems Approach	Academic Press	2015

Pedagogy

Power point presentation, Group Discussion, Seminar, Assignment.

Web links

- https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=16
- http://www.goldenrice.org/Content2-How/how1_sci.php
- http://fsl.delhi.gov.in/wps/wcm/connect/doit_fsl/fsl/home/
- https://www.who.int/csr/resources/publications/biosafety/Biosafety7.pdf
- http://dbtindia.gov.in/guidelines-biosafety

SKILL BASED ELECTIVE-I (A)

INFORMATION IN OMICS AND APPLICATIONS

Semester – IV	INFORMATION IN OMICS AND APPLICATIONS	Hours/Week – 2	
Skill based Elective-I (A)		Credits – 2	
Course Code - 19UBT4SBE1A		Internal 25	External 75

Objectives

- To understand the basic Principles and techniques of OMICS
- To familiarize with the basic tools and techniques employed in OMICS
- To grow knowledge regarding the modern application of molecular tools in real life problems
- To apply knowledge of different omics technology for designing experiment

Course Outcomes

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

CO Number	CO Statement	Knowledge level
CO1	Develop knowledge on the basics of omics and their versatile applications	K1
CO2	Understand the omics data analysis	K2
CO3	Integration of omics approaches for improvement of life	K2
CO4	Technical skills and knowledge development on versatile techniques in omics	K3
CO5	Explore more advanced application based aspects in omics	K3

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4
CO1	M	M	S	M
CO2	L	M	M	M
CO3	S	M	S	M
CO4	S	S	S	M
CO5	S	S	M	M

S – Strong, M – Medium, L – Low

SKILL BASED ELECTIVE-I (A)

INFORMATION IN OMICS AND APPLICATIONS

Unit I **6 Hours**

Overview and general principles of omics technologies in biotechnology. The data analysis workflow- from quantitative data to biological information.

Unit II **6 Hours**

Omics approaches: Genomics, Proteomics, Transcript omics and Metabolomics. Functional omics for discovery of novel organisms, enzymes, value added products.

Unit III **6 Hours**

Omics tools- DNA sequencing, Genome sequencing, Next generation sequencing methods. Genome annotation, Functional genomics. RNA Sequencing, Microarray.

Unit IV **6 Hours**

Basics concepts, Tools of proteomics- SDS PAGE, 2D PAGE, Liquid chromatography, Mass spectrometry (ESI and MALDI), Protein identification by peptide mass finger printing. Applications of proteomics.

Unit V **6 Hours**

Fundamental concepts and tools of metabolomics. Capillary electrophoresis, Gas chromatography. Application of omics in different field of biotechnology including agriculture, environment, pharmaceuticals, medicine and forensics

Text books

S. No	Name of the Author(s)	Title of the book	Publishers name	Year of publication
1	Debmalya Barh Vasco Azevedo	Omics Technologies and Bio-engineering	Academic press	2017
2	Wittmann,c. and Lee,S.Y.eds	Systems metabolic engineering	Springer science and Business Media	2012
3	Barh,D.,Zambare,V. and Azevedo,V.	Omics: applications in biomedical, agriculture and environment	Springer science and Business Media	2017
4	Kihara,D.	Protein function prediction for omics era	Springer science and business Media	2011
5	Debmalya Barth, Vasco Azevedo	Omics Technologies and Bio- Engineering	Academic press	2018

Reference books

S. No	Name of the Author(s)	Title of the book	Publishers name	Year of publication
1	Lawrence Baker	Bioinformatics: Tools and Techniques	Callisto Reference	2018
2	Jeremy W Dale, Malcolm van Schantz	From genes to genome	Willey – Blackwell	2011
3	Martins-de-souza,D.	Shotgun Proteomics	Humana Press	2014
4	Michael Agostino	Practical Bioinformatics	Garland Publishing	20013
5	Low, L and Tammi, M	A Practical Handbook of Next Generation Sequencing and Its Applications	World Scientific	2017
6	Mohammed Iftekhar	Bioinformatics Practical Manual	Create Space Independent Publishing Platform	2015

Pedagogy

Powerpoint presentation, Simulation, Animated videos, Lab and industrial visits, Group Discussion, Seminar and Assignment.

Web links

- www.sciencedirect.com
- https://www.ncbi.nlm.nih.gov/pubmed/
- https://nptel.ac.in/courses/102103045/
- http://www.nih.gov
- http://www.nas.edu

SKILL BASED ELECTIVE - I (B)

BIOINFORMATICS

Semester – IV	BIOINFORMATICS	Hours/Week – 2	
Skill Based Elective – I (B)		Credits – 2	
Course Code –19UBT4SBE1B		Internal 25	External 75

Objectives

- To get introduced to the basic concepts of Bioinformatics
- To familiarize with the available databases related to bioinformatics
- To learn the usage of basic online bioinformatics tools and techniques
- To apply the concepts and tools of bioinformatics in various fields

Course Outcomes

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

CO Number	CO Statement	Knowledge level
CO1	Understand the basic concepts and terminologies in bioinformatics	K1
CO2	Learn the basic online biological resources and databases	K2
CO3	Learn and apply the online software and tools for macromolecular structure prediction and sequencing	K2
CO4	Apply the bioinformatics tools in medicine for drug discovery and identification of novel drugs	K3
CO5	Apply the bioinformatics ideas in different fields and explore upcoming areas of interest in bioinformatics	K3

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4
CO1	L	M	M	S
CO2	M	M	S	M
CO3	S	M	S	M
CO4	S	M	S	M
CO5	S	S	S	M

S – Strong, M – Medium, L - Low

SKILL BASED ELECTIVE - I (B)

BIOINFORMATICS

Unit I **6 Hours**

History of Bioinformatics[#] – Introduction to concepts and terminology of Internet, Search Engines, Databases and Softwares

Unit II **6 Hours**

Review of basics about structure of macromolecules - DNA, RNA and Proteins. Online resources for Bioinformatics – Biological Databases – NCBI, Genbank, EMBL, Swissprot, PDB. Executing search and retrieval of data. Sequence alignment – Multiple sequence alignment – Pairwise alignment.

Unit III **6 Hours**

Bioinformatics in genomics and proteomics – gene sequencing tools traditional methods – Maxam and Gilbert's method, Sanger's sequencing – structure prediction tools – Nucleic acid and protein structure prediction – Gene and protein expression analysis – similarity search databases – FASTA, BLAST. Analysis of Phylogeny - Phylogenetic tree construction. Protein ligand interaction, Ramachandran Plot, PYMOL.

Unit IV **6 Hours**

Structure based drug discovery – Molecular docking of novel compounds – SAR and QSAR, Introduction to Simulation softwares in biology – Autodock, ADMET.

Unit V **6 Hours**

Applications of Bioinformatics in different fields – Medicine, Agriculture, Environmental monitoring - Emerging areas in bioinformatics[#].

 # Self Study Topics

Text books

S. No.	Name of the Author(s)	Title of the book	Publishers name	Year of publication
1	Manoj Kumar	Introduction to Bioinformatics	Notion press	2020

2	Ibrokhim Y. Abdurakhmonov	Bioinformatics: Updated Features and Applications	BoD – Books on Demand	2016
3	Paul M. Selzer, Richard J. Marhöfer, Oliver Koch	Applied Bioinformatics: An Introduction	Springer	2018
4.	Prakash S. Lohar	Bioinformatics	MJP Publisher	2019
5	Noor Ahmad Shaik, Khalid Rehman Hakeem, Babajan Banaganapalli, Ramu Elango	Essentials of Bioinformatics, Volume I: Understanding Bioinformatics: Genes to Proteins	Springer	2019

Reference books

S. No	Name of the Author(s)	Title of the book	Publishers name	Year of publication
1	Shoba Ranganathan, Kenta Nakai, Christian Schonbach	Encyclopedia of Bioinformatics and Computational Biology: ABC of Bioinformatics	Elsevier	2018
2	Hamid R Arabnia, Quoc Nam Tran	Emerging Trends in Computational Biology, Bioinformatics, and Systems Biology: Algorithms and Software Tools (Emerging Trends in Computer Science and Applied Computing)	Morgan Kaufmann; 1st Edition	2015
3	Asheesh Shanker	Bioinformatics: Sequences, Structures, Phylogeny	Springer	2018
4	Paola Lecca,	Systemic Approaches in Bioinformatics and Computational Systems Biology: Recent Advances	Business Science Reference	2011
5	Arthur Lesk	Introduction to Bioinformatics	Oxford University Press	2019
6	Jamil Momand, Alison McCurdy, Silvia Heubach	Concepts in Bioinformatics and Genomics	Oxford University Press	2016

Pedagogy

PowerPoint presentation, Video lectures, Demonstration and hands on teaching, Group discussion, Seminar and assignment.

Web links

- www.ncbi.nlm.nih.gov
- genbank https://nptel.ac.in/courses/102106065/
- www.ebi.ac.uk training › online › course › bioinformatics-terrified
- www.wwpdb.org
- www.bioinformatics.org