CAUVERY COLLEGE FOR WOMEN

(AUTONOMOUS)



DEPARTMENT OF BIOTECHNOLOGY

UG SYLLABUS

(For the candidates admitted from the academic year 2019 -20 onwards)

<u>B.Sc BIOTECHNOLOGY</u> 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 COURSE STRUCTURE (For the candidates admitted from the academic year 2019 -2020 onwards)

ster		Course	T '41a	Subject Code	Inst. Hour	-	Exam	Marks		
Semes	Part	Course	Subject Code		/ Week	Credi	Hours	Int	Ext	Total
			இக்கால இலக்கியம் Story Noval Hindi	19ULT1						
		Language Course–I (LC)	Literature & Grammar – I	19ULH1			3 3	25		
	Ι	-Tamil/Other Languages	History of Popular Tales, Literature and Sanskrit Story	19ULS1	6	3			75	100
			Communication in French – I	19ULF1						
Ι	Π	English Language Course – I (ELC)	Functional Grammar for Effective Communication – I	19UE1	6	3	3	25	75	100
		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
	ш	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	Value Education	Value Education	19UGVE	2	2	3	25	75	100
			Total		30	19				600
			இடைக்கால இலக்கியமும்புதினமும்	19ULT2	6 3					
	Ι	Language Course– I II (LC)–Tamil	Prose, Drama, Hindi Literature – 2 & Grammar – II	19ULH2		3	3	25	75	100
		/Other Languages	Poetry, Textual Grammar and Alakara	19ULS2						
			Communication in French – II	19ULF2						
Π	Π	English Language Course–II (ELC)	Functional Grammar for Effective Communication – II	19UE2	6	3	3	25	75	100
		Core Course–II (CC)	Molecular Biology	19UBT2CC2	6	4	3	25	75	100
	ш	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	19UGES	2	2	3	25	75	100
		Tota	al		30	20				700

			காப்பியமும் நாடகமும்	19ULT3						
		Language Course – III	Medieval, Modern Poetry & History of Hindi Literature – 3	19ULH3						
	I	(LC)–Tamil/Other Languages	Prose, Textual Grammar and Vakyarachana	19ULS3	6	3	3	25	75	100
			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
		Core Course – III (CC)	rDNA Technology	19UBT3CC3	6	4	3	25	75	100
	ш	Core Practical – III (CP)	Lab in rDNA Technology	19UBT3CC3P	3	3	3	40	60	100
III	111	Second Allied Course – I(AC)	Biochemistry	19UBT3AC3	4	4	3	25	75	100
		Second Allied Course-II (AP)	Lab in Biochemistry	19UBT3AC2P	3	-	-	-	-	-
-		Non Major Elective I-for those who studied Tamil	Basics of Biotechnology	19UBT3NME1				25	75	100
	W	a)Basic Tamil for other language students	Basic Tamil	19ULC3BT1	2	2	3			
	ĨV	b)Special Tamil for those who studied Tamil upto +2 but optfor other languages in degree programme	Special Tamil	19ULC3ST1	2	2		23	75	100
	V	Swayam Online Course	Animal Physiology	-	-	-	А	s per UG	C norms	
			Total		30	19				600
			பண்டைய இலக்கியம்	19ULT4						
	Ι	Language Course –IV (LC) -Tamil/Other Languages	Letter writing, General essays, Technical Terms, Proverbs, Idioms& Phrases, Hindi Literature – 4 Drama, History of	19ULH4 19ULS4	6	3	3	25	75	100
			Communication in	19ULF4						
IV	II	English Language Course – IV(ELC)	French – IV Reading and Writing for Effective Communication	19UE4	6	3	3	25	75	100
		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
	III	Second Allied Course - II (AP)	Lab in Biochemistry	19UBT3AC2P	3	2	3	40	60	100
		Second Allied Course – III(AC)	Plant Anatomy and Physiology	19UBT4AC4	3	3	3	25	75	100

		Non Major Elective II- for those who studied Tamil under Part-I	Applied Biotechnology	19UBT4NME2						
		a) Basic Tamil for other	Basic Tamil	19ULC4BT2	2	2	3	25	75	100
	IV	b) Special Tamil for those who studied Tamil upto +2 but opt for other languages in degree programme	Special Tamil	19ULC4ST2						
		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 rec	ommenda	ations
		Te	otal		30	22				800
		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
	III	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 –	A) Pharmacognosy	19UBT5MBE1A	5	5	3	25	75	100
		1	B) Cancer Biology	19UBT5MBE1B						
V		Skill Based Elective –	A) Molecular Diagnostics and Therapeutics	19UBT5SBE2A	2	2	3	25	75	100
		Ш	B) Lab in Bioinformatics	19UBT5SBE2BP			-	40	60	100
	IV	Skill Based Elective –	A)DNA Fingerprinting	19UBT5SBE3A				25	75	100
		III	B) Lab in Plant Tissue Culture	19UBT5SBE3BP	2	2	3	40	60	100
		UGC Jeevan Kaushal Life Skills	Professional Skills	19UGPS	2	2	3	25	75	100
-	V	Extra Credit Course	Swayam OnlineCourse	To be Fixed Later	-	-	As per U	JGC Rec	ommenda	ation
		Tota	al		30	30				800
		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
VI	Ш	Core Practical – VI (CP)	Lab in Microbial Biotechnology A)Environmental	19UBT6CC6P19UBT6MBE2A	5	4	3	40	60	100
II		Major Based Elective – II	Biotechnology B) Stem Cell Biology	19UBT6MBE2B	6	6	3	25	75	100

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

CORE COURSE – I

CELL BIOLOGY

Semester – I		Hours/Week - 6		
Core Course – I	CELL BIOLOGY	Credi	ts - 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	М	S	S	М
CO2	М	М	S	М
CO3	S	М	М	М
CO4	S	S	S	S
CO5	М	М	S	S

S-Strong, M-Medium, L-Low

CORE COURSE – I CELL BIOLOGY

Unit I - Fundamentals of cell structure

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

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

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

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

18 Hours

18 Hours

18 Hours

18 Hours

Text Books

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

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

CORE PRACTICAL – I LAB IN CELL BIOLOGY

Semester – I		Hours/Week - 3		
Core Practical – I	LARIN CELL BIOLOGY	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	М	L	М	М
CO2	М	М	М	L
CO3	М	L	L	М
CO4	S	М	L	М
CO5	L	L	L	L

S- Strong, M-Medium, L-Low

CORE PRACTICAL – I

LAB IN CELL BIOLOGY

- 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.

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

FIRST ALLIED COURSE – I GENERAL MICROBIOLOGY

Semester – I		Hours/Week - 4	
First Allied Course – I	GENERAL MICROBIOLOGY	Credits - 4	
Course Code - 19UBT1AC1	GENERAL MICROBIOLOGY	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	CO Statement	Knowledge
Number		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.	К3

Mapping with Programme Outcomes

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

S-Strong, M-Medium, L-Low

FIRST ALLIED COURSE – I GENERAL MICROBIOLOGY

Unit I - History and Classification

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

Unit 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. Types of Sterilization and Disinfection.

Unit III – Bacteria

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

Unit IV – Diversity of Microbial world

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

Unit V – Protozoa & Viruses

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

13 Hours

12 Hours

10 Hours

12 Hours

13 Hours

Text Books

S.	Author name	Title of the book	Publishers name	Year of
No.				publication
1	Gerarad J.Tortora Berdell R.Funke and Christine L.Case	Microbiology An Introduction (11 th 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

S. No.	Author name	Title of the book	Publishers name	Year of
				publication
1	Tortora, Funke and Case	Microbiology: An Introduction – 13 th Edition	Pearson	2018
2	Madigam M.T. Bender K.S. Buckley D.H Sattley W.M and Stahl D.A	Brock Biology of Microorganism(15 th Edition)	Pearson Education	2017
3	Prescott, Harley and Klein.	Microbiology. 10 th 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		Hours/Week – 4	
First Allied Course – II	I AR IN MICRORIOLOGY	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

СО	CO Statement	Knowledge Level
Number		
CO 1	Illustrate the techniques involved in sterilization of media and	K1
	glasswares.	
CO 2	Outline the methods for isolation and enumeration of	K2
	microorganisms from different samples.	
CO 3	Demonstrate the various pure culture techniques and to measure	K2
	the bacterial growth.	
CO 4	Identify the organisms by various staining techniques.	K3
<u> </u>	A mala marine his sheet as to sheet staring mine anonious	V2
05	Apply various diochemical lesis to characterize microorganisms.	K3

Mapping with Programme Outcomes

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

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).

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

CORE COURSE – II MOLECULAR BIOLOGY

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

СО		Knowledge Level
Number	CO Statement	
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	М	М	М	М
CO2	S	S	S	М
CO3	S	М	М	М
CO4	L	L	L	L
CO5	S	М	М	М

S-Strong, M-Medium, L-Low

CORE COURSE – II MOLECULAR BIOLOGY

Unit I – Genetic Material

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

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

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

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

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

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18 Hours

18 Hours

18 Hours

18 Hours

18 Hours

Text Books

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

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

CORE PRACTICAL – II

LAB IN MOLECULAR BIOLOGY

Semester – II		Hours/	/Week – 3
Core Practical – II	LAB IN MOLECULAR BIOLOGY	Credits - 3	
Course Code - 19UBT2CC2P	DIOLOGI	Internal	External
		40	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.	К3
CO 4	Experiment with various gene transfer methods.	K3

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4
CO1	S	S	S	S
CO2	М	М	М	М
CO3	L	L	М	М
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

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

FIRST ALLIED COURSE- III BIOINSTRUMENTATION

Semester – II		Hours/Week - 3	
First Allied Course – III	BIOINSTRUMENTATION	Credits - 3	
Course Code - 19UBT2AC2	DIOINGINCHILIUIIII	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	CO Statement	Knowledge Level
Number		
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	М	S	М	S
CO2	S	М	М	S
CO3	S	М	М	S
CO4	S	S	М	S
CO5	М	S	S	М

S-Strong, M-Medium, L-Low

FIRST ALLIED COURSE- III BIOINSTRUMENTATION

Unit I – Microscopy

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

Unit II – Electrophoresis

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

Unit III – Chromatography

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

Unit IV- Colorimeter

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

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	2016
			Publishers	
2	L. Veerakumari	Bioinstrumentation	MJP	2015
			Publishers	
3	R. S. Khandpur	Handbook of Bio-Medical	Tata McGraw	2014
		Instrumentation	Hill.	
4	Carr and Brown	Introduction to Biomedical	Pearson	2001
		Equipment Technology	Education,	
5	J. Webster	Bioinstrumentation	Wiley and Sons	2000

10 Hours

10 Hours

7 Hours

11 Hours

7 Hours

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

- 1. Outline the nature and scope of environmental studies
- 2. Illustrate the various types of natural resources and its importance.
- 3. Classification of various types of ecosystem with its structure and function.
- 4. Develop an understanding of various types of pollution and biodiversity.
- 5. List out the various types of social issues related with environment.

СО	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.	К2
CO4	Develop an understanding of various types of pollution and biodiversity.	К3
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.
- f) Land resources: Land as a resources, 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
 - c. Soil Pollution

- d. Noise pollution
- e. Nuclear hazards
- Solid waste Management: Causes, effects and control measures of urban and industrial wastes.
- 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
- 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
- 23. Magazine (R) Reference (TB) Textbook http://nbaindia.org/uploaded/Biodiversityindia/Legal/33%20Biological%20 Diversity%20 Rules,%202004.pdf.

CORE COURSE – III

rDNA TECHNOLOGY

Semester – III		Hours/Week - 6	
Core Course – III	rDNA TECHNOLOGY	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
C01	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.	К3
CO5	Outline the applications of Genetic engineering in basic and applied biology, proficiency in designing and conducting experiments involving genetic manipulation for societal applications.	К3

Mapping with Programme Outcomes

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

S-Strong, M-Medium, L-Low

CORE COURSE – III rDNA TECHNOLOGY

Unit I

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

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

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

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

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.

18 Hours

16 Hours

18 Hours

18 Hours

20 Hours

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. 5 th 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.7 th Edition	Wiley Blackwell	2016
5	Dr. Arun Dev Sharma	rDNA Technology.2 nd Edition	Himalaya Publishing House	2014

Reference Books

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

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		Hours/	Week - 3
Core practical – III	LAB IN rDNA TECHNOLOGY	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.	К3
CO5	Identify the recombinant DNA products.	К3

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4
CO1	S	S	S	S
CO2	М	М	S	S
CO3	S	S	S	S
CO4	S	S	М	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 CaCl₂^{*}.
- 11. Southern blotting^{*}.
 - * Practical by demonstration only

Reference Books

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

Pedagogy

Power point presentation, Group Discussion, Seminar, Assignment.

Web Links

- 1. http://www.biology.arizona.edu/molecular_bio/problem_sets/Recombinant_DN A_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_DN A_Technology/recombinant_dna.html
SECOND ALLIED COURSE – I

BIOCHEMISTRY

Semester – III		Hours/V	Hours/Week – 4	
Second Allied Course – I	BIOCHEMISTRY	Credits – 4		
Course Code – 19UBT3AC3		Internal	External	
		25	75	

Objectives

- > To make the students understand the basics of biomolecules.
- > To study structural and functional properties of carbohydrates, proteins, lipids and nucleic acids.
- > To make the students learn the disorders of metabolic pathways

Course Outcome

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

CO No.	CO Statement	Knowledge Level
CO1	Study the structures and functions of biomolecules	K1
CO2	Outline the metabolism of macromolecules- proteins and nucleic	K1
	acids	
CO3	Understand the regulations and disorders of metabolic pathways	K2
CO4	Impart knowledge in principles and applications of Biochemistry	К3
CO5	Obtain knowledge in Pharmaceutical, Microbial and Industrial	K3
	Biochemistry.	

Mapping with Programme Outcomes

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

S-Strong, M-Medium, L-Low

SECOND ALLIED COURSE – I BIOCHEMISTRY

Unit I - Carbohydrates

Definition, Classification and properties of carbohydrates - Monosaccharides, Disaccharides, Oligosaccharides and polysaccharides – Structure and function. Glycolysis or Embden–Meyerhof–Parnas or Entner–Doudoroff pathway and TCA cycle.

Unit II - Lipids

Definition, Properties and Classification of lipids - Simple lipids, Compound lipids and Derived lipids. Structure and function of phospholipids, glycolipids and lipoproteins. Biosynthesis of fatty acids.

Unit III- Proteins

Introduction, Structure, Properties and classification of Amino acids (Essential and nonessential amino acids) and Proteins – Peptides, Polypeptides: Primary, secondary and tertiary structure and functions.

Unit IV- Vitamins and Minerals

Vitamins: Definition, Classification. Fat soluble vitamins- sources, structure and physiological functions; Water soluble vitamins-sources, structure and physiological functions. Vitamin deficiency diseases. Minerals: Macro minerals and micro minerals - sources and functions.

Unit V- Enzymes

Definition, Properties, Nomenclature, Classification of enzymes, Enzyme Kinetics – Michaelis & Menton Equation. Factors influencing enzyme activity. Enzyme Inhibition – Competitive, Non-Competitive, Uncompetitive, Feedback and Allosteric Inhibition.

Text Books

S.	Authors Name	Title of the Book	Publishers Name	Year of
No.				Publication
1	Robert K. Murray, David	Illustrated Biochemistry-29th	Mc Graw Hill	2012
	Bender, Kathleen	Edition		
	M. Botham and Peter J.			
	Kennelly, Harpers			

12 Hours

12 Hours

12 Hours

12 Hours

2	Lehninger, Nelson and	Principles of Biochemistry-6 th	W.H.	2013
	Cox	edition	Freeman and	
			Company	
3	U. Sathyanarayana and U	Biochemistry-5 th edition	Generic	2019
	Chakrapani			
4	Dr. J. L Jain, Dr Sunjay	Fundamentals of Biochemistry	Chand	2016
	Jain and Nitin Jain		Publication	
5	Dr. Mrs Padmaja H.	Biochemistry	Nirali Prakashan	2019
	Agarkar, Dr Yogesh			
	kulkarni and Dr			
	Rammohan Rao			

Reference Books

S.No.	Authors Name	Title of the Book	Publishers Name	Year of
				Publication
1	Voet & Voet	Fundamentals of Biochemistry	John Willey &	2010
			Sons	
2	R. Appling Dean, J.	Biochemistry: Concepts and	Pearson Education	2017
	Anthony-Cahill	Connections		
	Spencer, K. Mathews			
	Christopher			
3	Dean R Appling,	Biochemistry Concepts and	Pearson Education	2017
	Spencer J Anthony-	Connections		
	Cohill and Christopher K			
	Mathews			
4	Jeremy M. Berg, Lubert	Biochemistry	Freeman and	2019
	Stryer, John Tymoczko,		Company	
	Gregory Gatto			
5	Naik Pankaja	Essentials Of Biochemistry	Jaypee Brothers	2017
			Medical	
			Publishers(P)	
			Ltd	

Pedagogy

Power point presentation, Group Discussion, Seminar, Assignment.

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

SECOND ALLIED COURSE –II LAB IN BIOCHEMISTRY

Semester – III		Hours/V	Veek – 3
Second Allied Course – II		Credits – 2	
Course Code – 19UBT3AC2P	LAB IN BIOCHEMISTRY	Internal	External
		40	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 analyse the enzyme kinetics

Course Outcome

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

СО	CO Statement	Knowledge Level
Number		
CO 1	Outline the process of separation of plant pigments by chromatographic techniques	K1
CO 2	Apply the various methods for the estimation of proteins, lipids and carbohydrates	К3
CO 3	Analysis of Blood glucose level	K3
CO 4	Analysis of Enzyme Kinetics for various enzymes	К3

Mapping with Programme Outcomes

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

S- Strong, M-Medium, L-Low

SECOND ALLIED COURSE -- II

LAB IN BIOCHEMISTRY

- 1. Units and Measurements.
- 2. Estimation of Monosaccharides Glucose
- 3. Estimation of Disaccharides Sucrose
- 4. Estimation of Polysaccharides Starch.
- 5. Analysis of Blood glucose level.
- 6. Estimation of Proteins Bradford and Lowry method.
- 7. Estimation of lipids.
- 8. Analysis of amino acids.
- 9. Separation of plant pigments using Chromatography techniques TLC, Paper Chromatography.
- 10. Separation of Blood, Plasma and Serum.
- 11. Measurement of Enzyme activity- Catalase.
- 12. Enzyme Kinetics of Amylase.

Reference books

S. No.	Author's Name	Title of the Book	Publishers Name	Year of
				Publication
1.	ArunRastogi, Mathur,	An Introduction to Practical	Anmol publications,	2010
	N.B.L.	Biochemistry	India	
2.	Rajan,S.Anjanaa	Experimental Procedures in	Book House	2010
		Life Sciences		
3.	Jayaraman	Laboratory manual in	New Age International	2011
		Biochemistry	private	
			limited.	
4.	Sadasivam.S. and	Introduction to Practical	New Age International	2009
	Manickam A.	Biochemistry.	Private	
		2 nd Edition	Ltd Publishers.	
5.	Plummer, D.T.	An Introduction to Practical	Tata McGraw Hill Co., 2006	
		Biochemistry -3^{rd} Edition.	New Delhi	
6.	Joshi, R.A. and	A textbook of Practical	Jain Publishers private	2002
	Saraswat, M.	Biochemistry	limited,	
			India.	

NON MAJOR ELECTIVE – I BASICS OF BIOTECHNOLOGY

Semester – III		Hours/V	Veek – 2
Non Major Elective – I	BASICS OF	Credi	ts – 2
Course Code – 19UBT3NME1	BIOTECHNOLOGY	Internal	External
		25	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	CO Statement	Knowledge level
Number		
CO1	Understand the basic concepts and significant findings in the field of biotechnology.	K1
CO2	Understand the structure and function of cells and organelles	К2
CO3	Learn the basic structure of DNA, RNA and understand the flow of genetic information	K2
CO4	Apply the existing techniques in waste management	К3
CO5	Explore more advanced application based aspects in biotechnology	К3

Mapping with Programme Outcomes

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

S – Strong, M – Medium, L - Low

NON MAJOR ELECTIVE – I BASICS OF BIOTECHNOLOGY

Unit I

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

Unit II

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

Unit III

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

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

Unit V

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

Text books

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

6 Hours

7 Hours

4 Hours

7 Hours

Reference books

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

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		Hours/W	Veek – 5	
Core Course – IV	IMMUNOLOGY C		redits – 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	К3
CO 5	Obtain Knowledge in transplantation and tumor immunology.	К3

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4
CO1	S	S	S	S
CO2	М	М	S	S
CO3	S	S	S	S
CO4	S	S	М	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 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

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

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

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

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

12 Hours

12 Hours

12 Hours

12 Hours

Text Books

S.No	Author	Title	Publisher	Year of Publication
1	Lauren M.Sompayrac	How the Immune system works. 6 th 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. 9 th Edition	Elsevier	2017
4	Warren Levinson	Review of Medical Microbiology and Immunology	Mc Graw Hill Education	2016
5	Paul	Fundamental Immunology. 7 th Edition	Lippincott Williams and Wilkins	2012
6	Louis Hawley Richard J Ziegler Benjamin L Clarke	BRS Immnology and Microbiology (6 th 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. 6 th Edition	Elseiver	2019
2	Jenni Punt, Sharon Stranford, Patrica Jones, Judith Owen	Kuby Immunology. 8 th Edition	ML IE PRNT	2018
3	Peter , J.Delves,Seamus J.Martin, Dennis R.Burton, Ivan M.Roitt	Roitt's Essential Immunology. 1 st Edition	Wiley Blackwell	2017
4	Kenneth Murphy, Casey Weaver	Janeway's Immunobiology. 9 th Edition	Garland Science	2016
5	Kathy M.Durkin	Understanding the Vaccines and the Immune system.1 st 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		Hours / We	eek – 03
Core Practical – IV	LAB IN IMMUNOLOGY	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	М	S	S
CO2	S	S	М	L
CO3	М	S	М	S
CO4	S	М	L	М

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.	Authors Name	Title of the Book	Publishers Name	Year of
INO.	<u> </u>		LADIALOFDE	Publication
1	Senthilkumar	Practical Immunology A	LAP LAMBERT	2017
	Balakrishnan, Karthik	Laboratory Manual	Academic	
	Kaliaperumal,		Publishing,	
	Senbagam Duraisamy		Germany	
2	Wilmore C.Webley	Immunology Laboratory	LAD Custom	2017
		Manual	Publishing,	
			Georgia.	
3	Barbara Detrick, John	Manual of Moleclar and	ASM Press,	2016
	L Schmitz, Robert G	Clinical Laboratory	Washington, DC.	
	Hamilton	Immunology – 8 th		
		Edition		
4	Christine Dorresteyn	Clinical Immunology	F.A.Davis	2016
	Stevens	and Serology: A	Company,	
		Laboratory Perspective	Philadelphia	
5	G.P.Talwar and	A Handbook of Practical	CBS,	2012
	S.K.Gupta	and Clinical	Publications,	
		Immunology	Delhi, India	

SECOND ALLIED COURSE- III

PLANT ANATOMY AND PHYSIOLOGY

Semester – IV		Hours/Week – 3		
Second Allied Course- III	PLANT ANATOMY AND PHYSIOLOGY	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	К3
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	М	S	L	М
CO2	М	S	S	S
CO3	S	S	S	S
CO4	L	L	М	М
CO5	М	S	М	М

S- Strong, M-Medium, L-Low

SECOND ALLIED COURSE- III PLANT ANATOMY AND PHYSIOLOGY

Unit I - Plant anatomy

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

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 Stressunwanted weeds, insects, bacteria, fungus, virus and abiotic Stress-Drought, high salinity, cold and heat.

Unit III - Plant Growth Development

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

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

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

9 Hours

9 Hours

9 Hours

9 Hours

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

	Bob B.Buchanan,	Biochemistry &		
6	Wilhelm Gruissem,	molecular Biology of	John Wiley & Sons, Ltd	2015
	and Russell L.Jones	plants		

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

СО	CO Statement	Knowledge level
Number		
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	М	L	М	М
CO2	М	М	L	М
CO3	S	М	S	М
CO4	М	L	L	М
CO5	L	М	L	М

S – Strong, M – Medium, L - Low

NON MAJOR ELECTIVE – II APPLIED BIOTECHNOLOGY

Unit I

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

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

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

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

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

6 Hours

6 Hours

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6 Hours

6 Hours

Text books

S. No	Name of the Author(s)	Title of the book	Publishers name	Year of publication
				pushcution
	Varsha Gupta, Manjistha	Basic and Applied aspects of		
1	Sengupta, Jaya Prakash and	Biotechnology	Springer	2017
	Baishnab Charan Tripathy			
	Malik Zainul Abdin, Usha	Plant Biotechnology: Principles		
2	Kiran, Kamaluddin and Athar	and Applications	Springer	2017
	Ali			
3	Firdos Alam Khan	Biotechnology Fundamentals	CRC Press	2016
4	Ashish S. Verma, Anchal and	Animal Biotechnology – Models	Elsevier	2014
	Singh	in Discovery and Translation		
		Introduction to Environmental		
5	A. K. Chakravarthy	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		Hours/Week – 2		
Skill based Elective-I (A)	INFORMATION IN		Credits – 2	
Course Code -	OMICS AND	Internal	External	
19UBT4SBE1A	APPLICATIONS	25	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	CO Statement	Knowledge level
Number		
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	М	М	S	М
CO2	L	М	М	М
CO3	S	М	S	М
CO4	S	S	S	М
CO5	S	S	М	М

S - Strong, M - Medium, L - Low

SKILL BASED ELECTIVE-I (A) **INFORMATION IN OMICS AND APPLICATIONS**

Unit I

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

Unit II

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

Unit III

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

Unit IV

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

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.	Name of the Author(s)	Title of the book	Publishers name	Year of
No				publication
1	Debmalya Barh Vasco	Omics Technologies	Academic press	2017
	Azevedo	and Bio-engineering		
2	Wittmann,c. and	Systems metabolic	Springer science and	
	Lee,S.Y.eds	engineering	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

6 Hours

6 Hours

6 Hours

6 Hours

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

СО	CO Statement	Knowledge level
Number		
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 softwares 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	К3

Mapping with Programme Outcomes

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

 $[\]mathbf{S}-\mathbf{Strong},\,\mathbf{M}-\mathbf{Medium},\,\mathbf{L}$ - Low

SKILL BASED ELECTIVE - I (B) BIOINFORMATICS

Unit I

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

Unit II

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

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

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

Unit V

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

Self Study Topics

Text books

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

6 Hours

6 Hours

6 Hours

6 Hours

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

Reference books

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

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

CORE COURSE – V

PLANT BIOTECHNOLOGY

Semester – V		Hours	/Week – 5
Core Course – V	PLANT BIOTECHNOLOCY	Credits – 5	
Course Code – 19UBT5CC5	BIOILCHNOLOGI	Internal	External
		25	75

Objectives

- > To know the basic principles and techniques involved in plant tissue culture.
- \succ To study the importance of plant models.
- To acquire knowledge absout the concepts of transformation in Plant Biotechnology.
- > To understand the achievements of biotechnology in plant system.

Course Outcomes

СО	CO Statement	Knowledge
Number		Level
CO 1	Demonstrate the plant tissue culture, types and production of triploids.	K1
CO 2	Describe the plant nuclear, mitochondrial and chloroplast genome organization and genomic interactions.	K2
CO 3	Illustrate about the Genetic engineering of plants.	K2
CO 4	Outline the clear and concise idea about Plant products.	K3
CO 5	Obtain Knowledge in role of RFLP in plant breeding.	K3

Mapping with Programme Outcomes

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

S- Strong, M- Medium, L-Low

CORE COURSE – V PLANT BIOTECHNOLOGY

Unit I - Plant Tissue Culture

Establishment of plant tissue culture: Culture media (types of media), Explant: selection and preparation, Types of culture (Callus, Suspension, Meristem, #Embryo, #Anther and Root). Regeneration of plants (Organogenesis and somatic embryogenesis), Somaclonal variations and applications. Production of triploids (Endosperm culture).

Unit II - Plant Genome Organization

Genome Organization (*Arabiodopsis thaliana*): Nuclear Genome, Choloroplast and its Genome, Mitochondrion and its Genome, Cytoplasmic Male Sterility (CMS), Thermo sensitive genic Male sterility (TGMS), Genomic Interaction – Protoplast isolation, culture and fusion.

Unit III - Transgenic Plants

Genetic engineering and crop improvement – Transgenic plants: Biotic stress resistance (Insect, Virus, Bacteria). Abiotic stress resistance (Herbicide, Drought). Crop Improvement (Flavr savr tamato, Golden Rice). Advantages and disadvantages of transgenic crops – Biosafety concerns and regulations of transgenic plants, Production of Organic food.

Unit IV - Biofertilizers and Molecular Pharming

Crop production: Production of biofertilizers (Azolla): Criteria for strain selection, steps for preparing biofertilizers (Seed pelleting, inoculant carriers, quality standards for inoculants), Green manuring.

Transgenic plants as Bioreactors: Medical Pharming – Therapeutic proteins (Serum albumin, Hirudin, Collagen and Somatotrophin), Plantibodies, Edible Vaccines (Potato, Banana, Tomato, Lettuce and Alfalfa). Non medical Pharming – Industrial Enzymes (Cellulase and α -amylase), Bioplastics.

Unit V - Role of Molecular techniques in Plant Breeding12 Hours

Markers based on DNA Hybridization (RFLP) –Markers based on PCR amplification (RAPD, AFLP, STS, SNPs and Microsatllites). Genomic enabled breeding methods– Linkage analysis and Quantitative Trait Loci. Biosafety and bioethics in plant breeding.

Self Study

16 Hours

14 Hours

15 Hours

18 Hours

10.11

Text Books

S. No	Author	Title	Publisher	Year of Publication
1	KaporRenu, RanabhattHiru	Plant Biotechnology	Woodhead Publishing, India	2018
2	Neal Stewart Jr	Plant Biotechnology and Genetics : Principles, techniques and applications	John Wiley & Sons, Inc	2016
3	Shaileash Kumar, Sweta Mishra, Mishra A.P.	Plant Tissue Culture: Theory and Techniques	Scientific Publisher	2016
4	PalmiroPaltronieri, Yiguo Hong	Applied Plant Genomics and Biotechnology	Woodhead Publishing, India	2015
5	Muhammad SK, Iqrar AK, DebmalyaBarh	Applied Molecular Biotechnology. The Next Generation of Genetic Engineering.	CRC Press	2016

Reference Books

S. No	Author	Title	Publisher	Year of Publication
1	BishunDeo Prasad, SangitaSahini, Prashant Kumar, Mohammed WasinSiddih	Plant Biotechnology Vol I: Principles, Techniques and Applications	Apple Academic Press	2018
2	Abdin MZ,Kiran U, KamaluddinM, Ali A	Plant Biotechnolgy: Principles and Applications	Springer, Singapore	2017
3	Bahadur B, Rajam B, Sahijram MV, Krishnamoorthy KV	Plant Biology and Biotechnology	Springer, India	2015
4	Bob.B.Buchnan, Wilhelm and Cruissem and RusselL.Jones	Biochemistry and Molecular Biology of Plants	John Wiley and Sons, Ltd	2015
5	Hae Jong Koh and Michael Thomson	Current technologies in Plant Molecular Breeding	Springer	2016

Pedagogy

- Lecture (Chalk and Talk OHP- LCD) \triangleright
- Quiz, Seminar, Assignment, Group Discussion, Videos and Animations.

Web links

- https://www.z-lib.org
- https://www.pdfdrive.org
 https://nptel.ac.in/courses/102/103/102103016/#watch
 https://www..dcu.ie
- https://www.edx.org
- https://unacademy.com
 https://www.sciencedirect.com
- https://khanacademy.org

CORE COURSE - VI

ANIMAL BIOTECHNOLOGY

Semester – V		Hours/Week - 5		
Core Course – VI	ANIMAL BIOTECHNOLOGY	Credit	s - 5	
Course Code - 19UBT5CC6		Internal 25	External 75	

Objectives

- To understand the basic requirements and techniques about Animal Cell Culture.
- > To provide the knowledge about the manipulation of Embryo.
- To provide basic concepts about Cloning.
- To provide an overview and current developments in different areas of animal biotechnology.

Course outcome

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

CO No	CO statement	Knowledge level
CO1	Explain the fundamental scientific principles that underlie cell culture and its importance.	K1
CO2	Acquire knowledge for isolation, maintain and growth of cells.	K2
CO3	Develop techniques for the production of Growth Hormones, monoclonal antibodies etc.	K3
CO4	Explain proficiency in establishing and maintaining of cell lines.	K3
CO5	Analyze principles and applications of animal cloning and gene therapy along with ethical concerns.	K1

Mapping with Programme Outcomes

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

S-Strong, M-Medium, L-Low

CORE COURSE - VI ANIMAL BIOTECHNOLOGY

Unit I - Animal Cell Culture

Animal cell culture - Introduction and History. Lab Facilities – Infrastructure- Equipment – Culture Vessels. Media Composition – Types – Natural – Synthetic – Semisynthetic – Freezing Media. Reagents – Antibiotics – Trypsin – Indicators.

Unit II - Types of Animal Cell Culture

Types of Cultures – Primary – Secondary – Established Cultures. Culture – Finite – Continuous Culture - Histotypic – Organotypic. Biology of Cultured Cells – Cell Synchronization – Cell Viability – Cytotoxicity – Cryopreservation.

Unit III - Gene transfer and Reproductive Cloning

Gene transfer methods in Animals –Physical - Chemical - Biological methods. Biological vectors – Bacteria - Virus. Hybridoma technology. Gametogenesis. Stages of embryonic development – Morula, Blastulation, Gastrulation and Organogenesis. Cryopreservation - Sperm - Ova - Embryo of livestock. Artificial Insemination - Super ovulation - In vitro Fertilization- Culture of Embryos - Embryo transfer- Embryo Splitting- Embryo Sexing.

Unit IV- Trangenesis

Animal Cloning - Basic Concepts. Cloning from Embryonic Cells - Adult cells. Cloning of different Animals - Transgenic Animals - Mice - Sheep - Fish. Products from Transgenic Animals - Insulin - Growth Hormones - Blood Clotting Factors. Merits - demerits.

Unit V- Gene Therapy

Gene Therapy - Types of Gene Therapy- Somatic – Germline Gene Therapy. Approaches – Ex vivo – In vivo Gene Therapy. Gene knock out technology. [#]Global Ethical Challenges in Animal Biotechnology.

Self Study #

15 Hours

15 Hours

15 Hours

13 Hours– Finite –

Text Books

S. No.	Author	Title	Publisher	Year of Publication
1	Ashish Verma and Anchal Singh	Animal Biotechnology – Models in Discovery and Translation 2 nd Edition	Elsevier, India	2020
2	Birbal Singh Gorakh Mal Sanjeev K. Gautam Manishi Mukesh	Advances in Animal Biotechnology	Springer, Switzerland	2019
3	Daniel Scherman	Advanced Textbook On Gene Transfer, Gene Therapy And Genetic Pharmacology, 2nd Edition	World Scientific Europe Ltd	2019
4	Niemann H and Christine Wrenzycki	Animal Biotechnology 1 – Reproductive Biotechnologies	Springer International Publishing AG, Switzerland	2018
5	Inderbir Singh's	Human Embryology – 11 th Revised Edition	Jaybee Brothers Medical Publishers, India	2017
6	B. Singh and S.K. Gautam	Textbook of Animal Biotechnology	The Energy and Resources Institute, TERI	2013

Reference Books

S. No.	Author	Title	Publisher	Year of Publication
1	U. satyanarayana, U. chakrapani	Biotechnology12th Edition	Books, India	2019
2	Uma Lakshmipathy&Bha skarThyagarajan	Primary And Stem Cells: Gene Transfer Technologies And Applications	Wiley,New Jersey.	2011
3	Glick, B.R. and Pasternak, J.J.	Molecular biotechnology- Principles and applications of recombinant DNA	ASM press, Washington, USA	2009
4	Myers, R.M., Caudy, A. and Witkowski, J.K.	DNAgenes and genomes- A short course	N.Y., USA	2007
Pedagogy

e-content, Lecture, Power Point Presentation, Seminar, Assignment, Quiz, Group Discussion, Video/Animation.

Web links

- www.whatisbiotechnology.org
- https:// youtu.be/ON2e1VsBhJk
- https:// youtu.be/UV7T9JsxdXA
- https:// youtu.be/UMdC6m_BxfM

CORE COURSE – VII

BIOSTATISTICS

Semester – V	BIOSTATISTICS	Hours/Week – 5	
Core Course – VII		Credits – 5	
Course Code –19UBT5CC7		Internal 25	External 75

Objectives

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- To study the basic concepts of statistics and sampling design
- To equip analytical thinking to solve biological problems

Course Outcome

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

CO	CO Statement	Knowledge
Number		Level
C01	Explain the basic concepts of biostatistics, functions and limitations	К3
CO2	Classify the data and sampling deign	К3
CO3	Compute the measures of central tendency and measures of Dispersion	К3
CO4	Apply the concepts of skewness, moments, kurtosis, correlation and regression to solve the problems.	K4
CO5	Examine the various testing of hypothesis and also analysis of variance based on one-way classification and two-way classification	K4

Mapping with Programme Outcomes

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

S-Strong, M-Medium, L-Low

CORE COURSE – VII

BIOSTATISTICS

Unit I

Introduction to biostatistics - definition, statistical methods, biological measurement, kind of biological data, functions of statistics and limitation of statistics - Collection of data, sampling and sampling design.

Unit II

Tabulation and Frequency distribution, types of representations graphic-bar diagrams, pie diagrams and curves

Unit III

Measures of central tendency- Mean, Median, Mode, Geometric mean, Harmonic mean -Measures of dispersion and variability changes- Mean deviation, standard deviation, coefficient of variation

Unit IV

Analysis Skewness, Moments and Kurtosis - Meaning - test of skewness, characteristics of dispersion and skewness. Measures of skewness, objectives - Karl Pearson's coefficient of skewness, Bowley's Coefficient of skewness- Correlation and regression

Unit V

Testing of hypothesis for small samples-Students' T -Test- Chi square test- F-test or Fisher's F test – Analysis of Variance: Introduction – The Technique of Analysis of Variance- One-way Classification – Two-way Classification.

Text Books

S. No.	Authors Name	Title of the Book	Publishers Name	Year of Publication
	P.N. Arora and		Himalaya Publishing house	2008
1	P.K. Malhan	Biostatistics		
2	Suranjan Saha	Mathematics and Statistics	New Central Book Agency (P) LTD	2009

15 Hours

15 Hours

15 Hours

15 Hours

15 Hours

Reference Books

S. No.	Authors Name	Title of the Book	Publishers Name	Year of Publication
1	R.S.N. Pillai and V.Bagavathi	Statistics Theory and Practice	S.Chand	2016
2	Bernard Rosner	Fundamentals of Biostatistics	Lengage learning	2006
3	Stephen Bernstein & Ruth Bernstein	Elements of Statistics	Tata McGraw – Hill Edition 2005	2005
4	Veer Bala Rastogi	Fundamentals of Biostatistics	Ane Books India	2006
5	Samuel Delvin	Biostatistics	Sarup and Sons	2007
6	John E. Freund	Mathematical Statistics	Pearson Education Asia	2002

Pedagogy

Power Point Presentation, Group Discussion, Seminar, Assignment

Web Links

- https://www.youtube.com/watch?v=_e4mwlqCQrc
- https://www.youtube.com/watch?v=AdH5vfobH5E
- https://www.youtube.com/watch?v=fNLeogEjMmM
- https://www.youtube.com/watch?v=0zZYBALbZgg

CORE PRACTICAL - V

LAB IN PLANT AND ANIMAL BIOTECHNOLOGY

Semester – V		Hours/	Week – 4
Core Practical V	LAB IN PLANT AND ANIMAL	Credits	- 4
Course Code - 19UBT5CC5P	BIOTECHNOLOGY	Internal	External
		40	60

Objectives

- > To get trained in maintaining aseptic conditions in animal cell culture.
- > To acquire hands-on training in formulation of specific media.
- > To obtain skills pertaining to isolation procedures from plant and animal sources.
- > To understand and learn the establishment of animal cell culture experiments.

Course Outcomes

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

СО	CO Statement	Knowledge
Number		Level
CO1	Establish and maintain aseptic conditions in tissue culture lab	K1
CO2	Demonstrate the method of DNA isolation from various sources	K2
	and identification in agarose gel electrophoresis.	
CO3	Select & formulate media based on requirement of animal cell	K3
	culture.	
CO4	Enumerate the cells using haemocytometer	K3
CO5	Utilize the skills and basic techniques in culturing cells using	K3
	primary and secondary methods	

Mapping with Programme Outcomes

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

S-Strong, M-Medium, L-Low

CORE PRACTICAL – V LAB IN PLANT AND ANIMAL BIOTECHNOLOGY

- 1. Introduction to safety and aseptic maintenance of tissue culture laboratory.
- 2. Isolation of Plant genomic DNA.
- 3. Isolation of *Rhizobium* species from root nodules of legumes.
- 4. Isolation of protoplast from spinach leaves by mechanical and enzymatic methods.
- 5. Protoplast fusion by using polyethylene glycol.
- 6. Isolation of VAM fungi from *Canna indica*.
- 7. Isolation of genomic DNA from animal liver tissue.
- 8. Quantification of DNA by Spectrophotometric method.
- 9. Identification of stages during chick embryo development.
- 10. Assessment of cell viability by cell counting in Haemocytometer.
- 11. Preparation of animal tissue culture media.
- 12. Establishment of Primary cell culture *
- 13. Establishment of Secondary cell culture *
- 14. Cryopreservation and thawing of cells*
- 15. Visit to Animal Cell Culture Lab.

* Practical by demonstration only

Reference books:

S. No.	Author	Title	Publisher	Year of Publication
1	R. Ian Freshney and Amanda Capes-Davis	Freshney's Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications	Wiley - Blackwell	2021
2	Cornelia Kasper, Verena Charwat and Antonina Lavrentieva	Cell Culture Technology	Springer	2018
3	Supriya Dash and Swagat Kumar Das H N Thatoi	Practical Biotechnology: Principles and Protocols	I K International Publishing House	2017
4	Ralf Pörtner	Animal Cell Biotechnology: Methods and Protocols (3 rd Edition)	Humana Press	2016
5	R. Ian Freshney	Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, 7 th Edition	Wiley - Blackwell	2016

MAJOR BASED ELECTIVE - I (A)

PHARMACOGNOSY

Semester – V		Hours/V	Veek – 5
Major Based Elective – I (A)	PHARMACOGNOSY	Credits – 5	
Course Code – 19UBT5MBE1A		Internal 25	External 75

Objectives

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

Course Outcomes

СО	CO Statement	Knowledge
Number		Level
CO 1	Understand the importance of drugs in the treatment of Diseases	K1
CO 2	Demonstrate the. Physical, Chemical and sensory characters of crude drugs of plant and mineral origin	К2
CO 3	Outline the scope and importance of Ethnomedicine,	K2
CO 4	Design the Drug Preparation Methods from medicinal plants	K3
CO 5	Analyse the effects of drugs in allopathy with traditional systems of medicine	K3

Mapping with Programme Outcomes

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

S- Strong, M- Medium, L-Low

MAJOR BASED ELECTIVE – I (A) PHARMACOGNOSY

Unit I- Introduction to Pharmacognosy

Definition, #History and Scope of Pharmacogonosy including indigenous system of medicine - Ayurveda, Siddha, Unani, Yoga, Homeopathy and Naturopathy. Various systems of classification of drugs and natural origin. Adulteration -Types of Adulteration: Intentional and Accidental adulteration. Drug evaluation - Organoleptic evaluation, Anatomical evaluation, Physical evaluation. Chemical evaluation, Biological evaluation, and organoleptic evaluation: significance of pharmacopoeial standards.

Unit II- Classification and Sources of Drugs

Classification of Crude drugs - Unofficial and non-official drugs. Based on Morphology, Taxonomy, Therapeutic application and Chemical Constituents. Alphabetical Classification of Crude drugs, biological Classification of Crude drugs, chemical Classification of Crude drugs, pharmacological Classification of Crude drugs-, taxonomical Classification of Crude drugs, chemo taxonomical Classification of Crude drugs and Serotaxonomical Classification of Crude drugs.

Unit III- Production of Natural drugs

Brief outline of occurrence, distribution, outline of isolation, identification tests, therapeutic effects of alkaloids, terpenoids, glycosides, volatile oils and tannins. Steps involved in Crude drug production- Cultivation, collection, Drying, Extraction, Isolation, Bioassaying, Quality control and preparation of crude drugs of natural origin.

Unit IV- Modern pharmacognosy

The development of modern pharmacognosy in organic chemistry - structure prediction using analytic chemistry techniques, including paper, HPTLC and Gas chromatography Mass spectrophotometry for pharmacologically bio-synthesised substances from the plants -Strychnine, Quinine, caffeine, Nicotine and Vinca alkaloids-vincristine and vinblastine

Unit V- Application of Pharmacognosy

Pharmaceutical applications of secondary metabolites like Alkaloids: Vinca, Rauwolfia.. Flavonoids: Lignans, Tea. Triterpenoids: Dioscorea. Volatile oils: Mentha, Clove, Cinnamon, Coriander. Tannins: Catechu, Pterocarpus.Resins: Ginger, Asafoetida, Glycosides: Senna, Aloes, Bitter Almond.

Self Study Topic

15 hours

15 hours

15 hours

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15 hours

15 hours

Text Books

S.	Author	Title	Publisher	Year of
No.				Publication
1	Shagufta Perveen	Pharmacognosy Medicinal	eBook (PDF)	2019
		plants	ISBN:978-1-83880-	
			874-7	
2	Mohammed Ali	Text Book of	CBS Publishers&	2019
		Pharmaceutical Chemistry-I	Distributors	
3	P Suresh Narayana	Text Book of	CBS Publishers and	2016
	D.Varalakshmi	Pharmacognosy	Distributors	
	T.Pullaiah			
4	Pathania JS	Text Book of Pharmacology	CBS Publishers and	2020
		for Paramedical students	Distributors	
5	Dr.Kuntal Das	Pharmacognosy and	Nirali Publishers	2019
		Phytochemistry -II		
6	Veronika Butterweck	Planta Medica	Thieme.de	2020
	and Robert furst	Journal of Medicinal Plant		
		and Natural Product		
		Research		
7		THE AYURVEDIC	Hand cover	2011
	Government of India	FORMULARY OF INDIA		
		(PART - 1,2 AND 3)		

Reference Books

S.	Author	Title	Publisher	Year of
No.				Publication
1	J. S. Qadry	Pharmacognosy	CBS Publishers	2018
			and Distributors	
2	Simone Badal	Pharmacognosy: Fundamentals,		
	McCreath and	Applications and Strategies	Academic Press	2016
	Rupika Delgoda			
	M. A. Iyengar and	Pharmacognosy Lab Manual	Pharma Med	
3	S.G.K. Nayak		press	2018
4	M.S. Krishnamurthy	Easy Ayurveda Home	Hand Cover	2018
	and JV Hebbar	Remedies: Based On Authentic,		
		Traditional Ayurveda Practice		
		Paperback – 1 January		
5	Dr.Kuntal Das	Pharmacognosy and	Nirali Publishers	2019
		Phytochemistry –II		

Pedagogy

e-content, Lecture, Powerpoint presentation, Seminar, Assignment, Quiz, Group Discussion, Video/Animation

Web links

- https://www.youtube.com/watch?v=MSabeRbl7fA
- https://www.youtube.com/watch?v=3_wo0H92sOU
- https://www.hrpatelpharmacy.co.in/pharmacognosy
- http://www.pharmacognosy.us/wp-content/uploads/ASPNL_53-1IX2017.pdf

MAJOR BASED ELECTIVE – I (B)

CANCER BIOLOGY

Semester – V		Hours/Week – 5	
Major Based Elective – I (B)	CANCER BIOLOCY Credits – 5		redits – 5
Course Code – 19UBT5MBE1B	CANCER BIOLOGI	Internal 25	External 75

Objectives

- To identify criteria for various staging of cancer.
- To learn the risks of cancer treatment (experimental and non-experimental)
- To prevent the occurrence of cancer and to get awareness about prevalence of cancer
- To Analyze how the stage of cancer impact goals of treatment, prognosis and progression.

Course Outcomes

CO	CO Statement	Knowledge
Number		Level
CO 1	Demonstrate the types of carcinomas.	K1
CO 2	Infer recent incidents and mortality of Global Cancer	K2
CO 3	Outline the clear and concise idea about Lifestyle& Dietary factors causing cancer.	K2
CO 4	Apply concepts of prevention of cancer, cancer-related deaths and cancer-related disabilities	К3
CO 5	Analyse the molecular mechanisms of cancer establishment and its progression by the process of metastasis and Angiogenesis	К3

Mapping with Programme Outcomes

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

S- Strong, M- Medium, L-Low

MAJOR BASED ELECTIVE – I (B) CANCER BIOLOGY

Unit I- Introduction to Cancer

Historical and Basic Aspects of Cancer. Hallmarks of cancer. Biological properties of normal and cancer cells. Cancer - Benign and Malignant neoplasms. Types of cancer - Carcinoma, Sarcoma, Leukemia, Lymphoma and myeloma Global Cancer incidents and mortality#. Epidemiology studies.

Unit II- Causative Agents of Cancer

Biology - Genetic Factor, Viruses, Hormones. Lifestyle and Dietary factors - Tobacco, Alcohol and Ciggerette. Environmental and occupational Exposure - Chemical carcinogens and Mutagens.

Unit III- Biology of Cancer Cells

Cell Cycle Regulation in Cancer Cell. Cyclin Dependent Protein Kinase, CDK inhibitors. Apoptosis. Molecular Mechanism-Intrinsic and Extrinsic pathway. Oncogene and Tumor suppressor gene-p53.Metastasis and Angiogenesis.

Unit IV- Cancer Diagnosis

Clinical Examination-Biopsy, Blood Test, Bone marrow Aspiration, Pap Test. Imaging-Xray, CT-Scan, MRI Scan, Endoscopy and Mammography

Unit V- Prevention and Treatment

Dietary Supplements- Retinoid, Carotenoids, Vitamin D, Soy Products, Lifestyle Practices-Yoga and Exercise. Treatment- Chemotherapy, Radiotherapy, Immunotherapy, Gene therapy, Stem Cell Therapy and Surgery.

Self Study Topic#

Text Books

S. No	Author name	Title of the book	Publishers name	Year of
				Publication
1	Gibbons J P	Khans the Physics of	LWW US Reprint	2020
		Radiation Therapy with		
		Access Code 6ed (HB 2020)		

15 hours

15 hours

15 hours

15 hours

15 hours

2	Edward	Physicians' Cancer	Jones and Bartlett	2018
	Chu, Vincent	Chemotherapy Drug	Publishers, Inc;	
	T. Devita Jr.	Manual 2019	19th edition	
3	Philip J. DiSaia MD	Clinical Gynecologic	Elsevier; 9th edition	2017
	William T. Creasman	Oncology		
	MD, Robert S Mannel			
	MD			
4	Clifford L. K. Pang	Hyperthermia in Oncology,	CRC Press	2015
		1st Edition		
5	Robert E. Bristow, BethY.	Surgery for Ovarian Cancer,	CRC Press	2015
	Karlan, Dennis S. Chi	3rd Edition		

Reference Books

S.No	Author name	Title of the book	Publishers name	Year of Publication
1	Paul Scotting	Cancer: A Beginner's Guide	Beginner's Guides	2017
2	Klein smith	Principles of Cancer Biology	UBS Publishers	2016
3	Martha Robles- Flores	Cancer Cell Signaling: Methods and Protocols (Methods in Molecular Biology (1165)	Humana; Softcover reprint of the original 2nded. 2014 edition	2016
4	Sayan Paul	The Bethesda Handbook of Clinical Oncology	Wolters Kluwer India Pvt. Ltd.	2020
5	Devita V. T.	Evita hellman and Rosenbergs cancer principles and Practice of oncology 11ED (HB 2019)	LWW; 11 th edition	2019

Pedagogy

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

Web links

- https://nptel.ac.in/courses/108/108/108108124/
- https://www.youtube.com/watch?v=46Xh7OFkkCE
- https://www.youtube.com/watch?v=U5vAO_f2LDQ
- https://www.biologydiscussion.com/cancer/study-notes-on-cancer/27314

SKILL BASED ELECTIVE – II (A)

MOLECULAR DIAGNOSTICS AND THERAPEUTICS

Semester – V		Hours/W	eek – 2
Skill Based Elective – II (A)	MOLECULAR	Credit	s – 2
Course Code – 19UBT5SBE2A	DIAGNOSTICS AND	Internal	External
	THERAPEUTICS	25	75

Objectives

- > To know the basic concepts underlying in the pathogenesis of human diseases.
- > To study the different techniques involved in the diagnosis of diseases.
- > To understand the principle of therapeutics for the betterment of healthcare

Course Outcome

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

CO No.	CO Statement	Knowledge Level
CO1	Define the principle behind various types of human	K1
	Diseases	
CO2	Outline the molecular markers and its sources	K2
CO3	Explain the molecular techniques involved in the	K2
	disease diagnosis.	
CO4	Apply the approaches pertaining to the treatment of	К3
	disease.	
CO5	Identify recombinant products that are made with the	К3
	help of cell machinery.	

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4
C01	L	L	L	М
CO2	L	М	М	S
CO3	L	М	М	М
CO4	L	М	М	М
CO5	S	S	М	М

S-Strong, M-Medium, L-Low

SKILL BASED ELECTIVE – II (A) **MOLECULAR DIAGNOSTICS AND THERAPEUTICS**

Unit I - Overview of Human Diseases

Types of Human Diseases: Microbial infections – Bacterial (Cholera and Tuberculosis), Viral (Chicken Pox and HIV) and fungal (Ringworm and Athletes foot), Genetic disease (Sickle cell anemia), Physiological disease (Diabetes), Immune system malfunction and disease (SCID & Rheumatoid arthritis).

Unit II - Biomarkers

Biomarkers - Definition and Types. Biomarkers in disease diagnosis - Sweat chloride in Cystic Fibrosis, Blood Sugar or HbA1c in Type 2 Diabetes. Serum Creatinine in Kidney Disease, Bilirubin and Alkaline phosphate in Liver Disease, Cardiac troponin in Myocardial infarction and Bronchoalveolar lavage fluid containing C-peptide and Cytokeratin in Pulmonary fibrosis.

Unit III - Techniques in Molecular diagnostics

Techniques in Molecular diagnostics - Random Amplified Polymorphic DNA (RAPD), Restriction Fragment Length Polymorphism (RFLP), Simple Sequence Repeats (SSR), Fluorescence In situ Hybridization (FISH), DNA Microarray, Metagenomics, Amniocentosis.

Unit IV- Introduction to therapeutics

Introduction to therapeutics, Pharmacodynamics, Pharmacokinetics, Development of drug resistance. Cell based and Recombinant DNA therapies - Gene therapy and Stem cell therapy.

Unit V - Recombinant Products

Applications of Recombinant products - Insulin[#], DNA Polymerase, Tissue Plasminogen Activator, Interferons, Erythropoietin, DNase I.

Self Study Topic[#]

6 Hours

6 Hours

6 Hours

6 Hours

6 Hours

Text Books

S. No	Author	Title	Publisher	Year of Publication
1	Nader Rifai, Andrea Rita Horvath & Carl T. Wittwer	Tietz Fundamentals of Clinical Chemistry and Molecular Diagnostics	Elsevier	2019
2	Barbara G Wells, Terry L Schwinghammer, Joseph T. DiPiro and Cecily V. DiPiro	Pharmacotherapy Handbook	Mc Graw Hill	2017
3	William B. Coleman, Gregory J. Tsongalis	Diagnostic Molecular Pathology: A Guide to Applied Molecular Testing	Academic Press	2016
4	Lela Buckingham	Molecular Diagnostics Fundamentals, Methods, and Clinical Applications – 2 nd Edition	E.A.Davis Company, Philadelphia	2012
5	Roger Walker and Cate Whittlesea	Clinical Pharmacy and Therapeutics - Fifth Edition	Elsevier	2012

Reference Books

S. No.	Author	Title	Publisher	Year of
				Publication
1	R S Satoskar, Nirmala N.	Pharmacology and	Elsevier	2020
	Rege, Raakhi K. Tripathi	Pharmacotherapeutics, 26 th		
	and Sandhya K. Kamat	Edition		
2	Arthur P. Bollon	Recombinant DNA Products	CRC Press	2018
3	Chao-Min Cheng, Chen-	In-Vitro Diagnostic Devices:	Springer	2016
	Meng Kuan and Chien-Fu	Introduction to Current Point-of-		
	Chen	Care Diagnostic devices		
4	Dr Jayanti Tokas	Immunology and Molecular	University Science	2015
		Diagnostics	Press	
5	Harald Seitz, Sarah	Molecular Diagnostics	Springer	2013
	Schumacher	(Advances in Biochemical		
		Engineering/ Biotechnology		
		Book 133)		

Pedagogy

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

Web links

- https://www.cdc.gov/labquality/molecular-methods.html
- https://wyss.harvard.edu/keywords/Diagnostics/?section=technology
- https://nptel.ac.in/content/storage2/courses/102103013/pdf/mod3.pdf

SKILL BASED ELECTIVE – II (B)

LAB IN BIOINFORMATICS

Semester – V		Hours/Week – 2	
Skill Based Elective – II (B)	LAB IN BIOINFORMATICS	Credits – 2	
Course Code - 19UBT5SBE2BP		Internal	External
		40	60

Objectives

• To learn and execute various molecular analysis using bioinformatics tools.

Course Outcomes

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

СО	CO Statement	Knowledge
Number		Level
CO 1	Demonstrate nucleotide analysis from various databases	K1
CO 2	Analyze the structure of novel proteins	K2
CO 3	Perform basic phylogenic analysis for species identification	K2
CO 4	Apply the sequencing skills in various molecular analysis	K3
CO 5	Identify and analyze any disorders in a genome sequence	K3

Mapping with Programme Outcomes

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

S-Strong, M-Medium, L-Low

SKILL BASED ELECTIVE – II (B) LAB IN BIOINFORMATICS

- 1. Retrieval of Nucleotide Sequence from GenBank, EMBL, DDBJ database.
- 2. Retrieval of Protein Sequences from PIR, Swissprot/ Uniprot database.
- 3. Protein Structure database PDB.
- 4. Motif and domain analysis using HOMER Motif database.
- 5. Pairwise Sequence analysis using BLAST.
- 6. Multiple Sequence analysis using ClustalW.
- 7. Construction of Phylogenetic tree.
- 8. Molecular visualization using Rasmol.
- 9. Pathway search using KEGG database.
- 10. Retrieval of Disease/ disorder genome sequence from OMIM database.
- 11. Homology Modeling using SWISS MODEL Workspace.

Reference books

S. No.	Author	uthor Title Publisher		Year of
				Publication
	Dr. Shashank Rana,			
	Dr. Vartika Singh,		Manojvm	
1	Preeti Kashyap,	Bioinformatics Practical Manual	Publishing House	2020
	Bhavya Sharma,			
	Shilpi Tiwari			
	Lloyd Wai Yee	Bioinformatics: A Practical	World Scientific	2017
2	Low, Martti Tapani	Handbook Of Next Generation	Publishing	
	Tammi	Sequencing And Its Applications	Company	
	Noor Ahmad Shaik,			2019
	Babajan	Essentials of Bioinformatics,	Springer	
3	Banaganapalli, Ramu	Understanding Bioinformatics:	International	
	Elango,	Genes to Proteins	Publishing	
	Khalid Rehman			
	Hakeem			
	Mohammad Yaseen			
4	Sofi, Afshana Shafi,	Bioinformatics for Everyone	Elsevier Science	2021
	Khalid Z. Masoodi			
	Kenta Nakai,	Encyclopedia of Bioinformatics and		
5	Christian	Computational Biology	Elsevier Science	2018
	Schonbach	ABC of Bioinformatics		

SKILL BASED ELECTIVE – III (A)

DNA FINGERPRINTING

Semester – V		Hours/	Week – 2
Skill Based Elective – III (A)	DNA FINGERPRINTING	Credits	- 2
Course Code - 19UBT5SBE3A		Internal	External
		25	75

Objectives

- To understand the basic concepts in DNA profiling
- To familiarise with analytical tools and sample preparation methods for DNA testing
- To apply the DNA fingerprinting technique to solve various research and real life problems

Course Outcomes

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

CO No.	CO Statement	Knowledge Level
CO1	Understand the basis of DNA fingerprinting	K1
CO2	Demonstrate the sample preparation and processing from various specimens	K2
CO3	Familiarise with the available analytical tools and techniques for DNA fingerprinting	K2
CO4	Analyse various case studies based on DNA fingerprinting	К3
CO5	Apply the knowledge in various problem solving aspects	К3

Mapping with Programme Outcomes

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

S-Strong, M-Medium, L-Low

SKILL BASED ELECTIVE – III (A)

DNA FINGERPRINTING

Unit I- Introduction to DNA fingerprinting

Introduction and history of DNA Fingerprinting –Discovery and advancements, Basis of molecular genetics – Organization of human genome, Pedigree analysis, DNA Polymorphisms.

Unit II- Sample preparation for DNA fingerprinting

Sample preparation techniques – extraction of DNA sample from various sources, isolation and quantification of DNA, Purity analysis of DNA and sample processing. Primer designing and applications. Application of PCR technology in Forensic DNA profiling. Amplification of variable regions using PCR Agarose gel Electrophoresis for amplified products.

Unit III- Analytical tools

Analytical tools for studying DNA polymorphism –PCR amplifications; Single nucleotide polymorphism (SNuPs); Genetic linkage mapping; Physical mapping of the genome.

Unit IV- Applications of DNA fingerprinting

Applications of DNA fingerprinting in genome research, medicine – diagnosis and drug development, forensic investigation – identification of suspects, kinship analysis, Agriculture – Plant varieties protection.

Unit V- Case studies

Case study based on DNA fingerprinting[#]– Disputed property, paternity, criminal identification.

Self study Topic[#]

Text Books

S. No.	Author	Title	Publisher	Year of
				Publication
1	Jeremey W. Dale and	From genes to genomes: Concepts	Wiley	2002
	Malcom von Schantz	and applications of DNA		
		technology		
2	MunisDundar	Current Applications of	European	2015
		Biotechnology	Biotechnology	
			Thematic Network	
			Association	

6 Hours

6 Hours

6 Hours

4 Hours

8 Hours

3	T. A. Brown	Gene Cloning and DNA Analysis:	Wiley Blackwell	2016
		An Introduction.7 th Edition		
4	Hoffman A	Wilson and Walkers Principles and	Cambridge	2018
		Techniques of Biochemistry and	University Press	
		Molecular Biology		
5	Sue Carson Heather	Molecular Biology Techniques A	Academic Press	2019
	Miller Melissa Srougi	Classroom Laboratory Manual, 4th		
	D. Scott	Edition		
	Witherow			

Reference Books

S. No	Author	Title	Publisher	Year of Publication
1	Hirakranjan Dash, Pankaj Shrivastava, Braja Kishore Mohapatra and Surajit	DNA Fingerprinting: Advancements and endeavours	Springer	2018
	das			
2	Bernard R. Glick and Cheryl L. Patten	Molecular Biotechnology: Principles and Applications of Recombinant DNA. 5 th Edition	ASM Press, Washington DC	2017
3	Nessacarey	Junk DNA: A Journey through the Dark Matter of the Genome	Columbia University Press	2017
4	Jo – Anne Bright and Michael Coble	Forensic DNA Profiling: A practical guide to assigning likelihood Rarios	CRC Press	2019
5	Pankaj Shrivastava, HirakRanjann Dash,	Forensic DNA typing: Principles, Applications and Advancements	Springer	2020

Pedagogy

Power point presentation, Group Discussion, Case study analysis, Seminar, Assignment, Animations and virtual lab.

Web Links

- https://www.genome.gov/genetics-glossary/DNA-Fingerprinting#:~:text=DNA%20fingerprinting%20is%20a%20laboratory,evidence% 20came%20from%20that%20suspect.
- https://nptel.ac.in/courses/102/103/102103017/
- https://www.youtube.com/watch?v=AkBUriMK9u8
- https://www.nature.com/scitable/topicpage/forensics-dna-fingerprinting-and-codis-736/
- https://jolt.law.harvard.edu/assets/articlePDFs/v03/03HarvJLTech223.pdf

SKILL BASED ELECTIVE III (B)

LAB IN PLANT TISSUE CULTURE

Semester – V		Hours/V	Week – 2
Skill Based Elective III (B)	LAB IN PLANT TISSUE	Cred	lits - 2
Course Code - 19UBT5SBE3BP	CULTURE	Internal	External
		40	60

Objectives

- To acquire hands-on training in maintaining aseptic conditions and formulation of specific media required for plant tissue culture.
- > To get skilled in handling different explants for plant tissue culture experiments.
- > To understand and learn the establishment of callus and propagation of plants.

Course Outcomes

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

СО	CO Statement	Knowledge
Number		Level
CO1	Design and maintain aseptic environment and formulate required media and stock solutions based on requirement.	K1
CO2	Demonstrate the methods of preparing callus and suspension Cultures	K2
CO3	Handle and establish various explants and induce callus Formation	K2
CO4	Isolate and culture protoplast from plant sources	K3
CO5	Analyse the callus propagated through tissue culture	K3

Mapping with Programme Outcomes

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

S-Strong, M-Medium, L-Low

SKILL BASED ELECTIVE III (B) LAB IN PLANT TISSUE CULTURE

- 1. Design and aseptic maintenance of plant tissue culture laboratory.
- 2. Formulation and sterilization of various plant tissue culture media.
- 3. Preparation of stock solutions hormones and growth regulators.
- 4. Choice of explants and surface sterilization.
- 5. Preparation of callus and suspension culture
- 6. Protoplast culture.
- 7. Cytological study of calli cells.
- 8. Hardening of tissue culture plants and acclimatization

* Practical by demonstration only

Reference books:

S.	Author	Title	Publisher	Year of
No.				Publication
1	Roberta H. Smith	Plant Tissue Culture: Techniques	Elsevier	2013
		And Experiments, 3rd Edition		
	Mohammad Anis,	Plant Tissue Culture: Propagation,		2016
2	Naseem	Conservation and Crop	Springer	
	Ahmad	Improvement		
		Introduction To Plant Tissue Culture	Oxford and	2019
3	M.K. Razdan	3 rd Edition	IBH	
			Publishing	
	J. Reinert, M.M.	Plant Cell and Tissue Culture: A		
4	Yeoman, P.	Laboratory Manual	Springer	2012
	MacDonald			
	Karl-Hermann			
	Neumann,	Plant Cell and Tissue Culture – A		
5	Ashwani	Tool in Biotechnology: Basics and	Springer	2020
	Kumar, Jafargholi	Application		
	Imani			

PROFESSIONAL SKILLS

Semester – V		Hours/V	Week – 2
UGC Jeevan Kaushal Life Skills		Credits - 2	
Course Code - 19UGPS	PROFESSIONAL SKILLS	Internal	External
		25	75

Objectives:

- To prepare students to become viable entrepreneurs or employees with necessary professional skills.
- To enhance the comprehensive skills required for a work environment leading them competent and confident.

Prerequisite:

An open minded and assertive attitude to acquire the salient skills for a prospective career.

Course Outcomes

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

СО	CO STATEMENT	KNOWLEDGE
NUMBER		LEVEL
CO1	Identify and define professional communication skills	K1
	and effective interaction.	
CO2	Examine and reproduce LSRW skills in professional	K2
	development.	
CO3	Explain and express views and opinions in an assertive	K2
	manner.	
CO4	Prepare and practise to communicate through digital	К3
	mode.	
CO5	Employ and transfer the acquired skills in a practical	К3
	approach	

Mapping with Programme Outcome

COS	PO1	PO2	PO3	PO4	PO5
CO1	S	S	L	L	S
CO2	S	S	L	М	S
CO3	S	S	М	М	S
CO4	S	L	L	М	S
CO5	S	S	L	S	S

S- Strong M-Medium L-Low

PROFESSIONAL SKILLS

• Preparation and Presentation. • Avoiding Common Errors. • Preparing Resumes for Specific Purposes. **Unit II- Interview Skills** 8 Hours • Useful Vocabulary • Preparation and Presentation. • Dos and Donts • Observation of a Simulated Interview. **Unit III - Body Language and Personal Grooming** 5 Hours • Importance of Body Language (Postures, Eye Contact, Expressions and Etiquettes) • Good Grooming is Being Clean **Unit IV- Social and Cultural Etiquettes 6** Hours • Good Manners and Etiquettes • Table Manners • Manners in Public 6 Hours **Unit V- Group Discussion Skills** • Meaning and Methods of Group Discussion.

- Common Errors How to Avoid It

Seminar, Simulation, Quiz and Assignment

Material for Teaching and Reference

- https://graphicdesign.sfcc.spokane.edu/dZine/projects/Q3typographic_resume/resume http://worldwideuniversity.org/library/bookboon/the-art-of-interview-skills.pdf
- https://www.tutorialspoint.com/positive body language/positive body language tutoria l.pdf
- https://oaktrust.library.tamu.edu/bitstream/handle/1969.1/160849/254/MP0254.pdf?sequ ence=8&isAllowed=y
- http://www.edudel.nic.in/welcome_folder/after12th/enrich_dt_11112014.pdf
- http://egyankosh.ac.in/bitstream/123456789/35846/5/Unit-10.pdf

5 Hours

Unit I - Resume Skills

- Procedure of Group Discussion.
- Group discussion Simulation.

Pedagogy

CORE COURSE – VIII

MICROBIAL BIOTECHNOLOGY

Semester – VI		Hours	/Week- 6
	MICROBIAL		
Core Course – VIII	BIOTECHNOLOGY	Credits – 6	
Course Code – 19UBT6CC8		Internal	External
		25	75

Objectives

- > To know the industrially important microbes and their metabolic pathways.
- > To study the microbial fermentation processes and its types.
- To acquire knowledge about the types of bioreactors and recovery of fermentation product.
- > To provide the knowledge about the industrially important products.

Course outcomes

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

CO Number	CO Statement	Knowledge Level
CO 1	Demonstrate the isolation of industrially important microorganisms and their preservation	K1
CO 2	Outline a clear and concise idea about concepts and basic methods in fermentation process	K2
CO 3	Discuss the design and types of bioreactor and upstream processing	K3
CO 4	Illustrate the various methods of bioseparation	K4
CO 5	Obtain knowledge in applications of microbes in food processing and production	K5

Mapping with Programme outcomes

СО	PO1	PO2	PO3	PO4
CO1	S	S	S	S
CO2	М	М	S	S
CO3	S	S	S	S
CO4	S	S	М	S
CO5	S	L	S	S

S- Strong, M-Medium, L-Low

CORE COURSE – VIII MICROBIAL BIOTECHNOLOGY

Unit I - Basic principles of Biochemical Engineering

Introduction and historical developments in industrial microbiology, industrially important microbes and metabolic pathways- various microbial metabolites and their overproduction – Isolation and selection of industrially important microorganisms preservation and maintenance of microbial culture.

Unit II - Concepts of basic mode of fermentation processes 16 Hours

Microbial substrates and media formulation; Components of microbial fermentation process; Types of fermentation processes- Solid state, static and submerged fermentation. Fermentation economics and fermentation media. Fermenter design - mechanically agitated, pneumatic and hydrodynamic fermenters. Design of laboratory bioreactor; Types of Bioreactor: Continous, semi continuous and fed batch bioreactors; Continuous Stirred tank bioreactors, Bubble column bioreactors, Air lift bioreactors, Fluidized bed bioreactors, Packed bed bioreactors and Photobioreactors.

Unit III - Upstream Processing

Bioprocessing: Culture collections, Industrial strains and strain improvement: Natural recomibination, conjugation, Mutagenesis, Genetic engineering of Microorganisms, Strain stability. Media formulation, sterilization, aeration and agitation. Large scale animal and plant cell cultivation and air sterilization. Measurement and control of bioprocess parameters, scale up and scale down process.

Unit IV - Downstream processing

Bioseparation - filtration, centrifugation, sedimentation, flocculation, microfiltration, sonication. Cell disruption – enzymatic lysis and liquid-liquid extraction.Purification by precipitation (ammonium sulfate, solvent), electrophoresis and crystallization. Extraction (solvent, aqueous two phase, super critical) and chromatographic techniques (Ion exchange chromatography, hydrophobic interaction chromatography, affinity chromatography and gel filtration chrromatography. Reverse osmosis and ultra filtration. Drying, crystallization, storage and packaging.

16 Hours

16 Hours

16 Hours

Unit V- Applications of Microbes in food processing and production 16 Hours

Production of Microbial Biomass – Baker's Yeast, Mushroom; Production of antibiotic; Penicillin and Streptomycin - Production of fermented foods; Alcoholic beverages - wine, beer. Production of ethanol[#], citric acid, amino acids and vitamins- Microbial enzymes for food – Biopesticides and biofertilizers.

- Self Study Topics

Text Books

S.No.	Author	Title of the book	Publishers	Year of publication
1	Joginder Singh,	Microbial Biotechnology:	Springer Nature	2020
	AshishVyas,	Basic Research and	Singapore pvt.Ltd	
	Shanquanwang, Ram	Applications		
	Prasad			
2	Jayanta Kumar Patra,	Microbial Biotechnology	Springer Nature	2018
	Gitishree Das, Han-	Application in Food and	Singapore pvt.Ltd	
	SeungShin	Pharmacology		
3	Pradeep Kumar,	Advances in Microbial	Apple Academic	2019
	Jayanta Kumar Patra,	Biotechnology Current	Press	
	Pranjal Chandra	Trends and Future		
		Prospects		
4	Rita Kundu , Rajiv	Advances in Plant and	Springer Nature	2019
	Narula	Microbial Biotechnology	Singapore pvt.Ltd	
5	Dr.R.C.Dubey	A Textbook of	Schand	5 th Revised
		Biotechnology	Publishing	Edition,2014

Reference Books

S.No.	Author	Title of the book	Publishers	Year of publication
1	Lee Yuan kun	Microbial Biotechnology Principles and Applications	e- Book	Third Edition,2019
2	Bernard R.Glick, Jack J.Pasternak	Molecular Biotechnology Principles and Applications of Recombinant DNA	Wiley Publication	2017
3	P.Singh	Recent Trends in Microbial Biotechnology	CBS Publication	2013

4	Debabrata Das,	Industrial Biotechnology	CRC Press	2021
	SoumyaPandit			
5	WimSoetaert, Erick	Industrial Biotechnology:	Wiley VCH	1 st
	J. Vandamme	Sustainable Growth and	Publication	Edition,2019
		Economic Success		

Pedagogy

- Lecture (Chalk and Talk OHP, LCD)
- Quiz, Seminar, Assignment, Group Discussion
- Videos and Animations

Web links

- https://www.z-lib.org
- https://www.pdfdirve.org
- https://www.dcu.ie
- https://www.edx.org
- https://unacademy.com
- https://www.sciencedirect.com
- https://khanacademy.org

CORE COURSE – IX

IPR, BIOETHICS AND BIOSAFETY

Semester – VI		Hours/Week – 6	
Core Course – IX	- IPR, BIOETHICS AND BIOSAFETY	Credits – 6	
Course Code – 19UBT6CC9		Internal 25	External 75

Objectives

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

Course Outcomes

CO Number	CO Statement	Knowledge Level
CO 1	Define the fundamental aspects of Intellectual Property Rights for development and management of innovative projects in industries	K1
CO 2	Outline the current trends in IPR and Govt. steps in fostering IPR	K2
CO 3	Explain about the ethical issues involving biological material.	K3
CO 4	Utilize adequate knowledge in the use of genetically modified organisms and its effect on human health	К3
CO 5	Make use of critical thinking skills to analyze information and situations in order to respond and act ethically with regard to scientific research, practice, and technology.	К3

Mapping with Programme Outcomes

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

S- Strong, M- Medium, L-Low

CORE COURSE – IX IPR, BIOETHICS AND BIOSAFETY

Unit I- Introduction to Intellectual Property and Types of IPs

Introduction to IPR, Basic concepts and need for Intellectual Property, types - Patents, Trademarks, Trade Secrete, Copyright, Geographical Indications- History of GATT and TRIPS Agreement. – World Intellectual Property Rights Organization (WIPO). IP rights in India and abroad (USA & Europe) - few Case Studies-patent-Turmeric Patent,GI- Darjeeling Tea.

Unit II - Patent Filing Procedures and Agreements

Patent- Elements of Patentability: Novelty, Non Obviousness (Inventive Steps), patentable and non-patentable – patenting life, Registration Procedure, Rights and Duties of Patentee, Assignment and license, Patent infringement. IPR Agreements and Treaties: Madrid Agreement; Hague Agreement; Budapest Treaty; PCT; Indian Patent Act 1970.

Unit III - Biosafety

Introduction, biosafety issues in biotechnology - historical background; Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; "Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals.

Unit IV- Biosafety Guidelines

Biosafety guidelines and regulations (National and International) – operation of biosafety guidelines and regulations of Government of India; [#]Definition of GMOs and LMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC, for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; Overview of National Regulations and relevant International Agreements including Cartagena Protocol.

Unit V- Bioethics

Introduction to ethics/ bioethics – purpose and principles of bioethics, Bioethics in medical – human cloning, Biotechnology and ethics, Benefits and risks of genetic engineering- ethical aspects of genetic testing – ethical aspects relating to use of genetic information – genetic engineering and bio warfare; Ethical implications of cloning: Reproductive cloning, therapeutic cloning; Ethical, legal and socioeconomic aspects of gene therapy, germ line,

18 Hours

18 Hours

18 Hours

18 Hours

18 Hours

somatic, embryonic and adult stem cell research-GM crops and GMO's – biotechnology and biopiracy –ICMR Guidelines- Ethical implications of human genome project.

#- Self Study Topics

Text Books

S. No.	Author	Title	Publisher	Year of Publication
1	Tom Koch	Ethics in Everyday Places	Esri Press	2017
2	Nithyananda, K V.	Intellectual Property Rights: Protection and Management	Cengage Learning India Private Limited	2019
3	AdarshRamanujan	Patent Law Cases and Materials: A Synthesis For India	Wolters Kluwer India Pvt. Ltd	2020
4	Andrew F. Roberts, JoergRomeis, Karen Hokanson, Reynaldo Ariel Alvarez Morales	Biosafety of Genetically Modified Organisms, Volume II	Frontiers Media SA	2020
5	V. ScopleVinod	Managing Intellectual Property	Prentice Hall of India pvt Ltd	2012

Reference Books

S. No.	Author	Title	Publisher	Year of
				Publication
1	Anil Kumar H S and	Fundamentals of Intellectual	Notion Press	2017
	B. Ramakrishna	Property Rights		
2	Dr. S.V. Damodar	Intellectual Property Rights	ASIA LAW	2019
	Reddy	Law and Practice	HOUSE	
3	Dawn P. Wooley and	Biological Safety: Principles and	ASM Press; 5th	2017
	Karen B.	Practices	edition	
	Byers			
4	Ahuja, V K.	Law relating to Intellectual	Lexis Nexis	2017
		Property Rights		
5	Ramakrishna B &	Fundamentals of Intellectual	Notion Press	2017
	Anil Kumar H.S	Property Rights: For Students,		
		Industrialist and Patent		
		Lawyers		

Pedagogy

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

Web links

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

CORE PRACTICAL – VI

LAB IN MICROBIAL BIOTECHNOLOGY

Semester – VI		Hours/Week - 5 Credits - 4	
Core Practical – VI	LAB IN MICROBIAL BIOTECHNOLOGY		
Course Code - 19UBT6CC6P	BIUTECHNOLOGY	Internal 40	External 60

Objectives

- To equip the students with skills pertaining to immobilization and genetic engineering techniques.
- > To acquire hands-on exposure to fermentation techniques.
- To get skilled in the production techniques of Single Cell Protein, Biofertilizer and Bio- Enzymes.

Course Outcomes

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

СО	CO Statement	Knowledge
Number		Level
CO1	Enumerate the industrially important microorganisms.	K1
CO2	Demonstrate various types Fermentation methods.	K2
CO3	Handle and establish the techniques of Immobilization.	K2
CO4	Produce Single Cell Protein, Biofertilizer and Bio -Enzymes.	K3
CO5	Understand the skills and basic techniques of Antibiotic Sensitivity Test of Microorganisms.	K3

Mapping with Programme Outcomes

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

S-Strong, M-Medium, L-Low

CORE PRACTICAL – VI LAB IN MICROBIAL BIOTECHNOLOGY

- 1. Isolation of industrially important microorganisms.
- 2. Isolation and of Lactic acid bacteria.
- 3. Immobilization of algal cells and enzymes by Sodium Alginate method.
- 4. Immobilization of algal cells and enzymes in agarose cubes.
- 5. Isolation of amylase producing organisms.
- 6. Wine production by yeast.
- 7. Pro Mushroom Cultivation
- 8. Biofertilizer Production Azolla and Vermicompost.
- 9. Production of Bio-Enzyme from Food waste.
- 10. Bioassay techniques for antibiotics Test for Antibiotic sensitivity of microorganisms by Disc method and Agar well diffusion method.
- 11. Physical Mutagenesis UV method.
- 12. Visit to Distillery unit; alcohol production and pharmacological industries.Pasteur Institute (Field visit).

Reference Books

S. No	Author	Title	Publisher	Year of
				Publication
1	Aneja.K.R	Experiments in	New Age	2018
		Microbiology, Plant	International	
		Pathology, Tissue Culture	(P) Ltd, New	
		and Microbial	Delhi, India.	
		Biotechnology. 5 th Edition.		
	Fernanda Mozzi,	Biotechnology of Lactic Acid	Wiley –	
2	Rahul.R.Raya,	Bacteria – Novel	Blackwell, New	2015
	Graciela.M.Vignolo	Applications. Second	Jersey,	
		Edition.	United States.	
			Taylor &	
3	FarshadDarvishiHarzevili,	Microbial Biotechnology –	Francis/	2014
	Hongzhang Chen	Progress and Trends	Routledge,	
			UK.	
	Surajit Das, HirakRanjan	Microbial Biotechnology – A	Springer India.	
4	Dash	Laboratory Manual for		2014
		Bacterial System		
5	Singh.P	Recent Trends in Microbial	CBS,	2013
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		Biotechnology.	Chennai, India.	
6	Thatoi .H.N, Mishra.B.B	Microbial Biotechnology -	Alpha Science	2012
		Methods and Applications.	International,	
			UK	
7	El-Mansi.E.M.T,	Fermentation Microbiology	Taylor &	2012
	Bryce.C.F.A, Dahhou. B,	and Biotechnology, Third	Francis, UK	
	Sanchez.S, Demain.A.L,	Edition		
	Allman.A.R.			

Web Links

- https://youtu.be/oormRweSf3E
- https://youtu.be/HqbVca1elak
- https://youtu.be/4nNQEO8ZQR0
- https://youtu.be/9u-UEqiUZtk
- https://youtu.be/sIWADw9vFNM

MAJOR BASED ELECTIVE- II (A)

ENVIRONMENTAL BIOTECHNOLOGY

Semester – VI		Hours/Week – 6		
Major Based Elective-II (A)	ENVIRONMENTAL BIOTECHNOLOGY	Credits – 6 Internal External		
Course Code-19UBT6MBE2A				
		23	15	

Objectives

- > To know the basic concept and scope of environmental biotechnology
- > To study the Applications of biotechnology in environmental monitoring.
- > To analyse Bio sensors in environmental protection.
- To understand the achievements of biotechnology in Environmental Management.

Course Outcomes

СО	CO Statement	Knowledge
Number		Level
CO 1	Demonstrate the utilization of microbial processes in waste.	K1
CO 2	Describe the concept of pollution management.	K2
CO 3	Apply the Green manuring technology for crop production.	K3
CO 4	Apply the concepts of Biotechnology in Environmental Management.	К3
CO 5	Apply the practical skills for entrepreneurial development in biofertilizer production	К3

Mapping with Programme Outcomes

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

S- Strong, M- Medium, L-Low

MAJOR BASED ELECTIVE-II (A) ENVIRONMENTAL BIOTECHNOLOGY

Unit I - Introduction to Environmental Biotechnology

Basic components of environment. Definition – concept and scope of ecosystem, abiotic and biotic components. Environmental pollution: Air - Types of Air Pollutants: Sources, Effects and control of Air pollution .Water pollution- Sources, Effects and control of Water pollution and Soil pollution- Sources, Effects and control of Water pollution. Liquid Waste management - Sewage water treatment – Process involved-Dilution, Mechanical treatments, Biological treatments, Chemical treatments.

Unit II - Role of Biotechnology in Waste management

Solid waste management. Classification of Solid waste management- Municipal Solid Waste and Hazardous Solid Waste. Nitrification and denitrification – microbial fundamentals and application. Aerobic processes: Activated sludge, oxidation ditches, trickling filters, towers, rotating discs, rotating drums, oxidation ponds. Anaerobic processes: Anaerobic digestion, anaerobic filters, up flow anaerobic sludge blanket reactor.

Unit III - Biodegradation and Bioremediation

Principle and mechanism of biodegradation, Biodegradation of xenobiotic compounds (Lignin, Hydrocarbons, Detergents, Dyes and pesticides). Biodegradation of agro chemicals and other organic compounds – Biotransformation of xenobiotic compound; Bioremediation-Principles - Bioscrubbers – Biomining of metals - Biopulping. Phytoremediation: Use of plants for removal of organic and metallic pollutants.

Unit IV - Biotechnology and value addition

Biofertilizers- Different types of biofertilizer -Rhizobium, Azotobacter, Azospirillum, cyanobacteria- Azolla .Production of biofertilizers (Azolla): Criteria for strain selection, steps for preparing biofertilizers (Seed pelleting, inoculant carriers, quality standards for inoculants), Green manuring for crop production. Application of biofertilizers. Algal Biomass- Chlorella and Spirulina. Factors Affecting Biomass Production. Mass Production of Spirulina. Types of Spirulina Production - Semi-natural lake system and artificially built cultivation system - Clean water system and Waste water system. Uses of Spirulina - Single Cell Protein - protein supplemented food, health food, therapeutic and natural Medicine, Cosmetics.

18 Hours

18 Hours

18 Hours

18 Hours

Unit V- Environmental Monitoring

18 Hours

Environmental monitoring: environmental impacts and their assessments using bioindicators, Biomarkers, biosensors and toxicity testing Air, water and soil sampling. Merits and demerits Bio-tools for environmental monitoring – Role of biotechnology in environmental protection. Various environmental standards: air, water and noise quality. Environment protection Act: environmental laws, policies, ethics. [#]Global Environmental Current Issues. [#]Social responsibilities of Environmental protection and Monitoring.

#-Self-Study Topics

Text Books

S. No.	Author	Title	Publisher	Year of
				Publication
1	Pradipta Kumar	Textbook of Environmental	Dreamtech Press,	2020
	Mohapatra	Biotechnology	Wiley India Pvt Ltd.	
2	Daniel Vallero	Environmental	Academic Press	2015
		Biotechnology: A Biosystems		
		Approach		
3	Pramod Kumar,Vipin	Textbook of Environmental	WPI, India Pvt. Ltd	2018
	Kumar and Pravin	Biotechnology		
	Kumar Sachan			
4	Lakhveer Singh,	Waste Biomass Management -	Springer International	
	Vipin Chandra	A Holistic	Publishing	2017
	Kalia	Approach		
5	Anonim	Environmental	I. K. International	2017
		Biotechnology	Pvt Ltd	

Reference Books

S.No	Author	Title	Publisher	Year of
				Publication
1	JeyabalanSangeetha	Environmental	CRC Press	2016
		Biotechnology		
2	Roberto Adkins	Environmental Biotechnology	Scientific e-	2019
			Resources	
3	Bruce E. Rittmann	Environmental Biotechnology	McGraw-Hill	2020
		Principles and Applications	Education	

4	IndhuShekhar Thakur	Environmental	I. K. International	2021
		Biotechnology Basic Concepts	Pvt Ltd	
		and Applications		
5	Dilip Kumar Markandey	Environmental Biotechnology	APH	2021
			Publishing	

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

Web links

- https://www.digimat.in/nptel/courses/video/102105087/L01.html
- ➢ www.hydrosilintl.com
- https://www.youtube.com/watch?v=qs_oO0Nqvk8&t=26s
- https://www.digimat.in/nptel/courses/video/102105088/L01.html
- https://www.youtube.cov=qOshPABx9D4m/watch?
- https://www.youtube.com/watch?v=giJWzLQc15s
- https://www.youtube.com/watch?v=Tgiz4_i_2X4

MAJOR BASED ELECTIVE-II (B)

STEM CELL BIOLOGY

Semester – VI		Hours/Week - 6		
Major Based Elective – II (B)	STEM CELL BIOLOGY	Credits - 6		
Course Code - 19UBT6MBE2B		Internal 25	External 75	

Objectives

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

Course Outcome

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

СО	CO statement	Knowledge level
Number		
CO1	Define the fundamental scientific principles of embryonic and adult stem cells.	K1
CO2	Explain the techniques involved in isolation, maintain and growth of stem cells.	K2
CO3	Outline the basic concepts in stem cell epigenetics.	K2
CO4	Make use of the potential benefits and clinical applications of stem cells	К3
CO5	Utilize the clinical significance and ethical issues pertaining to stem cell research	К3

Mapping with Programme Outcomes

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

S-Strong, M-Medium, L-Low

MAJOR BASED ELECTIVE-II (B) STEM CELL BIOLOGY

Unit I- Introduction to Stem cells

Stem cell – Introduction, History, Properties, Potency – Totipotent, Pluripotent, Multipotent, Oligopotent, Unipotent; Types – Embryonic and Adult Stem cells. Stem cell niche - Components and function. Cell cycle regulation in stem cells.

Unit II- Stem cell culture

Isolation of Embryonic stem cell and Adult stem cell – Blastocyst from IVF, Umbilical Cord, Somatic Cell Nuclear Transfer, Bone marrow. Culture Media – Feeder cell layers, Serum and feeder free media, growth factors. Stem cell expansion and differentiation. Cryopreservation and storage techniques of stem cells. Stem cell bank.

Unit III- Stem cell epigenetics

Epigenetic mechanisms in normal development - DNA Methylation, histone modifications and Micro-RNAs. Cell Reprogramming – Induction and Maintenance of pluripotency and differentiation of pluripotency into various cell lineages.

Unit IV- Application of Stem Cells

Application of stem cells in disease management and treatment - Neurodegenerative diseases, autoimmune disease, ocular disease, spinal cord injury, cardiovascular disease, Cancer, diabetes, burns and skin ulcers, muscular dystrophy, cell replacement and gene therapy.

Unit V- Stem Cell Ethics

Ethical and legal issues in stem cell research and therapy[#]. Regulatory Guidelines from ISSCR (International Society for Stem Cell Research), CLAA (Central Licensing Approving Authority); FDA, National Guidelines for Stem Cell Research (NGSCR) and NAC-SCRT (National Apex Committee for Stem Cell Research and Therapy).

-Self-Study Topic

15 Hours

20 Hours

20 Hours

20 Hours

15 Hours

15 110015

Text books

S.	Author	Title	Publisher	Year of
No.				Publication
1	Gian Paolo Bagnara,	Stem Cells	SocietaEditriceEsculapio	2020
	Laura Bonsi&Francesco			
	Alviano			
2	Gerd Klein and Patrick	Stem Cell Mobilization	Humana	2019
	Wuchter	– Methods and Protocols		
3	Jonathan M. W. Slack	The Science of Stem cells	Wiley Blackwell	2018
4	Jack Collins	Essentials of Stem cell	Foster Academics	2017
		biology		
5	Rob Burgess	Stem Cells – A short	Wiley Blackwell	2016
		course		

Reference books

S. No.	Author	Title	Publisher	Year of
				Publication
1	Mirna Perez-Moreno	Advances in Stem Cells and their	Academic Press	2019
		Niches - Epidermal Stem Cell Niche	Inc	
		Volume 3		
2	Phuc Van Pham and	Stem Cells in Clinical Applications -	Springer	2017
	AchimRosemann	Safety, Ethics and Regulations		
3	Ahmed El-Hashash	Developmental and stem cell	Bentham Science	2017
		biology in health and disease		
4	Neil H Riordan P A	Stem Cell therapy – A Rising tide	Zaccheus	2017
			Entertainment	
5	TarikRegad, Thomas	Principle of Stem cell Biology and	Wiley Blackwell	2015
	Sayers & Robert Rees	cancer : Future Applications and		
		Therapeutics		

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

Web Links

- https://www.creative-diagnostics.com/stem-cell-epigenetics.htm
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4020242/
- https://maplespub.com/article/OVERVIEW-OF-CURRENT-REGULATORY-PRACTICES-CHALLENGES-GUIDANCE-FOR-REGULATION-OF-STEM-CELLS-AND-STEM-CELL-DERIVED-PRODUCTS-IN-INDIA
- https://stemcells.nih.gov/info/Regenerative_Medicine/2006Chapter1.htm
- https://stemcells.nih.gov/info/2001report/chapter4.htm

MAJOR BASED ELECTIVE – III (A)

BIOENTREPRENEURSHIP

Semester – VI		Hours/	Week - 6
Major Based Elective – III (A)	BIOENTREPRENEURSHIP	Creo	lits - 6
Course Code – 19UBT6MBE3A		Internal 25	External 75

Objectives

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

Course Outcomes

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

СО	CO Statement	Knowledge
Number		Level
CO 1	Understand the basic concepts in entrepreneurship and	K1
	marketing strategies related to biotechnology	
CO 2	Demonstrate the composting process using various methods	K2
CO 3	Learn apiculture concepts and methods	К3
CO 4	Analyse the techniques and methods in mushroom cultivation	К3
CO 5	Implement an integrated farming system with multiple	К3
	Components	

Mapping with Programme Outcomes

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

S- Strong, M- Medium, L-Low

MAJOR BASED ELECTIVE – III (A) **BIOENTREPRENEURSHIP**

Unit I- Introduction to Bioentrepreneurship

Introduction to bioentrepreneurship – basic concepts, marketing strategies, Entrepreneurship Traits and Motivation: Growth of entrepreneurship, steps involved in converting ideas to products - commercialization methods, Growth of entrepreneurship, Funding opportunities, IP and licensing, start-ups in biotechnology. Training, Institution in aid of entrepreneur, Risks and benefit.

Unit II- Compost and Vermicompost

Compost - Purpose of Composting. Decomposition of organics - Aerobic and Anaerobic Digestion. Factors Affecting Composting Process - Carbon - Nitrogen ratio - Moisture -Temperature – Aeration – Surface area – pH. Advantages of application of Organic Fertilizer. Limitations of Composting, Applications. Vermicompost - Earthworm - Biology of Earthworm – Life cycle – Classification – Species Suitable for processing organic wastes. Microbial biomass responsible during the vermicomposting.

Unit III- Apiculture

Introduction to Beekeeping. History of apiculture. Importance of honey bees. Different species of honey bees. Morphology, anatomy, colony organization and life cycle of honey bees. Beekeeping equipment. Beekeeping in India. Benefits of beekeeping. Social behaviour. Queen rearing. Collection and preservation of bee pasture. Seasonal management. Diseases affecting honey bees and their control measures. Handling of bee colonies and manipulation for honey production. Potential market of honey. Economics of beekeeping.

Unit IV- Mushroom cultivation

Mushroom culture - historical background, current status of mushroom culture in India. Nutritional values – cultivation methods; Obtaining a pure culture preparation of spawn; formulation and preparation of composts; spawning, spawn running and cropping; cultivation of paddy straw mushrooms - cultivation of Dhingri (Pleurotussajorcaju) medicinal value of mushrooms - Ganoderma, antiviral value, antibacterial, antifungal and antitumour effect. Recipes of mushroom (Mushroom soup, pulav)[#], preservation and packaging of mushrooms – economics of mushroom production.

18 hours

18 hours

20 hours

20 hours

Unit V- Integrated Farming System (IFS)

14 hours

Integrated Farming System - introduction, principles, Components of IFS, advantages of IFS, Farming System Research, IFS for Different Agroclimatic Zones, Production and Economics of IFS, Resource Flow – Wetland – Gardenland – Dryland.

#-Self-Study Topics

Text Books

S. No	Author	Title	Publisher	Year of
				Publication
		Biotechnology Entrepreneurship:		
1	Craig Shimasaki	Starting, Managing, and Leading	Academic Press	2014
		Biotech		
		Introduction to Biotech		
2	Matei, Florentina,	Entrepreneurship: From Idea to	Springer	2019
	Zirra, Daniela	Business: A European		
		Perspective		
3	R. Gogoi, Y.	Mushroom Cultivation Technology	Scientific	2019
	Rathaiah, T.R. Borah		Publishers	
4	Dr. Ashok K.	Vermitechnology Farm and	Discovery	2020
	Rathour, Dr. Pawan	Fertilizer	publishing	
	Kumar 'Bharti', Dr.		House Pvt Ltd,	
	Jaswant Ray,		New	
			Delhi, India.	
5	A. Zaman	Integrated Farming System and	New India	2019
		Agricultural Sustainability	Publishing	
			Agency	

Reference Books

S.	Author	Title	Publisher	Year of
No				Publication
1	HeidrunFlaadtCervini,	Bio- and MedTech	StämpfliVerlag	2020
	JörgDogwiler	Entrepreneurship		
		From Start-up to Exit		
2	Tavis Lynch	Mushroom Cultivation An	Quarry Books	2018
		Illustrated Guide to Growing		
		Your Own Mushrooms at Home		

3	John Tyler	Essential Guide to Mushroom	Independently	2019
		Cultivation A Definite Guide to	Published	
		Cultivation and Self Use		
4	Rhonda Sherman	The Worm Farmer's Handbook	Chelsea Green	2018
		Mid- to Large-Scale	Publishing	
		Vermicomposting for Farms,		
		Businesses, Municipalities,		
		Schools, and Institutions		
5	Shawn Jadrnicek,	The Bio-integrated Farm A	Chelsea Green	2016
	Stephanie Jadrnicek	Revolutionary	Publishing	
		Permaculture-based System		
		Using Greenhouses, Ponds,		
		Compost Piles, Aquaponics,		
		Chickens, and More		

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

Web links

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

MAJOR BASED ELECTIVE – III (B) DRUG DISCOVERY AND DEVELOPMENT

Semester – VI		Hours/Week - 6	
Major Based Elective – III (B)	DRUG DISCOVERY	Credits	- 6
Course Code - 19UBT6MBE3B		Internal 25	External 75

Objectives

- To study about the Basic techniques, methods and applications involved in Drug Designing.
- To understand the drug metabolism, mechanism of action including its kinetics and the principles of pharmacokinetics.
- To understand about the different regulatory aspects and novel drug delivery systems.

Course Outcomes

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

CO	CO Statement	Knowledge
Number		Level
CO 1	Classify drugs based on their source, nature, nomenclature and dosage and routes of administration.	K1
CO 2	Interpret the current approaches of drug discovery with their advantages and limitations.	К2
CO 3	Summarize the fate of drug in the biological system.	K2
CO 4	Interpret the regulatory aspects and stages of drug development.	K3
CO 5	Impart the concepts of novel drug systems.	K3

Mapping with Programme Outcomes

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

S-Strong, M-Medium, L-Low

MAJOR BASED ELECTIVE – III (B) DRUG DISCOVERY AND DEVELOPMENT

Unit I - General Pharmacology

Drugs – Definition, sources and nature, types of classification, nomenclature, dosage, dose response curve and LD50. Role of drugs, Drug - Protein interactions and routes of administration. Mechanism of action. Pharmacokinetics and Pharmacodynamics. Protein therapeutics. Drug toxicity - definition, classification. Factors affecting toxicity.

Unit II - Stages in Drug Design

Target Identification and validation: Drug targets - Membrane Proteins, DNA, RNA and enzymes. Lipinski's rule of five. Lead selection and optimization, drug candidate confirmation. Types of Receptors - Hormone, developmental - protein, carbohydrate and lipid receptors. Biological role and significance of each receptor. Neurotransmitters.

Unit III - ADME PROFILING

Drug metabolism - Drug metabolizing enzymes and their induction- absorption, bioavailability, distribution, metabolism and Elimination Pathways. Efficacy assessment, Toxicology/safety pharmacology assessment.

Unit IV- Stages of Drug Development

Drug development- Target identification, Target validation, Lead discovery and Optimization- Role of FDA. [#]Drug regulatory bodies in India –CDSCO, MHFW, IPC, ICMR, NPPA, The Drugs (Prices Controls) Order, 1955. The Indian Patents and Designs, Act 1970, Magic Remedies and Objectionable advertisements Act. Intellectual property rights. Computer aided drug designing (CADD), structure based drug design, QSAR, HTP screening, molecular docking.

Unit V- Novel Drug Delivery Systems

Novel Drug delivery systems - Carrier based Drug Delivery System, Liposomes, Nanoparticles, Microspheres, Monoclonal antibodies, Niosomes, Resealed erythrocytes as drug carriers. Transdermal Drug Delivery Systems, Sonophoresis, Osmotic drug delivery systems, Microencapsulation.

Self Study Topics

18 Hours

18 Hours

18 Hours

18 Hours

18 Hours

Text books

S.	Author	Title	Publisher	Year
No.				Publication
1	H. L. Sharma and K.	Principles of Pharmacology	Paras Medical	2017
	K. Sharma		Publishers	
2	Donald J. Abraham	Burger's Medicinal Chemistry,	Wiley	2021
		Drug Discovery and		
		Development		
3	Sakthivel Lakshmana	Computer Applications in Drug	IGI Global	2018
	Prabu, Appavoo	Discovery and Development		
	Umamaheswari			
4	Ansel, H.C.	"Pharmaceutical Dosage Forms	Lippincott Williams	2018
		and Drug Delivery Systems"	and Wilkins	
5	Ranabir Chanda,	Textbook of Novel Drug	AITBS Publishers	2019
	Alugubelli Gopi	Delivery System		

Reference books

S.	Author	Title	Publisher	Year of
No.				Publication
1	Laurence	"The Pharmacological Basis	McGraw-Hill	2017
	Gilman S	of Therapeutics"	Education / Medical	
2	Tom Brody	Clinical Trials: Study	Academic Press	2016
		Design, Endpoints and		
		Biomarkers, Drug Safety,		
		and FDA and ICH		
		Guidelines		
3	Donald J. Abraham	Burger's Medicinal	Wiley	2021
		Chemistry, Drug Discovery		
		and Development		
4	John Somberg,	Drug Discovery and	CRC Press	2019
	Vincent Idemyor,	Development, Third		
	James T. O'Donnell	Edition		
5	Binghe Wang,	Drug Delivery: Principles	Wiley Blackwel, 2nd	2016
	Longqin Hu, Teruna	and Applications	Edition	
	J. Siahaan			

Lecture, Power Point Presentation, Assignment, Seminar, Quiz, Group Discussion, Video

Web links

- https://www.fda.gov/patients/drug-development-process/step-1-discovery-and-development https://www.nebiolab.com/drug-discovery-and-development-process/
- https://nptel.ac.in/content/storage2/courses/104103071/pdf/mod15.pdf
- https://nptel.ac.in/courses/102/106/102106070/
- https://www.abdn.ac.uk/study/postgraduate-taught/degree-programmes/55/drug-discovery- and-development/