DHANALAKSHMI SRINIVASAN
COLLEGE OF ARTS AND SCIENCE FOR WOMEN (AUTONOMOUS)
Affiliated to Bharathidasan University, Tiruchirappalli
(Nationally Re-Accredited with A++ Grade by NAAC)
Perambalur – 621212.

B.Sc. Biotechnology

Choice Based Credit System-Learning Outcomes Based Curriculum Framework (CBCS-LOCF)
(Applicable to the candidates admitted from the academic year 2024-25 onwards)

UG BIOTECHNOLOGY

Programme Pattern

Sem	Part	Course	Course Title	Course Code	Ins.Hrs	Credit	Exam Hours	Marks		Total
								Internal	External	
I	I	Language Course - I	Tamil-Cheyyul(Ikkala elakiyam),Sirukathai, Ilakkiya varalaru/Hindi/French/ Arabic/Sanskrit	24U1LT1 24U1LH1 24U1LF1	6	3	3	25	75	100
	II	English Course-I	English for Communication-I	24U1EL1	6	3	3	25	75	100
	III	Core Course-I	Cell biology	24UBT1C1	5	5	3	25	75	100
	III	Core Course-II Practical	Lab in Cell biology	24UBT1C2P	4	3	3	40	60	100
	III	Allied Course - I	Biochemistry	24UBT1A1	4	4	3	25	75	100
	III	Allied- I & II Practical	Lab in Biochemistry and Immunology	24UBT1A1P	3	-	-	-	-	-
	IV	Value Education		24U1VED	2	2	3	25	75	100
	Total				**30**	**20**	**-**	**-**	**-**	**600**
II	I	Language Course - II	Tamil-Cheyyul(Edikala elakiyam),Puthinam/ Hindi/French/Arabic/ Sanskrit	24U2LT2 24U2LH2 24U2LF2	6	3	3	25	75	100
	II	English Course-II	English for Communication-II	24U2EL2	6	3	3	25	75	100
	III	Core Course-III	Microbiology	24UBT2C3	5	5	3	25	75	100
	III	Core Course-IV Practical	Lab in Microbiology	24UBT2C4P	4	3	3	40	60	100
	III	Allied Course - II	Immunology	24UBT2A2	4	4	3	25	75	100
	III	Allied-I& II Practical	Lab in Biochemistry & Immunology	24UBT1A1P	3	3	3	40	60	100
	IV	Environmental Studies		24U2EVS	2	2	3	25	75	100
	Total				**30**	**23**	**-**	**-**	**-**	**700**
III	I	Language Course - III	Tamil-Cheyyul(Edikala elakiyam),Urainadai,aluval murai madalgal,Elakiyavaralaru/	24U3LT3 24U3LH3 24U3LF3	6	3	3	25	75	100

			Hindi/French/Arabic/ Sanskrit							
	II	English Course-III	English-English through literature	24U3EL3	6	3	3	25	75	100
	III	Core Course-V	Molecular biology	24UBT3C5	5	5	3	25	75	100
	III	Core Course-VI Practical	Lab in Molecular biology	24UBT3C6P	4	3	3	40	60	100
	III	Allied Course - III	Bioinformatics &Biostatistics	24UBT3A3	4	4	3	25	75	100
	III	Allied-III & IVPractical	Lab in Bioinformatics & Biostatistics	24UBT3A2P	3	-	-	-	-	-
	IV	Non Major Elective-I	A) Basics of Biotechnology	24UBT3N1A	2	2	3	25	75	100
			B) Health care Biotechnology	24UBT3N1B						
			C) Process Instrumentation Dynamic and control	24UBT3N1C						
	Total				**30**	**20**		**-**	**-**	**600**
IV	I	Language Course - IV	Tamil-Cheyyul(Sanga illakiyam),Neethi illakiyam,Nadagam,Ellakia varalaru,Pothukatturai/ Hindi/French/Arabic/ Sanskrit	24U4LT4 24U4LH4 24U4LF4	6	3	3	25	75	100
	II	English Course-IV	English-English for competitive exam	24U4EL4	6	3	3	25	75	100
	III	Core Course-VII	Recombinant DNA Technology	24UBT4C7	5	5	3	25	75	100
	III	Core Course-VIII Practical	Lab in Recombinant DNA Technology	24UBT4C8P	4	3	3	40	60	100
	III	Allied Course - IV	Bioinstrumentation	24UBT4A4	4	4	3	25	75	100
	III	Allied-III & IV Practical	Lab in Bioinformatics and Biostatistics	24UBT3A2P	3	3	3	40	60	100
	IV	Non Major Elective-II	A) Agricultural Biotechnology	24UBT4N2A	2	2	3	25	75	100
			B) Solid waste Management	24UBT4N2B						
			C) Industrial waste Management	24UBT4N2C						
	Total				**30**	**23**		**-**	**-**	**700**
V	III	Core course-IX	Plant biotechnology	24UBT5C9	5	5	3	25	75	100
	III	Core course-X	Animal biotechnology	24UBT5C10	5	5	3	25	75	100
	III	Core course-XI	Environmental Biotechnology	24UBT5C11	5	5	3	25	75	100
	III	Core course-XII Practical	Lab in Plant biotechnology, Animal Biotechnology, Environmental Biotechnology	24UBT5C12P	6	3	3	40	60	100
	III	Major Based Elective-I	A) Developmental biology	24UBT5MBE1A	4	4	3	25	75	100
			B) Molecular modelling & drug designing	24UBT5MBE1B						
			C) Food technology	24UBT5MBE1C						
	III	Internship /Field Study / Industrial Visit		24UBT5IS1	-	1				100*
	IV	Skill Based Elective-I	A) Ethnomedicine	24UBT5SBE1A	3	2	3	25	75	100
			B) Molecular diagnostics	24UBT5SBE1B						
			C) Phytochemical technique	24UBT5SBE1C						

	IV	Soft Skills		24U5SS	2	2	3	25	75	100
		Self-Paced Learning - I (Online course)			-	2*				
	Total				**30**	**27**	**-**	**-**	**-**	**700**
VI	III	Core course-XIII	Industrial biotechnology	24UBT6C13	6	6	3	25	75	100
	III	Core course-XIV	Marine Biotechnology	24UBT6C14	5	5	3	25	75	100
	III	Core Course-XV Practical	Lab in industrial and environmental biotechnology	24UBT6C15P	6	3	3	40	60	100
	III	Major Based Elective-II	A) Enzyme Technology	24UBT6MBE2A	4	4	3	25	75	100
			B) Biosafety & bioethics	24UBT6MBE2B						
			C) Forensic biotechnology	24UBT6MBE2C						
	III	Project work		24UBT6PW	5	5		40	60	100
	IV	Skill Based Elective-II	A) Clinical Trial and Data Management	24UBT6SBE2A	3	2	3	25	75	100
			B) Bio business	24UBT6SBE2B						
			C) Pharmacognosy	24UBT6SBE2C						
	IV	Gender studies		24U6GS	1	1	3	25		100
		Self-Paced Learning - II (Online course)			-	2*				
	Total				**30**	**26**		**-**	**-**	**700**
I-VI	V	Extension Activities			-	1		-	-	-
	Total (Three years)					**140(4*)**				**4000**

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B.Sc. Biotechnology – Course Structure under (CBCS LOCF)
(Applicable to the candidates admitted from the academic year 2024-25 onwards)

Specialization Stream of B.Sc., Biotechnology Programme

The College offer B.Sc., Biotechnology

Course Duration : 3 years (6 Semester)

Course Value : 116 CP (credits points)

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Bachelor course in biotechnology offers the synergism of basic concepts of biology, biotechnology, molecular biology, genomics, Recombinant DNA technology, microbiology, biochemistry and bioinformatics with technological applications.

PEO2: The main objective of this degree course is to produce graduates with enhanced skills, knowledge and research aptitude to carry out higher studies, entrepreneurship or research and development in the various health, research and industrial areas.

PEO3: Develop proficiency in application of current aspects of biotechnology, molecular biology, Recombinant DNA technology, bioinformatics and genomics.

PEO4: Students will be able to use state of the art techniques relevant to academia and industry, generic skills and global competencies including knowledge and skills that enable the students to undertake further studies in the field of biotechnology, molecular biology, Recombinant DNA technology, genomics, microbiology, biochemistry or any other related field.

PEO5: Imparting an education that includes communication skills, the ability to work in a team with leadership quality, devoted to societal problems with an ethical attitude

PROGRAMME OUTCOMES (POs)

PO-1: After completing three years Bachelors in biotechnology, students would gain a thorough grounding in the fundamentals of new technologies in biotechnology.

PO-2: Industry applications of better understanding of the key principles of biochemical functioning at an advanced level. Better awareness of the major issues at the forefront of the discipline, will possess an in-depth understanding of the area of biochemistry chosen for research emphasis.

PO-3: An ability to conduct experiments, as well as to analyze data, understood the basic concepts, fundamental principles, and the scientific theories related to various scientific phenomena and their relevancies in the day-to-day life.

PO-4: The knowledge of basics of biotechnology beyond fundamentals results in affective development of the students, hence will make them progress to valuing and organization levels.

PO-5: An ability to acquire the skills in handling scientific instruments, planning and performing in laboratory experiments to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability in biotechnology.

Semester	Course code	Title of the course	Hours/week	credits
I	24UBT1C1	**CORE COURSE-I**: Cell Biology	5	5

COURSE OBJECTIVES:

This course presents the types and structural details of the basic unit by which all the living things are made of (the cell). On successful completion the subject student should have understand: Structural features, Organelles and the cellular mechanisms.

UNIT I: BASICS OF CELL BIOLOGY

Cell as a basic unit: Discovery and diversity of cells - Cell theory - Structure of prokaryotic (bacteria) and eukaryotic cells (plant and animal cells). Difference between plant and animal cell at different level.

UNIT II: CELLULAR ORGANELLES

Biomacromolecules and Bio micromolecules (Primary functions in the cell). Structure and Functions of Cell Organelles: Cell wall - Cell membrane - Cytoplasm - Nucleus - chromosomes -Endoplasmic reticulum - Ribosomes - Golgi bodies - Plastids - Vacuoles - Lysosomes - Mitochondria - Microbodies - Flagella - Cilia - Centrosome and Centrioles - Cytoskeleton.

UNIT III: CELLULAR TRANSPORT

Cell transport phenomenon - Permease, Na^+ and K^- Pump, Ca^{2++} ATPase Pump, co-transport, symport, antiport, endocytosis and exocytosis, Active and Passive transport, Diffusion and osmosis, Membrane architecture.

UNIT IV: CELL DIVISION

Cell division in prokaryotes and eukaryotes: Stages of Cell cycle, Different Stages of mitosis, meiosis, Crossing over and Abnormalities of cell cycle – Cancer, Apoptosis, Stem cell and its application.

UNIT V: CELLULAR EVENT

Integrative and Specialized cellular events, cell-cell signaling, Specialized cells nerve cells, sperm cells and Ovarian cells, microfilaments, microtubules, muscle cells. Cells of vision, Nucleon-cytoplasmic interaction, cell cloning.

UNIT VI: **CURRENT CONTOURS (For Continuous Internal Assessment only):**

The recent advancements in the course topics will be explained to the students then and there through expert lectures, online seminars or webinars.

Recommended Text:

1) T. Devasena (2012), Cell Biology, Oxford University Press.
2) Gupta, Renu & Makhija, Seema & Toteja, Ravi. (2018). Cell Biology: Practical Manual.
3) Gilbert, S.F. 2016. Developmental Biology, 11th edition. Sinauer Associates Inc. Publishers, MA. USA.
4) Bruce Alberts, 6th Edition (2014). Molecular Biology of the cell, W. W. Norton & Company.

   James D. Watson (2001), The Double Helix: A personal account of the Discovery of the Structure of DNA, Touchstone Publishers.
5) Wolpert L, Tickle C, 2015. Principles of Development, 5th edition, Oxford University Press.

Website and e-Learning Source:

1) http://www.cellbiol.com/education.php
2) https://global.oup.com/uk/orc/biosciences/cellbiology/wang/student/weblinks/ch16/
3) https://dnalc.cshl.edu/websites/
4) https://www.cellsignal.com/contents/science/cst-pathways/science-pathways

COURSE OUTCOME:

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

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	To learn the history of cytology and basic concept of cell	K1,K2
CO 2	To Distinguish the structure of prokaryotic and eukaryotic cell organelles and locate its parts along with functions.	K4
CO 3	To learn the classification, biological function, structure and interactions of Biomolecules	K5
C0 4	Students can understand Organization of chromosomes ,Cell division and cell cycle	K3
CO 5	To understand the concept of cell function and major cellular events takes place in our cell	K5

Mapping with programme Outcomes:

Relationship Matrix											
Semester	**Course code**		**Title of the course**							**Hours**	**Credits**
1	**24UBT1C1**		**CORE COURSE-I** : Cell Biology							**5**	**5**
Course Outcomes	**Programme Outcome (POs)**					**Programme specific outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	2	2	3	3	2	2	3	3	3	2
CO2	3	2	2	2	3	3	3	3	2	2	2
CO3	3	3	3	2	2	2	2	3	3	2	2
CO4	3	3	3	2	2	2	2	2	2	3	3
CO5	2	2	2	2	2	3	2	2	2	2	3
										Mean Overall Score	2.4 HIGH

Semester	Course code	Title of the course	Hours/week	credits
I	24UBT1C2P	**CORE COURSE-II Practical:** Lab in Cell Biology	4	3

OBJECTIVES

This practical used to know the basic handling of instruments, staining techniques and sterilization, stages of mitosis and meiosis

EXPERIMENTS:

1. Equipment used in laboratory, general practice and maintenances
2. Principles of microscopy
3. Components of a Compound / Light Microscope.
4. Phase contrast and fluorescent microscopy
5. Blood smear preparation and Identification of Blood cells
6. Buccal smear preparation and Identification of squamous epithelial cells
7. Identification of various stages of cell division (mitosis and meiosis).
8. Mitosis and Meiosis – onion root tip and grasshopper testis squash methods
9. Cell fractionation and Identification of cell organelles (Demo)

REFERENCES:

i. Dr. William H.Heidcamp 2017 Cell Biology Laboratory manual,Pearson Education

ii. David A.Thompson,2011 Cell and Molecular,Biology Lab. Manual.Create Space Independent PublishingPlatform

iii. P. Gunasekaran. 2007 Laboratory Mannual in Microbiology. New Age International.

iv. Mary L. Ledbetter. 1993 Cell Biology:Laboratory Manual.RonJon Publishing.Incorporated.

v. .Molecular Cloning by J. Sambrook and D. W. Russell (2001). Cold Spring Harbour Lab. Press.

vi. A short course in Bacterial Genetics by J.H. Miller (1992) Cold Spring Harbor Laboratory.

vii. Methods for Genetics and molecular Bacteriology by Ed. RGF Murray, WA. Wood & NB krieg (1994) American society for Microbiology

1. https://youtu.be/Izk1QMg8190 5.

2.. https://youtu.be/IR5jps-xmzA

OUTCOME OF THIS PAPER:

On completion of the course, the student should achieve an understanding of the following:

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Describe the sterile techniques involved in Cell Biology	K1,K2
CO 2	To study various parts of compound microscope	K4
CO 3	To prepare the temporary slides and differentiate the plant cells and animal cells in reference to their phenotypes	K5
C0 4	Learn the use of micrometer to measure the length and breadth of a given cell sample	K3
CO 5	Observe and classify the prokaryotic cells (bacteria) using differential staining.	K5

Mapping with programme Outcomes:

Relationship Matrix											
Semester	**Course code**		**Title of the course**							**Hours**	**Credits**
1	**24UBT1C2P**		**CORE COURSE-I** : Lab In Cell Biology							**4**	**3**
Course Outcomes	**Programme Outcome (POs)**					**Programme specific outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	2	3	2	3	3	2	3	3	3
CO2	2	3	2	2	3	3	2	3	2	2	2
CO3	2	3	3	2	2	3	2	3	3	2	2
CO4	2	3	3	3	2	3	2	3	2	3	3
CO5	3	2	2	3	2	3	2	2	2	2	2
Mean Overall Score											2.4

Semester	Course code	Title of the course	Hours/Week	credits
I	24UBT1A1	**Allied-I** Biochemistry	4	4

OBJECTIVES:

This course presents the chemical reactions or metabolic functions in the living system and their regulations. On successful completion the subject student should have understand: Basic metabolism, Enzymes and their kinetics and Applications of metabolites.

UNIT I CARBOHYDRATES

Definition – Structure and Classifications of Carbohydrates – Properties and Biological Functions of Carbohydrates – Monosaccharides, Disaccharides, Polysaccharides, Storage Polysaccharides, Structural Polysaccharides – Glycoproteins Storage and Metabolism of Carbohydrates.

UNIT- II PROTEINS AND AMINOACIDS

Structure and Classification and properties of Amino Acids – Polypeptides – Primary Structure – Types of Bonding– Confirmation – Secondary Structure – Alpha Helix, Beta Sheets, Tertiary Structure – Quaternary Structure – Protein. Metabolism of Proteins.

UNIT- III ENZYMES & LIPIDS

Introduction to Enzymes – Enzymes: Occurrence, cellular localization. Nomenclature, classification, EC Number. Enzyme properties (kinetics), Enzyme preparation and purification & enzyme activity.

Lipids-Definition – Classification – Structure and Functions of Lipids – Storage Lipids – Membrane Lipids– Fatty Acids – Waxes – Phospholipids – Eicosanoids – Terpenes – Steroids.

UNIT –IV NUCLEIC ACIDS

Definition –Structure and Types of Nucleic acids – DNA and RNA – Types – Structure and Function – Nucleotides – Nucleosides – Sugars – Circular – Double Helix and Super Coiled DNA

UNIT –V VITAMINS & HORMONES

Vitamins - Source, structure, biological role, daily requirement and deficiency manifestation of vitamin A, B, C, D, E and K. Role of hormones in metabolism.

UNIT VI: **CURRENT CONTOURS (For Continuous Internal Assessment only):**

The recent advancements in the course topics will be explained to the students then and there through expert lectures, online seminars or webinars

Recommended Text:

1) P.L. Soni, A Text-book of Inorganic Chemistry, 11th Edition, S. Chand & Sons publications
2) Abhilasha Shourie, Shilpa S, Chapadgoankar & Anamika Singh (2020) Textbook of Biochemistry 1st Edition
3) J.L. Jain, 2016, Fundamentals of Biochemistry, S. Chand publication, 7th edition.
4) A.C. Deb, 2016, Fundamentals of Biochemistry, New central book agencies, 7th edition.
5) Satyanarayana.U, 2016, Biochemistry, MJ publisher's 3rd edition (2006).

Reference Books:

1) Lehninger (2013) Principles of Biochemistrty 4 th edition WH Freeman and Company NY
2) Murray *et al.,* (2003) Harper's biochemistry 26 th edition Appleton and Lange Publishers Florida USA
3) Geoffrey L. Zubay, William W. Parson, Dennis E. Vance, 1995, Principles of Biochemistry, W.C. Brown Publishers, 1995, 3rd edition.
4) Lubert Stryer (2007) Biochemistry –Stanford University 5 th Edition-W H Freemann and company San Francisco

   Bahl Arun, Bahl B. S. (2016), A Textbook of Organic Chemistry, 22nd Edition, S. Chand & Sons publications

OUTCOME OF THIS PAPER:

On completion of the course, the student should achieve an understanding of the following:

Course Outcome		
CO No.	**CO STATEMENT** On the successful completion of the course, the students would be able to	**Cognitive Levels (K-level)**
CO 1	To understand the structure of fundamental monosaccharides and polysaccharides structure and functions	K1,K2
CO 2	To study the structures of amino acids, their chemical properties and their organization into polypeptides and proteins	K5
CO 3	To learn the structure of different classes of lipids and their roles in biological systems.	K3
C0 4	To Learn Basic function of nucleotides structure and function	K4
CO 5	To learn the Vitamins and Minerals function in biology	K3

Mapping with programme Outcomes:

Relationship Matrix											
Semester	**Course code**		**Title of the course**							**Hours**	**Credits**
1	**24UBT1A1**		**ALLIED COURSE I- BIOCHEMISTRY**							**4**	**4**
Course Outcomes	**Programme Outcome (POs)**					**Programme specific outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	2	2	3	2	3	3	2	2
CO2	2	3	3	2	3	2	3	3	2	3	3
CO3	3	3	2	2	2	3	3	2	3	2	2
CO4	2	3	2	2	3	3	3	2	2	2	2
CO5	3	3	2	3	2	2	3	2	2	3	2
										Mean Overall Score	2.2 HIGH

Semester	Course code	Title of the course	Hours/week	Credits
I & II	**24UBT1A1P**	**Allied-I Practical**: Lab in Biochemistry & Immunology	6	3

OBJECTIVE

This practical used to know the basic biochemical test like quantification ofmacromolecule and immunological test like immune diffusion, Blood grouping.

BIOCHEMISTRY

Experiments:

1. Demonstration of Use of Volume and Weight Measurements Devices.
2. Quantitative test for Carbohydrates.
3. Distinguish Reducing and Non Reducing Sugars.
4. Using Ninhydrin for Distinguishing Imino and Aminoacids.
5. Protein Estimation by Biuret Method.
6. Protein Estimation by Lowry's Method.
7. Separation of amino acids using TLC/Paper Chromatography

IMMUNOLOGY

Experiments:

1. Blood Grouping.
2. Identification of Cells in a Blood Smear
3. Preparation of Serum from Blood.
4. ELISA-Demonstration.
5. Immuno Diffusion. (Single Radial andDouble)
6. Immunoassay and TyphoidAntibodies.
7. Immunoelectrophoresis(Rocket).
8. Isolation of Monocyte from Blood.

REFERENCE:

Voet & Voet (1995) Fundamentals of Biochemistry, 2nd Ed, John Wiley and sonsinc., New York.

1. Geoffery L Zubay (1995) Principles of Biochemistry, WCB publishers,London

OUTCOME OF THIS PAPER:

On completion of this paper the student should achieve anunderstanding of the following:

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Describe the sterile techniques involved in Cell Biology	K1,K2
CO 2	To study various parts of compound microscope	K3
CO 3	To prepare the temporary slides and differentiate the plant cells and animal cells in reference to their phenotypes	K4
C0 4	Learn the use of micrometer to measure the length and breadth of a given cell sample	K5
CO 5	Observe and classify the prokaryotic cells (bacteria) using differential staining.	K3

Mapping with programme Outcomes:

Relationship Matrix											
Semester	**Course code**		**Title of the Course**							**Hours**	**Credits**
1 &II	**24UBT1A1P**		**Allied-I Practical**: Lab in Biochemistry & Immunology							**6**	**3**
Course Outcomes	**Programme Outcome (POs)**					**Programme specific outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	3	3	2	2	3	3	2	3	3
CO2	3	3	2	2	3	2	3	3	2	2	2
CO3	2	3	3	3	2	2	3	3	2	3	3
CO4	3	2	2	3	2	3	3	2	2	3	2
CO5	2	3	3	2	3	2	3	3	2	2	2
										Mean Overall Score	2.4

Semester	Course code	Title of the course	Hours/week	credits
II	24UBT2C3	**CORE COURSE-III**: Microbiology	5	5

OBJECTIVES:

This course presents the Introduction about Microbiology and it helps the students to understand the types of Microscopies. On successful completion the subject student should have understand: structural organization of various organisms and the Microbial techniques involved in the environment, and applications of them.

UNIT I: INTRODUCTION

History of Microbiology, Classification of bacteria, fungi, virus, protozoa and algae – classical and molecular approaches. Scope of microbiology – Role of microbes in biotechnology.

UNIT II: MICROSCOPY & STERILIZATION

Microscopy - Simple and compound microscopy, Dark field, Phase contrast, Fluorescence and Electron Microscopy. Sterilization methods - physical and chemical methods- Mode of action – Antibiotic in clinical use - Resistance to antibacterial agents - MRSA, ESBL

UNIT III: MICROBIAL TECHNIQUES

Structure of bacteria - Bacterial growth and measurement of growth, Media – types and preparation- plating methods - staining methods (Gram's, capsule, spore, LCB mount)- methods of preservation and storage of microbes. Culture of fungi, virus and algae.

UNIT IV: APPLICATIONS OF MICROBIOLOGY

Bioinsecticides - Bacillus thuringiensis, Baculoviruses- Biofertilizers -Az spirillum and blue green algae - single cell protein – prebiotics and probiotics - Dairy products (Cheese and Yoghurt).

UNIT V: MICROBIAL PATHOGENESIS

Microbial Disease- host -pathogen interaction, clinical features, lab diagnosis and treatment of Airborne disease (Pneumonia, Chicken pox), food borne disease (Typhoid, Aspergillosis), Water borne disease (Cholera, Amoebiasis), Sexually transmitted disease (AIDS, Trichomoniasis), Vector borne disease (Dengue, Malaria).

UNIT VI: **CURRENT CONTOURS (For Continuous Internal Assessment only):**

The recent advancements in the course topics will be explained to the students then and there through expert lectures, online seminars or webinars.

Recommended Text

1) Pelczar.M. J., Chan E.C.S. and Noel. R.K. (2007). Microbiology. 7th Edition.,McGraw –Hill, New York.
2) Ananthanarayanan, Paniker, Kapil, Textbook book of Microbiology, 9th edition, Orient BlackSwan, 2013.
3) Dubey R.C. and Maheswari, S. (2003). A textbook of Microbiology, New Delhi: S. Chand & Co.
4) Prescott, Harley, Klein, Microbiology, 10th Edition, McGraw – Hill, 2016.
5) Gerhardt, P., Murray, R.G., Wood, W.A. and Kreig, N.R. (Editions) (1994) Methods for General and Molecular Bacteriology. ASM Press, Washington, DC

Reference Books

1)Madigan, Martinko, Bender, Buckley, Stahl, Brock Biology of Microorganisms, 14th edition, 2017.

2) Gillespie, Bamford, Medical Microbiology and Infection at a Glance, 4th edition, 2012.

3)Boyd, R.F. (1998). General Microbiology,2nd Edition., Times Mirror, Mosby CollegePublishing, St Louis.

4)Tortora, G.J., Funke, B.R., Case,C.L. (2013). Microbiology. An Introduction 11th Edition., A La Carte Pearson.

5) Salle. A.J (1992). Fundamental Principles of Bacteriology. 7th Edition., McGraw Hill Inc.New York.

Website and e-Learning Source

1) Horst W. Doelle (2004). Microbial Metabolism and Biotechnology. Proceedings of an E-seminar organized by the International organization for Biotechnology and Bioengineering (IOBB)
2) www. Biotech.kth.se Electronic Journal of biotechnology
3) http://www ejb.org/content.
4) https://www.cliffsnotes.com/study guides/biology/microbiology/introduction-to- microbiology/a-brief-history-of-microbiology
   https://bio.libretexts.org/@go/page/9188

OUTCOME OF THIS PAPER

On completion of the course, the student should achieve an understanding of the following:

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	To learn the Scope of Microbiology and History and Kingdom cocept of living organisms	K1,K4
CO 2	To study the various Microsopy and working principles	K4
CO 3	Summarize the structural organization of Bacteria, Virus, Protozoa and Actinomycetes and their reproduction	K5
C0 4	Outline the methods involved in media preparation and sterilization.	K3
CO 5	To learn the Vitamins and Minerals function in biology	K5

Mapping with programme Outcomes:

Relationship Matrix											
Semester	**Course code**		**Title of the Course**							**Hours**	**Credits**
II	**24UBT2C3**		**CORE COURSE-III**: Microbiology							**5**	**5**
Course Outcomes	**Programme Outcome (POs)**					**Programme specific outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	2	3	3	3	2	2	3	2	2
CO2	3	3	2	3	2	2	3	3	2	3	3
CO3	3	2	2	2	3	3	2	2	2	2	2
CO4	2	2	3	2	2	2	3	3	2	3	2
CO5	3	3	2	3	3	2	3	3	2	2	3
										Mean Overall Score	2.4 HIGH

Semester	Course code	Title of the course	Hours/week	credits
II	**24UBT2C4P**	**CORE COURSE-IV**: Lab in Microbiology	4	3

OBJECTIVE

This course presents the study of Laboratory Rule, Media preparation and growth measurement of the microbes.

Experiments:

1. Laboratory Rules and Regulations of Microbiology
2. Preparation of glassware and sterilization
3. Preparation of culture media for bacteria
4. Pure Culture Technique—Pour Plate, Spread Plate and Streak Plate Methods.
5. Serial Dilution Technique.
6. Isolation of Microorganism from Soil, Water and Spoiled Food.
7. Motility of bacterial cell
8. Staining of Bacteria- Simple, Gram's, Spore, Capsule.
9. Fungal Staining -Wet Mount technique.
10. Biochemical characterization of Bacteria.
11. Antibiotic sensitivity test

REFERENCE:

1. Joanne Willey, Linda Sherwood & Christpher J.Woolverton 2017, Prescott's Microbiology Mc Graw Hill Education
2. James G. Cappuccino 2017 Microbiology - Laboratory ManualPearson.
3. Michael J. Leboffe & Burton, E. Pierce 2016, Microbiology:Laboratory Theory and Application,Brief. Morton.
4. Mark Gladwin, William,Trattler & C. Scott Mahan,2016 Clinical Microbiology,made Ridiculously simple–6th Edition,Medmaster

OUTCOME OF THIS PAPER

On completion of the course, the student should achieve an understanding of thefollowing:

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Illustrate the techniques involved in sterilization of media and glasswares	K1,K2
CO 2	Demonstrate the various pure culture techniques and to measure the bacterial growth.	K4
CO 3	Identify the organisms by various staining techniques.	K3
C0 4	Apply various biochemical tests to characterize microorganisms.	K5
CO 5	T o learnAntibiotic sensitivity test	K4

Mapping with programme Outcomes:

Relationship Matrix											
Semester	**Course code**		**Title of the Course**							**Hours**	**Credits**
II	**24UBT2C4P**		**CORE COURSE-IV**: Lab in Microbiology							**4**	**3**
Course Outcomes	**Programme Outcome (POs)**					**Programme specific outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	3	2	2	2	3	2	3	3	2
CO2	3	2	3	3	2	3	2	3	2	3	3
CO3	2	3	3	2	3	2	2	3	2	2	2
CO4	3	2	3	3	2	3	3	2	2	3	3
CO5	2	3	2	3	3	2	2	3	2	2	2
Mean Overall Score											2.4

Semester	Course code	Title of the course	Hours/week	credits
II	24UBT2A2	**Allied-II**: Immunology	4	4

OBJECTIVE:

On successful completion the subject student should have understand: immunity, antigen, antibody, cells of immune system and their function and regulations.

UNIT INTRODUCTION

Introduction to Immunology. Cells involved in immune response. Primary and Secondary lymphoid organs – Thymus, Bone marrow, Lymph nodes and Spleen. Hematopoiesis – development of B and T lymphocytes. Types of immunity – Innate and acquired

UNIT II ANTIGEN

Antigen: Characteristics and types. Antibody – Structure, Types, Properties and their Biological Function. Production of antibodies- Hybridoma technology: Applications of Monoclonal antibodies in biomedical research.

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UNIT III ANTIGEN–ANTIBODY REACTIONS

Antigen – Antibody interactions, Immunodiffusion and Immune electrophoresis. Principle and application of ELISA and RIA and Fluorescent antibody technique and Western Blotting. Purification of antibodies.

UNIT IV COMPLEMENT SYSTEM

The complement system and activation and regulation. Types – Classical, alternative and Lectin pathway. Biological function of C' proteins. Cytokines- Structure and Function. Vaccines – Types, Production and application.

UNIT V HYPERSENSITIVITY REACTIONS

Hypersensitivity Reactions and Types. Major Histocompatibility Complex – MHC genes, MHC in immune responsiveness, Structure and function of Class I and Class II MHC molecules. HLA tissue typing.

UNIT VI: CURRENT CONTOURS (For Continuous Internal Assessment only):

The recent advancements in the course topics will be explained to the students then and there through expert lectures, online seminars or webinars.

Recommended Text

1) Thomas J. Kindt, Barbara A. Osborne and Richard A Goldsby, 2006. Kuby Immunology. 6th edition, W. H . Freeman and Company.
2) Kannan, I., 2010. Immunology. MJP Publishers, Chennai.
3) Abbas, A.K., A.H.L., Lihtman and S. Pillai, 2010. Cellular and Molecular Immunology, 6th Edition. Saunders Elsevier Publications, Philadelphia.
4) NandiniShetty, 1996, Immunology : introductory textbook – I. New Age International, New Delhi.
5) Fahim Halim K.,2009. The Elements of Immunology. Pearson Education

Reference Books

1) Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt, 2011. Roitt.s Essential Immunology, 12 edition, Wiley- Blackwell. USA.
2) Janeway Travers. (1997). Immunobiology- the immune system in health and disease. Current Biology Ltd. London, New York. 3rd Edition.
3) William R Clark. (1991). The Experimental Foundations of Modern Immunology. 3rdEdition. John Wiley and Sons Inc. New York.
4) Frank C. Hay, Olwyn M. R. Westwood. (2002). Practical Immunology, 4thEdition., Wiley-Blackwell.
5) Noel R. Rose, Herman Friedman, John L. Fahey. (1986). Manual of Clinical Laboratory Immunology. ASM.3rd Editio

Website and e-Learning Source

https://www.ncbi.nlm.nih.gov/books/NBK279395/
https://med.stanford.edu/immunol/phd-program/ebook.html
https://ocw.mit.edu/courses/hst-176-cellular-and-molecular-immunology-fall-2005/pages/lecture-notes/
Immunology Overview - Medical Microbiology - NCBI Bookshelf (nih.gov)

OUTCOME OF THIS PAPER:

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Compare and contrast innate and adaptive immunity.	K1,K2
CO 2	Describe which cell types and organs present in the immune response.	K3
CO 3	Describe the immunological response agains, Elucidate the reasons for immunization and aware of different vaccination	K3
C0 4	llustrate various mechanisms that regulate immune responses and maintain tolerancet tumor and blood transfusion.	K5
CO 5	To learn the clinical immunology .	K4

Mapping with programme Outcomes:

Relationship Matrix											
Semester	**Course code**		**Title of the Course**							**Hours**	**Credits**
II	**24UBT2A2**		**Allied-II**: Immunology							**4**	**4**
Course Outcomes	**Programme Outcome (POs)**					**Programme specific outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	3	2	3	3	2	3	2	3	3
CO2	3	2	3	2	3	2	2	2	3	2	2
CO3	3	2	2	3	2	3	2	2	2	3	2
CO4	2	3	3	2	3	2	3	3	2	3	3
CO5	3	2	2	3	2	3	2	2	3	3	2
									Mean Overall Score		2.4 HIGH

Semester	Course code	Title of the course	Hours/week	credits
III	24UBT3C5	**CORE COURSE-V**: Molecular Biology	5	5

OBJECTIVES:

The course provides information regarding genes their structure and genetic drifting. Further the chromosomal variation is also explained genetics gene expression and regulation.

UNIT I GENES, CHROMOSOMES & HEREDITARY

Definition and scope of genetics. DNA as a genetic material: transforming principle, biochemical characterization of transforming principle, Hershey and chase experiment, properties of genetic material. Cellular reproduction (cell division): significance and types of cell division. mendelism: basic principles.

UNIT II GENE INTERACTION

Gene interaction, Epistasis, Lethality and lethal genes, sex determination and sex linkage in diploids, Linkage and Crossing over, Gene mapping. Chromosomal theory of inheritance, maternal effects, chromosomal aberrations, Genetics of hemoglobin, Transposable elements in prokaryotes and eukaryotes.

UNIT III STRUCTURE OF GENE

Fine structure of Prokaryotic and Eukaryotic gene, Cytoplasmic genetic systems- Mitochondria and Chloroplast DNA, Plasmids- F, R and Col plasmids, Population genetics, Calculating Gene frequency, Factors affecting gene frequency. Genetic drift, shift, pedigree analysis and genetic counseling.

UNIT IV STRUCTURE OF NUCLEIC ACIDS &DNA REPLICATION

Conformation of DNA and RNA; Replication in prokaryotes. Organization of eukaryotic chromosome – cot value, Recombination in bacteria - transformation, transduction and conjugation, Transcription, Translation.

UNIT V REGULATION OF GENE EXPRESSION

Elucidation of genetic code, codon usage, Operons: prokaryotic gene regulation; Lac and trp operon , Lambda phage life cycle and gene regulation.

UNIT VI: **CURRENT CONTOURS (For Continuous Internal Assessment only):**

The recent advancements in the course topics will be explained to the students then and there through expert lectures, online seminars or webinars.

REFERENCE:

1.D.L.Hartl (1991) Basic Genetics. Jones and Bartett publishers, Burlington.

2.Friedfelder (1987) Microbial genetics. Jones and Bartett publishers, Burlington.

3.Watson (1987) Molecular Biology of the genes 4th Ed. Benjamine /cummings coins.

4.James Darnell, Harvey Lodish, and David Baltimore (1993) Molecular cell biology 2nd Ed. Scientific American Books,New York.

OUTCOME OF THIS PAPER

- At the end of this paper students can learn about,

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	To study about the chromosomes, genes and their functions, basic concepts of hereditary and population genetics	K1,K2
CO 2	Describe the organisation and development of the genetic makeup on cellular, chromosomal and gene level.	K3
CO 3	To study the Structure of gene and function	K5
C0 4	Explain DNA replication and repair mechanism..	K4
CO 5	Outline the gene regulatory mechanisms.	K3

Mapping with programme Outcomes:

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Relationship Matrix											
Semester	**Course code**		**Title of the Course**							**Hours**	**Credits**
III	**24UBT3C5**		**CORE COURSE-V**: Molecular Biology							**5**	**5**
Course Outcomes	**Programme Outcome (POs)**					**Programme specific outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	2	3	3	2	3	3	2	3	3
CO2	3	2	3	2	3	3	2	3	2	2	2
CO3	2	3	3	2	3	3	2	3	2	3	3
CO4	3	2	2	2	3	2	3	3	2	3	2
CO5	2	3	2	3	3	2	2	3	2	3	2
Mean Overall Score											2.4 HIGH

Semester	Course code	Title of the course	Hours/week	credits
III	24UBT3C6P	**CORE COURSE-VI**: Lab in Molecular Biology	4	3

OBJECTIVE

This course presents the study of extraction an estimation method of nucleic acid, Biochemical characteristics, isolation techniques and mutation.

Experiments:

1. Extraction of DNA
2. Extraction of RNA
3. Estimation of DNA (DPA method)
4. Estimation of RNA (Orcinol method)
5. Isolation of Plasmid DNA.
6. Mutagenesis in Bacteria: The Ames test
7. Transformation in *E. coli.*
8. Mutant isolation by gradient plate technique - Replica plate technique.
9. Preparation of polytene chromosome from chironomus larvae.

REFERENCES:

1. Voet & Voet (1995) Fundamentals of Biochemistry, 2nd Ed, John Wiley and sonsinc., New York.
2. Geoffery L Zubay (1995) Principles of Biochemistry, WCB publishers, London.

OUTCOME OF THIS PAPER:

On completion of this paper the student should achieve an understanding of the following:

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Illustrate the techniques of Extraction of DNA Extraction of RNA	K3
CO 2	Demonstrate the Estimation of DNA (DPA method) Estimation of RNA (Orcinol method)	K4
CO 3	Illustrate the techniques of Mutagenesis in Bacteria: The Ames test	K3
C0 4	Demonstrate the Mutant isolation by gradient plate technique - Replica plate technique.	K5
CO 5	To learn the Preparation of polytene chromosome from chironomus larvae.	K4

Mapping with programme Outcomes:

Relationship Matrix											
Semester	**Course code**		**Title of the Course**							**Hours**	**Credits**
1II	24UBT3C6P		**CORE COURSE-VI**: Lab in Molecular Biology							**4**	**3**
Course Outcomes	**Programme Outcome (POs)**					**Programme specific outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	3	2	3	2	3	2	3	3
CO2	2	3	3	2	2	3	2	3	2	2	2
CO3	3	2	3	2	2	3	2	3	2	3	2
CO4	2	3	2	3	3	2	3	3	2	3	3
CO5	2	3	3	2	2	3	2	3	2	2	2
									Mean Overall Score		2.4 HIGH

Semester	Course code	Title of the course	Hours/week	credits
III	24UBT3A3	**Allied Course III** -Bioinformatics & Biostatistics	4	4

OBJECTIVES:

- The objectives of this course is to learn ,understand and apply the basic concepts of Bioinformatics and its significance in biological data analysis.
- Biostatistics course aims to develop competency and expertise in the application of statistical methods applied to biological data obtained in experimental techniques.

UNIT I INTRODUCTION TO BIOINFORMATICS AND BIOLOGICAL DATABASES

Bioinformatics- Definition, History, scope and applications. Internet Basics: Connecting to the Internet,E-mail,FTP,WWW,Difference between www and Internet .Bioinformatics web portals :NCBI, EBI, ExPASy. Biological databases: Classification of databases primary (Genbank), secondary (PIR)and tertiary or composite(KEGG) databases. Sequence databases -DNA Sequence databases(ENA,DDBJ).Protein sequence databases(Swissprot, PROSITE)

UNIT II SEQUENCE ALIGNMENT

Basics of sequence alignment-match, mismatch, gaps, gap penalties, scoring alignment. Types of sequence alignment- pairwise and multiple alignment, local and global alignment

UNIT III MATRIX COMPARISON

Dot matrix comparison of sequences. Scoring matrices-PAM and BLOSUM. Pairwise sequence similarity search by BLAST and FASTA. Concepts of phylogeny-Distance based (NJ method) and character based (ML method) tree construction methods

UNIT IV BASIC CONCEPTS IN BIOSTATISTICS

Introduction to Biostatistics, kind of data and variables- based on nature (numerical-discrete and continuous, categorical-ordinal and nominal) -based on source (primary and secondary data), sample size, sampling methods and sampling errors. Data tabulation and representation methods: graphical methods- stem and leaf plot, line diagram, bar graphs, histogram, frequency polygon, frequency curves; diagrammatic method-pie diagram

UNIT V BIOSTATISTICS-APLLICATIONS

Introduction to Probability-definition; Normal distribution- definition and properties. Hypothesis testing- steps in testing for statistical hypothesis, null and alternative hypothesis, level of significance-type-1 and type-2 errors. Test of significance for large samples- Z-test for means and proportions Test of significance for small samples- student's t-test (one sample and two samples). Chi-square test and its applications- goodness of fit (not based on distribution), test of Independence. Analysis of variance (One- way ANOVA) and their applications to biology

UNIT VI CURRENT CONTOURS (For Continuous Internal Assessment only)

The recent advancements in the course topics will be explained to the students then and there through expert lectures, online seminars or webinars.

REFERENCE BOOKS:

1. Khan &Khanum (2004), Fundamentals of Biostatistics, I Revised Edition, Ukaaz Publication
2. Bailey, N.T.J., Statistical methods in Biology, Cambridge Univ. Press
3. Fundamentals of Biostatistics, P Hanmanth Rao and K> Janardhan
4. Danial, W. W. Biostatistics, Wiley
5. Introduction to Bioinformatics By Aurther Mlesk
6. Developing Bioinformatics Computer Skills By: Cynthia Gibas, Per Jambeck
7. Bioinformatics second edition By David Mmount
8. Essential Bioinformatics By JinXiong
9. Bioinformatics Computing By Bryan Bergeron
10. Bioinformatics: Concepts, Skills & Applications By R.S.Rastogi

OUTCOME OF THIS PAPER:

On completion of this paper the student should achieve an understanding of the following:

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	To understand and apply the skills gained, in basic concepts of bioinformatics including databases search as and role of internet in bioinformatics	K1
CO 2	To understand and analyse methods to characterize and manage the different types of biological data and gain an insight in to the basics of sequence alignment and analysis	K2
CO 3	To understand and apply basic concept in biostatistics exemplifying sampling methods, graphical representation of data, measuring central tendencies, dispersion etc.	K3& K4
CO 4	To understand and apply skills in hypothesis testing using statistical methods for analyzing one or two variables, interpret and explain a p-value, perform a two sample t-test and interpret the results.	K5

Mapping with programme Outcomes:

Relationship Matrix											
Semester	**Course code**		**Title of the Course**							**Hours**	**Credits**
III	24UBT3A3		**ALLIED COURSE III-** Bioinformatics & Biostatistics							**4**	**3**
Course Outcomes	**Programme Outcome (POs)**					**Programme specific outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	3	2	3	2	3	2	3	3
CO2	2	3	3	2	2	3	2	3	2	2	2
CO3	3	2	3	2	2	2	2	2	2	3	2
CO4	2	3	2	3	3	2	3	3	2	3	3
CO5	2	3	3	2	2	3	2	3	2	2	2
Mean Overall Score											2.4 HIGH

Semester	Course code	Title of the course	Hours/week	credits
III	24UBT4A2P	**ALLIED PRACTICAL III &IV-** Lab in Bioinformatics & Biostatistics	3	3

OBJECTIVE

The course structure of the course provides the basic tools used in biostatistics like mean, median,t test an basic bioinformatics tools like Genbank, NCBI,SCOP and CATH.

Experiments:

1. Collection of data, sampling designs, tabulation and Graphical representation.
2. To find Mean, Mode, Median, Co-efficient of variance.
3. 't' Test, chi square, statistical error, standard deviation also, to be practically done through SPSS programme [statistical Package for Social Sciences].
4. Study of Nucleic acid sequence databanks – GenBank, EMBL nucleotide sequence databank, DDBJ.
5. Study of Protein Structure and Classification databases – PDB, SCOP and CATH.`
6. Multiple alignment – Clustal W, BLAST.
7. Evaluation of protein structure by Swiss PDB viewer and RASMOL.
8. Simulation Techniques – GROMACS

OUTCOME OF THIS PAPER:

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	To understand the nucleotide and protein sequence analysis package	K4
CO 2	To understand protein and RNA structure analysis tools	K3
CO 3	To understand the various tools involved in genome annotation	K5
C0 4	CRNA structure analysis tools. and importance of Bioinformatics	K3
CO 5	To learn the role of internet in Bioinformatics.	K4

Note.Kl-Remembering,K2 —Understanding; K3 —Applying, K4 —Analysing; K5- Evaluating,

Mapping with programme Outcomes:

Relationship Matrix											
Semester	**Course code**		**Title of the Course**							**Hours**	**Credits**
III & IV	24UBT4A2P		**ALLIED PRACTICAL IV-** Lab in Bioinformatics & Biostatistics							**6**	**3**
Course Outcomes	**Programme Outcome (POs)**					**Programme specific outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	3	2	2	3	2	3	2	2	2
CO2	3	2	3	3	2	3	2	3	2	3	3
CO3	3	2	3	2	2	3	2	3	2	3	2
CO4	2	3	2	3	3	2	3	3	2	3	3
CO5	2	3	3	2	2	3	2	3	2	2	2
Mean Overall Score											2.4 HIGH

Semester	Course code	Title of the course	Hours/week	credits
III	24UBT3N1A	**NME-1**: A) Basics of	2	2

		Biotechnology		

OBJECTIVES

This course provides an understanding of biotechnology, carefully blending science, consumer applications, regulatory information. A comprehensive overview of the basic science underlying the principles of biotechnology is also explained.

UNIT 1 INTRODUCTION

Historical perspective on Science, technology, and society-Advancement of mankind due to science and its relevance in present day living conditions.

UNIT II BASIC CONCEPTS ABOUT CELL

Cell: basic unit of life-Molecular components of cell-Expression of genetic information-Protein structure and function-Cell metabolism-Cells maintain their internal environments-Cells respond to external environments-Cells grow, reproduce,and differentiate.

UNIT III ORGANISMS TO ECOSYSTEMS

Patterns of Genetic Inheritance--From Genotype to Phenotype-Evolutionary Mechanisms Ecological Interactions.

UNIT IV BIOTECHNOLOGY-APPLICATIONS AND ISSUES

Basic concepts about biotechnology-Research applications-Biotechnology toolbox Biotechnology in the research laboratory.

UNIT V COMMERCIAL APPLICATIONS OF BIOTECHNOLOGY

Moving Science from the Laboratory into Society-Risks and Regulations -Health Care Applications -Medical Biotechnology in Society - Biotechnology in the Food Industry-Ecology and Evolution in Agriculture-Biotechnology and Sustainable Agriculture-Environmental Sustainability and Biotechnology.

UNIT VI: **CURRENT CONTOURS (For Continuous Internal Assessment only):**

The recent advancements in the course topics will be explained to the students then and there through expert lectures, online seminars or webinars.

REFERENCES

1. Helen Kreuzer and Adrianne Massey (2005) Biology and Biotechnology: Science,Applications, and Issues , ASM Press.

COURSE OUTCOME

- At the end of this paper Students can learn about

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Students students will be able to understand the basic unit of the organisms	K3,K1
CO 2	To learn differentiate the organisms by its cell structur	K4
CO 3	To learn to Components of the Cell and their division	K3
CO 4	Students can gain the enzyme and nucleic acid modification and conjugation	K5
C0 5	Students will know the influence of environment on gene expression.	K4

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Mapping with programme Outcomes:

Relationship Matrix											
Semester	**Course code**		**Title of the Course**							**Hours**	**Credits**
1III	24UBT3N1A		**NME-1**: A) Basics of Biotechnology							**2**	**2**
Course Outcomes	**Programme Outcome (POs)**					**Programme specific outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	2	3	3	2	3	3	2	3	3
CO2	3	2	3	2	3	3	2	3	2	2	2
CO3	2	3	3	2	3	3	2	3	2	3	3
CO4	3	2	2	2	3	2	3	3	2	3	2
CO5	2	3	2	3	3	2	2	3	2	3	2
										Mean Overall Score	2.4 HIGH

Semester	Course code	Title of the course	Hours/week	credits
III	24UBT3N1B	**NME-1**: B) Health care Biotechnology	2	2

OBJECTIVES

The course is designed to make the student learn about the therapeutic agents such as Proteins, Enzymes, Hormones and its application. They also get the knowledge about the Production of vaccines and the Gene therapy techniques.

UNIT I SIMPLE PROTEINS AND THERAPEUTIC AGENTS

Proteins as therapeutic agents - Choice of expression systems and optimizing gene expression - Applications, delivery and targeting of therapeutic proteins – Regulatory aspects of therapeutic proteins.

UNIT II HORMONES, RECOMBINANT BLOOD PRODUCTS&ENZYMES AS THERAPEUTIC AGENTS

Insulin, Glucagon, Human growth hormones - Gonadotrophins - Haemostasis –Anticoagulants - Thrombolytic agents - Enzymes of therapeutic value – Asparaginase-Dnase– Glucocerebrosidase – Galactosidase - Urate oxidase – Laronidase - Superoxide dismutase - Debriding agents Digestive aids.

UNIT III MONOCLONAL ANTIBODIES & VACCINES

Introduction to monoclonal antibodies - Development of monoclonal antibodies – Expression of antibody molecules - Purification of monoclonal antibodies - Clinical uses of monoclonal antibodies - Hybrid human - Mouse antibodies - Production of recombinant monoclonal antibodies, Bacterial polysaccharides, proteins and toxins as vaccines – Recombinant vaccines- subunit, attenuated and vector vaccines - Multivalent vaccine development against AIDS.

UNIT IV CYTOKINES & GENE THERAPY

Interferons- Engineering human interferons -Tumour necrosis factor – interleukins Haemopoietic growth factors - Gene therapy – in search of the perfect disease - Gene therapy – the real diseases - Delivery systems for gene therapy - Gene therapy in the clinic.

UNIT V PEPTIDES & ANTISENSE OLIGONUCLEOTIDES

The nervous system- Immune responses to peptides - Neurological diseases - The use of peptides in the treatment of neurological disease -The science of antisense - Requirements of a genetic drug- Mechanisms of action of antisense molecules - Animal models and oligonucleotides-Clinical trials- towards the next generation of antisense drugs.

UNIT VI: **CURRENT CONTOURS (For Continuous Internal Assessment only):**

The recent advancements in the course topics will be explained to the students then and there through expert lectures, online seminars or webinars

REFERENCES

1. Ratledge, C., Kristiansen, B (2001) Basic Biotechnology 2nd Ed. Cambridge University Press,USA.
2. Walsh, G (2007) Pharmaceutical Biotechnology: Concepts and Applications, JohnWiley &Sons, England.

COURSE OUTCOME

- At the end of this paper Students can learn about

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	students can learn about simple proteins and therapeutic agents	K3
CO 2	students can learn about simple proteins and therapeutic agents, hormones, recombinant blood products &enzymes as therapeutic agents	K4
CO 3	Students can explain the concept and application of monoclonal antibody technology	K4
CO 4	Students can learn cytokines and gene therapy techniques	K5
C0 5	Students will know the peptides and Antisence oligonucleotides	K3

Mapping with programme Outcomes:

Relationship Matrix											
Semester	**Course code**		**Title of the Course**							**Hours**	**Credits**
III	24UBT3N1B		**NME-1**: B) Health care Biotechnology							**2**	**2**
Course Outcomes	**Programme Outcome (POs)**					**Programme specific outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	3	2	2	3	2	3	2	2	2
CO2	3	2	3	3	2	3	2	3	2	3	3
CO3	3	2	3	2	2	3	2	3	2	3	2
CO4	2	3	2	3	3	2	3	3	2	3	3
CO5	2	3	3	2	2	3	2	3	2	2	2
									Mean Overall Score		2.4 HIGH

Semester	Course code	Title of the course	Hours/week	credits
III	24UBT3N1C	**NME-1**: C) Process Instrumentation Dynamic and Control	2	2

OBJECTIVES

The students gains the knowledge in designing a control system and identifying the alternative control configuration for a given process plant or entire plant.

UNIT I MATHEMATICAL TECHNIQUES

Laplace transformation, transform of standard functions, derivatives and integrals, inversion, theorems in Laplace transformation, application. Open-loop systems, first order systems and their transient response for standard input functions, first order systems in series, linearization and its application in process control, second order systems and their dynamics, transfer function for chemical reactors and dynamics.

UNIT II CONTROL SYSTEMS

Closed loop control systems, development of block diagram for feed-back control systems, servo and regulator problems, Transfer function for controllers and final control element, principles of pneumatic and electronic controllers, transportation lag, transient response of closed-loop control systems and their stability.

UNIT III FREQUENCY RESPONSE

Introduction to frequency response of closed-loop systems, control system design by frequency, bode diagram, stability criterion, Nyquist diagram; Tuning of controller settings.

UNIT IV CONTROLLER MECHANISM

Controller mechanism, introduction to advanced control systems, cascade control, feed forward control, control of distillation towers and heat exchangers, introduction to microprocessors and computer control of chemical processes.

UNIT V PROCESS CONTROL INSTRUMENTS

Principles of measurements and classification of process control instruments, measurements of temperature, pressure, fluid flow, liquid weight and weight flow rate,viscosity and consistency, pH, concentration, electrical and thermal conductivity, humidity of gases.

REFERENCES

1.Coughnowr and Koppel (1986) Process Systems Analysis and Control. McGraw-Hill, New York

2.Process Control: Modeling, Design, and Simulation" by B. Wayne Bequette (2003, 1st Edition, Prentice Hall),

3.Process Dynamics and Control" by Dale E. Seborg, Thomas F. Edgar, and Duncan A. Mellichamp (2010, 3rd Edition, Wiley),

4.Introduction to Process Control" by Carlos A. Smith (2005, 2nd Edition, McGraw-Hill) are authoritative references on process instrumentation dynamics and control.

COURSE OUTCOME

- At the end of this paper Students can learn about

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	To make the students understand basic ideas, challenges, techniques, and applications of process control for controlling various processes	K1,K2
CO 2	Specify the required instrumentation and final elements to ensure that well-tuned control is achieved	K4
CO 3	block diagrams & the mathematical basis for the design of control systems	K3
CO 4	To lean the Design and tune process (PID) controllers	K5
C0 5	Students will know the Principles of measurements and classification of process control instruments,	K3

Mapping with programme Outcomes:

Relationship Matrix											
Semester	**Course code**		**Title of the Course**							**Hours**	**Credits**
III	24UBT3N1C		**NME-1**: C) Process Instrumentation Dynamic and Control							**2**	**2**
Course Outcomes	**Programme Outcome (POs)**					**Programme specific outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	2	3	3	2	3	3	2	3	3
CO2	3	2	3	2	3	3	2	3	2	2	2
CO3	2	3	3	2	3	3	2	3	2	3	3
CO4	3	2	2	2	3	2	3	3	2	3	2
CO5	2	3	2	3	3	2	2	3	2	3	2
										Mean Overall Score	2.4 HIGH

Semester	Course code	Title of the course	Hours/week	credits
IV	24UBT4C7	**CORE COURSE-VII**: Recombinant DNA Technology	5	5

OBJECTIVES: The course provides information regarding the enzyme, strategies and techniques. The ethical issues involved in the recombinant DNA technology is also discussed.

UNIT – I INTRODUCTION

Introduction to recombinant DNA technology – tools for rDNA technology – DNA manipulative enzymes: restriction enzymes, ligases, polynucleotide kinase,phosphatase, cutting of DNA molecules – joining of DNA molecules – homopolymer tails, linkers, adapters.

UNIT – II VECTORS

Gene cloning vectors: salient features, plasmids – properties, types, pBR322 and pUC18, bacteriophage vectors – l, l ZAP, lgt11, cosmids, artificial chromosomes – BAC, YAC, MAC. Cloning bovine somatostatin gene in E. coli.

UNIT – III TRANSFORMATION

Transformation of r-DNA into target host organisms: calcium chloride mediated gene transfer, Agrobacterium mediated DNA transfer, electroporation, microinjection, liposome fusion, particle gun bombardment. Screening and selection of recombinant host cells: blue/white screening**.**

UNIT- IV TECHNIQUES OF GENE CLONING

Polymerase Chain Reaction & qPCR, Electrophoresis & Blotting Techniques, Site- Directed Mutagenesis, DNA Sequencing, Reporter Gene Assays, DNA-Protein Interaction Assays, Protein-Protein Interaction Assays, DNA Fingerprinting. Construction of gene libraries: genomic and cDNA libraries.

UNIT – V APPLICATION

Applications of rDNA technology in industry, medicine, agriculture and pharmacy.Social impact of recombinant DNA technology.

UNIT VI: **CURRENT CONTOURS (For Continuous Internal Assessment only):**

The recent advancements in the course topics will be explained to the students then and there through expert lectures, online seminars or webinars.

REFERENCES:

1. Ernst.L.Winnacker (2003) From genes to Clones 2nd Ed. Panima publishing corporation, New Delhi.
2. James.D.Watson (2001) Recombinant DNA technology 2nd Ed. WH Freeman and company, New York.
3. Glick and Pasternak (1996) Molecular Biotechnology. Panima publishing corporation,New Delhi.

4. BrownT.A. (1998) Introduction to gene cloning 3rd Ed. Stanley Thomas Publishing Ltd, London.
5. PrimroseS.B. (2003) Principles of gene manipulation 6th Ed. Blackwell Science Ltd, Germany
6. The Secretariat of the Convention on Biological Diversity (2000) Cartagena Protocol on Biosafety.
7. M.R. Dano (1994) Biological Warfare in the 21st century. BrassiesLondon.

OUTCOME OF THIS PAPER

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	To understand the Introduction of rDNA into bacterial cells	K4
CO 2	To understand Selection of transformants and recombinants – lac selection	K3
CO 3	To Learning tools and techniques in rDNA technology- DNA manipulative enzymes	K4
C0 4	Methods for selection of recombinants and analysis of cloned genes by sequencing methods,	K5
CO 5	To learn the Expression of recombinant protein in *E. coli* and eukaryotes	K3

Mapping with Programme Outcomes:

Relationship Matrix											
Semester	**Course code**		**Title of the Course**							**Hours**	**Credits**
IV	24UBT4C7		**CORE COURSE-VII**: Recombinant DNA Technology							**5**	**5**
Course Outcomes	**Programme Outcome (POs)**					**Programme specific outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	3	2	2	3	2	3	2	2	2
CO2	3	2	3	3	2	3	2	3	2	3	3
CO3	3	2	3	2	2	3	2	3	2	3	2
CO4	2	3	2	3	3	2	3	3	2	3	3
CO5	2	3	3	2	2	3	2	3	2	2	2
Mean Overall Score											2.4 HIGH

Semester	Course code	Title of the course	Hours/week	credits
IV	24UBT4C8P	**CORE COURSE-VIII**: Lab in Recombinant DNA Technology	4	3

OBJECTIVE

To learn about recombinant DNA technology –isolation techniques,Restriction and ligation, transformation techniques

Experiments:

1. Isolation of genomic DNA from plant, animal cells & from bacteria
2. Isolation of plasmid DNA
3. Analysis of plasmid DNA by agarose gel electrophoresis
4. Restriction digestion – single & double digestion.
5. Ligation.
6. Preparation of competent *E.coli* cells
7. Transformation of *E.coli* with recombinant DNA.
8. Selection & screening of rDNA products – Antibiotic resistance, Blue white colony.
9. PCR amplification
10. Blotting Techniques- Southern blotting, Northern blotting and Western blotting.
11. RAPD
12. RFLP

OUTCOME OF THIS PAPER: At the end of this paper Students can learn about

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	To understand the Isolation of genomic DNA from plant, animal cells & from bacteria	K4,K1
CO 2	To understand Selection of transformants and recombinants – lac selection	K3
CO 3	To Learning tools and techniques in rDNA technology- DNA manipulative enzymes	K5
C0 4	Methods for selection of recombinants and analysis of cloned genes by sequencing methods,	K3
CO 5	To learn the Expression of recombinant protein in *E. coli* and eukaryotes	K3

Mapping with programme Outcomes:

Relationship Matrix											
Semester	**Course code**		**Title of the Course**							**Hours**	**Credits**
IV	24UBT4C8P		**CORE COURSE-VIII**: Lab in Recombinant DNA Technology							**4**	**3**
Course Outcomes	**Programme Outcome (POs)**					**Programme specific outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	2	3	3	2	3	3	2	3	3
CO2	3	2	3	2	3	3	2	3	2	2	2
CO3	2	3	3	2	3	3	2	3	2	3	3
CO4	3	2	2	2	3	2	3	3	2	3	2
CO5	2	3	2	3	3	2	2	3	2	3	2
Mean Overall Score											2.4 HIGH

Semester	Course code	Title of the course	Hours/week	credits
IV	24UBT4A4	**ALLIED-IV**: Bioinstrumentation	4	4

OBJECTIVES: This course will give an understanding about the working principles, construction and applications of the instruments often used in the studies related to various disciplines of Biological Sciences.

UNIT I BASIC INSTRUMENTS

Principles, operation protocol & applications of the following instruments: Weighing balance, pH meter, Polarography, Radioactivity, ECG, FTIR.

UNIT II MICROSCOPY

Observation of different microbes. Light – Bright & Dark field; Phase contrast, Inverted Phase contrast; Fluorescent, Electron – TEM & SEM; Confocal

UNIT III SPECTROSCOPY

Colorimeter, Spectrometer, UV visible spectrometer, X – ray spectrometer, ELISA reader, atomic absorption spectrometer, Flame photometer, Flourimeter & Spectro flourimeter.

UNIT IV SEPARATION TECHNIQUES

Centrifugation - Principle, operation, types & applications. Chromatography - Principle, operation & applications - Paper – ascending, descending & Circular, TLC, HPTLC, GC, HPLC, Column Chromatography, Ion Exchange & Affinity Chromatography, LC – MS.

UNIT V ELECTROPHORESIS

Basic principle and types of electrophoresis. Electrophoretic mobility. Factors affecting electrophoretic migration, Technique and uses of agarose gel electrophoresis, PAGE, SDS-PAGE, Two-dimensional electrophoresis and Isoelectric focussing, Maldi Tof.

UNIT VI: **CURRENT CONTOURS (For Continuous Internal Assessment only):**

The recent advancements in the course topics will be explained to the students then and there through expert lectures, online seminars or webinars.

REFERENCE BOOKS

1. S.Sadasivam., A. Manickam. 1996. Biochemical Methods 2ndEdition. New Age International (p) Ltd, Publishers.
2. Dr. G.Rajagobal., Dr. B.D.Toora. 2001. Practical Biochemistry. 1st Edition. AhujaBook Company Pvt.Ltd.
3. J.Jayaraman. 2000. Laboratory Manual in Biochemistry. New Age International (p).
4. Plummer Mu, David T. Plummer. 1988. Introduction to Practical Biochemistry. Tata

McGraw-Hill Education.
5.M. Mooyoung. 1985. Comprehensive Biotechnology. Vol. 2, 3 & 4. Pergamon press.

OUTCOME OF THIS PAPER:

- At the end of this paper Students can learn about

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	To learn the basic knowledge about instruments in biological industries such as microscope and its Types	K1,K2
CO 2	To study the understand the chromatography techniques to separate products	K4
CO 3	Tounderstand to analyse the Electrophoresis techniques.	K3
CO 4	To learn the Purification echniques	K5
C0 5	To Understand the Spectroscopy techniques	K3

Mapping with programme Outcomes:

Relationship Matrix											
Semester	**Course code**		**Title of the Course**							**Hours**	**Credits**
1V	24UBT4A4		**ALLIED-IV**: Bioinstrumentation							**4**	**4**
Course Outcomes	**Programme Outcome (POs)**					**Programme specific outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	2	2	3	2	3	3	2	2
CO2	2	3	3	2	3	2	3	3	2	3	3
CO3	3	3	2	2	2	3	3	2	3	2	2
CO4	2	3	2	2	3	3	3	2	2	2	2
CO5	3	3	2	3	2	2	3	2	2	3	2
Mean Overall Score											2.2 HIGH

Semester	Course code	Title of the course	Hours/week	credits
IV	24UBT4N2A	**NME-II-**A) Agricultural Biotechnology	2	2

OBJECTIVES: This course is designed to provide an idea about the basic principles and techniques involved in plant tissue culture and to understand the concepts of crop improvement and achievements of biotechnology in Agricultural sector.

UNIT I CONVENTIONAL CROP IMPROVEMENT

Crop improvement – Selection, mutation, polyploidy and clonal selection; Advantages of biotechnological methods over conventional methods of cropimprovement.

UNIT II PLANT TISSUE CULTURE

Basic techniques and tools in Plant Tissue Culture. Establishment of plant tissue culture lab: equipment, culture vessels, surface sterilization of various explants, pretreatment of explant, subculture and repeated transfer of explants and cultures. Composition of various tissue culture media and their preparation. Establishment of callus, suspension cultures, organogenesis and embryogenesis, Meristem tip culture, Hardening of plants, Techniques of anther, embryo and ovule culture. Protoplast isolation, culture and fusion. Artificial seed (synthetic seed)

UNIT III PLANTS AS BIOREACTORS

Use of bioreactors in plant production & Scale-up Marker assisted selection – introduction to markers (RFLP, AFLP, microsatellites, RAPD, QTL), generation of maps using markers, case studies of MAS, virus indexing.

UNIT IV TRANSGENICS IN CROP IMPROVEMENT

Genetic engineering in plants, Genetic engineering of plants for pest resistance, Herbicide resistance. Resistance to fungi and Bacteria, Delay of fruit ripening. Regulation of gene expression in plant development. Plant hormones and phytohormone. Seed storage proteins.

UNIT V HERBAL AND NURSERY TECHNOLOGY

Economic value of herbals and herbal drugs. Identification, cultivation andmicropropagation of herbals, biotechnological exploitation. Vegetative cuttings – selection of cuttings, collection season, treatment of cuttings, rooting medium- planting of cuttings. Hardening of plants – Green houses – mist chamber, shed root, shade house and glass home.

UNIT VI: **CURRENT CONTOURS (For Continuous Internal Assessment only):**

The recent advancements in the course topics will be explained to the students then and there through expert lectures, online seminars or webinars.

REFERENCES

1. Hou CT, Shaw JF (2009) – Biocatalysis and agricultural biotechnology, CRCPress, USA
2. Raw at H (2008) Agricultural biotechnology, 1st Ed. Oxford Book Co, India.
3. Kumar HD (2005) Agricultural biotechnology Daya Publ House, India
4. Newbury HJ (2009) Plant molecular breeding , John Wiley and Sons., USA.
5. S.S. Bhojwani and S.P. Bhatnagar (2009) Embryology of Angiosperms, VikasPubl House, India.
6. Ashwani Kumar, Shekhawat NS (2009) – Plant tissue culture and molecularmarkers: theor role in improving crop productivity (IK International)
7. H K Das (2010), Biotechnology 4th Ed , Wiley India Pvt. Limited, India.

COURSE OUTCOME

- At the end of this paper Students can learn about

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	The student will acquire knowledge about the range of approaches to manipulate and improve plants.	K1,K2
CO 2	Students will demonstrate the ability to develop, interpret in crop improvement	K4
CO 3	critically evaluate modern approaches to scientific investigation in field of agriculture.	K5
CO 4	Students can learn the produce transgenics in crop improvement	K3
C0 5	Students will know the Economic value of herbals and herbal drugs	K4

Mapping with programme Outcomes:

Relationship Matrix											
Semester	**Course code**		**Title of the Course**							**Hours**	**Credits**
IV	24UBT4N2A		**NME-II-**A) Agricultural Biotechnology							**2**	**2**
Course Outcomes	**Programme Outcome (POs)**					**Programme specific outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	2	3	3	2	3	3	2	3	3
CO2	3	2	3	2	3	3	2	3	2	2	2
CO3	2	3	3	2	3	3	2	3	2	3	3
CO4	3	2	2	2	3	2	3	3	2	3	2
CO5	2	3	2	3	3	2	2	3	2	3	2
										Mean Overall Score	2.4 HIGH

Semester	Course code	Title of the course	Hours/week	credits
IV	24UBT4N2B	**NME-II**-B) Solid Waste Management	2	2

OBJECTIVES: This course provides idea about the sources of solid wastes and the technologies used to manipulate them and the Process involved for their storage.

UNIT I SOURCES AND TYPES OF MUNICIPAL SOLID WASTES

Sources and types of solid wastes - Quantity - Factors affecting generation of solid wastes; characteristics - methods of sampling and characterization; Effects of improper disposal of solid wastes - public health effects

UNIT II ON-SITE STORAGE AND PROCESSING

On-site storage methods - Materials used for containers - on-site segregation of solid wastes -public health and economic aspects of storage - options under Indian conditions – Critical Evaluation of Options

UNIT III COLLECTION AND TRANSFER

Methods of Collection - types of vehicles - Manpower requirement - collection routes; transfer stations - selection of location, operation and maintenance; options under Indian conditions

UNIT IV OFF-SITE PROCESSING

Processing techniques and Equipment; Resource recovery from solid wastes - composting, incineration, Pyrolysis - options under Indian conditions

UNIT V DISPOSAL

Dumping of solid waste; sanitary land fills - site selection, design and operation of sanitary landfills - Leachate collection and treatment. Principle of solid waste management – social and economic aspects; Public awareness; Role of NGOs; Legislation

UNIT VI: **CURRENT CONTOURS (For Continuous Internal Assessment only):**

The recent advancements in the course topics will be explained to the students then and there through expert lectures, online seminars or webinars.

REFERENCES

1. Hilary Theisen and Samuel A (1993) George Tchobanoglous, Vigil IntegratedSolid Waste Management, McGraw-Hill Publishers.
2. Manual on Municipal Solid Waste Management (2000) CPHEEO, Ministry ofUrban Development, Government of India, New Delhi.
3. R.E.Landreth and P.A.Rebers (1997) Municipal Solid Wastes - problems andSolutions, Lewis Publishers.
4. Bhide A.D and Sundaresan B.B (1993) Solid Waste Management inDeveloping Countries, INSDOC.

COURSE OUTCOME

At the end of this paper Students can learn about

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Learn basic concepts of solid waste management	K1,K2
CO 2	Beginning from source generation to waste disposal in a system of municipality organizational structure	K4
CO 3	Develop understanding on various technological applications for processing of waste	K4
CO 4	Students can learn the and their disposals in various ways	K5
C0 5	Acquire knowledge on waste to energy productions in the perspectives of sustainable development	K3

Mapping with programme Outcomes:

Relationship Matrix											
Semester	**Course code**		**Title of the Course**							**Hours**	**Credits**
IV	24UBT4N2B		**NME-II**-B) Solid Waste Management							**2**	**2**
Course Outcomes	**Programme Outcome (POs)**					**Programme specific outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	2	2	3	2	3	3	2	2
CO2	2	3	3	2	3	2	3	3	2	3	3
CO3	3	3	2	2	2	3	3	2	3	2	2
CO4	2	3	2	2	3	3	3	2	2	2	2
CO5	3	3	2	3	2	2	3	2	2	3	2
									Mean Overall Score		2.2 HIGH

Semester	Course code	Title of the course	Hours/week	credits
IV	24UBT4N2C	**NME-II**-C) Industrial Waste Management	2	2

OBJECTIVES: The course is designed to impart knowledge on sources and characteristics of various industrial wastes and strategies for its prevention and control

UNIT I INTRODUCTION

Industrial scenario in India- Industrial activity and Environment - Uses of Water by industry - Sources and types of industrial wastewater - Industrial wastewater and environmental impacts - Regulatory requirements for treatment of industrial wastewater - Industrial waste survey - Industrial wastewater generation rates, characterization and variables – Population equivalent -Toxicity of industrial effluentsand Bioassay tests

UNIT II INDUSTRIAL POLLUTION PREVENTION

Prevention Vs Control of Industrial Pollution - Benefits and Barriers - Source reduction techniques - Waste Audit - Evaluation of Pollution prevention options – Environmental statement as a tool for pollution prevention - Waste minimization Circles

UNIT III INDUSTRIAL WASTEWATER TREATMENT

Equalisation - Neutralisation - Oil separation - Flotation - Precipitation - Heavy metal Removal - Refractory organics separation by adsorption - Aerobic and anaerobic biological treatment - Sequencing batch reactors - High Rate reactors – Chemical oxidation – Ozonation Photocatalysis - Wet Air Oxidation - Evaporation - Ion Exchange – Membrane Technologies - Nutrient removal

UNIT IV WASTEWATER REUSE & RESIDUAL MANAGEMENT

Individual and Common Effluent Treatment Plants - Joint treatment of industrial wastewater Zero effluent discharge systems – Quality requirements for Wastewater reuse – Industrial reuse -Disposal on water and land - Residuals of industrial wastewater treatment - Quantification and characteristics of Sludge - Thickening, digestion, conditioning, dewatering and disposal of sludge - Management of RO rejects

UNIT V CASE STUDIES

Industrial manufacturing process description, wastewater characteristics, source reduction options and waste treatment flow sheet for Textiles - Tanneries - Pulp and paper – metal finishing- Petroleum Refining - Pharmaceuticals - Sugar and Distilleries

- Food Processing - fertilizers - Thermal Power Plants and Industrial Estates

UNIT VI: **CURRENT CONTOURS (For Continuous Internal Assessment only):**The recent advancements in the course topics will be explained to the students then and there through expert lectures, online seminars or webinars.

REFERENCES

1. Eckenfelder W.W (1999)Industrial Water Pollution Control, McGraw-Hill, Arceivala, S.J., Wastewater (1998) Treatment for Pollution Control, Tata McGraw-Hill,
2. Frank Woodard (2001) Industrial waste treatment Handbook, ButterworthHeinemann, New Delhi.
3. Paul L (2000) Bishop Pollution Prevention: - Fundamentals and Practice, McGraw-Hill International

COURSE OUTCOME

- At the end of this paper Students can learn about

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	recognize the properties of the basic industries and the environmental impact of waste generated is able to compare,define the characteristics of industrial waste water	K1,K2
CO 2	To study the industrial pollution prevention	K4
CO 3	establish a relationship between the properties of of industrial waste water and principles of industrial waste water refining.	K3
CO 4	Develop understanding on various technological applications for processing of waste	K5
CO 5	Students can learn the and their disposals in various ways	K3

Mapping with programme Outcomes:

Relationship Matrix											
Semester	**Course code**		**Title of the Course**							**Hours**	**Credits**
1V	24UBT4N2C		**NME-II-**C) Industrial Waste Management							**2**	**2**
Course Outcomes	**Programme Outcome (POs)**					**Programme specific outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	3	2	2	3	2	3	2	2	2
CO2	3	2	3	3	2	3	2	3	2	3	3
CO3	3	2	3	2	2	3	2	3	2	3	2
CO4	2	3	2	3	3	2	3	3	2	3	3
CO5	2	3	3	2	2	3	2	3	2	2	2
Mean Overall Score											2.4 HIGH

Semester	Course code	Title of the course	Hours/week	credits
V	24UBT5C9	**CORE COURSE-IX** Plant Biotechnology	5	5

OBJECTIVES: This course is designed to make the understand about cropdevelopment, Callus culture, Biotechnological applications of plants.

UNIT I CROP IMPROVEMENT –CONVENTIONAL METHOD

Conventional methods of crop improvement- Selection, mutation, polyploidy andclonal selection. Application and need of crop improvement.

UNIT II INTRODUCTION OF PTC

History of PTC, Concept of Cellular Totipotency. Laboratory Organization, Sterilization Techniques, Media Preparation. Types of media – MS, Nitesh, Gambro's. Plant growth regulators. Cytoplasmic Male Sterility. Seed storage proteins and heat shock proteins.

UNIT III PLANT TISSUE CULTURE

Plant tissue culture. Callus culture, organogenesis, meristem culture, anther, pollen, embryo culture and their applications .somatic hybridization Somatic embryogenesis and cybrids, biopriming technology.

UNIT IV NITROGEN FIXATION

Symbiotic nitrogen fixation in legumes -Biochemistry and molecular biology, gene rearrangement and nitrogen fixation in cyanophytes. Agrobacterium and Crown gall tumors. Ti plasmid vectors for plant transformation, agro-infection.

UNITV TRANSFORMATION

Direct transformation of plants by using physical methods, Genetic engineering in plants-selectable markers, reporter genes and promoters used in plant vectors. Genetic engineering of plants for virus resistance, pest resistance, herbicide tolerance, delay of fruit ripening, resistance to fungi and bacteria. Importance of RFLP in plant breeding.

UNIT VI: **CURRENT CONTOURS (For Continuous Internal Assessment only):**

The recent advancements in the course topics will be explained to the students then and there through expert lectures, online seminars or webinars.

REFERENCES

1. Grierson,D., and S.N. Covey (1988) Plant Molecular Biology. Blackie&Sons. Ltd.Glascow.
2. Lycett, G.W. and D. Grierson (Eds) (1990) Genetic Engineering ofCrop Plants. Heinemann, London.

3. Mantel. S. H, Mathews. J. A, Mickee. R.A.(1985) An Introductionto Genetic Engineering in Plants. Blackwell Scientific Publishers, London.
4. Bernard R Glick. and J.J. Pasternak (2002). Molecular biotechnology, Principle and Applications of Recombinant DNA.ASM Press, Washington,D.C.

OUTCOME OF THIS PAPER:

- At the end of this paper Students can learn about

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	To learn the Crop improvement methods	K1,K2
CO 2	To study the basic principles and techniques involved in plant tissue cell culture,	K4,K5
CO 3	To propagate endangered plants by modifying cell in biotechnology for use in microbiological, medical, and biochemical research	K3
CO 4	To provide students with experiences in industry appropriate applications of biotechnology related to plant agriculture	K5
C0 5	To Understand the concepts of transformation in Plant systems and achievements of biotechnology in Plant systems.	K4

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Mapping with programme Outcomes:

Relationship Matrix											
Semester	**Course code**		**Title of the Course**							**Hours**	**Credits**
V	24UBT5C9		**CORE COURSE-IX** Plant Biotechnology							**5**	**5**
Course Outcomes	**Programme Outcome (POs)**					**Programme specific outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	2	2	3	2	3	3	2	2
CO2	2	3	3	2	3	2	3	3	2	3	3
CO3	3	3	2	2	2	3	3	2	3	2	2
CO4	2	3	2	2	3	3	3	2	2	2	2
CO5	3	3	2	3	2	2	3	2	2	3	2
									Mean Overall Score		2.2 HIGH

Semester	Course code	Title of the course	Hours/week	credits
V	24UBT5C10	**CORE COURSE-X** Animal Biotechnology	5	5

OBJECTIVES: This course provides basic information regarding animal tissueculture, animal products, production & improvement of them.

UNIT I ANIMAL CELL CULTURE

Animal cell culture: Fundamentals. Facilities and applications. Media for animal cells. Biology of cultured cells, measurement of growth, cell synchronization, senescence and apoptosis

UNIT II TYPES OF CELL CULTURE

Types of cell culture: Primary cell culture, secondary culture, cell transformation, cell lines, stem cell cultures, cell viability and cytotoxicity. Organ culture. Cryopreservation Insect cell lines

UNIT III EMBYOLOGY

Embyology: Collection and preservation of embryo, culture of embryos, culture of embryonic stem cells and its applications. Gametogenesis and fertilization in animals, Molecular events during fertilization, Genetic regulations in embryonic development.

UNIT IV GENETIC ENGINEERING IN ANIMALS

Genetic engineering in animals: methods of DNA transfer into animal cells- Calcium phosphate co precipitation, Micro-injection, Electroporation, Electrofus ion, Liposome encapsulation, Biological vectors. Hybridoma technology, Vaccine production

UNIT V TRANSGENICS

Transgenics: Transgenic animals. Production and recovery of products from animal tissue cultures: cytokines, Plasminogen activators, Blood clotting factors, Growth hormones.

UNIT VI: **CURRENT CONTOURS (For Continuous Internal Assessment only):**

The recent advancements in the course topics will be explained to the students then and there through expert lectures, online seminars or webinars.

REFERENCES:

1.E.J. Murray (Ed) (1991) Gene Transfer and Expression Protocols – Methodsin Molecular Biology Vol.7. Humana Press,Totowa, NJ.

2.Watson, J.D., N.H.Hopkins, T.W.Roberts, J.A.Steitz and A.M. Weiner (1987) Molecular Biology of Gene. Benjamin Cummins, San Franscisco.

3.Watson, J.D., M. Gilman, J. Witkouski and M.Zoller (1992) Recombinant DNA. Scientific American Books, New York.
4.Puller A(1993) Genetic Engineering of Animals. VCH Publishers, New York.
5.Balinsky, B.I (1975). An Introduction to Embryology. Saunders, Philadelphia.

OUTCOME OF THIS PAPER:

- At the end of this paper Students can learn about

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	To learn the Fundamental of Animal cell culture	K1,K2
CO 2	learn about the various types of Animal cell culure	K3
CO 3	To understand the media involved for growth of Animal cells	K4
CO 4	To Learning techniques to transfer the animal cells to recipients	K5
C0 5	To understand the transgenic animals production	K3

Mapping with programme Outcomes:

Relationship Matrix											
Semester	**Course code**		**Title of the Course**							**Hours**	**Credits**
V	24UBT5C10		**CORE COURSE-X** Animal Biotechnology							**5**	**5**
Course Outcomes	**Programme Outcome (POs)**					**Programme specific outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	3	2	2	3	2	3	2	2	2
CO2	3	2	3	3	2	3	2	3	2	3	3
CO3	3	2	3	2	2	3	2	3	2	3	2
CO4	2	3	2	3	3	2	3	3	2	3	3
CO5	2	3	3	2	2	3	2	3	2	2	2
									Mean Overall Score		2.4 HIGH

Semester	Course code	Title of the course	Hours/week	credits
V	24UBT5C11	**CORE COURSE-XI** Environmental biotechnology	5	5

OBJECTIVES: The course is designed to make the student understand about Ecosystem, Natural cycles, impact of various environmental pollution, remedies androle of genetic engineering in environmental biotechnology.

UNIT I ECOSYSTEM

Ecosystem –Definition –structure – pond ecosystem – primary production –secondary production – food chain – food web – trophic levels – energy flow – pyramid of biomass– pyramid of energy. Biogeochemical cycle: Nitrogen and Phosphorous.

UNIT II ENVIRONMENTAL POLLUTION

Pollution – types – sources – effects – Air-water – land – Noise – Thermal – Pesticide – Radioactive – green house effect, ozone and its importance – global warming – Acid rain– Bio accumulation – Bio magnification. Biological control. Principles of environment Impact. Assessment and environmental monitoring.

UNIT III BIOSORPTION AND BIOACCUMULATION

Bioremediation of toxic metal ions – biosorption and bioaccumulation .Composting of organic wastes. Microbial bioremediation of oil spills; Microbial treatment of waste water (sewage of industrial effluent) - aerobic and anaerobic methods.

UNIT IV BIOREMEDIATION

Concepts of bioremediation (in-situ and ex-situ), Bioremediation of toxic metal ions – biosorption and bioaccumulation principles. Concepts of phytoremediation; Microbial biotransformation of pesticides and xenobiotics; Microbial leaching of ores and Rhizospheric soil – direct and indirect mechanisms.

UNIT V GENETIC ENGINEERING IN ENVIRONMENTAL BIOTECHNOLOGY

Genetically engineered microorganisms in environmental health-Genetically engineered plants and microorganisms in agriculture. Genetically engineered bacteria in bioremediation of pesticides, insecticides oil spills-Hazards of genetically engineered microorganisms, plants and animals-Policies of genetic engineering research.

UNIT VI: **CURRENT CONTOURS (For Continuous Internal Assessment only):**

The recent advancements in the course topics will be explained to the students then and there through expert lectures, online seminars or webinars.

REFERENCES:

1. Groombridge, B (Ed.) (1992) Global Biodiversity – Status of the Earth's Living Resources. Chapman & Hall, London.
2. UNEP (1995) Global Biodiversity Assessment , Cambridge Univ. Press, Cambridge.
3. Virchow, D (1998). Conservation & Genetic Resources , Springer – Verlag,Berlin.

Gary K.Meffe and Ronald Carroll C (1994) Principles of Conservation Biology, SinauerAssociates, Inc., Massachusetts.

OUTCOME OF THIS PAPER:

- At the end of this paper Students can learn about

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	The student will be able to evaluate the potential of biodegradation of organic pollutants	K3
CO 2	To study the microbial and physical/chemical environments, ,	K4
CO 3	To understand the phenomenon of phytoremediation for the decontamination of soil and water,research	K3
CO 4	To learn the wetlands as treatment processes	K5
C0 5	To Understand the concepts of biofilms/biofilters for vapor-phase wastes, and composting.	K3

Mapping with programme Outcomes:

Relationship Matrix											
Semester	**Course code**		**Title of the Course**							**Hours**	**Credits**
V	24UBT5C11		**CORE COURSE-XI** Environmental biotechnology							5	5
Course Outcomes	**Programme Outcome (POs)**					**Programme specific outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	2	2	3	2	3	3	2	2
CO2	2	3	3	2	3	2	3	3	2	3	3
CO3	3	3	2	2	2	3	3	2	3	2	2
CO4	2	3	2	2	3	3	3	2	2	2	2
CO5	3	3	2	3	2	2	3	2	2	3	2
										Mean Overall Score	2.4 HIGH

Semester	Course code	Title of the course	Hours/week	credits
V	24UBT5C12P	**CORE COURSE-XII** Lab in Plant biotechnology, Animal biotechnology Environmental biotechnology	6	3

OBJECTIVE

To learn about techniques involved in Animal biotechnology and animal cell culture, plant biotechnology micropropagation techniques and Environmental biotechnology.

LAB IN ANIMAL BIOTECHNOLOGY

1. Preparation of Animal cell culture media
2. Leucocyte culture.
3. Cell counting and viability
4. Cryopreservation and thawing
5. Isolation of DNA from Animal tissues

LAB IN PLANT BIOTECHNOLOGY

1. MS Media Preparation
2. Surface sterilization of various explants
3. Shoot tip culture
4. Protoplast Isolation using enzymatic method
5. Seed culture technique; Production of Synthetic seeds
6. Extraction and Separation of Chlorophyll by Chromatography techniques
7. Phytochemical analysis of total protein, sugar in culture tissue

LAB IN ENVIRONMENTAL BIOTECHNOLOGY

1. Measurement of Total Solids, Total-dissolved solids, Total-suspended solids,chloride, turbidity, nitrite, nitrate.
2. Measurement of dissolved oxygen, total hardness, fluoride and total nitrogen.
3. Measurement of COD, BOD
4. Microbial assessment of Air quality (open plate and air sample)

OUTCOME OF THIS PAPER:

- At the end of this paper Students can learn about

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	To learn thehow to separate the industrially important microorganisms from various souces	K3
CO 2	To study the techniques to produce various products by using Microbes.	K4
CO 3	Tounderstand to analyse the quality of water and air.	K3
CO 4	To learn the Quantitative analysis of milk.	K5
C0 5	To Understand the Measurement of COD, BOD	K4

Mapping with programme Outcomes:

Relationship Matrix											
Semester	**Course code**		**Title of the Course**							**Hours**	**Credits**
V	24UBT5C12P		**CORE COURSE-XII** Lab in Animal biotechnology, Plant biotechnology Environmental biotechnology							6	**3**
Course Outcomes	**Programme Outcome (POs)**					**Programme specific outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	2	2	3	2	3	3	2	2
CO2	2	3	3	2	3	2	3	3	2	3	3
CO3	3	3	2	2	2	3	3	2	3	2	2
CO4	2	3	2	2	3	3	3	2	2	2	2
CO5	3	3	2	3	2	2	3	2	2	3	2
Mean Overall Score											2.2 HIGH

Semester	Course code	Title of the course	Hours/ week	credits
V	**24UBT5MBE1A**	**MBE-1:** A) DEVELOPMENTAL BIOLOGY	4	4

COURSE OBJECTIVES:

The main objectives of this course are to:

- Understand different areas of developmental biology including the early and late embryonic development
- Develop a comprehensive understanding of the cell-cell communications

UNIT – I Patterns and Processes of Animal Development:

Mechanisms of Developmental Organization: A Frog's Life - Gametogenesis and fertilization, Cleavage and gastrulation, Organogenesis, Metamorphosis and gametogenesis, Differential Gene Expression: Mechanisms of Cell Differentiation, Cell-to-Cell Communication: Mechanisms of morphogenesis, Stem Cells: their potential and their niches.

UNIT – II Gametogenesis and Fertilization:

Mammalian Pattern of Sex Determination: Primary Sex Determination in Mammals, Secondary Sex Determination in Mammals, Chromosomal Sex Determination in Drosophila: The Sex-lethal gene, switch gene for sex determination. Mammalian Gametogenesis; Spermatogenesis, Oogenesis. Fertilization: External Fertilization in Sea Urchins, Activation of Egg Metabolism in Sea Urchins, Fusion of Genetic Material in Sea Urchins.

UNIT – III Early Development: Cleavage, Gastrulation, and Axis Formation:

Cleavage and Axis Formation in C. elegans: Rotational cleavage of the egg, Anterior-posterior axis formation, Dorsal-ventral and right-left axis formation, Control of blastomere identity. Gastrulation in C. elegans. Early Drosophila Development: Fertilization, Cleavage, mid-blastula transition, Gastrulation. Segmentation Genes: Segments and parasegments, gap genes, pair-rule genes, segment polarity genes.

UNIT – IV Postembryonic Development: Metamorphosis:

Morphological changes associated with amphibian metamorphosis, Hormonal control of amphibian metamorphosis, Regionally specific developmental programs. Metamorphosis in Insects: Imaginal discs, Hormonal control of insect metamorphosis, The molecular biology of 20- hydroxyecdysone activity, Determination of the wing imaginal discs, Metamorphosis of the Pluteus Larva. 41

UNIT – V Aging and Senescence: Genes and Aging:

DNA repair enzymes, Aging and the insulin signaling cascade, The mTORC1 pathway, Chromatin modification. Epigenetic Drift, Stem Cells and Aging. UNIT – VI Current Contours (For continuous internal assessment only): The recent advancements in the course topics will be explained to the students then and there through expert lectures, online seminars or webinars.

REFERENCES:

1. Grubb, B. J. (2006). Developmental Biology, Scott F. Gilbert, editor. Integrative and Comparative Biology, 46(5), 652-653.
2. Carlson, B. M. (2018). Human embryology and developmental biology. Elsevier Health Sciences.
3. Agarwal V.K., and Verma P.S., Chordate Embryology, S. Chand Publishing, New Delhi, 1995.
4. Balinsky B.I., An introduction to Embryology, International Thomson Computer Press, London, UK, 2008.
5. Jonathan M. W. Slack., Essential Developmental Biology, Wiley-Blackwell, Hoboken, NewJersey,United States, 2012.
6. https://nptel.ac.in/courses/102103045/

OUTCOME OF THIS PAPER:

- At the end of this paper Students can learn about

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Cognize the cell development and their stages.	K1,K2
CO 2	Comprehend the links between basic aspects of the cell and early embryogenic development.	K4
CO 3	Elaborate on the Later Embryonic development of different organs with placentation structure and types	K3
CO 4	Provide knowledge on implications and diagnosis techniques	K5
C0 5	Illustrate the post-embryonic development and its stages	K4

Mapping with programme Outcomes:

Relationship Matrix											
Semester	**Course code**		**Title of the Course**							**Hours**	**Credits**
V	**24UBT5MBE1A**		**MBE-1:** A) DEVELOPMENTAL BIOLOGY							4	4
Course Outcomes	**Programme Outcome (POs)**					**Programme specific outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	3	2	2	3	2	3	2	2	2
CO2	3	2	3	3	2	3	2	3	2	3	3
CO3	3	2	3	2	2	3	2	3	2	3	2
CO4	2	3	2	3	3	2	3	3	2	3	3
CO5	2	3	3	2	2	3	2	3	2	2	2
									Mean Overall Score		2.4 HIGH

Semester	Course code	Title of the course	Hours/week	credits
V	**24UBT5MBE1B**	**MBE-1:** B) Molecular Modelling & Drug Designing	4	4

OBJECTIVES: The course is designed to make the student learn about the basics of drug design, Processes involved in drug design and the Statistical techniques.

UNIT I INTRODUCTION
Introduction to drug designing, drug design to discovery and development, drug metabolism, toxicity and pharmacokinetics, toxicology considerations, problems and drawbacks on drug discovery and development.

UNIT II IDENTIFICATION AND VALIDATION STRATEGIES
Drug Target classification, identification and validation strategies, Design and development of combinatorial libraries for new lead generation

UNIT III STRUCTURE BASED DRUG DESIGN
Structure-based design – 'de novo' design methodologies 3D-database searching techniques, docking, Ramachandran Plot.

UNIT IVQSAR
QSAR: Statistical techniques behind QSAR, classical QSAR, molecular descriptors 3D QSAR and COMFA, Pharmacophore Modelling.

UNITV MOLECULAR DYNAMICS
Basic principles of molecular modeling, molecular dynamics simulation techniques.

UNIT VI: **CURRENT CONTOURS (For Continuous Internal Assessment only):**

The recent advancements in the course topics will be explained to the students then and there through expert lectures, online seminars or webinars.

REFERENCES

1. R.Leach (1996) Molecular Modeling Principles and Application, 2nd edition,Longman Publications.
2. D. Baxivanis and Foulette (2001) Bioinformatics: A Practical Guide to the Analysis ofGenes and Proteins, Wiely Indian Edition.
3. T K Attwood, D J parry-Smith (2005)Introduction to Bioinformatics, Pearson Education,1st Edition, 11th Reprint .

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	To learn thehow to separate the industrially important microorganisms from various souces	K1,K2
CO 2	To study the techniques to produce various products by using Microbes.	K4
CO 3	Tounderstand to analyse the quality of water and air.	K3
CO 4	To learn the Quantitative analysis of milk.	K5
C0 5	To Understand the Measurement of COD, BOD	K4

Relationship Matrix											
Semester	**Course code**		**Title of the Course**							**Hours**	**Credits**
V	**24UBT5MBE1B**		**MBE-1:** B) Molecular Modelling & Drug Designing							4	4
Course Outcomes	**Programme Outcome (POs)**					**Programme specific outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	2	2	3	2	3	3	2	2
CO2	2	3	3	2	3	2	3	3	2	3	3
CO3	3	3	2	2	2	3	3	2	3	2	2
CO4	2	3	2	2	3	3	3	2	2	2	2
CO5	3	3	2	3	2	2	3	2	2	3	2
Mean Overall Score											2.4 HIGH

Semester	Course code	Title of the course	Hours/week	credits
v	**24UBT5MBE1C**	**MBE-1:** C) Food Technology	4	4

OBJECTIVES

This course is designed to give adequate knowledge on food technology so as to train the students entrepreneurs

UNIT I FOOD CHEMISTRY

Constituent of food - contribution to texture, flavor and organoleptic properties of food; food additives - intentional and nonintentional and their functions; enzymes in food processing.

UNIT II FOOD MICROBIOLOGY

Sources and activity of microorganisms associated with food; food fermentation; food chemicals; food borne diseases - infections and intoxications, food spoilage - causes.

UNIT III FOOD PROCESSING

Raw material characteristics; cleaning, sorting and grading of foods; physical conversion operations - mixing, emulsification, extraction, filtration, centrifugation, membrane separation, crystallization, heat processing.

UNIT IV FOOD PRESERVATION

Use of high temperatures - sterilization, pasteurization, blanching, canning - concept, procedure & application; Low temperature storage - freezing curve characteristics. Factors affecting quality of frozen foods; irradiation preservation of foods.

UNIT V MANUFACTURE OF FOOD PRODUCTS

Bread and baked goods, dairy products - milk processing, cheese, butter, ice-cream, vegetable and fruit products; edible oils and fats; meat, poultry and fish products; confectionery, beverages.

UNIT VI: **CURRENT CONTOURS (For Continuous Internal Assessment only):**

The recent advancements in the course topics will be explained to the students then and there through expert lectures, online seminars or webinars.

TEXT BOOKS

1.Crosby, N.T. 1981. Food packaging. Materials Applied Science Publishers, London.
2.David, S. Robinson. 1997. Food Chemistry and nutritive value. Longman group, UK.
3.Frazier, W.C. and Westhoff, D.C. 1988. Food Microbiology. 4th Edition. McGram-Hill, New York.
4.Pyke, M. 1981. Food Science and Technology. 4th Edition. John Murray, London.
5.Sivasankar, B. 2002. Food processing and preservation. Prentice Hall, New Delhi.

REFERENCE BOOKS

1.Brenner, J.G., Butters, J.R., Cowell, N.D. and Lilly, A.E.V. 1979. Food engineering Operations. 2nd Edition. Applied Sciences Pub. Ltd., London.
2.Desrosier, N.W. 1996. The Technology of Food Preservation. CBS Publishers and Distributors, New Delhi.
3.Fennema, O.R. 1976. Principles of food science: Part I, Food chemistry, Marcel Dekker, New York.
4.Lindsay, W. 1988. Biotechnology, Challenges for the flavor and food Industries.

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	To learn thehow to separate the industrially important microorganisms from various souces	K1
CO 2	To study the techniques to produce various products by using Microbes.	K2
CO 3	To understand to analyse the quality of water and air.	K3
CO 4	To learn the Quantitative analysis of milk.	K4
C0 5	To Understand the Measurement of COD, BOD	K5

Relationship Matrix											
Semester	**Course code**		**Title of the Course**							**Hours**	**Credits**
v	**24UBT5MBE1C**		**MBE-1:** C) Food Technology							4	4
Course Outcomes	**Programme Outcome (POs)**					**Programme specific outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	2	2	3	2	3	3	2	2
CO2	2	3	3	2	3	2	3	3	2	3	3
CO3	3	3	2	2	2	3	3	2	3	2	2
CO4	2	3	2	2	3	3	3	2	2	2	2
CO5	3	3	2	3	2	2	3	2	2	3	2
									Mean Overall Score		2.4 HIGH

Semester	Course code	Title of the course	Hours/week	credits
V	**24UBT5SBE1A**	**SBE-1** A.) Ethnomedicine	3	2

OBJECTIVES

The course is designed to make the students gain the knowledge about thetraditional plants present in our society and their importance

UNIT I ETHNOMEDICINE

Definition, history and its scope –Inter disciplinary approaches in ethnobotany – Collection of ethnic information.

UNIT II IMPORTANCE OF MEDICINAL PLANTS

Role in human health care – health and balanced diet (Role of proteins, carbohydrates,lipids and vitamins).

UNIT III TRIBAL MEDICINE

Methods of disease diagnosis and treatment – Plants in folk religion – Aegle marmelos, Ficus benghalensis, Curcuma domestica, Cyanodon dactylon and Sesamum indicum.

UNIT IV MEDICINAL PLANTS OF TAMIL NADU

Traditional knowledge and utility of some medicinal plants in Tamilnadu – Solanum trilobatum, Cardiospermum halicacabum, Vitex negundo, Adathoda vasica, Azadirachta indica, Gloriosa superba, Eclipta alba, Aristolochia indica, Phyllanthus fraternus and Boerhaavia diffusa.

UNIT V PLANTS IN DAY TODAY LIFE

Ocimum sanctum, Centella asiatica, Solanum trilobatum, Cassia auriculata, Aloe vera. Nutritive and medicinal value of some fruits (Guava, Sapota, Orange, Mango, Banana, Lemon, Pomegranate) and vegetables - Greens (Moringa, Solanum nigrum) Cabbage.

UNIT VI: **CURRENT CONTOURS (For Continuous Internal Assessment only):**

The recent advancements in the course topics will be explained to the students then and there through expert lectures, online seminars or webinars.

REFERENCES:

1. R.K.Sinha & Shweta Sinha (2001). Ethnobiology .Surabhe Publications – Jaipur.

2.D.C. Pal & S.K. Jain (1998), Tribal medicine –Naya Prakash, Bidhan Sarani.

3.S.K. Jain (1995) Contribution to Indian Ethnobotany –3rdEd, Scientific publishers, P.B.No.91, Jodhpur, India.

COURSE OUTCOME

- At the end of this paper Students can learn about

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	learn about the importance of medicinal plants	K1
CO 2	To study the industrial pollution prevention	K2
CO 3	They also know about how to form the medicines from herbs	K4
CO 4	Understand important interactions between cultural practices, ecosystems, and modern science	K5
C0 5	Learn to commonly used qualitative research methods	K3

Mapping with programme Outcomes:

Relationship Matrix											
Semester	**Course code**		**Title of the Course**							**Hours**	**Credits**
V	**24UBT5SBE1A**		**SBE-1** A.) Ethnomedicine							3	2
Course Outcomes	**Programme Outcome (POs)**					**Programme specific outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	3	2	2	3	2	3	2	2	2
CO2	3	2	3	3	2	3	2	3	2	3	3
CO3	3	2	3	2	2	3	2	3	2	3	2
CO4	2	3	2	3	3	2	3	3	2	3	3
CO5	2	3	3	2	2	3	2	3	2	2	2
Mean Overall Score											2.4 HIGH

Semester	Course code	Title of the course	Hours/week	credits
V	24UBT5SBE1B	**SBE-1 B)** MOLECULAR DIAGNOSTICS	3	2

COURSE OBJECTIVES:

- To learn basics of instruments at clinical level
- To know the safety and regulations at laboratory
- To familiarize on molecular level gene identification
- To learn about methods to determine infection rate for diseases

UNIT – I Fundamentals:

Principles of molecular biology - specimen type, collections and uses - Design of molecular diagnosis laboratory - Ethical issues –- role of Molecular diagnosis's in blood bank-Benefits of molecular diagnostics- future prospects.

UNIT – II Techniques and Principles:

Basics clinical techniques – Laboratory safety and guidelines - Optical techniques- Nucleic acid techniques – Immunochemical technique – Application of microfabrication and microfluidics- Instrumentation care.

UNIT – III Nucleic Acid Techniques:

Isolation of Extraction of Nucleic acids- Detection of gene mutation: Hybridization-Based Methods -Sequencing (Polymerization)-Based Methods – Detection of SNPs using agarose based and PCR based methods

UNIT – IV Infectious diseases:

Molecular diagnostics of bacterial infections: Mycobacterium tuberculosis, Pathogenic E. coli, sample preparation and pathogen detection. Parasitic diseases - Neiseria gonorrhoeae and malaria. Molecular diagnostic of various viral diseases: HIV, Herpes, hepatitis B, Influenza (H1N1) - sample preparation - viral infection analysis and Viral load monitoring - Infectious diseases .

UNIT – V Genetic disorder: Monogenetic disorder – Cystic fibrosis;

Epigenetic disorder – cancer - Polygenetic disorder – Diabetes. Inborn error of metabolism: Lipidosis, Lysosomal storage disorders, glycogen storage disorders; Neuro-degenerative disorders: Parkinson's and Alzheimer

REFERENCES:

1. Lela Buckingham (2019).Molecular Diagnostics: Fundamentals, Methods, and Clinical Applications. F. A. Davis Company Publishers.
2. Betty A. Forbes, Daniel F. Sahm, Alice, (2007).Bailey & Scott's Diagnostic Microbiology, 12th Edition, Elsevier Mosby. 45
3. David E. Bruns, Edward R. Ashwood,Carl A. Burtis. Fundamentals of Molecular Diagnostics (2007). Saunders Group. ISBN-13: 978-1-4160-3737-8.
4. George P. Patrinos, Wilhelm Ansorge, Phillip B. Danielson (2016). Molecular Diagnostics 3rd Edition. Elsevier.

COURSE OUTCOME

- At the end of this paper Students can learn about

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Understand the working principle and maintenance of clinical instruments.	K1
CO 2	Acquire knowledge on laboratory safety guidelines	K2
CO 3	Ability to isolate nucleic acids and to study gene expression	K4
CO 4	Learn about infectious disease and infectivity at molecular level	K5
C0 5	Know about role of molecular diagnosis at genetic abnormalities	K3

Mapping with programme Outcomes:

Relationship Matrix											
Semester	**Course code**		**Title of the Course**							**Hours**	**Credits**
V	**24UBT5SBE1B**		**SBE-1 B)**MOLECULAR DIAGNOSTICS							3	2
Course Outcomes	**Programme Outcome (POs)**					**Programme specific outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	2	2	3	2	3	3	2	2
CO2	2	3	3	2	3	2	3	3	2	3	3
CO3	3	3	2	2	2	3	3	2	3	2	2
CO4	2	3	2	2	3	3	3	2	2	2	2
CO5	3	3	2	3	2	2	3	2	2	3	2
Mean Overall Score											2.2 HIGH

Semester	Course code	Title of the course	Hours/week	credits
V	24UBT5SBE1C	**SBE-1 C)** PHYTOCHEMICAL TECHNIQUES	3	2

OBJECTIVES

The main objective is to make the learner explore the structural complexity and diversity of pharmaceutically relevant plant metabolites. A overview of different classes of metabolites present in plants is also presented.

UNITI OVERVIEW OF PLANT SECONDARY METABOLITES

Drugs from plants - Insecticides and rodenticides- Industrially important Plant products Essential oils, Fatty oils & waxes, Fibers & Fiber Plants, Forest Products: ood and cork, Forest Resources, Gums & Resins, Rubber and Other Latex Products, Tanning, Dye & Processing Materials.

UNIT II METABOLITES DERIVED FROM THE SHIKMATE CHORISMATE PATHWAY

Plant acids, fatty acids and lipids, alkanes and related hydrocarbons, polyacetylenes, sulphur compounds, Nitrogen compounds-amino acids, amines, alkaloids, cyanogenic glycosides, inoles, purines, pyrimidines and cytokinins, chlorophylls.

UNIT III METABOLITES DERIVED FROM THE MALONIC AND MEVALONIC ACID PATHWAYS

Phenols and phenolic acids, phenylpropanoids, flavonoid pigments, anthocyanins, flavaonols and flavones, tanins, quinines, essential oils, diterpenoids and gibberellins, triterpenoids, steroids and catotenoids.

UNIT IV CONVENTIONAL METHODS IN PLANT ANALYSES

Introduction- selection of plants and plant parts - methods of extraction and isolation, methods of separation, methods of identification, analysis of results and application

UNIT V ADVANCES IN PLANT ANALYTICAL TECHNIQUES

GC - HPLC- HPTLC-OPLC – NMR-MS Microarray- RT PCR- RNA SEQ – fluorescence and confocal microscopy - CHN analysis - X ray crystallography

UNIT VI: **CURRENT CONTOURS (For Continuous Internal Assessment only):**

The recent advancements in the course topics will be explained to the students then and there through expert lectures, online seminars or webinars.

REFERENCES

1. Harbone J. B (2005) Phytochemical Method A guide to modern techniques of plantanalysis.

2.Sarker, S. D., Latif, Z. and Gray,A.I (2006) Methods in Biotechnology –Natural Product Isolation" Second Edition, Humana Press

3.Raman N (2006) Phytochemical Techniques. New India Publishing agency .

COURSE OUTCOME

- At the end of this paper Students can learn about

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	learn about the importance of medicinal plants	K1,K2
CO 2	By studying of this paper students can learn about the Metabolites produced from Plant	K4
CO 3	They also gain the knowledge about the conventional methods in plant analysis	K3
CO 4	To learn the Conventional Methods in Plant Analyses	K5
CO 5	They also know about advances in plant analytical advanced techniques	K3

Mapping with programme Outcomes:

Relationship Matrix											
Semester	**Course code**		**Title of the Course**							**Hours**	**Credits**
V	**24UBT5SBE1C**		**SBE-1 C)**PHYTOCHEMICAL TECHNIQUES							3	2
Course Outcomes	**Programme Outcome (POs)**					**Programme specific outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	3	2	2	3	2	3	2	2	2
CO2	3	2	3	3	2	3	2	3	2	3	3
CO3	3	2	3	2	2	3	2	3	2	3	2
CO4	2	3	2	3	3	2	3	3	2	3	3
CO5	2	3	3	2	2	3	2	3	2	2	2
Mean Overall Score											2.4 HIGH

Semester	Course code	Title of the course	Hours/week	credits
VI	24UBT6C13	**CORE COURSE-XIII** Industrial biotechnology	6	6

OBJECTIVES: The course is designed to gain knowledge on Industrial importance of Biotechnology, importance of Enzymes, upstream and downstream processing & to learn the Industrial applications of Biotechnology.

UNIT I INTRODUCTION

Principles of Microbial growth – introduction, the ways of growing microorganisms, ways to increase yield of microbes, Batch, fed-batch and continuous cultures (definition and kinetics)

UNIT II BIOREACTOR

Bioreactor / Fermenter – types, working & operation of Bioreactors, Fermenters (Stirred tank, bubble columns, airlift. Bioreactors, Static, Submerged and agitated fermentation), advantages & disadvantages of solid substrate & liquid fermentations, Quality Control.

UNIT III UPSTREAM AND DOWNSTREAM PROCESS

Upstream processing (Strain selection, Sterilization), Downstream processing – extraction, separation, concentration, recovery & purification, operations (Insulin,Vitamins, Metabolites

UNIT IV ENZYME TECHNOLOGY

Enzyme technology – nature of enzymes, application of enzymes, limitations ofmicrobial cells used as catalysts in fermentation, multi-enzyme reactors, cloning strategy for enzymes, technology of enzyme production, industrial applications of immobilized enzymes, Quality Control.

UNIT V APPLICATIONS

Biotechnology in specific medical & industrial applications - microbial process for immunization (Production of monoclonal antibodies), Delerioration of Microbial culture selection with high yield potential, Quality Control.

UNIT VI: **CURRENT CONTOURS (For Continuous Internal Assessment only):**

The recent advancements in the course topics will be explained to the students then and there through expert lectures, online seminars or webinars.

REFERENCES

1.Sullia S. B& Shantharam S (1998) General Microbiology, Oxford & IBH Publishing Co. Pvt. Ltd.

2.Bisen P.S (1994) Frontiers in Microbial Technology, 1st Edition, CBS Publishers.

3.Glaser A.N & Nilaido.H (1995) Microbial Biotechnology,W.H Freeman & Co.

4.Prescott&Dunn(1987) Industrial Microbiology 4th Edition, CBS Publishers & Distributors.

5.Prescott & Dunn (2002) Industrial Microbiology, Agrobios (India) Publishers.

6.Crueger W. & Crueger A. (2000) A text of Industrial Microbiology, 2nd Edition, Panima Publishing Corp.

OUTCOME OF THIS PAPER

On completion of the course, the student should achieve an understanding of thefollowing:

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Increase their understanding that 'industrial biotechnology' is based on using machines to control the growth of microorganisms	K1,K2
CO 2	To develop knowledge of complex processes that occur in the plants and animals	K3
CO 3	Develop knowledge of a variety of fermentation strategies and types of Fermenter	K4
C0 4	To learn the Purification process and its applications	K5
CO 5	To develop skills of Biotechnology in specific medical & industrial applications	K3

Mapping with programme Outcomes:

Relationship Matrix											
Semester	**Course code**		**Title of the Course**							**Hours**	**Credits**
VI	**24UBT6C13**		**CORE COURSE-XIII** Industrial biotechnology							6	6
Course Outcomes	**Programme Outcome (POs)**					**Programme specific outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	3	2	2	3	2	3	2	2	2
CO2	3	2	3	3	2	3	2	3	2	3	3
CO3	3	2	3	2	2	3	2	3	2	3	2
CO4	2	3	2	3	3	2	3	3	2	3	3
CO5	2	3	3	2	2	3	2	3	2	2	2
Mean Overall Score											2.4 HIGH

Semester	Course code	Title of the course	Hours/week	credits
VI	24UBT6C14	**Core Course XIV**- Marine biotechnology	5	5

OBJECTIVES: The objective of this course is to gain knowledge on marine microbial diversity and its importance. The importance of marine microbes, marine flora, fauna and microbial metabolites is to be made clear.

UNIT I INTRODUCTION

Importance of marine biotechnology; Introduction to marine environment; Zonation - Organic Adaptation.

UNIT II MARINE FLORA

Phytoplankton, seaweeds, sea grasses and mangroves-their characteristics andidentification;

UNIT III MARINE FAUNA

Marine fauna-zooplankton; major marine invertebrates; vertebrates and marine mammals-characteristics and identification

UNIT IV MARINE MICROBES

Marine microbes – Types, classification, methods of culturing and identification; methods of preservation, Cycles of Marine Ecosystem, Leaching and Biofouling.

UNIT V MARINE POLLUTANTS

Types , sources and ecological effects on marine environment – sewage , heavy metal,pesticide, oil, nuclear, thermal, plastic and micro-plastic pollution. Ecological impact of pollutants on marine organisms.

UNIT VI: **CURRENT CONTOURS (For Continuous Internal Assessment only):**

The recent advancements in the course topics will be explained to the students then and there through expert lectures, online seminars or webinars

REFERENCES

1.Bhakuni, D.S., Rawat, D.S. (2005). Bioactive Marine Natural Products. Springer.

2.Qubiroga, H.(2006) Marine biodiversity, Springer, 353pp.

3.Attaway, D.H. and Z. Oskar (1993) Marine Biotechnology Vol I. Pharmaceutical and bioactive natural products. Springer publications, Plenum Press, USA. 524pp.

4.Fingerman, M., Nagabhushanam, R and M. Thompson (1998) Recent advances inmarine biotechnology. Vol. 2.

OUTCOME OF THIS PAPER:

- At the end of this paper Students can learn about

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	To learn the principle features of marine ecosystems and the microbial diversity in oceans	K3,K4
CO 2	.To study the Marine flora	K3
CO 3	To understand to marine fauna such as zooplankton,	K3,K2
CO 4	To study the marine microbes in terms of physiological capability and their biogeochemical role	K2
C0 5	To learn the Importance of marine ,Various marine organisms and its adaptation,Various marine pollutants and its ecological impacts	K5,K1

Mapping with programme Outcomes:

Relationship Matrix											
Semester	**Course code**		**Title of the Course**							**Hours**	**Credits**
VI	**24UBT6C14**		**Core Course XIV**- Marine biotechnology							5	5
Course Outcomes	**Programme Outcome (POs)**					**Programme specific outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	2	2	3	2	3	3	2	2
CO2	2	3	3	2	3	2	3	3	2	3	3
CO3	3	3	2	2	2	3	3	2	3	2	2
CO4	2	3	2	2	3	3	3	2	2	2	2
CO5	3	3	2	3	2	2	3	2	2	3	2
									Mean Overall Score		2.4 HIGH

Semester	Course code	Title of the course	Hours/week	credits
VI	24UBT6C15P	**CORE COURSE-XV PRACTICAL** Lab in Industrial and Environmental biotechnology	6	3

OBJECTIVE

To learn about recombinant DNA technology Restriction and ligation, protein separation, blotting techniques and amplification technique. Environmental andculturing technique.

Experiments:

LAB IN INDUSTRIAL BIOTECHNOLOGY

1. Media formulation - Sterilization of bioreactors.
2. Isolation of industrially important microorganisms (amylase, pectinase, cellulase) for microbial process & maintenance of bacterial & fungal cultures.
3. Determination of thermal death point and thermal death time of micro organisms
4. Quantitative analysis of milk.
5. Microbial production of wine
6. Production of amylase
7. Cell and enzyme immobilization.
8. Growth kinetics-Effect of pH and temperature on growth kinetics(Demonstration)

LAB IN ENVIRONMENTAL BIOTECHNOLOGY

9. Measurement of Total Solids, Total-dissolved solids, Total-suspended solids, chloride, turbidity, nitrite, nitrate.
10. Measurement of dissolved oxygen, total hardness, fluoride and total nitrogen.
11. Measurement of COD, BOD
12. Microbial assessment of Air quality (open plate and air sample)

OUTCOME OF THIS PAPER: At the end of this paper Students can learn about

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	To learn how to separate the industrially important microorganisms from various sources	K3,K4
CO 2	To study the techniques to produce various products by using Microbes.	K3
CO 3	To understand to analyze the quality of water and air.	K3
CO 4	To learn the Quantitative analysis of milk.	K2,K1
C0 5	To Understand the Measurement of COD, BOD	K5

Mapping with programme Outcomes:

Relationship Matrix											
Semester	**Course code**		**Title of the Course**							**Hours**	**Credits**
VI	24UBT6C15P		**CORE COURSE-XV PRACTICAL** Lab in Industrial and Environmental biotechnology							6	3
Course Outcomes	**Programme Outcome (POs)**					**Programme specific outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	3	2	2	3	2	3	2	2	2
CO2	3	2	3	3	2	3	2	3	2	3	3
CO3	3	2	3	2	2	3	2	3	2	3	2
CO4	2	3	2	3	3	2	3	3	2	3	3
CO5	2	3	3	2	2	3	2	3	2	2	2
									Mean Overall Score		2.4 HIGH

Semester	Course code	Title of the course	Hours/week	credits
VI	24UBT6MBE2A	**MBE-2** A) ENZYME TECHNOLOGY	4	4

OBJECTIVE

To learn about General introduction and historic background , Enzyme Catalysis and Inhibition, Enzyme Regulation, Enzyme Kinetics.

Unit I- Introduction to Enzymes

General introduction and historic background- General Terminology, Nomenclature and Classification of Enzymes. Criteria of purity of enzymes- Specific activity. Enzyme units-Katal and IU. Enzyme activity- chemical nature of enzymes. Protein nature of enzymes and Non protein enzymes- Ribozymes and DNAzymes.

Unit II- Enzyme Catalysis and Inhibition

Lock and key, Induced fit and Transition state Hypotheses. Mechanism of enzyme catalysis- Acid-base catalysis, covalent catalysis, Metal ion catalysis, Proximity and orientation effects etc. Mechanism of Serine proteases-Chymotryspin, Lysozyme, Carboxypeptidase A and Ribonuclease., Proenzymes (Zymogens).

Unit III- Enzyme Regulation

Feedback Regulation, Allosteric Regulation, Reversible Covalent Modification and Proteolytic Activation. Organisation of enzymes in the cell. Enzymes in the cell, localization, compartmentation of metabolic pathways, enzymes in membranes, concentrations. Mechanisms of enzyme degradation, lysosomal and nonlysosomal pathways, examples.

Unit IV- Enzyme Kinetics

Factors affecting the enzyme activity- Concentration, pH and temperature. Kinetics of a single-substrate enzyme catalysed reaction, Michealis-Menten Equation, Km, Vmax, L.B Plot, Turnover number, Kcat. Kinetics of Enzyme Inhibition. Kinetics Allosteric enzymes.

Unit V- Industrial and Clinical uses of Enzymes (Applied Enzymology)

Industrial Enzymes- Thermophilic enzymes, amylases, lipases, proteolytic enzymes in meat and leather industry, enzymes used in various fermentation processes, cellulose degrading enzymes, Metal degrading enzymes.

Clinical enzymes- Enzymes as thrombolytic agents, Anti-inflamatory agents, strptokinasae, asparaginase, Isoenzymes like CK and LDH, Transaminases (AST, ALT), Amylases, Cholinesterases, Phosphatases. Immobilization of enzymes, ELIZA. Biosensors. Enzyme Engineering and site directed mutagenesis, Designer enzymes

UNIT VI: **CURRENT CONTOURS (For Continuous Internal Assessment only):**

The recent advancements in the course topics will be explained to the students then and there through expert lectures, online seminars or webinars

REFERENCE BOOKS

- 1 Purifying Proteins for Proteomics Richard J Simpson IK International 2003
- 2 Fundaments of Enzymology Prices and Stevens Oxford Press. Third Edition, 1999
- 3 Enzymes in Industry: Production and Applications W. Gerhartz Wiley- VCH Publishers 3rd Edition 2007

TEXT BOOKS:

- Fundamentals of Enzymology : Nicholas Price & Lewis Stevens
- Enzymes : Biochemistry, Biotechnology and Clinical Chemistry- Trevor Palmer Biochemistry text books by Stryer, Voet and Lehninger (Relevant Chapters)
- Proteins by Gary Walsh
- Internet/ Journal Resources

OUTCOME OF THIS PAPER:

- At the end of this paper Students can learn about

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	General Terminology, Nomenclature and Classification of Enzymes.	K3,K1
CO 2	Mechanism of Serine proteases-Chymotryspin, Lysozyme, Carboxypeptidase A and Ribonuclease., Proenzymes (Zymogens).	K2,K4
CO 3	Organisation of enzymes in the cell.	K3
CO 4	Factors affecting the enzyme activity	K5
C0 5	Industrial Enzymes- Thermophilic enzymes	K3

Mapping with programme Outcomes:

Relationship Matrix											
Semester	**Course code**		**Title of the Course**							**Hours**	**Credits**
VI	**24UBT6MBE2A**		**MBE-2** A) ENZYME TECHNOLOGY							4	4
Course Outcomes	**Programme Outcome (POs)**					**Programme specific outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	2	2	3	2	3	3	2	2
CO2	2	3	3	2	3	2	3	3	2	3	3
CO3	3	3	2	2	2	3	3	2	3	2	2
CO4	2	3	2	2	3	3	3	2	2	2	2
CO5	3	3	2	3	2	2	3	2	2	3	2
Mean Overall Score											2.2 HIGH

Semester	Course code	Title of the course	Hours/week	credits
VI	24UBT6MBE2B	**MBE-2** B) Biosafety & Bioethics	4	4

OBJECTIVE

The main objectives of this course are to:

- Imply the Applications of statistics in biological data
- Different analytical methods for biological data

Unit – I Biosafety:

Introduction, biosafety issues in biotechnology-historical background; Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels (I, II and III); Recommended

Unit – II Biosafety Guidelines:

Biosafety guidelines and regulations (National and International) – operation of biosafety guidelines and regulations of India; Definition of GMOs & LMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; Overview of National Regulations-Protocol.

UNIT – III Bioethics:

Introduction to ethics/bioethics – framework for ethical decision making; purpose and principles of bioethics, Bioethics in medical – drug testing, non-maleficence, Informed consent and human cloning, Bioethical aspects of generating transgenic organisms.

Unit-IV Ethics and Bioethics:

Freewill and Determinism, Morals and Values, Theories of Ethics Ethical, moral, social, and legal issues in Biotechnological research: Relevance of regulation and control of research in biotechnology, societal obligations of a biotechnologist; Concerns relating to experimentation on animals, genetic engineering of plants and animals for food (GM foods), cloning, stem cell research, human gene therapy and genetic 42 modifications, genetic testing and screening, human clinical trials and drug testing, biweapons program/bioterrorism.

UNIT – V Biotechnology and ethics:

Benefits and risks of genetic engineering – ethical aspects of genetic testing, genetic engineering and bio-warfare. Ethical implications of cloning: Reproductive cloning, therapeutic cloning. Ethical, legal and socioeconomic aspects of gene therapy, germ line therapy, GM crops and GMO's. Ethical implications of human genome project and bio-piracy.

UNIT VI: **CURRENT CONTOURS (For Continuous Internal Assessment only):**

The recent advancements in the course topics will be explained to the students then and there through expert lectures, online seminars or webinars

REFFERENCE

1. An Introduction to Ethical, Safety and Intellectual Property Rights Issues in Biotechnology, Padma Nambisan, 2017, Academic Press.

2. Textbook of Research Ethics - Theory and Practice, Sana Loue, 2002, Kluwer Academic Publishers.

3. Bioethics - An introduction, Marianne Talbot, 2012, Cambridge University Press.

5. The Cambridge Textbook of Bioethics, Ed. Peter A. Singer, 2008, Cambridge University Press.

Text Books:

1. Introduction to Plant Biotechnology, H S Chawla

2. M K Sateesh .Bioethics and Biosafety. Kindle Edition

3. Shomini Parashar, Deepa Goel IPR, Biosafety and Bioethics Pearson India 2013

OUTCOME OF THIS PAPER:

- At the end of this paper Students can learn about

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Biosafety issues in biotechnology-historical background	K1
CO 2	Biosafety guidelines and regulations (National and International)	K4
CO 3	Introduction to ethics/bioethics	K2
CO 4	Relevance of regulation and control of research in biotechnology	K5
C0 5	Benefits and risks of genetic engineering	K3

Mapping with Programme Outcomes:

Relationship Matrix											
Semester	**Course code**		**Title of the Course**							**Hours**	**Credits**
VI	**24UBT6MBE2B**		**BTE-2** B)Biosafety&Bioethics							4	4
Course Outcomes	**Programme Outcome (POs)**					**Programme specific outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	2	2	3	2	3	3	2	2
CO2	2	3	3	2	3	2	3	3	2	3	3
CO3	3	3	2	2	2	3	3	2	3	2	2
CO4	2	3	2	2	3	3	3	2	2	2	2
CO5	3	3	2	3	2	2	3	2	2	3	2
Mean Overall Score											2.4 HIGH

Semester	Course code	Title of the course	Hours/week	credits
VI	24UBT6MBE2C	**MBE-2** C) Forensic biotechnology	4	4

OBJECTIVES: This course helps the students to understand the Sequencing of DNA and the Methods used in this field.

UNIT I INTRODUCTION

History of DNA fingerprinting and DNA polymorphism. Genes and DNA markers in forensic DNA analysis. Introduction to Polymerase Chain Reaction and its applications.HLA typing and it's forensic importance.

UNIT II FUNDAMENTALS OF DNA SEQUENCING

Use of RFLP, RAPD, AFLP in forensics. STR genotyping, Result of STR marker analysis and its interpretation. Single Nucleotide Polymorphism (SNP) and its applications in forensic investigation.

UNIT III LCN TYPING

Mitochondrial DNA – introduction and use in Forensic investigation.

Y-STR analysis and its significance in establishing paternal relationships. Non-human DNA analysis.

UNIT IV POPULATION OF GENETICS

Concept of population structure, Hardy-Weinberg equilibrium, Phylogenetic tools. Paternity/ maternity indices, Population Genetics in Forensic DNA typing.

Forensically important databases – BOLD, STRBase, DNA databases

UNIT V POLICIES AND LAWS

Introduction to Quality, Quality Assurance, Quality control. Definition of Accreditation, History and development of ISO. Importance of accreditation in Forensic science laboratories. Intellectual Property Rights, IPR policy of Government of India. Patent: Qualification (novel, commercial and non-obvious), jurisdiction of patent laws, Indian and international patent laws, filing procedures.

UNIT VI: **CURRENT CONTOURS (For Continuous Internal Assessment only):**

The recent advancements in the course topics will be explained to the students then and there through expert lectures, online seminars or webinars

REFERENCES

1. J. M. Butler (2014) Advanced Topics in Forensic DNA Typing- Methodology, Academic Press.
2. J m butler (2005) Forensic DNA typing biology, technology & gentics of STR markings,Academic Press
3. John Butler (2014) Advanced Topics in Forensic DNA Typing:Interpretation, Academic Press.
4. W.J. Tilstone, M.L. Hastrup and C. Hald (2013).Fisher's, Techniques of Crime Scene Investigation, CRC Press, Boca Raton.

OUTCOME OF THIS PAPER:

- At the end of this paper Students can learn about

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Demonstrate competency in the collection, processing, analyses,	K1,K2
CO 2	To understand evaluation of evidence, collection, identification, preservation,	K3
CO 3	To Learning Identify the role of the forensic scientist and physical evidence within the criminal justice system	K4
C0 4	To understand physical evidence, and scientific processes.	K4
CO 5	To learn the forensic biotechnology policies and law	K5

Mapping with Programme Outcomes:

Relationship Matrix											
Semester	**Course Code**		**Title of the Course**							**Hours**	**Credits**
VI	**24UBT6MBE2C**		**MBE II** C) Forensic biotechnology							4	4
Course Outcomes	**Programme Outcome (POs)**					**Programme specific outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	2	2	3	2	3	3	2	2
CO2	2	3	3	2	3	2	3	3	2	3	3
CO3	3	3	2	2	2	3	3	2	3	2	2
CO4	2	3	2	2	3	3	3	2	2	2	2
CO5	3	3	2	3	2	2	3	2	2	3	2
Mean Overall Score											2.4 HIGH

Semester	Course code	Title of the course	Hours/week	credits
VI	24UBT6SBE2A	**SBE-II A)** Clinical Trial and Data Management	3	2

COURSE OBJECTIVES:

- Demonstrate the knowledge and capability to search and retrieve information of individual clinical practice issues.
- Describe and demonstrate leadership skills that can lead to effective in a healthcare environment.
- Demonstrate effective written and oral communication skills.

UNIT – I Introduction:

Definition – History of clinical trial - Glossary of Common Terms in clinical Trials: Clinical Research, clinical Practice, Healthy Volunteer, Inclusion/Exclusion, Criteria, Informed Consent, Patient Volunteer, Phases of Clinical Trials, Placebo, Protocol, Principal Investigator, Randomization, Single- or Double-Blind Studies. mTypes – Diagnostic trials, Natural history studies, Prevention trials, Quality of life trials, Screening trials, Treatment trials. Clinical Trial Protocol and its components.

UNIT – II Clinical Trial Management:

Project Management, Protocol in Clinical Research, Informed Consent, Case Report Form, Investigator's Brochure (IB), Selection of an Investigator and SiteClinical Trial Stakeholders, Contract Research Organization (CRO), Site management organizations.

UNIT – III Data Safety Monitoring Board:

Monitoring Visits, Investigator Meeting, Documentation in Clinical Trials, Regulatory Binder, Record Retention – Pharmacovigilance, Training in clinical Research, Project Auditing, Inspection, Fraud and Misconduct, Roles and Responsibilities of Clinical Research Professionals.

UNIT – IV Clinical Data Management:

Introduction to CDM – Case Report Forms design – Clinical Data entry and validation – Discrepancy Management – Quality Assurance and CDM- Guidelines and Regulation in clinical trial data.

UNIT – V Importance of Ethics in Clinical trial:

General ethical issues in clinical trials, General principles, Historical guidelines in Clinical Research: Nuremberg code-Declaration of Helsink-Belmont report. International Conference on Harmonization (ICH)-Brief history of ICH-Structure of ICH- ICH Harmonization Process, Responsible conduct of research, Ethical review procedures, Informed consent process, Vulnerability.

UNIT VI: **CURRENT CONTOURS (For Continuous Internal Assessment only):**

The recent advancements in the course topics will be explained to the students then and there through expert lectures, online seminars or webinars

REFERENCES:

1. Richard K. Rondel, Sheila A. Varley, Colin F. Webb Clinical Data Management: 2nd Edition.

2. Susanne Prokscha Practical Guide to Clinical Data Management by - Taylor & Francis.

3. Basic Principles of Clinical Research and Methodology by S.K.Gupta

4. Clinician's Guide to Medical Writing :Robert B. Taylor. 1st ed. 2004. Springer Publications.

5. Lawrence M. Friedman (2010). Fundamentals of Clinical Trials, Springer Science & Business Media.

COURSE OUTCOME

- At the end of this paper Students can learn about

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Recognize and respond to misconduct	K1,K2
CO 2	Safeguard participant safety and trial integrity	K3
CO 3	Develop and maintain study documents	K5
CO 4	Knowledge on the Ethics & regulatory perspectives on clinical research trials activities.	K4
CO 5	Acquire knowledge on pharmacovigilance, Project Management and Medical Affairs teams function.	K3

Mapping with programme Outcomes:

Relationship Matrix											
Semester	**Course code**		**Title of the Course**							**Hours**	**Credits**
VI	**24UBT6SBE2A**		**SBE-II A)**Clinical Trial and Data Management							3	2
Course Outcomes	**Programme Outcome (POs)**					**Programme specific outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	3	2	2	3	2	3	2	2	2
CO2	3	2	3	3	2	3	2	3	2	3	3
CO3	3	2	3	2	2	3	2	3	2	3	2
CO4	2	3	2	3	3	2	3	3	2	3	3
CO5	2	3	3	2	2	3	2	3	2	2	2
Mean Overall Score											2.4 HIGH

Semester	Course code	Title of the course	Hours/week	credits
VI	**24UBT6SBE2B**	**SBE-II** B) Bio business	3	2

OBJECTIVES

The course is designed to develop knowledge and skills to master the future challenges of the biotechnology industries. It is designed to understand the Life Cycle Process of Biotech R&D and Marketing.

UNIT I BIOTECHNOLOGYBUSINESSMANAGEMENT

Principles & Practices of Management & Communication Skills.Basics of Biotechnology and Bioinformatics – Business, Marketing, Materials, & LogisticsManagement. Biotechnology plant, Project & Production management. Intellectualproperty rights & technology transfer Innovation & knowledge management.

UNIT II BIOTECHNOLOGY INDUSTRY & BUSINESS MANAGEMENT

Antibody Technologies; Antisense & RNAi Technology; Biologics; Biomarkers; Biomaterials; Cell Culture; DNA Sequencing; Drug Development; Emerging Technology; Enzymes; Gene Therapy; Genetic Engineering; Genomics ; Informatics ; Instrumentation & Equipment Microarray ; Molecular Biology ; Nanomedicine ; Personalized Medicine ; Proteomics ; Regenerative Medicine ; Stem Cell ; Tissue Engineering.

UNIT III PHARMACEUTICALBUSINESSINDUSTRY &MANAGEMENT

Pharmaceutical Industry: Issues, Structure & Dynamics; Legal, Regulatory, and Ethical Issues in the Pharmaceutical Industry; U.S Healthcare System & Pharmaceutical Managed Markets. Pharmaceutical Marketing: Pharmaceutical Marketing Research; Pharmaceutical Product Management; Managing the Pharmaceutical Sales Organization

UNIT IV AGRICULTURE BUSINESS MANAGEMENT

Management of Agricultural Input Marketing; Fertilizer Technology & Management; Management of Agro Chemical Industry; Management of Agro Chemical Industry; Seed Production Technology & Management; Case studies : Banana; sugarcane, wheat, rice etc., Transgenic Seeds/Crops (Soybean, Corn, Cotton, & Others (Includes Canola, Wheat, Rice, and Potato among Others), and Biopesticides.

UNIT V HEALTH CARE BUSINESS MANAGEMENT

Economics of Health Care and Policy, Managed Care and Market Structure, Financial Management of Health Institutions, Health Policy, Health Services Delivery: A Managerial Economic Approach, Legal Aspects of Health Care, E-Health: Business

Models and Impact, Health Care Entrepreneurship.

UNIT VI: **CURRENT CONTOURS (For Continuous Internal Assessment only):**

The recent advancements in the course topics will be explained to the students then and there through expert lectures, online seminars or webinars

REFERENCES

1. Mark J. Ahn, Michael A. Alvarez, Arlen D. Meyers, Anne S York
2. (2011)Building the Case for Biotechnology.
3. Peter Kolchensky (2011) The Entrepreneurship Guide to a Biotech startup", Evelexa,
4. Maureen D.MacKelvey,Luigi Orsenigo(2001)The Economics of Biotechnology" Edward Elgar Pub.
5. Steven B. Kayne (2005) Pharmacy Business Management" ,Pharmaceutical Press.
6. Damian Hine, John Kapeleris (2008) Innovation and Entrepreneurship in Biotechnology", Concepts, Theories and Case", Edward Elgar Publishing..
7. Yali Friedman(2008) Best practices in biotechnology business Development ",Logos Press.

COURSE OUTCOME

- At the end of this paper Students can learn about

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	students towards a fundamental understanding of how scientific advances contribute to, and influence, industrial structures, innovation,	K1,K2
CO 2	By studying this paper students can learn about the business techniques involved in Biotechnology.	K3
CO 3	To learn the dynamics of collaboration and competition at the level of the single industrial sector.	K5
CO 4	The course is designed to provide students with a comprehensive overview of and the ability to assess how innovation in the life sciences is changing production methods, business and financial models, markets, society and strategic decision making	K4
CO 5	To fully grasp these issues inevitably involves tackling the complex ethical and legal issues that individuals and society face as a result of these changes.	K4

Mapping with programme Outcomes:

Relationship Matrix											
Semester	**Course code**		**Title of the Course**							**Hours**	**Credits**
VI	**24UBT6SBE2B**		**SBE-II** B) Bio business							3	2
Course Outcomes	**Programme Outcome (POs)**					**Programme specific outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	2	2	3	2	3	3	2	2
CO2	2	3	3	2	3	2	3	3	2	3	3
CO3	3	3	2	2	2	3	3	2	3	2	2
CO4	2	3	2	2	3	3	3	2	2	2	2
CO5	3	3	2	3	2	2	3	2	2	3	2
Mean Overall Score											2.4 HIGH

Semester	Course code	Title of the course	Hours/week	credits
VI	24UBT6SBE2C	**SBE-II** C) Pharmacognosy	3	2

OBJECTIVES

The course provides basic concepts related to discovery and physiological effects of plant growth regulators. It imparts an understanding of control of various physiological and developmental mechanisms by hormones.

UNIT I INTRODUCTION

History, Definition and scope of pharmacognosy; Systems of Indian Medicines – Siddha, Unani, Ayurveda, Homeopathy; Terminologies.

UNIT II CLASSIFICATION OF CRUDE DRUGS

Taxonomical, Morphological, Pharmacological and chemical classifications; Chemistry of drugs and its evaluation.

UNIT III PREPARATION OF CRUDE AND COMMERCIAL DRUGS

Making infusion, decoction, lotion, washers, insect repellents, suppositories, tincture, making herbal syrups, compresses, poultice, plasters, oinments, herbal oils and herbal salves. Surgical fibres, sutures and dressing.

UNIT IV ORGANOLEPTIC STUDY

Fruit – Amla, Bulb – Garlic, Rhizome – Ginger, seed – castor, Bark – Cinchona, Leaves – Neem, Flower – Clove.

UNIT V ANALYTICAL PHARMACOGNOSY

Drug adultration and detection. Biological testing of herbal drug. Phytochemical investigations with reference to secondary metabolites of locally available medicinal plants.

UNIT VI: **CURRENT CONTOURS (For Continuous Internal Assessment only):**

The recent advancements in the course topics will be explained to the students then and there through expert lectures, online seminars or webinars

REFERENCES

1.S.B.Gokhale, Dr.C.K. Kokate, A.P. Purohit (2002) Pharmacognosy, Publisher: Nirali Prakasham, Pune.

2.N.C. Kumar (2004) An Introduction to Medicinal Botany and Pharmacognosy

–, Emkay Publications, New Delhi.

COURSE OUTCOME

- At the end of this paper Students can learn about

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Learn about the importance of medicinal plants	K1,K2
CO 2	They also gain the knowledgeExtraction procedures for natural compounds, their differences and their applications the main pathways of aromatic amino acids, alkaloids, phenylpropanoids	K3
CO 3	They also gain the knowledge about the preparation of crude and commercial drugs	K4
CO 4	To learn the organoleptic study of medicinal plants	K5
CO 5	They also know about advances in plant analytical advanced techniques	K4,K5

Mapping with programme Outcomes:

Relationship Matrix											
Semester	**Course code**		**Title of the Course**							**Hours**	**Credits**
VI	**24UBT6SBE2C**		**SBE-II** C) Pharmacognosy							3	2
Course Outcomes	**Programme Outcome (POs)**					**Programme specific outcomes (PSOs)**					**Mean score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	2	2	3	2	3	3	2	2
CO2	2	3	3	2	3	2	3	3	2	3	3
CO3	3	3	2	2	2	3	3	2	3	2	2
CO4	2	3	2	2	3	3	3	2	2	2	2
CO5	3	3	2	3	2	2	3	2	2	3	2
Mean Overall Score											2.2 high