DHANALAKSHMI SRINIVASAN
COLLEGE OF ARTS & SCIENCE FOR WOMEN
(AUTONOMOUS)
Affiliated to Bharathidasan University
(Nationally Re-Accredited with 'A' Grade by NAAC)
PERAMBALUR 621212
(For the candidates admitted from the academic year 2021-2022 onwards)

B.Sc., BIOTECHNOLOGY

PROGRAM OUTCOME

PO 1. Apply ethical principles and commit to professional ethics and responsibilities in technology usages.

PO 2. Acquire knowledge in domain of biotechnology enabling their applications in industry and research.

PO 3. Demonstrate knowledge in various environments with respect to sustainable development.

PO 4. Recognize the need for and have the preparation & ability to engage independent and Life

PO 5.To equip the students to pursue higher education and research in reputed institutes at national and international levels.elong learning in the broadest context of technological change.

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(For the candidates admitted from the academic year 2021-2022 onwards)
B.Sc., BIOTECHNOLOGY -COURSE STRUCTURE UNDER CBCS

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

YEAR /SEM	PART	COURSE	TITLE OF THE PAPER	SUBJECT CODE	Inst Pds/week	credit	Exam hours	Marks		Total
								Internal	External	
I Year-I Semester	I	Language Course-I	Tamil-Cheyyul(Ikkala elakiyam),Sirukathai, Ilakkiya varalaru/ Hindi/French/ Arabic/Sanskrit	21U1LT1/ 21U1LH1/ 21U1LF1/ 21U1LA1/ 21U1LS1	6	3	3	25	75	100
	II	English Language Course-I	English for Communication-I	21U1EL1	6	3	3	25	75	100
	III	Core Course-I	Cell biology	21UBT1C1	6	6	3	25	75	100
		Core Course-II	Lab in cell biology	21UBT1C2P	4	3	3	40	60	100
		Allied course-I	Biochemistry	21UBT1A1	3	4	3	25	75	100
		Allied course-II	Lab in Biochemistry and Immunology	21UBT1A2P	3	-	-	-	-	-
	IV	Environmental studies	Environmental studies	21U1EVS	2	2	3	25	75	100
			Total		**30**	**21**				**600**
I Year-II Semester	I	Language Course-II-	Tamil-Cheyyul(Edikala elakiyam),Puthinam/ Hindi/French/Arabic/ Sanskrit	21U2LT2/ 21U2LH2/ 21U2LF2/ 21U2LA2/ 21U2LS2	6	3	3	25	75	100
	II	English Language Course-II	English for Communication-II	21U2EL2	6	3	3	25	75	100
	III	Core Course-III	Microbiology	21UBT2C3	6	5	3	25	75	100
		Core Course-IV	Lab in Microbiology	21UBT2C4P	4	3	3	40	60	100
		Allied course-II	Lab in Biochemistry and Immunology	21UBT1A2P	3	3	3	40	60	100
		Allied course III	Immunology	21UBT2A3	3	3	3	25	75	100
	IV	Value education	Value education	21U2VED	2	2	3	25	75	100
			Total		**30**	**22**				**700**

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II Year-III Semester	I	Language Course-III-	Tamil-Cheyyul(Edikala elakiyam),Urainadai, aluval murai madalgal,Elakiyavaralaru/ Hindi/French/Arabic/ Sanskrit	21U3LT3/ 21U3LH3/ 21U3LF3/ 21U3LA3/ 21U3LS3	6	3	3	25	75	100
	II	English Language Course-III	English-English through literature	21U3EL3	6	3	3	25	75	100
	III	Core Course-V	Principles of Genetics and Molecular Biology	21UBT3C5	6	5	3	25	75	100
		Core Course-VI	Lab in Genetics and Molecular biology	21UBT3C6P	4	3	3	40	60	100
		Allied course-IV	Basics of Bioinformatics	21UBT3A4	3	3	3	25	75	100
		Allied lab-V	Lab in Bioinformatics and Biostatistics	21UBT3A5P	3	-	-	-	-	-
	IV	Non Major Elective-I	A) Basics of Biotechnology	21UBT3N1A	2	2	3	25	75	100
			B) Health care Biotechnology	21UBT3N1B						
			C) Process Instrumentation Dynamic and control	21UBT3N1C						
			Total		**30**	**19**				**600**
II Year-IV Semester	I	Language Course-IV-	Tamil-Cheyyul(Palanthamil Ilakkiyam, Nadagam) Hindi/French/Arabic/ Sanskrit	21U4LT4/ 21U4LH4/ 21U4LF4/ 21U4LA4/ 21U3LS3	6	3	3	25	75	100
	II	English Language Course-IV	English-English for competitive exam	21U4EL4	6	3	3	25	75	100
	III	Core Course-VII	Recombinant DNA technology	21UBT4C7	6	6	3	25	75	100
		Core Course-VIII	Lab in Recombinant DNA technology	21UBT4C8P	4	3	3	40	60	100
		Allied course-V	Lab in Bioinformatics and Biostatistics	21UBT3A5P	3	3	3	40	60	100
		Allied course-VI	Biostatistics	21UBT4A6	3	2	3	25	75	100
	IV	Non Major Elective-II	A) Agricultural Biotechnology	21UBT4N2A	2	2	3	25	75	100
			B) Solid Waste Management	21UBT4N2B						
			C) Industrial waste Management.	21UBT4N2C						
			Total		**30**	**22**			3	**700**

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III Year- V Semester	III	Core Course-IX	Forensic Biotechnology	21UBT5C9	6	6	3	25	75	100
		Core Course-X	Animal Biotechnology	21UBT5C10	6	6	3	25	75	100
		Core Course-XI	Plant Biotechnology	21UBT5C11	5	5	3	25	75	100
		Core Course-XII	Lab in FBT, ABT and PBT	21UBT5C12P	3	3	3	40	60	100
		Major Based Elective - I	A) Bioinstruments	21UBT5M1A	4	4	3	25	75	100
			B) Marine Biotechnology	21UBT5M1B						
			C) Molecular Modeling and drug design	21UBT5M1C						
		Skill based Elective -I	A) Ethonomedicine	21UBT5S1A	2	2	3	25	75	100
			B) Phytochemical Technique	21UBT5S1B						
			C) Herbs and Drug action.	21UBT5S1C						
		Skill based Elective -II	A) Pharmacognosy	21UBT5S2A	2	2	3	25	75	100
			B) Plant Hormones and Signal transduction	21UBT5S2B						
			C) Biobusiness	21UBT5S2C						
		Soft Skill development	Soft Skill development	21U5SS	2	2	3	25	75	100
			Total		**30**	**30**				**800**
III Year- VI Semester	III	Core Course-XIII	Industrial Biotechnology	21UBT6C13	6	6	3	25	75	100
		Core Course-XIV	Environmental Biotechnology	21UBT6C14	6	6	3	25	75	100
		Core Course-XV	Lab in IBT and EBT	21UBT6C15P	6	4	3	40	60	100
		Major Based Elective - II	A)Industrial Fermentation Technology	21UBT6M2A	6	4	3	25	75	100
			B) Food and beverage Fermentation technology	21UBT6M2B						
			C) Bioresources Technology	21UBT6M2C						
		Major Based Elective - III	A) Metabolic Biotechnology	21UBT6M3A	5	4	3	25	75	100
			B) Pharmaceutical Biotechnology	21UBT6M3B						
			C) Bioconjugate Technology & Applications	21UBT6M3C						
	IV	Gender studies	Gender studies	21U6GS	1	1	3	25	75	100
	V	Extension activities	Extension activities(NCC, NSS, Rotract, YRC,etc)	-		1				
			Total		**30**	**26**				**600**
Grand Total					**180**	**140**				**4000**

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MAJOR BASED ELECTIVE

SEMESTER	SUBJECT NAME	SUBJECT CODE
V	Bioinstruments	21UBT5MB1A
	Marine Biotechnology	21UBT5MB1B
	Molecular Modeling and drug design	21UBT5MB1C
VI	Industrial Fermentation Technology	21UBT6MB2A
	Food and beverage fermentation technology	21UBT6MB2B
	Bioresources Technology	21UBT6MB2C
VI	Metabolic Biotechnology	21UBT6MB3A
	Pharmaceutical Biotechnology	21UBT6MB3B
	Bioconjugate Technology & Applications	21UBT6MB3C

NON MAJOR ELECTIVE

SEMESTER	SUBJECT NAME	SUBJECT CODE
III	Basics of Biotechnology	21UBT3N1A
	Health care Biotechnology Process	21UBT3N1B
	Instrumentation Dynamic and control	21UBT3N1C
IV	Agricultural Biotechnology	21UBT4N2A
	Solid Waste Management	21UBT4N2B
	Industrial waste Management.	21UBT4N2C

SKILL BASED ELECTIVE

SEMESTER	SUBJECT NAME	SUBJECT CODE
V	Ethonomedicine	21UBT5S1A
	Phytochemical Technique	21UBT5S1B
	Herbs and Drug action.	21UBT5S1C
V	Pharmacognosy	21UBT5S2A
	Plant Hormones and Signal transduction	21UBT5S2B
	Biobusiness	21UBT5S2C

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CORE COURSE-I

CELL BIOLOGY

Semester: I **Max mark:100(Int:25,Ext:75)**

Course code: 21UBT1C1 **Credit:6**

Total Periods: 90 **Exam hrs : 3**

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 18

Cell as a basic unit: Discovery of the cells, Classification of cell types, Development of cell theory. Prokaryotic and Eukaryotic cell organization. Difference between plant and animal cell at different level.

UNIT II CELLULAR ORGANELLES 18

Structure and function of Cytoplasmic compartments of the cell: Ribosome and protein synthesis, energy flow through mitochondria, chloroplast and photosynthesis, Golgi apparatus, lysozymes and micro bodies, Endoplasmic Reticulum(ER) , cytoskeleton, vacuoles, peroxysomes, lysozomes and Nuclear compartment. Heterochromatin and Euchromatin chromosomes.

UNIT III CELL STRUCTURE AND FUNCTION 18

Cell transport phenomenon - Permease, Na+ and K– Pump, Ca2++ ATPase Pump, co-transport, symport, antiport, endocytosis and exocytosis, Active and Passive transport, Diffusion and osmosis, Membrane architecture.

UNIT IV CELL DIVISION 18

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 18

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

REFERENCES

1. Freifelder D. 1985. Molecular Biology, Narosa Publishing House. New Delhi.

2. Ajoy Paul. 2011. Textbook of Cell and Molecular Biology. Books and Allied Ltd.

3. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter. 2008. Molecular Biology of Cell. 6th Edition. Garland Science, Taylor & Francis group Publishers.

4 Harvey Lodish, Arnold Berk, S Lawrence Zipursky, Paul Matsudaira, David Baltimore, and James Darnell. 1995. Molecular Cell Biology. 3rd Edition. W.H. Freeman Publishers.

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

Note.Kl-Remembering,K2 —Understanding; K3 —Applying, K4 —Analysing; K5-Evaluating, K 6—Creating.

Mapping with programme Outcomes:

COs/Pos	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	M	S	M	S
CO 2	M	S	M	S	S
CO 3	S	M	L	M	M
C0 4	S	M	S	S	M
CO 5	S	M	M	L	S

S STRONG M MEDIUM L LOW

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CORE COURSE-II

LAB IN CELL BIOLOGY

Semester: I Max mark:100(Int:40,Ext:60)

Course code: 21UBT1C2P Credit:3

Total Periods: 60 Exam hrs : 3

OBJECTIVE

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

Experiments:

1. Introduction to principles of sterile techniques and cell propagation
2. Principles of microscopy, phase contrast and fluorescent microscopy
3. Identification of given plant, animal and bacterial cells and their components by microscopy
4. Leishman Staining
5. Micrometry
6. Giemsa Staining
7. Separation of Peripheral Blood Mononuclear Cells from blood
8. Osmosis and Tonicity
9. Tryphan Blue Assay
10. Staining for different stages of mitosis in AlliumCepa (Onion)
11. Staining and observation of meiosis in testes of the grasshopper.

REFERENCE:

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

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

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

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

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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	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.	K5

Note.Kl-Remembering,K2 —Understanding; K3 —Applying, K4 —Analysing; KS —Creating & Evaluating

Mapping with programme Outcomes:

COs/Pos	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	M	L	M	M	S
CO 2	S	S	M	S	S
CO 3	S	M	S	M	M
C0 4	S	M	M	S	S
CO 5	S	M	M	S	S

S- STRONG, M- MEDIUM, L-LOW

ALLIED COURSE-I

BIOCHEMISTRY

Semester :I Max mark:100(Int:25,Ext:75)

Course code: 21UBT1A1 Credit:4

Total Periods: 45 Exam hrs :3

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 9

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

UNIT- II PROTEINS ANDAMINOACIDS 9

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 and Nitrogen Balancing – Introduction to Enzymes – Acids base Balance.

UNIT- III LIPIDS 9

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

UNIT –IV NUCLEIC ACIDS 9

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 AND MINERALS

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

REFERENCES:

1.L. Lehninger. 2004. Principles of Biochemistry, 4th Edition. W.H FreemanandCompany.

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2. Boyer.R., (2002) Concepts in Biochemistry 2nd ed. Brooks/cole publishingcompany New York.
3. David L. Nelson and M. Cox (2003) Lehninger's Principles of Biochemistry, 3rd Ed, Worth publication NewYork
4.Voet & Voet (1995) Fundamentals of Biochemistry, 2nd Ed, John Wiley and sonsinc., New York.
5.Geoffery L Zubay (1995) Principles of Biochemistry, WCB publishers,London

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 understand the structure of fundamental monosaccharides and polysaccharides structure and functions	K2
CO 2	To study the structures of amino acids, their chemical properties and their organization into polypeptides and proteins	K3
CO 3	To learn the structure of different classes of lipids and their roles in biological systems.	K4
C0 4	To Learn Basic function of nucleotides structure and function	K5
CO 5	To learn the Vitamins and Minerals function in biology	K5

Note.Kl-Remembering,K2 —Understanding; K3 —Applying, K4 —Analysing; KS —Creating & Evaluating

Mapping with programme Outcomes:

COs/Pos	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	M	S	M	S
CO 2	S	M	M	S	S
CO 3	M	S	M	M	M
C0 4	S	M	S	S	L
CO 5	S	M	L	S	M

T- STRONG, M- MEDIUM, L-LOW

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ALLIED COURSE-II

LAB IN BIOCHEMISTRY AND IMMUNOLOGY

Semester:I Maxmark:100(Int:40,Ext:60)
Coursecode: 21UBT1A2P Credit:3 Total Periods: 90 Exam hrs :3

OBJECTIVE

This practical used to know the basic biochemical test like quantification of macromolecule 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:

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	To understand the Demonstration of Use of Volume and Weight Measurements Devices, Quantitative test for Carbohydrates	K3
CO 2	To learn the various Protein estimation methods	K3
CO 3	To learn separation of amino acids using TLC/Paper Chromatography	K3
C0 4	To .Understanding the antigen-antibody interactions and the mechanism of the immune system to protect the body from the pathogens.	K3
CO 5	To learn the Isolation of Monocyte from Blood.	K3

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

Mapping with programme Outcomes:

COs/Pos	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	M	S	M	S
CO 2	S	M	M	S	S
CO 3	S	S	S	M	M
C0 4	S	M	M	S	S
CO 5	S	M	S	L	M

S STRONG, M MEDIUM, L LOW

CORE COURSE-III

MICROBIOLOGY

Semester: II Max mark:100(Int:25,Ext:75)
Course code: 21UBT2C3 Credit:6
Total Periods: 90 Exam hrs : 3

OBJECTIVES: This course presents the Introduction about Microbiology and it helps the students to understand the types of Microscopy. 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 18

Definition and Scope of Microbiology. History and Recent developments, Contribution of Leeuwenhoek, Louis Pasteur, Robert Koch, Elie Eetchinkoff, Edward Jenner and Alexander Fleming. Systems of classification - Binomial Nomenclature, Whittaker's five- kingdom concept of living organism.

UNIT II MICROSCOPY 18

Microscopy - Simple and compound microscopy, Dark field, Phase contrast, Fluorescence and Electron Microscopy. Stain and staining techniques - Simple, differential and special staining (Endospore, Capsular).

UNIT III STRUCTURAL ORGANIZATION 18

General structural organization of Bacteria, Virus, Fungi, Protozoa and Actinomycetes and their reproduction. Bacteriophages, multiplication of bacteriophages-lytic and lysogeny cycle.

UNIT IV MICROBIAL TECHNIQUES 18

Microbiological Media: Types, Preparation, Methods of Sterilization; Enumeration of Microorganisms in Soil, Water and Air; Isolation of Microorganisms from Environment and Infected Tissue; Techniques of Pure Culture, Maintenance and Preservation; Staining: Stains and Types of Staining - Simple Staining, Differential Staining and Structural Staining.

UNIT V TYPES AND APPLICATION OF MICROBIOLOGY 18

Production of Enzymes and Antibiotics; Production of Biofertilizer and Biopesticides; Economic Importance of Moulds and Yeast; Role of Microbes in Biogeochemical cycles.

REFERENCES:

1.Prescott, Harley, Klein. 2003. Microbiology. 5th Edition. Mcgraw Hill Publ.

2.Pelzer, Chan and Kreig. 1986. Microbiology. 5th Edition. Mcgraw-Hill, New Delhi,India.

3.S. Meenakumari. 2009. Microbial Physiology. MJP Publishers, New Delhi.

4.Tortora, G.J., Funke, B.R. And Case, C.L. 2012. Microbiology - an Introduction. 11th Edition. Pearson Education.

5.Edward A. Birge, 1992, Modern Microbiology – Principles and Application.,Wm.C. Brown Publishers, Inc. U.S.A.

6.Gerard J. Tortora, Berdell R. Funke, Christine & L. Case, 2001, Microbiology -

7.Danial Lim, 1998, Microbiology, Mcgraw-Hill Companies, New York.

8.Stephen A. Hill, 1984, Methods In Virology. Blackwell Scientific Publication, London.

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	K2
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	K4
C0 4	Outline the methods involved in media preparation and sterilization.	K3
CO 5	To learn the Vitamins and Minerals function in biology	K2

Note.Kl-Remembering,K2 —Understanding; K3 —Applying, K4 —Analysing; K5-Evaluating, K6—Creating,

Mapping with programme Outcomes:

COs/Pos	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	M	S	M	S
CO 2	S	M	M	S	M
CO 3	S	M	S	M	M
C0 4	S	M	S	S	S
CO 5	S	M	S	L	M

S - STRONG, M - MEDIUM, L-LOW.

CORE COURSE-IV

LAB IN MICROBIOLOGY

Semester: II Max mark:100(Int:40,Ext:60)
Course code: 21UBT2C4P Credit:3
Total Periods: 60 Exam hrs : 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 the following:

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Illustrate the techniques involved in sterilization of media and glasswares	K3
CO 2	Demonstrate the various pure culture techniques and to measure the bacterial growth.	K3
CO 3	Identify the organisms by various staining techniques.	K4
C0 4	Apply various biochemical tests to characterize microorganisms.	K5
CO 5	T o learnAntibiotic sensitivity test	K6

Note.Kl-Remembering,K2 —Understanding; K3 —Applying, K4 —Analysing; K5-Evaluating, K6—Creating,

Mapping with programme Outcomes:

COs/Pos	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	M	S	M	S
CO 2	S	S	M	S	S
CO 3	S	S	S	M	M
C0 4	S	M	S	S	S
CO 5	S	M	S	S	M

S - STRONG, M - MEDIUM, L-LOW.

ALLIED COURSE-III

IMMUNOLOGY

Semester: II Max mark:75(Int:25, Ext:75)
Course code: 21UBT2A3 Credit:3 Total Periods: 45 Exam hrs : 3

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

UNIT I INTRODUCTION 9

Historical development in immunology. immunity-. humoral and cell mediated response, primary and secondary immune response. cells involved in immune system - hematopoiesis. innate and acquired immunity.

UNIT II ANTIGEN 9

Antigen- types and classifications. Hybridoma technology - Poly clonal sera, Monoclonal antibody. Primary and Secondary lymphoid organs – Thymus, Bone marrow, Lymph nodes and Spleen. Lymphocytes traffic and regulation, CD molecules, MHC complex and its classification, HLA typing.

UNIT III CMI AND HI RESPONSES 9

CMI Response -T cell development, maturation, activation and differentiation. T cell receptor and determinant. T cell subsets. TCR complex. antigen processing and presentation. HI response - B cell: B cell development, maturation, activation and differentiation. B cell receptor and determinants. B cell subsets. immunoglobulins - basic structure, classes & subclasses of immunoglobulins, antigenic determinants.

UNIT IV VACCINOLOGY 9

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

UNIT V CLINICAL IMMUNOLOGY 9

Immunity to Infection. - Bacteria, viral, fungal and parasitic; hypersensitivity – type I, II, III and IV; autoimmunity; transplantation immunology; tumor & cancer immunology and immunotherapy; immunodeficiency

REFERENCES

1. E. Riot. 2011. Essential Immunology 12th Edition. Wiley & Blackwell.
2. Janeway et al. 1999. Immunobiology. 4th Edition. J Current Biology publications.
3. D. M. Weir, John Stewart. 1997. Immunology. 8th Edition. Churchill Livingstone.
4. P.J.Delves, I S.J.Artin, I D.R.Burton and I I.M.Roitt. 2006. Essential Immunotechnology. 12th Edition. Wiley & Blackwell.
5. Richard M. Hyde. 2012. Microbiology and Immunology. 3rd Edition. Springer Science & Business Media.
6. Brostoff J, Seaddin JK, Male D, Roitt IM., 2002. Clinical Immunology. 6th Edition. Gower Medical Publishing.
7. Paul. 1999. Fundamental of Immunology. 4th Edition. Lippencott Raven.

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	Compare and contrast innate and adaptive immunity.	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

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

Mapping with programme Outcomes:

COs/Pos	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	M	S	M	S
CO 2	S	S	M	S	S
CO 3	M	M	S	S	M
C0 4	S	M	S	S	S
CO 5	S	M	L	S	M

S - STRONG, M - MEDIUM, L-LOW.

CORE COURSE-V

PRINCIPLES OF GENETICS AND MOLECULAR BIOLOGY

Semester: III Max mark: 100(Int:25, Ext:75)
Course code: 21UBT3C5 Credit: 5
Total Periods: 90 Exam hrs : 3

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

UNIT I GENES, CHROMOSOMES & HEREDITARY 18

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 INTRACTION 18

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 18

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 control of development in *Drosophila and Arabidopsis.* Genetic drift, shift, pedigree analysis and genetic counseling.

UNIT IV STRUCTURE OF NUCLEIC ACIDS &DNA REPLICATION 18

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

UNIT V REGULATION OF GENE EXPRESSION 18

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

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	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	K2
C0 4	Explain DNA replication and repair mechanism..	K2
CO 5	Outline the gene regulatory mechanisms.	K4

Note.Kl-Remembering,K2 —Understanding; K3 —Applying, K4 —Analysing; K5 -- - Evaluating, K6—Creating

Mapping with programme Outcomes:

COs/Pos	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	M	M	S	M	S
CO 2	S	S	L	S	S
CO 3	M	S	S	M	M
C0 4	S	M	S	S	S
CO 5	S	L	S	M	M

S - STRONG, M - MEDIUM, L-LOW.

LAB IN GENETICS AND MOLECULAR BIOLOGY

Semester: III | Max mark: 100(Int:40, Ext:60)
Course code: 21UBT3C6P | Credit: 3
Total Periods: 60 | Exam hrs : 3

OBJECTIVE

This course presents the study of extraction and 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.

OUTCOME OF THIS PAPER:

- At the end of this paper students can

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	clear about the methods and reagents used for DNA and RNA extraction,t	K2
CO 2	they also know about how to estimate the extracted DNA and RNA compounds,	K3
CO 3	They also know about the Molecular Biological techniques like Transformation, Dialysis processes.	K2
C0 4	To study the Replica plate technique.	K2
CO 5	Outline the molecular biology techniques	K4

Note.Kl-Remembering,K2 —Understanding; K3 —Applying, K4 —Analysing; K5 - Evaluating, K6—Creating

Mapping with programme Outcomes:

COs/Pos	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	M	S	M	S
CO 2	M	S	M	S	S
CO 3	S	S	M	M	M
C0 4	S	M	S	S	S
CO 5	S	L	L	M	M

S - STRONG, M - MEDIUM, L-LOW.

ALLIED COURSE - IV

BASICS OF BIOINFORMATICS

Semester: III | Max mark: 100 (Int:25, Ext:75)
Course code: 21UBT3A4 | Credit: 3
Total Periods: 45 | Exam hrs : 3

OBJECTIVES: The course structure of the course provides an in-depth knowledge o all the necessary concepts related to bioinformatics, basic engineering, information technology and computer languages.

UNIT I INTRODUCTION

Introduction and history of bioinformatics – Internet, World Wide Web, Web browser, EMB net, NCBI. File transfer protocol. Search engines.

UNIT II BIOLOGICAL DATABASE AND ITS TYPES

General Introduction of Biological Databases; Nucleic acid databases (NCBI, DDBJ, and EMBL). Protein databases (Primary, Composite, and Secondary). Specialized Genome databases: (SGD, TIGR, and ACeDB). Structure databases (CATH, SCOP, and PDBsum)

UNIT III SEQUENCE ANALYSIS

Sequence Analysis: Introduction to sequence analysis and alignment - Global and Local Alignments - Pairwise and Multiple sequence alignment. Tools for sequence alignments - BLAST, FASTA, clustalW. Phylogenetic analysis – rooted and unrooted trees.

UNIT IV PREDICTION STUDIES

Prediction studies: Introduction to protein structure - domains, motifs and their uses. Secondary structure prediction - tools used. Introduction to 3D structure prediction- Homology modeling, Threading & Ab initio Methods. Gene prediction

UNIT V APPLICATIONS

Application aspects – Drug database-Microbial Databases– target searchings – drug designing – Docking Studies (Basics) E- cell, phylogenetic analysis, PERL, Chemoinformatics

REFERENCES:

1. T.K.Attwood, D.J.Parry-smith D.J. Delhi (2004) Introduction to Bioinformatics. Pearson Education, Singapore.
2. K.Mani and N.Vijayaraj (2002) Bioinformatics for Beginners. Kalaikathir Achchagam, Coimbatore.
3. Pennington and Dunn (2002) Proteomics. Viva books publishers, New Delhi
4. A.D. Baxevanis and B.F.F. Ouellette (2002) Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins 2nd Ed. John Wiley and Sons publishers, New York.

OUTCOME OF THIS PAPER

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	To get introduced to the basic concepts of Bioinformatics	K4
CO 2	To understand significance in Biological data analysis,	K2
CO 3	To understand the methods to characterise and manage the different types of Biological data.	K4
C0 4	Classify different types of Biological Databases,history, scope and importance of Bioinformatics	K5
CO 5	T o learn the role of internet in Bioinformatics.	K6

Note.Kl-Remembering,K2 —Understanding; K3 —Applying, K4 —Analysing; K5-Evaluating, K6—Creating,

Mapping with programme Outcomes:

COs/Pos	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	M	S	M	S
CO 2	S	S	M	S	S
CO 3	S	S	S	M	M
C0 4	S	M	S	S	S
CO 5	S	M	S	S	M

S - STRONG, M - MEDIUM, L-LOW.

ALLIED COURSE-V

LAB IN BIOINFORMATICS AND BIOSTATISTICS

Semester: III | Max mark: 100 (Int:40, Ext:60)
Course code: 21UBT3A5P | Credit: 3
Total Periods: 45 | Exam hrs : 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	K2
CO 3	To understand the various tools involved in genome annotation	K4
C0 4	CRNA structure analysis tools. and importance of Bioinformatics	K3
CO 5	T o learn the role of internet in Bioinformatics.	K3

Note.Kl-Remembering,K2 —Understanding; K3 —Applying, K4 —Analysing; K5-Evaluating, K6—Creating,

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Mapping with programme Outcomes:

COs/Pos	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	M	M	M	S
CO 2	M	S	M	S	S
CO 3	S	S	S	M	M
C0 4	S	M	L	M	S
CO 5	S	M	M	L	M

S - STRONG, M - MEDIUM, L-LOW.

CORE COURSE VII

RECOMBINANT DNA TECHNOLOGY

Semester: IV Max mark: 100 (Int:25, Ext:75)
Course code: 21UBT4C7 Credit: 6
Total Periods: 90 Exam hrs : 3

OBJECTIVES: The course provides information regarding the enzyme, strategis 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, lZAP, 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.

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.

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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. Brassies London.

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	K2
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,	K3
CO 5	To learn the Expression of recombinant protein in *E. coli* and eukaryotes	K3

Note.Kl-Remembering,K2 —Understanding; K3 —Applying, K4 —Analysing; K5-Evaluating, K6—Creating,

Mapping with programme Outcomes:

COs/Pos	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	M	S	M	S
CO 2	S	S	M	S	S
CO 3	S	S	S	M	M
C0 4	S	M	S	S	S
CO 5	S	M	S	S	M

S - STRONG, M - MEDIUM, L-LOW.

CORE COURSE VIII

LAB IN RECOMBINANT DNA TECHNOLOGY

Semester: IV | Max mark: 100 (Int:40, Ext:60)
Course code: 21UBT4C8P | Credit: 3
Total Periods: 60 | Exam hrs : 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.

Demonstration

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
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,	K3
CO 5	To learn the Expression of recombinant protein in *E. coli* and eukaryotes	K3

Note.Kl-Remembering,K2 —Understanding; K3 —Applying, K4 —Analysing; K5-Evaluating, K6—Creating,

Mapping with programme Outcomes:

COs/Pos	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	M	S	M	S
CO 2	M	S	M	M	S
CO 3	S	M	S	M	M
C0 4	S	M	S	S	S
CO 5	S	M	L	S	M

S - STRONG, M - MEDIUM, L-LOW.

CORE COURSE IX

FORENSIC BIOTECHNOLOGY

Semester: V | Max mark: 100 (Int:25, Ext:75)
Course code: 21UBT5C9 | Credit: 6
Total Periods: 90 | Exam hrs : 3

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

UNIT I INTRODUCTION 18

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 18

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. 18

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 18

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 18

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.

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 SceneInvestigation, 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,	K3
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	K2

Note.Kl-Remembering,K2 —Understanding; K3 —Applying, K4 —Analysing; K5-Evaluating, K6—Creating,

Mapping with programme Outcomes:

COs/Pos	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	M	S	M	S
CO 2	M	S	M	S	S
CO 3	S	S	M	M	M
C0 4	M	M	S	S	S
CO 5	S	M	S	M	L

S - STRONG, M - MEDIUM, L-LOW.

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CORE COURSE X

ANIMAL BIOTECHNOLOGY

Semester: V Max mark: 100 (Int:25, Ext:75)
Course code: 21UBT5C10 Credit: 6
Total Periods: 90 Exam hrs : 3

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

UNIT I ANIMAL CELL CULTURE 18

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 18

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 18

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 18

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

UNIT V TRANSGENICS 18

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

REFERENCES:

1. E.J. Murray (Ed) (1991) Gene Transfer and Expression Protocols – Methods in 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	K3
CO 2	learn about the various types of Animal cell culure	K3
CO 3	To understand the media involved for growth of Animal cells	K3
CO 4	To Learning techniques to transfer the animal cells to recipients	K2
C0 5	To understand the transgenic animals production	K2

Note.Kl-Remembering,K2 —Understanding; K3 —Applying, K4 —Analysing; K5-Evaluating, K6—Creating,

Mapping with programme Outcomes:

COs/Pos	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	M	S	M	S
CO 2	S	S	M	S	S
CO 3	S	S	S	M	M
C0 4	S	M	S	S	S
CO 5	S	M	S	S	M

S - STRONG, M - MEDIUM, L-LOW.

CORE COURSE XI

PLANT BIOTECHNOLOGY

Semester: V Maxmark:100(Int:25,Ext:75)
Coursecode: 21UBT5C11 Credit:5
Total Periods:75 Exam hrs :3

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

UNIT I CROP IMPROVEMENT –CONVENTIONAL METHOD 15

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

UNIT II INTRODUCTION OF PTC 15

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

UNIT III PLANTTISSUE CULTURE 15

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 15

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 15

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.

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 of Crop Plants. Heinemann, London.
3. Mantel. S. H, Mathews. J. A, Mickee. R.A.(1985) An Introduction to 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.

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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	K3
CO 2	To study the basic principles and techniques involved in plant tissue cell culture,	K3
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	K2
C0 5	To Understand the concepts of transformation in Plant systems and achievements of biotechnology in Plant systems.	K2

Note.Kl-Remembering,K2 —Understanding; K3 —Applying, K4 —Analysing; K5-Evaluating, K6—Creating,

Mapping with programme Outcomes:

COs/Pos	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	M	S	M	S
CO 2	S	S	M	M	S
CO 3	S	S	S	M	S
C0 4	S	M	S	M	S
CO 5	S	M	L	S	M

S Strong, M Medium, L Low.

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CORE COURSE XII

LAB IN FORENSIC BIOTECHNOLOGY, ANIMAL BIOTECHNOLOGY, PLANT BIOTECHNOLOGY1

Semester: V | Max mark: 100 (Int:40, Ext:60)
Course code: 21UBT5C12P | Credit: 3
Total Periods: 45 | Exam hrs : 3

OBJECTIVE

To learn about trchniques involved in forensic biotechnology and handling methods. Animal biotechnology and animal cell culture, plant biotechnology microprobacation techniques.

Experiments:

LAB IN FORENSIC BIOTECHNOLOGY

1. Restriction Fragment Length Polymorphism.
2. Random Amplified Polymorphic DNA.
3. Polymerase Chain Reaction
4. DNA Finger Printing
5. Blotting Techniques

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 culturedtissue

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 explain the basics of the physiological and molecular processes that occur in plants	K2
CO 2	To develop knowledge of complex processes that occur in the plants and animals	K3
CO 3	basic biotechnological techniques to explore molecular biology of plants and animals	K4
C0 4	Outline the methods involved in media preparation and sterilization.	K5
CO 5	To deleop skills in the animal cell culture techniques. understand explicitly the concepts of plant tissue culture techniques	K2

Note.Kl-Remembering,K2 —Understanding; K3 —Applying, K4 —Analysing; K5-Evaluating, K6—Creating,

Mapping with programme Outcomes:

COs/Pos	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	M	S	M	S
CO 2	S	S	M	S	S
CO 3	S	S	S	M	M
C0 4	S	M	S	S	S
CO 5	S	M	S	S	M

S - STRONG, M - MEDIUM, L-LOW.

CORE COURSE XIII

INDUSTRIAL BIOTECHNOLOGY

Semester: VI Max mark: 100 (Int:25, Ext:75)
Course code: 21UBT6C13 Credit: 6
Total Periods: 90 Exam hrs : 3

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 18

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 18

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 18

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

UNIT IV ENZYME TECHNOLOGY 18

Enzyme technology – nature of enzymes, application of enzymes, limitations of microbial 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 18

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.

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.

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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	Increase their understanding that 'industrial biotechnology' is based on using machines to control the growth of microorganisms	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 deleop skills of Biotechnology in specific medical & industrial applications	K2

Note.Kl-Remembering,K2 —Understanding; K3 —Applying, K4 —Analysing; K5-Evaluating, K6—Creating,

Mapping with programme Outcomes:

COs/Pos	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	M	S	M	S
CO 2	M	M	M	S	S
CO 3	S	S	S	M	M
C0 4	M	M	S	S	S
CO 5	S	M	S	S	M

S - STRONG, M - MEDIUM, L-LOW.

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CORE COURSE XIV

ENVIRONMENTAL BIOTECHNOLOGY

Semester: VI Max mark: 100 (Int:25, Ext:75)
Course code: 21UBT6C14 Credit: 6
Total Periods: 90 Exam hrs : 3

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

UNIT I ECOSYSTEM 18

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 ENVIRONMENTALPOLLUTION 18

Pollution – types – sources – effects – Air-water – land – Noise – Thermal – esticide – 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 18

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 18

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 18

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.

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

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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, ,	K3
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	K2
C0 5	To Understand the concepts of biofilms/biofilters for vapor-phase wastes, and composting.	K2

Note.Kl-Remembering,K2 —Understanding; K3 —Applying, K4 —Analysing; K5-Evaluating, K6—Creating,

Mapping with programme Outcomes:

COs/Pos	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	M	S	M	S
CO 2	S	S	M	S	S
CO 3	S	S	S	M	M
C0 4	S	M	S	S	S
CO 5	S	M	S	S	M

S Strong, M Medium, L Low.

CORE COURSE XV

LAB IN INDUSTRIAL BIOTECHNOLOGY AND ENVIRONMENTAL BIOTECHNOLOGY

Semester: VI | Max mark: 100 (Int:40, Ext:60)
Course code: 21UBT6C13 | Credit: 6
Total Periods: 90 | Exam hrs : 3

OBJCTIVE

To learn about recombinant DNA technology Restriction and ligation, protein separation, blotting techniques and amplification technique. Environmental and culturing 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 microorganisms
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 thehow to separate the industrially important microorganisms from various souces	K3
CO 2	To study the techniques to produce various products by using Microbes.	K3
CO 3	Tounderstand to analyse the quality of water and air.	K3
CO 4	To learn the Quantitative analysis of milk.	K2
C0 5	To Understand the Measurement of COD, BOD	K2

Note.Kl-Remembering,K2 —Understanding; K3 —Applying, K4 —Analysing; K5-Evaluating, K6—Creating,

Mapping with programme Outcomes:

COs/Pos	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	M	S	M	S
CO 2	S	S	M	S	S
CO 3	S	S	S	M	M
C0 4	S	M	S	S	S
CO 5	S	M	S	S	M

S Strong, M Medium, L Low.

MAJOR BASED ELECTIVE I

BIOINSTRUMENTS

Semester: V | Max mark: 100 (Int:25, Ext:75)
Course code: 21UBT5M1A | Credit: 4
Total Periods: 60 | Exam hrs : 3

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 **12**

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

UNIT II MICROSCOPY **12**

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

UNIT III SPECTROSCOPY **12**

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

UNIT IV SEPARATION TECHNIQUES **12**

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 **12**

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 Isoelectricfocussing, MoldiTof.

REFERENCE BOOKS

1. S.Sadasivam., A. Manickam. 1996. Biochemical Methods. 2nd Edition. New Age International (p) Ltd, Publishers.
2. Dr. G.Rajagobal., Dr. B.D.Toora. 2001. Practical Biochemistry. 1st Edition. Ahuja Book 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	K3
CO 2	To study the understand the chromatography techniques to separate products	K3
CO 3	Tounderstand to analyse the Electrophoresis techniques.	K3
CO 4	To learn the Purification echniques	K2
C0 5	To Understand the Spectroscopy techniques	K2

Note.Kl-Remembering,K2 —Understanding; K3 —Applying, K4 —Analysing; K5-Evaluating, K6—Creating,

Mapping with programme Outcomes:

COs/Pos	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	M	S	M	S
CO 2	S	S	M	S	S
CO 3	S	S	S	M	M
C0 4	S	M	S	S	S
CO 5	S	M	S	S	M

S Strong, M Medium, L Low

B. MARINE BIOTECHNOLOGY

Semester: V | Max mark: 100 (Int:25, Ext:75)
Course code: 21UBT5M1B | Credit: 4
Total Periods: 60 | Exam hrs : 3

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 12

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

UNIT II MARINE FLORA 12

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

UNIT III MARINE FAUNA 12

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

UNIT IV MARINE MICROBES 12

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

UNIT V MARINE POLLUTANTS 12

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.

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 in marine biotechnology. Vol. 2.

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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
CO 2	.To study the Marine flora	K3
CO 3	Tounderstand to marine fauna such as zooplankton,	K3
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	K2

Note.Kl-Remembering,K2 —Understanding; K3 —Applying, K4 —Analysing; K5-Evaluating, K6—Creating,

Mapping with programme Outcomes:

COs/Pos	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	M	S	M	S
CO 2	S	S	M	S	S
CO 3	S	S	S	M	M
C0 4	S	M	S	S	S
CO 5	S	M	S	S	M

S Strong, M Medium, L Low

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MAJOR BASED ELECTIVE II

A. INDUSTRIAL FERMENTATION TECHNOLOGY

Semester: VI Max mark: 100 (Int:25, Ext:75)
Course code: 21UBT6M2A Credit: 4
Total Periods: 90 Exam hrs : 3

OBJECTIVES: It is to make the student learn about the Industrial Fermentation Processes and the Production of Industrially important Products.

UNIT I BASICS OF INDUSTRIAL FERMENTATION 18

Introduction to industrial fermentations: Types of fermentation process – Microbial growth metabolism: Microbial metabolites – screening – strain development, preservation methods – Product development: regulation and safety -use of Process flowcharts and block diagrams.

UNIT II PRODUCTION OF PRIMARY METABOLITES 18

Production of primary metabolites: Organic acids fermentation:Citric acid – Acetic acid – Lactic acid – Amino acids: L-glutamic acid – L-lysine-Ltryptophan-Solvents:Acetone-Butanol –Ethanol.

UNIT III PRODUCTION OF SECONDARY METABOLITES 18

Antibiotic production: Classification-Carbohydrate containing antibiotic:Streptomycin – Macro cyclic lactones: Erythromycin – Quiones: Tetracycline – Amino acid containing antibiotic: Penicillin – Peptide antibiotic: Bacitracin – Industrial Enzyme production: α-amylase – Cellulase – Protease – Lipase, Vitamins: Cyanaocobalamin – Riboflavin Fermentation.

UNIT IV FOOD AND BEVERAGE FERMENTATION 18

Food fermentations: Cheese – yogurt – sauerkraut – soy sauce- Food flavoring agents: MSG – γ-decalactone – Food preservative: Nisin – Food colorants:*Monascus* pigments fermentation – Production of single cell protein: Bel – symba – pekilo – pruteen processes - Beverages: Brewing process – Wine and Cider production.

UNIT V PRODUCTION OF COMMERCIAL PRODUCTS 18

Recombinant protein production: Insulin – interferon – Production of nucleosides and nucleotides: 5' IMP – 5' GMP – Enzyme biotransformations: Types- steriod – antibiotic transformations-Biopolymers: Xanthan gum – PHA – PHB – Agrochemicals: *Bacillus thuringenesis* insecticide production.

REFERENCES

1. Yuan Kun Lee (2006) Microbial Biotechnology: Principles and Applications. World Scientific Publishing.
2. L.E.Casida JR (1968) Industrial Microbiology", New Age international Publishing.
3. Samuel Cate Prescott, Cecil Gordon Dunn, Gerald Reed (1983) Prescott & Dunn's Industrial Microbiology.CBS Publishers.
4. Patel.A.H (1985) Industrial Microbiology. MacMillan Publishers.
5. Ratledge, Colin and Bjorn Kristiansen (2001) Basic Biotechnology" 2nd EdN, Cambridge University Press,.
6. Henry J. Peppler, D. Perlman (1979) Microbial Technology: Microbial processes.Volume I, Academic Press.

OUTCOME OF THIS PAPER:

- At the end of this paper Students can learn about

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	To :evaluate factors that contribute in enhancement of cell	K3
CO 2	.To study the product formation during fermentation process	K3
CO 3	To analyse kinetics of cell and product formation in batch, continuous and fed-batch culture	K3
CO 4	To study the differentiate the rheological changes during fermentation process.	K2
C0 5	To learn the commercial products production by using fermentation	K2

Note.Kl-Remembering, K2 —Understanding; K3 —Applying, K4 —Analysing; K5-Evaluating, K6—Creating,

Mapping with programme Outcomes:

COs/Pos	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	M	M	S	M	S
CO 2	S	S	M	S	S
CO 3	M	S	S	M	M
C0 4	S	M	M	S	S
CO 5	M	M	L	S	M

S Strong, M Medium, L Low

B. FOOD AND BEVERAGE FERMENTATION TECHNOLOGY

Semester: VI | Max mark: 100 (Int:25, Ext:75)
Course code: 21UBT6M2B | Credit: 4
Total Periods: 90 | Exam hrs : 3

OBJECTIVES: The objective of the course is to make the student learn about the Food Fermentation and the Preservation techniques.

UNIT I THE SCIENCE UNDERPINNING FOOD FERMENTATIONS 18

Microorganisms: microbial metabolism– nutritional needs – environmental impacts – metabolic events – Fermenters: Downstream processing – Some general issues for a number of food stuffs.

UNIT II FOOD PRESERVATION 18

Preservation by Moist Heat: Heat Resistance of microorganisms and spores – Decimal reduction time (D values) – 12D concept – Thermal Death Time curves – Unit of lethality – determination of process lethality requirements – effective F values – Preservation by low temperature: The behavior of microorganisms under freezing and refrigeration environment – Growth and lethal effects of low temperature treatments on microorganisms in raw and processed foods. Preservation by drying, Chemicals and ionizing irradiation– Pulsed electric field (PEF) method.

UNIT III TECHNOLOGY OF FERMENTED BEVERAGES 18

Fermented products: Beer – Kefir-Mead-KVASS-Wine – Distilled alcoholic beverages – Flavoured spirits and sake.

UNIT IV TECHNOLOGY OF FERMENTED FOOD PRODUCTS 18

Fermented food products: Vinegar – cheese – yoghurt and other fermented milk products – bread – Meat: sausage, bologna, Fermented vegetables: Sauerkaurt – Kimchi – Soya sauce – Miso Natto.

UNIT V FOOD SANITATION 18

Basic principles of food plant sanitation: cleaning chemicals and sanitizers in the food industry –Indicator organism – coliform bacteria – Hazard Analysis and Critical Control Point (HACCP) Program – Good manufacturing Practices(GMP's)and microbiological standards.

REFERENCES

1. Charles W.Bamforth (2005) Food, fermentation and microorganisms.Blackwell
2. Publishing,.
3. Frazier, W.C. and Dennis.D.Westhoff (1978) Food Microbiology", 3rd Edn, Tata
   McGraw Hill Publishing,.
4. Zeki Berk (2009) Food Process Engineering and Technology.Academic Press,.
5. James.M.Jay, Martin.J.Loessner, David.A. Golden (2005) Modern Food Microbiology", 7th Edn,.

6. Paul SinghR., Dennis R. Heldman (2009) Introduction to Food Engineering", 4th Edn, Academic Press,

OUTCOME OF THIS PAPER:

- At the end of this paper Students can learn about

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	This course acquaints students with various aspects of chemistry involved in the food	K3
CO 2	This course acquaints students with various types of food contamination and spoilage by different microorganisms and their preservation techniques.	K3
CO 3	This course acquaints students with fermentation technology, types of fermentation that can be applied in Industry	K3
CO 4	They learn various production technologies for various industrial products where microbes are involved.	K2
C0 5	To learn the food sanitation principles	K2

Note.Kl-Remembering,K2 —Understanding; K3 —Applying, K4 —Analysing; K5-Evaluating, K6—Creating,

Mapping with programme Outcomes:

COs/Pos	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	M	S	M	S
CO 2	S	S	M	S	S
CO 3	S	S	S	M	M
C0 4	S	M	S	S	S
CO 5	S	M	S	S	M

S Strong, M Medium, L Low

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C. BIORESOURCE TECHNOLOGY

Semester: VI | Max mark: 100 (Int:25, Ext:75)
Course code: 21UBT6M2C | Credit: 4
Total Periods: 90 | Exam hrs : 3

OBJECTIVES

The course makes the student understand about about the Energy source, Products and the Bioconversion Technologies.

UNIT I RENEWABLE ENERGY SOURCE 18

Hydropower, geothermal power, solar power, wind power – Biofuel -Biomass - Feed stocks (agricultural crops, bioenergy crops, agricultural waste residues, wood residues, waste stream) .

UNIT II FUEL TECHNOLOGY AND BIOCONVERSION 18

History - Definition of biofuel, applications of biofuel (transport, direct electricity generation, home use and energy content of biofuel) - Bioconversion of lignocellulosics, cellulose saccharification, pretreatment technologies (air separation process, mechanical size reduction, autohydrolysis) - Pulping and bleaching.

UNIT III BIOGAS 18

Biogas plant, feed stock materials, biogas production, factors affecting methane formation - Role of methanogens – Biohydrogen production - Oxygen sensitivity problems in hydrogenenases

UNIT IV BIO ETHANOL AND BUTANOL 18

Advantages of ethanol over fossil fuels, production of ethanol from cellulosic materials, ethanol recovery - Biobutanol production, energy content and effects on fuel economy - Octane rating, air fuel ratio, specific energy, viscosity, heat of vaporization.

UNIT V BIODIESEL 18

Production of biodiesel, oil extraction from algae by chemical solvents, enzymatic, expeller press - Osmotic shock and ultrasonic assisted extraction - Applications of biodiesel, environmental benefits and concerns

REFERENCES

1. Baker, K. H., Herson, S.D (1993) Bioremediation (Advanced Science and Technology) 1st Ed. MGH, New York.
2. Waites, M.J., Organ, N.L.M., Rokeyand, J.S., Higton, G. (2002) Industrial Microbiology – An Introduction 1st Ed, Blackwell Science. Indian edition. New Delhi.
3. Larroche,C., Pandey,A., Dussap, C.G (2006)Current topics on Bioprocess in food Industry, Asiatech publishers Inc, New Delhi.

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OUTCOME OF THIS PAPER:

- At the end of this paper Students can learn about

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Fundamental understanding of the bioresources and its applications for attainment of social objectives (energy, environment, product, sustainability).	K3
CO 2	Acquire knowledge with respect to the properties of the bioresources and the conversion technologies.	K3
CO 3	Exhibiting knowledge of the systems used for bioresources and bioresource technology.	K3
CO 4	Understanding about analysis of data and their applications in design of the systems and development of the bioprocess.	K2
C0 5	To learn the Biodiesel productionand applications	K2

Note.Kl-Remembering,K2 —Understanding; K3 —Applying, K4 —Analysing; K5-Evaluating, K6—Creating,

Mapping with programme Outcomes:

COs/Pos	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	M	S	M	S
CO 2	S	S	M	S	S
CO 3	S	S	S	M	M
C0 4	S	M	S	S	S
CO 5	S	M	S	S	M

S Strong, M Medium, L Low

MAJOR BASED ELECTIVE III

A. METABOLIC BIOTECHNOLOGY

Semester: VI Max mark: 100 (Int:25, Ext:75)
Course code: 21UBT6M3A Credit: 4
Total Periods:75 Exam hrs : 3

OBJECTIVES

The objective of the course is to make the student understand about the Biosynthesis of primary & secondary metabolites, Bioconversion etc and its relevance to Industrial applications.

UNIT I INTRODUCTION 15

Induction-jacob monod model, catabolite regulation, glucose effect, camp deficiency, feed back regulation, regulation in branched pathways, differential regulation by isoenzymes, concerted feed back regulation, cumulative feed back regulation, amino acid regulation of RNA synthesis, energy charge, regulation, premeability control passive diffusion, active transport group transportation.

UNIT II SYNTHESIS OF PRIMARY METABOLITES 15

Alteration of feed back regulation, limiting accumulation of end products, feedback, resistant mutants, alteration of permeability, metabolites.

UNIT III BIOSYNTHESIS OF SECONDARY METABOLITES 15

Precursor effects, prophophase, idiophase relationship, enzyme induction, feedback regulation, catabolite regulation by passing control of secondary metabolism, producers of secondary metabolites.

UNIT IV BIOCONVERSIONS 15

Advantages of bioconversions, specificity, yields, factors important to bioconversion, regulation of enzyme synthesis, mutation, permeability, co-metabolism, avoidance of product inhibition, mixed or seqencial bioconversions, conversion of insoluble substances.

UNIT V REGULATION OF ENZYME PRODUCTION 15

Strain selection, improving fermentation, recognising growth cycle peak, induction, feed back repression, catabolite repression, mutants resistant to repression, gene dosage.

REFERENCE

1. Wang D.I.C., Cooney C.L., Demain A.L., Dunnil.P., Humphery A.E., Lilly M.D (1980) Fermentation And Enzyme Technology.John Wiley And Sons.,
2. Stanbury P.F and Whitaker A (1984) Principles Of Fermention Technology", Pergamon Press,.

COURSE OUTCOME

- At the end of this paper Students can learn about

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	At the end of this course students can learn about the methods used to analyse the metabolisms in cell	K3
CO 2	To learn to produce the Primary metabolites	K3
CO 3	To learn to produce the secondary metabolites	K4
CO 4	Exhibiting knowledge of bioconversions regulation of enzyme production	K3
C0 5	To learn the Biodiesel productionand applications	K2

Note.Kl-Remembering,K2 —Understanding; K3 —Applying, K4 —Analysing; K5-Evaluating, K6—Creating,

Mapping with programme Outcomes:

COs/Pos	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	M	S	M	S
CO 2	M	S	M	S	S
CO 3	S	M	S	M	M
C0 4	S	M	S	l	S
CO 5	S	M	L	L	M

S Strong, M Medium, L Low

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B. PHARMACEUTICAL BIOTECHNOLOGY

Semester: VI | Max mark: 100 (Int:25, Ext:75)
Course code: 21UBT6M3B | Credit: 4
Total Periods:75 | Exam hrs : 3

OBJECTIVES

The objective of the course is to make the student understand about the Pharmaceutical Industrial Processes and the Products and its application.

UNIT I INTRODUCTION 15

Development of Drug and Pharmaceutical Industry -Therapeutic agents, their uses and economics; Routes of drug administration.

UNIT II DRUG METABOLISM AND PHARMACOKINETICS 15

Drug metabolism – physico chemical principles, radioactivity – pharmacokinetics-action of drugs on human bodies.

UNIT III IMPORTANT UNIT PROCESSES AND THEIR APPLICATIONS 15

Bulk drug Manufactures, Types of Reactions in Bulk drug Manufacture and Processes. Special Requirements for Bulk Drug Manufacture and its regulatory aspects.

UNIT IV PRODUCT FORMS AND DEVELOPMENT 15

Compressed tables, wet granulation-dry granulation or slugging-direct compression-tablet presses, coating of tablets, capsules sustained action dosage forms-parental solutions-oral liquids-injections-ointments-Topical Application, Preservation, analytical methods and test for various drugs and pharmaceuticals, Labeling, Packing-Packing Techniques, Quality Management, GMP.

UNIT V PHARMACEUTICAL PRODUCTS 15

Therapeutic categories such as vitamins, laxatives, analgesics, non-steroidal contraceptives, Antibiotics, biological, hormones examples with respect to system

REFERENCES

1. Gary W (2007) Pharmaceutical Biotechnology: Concepts and Applications, John Wiley & Sons Ltd., Sussex, England,.
2. .S. Purohit, H.N. Kakrani and A.K. Saluja (2006) Pharmaceutical Biotechnology, Jodhpur, India.
3. Kayser, O. and Müller R. H (2004) Pharmaceutical Biotechnology: Drug Discovery and Clinical Applications Wiley-VCH.
4. Dutton, R. and Scharer, J (2007) Advanced Technologies in Biopharmaceutical Processing, Blackwell Publishing.

COURSE OUTCOME

- At the end of this paper Students can learn about

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	.Students will understand the various techniques used in modern biotechnology	K3
CO 2	To learn to produce the Primary metabolites	K3
CO 3	To learn to produce the Drug manufacturing process	
CO 4	Students can demonstrate and Provide examples on how to use microbes and mammalian cells for the production of pharmaceutical products	K3
C0 5	Students can able to provide examples of current applications of biotechnology and advances in the different areas like medical, microbial, environmental, bioremediation, agricultural, plant, animal, and forensic	K2

Note.Kl-Remembering,K2 —Understanding; K3 —Applying, K4 —Analysing; K5-Evaluating, K6—Creating,

Mapping with programme Outcomes:

COs/Pos	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	M	S	M	S
CO 2	S	S	M	S	S
CO 3	S	S	S	M	M
C0 4	S	M	S	S	S
CO 5	S	M	S	S	M

S Strong, M Medium, L Low

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C. BIO CONJUGATE TECHNOLOGY AND APPLICATIONS

Semester: VI Max mark: 100 (Int:25, Ext:75)
Course code: 21UBT6M3C Credit: 4
Total Periods:75 Exam hrs : 3

OBJECTIVES

The course is designed to make the student learn about enzymes, nucleic acids and target specificity. Student also gets familiarized with the industrial applications of this technology.

UNIT I FUNCTIONAL TARGETS 15

Modification of Amino Acids, Peptides and Proteins – Modification of sugars, polysaccharides and glycoconjugates – modification of nucleic acids and oligonucleotides.

UNIT II CHEMISTRY OF ACTIVE GROUPS 15

Amine reactive chemical reactions – Thiol reactive chemical reactions – carboxylate reactive chemical reactions – hydroxyl reactive chemical reactions – aldehyde and ketone reactive chemical reactions – Photoreactive chemical reactions.

UNIT III BIOCONJUGATE REAGENTS 15

Zero length cross linkers – Homobifunctional cross linkers – Heterobifunctional cross linkers – Trifunctional cross linkers – Cleavable reagent systems – tags and probes.

UNIT IV ENZYME AND NUCLEIC ACID MODIFICATION & CONJUGATION 15

Properties of common enzymes – Activated enzymes for conjugation – biotinylated enzymes – chemical modification of nucleic acids – Biotin labeling of DNA- Enzyme conjugation to DNA – Fluorescent of DNA.

UNIT V BIOCONJUGATE APPLICATIONS 15

Preparation of Hapten-carrier Immunogen conjugates - Antibody modification and conjugation –immunotoxin conjugation techniques – liposome conjugated and derivatives- Colloidal – gold labeled proteins – modification with synthetic polymers.

REFERENCES

1. G.T. Hermanson (1999) Bioconjugate Techniques, Academic Press.

COURSE OUTCOME

- At the end of this paper Students can learn about

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	students can gain the knowledge about the functional targets of Amino acids	K3
CO 2	To learn Chemistry of active targets	K3
CO 3	To learn to produce the Drug manufacturing process	
CO 4	Students can gain the enzyme and nucleic acid modification and conjugation	K3
C0 5	Students can able to conjucative application	K2

Note.Kl-Remembering,K2 —Understanding; K3 —Applying, K4 —Analysing; K5-Evaluating, K6—Creating,

Mapping with programme Outcomes:

COs/Pos	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	M	S	M	S
CO 2	S	S	M	S	S
CO 3	S	S	S	M	M
C0 4	S	M	S	S	S
CO 5	S	M	S	S	M

S Strong, M Medium, L Low

NON MAJOR ELECTIVE I

BASICS OF BIOTECHNOLOGY

Semester: III Max mark: 100 (Int:25, Ext:75)
Course code: 21UBT3N1A Credit: 2
Total Periods: 30 Exam hrs : 3

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 6

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 6

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 6

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

UNIT IV BIOTECHNOLOGY-APPLICATIONS AND ISSUES 6

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

UNIT V COMMERCIAL APPLICATIONS OF BIOTECHNOLOGY 6

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

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
CO 2	To learn differentiate the organisms by its cell structur	K3
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	K3
C0 5	Students will know the influence of environment on gene expression.	K2

Note. Kl-Remembering,K2 —Understanding; K3 —Applying, K4 —Analysing; K5-Evaluating, K6—Creating,

Mapping with programme Outcomes:

COs/Pos	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	M	M	M	S
CO 2	M	S	M	S	S
CO 3	S	L	S	M	M
C0 4	S	M	S	S	S
CO 5	S	M	L	L	M

S Strong, M Medium, L Low

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B. HEALTHCARE BIOTECHNOLOGY

Semester: III | Max mark: 100 (Int:25, Ext:75)
Course code: 21UBT3N1B | Credit: 2
Total Periods: 30 | Exam hrs : 3

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 6

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 6

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 6

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 6

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 6

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

REFERENCES

1. Ratledge, C., Kristiansen, B (2001) Basic Biotechnology 2nd Ed. Cambridge University Press,USA.
2. Walsh, G (2007) Pharmaceutical Biotechnology: Concepts and Applications, John Wiley &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	K3
CO 3	Students can explain the concept and application of monoclonal antibody technology	K4
CO 4	Students can learn cytokines and gene therapy techniques	K3
C0 5	Students will know the peptides and Antisence oligonucleotides	K2

Note. Kl-Remembering,K2 —Understanding; K3 —Applying, K4 —Analysing; K5-Evaluating, K6—Creating,

Mapping with programme Outcomes:

COs/Pos	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	M	S	M	S
CO 2	S	S	M	S	S
CO 3	S	S	S	M	M
C0 4	S	M	S	S	S
CO 5	S	M	S	S	M

S Strong, M Medium, L Low

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C. PROCESS INSTRUMENTATION DYNAMICS AND CONTROL

Semester: III Max mark: 100 (Int:25, Ext:75)
Course code: 21UBT3N1C Credit: 2
Total Periods: 30 Exam hrs : 3

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 6

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 6

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 6

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 6

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 6

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, composition by physical and chemical properties and spectroscopy.

REFERENCES

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

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	K3
CO 2	Specify the required instrumentation and final elements to ensure that well-tuned control is achieved	K3
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	K3
C0 5	Students will know the Principles of measurements and classification of process control instruments,	K2

Note. Kl-Remembering,K2 —Understanding; K3 —Applying, K4 —Analysing; K5-Evaluating, K6—Creating,

Mapping with programme Outcomes:

COs/Pos	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	M	M	M	S
CO 2	M	S	M	S	S
CO 3	S	M	S	M	M
C0 4	S	M	M	S	S
CO 5	S	L	L	M	M

S Strong, M Medium, L Low

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NON MAJOR ELECTIVE II

A. AGRICULTURAL BIOTECHNOLOGY

Semester: IV Max mark: 100 (Int:25, Ext:75)
Course code: 21UBT4N2A Credit: 2
Total Periods: 30 Exam hrs : 3

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 6

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

UNIT II PLANT TISSUE CULTURE 6

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 mediaand 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 6

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 6

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

UNIT V HERBAL AND NURSERY TECHNOLOGY 6

Economic value of herbals and herbal drugs. Identification, cultivation and micropropagation 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.

REFERENCES

1. Hou CT, Shaw JF (2009) – Biocatalysis and agricultural biotechnology, CRC Press, 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.

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5. S.S. Bhojwani and S.P. Bhatnagar (2009) Embryology of Angiosperms, Vikas Publ House, India.
6. Ashwani Kumar, Shekhawat NS (2009) – Plant tissue culture and molecular markers: 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.	K3
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	K5

Note. Kl-Remembering,K2 —Understanding; K3 —Applying, K4 —Analysing; K5-Evaluating, K6—Creating,

Mapping with programme Outcomes:

COs/Pos	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	M	S	M	S
CO 2	S	S	M	S	L
CO 3	M	S	M	M	M
C0 4	S	M	S	S	S
CO 5	S	M	L	M	M

S Strong, M Medium, L Low

B. SOLID WASTE MANAGEMENT

Semester: IV Max mark: 100 (Int:25, Ext:75)
Course code: 21UBT4N2B Credit: 2
Total Periods: 30 Exam hrs : 3

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 6

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 6

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 6

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 6

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

UNIT V DISPOSAL 6

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

REFERENCES

1. Hilary Theisen and Samuel A (1993) George Tchobanoglous, Vigil Integrated Solid Waste Management, McGraw-Hill Publishers.
2. Manual on Municipal Solid Waste Management (2000) CPHEEO, Ministry of Urban Development, Government of India, New Delhi.
3. R.E.Landreth and P.A.Rebers (1997) Municipal Solid Wastes - problems and Solutions, Lewis Publishers.
4. Bhide A.D and Sundaresan B.B (1993) Solid Waste Management in Developing 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	K3
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

Note. Kl-Remembering,K2 —Understanding; K3 —Applying, K4 —Analysing; K5-Evaluating, K6—Creating,

Mapping with programme Outcomes:

COs/Pos	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	M	S	M	S
CO 2	S	S	M	S	S
CO 3	S	S	S	M	M
C0 4	S	M	S	S	S
CO 5	S	M	S	S	M

S Strong, M Medium, L Low

C. INDUSTRIAL WASTEWATER MANAGEMENT

Semester: IV Max mark: 100 (Int:25, Ext:75)
Course code: 21UBT4N2C Credit: 2
Total Periods: 30 Exam hrs :3

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 6

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 effluents and Bioassay tests

UNIT II INDUSTRIAL POLLUTION PREVENTION 6

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 6

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 6

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 6

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

REFERENCES

1. Eckenfelder W.W (1999)Industrial Water Pollution Control, McGraw-Hill,
2. Arceivala, S.J., Wastewater (1998) Treatment for Pollution Control, Tata McGraw-Hill,
3. Frank Woodard (2001) Industrial waste treatment Handbook, Butterworth Heinemann, New Delhi.
4. 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	K3
CO 2	To study the industrial pollution prevention	K2
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	K2
CO 5	Students can learn the and their disposals in various ways	K3
C0 5	Acquire knowledge on waste to energy productions in the perspectives of sustainable development	K2

Note. Kl-Remembering,K2 —Understanding; K3 —Applying, K4 —Analysing; K5-Evaluating, K6—Creating,

Mapping with programme Outcomes:

COs/Pos	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	M	S	M	S
CO 2	M	S	M	L	S
CO 3	S	M	M	M	M
C0 4	M	M	S	M	S
CO 5	S	M	S	L	M

S Strong, M Medium, L Low

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SKILL BASED ELECTIVE I
A. ETHNOMEDICINE

Semester: V Max mark: 100 (Int:25, Ext:75)
Course code: 21UBT5S1A Credit: 2
Total Periods: 30 Exam hrs : 3

OBJECTIVES

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

UNIT I ETHNOMEDICINE 6

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

UNIT II IMPORTANCE OF MEDICINAL PLANTS 6

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

UNIT III TRIBAL MEDICINE 6

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 6

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 6

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.

REFERENCE:

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.

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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	K3
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	K3
C0 5	Learn to commonly used qualitative research methods	K5

Note. Kl-Remembering,K2 —Understanding; K3 —Applying, K4 —Analysing; K5-Evaluating, K6—Creating,

Mapping with programme Outcomes:

COs/Pos	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	M	S	M	S
CO 2	S	S	M	S	S
CO 3	S	S	S	M	M
C0 4	S	M	S	S	S
CO 5	S	M	S	S	M

S Strong, M Medium, L Low

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B. PHYTOCHEMICAL TECHNIQUES

Semester: V | Max mark: 100 (Int:25, Ext:75)
Course code: 21UBT5S1B | Credit: 2
Total Periods: 30 | Exam hrs : 3

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.

UNIT I OVERVIEW OF PLANT SECONDARY METABOLITES 6

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 6

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 6

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 6

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 6

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

REFERENCES

1. Harbone J. B (2005) Phytochemical Method A guide to modern techniques of plant analysis.
1. Sarker, S. D., Latif, Z. and Gray,A.I (2006) Methods in Biotechnology –Natural Product Isolation" Second Edition, Humana Press
2. Raman N (2006) Phytochemical Techniques. New India Publishing agency .

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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	K3
CO 2	By studying of this paper students can learn about the Metabolites produced from Plant	K2
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	K2
CO 5	They also know about advances in plant analytical advanced techniques	K3

Note. Kl-Remembering,K2 —Understanding; K3 —Applying, K4 —Analysing; K5-Evaluating, K6—Creating,

Mapping with programme Outcomes:

COs/Pos	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	M	S	M	S
CO 2	S	M	M	S	S
CO 3	S	S	M	M	M
C0 4	S	M	M	S	S
CO 5	L	M	M	S	M

S Strong, M Medium, L Low

C. HERBS AND DRUG ACTION

Semester: V | Max mark: 100 (Int:25, Ext:75)
Course code: 21UBT5S1C | Credit: 2
Total Periods: 30 | Exam hrs : 3

OBJECTIVES

The main objective of the course is to study about the medicinal Plants and its action. The student will understand about the action o Drugs to combat various diseases.

UNIT I INTRODUCTION 6

Terminologies – Definitions – Classification of medicinal plants based on their effects with special reference to India.

UNIT II ALLERGENS 6

Types – sources – active principles – Chemical nature – Cell modifiers – Lectins – mutagens, teratogens – Allergic reactions with known examples.

UNIT III DRUGS FOR NEW AND PSYCOLOGICAL DISORDERS 6

Drugs acting on brain and nervous system – Rheumatic arthritis – Psychoactive drugs – Depressants, Stimulants, hallucinogens – sources, effects, basic mechanism of action.

UNIT IV DRUGS FOR COMMON DISEASE 6

Cardiovascular diseases – blood pressure – cardiac drugs of plant origins – alkaloids, anticoagulants – basic mechanism of action. Pulmonary / respiratory disorders – asthma – bronchitis – common cold – allergy – Remedy from plants.

UNIT V DRUGS FOR URINOGENITAL DISORDERS 6

Roots of Withania somnifera – Memory stimulants – Centella asiatica – Drugs for dissolving kidney stones – Musa paradisica (pseudostem) – Antiinflammatory drugs – Cardiospermum – Anticancer drugs – Catharanthus roseus.

REFERENCES

1. Kumar, N.C (1993) An Introduction to Medical botany and Pharmacognosy. Emkay Publications, New Delhi.
2. Rao, A.P (1999) Herbs that heal. Diamond Pocket Books (P) Ltd., 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 and Herbs which are used to produce the medicines.	K3
CO 2	Students would have understood the pharmacological actions of different categories of drugs	K2
CO 3	They would have understood the application of basic pharmacological knowledge in the prevention and treatment of various diseases.	K4
CO 4	They also know the Plant drugs for common disease	K2
CO 5	They also know about **drugs** for urinogenital disorders	K3

Note. Kl-Remembering,K2 —Understanding; K3 —Applying, K4 —Analysing; K5-Evaluating, K6—Creating,

Mapping with programme Outcomes:

COs/Pos	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	M	S	M	S
CO 2	S	S	M	S	S
CO 3	S	S	S	M	M
C0 4	S	M	S	S	S
CO 5	S	M	S	S	M

S Strong, M Medium, L Low

C. HERBS AND DRUG ACTION

Semester: V Max mark: 100 (Int:25, Ext:75)
Course code: 21UBT5S1C Credit: 2
Total Periods: 30 Exam hrs : 3

OBJECTIVES

The main objective of the course is to study about the medicinal Plants and its action. The student will understand about the action o Drugs to combat various diseases.

UNIT I INTRODUCTION 6

Terminologies – Definitions – Classification of medicinal plants based on their effects with special reference to India.

UNIT II ALLERGENS
6

Types – sources – active principles – Chemical nature – Cell modifiers – Lectins – mutagens, teratogens – Allergic reactions with known examples.

UNIT III DRUGS FOR NEW AND PSYCOLOGICAL DISORDERS
6

Drugs acting on brain and nervous system – Rheumatic arthritis – Psychoactive drugs – Depressants, Stimulants, hallucinogens – sources, effects, basic mechanism of action.

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- 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 and Herbs which are used to produce the medicines.	K3
CO 2	Students would have understood the pharmacological actions of different categories of drugs	K2
CO 3	They would have understood the application of basic pharmacological knowledge in the prevention and treatment of various diseases.	K3
CO 4	They also know the Plant drugs for common disease	K2
CO 5	They also know about **drugs for urinogenital disorders**	K3

Note. Kl-Remembering,K2 —Understanding; K3 —Applying, K4 —Analysing; K5-Evaluating, K6—Creating,

Mapping with programme Outcomes:

COs/Pos	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	M	S	M	S
CO 2	S	S	M	S	S
CO 3	S	S	S	M	M
C0 4	S	M	S	S	S
CO 5	S	M	S	S	M

S Strong, M Medium, L Low

SKILL BASED ELECTIVE II

A. PHARMACOGNOSY

Semester: V Max mark: 100 (Int:25, Ext:75)
Course code: 21UBT5S2A Credit: 2
Total Periods: 30 Exam hrs : 3

OBJECTIVES

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

UNIT I INTRODUCTION 6

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

UNIT II CLASSIFICATION OF CRUDE DRUGS 6

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

UNIT III PREPARATION OF CRUDE AND COMMERCIAL DRUGS 6

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 6

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

UNIT V ANALYTICAL PHARMACOGNOSY 6

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

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	K3
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	K5
CO 3	They also gain the knowledge about the preparation of crude and commercial drugs	K3
CO 4	To learn the organoleptic study of medicinal plants	K2
CO 5	They also know about advances in plant analytical advanced techniques	K3

Note. Kl-Remembering,K2 —Understanding; K3 —Applying, K4 —Analysing; K5-Evaluating, K6—Creating,

Mapping with programme Outcomes:

COs/Pos	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	M	S	M	S
CO 2	S	S	M	S	S
CO 3	S	S	S	M	M
C0 4	S	M	S	M	S
CO 5	S	M	M	M	M

S Strong, M Medium, L Low

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B. PLANT HORMONES AND SIGNAL TRANSDUCTION

Semester: V | Max mark: 100 (Int:25, Ext:75)
Course code: 21UBT5S2B | Credit: 2
Total Periods: 30 | Exam hrs : 3

OBJECTIVES

To introduce basic concepts related to discovery and physiological effects of plant growth regulators. To impart an understanding of control of various physiological and developmental mechanisms by hormones. To give an insight into the cellular and molecular modes of action of phytohormones.

UNIT I AUXINS 6

Introduction – The emergence of the auxin concept, biosynthesis and metabolism of auxin, auxin transport, physiological effects of auxin, developmental effects of auxin – auxin receptors and signal transduction pathways of auxin.

UNIT II GIBBERELLINS 6

The discovery of the gibberellins, effects of gibberellin on growth and development, Biosynthesis and metabolism of gibberellin, physiological mechanisms of gibberellin-induced growth, signal transduction -cereal aleuronic layers.

UNIT III CYTOKININS 6

The discovery, identification and properties, Biosynthesis, metabolism and transport of cytokinins, biological roles of cytokinins, cellular and molecular modes of cytokinin action

UNIT IV ETHYLENE 6

Structure, biosynthesis and measurement of ethylene, developmental and physiological effects, cellular and molecular modes of ethylene action- Ethylene receptors

UNIT V - ABSCISIC ACID 6

Occurrence, chemical structure and measurement of ABA, developmental and physiological effects of ABA, ABA Receptors - cellular and molecular modes of ABA action

REFERENCES

1. Lincoln Taiz and Eduardo Zeiger (2003) Plant Physiology. Third edition. Panima Publishing corporation.
2. Davies, P. J (2010) Plant Hormones - Biosynthesis, Signal Transduction, Action", Springer.
3. Perrot-Rechenmann, C. and Hagen, G (2002) Auxin Molecular Biology. Springer.

COURSE OUTCOME

- At the end of this paper Students can learn about

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	learn about the plant products like Auxins,	K2
CO 2	They also gain the knowledge Bibberlins	K2
CO 3	They also gain the knowledge about the Cytokinins hormones and their role in cell division	K4
CO 4	To learn the Structure, biosynthesis and measurement of ethylene,	K2
CO 5	They also know about structure and measurement of ABA,	K4

Note. Kl-Remembering,K2 —Understanding; K3 —Applying, K4 —Analysing; K5-Evaluating, K6—Creating,

Mapping with programme Outcomes:

COs/Pos	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	M	S	M	S
CO 2	S	S	M	S	S
CO 3	S	S	S	M	M
C0 4	S	M	S	S	S
CO 5	S	M	S	S	M

S Strong, M Medium, L Low

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C. BIOBUSINESS

Semester: V | Max mark: 100 (Int:25, Ext:75)
Course code: 21UBT5S2C | Credit: 2
Total Periods: 30 | Exam hrs : 3

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 BIOTECHNOLOGY BUSINESS MANAGEMENT 6

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

UNIT II BIOTECHNOLOGY INDUSTRY & BUSINESS MANAGEMENT 6

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 PHARMACEUTICAL BUSINESS INDUSTRY & MANAGEMENT 6

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 6

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 6

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.

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REFERENCES

1. Mark J. Ahn, Michael A. Alvarez, Arlen D. Meyers, Anne S York (2011) Building the Case for Biotechnology.
2. Peter Kolchensky (2011) The Entrepreneurship Guide to a Biotech startup", Evelexa,
3. Maureen D. MacKelvey, Luigi Orsenigo (2001) The Economics of Biotechnology" Edward Elgar Pub.
4. Steven B. Kayne (2005) Pharmacy Business Management" ,Pharmaceutical Press.
5. Damian Hine, John Kapeleris (2008) Innovation and Entrepreneurship in Biotechnology", Concepts, Theories and Case", Edward Elgar Publishing..
6. 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,	K2
CO 2	By studying this paper students can learn about the business techniques involved in Biotechnology.	K2
CO 3	To learn the dynamics of collaboration and competition at the level of the single industrial sector.	K3
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	K6
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.	K6

Note. Kl-Remembering,K2 —Understanding; K3 —Applying, K4 —Analysing; K5-Evaluating, K6—Creating,

Mapping with programme Outcomes:

COs/Pos	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	M	S	M	S
CO 2	S	M	M	S	S
CO 3	S	M	M	M	M
C0 4	L	M	S	S	S
CO 5	S	M	S	L	M

S Strong, M Medium, L Low