

2023

B.Sc BIOTECHNOLOGY

Course Structure and Syllabus

(For the candidates admitted from the academic year 2023-2024 onwards)

Choice Based Credit System (CBCS)
&
Learning Outcomes-Based Curriculum Framework (LOCF)



THANTHAI HANS ROEVER COLLEGE (AUTONOMOUS)

(Approved by NAAC, Affiliated to Bharathidasan University)

ELAMBALUR, PERAMBALUR – 621 220



BIOTECHNOLOGY

VISION

To impart theoretical and practical understanding of contemporary Biology and Biotechnology so that they can pursue research in agriculture, industry, healthcare and restoration of environment providing sustainable competitive edge to societal benefits.

MISSION

- To ensure students to acquire knowledge in biotechnology for human welfare.
- To encourage students in converting knowledge into skill through effective practices, exposure to research institutions, Industries, etc.
- To create platform for students to interact with eminent scientist, researchers and industries of Biotechnology towards their personality development.
- To inculcate research attitude among students in biotechnological aspects for future sustainable development.
- To evolve entrepreneurial skills among the students in evolving biotechnology based industry.

Undergraduate Programme

B.Sc., Biotechnology

Programme Outcomes (POs)

Upon completion of the programme, the undergraduate will be able to

1. Acquire knowledge, understand concepts and apply new ideas which enable them to be employable or self employed
2. Demonstrate motivation in advancing to higher learning programmes
3. Engage in socially responsible behaviour and have value-added education
4. Have exposure to technical proficiency, analytical capability, soft skills and life skills development
5. Develop broad understanding in the basic concepts of Languages/Commerce/Management Studies/ Physical Sciences Computing Sciences Biological Sciences/Life Sciences

Programme Specific Outcomes (PSOs)

1. Acquire knowledge on the fundamentals of biotechnology, Environmental Biotechnology, Nanobiotechnology, animal and plant biotechnology, Industrial Biotechnology, genetic engineering, immunology, bioinformatics for research activities in the department research center or in collaboration with other research institutes
2. Understand the applications of biotechnology in all spheres of agriculture and develop crops with improved productivity thereby increasing farmers' income, better human health and decreased environmental pollution.
3. The objective of the Biotechnology is to equip the students to apply knowledge of molecular mechanisms of cellular processes in living systems including microbes, plants, and higher order organisms to applied aspects.
4. Interdisciplinary approach helps in providing better solutions and new ideas for the sustainable developments, recognition of the need for, and an ability to engage in life-long learning.
5. Recognize the importance of biotechnological applications as to user next generation entrepreneurship

Thanthai Hans Roever College (Autonomous), Elambalur, Perambalur - 621 220

B.Sc. BIOTECHNOLOGY

CHOICE BASED CREDIT SYSTEM–LEARNING OUTCOMES BASED CURRICULUM FRAME WORK (CBCS- LOCF)

(For the candidates admitted from the academic year 2023 - 2024 onwards)

Semester	Part	Course Code	Title of the Course	Ins. Hours/ Weeks	Credits	Exam Hours	CIA (Max)	ESE (Max)	Total (Max)
1	I	23UT1/H1	Language	6	3	3	25	75	100
1	II	23UE1	English-I	6	3	3	25	75	100
1	III	23UBT1CC1	Cell and Molecular Biology & Developmental Biology	6	6	3	25	75	100
1	III	23UBT1CC2P	Cell and Molecular Biology & Developmental Biology(P)	3	3	3	40	60	100
1	III	23UBT1AC1	Biological Chemistry	5	4	3	25	75	100
1	III	23UBT2AP1	Biological Chemistry & Fundamentals of Microbiology (P)	2	--	--	--	--	--
1	IV	23UBT1SE1	NME – 1	2	2	3	25	75	100
			Value Added Course		2*	2	50	50	100*
Total				30	21	-	-	-	600
2	I	23UT2/H2	Language	6	3	3	25	75	100
2	II	23UE2	English-II	6	3	3	25	75	100
2	III	23UBT2CC3	Genetics	5	5	3	25	75	100
2	III	23UBT2CC4P	Genetics (P)	3	3	3	40	60	100
2	III	23UBT2AC2	Fundamentals of Microbiology	4	3	3	25	75	100
2	III	23UBT2AP1	Biological Chemistry & Fundamentals of Microbiology (P)	2	2	3	40	60	100
2	IV	23UBT2SE2	NME- 2	2	2	3	25	75	100
2	IV	23UBT2SE3	Enzymology	2	2	3	25	75	100
			Value Added Course		2*	2	50	50	100*
Total				30	23	-	-	-	800
3	I	23UT3/H3	Language	6	3	3	25	75	100
3	II	23UE3	English-III	6	3	3	25	75	100
3	III	23UBT3CC5	Immunology and Immunotechnology	4	4	3	25	75	100
3	III	23UBT3CC6P	Immunology and Immunotechnology (P)	3	3	3	40	60	100
3	III	23UBT3AC3	Bioinstrumentation	4	3	3	25	75	100

3	III	23UBT4AP2	Bioinstrumentation & Bioinformatics and Biostatistics(P)	2	--	--	--	--	--
3	IV	23UBT3SE4	Bioentrepreneurship	2	2	3	25	75	100
3	IV	23UBT3SE5	Forensic Science	2	2	3	25	75	100
3	IV	23UGS	General Studies	1	1	3	25	75	100
			Value Added Course*		2*	2	50	50	100*
Total				30	21	-	-	-	800
4	I	23UT4/H4	Language	6	3	3	25	75	100
4	II	23UE4	English-IV	6	3	3	25	75	100
4	III	23UBT4CC7	Genetic Engineering and rDNA Technology	5	5	3	25	75	100
4	III	23UBT4CC8P	Genetic Engineering and rDNA Technology (P)	3	3	3	40	60	100
4	III	23UBT4AC4	Bioinformatics and Biostatistics	4	4	3	25	75	100
4	III	23UBT4AP2	Bioinstrumentation & Bioinformatics and Biostatistics (P)	2	2	3	40	60	100
4	IV	23UBT4SE6	Soft Skill Development	2	2	3	25	75	100
4	IV	23UES	Environmental Studies	2	2	3	25	75	100
			Value Added Course*		2*	2	50	50	100*
Total				30	24	-	-	-	800
5	III	23UBT5CC9	Plant Biotechnology	5	5	3	25	75	100
5	III	23UBT5CC10	Animal Biotechnology	5	5	3	25	75	100
5	III	23UBT5CC11P	Plant Biotechnology and Animal Biotechnology (P)	5	4	3	40	60	100
5	III	23UBT5CC12PW	Project with viva- voce	5	4	-	Evaluation 80	Viva Voce 20	100
5	III	23UBT5DE11 23UBT5DE12	Nano Biotechnology/ Good Laboratory Practices	4	4	3	25	75	100
5	IV	23UBT5DE21 23UBT5DE22	IPR, Bioethics and Biosafety/ Biotechnology For Human Welfare	4	4	3	25	75	100
5	IV	23UVE	Value Education	2	2	3	25	75	100
5	IV		Summer Internship/ Industrial visit/ Field visit	-	2*	-	-	-	-
5			Value Added Course*		2*	2	50	50	100*
Total				30	28	-	-	-	700

6	III	23UBT6CC13	Environmental and Industrial Biotechnology	6	5	3	25	75	100
6	III	23UBT6CC14	Pharmaceutical Biotechnology	6	5	3	25	75	100
6	III	23UBT6CC15P	Environmental and Industrial Biotechnology (P)	6	4	3	40	60	100
6	III	23UBT6DE31 23UBT6DE32	Medical Biotechnology/ Marine Biotechnology	6	4	3	25	75	100
6	III	23UBT6DE41 23UBT6DE42	Cancer Biology/ Stem Cell Biology	6	4	3	25	75	100
6	V		Extension activity	-	1	-	-	-	-
6			Value Added Course*		2*	2	50	50	100*
Total				30	23	-	-	-	500
Grand Total				180	140				4200

*** Extra Credit Courses which will not be included in the total CGPA**

- Summer Internship after 4th semester during summer vacation -30 Hours

-Value added course (Outside Instruction hours: 30 hours)

CREDIT DISTRIBUTION FOR UG BIOTECHNOLOGY

S.No	Part	Course Details	Credit
1	III	Core(15)	64
2		Allied Course (6) Elective Generic/Discipline Specific Elective(4)	34
3	I& II	Language & English (Language: 4x3=12 and English: 4x3=12)	24
4	IV	Skill Enhancement Course NME (2x2)	4
5		Skill Enhancement Course [4 Courses x 2 credits =10 credits]	8
6		EVS (1x2)	2
7		Value Education(1x2)	2
8		Extension Activity(1x1)	1
9		Gender studies	1
Total			140

LIST OF CORE COURSES OFFERED

Core Course I:	Cell and Molecular Biology & Developmental Biology
Core Course II:	Cell and Molecular Biology & Developmental Biology (P)
Core Course III:	Genetics
Core Course IV:	Genetics (P)
Core Course V:	Immunology and Immunotechnology
Core Course VI:	Immunology and Immunotechnology (P)
Core Course VII:	Genetic Engineering and rDNA Technology
Core Course VIII:	Genetic Engineering and rDNA Technology (P)
Core Course IX:	Plant Biotechnology
Core Course X:	Animal Biotechnology
Core course XI:	Plant Biotechnology and Animal Biotechnology (P)

Core Course XII:	Project
Core Course XIII:	Environmental and Industrial Biotechnology
Core Course XIV:	Pharmaceutical Biotechnology
Core Course XV:	Environmental and Industrial Biotechnology (P)

LIST OF ALLIED COURSES OFFERED

Allied Course-I:	Biological Chemistry
Allied Course-II:	Fundamentals of Microbiology
Allied Course-III:	Bioinstrumentation
Allied Course-IV:	Bioinformatics and Biostatistics
Allied Practical-I:	Biological Chemistry & Fundamentals of Microbiology (P)
Allied Practical-II:	Bioinstrumentation & Bioinformatics and Biostatistics (P)

LIST OF SKILL ENHANCEMENT COURSES OFFERED

Skill enhancement Course SEC-1 (NME):	Public Health and Hygiene
Skill Enhancement Course SEC-2 (NME):	Organic Farming and Health Management
Skill Enhancement Course SEC-3:	Enzymology
Skill Enhancement Course SEC-4 (Entrepreneurial Skill):	Bioentrepreneurship
Skill Enhancement Course SEC-5:	Forensic Science
Skill Enhancement Course SEC-6:	Soft Skill Development

LIST OF ELECTIVE COURSES OFFERED

Discipline Specific Elective- I:	Nano Biotechnology/ Good Laboratory Practices
Discipline Specific Elective II:	IPR, Bioethics and Biosafety/ Biotechnology for Human Welfare
Discipline Specific Elective III:	Medical Biotechnology/Marine Biotechnology
Discipline Specific Elective IV:	Cancer Biology/Stem Cell Biology

Note:

	Internal Marks	External Marks
1. Theory	25	75
2. Practical	40	60
3. Separate passing minimum is prescribed for Internal and External marks		

FOR THEORY

The passing minimum for CIA shall be 40% out of 25 marks [i.e. 10 marks]

The passing minimum for Semester Examinations shall be 40% out of 75 marks [i.e. 30 marks]

FOR PRACTICAL

The passing minimum for CIA shall be 40% out of 40 marks [i.e. 16 marks]

The passing minimum for Semester Examinations shall be 40% out of 60 marks [i.e. 24 marks]

Project : 100 Marks (The Project will be evaluated by an Internal and an External Examiner)

Dissertation - 80 Marks

Viva Voce - 20 Marks

List of Value Added Courses

Course Code	Course Title
23UBTVA1	ECONOMIC BIOTECHNOLOGY
23UBTVA2	VERMICOMPOSTING TECHNOLOGY
23UBTVA3	BIOCOSMETICS
23UBTVA4	MUSHROOM TECHNOLOGY
23UBTVA5	ORGANIC FARMING
23UBTVA6	HERBAL MEDICINE

Question Paper Pattern

UG Programme		
Maximum Marks : 75		Duration: 3 Hours
Section - A	i) a- (5 Questions for Multiple Choice) One question from each unit	5 x 1 = 5 Marks
	b- (5 Questions for Fill in the Blanks) One question from each unit	5 x 1 = 5 Marks
	ii) (5 short answer questions) One question from each unit	5 x 2 = 10 Marks
Section - B	5 Questions (Internal Choice: Either or) One set of questions from each unit	5 x 5 = 25 Marks
Section - C	3 Questions (Answer any 3 out of 5 Questions) One question from each unit	3 x10 = 30 Marks

SEMESTER I

Course Code: 23UBT1CC1
Instruction Hours: 6
Credits: 6

Exam Hours: 3
Internal Marks: 25
External Marks: 75

CORE COURSE I **CELL AND MOLECULAR BIOLOGY & DEVELOPMENTAL BIOLOGY**

Objectives

1. To study about structural design of Prokaryotic and Eukaryotic cells.
2. They will have an in-depth knowledge about the synthesis, structure, importance and the inter-relationships between DNA, RNA and Proteins.
3. They will be able to understand the major molecular processes, development which governs all the cellular activities.

Course outcomes

1. Discuss and differentiate the basic structure and function of cell components in prokaryotes and eukaryotes cells.
2. In this course the students will learn different areas of cellular biology including the structure and functions of cell, its organelles, bioenergetics; cellular communication;
3. Study the structure and functions of Nucleic acid and
4. Discuss the molecular mechanism of Replication, Transcription and Translation and post translational modifications of proteins.
5. Predict the response of cells to the intra and extracellular environment by studying about the intracellular signaling pathways. Understand the principles and molecular mechanisms involved in cellular differentiation, morphogenesis growth and Potency.

Unit-I

Discovery and diversity of cells - Cell theory - Structure of prokaryotic (bacteria) and eukaryotic cells (plant and animal cells).

Unit-II

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

Unit-III

Structure and functions of DNA and RNA-Central Dogma of the cell. DNA - Replication in prokaryotes - Transcription in Prokaryotes and Eukaryotes - RNA Processing - Genetic code- Translation - Similarities and differences in prokaryotic and eukaryotic translation - Post Translational Modifications - Protein Sorting - Protein degradation.

Unit-IV

Cell cycle - Cell cycle check points - Cell division - Mitosis and Meiosis - Cellular differentiation - Cell junctions - Cell Adhesion - Extra Cellular Matrix - Cell to cell communications - Signal transduction - G - Protein Coupled Receptors Signal transduction pathways.

Unit-V

Gametogenesis - Spermatogenesis and Oogenesis in mammals. Fertilization- Types of cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals- Organogenesis.

TextBooks

1. T. Devasena (2012), Cell Biology, Oxford University Press.
2. Gupta, Renu & Makhija, Seema & Toteja, Ravi. (2018). Cell Biology: Practical Manual.
3. Gilbert, S.F. 2016. Developmental Biology, 11th edition. Sinauer Associates Inc. Publishers, MA. USA.
4. Bruce Alberts, 6th Edition (2014). Molecular Biology of the cell, W. W. Norton & Company.
5. James D. Watson (2001), The Double Helix: A personal account of the Discovery of the Structure of DNA, Touchstone Publishers.

References

1. Karp's Cell and Molecular Biology: Concepts and Experiments. 8th Edition (2015). Wiley Publications.
2. James D. Watson, 7th Edition (2014), Molecular Biology of the Gene, Pearson Publications.
3. Geoffrey M. Cooper, 7th Edition (2015). The Cell: A Molecular Approach, Sinauer Associates, Oxford University Press.
4. Lodish Harwey, 6th Edition (2016), Molecular Cell Biology, W. H. Freeman Publications.
5. Wolpert L, Tickle C, 2015. Principles of Development, 5th edition, Oxford University Press.

Web Source

<https://www.nature.com/scitable/topic/cellbiology13906536/>

<https://byjus.com/biology/genetics/>

<http://www.cellbiol.com/education.php>

<https://global.oup.com/uk/orc/biosciences/cellbiology/wang/student/weblinks/ch16/>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits				
I	23UBT1CC1	Cell and Molecular Biology & Developmental Biology					6	6				
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓	✓		✓	✓	✓	✓		✓	✓		
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓			
CO3	✓	✓	✓		✓	✓	✓		✓	✓		
CO4	✓	✓	✓	✓		✓	✓	✓	✓			
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Number of Matches(✓) = 43 Relationship: High												

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER I

Course Code: 23UBT1CC2P
Instruction Hours: 3
Credits: 3

Exam Hours: 3
Internal Marks: 40
External Marks: 60

CORE PRACTICAL I

CELL AND MOLECULAR BIOLOGY & DEVELOPMENTAL BIOLOGY (P)

Objectives

1. To acquire knowledge about aseptic techniques.
2. To comprehend the various methods for identification of unknown microorganisms.
3. To study about cells and their enumeration by appropriate techniques.
4. To study about the cell division and development.
5. To know knowledge about cell identification, cell culture, cell and organelle staining.

Course outcomes

1. The students will learn, understand & develop the skill and hands on training in fundamentals of cell biology.
2. Utilize laboratory skills to enhance understanding of cell structure and function while
3. Develop responsible conduct of laboratory skills appropriate to the field of cell biology
4. Apply the cell biology techniques to biotechnological approaches
5. To gain knowledge about the cell organelle separation in both Prokaryotic and Eukaryotic cells

1. Structure observation Prokaryotic & Eukaryotic cell
2. Components of a Compound / Light Microscope
3. Cell division -Mitotic stages Preparation of Onion Root Tip, Meiotic stages Preparation of Tradescantia Flower bud.
4. Isolation and Identification of plant cells.
5. Blood smear preparation and Identification of Blood cells
6. Buccal smear preparation and Identification of squamous epithelial cells.
7. Observation of sperm & Egg
8. Mounting of chick embryo - 24 hrs, 48 hrs, 72 hrs, 96 hrs.
9. Types of placenta in mammals.

Reference Books

1. David A. Thompson. 2011. Cell and Molecular Biology Lab. Manual.
2. P.Gunasekaran. 2007. Laboratory Manual in Microbiology. New Age International.
3. D O Hall, S E Hawkins. 1974. Laboratory Manual of Cell Biology. British Society for Cell Biology, Published by Crane, Russia.
4. Mary L. Ledbetter. 1993. Cell Biology: Laboratory Manual. Edition: 2. Published by RonJon Publishing. Incorporated.
5. G. Koliantz , D.B. Szymanski.2006 Genetics A laboratory manual.
6. Gregore Koliantz , Daniel B. Szymanski .2015, Genetics A laboratory manual.

Web Source

https://webstor.srmist.edu.in/web_assets/downloads/2021/18BTC103Jlabmanual.pdf
https://www.bjcancer.org/Sites_OldFiles/_Library/UserFiles/pdf/Cell_Biology_Laboratory_Manual.pdf

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
I	23UBT1CC2P	CELL AND MOLECULAR BIOLOGY & DEVELOPMENTAL BIOLOGY (P)					3	3			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓		✓	✓	✓	✓	✓	✓	
CO2	✓	✓	✓	✓	✓	✓	✓	✓		✓	
CO3	✓	✓		✓	✓		✓	✓	✓	✓	
CO4	✓		✓	✓	✓	✓	✓		✓	✓	
CO5	✓	✓	✓	✓		✓	✓	✓	✓	✓	
Number of Matches(✓) = 43 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35- 44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER I

Course Code: 23UBT1AC1
Instruction Hours: 5
Credits: 4

Exam Hours: 3
Internal Marks: 25
External Marks: 75

ALLIED COURSE I BIOLOGICAL CHEMISTRY

Objectives

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

Course outcomes

1. Developed a very good understanding of various bio molecules
2. Understand the types of chemical reactions
3. Recall the Structure, Classification, Chemistry and Properties of Carbohydrates and Explain Various Biochemical Cycles involved in Carbohydrate Metabolism.
4. Recall the Structure, Classification, Chemistry and Properties of Lipids, Nucleic acid and Explain Various Biochemical Cycles involved in Fatty acid and Nucleic acid Metabolism.
5. Understand the Structure, Classification, Chemistry and Properties of proteins amino acids and Identify and explain nutrients in foods and the specific functions in maintaining health.

UNIT - I

Atomic theory, formation of molecules, electronic configuration of atoms- s & p shapes of atomic orbitals. Periodic table, periodic classification, valency. Types of chemical bonds. Classification of organic compounds -. Hybridization in methane, ethane, acetylene, and benzene. Definition with examples- electrophiles, nucleophiles and free radicals. Types of reactions with an example: addition, substitution, elimination, condensation and polymerization. Electrophilic substitution reaction in benzene, nitration and sulphonation.

UNIT - II

Acids & Bases properties and differences, Concepts of acids and bases- Arrhenius, Lowry-Bronsted and Lewis. Concentration of solution, ways of expressing concentrations of solutions – per cent by weight, normality, molarity, molality, mole fraction. pH of solution, pH scale, measurement of pH. Buffer solutions, properties of buffers, Henderson-Hasselbalch equation, mechanism of buffer action of acidic buffer and basic buffer.

UNIT - III

Importance to Biochemistry-the chemical foundation of life. Water: its unique properties, ionization of water, buffering action in biological system, properties and characteristics of water. Classification of carbohydrates. Properties of carbohydrates. Ring structure of sugars and conformations of sugars. Metabolism of Carbohydrates – Glycogenesis, Glycogenolysis, Cori's cycle, Glycolysis, TCA cycle, bioenergetics of carbohydrate metabolism.

UNIT - IV

Classification of Lipids. Characteristics, Properties and Biological importance of lipids. Metabolism of Fatty acids, triglycerides, phospholipids, cholesterol. B-oxidation of fatty acids. Classification of nucleic acids. Purine and Pyrimidine bases. Classification of DNA & RNA. Metabolism of Nucleic acids, Salvage pathway.

UNIT - V

Classification and structure of amino acids. Structural conformation of proteins. Classification of proteins. Properties and biological importance of amino acids and proteins.

Degradation of Amino acids and Urea Cycle. Vitamins and Hormones. Role of hormones in metabolism. ATP production. Oxidative phosphorylation, Electron transport chain and Photophosphorylation.

Text Books

1. P.L. Soni , A Text-book of Inorganic Chemistry, 11th Edition, S. Chand & Sons publications
2. J.L. Jain, 2016, Fundamentals of Biochemistry, S. Chand publication, 7th edition.
3. Sathyanarayana U and Chakrapani U. Biochemistry, 4th edition, Elsevier Publishers. 2013.
4. Michael Cox., David. L. Nelson, (2004). Lehninger, Principles of Biochemistry, Kalyani Publishers, New Delhi.
5. H.S. Srivastava (2006). Elements of Biochemistry, Rastogi Publications, Meerut.
6. Biophysical chemistry – Upadhyay, Himalaya Publication, edition 3, 2005.

Reference Books

1. Lehninger (2013) Principles of Biochemistry 4 th edition WH Freeman and Company NY
2. Murray *et al.*, (2003) Harper's biochemistry 26 th edition Appleton and Lange Publishers Florida USA
3. Geoffrey L. Zubay, William W. Parson, Dennis E. Vance, 1995, Principles of Biochemistry, W.C. Brown Publishers, 1995, 3rd edition.
4. Lubert Stryer (2007) Biochemistry –Stanford University 5 th Edition-W H Freemann and company San Francisco
5. Bahl Arun, Bahl B. S. (2016), A Textbook of Organic Chemistry, 22nd Edition, S. Chand & Sons publications

Web Source

<https://www.uwyo.edu/molecbio/courses/molb3610/files/3610%20chpts%2012%20notes.pdf/>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
I	23UBT1AC1	Biological Chemistry					5	4			
Course Outcomes (COs)	Programme Outcomes(Pos)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓		✓	✓	✓	✓		✓	
CO2	✓	✓	✓	✓		✓	✓	✓	✓	✓	
CO3	✓	✓		✓		✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓		✓	
CO5	✓	✓	✓	✓	✓	✓	✓		✓	✓	
Number of Matches(✓) = 42 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER - I

Course Code: 23UBT2AP1
Instruction Hours: 2
Credits: 2

Exam Hours: 3
Internal Marks: 40
External Marks: 60

ALLIED PRACTICAL – I

BIOLOGICAL CHEMISTRY & FUNDAMENTALS OF MICROBIOLOGY (P)

Objectives

1. To acquire knowledge about aseptic techniques.
2. To comprehend the various methods for identification of unknown microorganisms
3. To impart the students with hands on skills related to biochemical techniques.
4. To enable the students to perform qualitative and quantitative analysis of biomolecules.

Course outcomes

1. Describe the general Laboratory safety & Sterilization Techniques
2. Develop Skills in Media Preparation, Isolation & Serial Dilution Techniques and Pure Culture Techniques
3. Microscopically analyze the morphological features of Bacteria and fungi and define various Staining Techniques.
4. Perform the Motility of organisms
5. Able to characterize and identify bacteria using Biochemical tests.

BIOLOGICAL CHEMISTRY

Systematic analysis of Organic compounds

1. Functional group tests (Carboxylic acid (Benzoic acid, phthalic acid),
2. Phenol, Urea, Benzaldehyde, Aniline (Aniline not to be given for exam)
3. Detection of elements (N, Halogens)
4. Distinguish between aliphatic and aromatic compounds.
5. Distinguish between Saturated and unsaturated compounds.

Qualitative Analysis

6. Qualitative analysis of carbohydrates - Glucose, Fructose, Lactose, maltose, sucrose, starch & glycogen.
7. Qualitative analysis of amino acids - Tyrosine, Tryptophan, Arginine, Proline and Cysteine.

Volumetric Analysis:

8. Estimation of Glycine- Formal Titration.
9. Determination of Ascorbic acid – DCPIP method.
10. Estimation of Ferrous sulphate using standard Mohr's salt.

Colorimetric Analysis

11. Estimation of glucose
12. Estimation of Cholesterol- Zak's method
13. Estimation of proteins – Bradford's method

FUNDAMENTALS OF MICROBIOLOGY

1. Good Laboratory Practice, Maintenance of hygienic conditions in the laboratory and legal disposal of laboratory wastes.
2. Microscope and its functions, preparation of culture media and sterilization methods.
3. Staining techniques: Simple, Gram's, Capsule (Negative), Spores,
4. Preparation of temporary mounts- Lacto phenol cotton blue staining Inoculation techniques- Pour plate, spread plate
5. Isolation of bacteria from various sources and dilution techniques Motility of bacteria, Growth studies of bacteria
6. Sterilization techniques – Preparation of Media.
7. Biochemical characterization - catalase, oxidase, IMVIC test and TSI.
8. Antibiotic sensitivity test (demonstration).

Reference Books

1. J. Jayaraman, Laboratory Manual in Biochemistry, New Age International Pvt Ltd Publishers, 2011.
2. S. K. Sawhney Randhir, Singh, Introductory Practical Biochemistry, Alpha Science International Ltd, 2nd edition, 2005.
3. Irwin H.Segel, Biochemical calculations, Liss, Newyork,1991.P.Palanivelu and M.Saliyu. 2009. Analytical biochemistry and separation techniques. 4th Edition, MKU, Madurai.
4. Sadasivam .S and Manickam A. 2009. Introduction to Practical Biochemicstry. 2nd Edition. New Age International Private Ltd.Publishers.
5. Dr. O P Panday, D N Bajpai, Dr. S Giri, PRACTICAL CHEMISTRY, S Chand, Revised edition 2016.
6. Hands Thacher Clarke, A hand book of Oraganic: Qualitative and quantitative Analysis, 2007.
7. N.S. Gnanapragasam and G. Ramamurthy, Organic chemistry Lab manual, S.Viswanathan Co. Pvt. Ltd., 1998

Text Books

1. James G Cappucino and N. Sherman MB(1996). A lab manual Benjamin Cummins, New York 1996.
2. Kannan. N (1996). Laboratory manual in General Microbiology. Palani Publications.
3. Sundararaj T (2005). Microbiology Lab Manual (1st edition) publications.
4. Gunasekaran, P. (1996). Laboratory manual in Microbiology. New Age International Ld., Publishers, New Delhi.
5. R C Dubey and D K Maheswari (2002). Practical Microbiology. S. Chand Publishing.
6. Atlas.R (1997). Principles of Microbiology, 2nd Edition, Wm.C.Brown publishers.
7. Amita J, Jyotsna A and Vimala V (2018). Microbiology Practical Manual. (1st Edition). Elsevier India.
8. Talib VH (2019). Handbook Medical Laboratory Technology. (2nd Edition). CBS.
9. Wheelis M, (2010). Principles of Modern Microbiology, 1st Edition. Jones and Bartlett Publication.
10. Lim D. (1998). Microbiology, 2nd Edition, WCB McGraw Hill Publications.

Web Source

<http://www.biologydiscussion.com/micro-biology/sterilisation-and-disinfection-methods-and-principles-microbiology/24403>.

<https://www.ebooks.cambridge.org/ebook.jsf?bid=CBO9781139170635>

<https://tkk.elte.hu/dstore/document/871/book.pdf>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits				
II	23UBT2AP1	Biological chemistry & Fundamentals Of Microbiology (P)					2	2				
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓	✓		✓		✓	✓	✓	✓	✓		
CO2	✓	✓	✓		✓	✓	✓	✓		✓		
CO3	✓	✓		✓	✓	✓	✓		✓	✓		
CO4	✓	✓		✓	✓	✓	✓	✓	✓			
CO5	✓	✓	✓		✓	✓	✓	✓	✓	✓		
Number of Matches(✓) = 41 Relationship: High												

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER I

Course Code: 23UBT1SE1

Instruction Hours: 2

Credits: 2

Exam Hours: 3

Internal Marks: 25

External Marks: 75

SKILL ENHANCEMENT COURSE-1(NME-1) PUBLIC HEALTH AND HYGIENE

Objectives

1. To acquire knowledge about Public health.
2. To comprehend the various methods for identification of unknown microorganisms.

Course outcomes

1. The students will learn, understand & develop the skill and hands on training in fundamentals of Personal Hygiene.
2. Utilize skills to enhance understanding of Classification of food into micro and macro nutrients.
3. The students will learn Communicable viral diseases
4. Develop responsible conduct of laboratory skills appropriate to the field of Non-communicable diseases
5. To understand the Various Organization

Unit-I:

Scope health and hygiene – Concept of health and disease - Pollution and health hazards; water and airborne diseases. Radiation hazards: Mobile Cell tower and electronic. Role of health education in environment improvement and prevention of diseases. Personal hygiene, oral hygiene and sex hygiene.

Unit-II:

Classification of food into micro and macro nutrients. Balanced diet, Importance of dietary fibres. Significance of breast feeding. Malnutrition anomalies – Anaemia, Kwashiorkar, Marasmus, Rickets, Goiter (cause, symptoms, precaution and cure).

Unit-III:

Communicable viral diseases- measles, chicken pox, poliomyelitis, swine flu, dengue, chickungunya, rabies, leprosy and hepatitis. Communicable bacterial diseases- tuberculosis, typhoid, cholera, tetanus, plague, whooping cough, diphtheria, leprosy. sexually transmitted diseases- AIDS, syphilis and gonorrhoea. Health education and preventive measures for communicable diseases.

Unit- IV:

Non-communicable diseases such as hypertension, stroke, coronary heart disease, myocardial infarction. Osteoporosis, osteoarthritis and rheumatoid arthritis-cause, symptom, precautions. Diabetes- types and their effect on human health. Gastrointestinal disorders- acidity, peptic ulcer, constipation, piles (cause, symptoms, precaution and remedy) etc. Obesity (Definition and consequences). Mental illness (depression and anxiety). Oral and lung cancer and their preventive measures.

Unit-V

Health Services Organizations: World Health Organization (WHO), United Nations International Children's Emergency Fund (UNICEF) and Indian Red Cross (IRC).

REFERENCES:

1. Mary Jane Schneider (2011) Introduction to Public Health.
2. Muthu, V.K. (2014) A Short Book of Public Health.
3. Detels, R. (2017) Oxford Textbook of Public Health (6th edition).
4. Gibney, M.J. (2013) Public Health Nutrition.
5. Wong, K.V. (2017) Nutrition, Health and Disease.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
I	23UBT1SE1	PUBLIC HEALTH AND HYGIENE					2	2			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓		✓	✓	✓	✓	✓	✓	
CO2	✓	✓	✓	✓	✓	✓	✓	✓		✓	
CO3	✓	✓		✓	✓		✓	✓	✓	✓	
CO4	✓		✓	✓	✓	✓	✓		✓	✓	
CO5	✓	✓	✓	✓		✓	✓	✓	✓	✓	
Number of Matches(✓) = 43 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER II

Course Code: 23UBT2CC3
Instruction Hours: 5
Credits: 5

Exam Hours: 3
Internal Marks: 25
External Marks: 75

CORE COURSE III GENETICS

Objectives

1. To study about the concepts of heredity, genes.
2. Students will gain the knowledge of Mendelian genetics, Blood group inheritance, and genetic map preparation.
3. To study about human and population genetics and Microbial Recombination.

Course outcomes

1. Learn about the classical genetics and transmission of characters from one generation to the next.
2. Obtain a strong foundation for the advanced genetics.
3. Explain the properties of genetic materials and storage and processing of genetic information.
4. Acquire knowledge about the Mutagens, Mutations, DNA Repairs and Genetic disorders in human.
5. Categories the Eugenics, Euphenics, Euthenics and in depth Knowledge on population Genetics.

Unit-I

Mendel's experiments, Monohybrid cross, Dihybrid cross, Backcross or Testcross, Mendel's laws. Incomplete dominance. Interaction of Genes- Epistasis -lethal genes. Multiple alleles – In Drosophila, Rabbit and Blood group inheritance in man.

Unit-II

Linkage - linkage in Drosophila- Morgan's experiments, factors affecting linkage. Crossing over- types, mechanism, significance of crossing over. Mapping of Chromosomes, interference and coincidence. Cytoplasmic inheritance -Carbon dioxide sensitivity in Drosophila and milk factor in mice. Sex –Linked Inheritance and Sex- Determination in Man.

Unit-III

Fine structure of the gene and gene concept, Operon Concept. Identification of the DNA as the genetic material- Griffith experiments, Avery, McLeod, McCarty and Hershey Chase experiment. Microbial Genetics- bacterial recombination, Conjugation, Transformation, Transduction and sexduction

Unit-IV

Mutation – types of mutation, mutagens, DNA damage and Repair Mechanism. Chromosomal aberrations- Numerical and Structural, Pedigree Analysis-Mendelian inheritance in human. (Cystic Fibrosis, Muscular Dystrophy).

Unit-V

Population Genetics– Hardy Weinberg principle, gene frequency, genotype frequency and factors affecting gene frequency. Eugenics, Euphenics and Euthenics.

TextBooks

1. Dr. Veer Bala Rastogi, 2020, Elements of Genetics, 11 th Revised & Enlarged Edition, Kedar Nath Ram NathPublications,Meerut,250001.www.knrnpublications.com, ISBN-978-81-907011-2-9
2. Verma, P.S. and Agarwal, V.K., 1995. Genetics, 8th edition, S.Chand & Co., New Delhi – 110055.
3. Verma, P.S., and Agarwal, V.K., 1995. Cell and Molecular Biology, 8th edition, S.Chand and Co., New Delhi, 110055.

Reference Books

1. Benjamin Pierce 2020,Genetics: A Conceptual Approach, Wh Freeman; 7th Edition.
2. Concepts Of Genetics 2019By William S. Klug ,Michael R. Cummings ,Charlotte A. Spencer .
3. Veer Bala Rastogi ,2019, Genetics 4th Edition Medtech.
4. Bd Singh2018,Fundamentals Of Genetics Unknown Binding. Kalani Pub.
5. Gardner , Simmons , Snustad, 2006. Principles Of Genetics, Wiley; 8th Edition.
6. Gardener E.J. Simmons M.J. Slustad D. P. 2006. Principles of Genetics
7. Lewis, R.2001. Human Genetics- Concepts and application. 4th edition. McGraw Hill.
8. Griffiths, Miller, J.H., An Introduction to Genetic Analysis W.H.Freeman. New York.
9. Winter, P.C., Hickey, G.J. and Fletcher, H.L.2000. Instant notes in Genetics. Viva books, Ltd
10. Good enough U. 1985. Genetics. Hold Saunders international.

Web Source

<https://nptel.ac.in/courses/102/106/102106025/>
<http://www.ocw.mit.edu>
<https://www.nature.com/scitable/topic/cellbiology13906536/>
<https://byjus.com/biology/genetics/>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
II	23UBT2CC3	Genetics					5	5			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓		✓	✓	✓	✓		✓	✓	
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO3	✓	✓	✓		✓	✓	✓		✓	✓	
CO4	✓	✓	✓	✓		✓	✓	✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 43 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER II

Course Code: 23UBT2CC4P
Instruction Hours: 3
Credits: 3

Exam Hours: 3
Internal Marks: 40
External Marks: 60

CORE PRACTICAL-II GENETICS (P)

Objectives

1. To study about the cell division and development.
2. To know knowledge about cell identification, cell culture, cell and organelle staining.

Course outcomes

1. Demonstrate the basic principles of important techniques in Molecular biology and Genetics.
2. Analyze the Polytene chromosome of the organisms
3. Identify Barr bodies from Buccal smear
4. Demonstrate the Preparations and maintenance of culture medium
5. Demonstrate Human karyotyping

Practical Contents

1. Mitotic stages of onion (*Allium cepa*) root tip
2. Meiotic stages of cockroach testes/ Flower bud
3. Giant chromosomes from *Chironomus* larvae/ *Drosophila* salivary glands
4. Identification of Barr bodies from Buccal smear
5. Preparations of culture medium and culture of *Drosophila* – methods of maintenance
6. Identifications of mutants of *Drosophila*
7. Human karyotyping (Demo)
8. Mendel's law of genetics. Mono and Dihybrid crosses.
9. Isolation of spontaneous mutant cells.
10. To prepare stained temporary mounts of human cheek cell

Reference Book

1. Practical Manual on "Fundamentals of Genetics" (PBG-121). 2019, Edition: First
Publisher: Odisha University of Agriculture & Technology. Editor: Kaushik Kumar Panigrahi
2. G. Koliantz , D.B. Szymanski.2006 Genetics A laboratory manual.
3. Gregore Koliantz , Daniel B. Szymanski .2015, Genetics A laboratory manual.

Web Source

https://r.search.yahoo.com/_ylt=AwrjaUf0gnNjsI0L8pVXNyoA;_ylu=Y29sbwNncTEEcG9zAzEEdnRpZAMEc2VjA3Ny/RV=2/RE=1668543348/RO=10/RU=https%3a%2f%2fwww.researchgate.net%2fpublication%2f334330459_Practical_Manual_on_Fundamentals_of_Genetics_PBG-121/RK=2/RS=5od7iXwxRYJ6dx8wR0Wz7ZLdV0o-

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
II	23UBT2CC4P	GENETICS (P)					3	3			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓		✓	✓	✓	✓	✓	✓	
CO2	✓	✓	✓	✓	✓	✓	✓	✓		✓	
CO3	✓	✓		✓	✓		✓	✓	✓	✓	
CO4	✓		✓	✓	✓	✓	✓		✓	✓	
CO5	✓	✓	✓	✓		✓	✓	✓	✓	✓	
Number of Matches(✓) = 43 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER - II

Course Code: 23UBT2AC2
Instruction Hours: 4
Credits: 3

Exam Hours: 3
Internal Marks: 25
External Marks: 75

ALLIED COURSE - II FUNDAMENTALS OF MICROBIOLOGY

Objectives

1. Students can understand the basics of microbiology, types of microbes.
2. To learn the classification and characterization, various applied aspects of microbes in biotechnology field and the role of microbes in pathogenicity.

Course outcomes

1. Understand the classification of Microorganisms and structure of bacteria.
2. Understand the various microbiological techniques, different types of media, and techniques involved in culturing microorganisms.
3. Categorize the methods of sterilization and identify the significance of culture media in the growth of different microbes.
4. Exhibit knowledge in analysing the importance of Bioinsecticides, Biofertilizers prebiotics and probiotics.
5. Distinguish between normal flora and pathogens and describe the role of microbes in food intoxications.

UNIT - I

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

UNIT - II

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

UNIT – III

Sterilization methods - physical and chemical methods- Mode of action – Antibiotic in clinical use - Resistance to antibacterial agents - MRSA, ESBL. Microscopic examination of microorganisms

UNIT – IV

Bioinsecticides - *Bacillus thuringiensis*, Baculoviruses- Biofertilizers -*Azospirillum* and blue green algae - single cell protein – prebiotics and probiotics - Dairy products (Cheese and Yoghurt). Microbes in medicine; Antibiotics, Penicillin.

UNIT - V

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

Text Books

1. Prasad B.N., “A Text Book of Biotechnology”, (2003) Budha Academic Enterprises, G.P.O., Box 20195, Kathmandu, Nepal.
2. Pelczar MJ, Chan ECS and Krein NR, (2019,) Microbiology,Tata McGraw Hill Edition, New Delhi, India.
3. Ananthanarayanan R & Jayaram Panicker, C.K. (2005) Textbook of Microbiology, Orient Longman.

Reference Book

1. Microbial Systematics: Taxonomy, Microbial Ecology, Diversity 1st Edition (2020) by Bhagwan Rekadwad.
2. Prescott, L.M J.P. Harley and C.A. Klein, Microbiology (2007). Wm, C. Brown publishers.
3. Talaron K, Talaron A, Casita, Pelczar and Reid. (2014) Foundations in Microbiology, W.C. Brown Publishers.
4. Michael T. Madigan John M. Martin & Jack Parker, 8 th edition (1984) Biology of Microorganisms Prentice Hall International, Inc., London.
5. Edward A. Birge, 7 th edition (1992), Modern Microbiology–Principles and application..C. Brown Publishers, Inc. U.S.A.

Web Source

<https://microbenotes.com/category/cellbiology/>

<https://www.nios.ac.in/media/documents/SrSec314NewE/Lesson04.pdf>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits				
III	23UBT2AC2	Fundamentals of microbiology					4	3				
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓	✓	✓		✓	✓	✓	✓	✓			
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO3	✓		✓		✓	✓	✓		✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓		✓		
Number of Matches(✓) = 44 Relationship: High												

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER - II

Course Code: 23UBT2AP1
Instruction Hours: 2
Credits: 2

Exam Hours: 3
Internal Marks: 40
External Marks: 60

ALLIED PRACTICAL – I

BIOLOGICAL CHEMISTRY & FUNDAMENTALS OF MICROBIOLOGY (P)

Objectives

1. To acquire knowledge about aseptic techniques.
2. To comprehend the various methods for identification of unknown microorganisms
3. To impart the students with hands on skills related to biochemical techniques.
4. To enable the students to perform qualitative and quantitative analysis of biomolecules.

Course outcomes

1. Describe the general Laboratory safety & Sterilization Techniques. Develop Skills in Media Preparation, Isolation & Serial Dilution Techniques and Pure Culture Techniques
2. Microscopically analyze the morphological features of Bacteria and fungi and define various Staining Techniques. Perform the Motility of organisms . Able to characterize and identify bacteria using Biochemical tests.
3. Perform and estimate the amount of chemical substance present in a solution qualitatively. To analyze and detect the nature of various organic class of compounds qualitatively.
4. Qualitatively analyze the carbohydrates and amino acids and report the type of carbohydrate based on specific tests. Differentiate the carbohydrates based microscopic examination of the crystal. Understand the methods of acidimetry, alkalimetry and permanganometry.
5. Quantify Ascorbic acid in lemon by Dichlorophenol indo phenol dye method, Glycine by sorensons formal titration method. Estimate Glucose, Cholesterol and Proteins.

BIOLOGICAL CHEMISTRY

Systematic analysis of Organic compounds

1. Functional group tests (Carboxylic acid (Benzoic acid, phthalic acid),
2. Phenol, Urea, Benzaldehyde, Aniline (Aniline not to be given for exam)
3. Detection of elements (N, Halogens)
4. Distinguish between aliphatic and aromatic compounds.
5. Distinguish between Saturated and unsaturated compounds.

Qualitative Analysis

6. Qualitative analysis of carbohydrates - Glucose, Fructose, Lactose, maltose, sucrose, starch & glycogen.
7. Qualitative analysis of amino acids - Tyrosine, Tryptophan, Arginine, Proline and Cysteine.

Volumetric Analysis:

8. Estimation of Glycine- Formal Titration.
9. Determination of Ascorbic acid – DCPIP method.
10. Estimation of Ferrous sulphate using standard Mohr's salt.

Colorimetric Analysis

11. Estimation of glucose
12. Estimation of Cholesterol- Zak's method
13. Estimation of proteins – Bradford's method

FUNDAMENTALS OF MICROBIOLOGY

1. Good Laboratory Practice, Maintenance of hygienic conditions in the laboratory and legal disposal of laboratory wastes.
2. Microscope and its functions, preparation of culture media and sterilization methods.
3. Staining techniques: Simple, Gram's, Capsule (Negative), Spores,
4. Preparation of temporary mounts- Lacto phenol cotton blue staining Inoculation techniques- Pour plate, spread plate
5. Isolation of bacteria from various sources and dilution techniques Motility of bacteria, Growth studies of bacteria
6. Sterilization techniques – Preparation of Media.
7. Biochemical characterization - catalase, oxidase, IMVIC test and TSI.
8. Antibiotic sensitivity test (demonstration).

Reference Books

1. J. Jayaraman, Laboratory Manual in Biochemistry, New Age International Pvt Ltd Publishers, 2011.
2. S. K. Sawhney Randhir, Singh, Introductory Practical Biochemistry, Alpha Science International Ltd, 2nd edition, 2005.
3. Irwin H.Segel, Biochemical calculations,Liss, Newyork,1991.P.Palanivelu and M.Salih. 2009. Analytical biochemistry andseparation techniques. 4th Edition, MKU,Madurai.
4. Sadasivam .S and Manickam A. 2009. Introduction to Practical Biochemicstry. 2nd Edition. New Age International Private Ltd.Publishers.
5. Dr. O P Panday, D N Bajpai, Dr. S Giri, PRACTICAL CHEMISTRY, S Chand, Revised edition 2016.
6. Hands Thacher Clarke, A hand book of Oraganic:Qualitative and quantitative Analysis, 2007.
7. N.S. Gnanapragasam and G. Ramamurthy, Organic chemistry Lab manual, S.Viswanathan Co. Pvt. Ltd., 1998
1. James G Cappucino and N. Sherman MB(1996). A lab manual Benjamin Cummins, New York 1996.
2. Kannan. N (1996). Laboratory manual in General Microbiology. Palani Publications.
3. Sundararaj T (2005). Microbiology Lab Manual (1st edition) publications.
4. Gunasekaran, P. (1996). Laboratory manual in Microbiology. New Age International Ld., Publishers, New Delhi.
5. R C Dubey and D K Maheswari (2002). Practical Microbiology. S. Chand Publishing.
6. Atlas.R (1997). Principles of Microbiology, 2nd Edition, Wm.C.Brown publishers.
7. Amita J, Jyotsna A and Vimala V (2018). Microbiology Practical Manual. (1st Edition). Elsevier India.
8. Talib VH (2019). Handbook Medical Laboratory Technology. (2nd Edition). CBS.
9. Wheelis M, (2010). Principles of Modern Microbiology, 1st Edition. Jones and Bartlett Publication.
10. Lim D. (1998). Microbiology, 2nd Edition, WCB McGraw Hill Publications.

Web Source

<http://www.biologydiscussion.com/micro-biology/sterilisation-and-disinfection-methods-and-principles-microbiology/24403>.

<https://www.ebooks.cambridge.org/ebook.jsf?bid=CBO9781139170635>

<https://ttk.elte.hu/dstore/document/871/book.pdf>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
IV	23UBT2AP1	Biologicalchemistry &Fundamentals Of Microbiology (P)					2	2			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓		✓		✓	✓	✓	✓	✓	
CO2	✓	✓	✓		✓	✓	✓	✓		✓	
CO3	✓	✓		✓	✓	✓	✓		✓	✓	
CO4	✓	✓		✓	✓	✓	✓	✓	✓		
CO5	✓	✓	✓		✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 41 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER II

Course Code: 23UBT2SE2

Instruction Hours: 2

Credits: 2

Exam Hours: 3

Internal Marks: 25

External Marks: 75

SKILL ENHANCEMENT COURSE-II (NME-2)

Organic Farming and Health Management

Objectives

1. To acquire knowledge about Ecology.
2. To comprehend the various methods for Health management.

Course outcomes

1. The students will learn, understand Ecology and Environment
2. Utilize skills to enhance understanding of Composting method.
3. The students will learn Organic Farming
4. Develop responsible conduct of health concept
5. Utilize skills to enhance understanding of Exercise and Health related fitness

Unit-I

Ecology and Environment – Principles of ecology – Ecosystem - Biotic and abiotic components and interaction – Energy flow –Nutrient cycle – Biodiversity – Endemic – Exotic - Interrelationships.

Unit-II

Composting – Microbial Compost – Vermicompost – Setup for vermicompost unit - Nutrition garden – Ring garden – Double digging – Cultivating vegetables – Common medicinal herbs – Identification and Cultivation.

Unit-III

Organic farming – Principles and Policies – Certification agencies – AGMARK, fssai, Halal certification – Participatory grading system (PGS) – Storage – Packing – Transportation – Marketing. Micro-enterprises – Self Help Groups – Economics of cultivations - Sustainability

Unit-IV

Health: Concept of Health, changing concepts definitions of health, dimensions of health, concept of well being, spectrum of health, determinants of health, ecology of health, right to health, responsibility for health, indicators of health.

Unit-V

Exercise and Health related fitness: Health related fitness, health promotion, physical activity for health benefits. Sports related fitness: Role of nutrition in sports, nutrition to athletic performance.

REFERENCES:

1. G.K. Veeresh, 2006. Organic farming , First edition, New Delhi, India Foundation Books in association with Centre for Environment Education.
2. Mangala rai, 2012. Hand Book of Agriculture, Sixth Edition, ICAR New Delhi.
3. B.B. Sharma , 2007. A Guide to Home Gardening, Second Edition, MIB India, New Delhi.
4. Adrienne E. Hardman, 2009. Physical Activity and Health – The evidence explained, Second edition, Taylor and Francis Group.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
II	23UBT2SE2	Organic Farming And Health Management					2	2			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓		✓	✓	✓	✓	✓	✓	
CO2	✓	✓	✓	✓	✓	✓	✓	✓		✓	
CO3	✓	✓		✓	✓		✓	✓	✓	✓	
CO4	✓		✓	✓	✓	✓	✓		✓	✓	
CO5	✓	✓	✓	✓		✓	✓	✓	✓	✓	
Number of Matches(✓) = 43 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER - II

Course Code: 23UBT2SE3

Instruction Hours: 2

Credits: 2

Exam Hours: 3

Internal Marks: 25

External Marks: 75

SKILL ENHANCEMENT COURSE-III ENZYMOLGY

Objectives:

1. Acquire basic and specific skills to Enzyme process.
2. Gain knowledge in the scientific development of biocatalysts.

Course outcomes

1. Acquire the knowledge about history, classification, purification and separation of enzymes
2. Describe the mechanism of enzyme action and construct the knowledge on enzyme regulation.
3. To enable the learner to realize the importance of enzymes in daily life, the properties of enzymes, the use of enzymes in industry, research and human health, and methods for the discovery of novel enzymes will be thoroughly explored
4. To create a basic understanding of the importance of enzymes as cellular catalysts.
5. Appraise about the techniques of immobilization and application in enzymes in industries.

UNIT – I

Nomenclature and classification of enzymes according to the International Union of Biochemistry and Molecular Biologists Convention. Properties of enzymes and factors that influence rate of enzyme action (pH, temperature, substrate concentration, enzyme concentration, activators and inhibitors).

UNIT – II

Active site (definition, characteristic features), Enzyme specificity. Bisubstrate and multisubstrate reactions. ES complex formation, lock and key model and induced fit model. Enzyme units - IU & Katal. Turnover number

UNIT – III

Enzyme Kinetics – Michaelis-Menten equation and its derivation, significance of K_m and V_{max} , Lineweaver- Burk plot and Eadie- Hofstee plot, Hanes-Woolf plot. Enzyme inhibition - competitive, Non- competitive, Uncompetitive – (Derivations not included).

UNIT – IV

Membrane bound proteins – Fluid mosaic model. Extraction of enzymes – Chemical agents and Physical methods of extraction, French pressure cell and ultrasonication. Nature of the extraction medium. Technique for enzyme isolation, separation of cellular organelles by differential centrifugation, purification of enzymes- dialysis, chromatography, electrophoresis. Intracellular localization of enzymes and marker enzymes.

UNIT – V

Immobilization of enzymes- Chemical and Physical methods. Clinical and industrial applications of immobilized enzymes. Enzyme engineering and Designer enzymes. Pharmaceutical, Clinical and Industrial uses of enzymes.

Text Books

- 1 Satyanarayana. U. 2013. Biochemistry, 4th edition, Elsevier India.
- 2 Jain J L, 2014, Fundamentals of Biochemistry, 7th edition, S.Chand publishing.
- 3 Rodwell, V.W, Bender D.A, Botham K.M. 2015, Harper's Illustrated Biochemistry, 30th edition. McGraw-Hill Education.
- 4 Fundamentals of Enzymology - Nicholas C. Price and Lewis Stevens., Oxford University Press, New Delhi.
- 5 Voet, D. and Voet, J.G. 2016. Biochemistry, 5th edition. John Wiley and Sons, Inc.,

Reference Books

- 1 Enzyme – Palmer, 18th edition, 2004. London: Portland Press
- 2 Biochemistry- Jeremy M Berg, John L Tymoczko, and Lubert Stryer, 6th Edition, Freeman Publications, 2006.
- 3 Ralph A. Messing (2012) Immobilised Enzymes Academic Press, NY.
- 4 Nelson D.L., and Cox, M.M. 2013. Lehninger Principles of Biochemistry. 6th edition. W.H. Freeman & Company.
- 5 Jeremy M Berg, Stryer, L. 2015. Biochemistry, 8th edition. Macmillan Learning.

Web Resources

- 1 <https://www.youtube.com/watch?v=AD3-v1oKjSk>
- 2 <https://www.youtube.com/watch?v=tPCOEUo6J8s>
- 3 <https://www.youtube.com/watch?v=ALwziZSRiqM>
- 4 <https://www.youtube.com/watch?v=0ZiCqwtFMTs>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
II	23UBT2SE3	ENZYMOLGY					2	2			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓		✓	✓	✓	✓	✓	✓	
CO2	✓	✓	✓	✓	✓	✓	✓	✓		✓	
CO3	✓	✓		✓	✓		✓	✓	✓	✓	
CO4	✓		✓	✓	✓	✓	✓		✓	✓	
CO5	✓	✓	✓	✓		✓	✓	✓	✓	✓	
Number of Matches(✓) = 43 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER - III

Course Code: 23UBT3CC5

Instruction Hours: 4

Credits: 4

Exam Hours: 3

Internal Marks: 25

External Marks: 75

CORE COURSE - V

IMMUNOLOGY AND IMMUNOTECHNOLOGY

Objectives

1. Categorize and explain the role of the major components of the immune system at the organ, cellular and molecular levels.
2. Compare and contrast the functions of the various immune components with respect to their role in the two major types of immune responses.

Course outcomes

1. Explain the role of immune cells and their mechanism in body defense mechanism.
2. Demonstrate the antigen –antibody reactions in various immune techniques.
3. Gain new insights into Antigen -Antibody interactions and to demonstrate immunological techniques.
4. Gain knowledge of production of vaccines.
5. Apply the knowledge of immune associated disease, hypersensitivity reactions.

UNIT - I

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

UNIT - II

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

UNIT - III

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

UNIT - IV

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

UNIT - V

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

Text Books

1. E. Riet. 2011. Essential Immunology 12th Edition. Wiley &Blackwell.
2. P.J.Delves, I S.J.Artin, I D.R.Burton and I I.M.Roitt. 2006. Essential Immunotechnology. 12th Edition. Wiley &Blackwell.
3. Richard M. Hyde. 2012. Microbiology and Immunology. 3rd Edition. Springer Science & BusinessMedia.

Reference Books

1. Brostoff J, Seaddin JK, Male D, Roitt IM., 2002. Clinical Immunology. 6th Edition. Gower MedicalPublishing.
2. Sinha B.S, 2022, Principles Of Immunology Students Compendium 2nd Edition by CBS Publishers.
3. Dr.Deepak Kumar,2019, Immunology and Immunological Biotechnology, Blue Rose Publishers.David Male,Jonathon,2012,Immunology, International Edition, Elsevier Health Publishers.
4. S.K. Gupta, 2017, Essentials Of Immunology, Arya Publications
5. Jenni Punt , Sharon Stranford , Patricia Jones , Judith A Owen,2018,Kuby Immunology, WH Freeman

Web Source

<http://www.helmsberg.at/immunology.pdf>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits				
III	23UBT3CC5	Immunology and Immunotechnology					4	4				
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO2	✓	✓	✓		✓	✓	✓	✓		✓		
CO3	✓		✓	✓	✓	✓	✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓		✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Number of Matches(✓) = 46 Relationship: High												

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER - III

Course Code: 23UBT3CC6P
Instruction Hours: 3
Credits: 3

Exam Hours: 3
Internal Marks: 25
External Marks: 75

CORE PRACTICAL - III

IMMUNOLOGY AND IMMUNOTECHNOLOGY (P)

Objectives

1. On taking this course the student will be able to employ the immunological techniques.
2. To understand how the immune system develops, how the body defends itself against disease.

Course outcomes

1. Perform blood grouping and determine blood type.
2. Able to count WBC and RBC.
3. Conduct serological diagnostic tests such as ASO, CRP, RA and Widal test.
4. Acquire technical skills required for immunodiffusion and know the principle behind the techniques.
5. Able to Demonstrate ELISA, Handling of Laboratory animals.

Practical Contents

1. Separation of Serum and Plasma.
2. Blood grouping and Rh typing.
3. WBC counting
4. RBC counting
5. Differential blood count
6. WIDAL Slide test
7. ASO test
8. Double Immunodiffusion
9. Single Radial Immunodifusion
10. ELISA – Demonstration
11. Handling of Laboratory animals - Demonstration
12. Skin test - Demonstration

References

1. Frank C. Hay, Olwyn M. R. Westwood. (2008). Practical Immunology, 4th Edition, Wiley-Blackwell.
2. Rose. (1992). Manual of Clinical Lab Immunology, ASM.
3. Wilmore Webley. (2016). Immunology Lab Manual, LAD Custom Publishing.
4. Janeway Travers. (1997). Immunobiology- the immune system in health and disease. Current Biology Ltd. London, New York. 3rd Edition.
5. Peter J. Delves, Seamus Martin, Dennis R. Burton, Ivan M. Roitt. (2006). Roitt's Essential Immunology, 11th Edition

Web Source

https://www.researchgate.net/publication/275045725_Practical_Immunology-_A_Laboratory_Manual
<https://www.urmc.rochester.edu/MediaLibraries/URMCMedia/labs/frelinger->

lab/documents/Immunology-Lab-Manual.pdf

https://webstor.srmist.edu.in/web_assets/downloads/2021/18BTC106J-lab-manual.pdf

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
III	23UBT3CC6P	Immunology And Immunotechnology (P)					3	3			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓		✓	✓	✓	✓	✓	✓	
CO2	✓		✓	✓	✓	✓		✓	✓	✓	
CO3	✓	✓		✓	✓	✓	✓		✓	✓	
CO4	✓	✓		✓	✓	✓	✓	✓		✓	
CO5	✓		✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 42 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER - III

Course Code: 23UBT3AC3
Instruction Hours: 4
Credits: 3

Exam Hours: 3
Internal Marks: 25
External Marks: 75

ALLIED COURSE– III BIOINSTRUMENTATION

Objectives.

1. Categorize and explain the role of biological instruments.
2. Compare and contrast the functions of the various instrumental process.

Course outcomes

1. Practice, experiment with and apply the basic instruments in the laboratory.
2. Predict the functionality of Beer – Lambert’s law in identifying and quantifying a biomolecule
3. Employ the separation techniques for separating biomolecules based on chromatography and electrophoretic techniques.
4. Understand the clinical important isotopes and detection of isotopes.
5. Employ the separation techniques for separating biomolecules based on centrifugal force by centrifugation

UNIT-I

pH – Definition – pH meter. Measurement of pH and calibration of pH meter - Buffers – Preparation of Buffers. Microscopy: Principle and applications of Compound, Bright field, Phase contrast and Fluorescence Microscope

UNIT-II

Spectra – Absorption and Emission Spectra – Beer Lambert’s law – Colorimeter, UV-Visible Spectrophotometer. Mass spectroscopy - Atomic absorption spectrometer (AAS) - Nuclear magnetic resonance spectrometer (NMR).

UNIT-III

Chromatography - Principles – Paper Chromatography, TLC, Gel filtration, Ion-Exchange, Affinity Chromatography Gas Liquid Chromatography and HPLC. Electrophoresis: Principle, Paper Electrophoresis – Cellulose Acetate Electrophoresis - Agarose Gel Electrophoresis – SDS- PAGE and Iso-electric focusing.

UNIT-IV

Radioactivity – Isotopes – Clinically important isotopes – Measurement of Radioactivity — Autoradiography – Applications. SOPs for Radioactive materials.

UNIT-V

Centrifugation – Principles - RCF, Sedimentation concept - - Different types of centrifuge – Types of rotors – Centrifugation types: Differential and Density gradient centrifugation – Ultra Centrifuge.

Text Book

1. Veerakumar2011,Bioinstrumentation,Mjp Publishers
2. Natarajan R. Ananda,2012,Biomedical Instrumentation and Measurements ,PHI Publishers

Reference Book

1. Dr. G.Rajagobal., Dr. B.D.Toora. 2001. Practical Biochemistry. 1st Edition. Ahuja Book Company Pvt.Ltd.
2. J.Jayaraman. 2000. Laboratory Manual in Biochemistry. New Age International(p).
3. Webster, 2007,Bioinstrumentation, Wiley Publisher.
4. Rajgopal Shenoy K And Anitha Nileshwar,2012,Manipal Manual Of Instruments, CBJ Publication
5. Veerakumari L,2017,Bioinstrumentation, MJP Publisher.
6. M.J. Reilly, 2018 ,Bioinstrumentation, CBJ Publishers

Web Source

https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SMB2103.pdf.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits				
III	23UBT3AC3	Bioinstrumentation					4	3				
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO2	✓	✓		✓	✓	✓		✓	✓	✓		
CO3	✓		✓	✓	✓	✓	✓		✓	✓		
CO4	✓	✓		✓	✓	✓	✓	✓	✓	✓		
CO5	✓	✓	✓	✓		✓	✓	✓	✓	✓		
Number of Matches(✓) = 44 Relationship: High												

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER - III

Course Code: 23UBT4AP2

Instruction Hours: 2

Credits: 2

Exam Hours: 3

Internal Marks: 40

External Marks: 60

ALLIED PRACTICAL –II

BIOINSTRUMENTATION & BIOINFORMATICS AND BIOSTATISTICS (P)

Objectives

1. Analyse the Biological databases.
2. Able to perform BLAST and FASTA
3. Represent data in to graphical form.
4. Test the level of significance of biological data and interpret the results.
5. Determine averages of the biological data

Course outcomes

1. Practice, experiment with and apply the basic instruments in the laboratory.
2. Instruments such as weighing balance, pH meter, shaker, incubator etc. in various research processes.
3. Predict the functionality of Beer – Lambert’s law in identifying and quantifying biomolecules.
4. Employ the separation techniques for separating biomolecules based on paper chromatography.
5. Knowledge about the biological material into its various components by Centrifuge

BIOINSTRUMENTATION

1. Preparation of Buffer (Phosphate Buffer)
2. Determination of pH of biological samples using pH meter
3. UV spectra of Nucleic acids and proteins.
4. Chromatography analysis of sugar, amino acids, lipids by paper chromatography.
5. Chromatography analysis of sugar, amino acids, lipids by Thin layer chromatography.
6. Fractionation of biological material into its various components by Centrifuge.

BIOINFORMATICS AND BIOSTATISTICS

1. Biological databases (NCBI, Swissprot and PDB)
2. BLAST FASTA
3. Identification of functional domains in nucleotide binding proteins using a domain analysis server like SMART
4. Preparation of bar diagram, line diagram and pie diagram using MS EXCEL.
5. Calculation of Central tendency- mean, geometric mean, median using MS EXCEL
6. Calculation of dispersion – Mean deviation, quartile deviation and standard deviation using MS EXCEL
7. Calculation of student’s t test using MS EXCEL

Text Books

1. Pennington, S.R. and Punn, M.J. 2002. Proteomics: from protein sequence to function. Viva books Pri. Ltd.
2. Maleolm and Goosfship. J. 2001. Genotype to phenotype, 2nd edition. Bios Scientific Publishers Ltd
3. Misener, S. and Krawetz. S.A. 2000. Bioinformatics: Methods and Protocols. Humana press.

4. Attwood, T.K. and Parry-Smith, D.J.1999. Introduction to Bioinformatics. Pearson Education Asia.
5. Primrose, S.B. 1998. Principle of genome analysis. 2ndedition. Blackwell Science.
6. Sharda University Abstract Laboratory Manual for Bio-instrumentation, Biochemistry, Microbiology, Cell Biology and Enzyme Technology.2018
7. Bhomwik (2011),Analytical techniques in Biotechnology – A complete laboratory manual, MGH Publisher, ISBN-13 : 978-0070700130

Reference Books

1. Durbin, R., Eddy, S., Krogh, A. and Mitchison, G. 1998. Biological sequence analysis. Cambridge University Press.
2. Friedman, C.P. and Wyatt. J.C. 1997. Computers and Machine: Evaluation methods in medicinal information. Springer-verlag, New York.
- 3.P. Palanivelu (2017), Analytical Biochemistry and Separation techniques – A laboratory manual, (5th Edition), Twentyfirst century publishers, ISBN: 978-81-908489-0-9

Web Resources

1. Bishop, M.J. and Rawhings. C.J. 1997. DNA and protein sequence analysis: A practical approach. Oxford University press. New press. Kolodne
 2. Kolodner, R.M. 1997. Computer in Health care: Computerizing large integrated health networks. Springer – Verlag, New York
- Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
III	23UBT4AP2	BIOINSTRUMENTATION & BIOINFORMATICS AND BIOSTATISTICS (P)					2	2			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓		✓		✓	✓	✓	✓	✓	
CO2	✓	✓	✓		✓	✓	✓	✓		✓	
CO3	✓	✓		✓	✓	✓	✓		✓	✓	
CO4	✓	✓		✓	✓	✓	✓	✓	✓		
CO5	✓	✓	✓		✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 41 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER - III

Course Code: 23UBT3SE4

Instruction Hours: 2

Credits: 2

Exam Hours: 3

Internal Marks: 25

External Marks: 75

SKILL ENHANCEMENT COURSE– IV (ENTREPRENEURIAL SKILL)

BIOENTREPRENEURSHIP

Objectives

1. Students will be able to identify the challenges of being a Bioentrepreneur and understand the current global status of the Bio industry.
2. They will also be able to generate a detailed business plan and identify various funding agencies.
3. They will excel in technical skills such as Vermicomposting, Sericulture, Aquaponics, Mushroom cultivation and SCP Production.

Course outcomes

1. Gain knowledge about Bioentrepreneurship, biotech industries and funding agencies.
2. Understand Business plan for startups, Accounting and IPR.
3. Aspire to work in Vermicomposting, vermiculturing and Understand the importance of sericulture.
4. Will gain the knowledge of cultivation of different types of Mushroom and Aquaponics.
5. Understand the process and technology concerned with the mass production of Single cell protein.

UNIT - I

Basics of Bio entrepreneurship -Biotechnology in a Global scale; types of Bio-industries – Biopharma, Bioagri and Bioservice innovations – Successful Entrepreneur – Creativity, Leadership, Managerial skills, Team building, Decision making; Public and private funding agencies (MSME, DBT, BIRAC, Startup & Make in India)

UNIT - II

Business plan preparation; business feasibility analysis by SWOT, business plan proposal for virtual startup company; statutory and legal requirements for starting a company/venture; basics in accounting practices. Market Conditions, Identifying the need of the customers.

UNIT - III

Vermicomposting – Earthworms – Ecological types – Vermiculture – Compostpit – vermibed - applications. Sericulture – Mulberry cultivation – Silkworm Rearing – Economics of silkworm Production - Chawki Rearing - Sericulture in India.

UNIT - IV

Phases of Mushroom Cultivation; Selection of an acceptable mushroom species/strains, Management of mushroom development, Mushroom harvesting; Mushroom diseases, Medicinal and Nutritional properties of mushroom. Aquaponics- Systems-Fish and Vegetables-Nutrients and Biofilters-Advantages and Disadvantages.

UNIT - V

Single Cell Protein Production: Source: Algae, Bacteria, Yeast – Cultivation of Single Cell protein: Spirulina Cultivation – Production site, Microorganism, Experimental design; harvesting and Drying.

Text Books

1. Shimasaki, C. D. (2014). Biotechnology entrepreneurship: Starting, managing, and leading biotech companies. Amsterdam: Elsevier. Academic Press is an imprint of Elsevier.
2. Onetti, A., & Zucchella, A. (n.d.). Business modeling for life science and biotech companies: Creating value and competitive advantage with the milestone bridge. Routledge.

Reference Books

1. Adams, D. J., & Sparrow, J. C. Enterprise for life scientists: Developing innovation and entrepreneurship in the biosciences. Bloxham: Scion.
2. Jordan, J. F. (2014). Innovation, Commercialization, and Start-Ups in Life Sciences. London: CRC Press.
3. Desai, V. The Dynamics of Entrepreneurial Development and Management. New Delhi: Himalaya Pub. House.
4. The Essential Guide to Cultivating Mushrooms: Simple and Advanced Techniques for Growing Shiitake, Oyster, Lion's Mane, and Maitake Mushrooms at Home by Stephen Rusell
5. Neutraceutical spirulina: Commercial cultivation using rural technology in india by Pushpa Srivastava

Website and e-Learning Source

[https://archive.india.gov.in > citizen > agriculture](https://archive.india.gov.in/citizen/agriculture)

<http://www.recirculatingfarms.org/resources/>

<https://academy.vertical-farming.net/intro-to-mushroom-growing/>

Semester	Code	Title of the Course					Hours	Credits			
III	23UBT3SE4	BIOENTREPRENEURSHIP					2	2			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO 1	PO2	PO 3	PO4	PO 5	PSO1	PSO 2	PSO 3	PSO 4	PSO5	
CO1	✓	✓	✓	✓		✓	✓	✓	✓	✓	
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO3	✓		✓	✓	✓	✓	✓		✓	✓	
CO4	✓	✓	✓		✓	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 46 Relationship: Very High											
Mapping	1-29%		30-59%		60-69%		70-89%		90-100%		
Matches	1-14		15-29		30-34		35-44		45-50		
Relationship	Very Poor		Poor		Moderate		High		Very High		

SEMESTER - III

Course Code: 23UBT3SE5
Instruction Hours: 2
Credits: 2

Exam Hours: 3
Internal Marks: 25
External Marks: 75

SKILL ENHANCEMENT COURSE– V FORENSIC SCIENCE

Objectives

1. To understand the basic concepts in Forensic science
2. To familiarise with analytical tools and sample preparation methods.
3. To apply the DNA fingerprinting technique to solve various research and real life

Course outcomes

1. Understand the basis of Crime scenario.
2. Demonstrate the sample preparation and processing from various specimens
3. Familiarise with the available analytical tools and techniques for Forensic science.
4. Analyse various case studies based on Personal identification techniques.
5. Apply the knowledge in various problem solving aspects

UNIT - I

Definition and scope of Forensic Biotechnology, History and development, Forensic genetics, Forensic agriculture.

UNIT - II

Crime scene investigation; collection, preservation, packing and forwarding of physical and trace evidence. Questioned documents – identification of handwriting, signature and detection of forgery.

UNIT - III

Serology - Fresh blood grouping and typing, stains of bloods. Identification of blood stains, collection and storage of allied body fluids (semen, saliva and blood). Case studies.

UNIT - IV

PCR, RFLP, AFLP, Microscopy (Electron, Fluorescent) and Chromatography (Paper, TLC & HPLC) in forensic investigation.

UNIT - V

DNA Profiling, Isolation of DNA from blood samples, DNA testing in cases of disputed paternity and maternity.

Text book

1. Dr. Rukmani Krishnamurthy. Introduction to Forensic Science in Crime Investigation. Selective and scientific books publishers and distributors, New Delhi. (2005).
2. Kirby, LT. DNA Fingerprinting Technology. Palgrave Macmillan UK. (2009).

References

1. Kelly M. Pyrek ,2017. Pioneers In Forensic Science: Innovations And Issues In Practice, CRC Press.
2. Phill Jones,2012.Forensic Science For Writers, Createspace Independent Pub
3. Jo – Anne Bright and Michael Coble Forensic DNA Profiling: A practical guide to assigning likelihood Rarios CRC Press 2019

4. Pankaj Shrivastava, HirakRanjann Dash, Forensic DNA typing: Principles, Applications and Advancements Springer 2020.
5. Sara costontokis, 2017., World Of Forensic Science, Gale Virtual Reference Library.

Web Source

<https://microbenotes.com/dna-fingerprinting-principle-methods-applications/>

<https://www.vedantu.com/biology/dna-fingerprinting>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits				
III	23UBT3SE5	Forensic Science					2	2				
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓	✓	✓		✓	✓	✓	✓	✓	✓		
CO2	✓		✓	✓	✓	✓	✓		✓	✓		
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO4	✓	✓		✓	✓	✓	✓		✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Number of Matches(✓) = 45 Relationship: High												

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER - IV

Course Code: 23UBT4CC7
Instruction Hours: 5
Credits: 5

Exam Hours: 3
Internal Marks: 25
External Marks: 75

CORE COURSE - VII

GENETIC ENGINEERING AND rDNA TECHNOLOGY

Objectives

1. Make them understand the process of rDNA technology
2. Obtain the knowledge on the basics on cloning and sequencing strategies.

Course outcomes

1. Demonstrate the basic principles of genetic engineering techniques and illustrate the specificity of vectors for cloning and advantages.
2. Enumerate various recombinant techniques and gene probes and molecular markers identification.
3. Understand Gene transfer techniques by Viral and Non viral mediated gene transfer mechanisms.
4. Exhibit knowledge in sequencing technologies and protein engineering techniques.
5. Explore the strategies of Recombinant DNA Technology in r medicine, Industry and agriculture.

UNIT- I

Genetic Engineering – Introduction. Tools in recombinant DNA technology – recombinant DNA – cloning strategies (enzymes, vectors, host introduction of rDNA into host cells.

UNIT-II

Identification of recombinants, selection and screening for Recombinants. DNA sequencing – Construction of Genomic DNA library and cDNA library), Chromosome walking. Human Genome Project. Polymerase Chain reaction- Methodology and its Types.

UNIT-III

Gene transfer techniques – Viral mediated gene transfer, Selectable markers and reporter genes - Non viral mediated gene transfer - Physical methods: Microinjection - Electroporation - Particle Bombardment, Chemical methods: Calcium phosphate - DEAE dextran - Liposomes.

UNIT-IV

Gene Expression – Expression system and their applications - protein based products – Protein engineering– production of protein from cloned genes. Site directed Mutagenesis, Restriction Fragment Length Polymorphism (RFLP).

UNIT-V

Application of Recombinant DNA technology in medicine, industry, agriculture and r-DNA technology - merits and demerits.

Text Books

1. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts and Peter Walter. 2002. Molecular Biology of the Cell, 4th Edition. Garland Sciences.
2. Uldis N. Streips and Ronald E. Yasbin. 2002. Modern Microbial Genetics. 2nd Edition. Wiley-Blackwell.

3. Sandy B. Primrose, Richard M. Twyman, Robert W. Old. 2008. Principles of Gene Manipulation. 6th Edition. BlackwellScience.
4. Brown TA. 2008. Genomes. 3rd Edition. New York: Garland Publishing Co. New York: GarlandScience.
5. R C Dubey 2014, A Textbook Of Biotechnology S Chand

Reference Book

1. Rastogi 2015, Principles of Molecular Biology scientific international
2. Nair A. J. 2014 Principles of Biotechnology and Genetic Engineering, Laxmi Publications.
3. Daniel L. Hartl. 2011. Analysis of Genes and Genomes. 8th edition. Maryellen Ruvolo. Laxmi Publications.
4. Keya Chaudhuri. 2012. Recombinant DNA Technology. The Energy and Resources Institute, TERI.
5. J.F. Sambrook and D.W. Russell. 2011. *Molecular Cloning: A Laboratory Manual*. 3rd Edition. Volume 1, 2 and 3. Cold Spring Harbor Laboratory Press.

Web Source

<https://www.biotechnologynotes.com/recombinant-dna-technology/recombinant-dna-technology-notes/259>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits				
IV	23UBT4CC7	Genetic engineering and rDNA technology					5	5				
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓	✓		✓	✓	✓	✓	✓	✓	✓		
CO2	✓	✓	✓		✓	✓		✓	✓	✓		
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓		✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Number of Matches(✓) = 46 Relationship: Very High												

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER - IV

Course Code: 23UBT4CC8P
Instruction Hours: 3
Credits: 3

Exam Hours: 3
Internal Marks: 40
External Marks: 60

CORE PRACTICAL - IV

Genetic Engineering and rDNA Technology (P)

Objectives

1. Demonstrate the genetic materials analysis process.
2. Practically analyze the process of molecular biology experiments.

Course outcomes

1. Students will be exposed to the latest techniques employed in recombinant DNA technology related to DNA manipulation in prokaryotes and eukaryotes.
2. The student will be able to understand and develop the concept of recombinant DNA technique.
3. To gain hands on experience in gene isolation, cloning by PCR approach, DNA on and PCR-amplification for DNA fingerprinting analysis via RAPD and restriction digestion.
4. This course is planned to give hands on training in recombinant DNA technology.
5. The course helps the students to understand about the recombinants from the basics to advanced techniques, giving in detail about each factor during construction of recombinants.

Practical contents

1. Isolation and purification of genomic DNA from prokaryotes.
2. Isolation and purification of genomic DNA from eukaryotes.
3. Isolation and purification of plasmid DNA.
4. Isolation of RNA
5. Staining of proteins - Amido black, coomassie brilliant blue & AgNO₃.
6. Bacterial mutagenesis – physical & chemical.
7. Different type of Restriction digestion.
8. Genetic Ligation process.
9. Preparation of competent Microbial cells.
10. Transformation of microbes with recombinant DNA.

References

1. Najat Abdulrazzaq Hasan, 2021, Basic Molecular biology laboratory Manual, Zenodo Publisher.
2. S.K. Gakhar, Monika Miglani, Ashwani Kumar. 2019. Molecular Biology: A Laboratory Manual Dreamtech Press
3. Dr. David A Thompson. 2011. Cell and Molecular Biology Lab Manual.
4. S. John Vennison 2009 Laboratory Manual For Genetic Engineering phi Learning
5. J. Sambrook and D.W. Russel. 2001. Molecular Cloning: A Laboratory Manual, Vol. 1-3. CSHL.
6. Dr Hala M. Abdelmigid, 2013, Genetic engineering: Laboratory Manual, CreateSpace Independent Publishing Platform; Lab Manual edition.
7. Judith W. Zyskind and Sanford I. Bernstein. 1989. Recombinant DNA Laboratory Manual. Academic press.

Web Source

<http://www-personal.umd.umich.edu/~poelkers/OelkersMolbiolmanualUMD2016.pdf>

http://webstor.srmist.edu.in/web_assets/srm_mainsite/files/files/BT%200502%20-%20M_Tech%20r-DNA%20Technology%20lab%20manual.pdf

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
IV	23UBT4CC8P	Genetic Engineering and rDNA Technology (P)					3	3			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓		✓	✓	✓	✓	✓	✓	
CO2	✓		✓	✓	✓	✓		✓	✓	✓	
CO3	✓	✓		✓	✓	✓	✓		✓	✓	
CO4	✓	✓		✓	✓	✓	✓	✓		✓	
CO5	✓		✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 42 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER - IV

Course Code: 23UBT4AC4
Instruction Hours: 4
Credits: 4

Exam Hours: 3
Internal Marks: 25
External Marks: 75

ALLIED COURSE- IV BIOINFORMATICS AND BIOSTATISTICS

Objectives

1. Students will acquire knowledge on the basic principles and concepts of Bioinformatics and Biostatistics which can be employed in computer modeling, development of new algorithms and analysis methods.
2. To equip analytical thinking to solve biological problems

Course outcomes

1. Acquire knowledge about the Developments and Applications of Bioinformatics.
2. Gain knowledge about the importance of the bioinformatics, databases, tools and software of bioinformatics and Explain different types of Biological Databases.
3. Understand the basics of sequence alignment, sequence analysis and Protein structure prediction method.
4. Demonstrate the basic methods of data collection, graph construction and sampling techniques and Calculate measures of central tendency
5. Correlate and analyze biological data through various statistical methods and interpret biological data via various probabilistic distribution methods.

UNIT -I

Introduction to Bioinformatics – Genome, Transcriptome and Proteome, Gene prediction rules and software. Nucleic acid Databases – Primary and Secondary Databases – Structure Database – CATH, SCOP – Data base Searching – BLAST and FASTA, BLOSSUM.

UNIT - II

Sequence analysis (Proteins and Nucleic acids), Protein Database: Comparison of Protein sequences and Database searching – methods for protein structure prediction - Homology modeling of proteins, visualization tools (RASMOL).

UNIT - III

Multiple Sequences alignment – method of multiple sequences alignment. Evolutionary analysis, clustering methods Phylogenetic trees - Methods to generate phylogenetic tree- Tools for multiple sequences alignment and phylogenetic analysis - History of Drug Discovery, Steps in Drug design - Chemical libraries – Role of molecular docking in drug design.

UNIT - IV

Statistics – collection, classification, tabulations of Statistical Data – Diagrammatic representation – Graphs – Sampling method and standard error. Measures of central tendency

UNIT - V

Correlations and regression. Probability distribution-Binomial, Negative binomial, multinomial distribution, Poisson distribution. Tests of significance – t tests – F tests – Chi square test. Analysis of variance – Statistical Softwares.

Text Books

1. Pennington, S.R. and Punn, M.J. 2002. Proteomics: from protein sequence to function. Viva books Pvt. Ltd.
2. Shuba G., 2010. Bioinformatics., Tata McGraw Hill publishing. India.
3. Rastogi, S.C, Mendiratta, N, Rastogi, P., 2004. Bioinformatics methods and application. Prentice-Hall of India private limited, New Delhi.

4. N.Gurumani (2011) "An Introduction to Biostatistics" MJP Publishers
5. VerbalaRastogi.(2011).”Fundamentals of Biostatistics”, Ane books Pvt Ltd Publishers,Chennai

Reference Books

1. Attwood, T.K. and Parry-Smith, D.J.2008. Introduction to Bioinformatics. Pearson Education.
2. David Mount., Bioinformatics: sequence and genome analysis, second edition., Taylor & Francis, UK; 2009.
3. D.R.Westhead. Instant Notes in Bioinformatics., second edition., Taylor & Francis, UK; 2009.
4. Zar,(J.H.2010).”Biostatistical Analysis” Fifth Edition, Pearson Education Pvt Ltd, Indian Branch,NewDelhi.
5. P.N.Arora and P.K. Malhan.(2013)"Biostatistics"Himalaya publishing House.

Web Source

<https://microbenotes.com/category/bioinformatics/>

https://youtu.be/_e4mwlqCQrc

<https://youtu.be/AdH5vfobH5E>

<https://youtu.be/fNLeogEjMmM>

<https://youtu.be/0zZYBALbZgg>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits				
IV	23UBT4AC4	Bioinformatics And Biostatistics					4	4				
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓	✓	✓		✓	✓	✓	✓	✓	✓		
CO2	✓	✓	✓	✓	✓	✓		✓	✓	✓		
CO3	✓	✓		✓	✓	✓	✓		✓	✓		
CO4	✓	✓		✓	✓	✓	✓	✓		✓		
CO5	✓		✓	✓	✓	✓	✓	✓	✓	✓		
Number of Matches(✓) = 42 Relationship: High												

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER - IV

Course Code: 23UBT4AP2
Instruction Hours: 2
Credits: 2

Exam Hours: 3
Internal Marks: 40
External Marks: 60

ALLIED PRACTICAL –II

BIOINSTRUMENTATION & BIOINFORMATICS AND BIostatISTICS (P)

Objectives

1. Analyse the Biological databases.
2. Able to perform BLAST and FASTA
3. Represent data in to graphical form.

Course outcomes

1. Practice, experiment with and apply the basic instruments in the laboratory such as weighing balance, pH meter, shaker, incubator etc. in various research processes.
2. Predict the functionality of Beer – Lambert’s law in identifying and quantifying biomolecules.
3. Employ the separation techniques for separating biomolecules based on paper chromatography.
4. Test the level of significance of biological data and interpret the results.
5. Determine averages of the biological data

BIOINSTRUMENTATION

1. Preparation of Buffer (Phosphate Buffer)
2. Determination of pH of biological samples using pH meter
3. UV spectra of Nucleic acids and proteins.
4. Chromatography analysis of sugar, amino acids, lipids by paper chromatography.
5. Chromatography analysis of sugar, amino acids, lipids by Thin layer chromatography.
6. Fractionation of biological material into its various components by Centrifuge.

BIOINFORMATICS AND BIostatISTICS

1. Biological databases (NCBI, Swissprot and PDB)
2. BLAST FASTA
3. Identification of functional domains in nucleotide binding proteins using a domain analysis server like SMART
4. Preparation of bar diagram, line diagram and pie diagram using MS EXCEL.
5. Calculation of Central tendency- mean, geometric mean, median using MS EXCEL
6. Calculation of dispersion – Mean deviation, quartile deviation and standard deviation using MS EXCEL
7. Calculation of student’s t test using MS EXCEL

Text Books

1. Pennington, S.R. and Punn, M.J. 2002. Proteomics: from protein sequence to function. Viva books Pri. Ltd.
2. Maleolm and Goosfship. J. 2001. Genotype to phenotype, 2nd edition. Bios Scientific Publishers Ltd
3. Misener, S. and Krawetz. S.A. 2000. Bioinformatics: Methods and Protocols. Humana press.
4. Attwood, T.K. and Parry-Smith, D.J. 1999. Introduction to Bioinformatics. Pearson

Education Asia.

5. Primrose, S.B. 1998. Principle of genome analysis. 2nd edition. Blackwell Science.
6. Sharda University Abstract Laboratory Manual for Bio-instrumentation, Biochemistry, Microbiology, Cell Biology and Enzyme Technology. 2018
7. Bhomwik (2011), Analytical techniques in Biotechnology – A complete laboratory manual, MGH Publisher, ISBN-13 : 978-0070700130

Reference Books

1. Durbin, R., Eddy, S., Krogh, A. and Mitchison, G. 1998. Biological sequence analysis. Cambridge University Press.
2. Friedman, C.P. and Wyatt. J.C. 1997. Computers and Machine: Evaluation methods in medicinal information. Springer-verlag, New York.
3. P. Palanivelu (2017), Analytical Biochemistry and Separation techniques – A laboratory manual, (5th Edition), Twentyfirst century publishers, ISBN: 978-81-908489-0-9

Web Resources

1. Bishop, M.J. and Rawlings. C.J. 1997. DNA and protein sequence analysis: A practical approach. Oxford University press. New press. Kolodne
 2. Kolodner, R.M. 1997. Computer in Health care: Computerizing large integrated health networks. Springer – Verlag, New York
- Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
IV	23UBT4AP2	BIOINSTRUMENTATION & BIOINFORMATICS AND BIOSTATISTICS (P)					2	2			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓		✓		✓	✓	✓	✓	✓	
CO2	✓	✓	✓		✓	✓	✓	✓		✓	
CO3	✓	✓		✓	✓	✓	✓		✓	✓	
CO4	✓	✓		✓	✓	✓	✓	✓	✓		
CO5	✓	✓	✓		✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 41 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER - V

Course Code: 23UBT5CC9
Instruction Hours: 5
Credits: 5

Exam Hours: 3
Internal Marks: 25
External Marks: 75

CORE COURSE - IX **PLANT BIOTECHNOLOGY**

Objectives:

1. Students will gain knowledge about plant tissue culture, transgenic plants, nitrogen fixation mechanism and significance of viral vectors.

Course outcomes

1. Explore the history of plant biotechnology and state the importance of organization of plant genome.
2. Be acquainted with the molecular basics of action of hormones and gene expression.
3. Illustrate about various culture medium preparations, haploid, triploid plant production and its application.
4. Exploit symbiotic organisms as a vector for gene transfer to produce transgenic plants.
5. Develop molecular technique skills for crop improvement and transgenic plant production.

UNIT-I

History of plant biotechnology, Conservation of Plant using Biotechnology. Plant genome organization: structural features of a representative plant gene, gene families in plants. Organization of chloroplast genome and mitochondrial genome.

UNIT-II

Auxins, cytokinins and gibberlins – molecular basis of action – phytochrome – role in photomorphogenesis – abscisic acid – and stress – induced promoter switches in the control of gene expression – Ethylene and fruit ripening.

UNIT-III

Media composition (MS media) - Micropropagation techniques - direct and indirect organogenesis - somoclonal variation - somatic embryogenesis - haploid and triploid - Protoplast isolation, fusion and culture - hybrid and cybrid production, Synthetic seed production. Secondary metabolite production.

UNIT- IV

Agrobacterium and crown gall tumors – Mechanism of T-DNA transfer to plants, Tiand Ri Plasmid vectors and their utility – Plant viral vectors. Symbiotic nitrogen fixation in Rhizobia, nif gene.

UNIT-V

Crop improvement, herbicide resistance, insect resistance, virus resistance, plants as bioreactors. Transgenic plants- plant vaccines, genetically modified food - future perspectives & ecological impact of transgenic plants.

Text Books

1. Slater A., Scott N.W. and Fowler, M.R. 2008. Plant Biotechnology - The genetic manipulation of plants. Oxford University press,USA.
2. Krishna G.K. A. Elangovan S.Devika 2016.Plant Biotechnology,New Vishal Publication.

References

1. Phundan Singh, 2013. Principles of Plant Biotechnology. KalyaniPublishers,India.
2. V. Kumaresan, 2015. Applied Plant Biotechnology. Saras Publication,India.

3. Singh, 2014. Plant Biotechnology, 2nd Revised Edition, Kalyani Publishers, India.
4. Nirmala 2021 Plant Biotechnology Mjp Publishers
5. Halford N , 2015, Plant Biotechnology: Current And Future Applications Of Genetically Modified Crops, John Wiley Publishers.

Web Source

[https://annamalaiuniversity.ac.in/studport/download/agri/gen/resources/GPB%20316%20PLANT%20BIOTECHNOLOGY%20\(2+1\)%20-%20Online%20Study%20Material.pdf](https://annamalaiuniversity.ac.in/studport/download/agri/gen/resources/GPB%20316%20PLANT%20BIOTECHNOLOGY%20(2+1)%20-%20Online%20Study%20Material.pdf)

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
V	23UBT5CC9	Plant Biotechnology					5	5			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓		✓	✓	✓	✓	✓	✓	
CO2	✓	✓	✓	✓	✓	✓	✓		✓	✓	
CO3	✓	✓		✓	✓	✓	✓	✓	✓	✓	
CO4	✓	✓	✓		✓	✓	✓	✓		✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 45 Relationship: Very High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-V

Course Code: 23UBT5CC10

Instruction Hours: 5

Credits: 5

ExamHours:3

InternalMarks:25

External Marks: 75

CORECOURSE-X ANIMAL BIOTECHNOLOGY

Objectives

1. Students will gain knowledge in the concepts of animal and medical biotechnology.
2. They will acquire the skill and confidence to set up an animal tissue culture laboratory.
3. They will learn the molecular techniques in diagnosis and understand the production of vaccines.

Course outcomes

1. Understand the basic concepts of Animal cell culture and cell laboratory.
2. Describe the media preparation, preservation, trypsinization, counting, maintenance and application of cell lines.
3. Discuss the strategies for gene transfer and gene expressions with their applications.
4. Be acquainted with genetic modification and stem cell technology in production of transgenic animals.
5. Learn the Assisted reproductive technology and its applications.

UNIT - I

Animal cell culture – History and development, Pluripotency, Media, balanced salt solutions, Physical, chemical and metabolic functions of constituents of culture media, Role of carbon dioxide, Serum, growth factors and amino acids in media. Serum containing and serum free media. Constitution of a media for cell line. Essential equipments required for animal cell culture.

UNIT - II

Types of cell culture- Primary, Secondary, Organ culture and cell lines. Role of feeder layers in cell culture, Cell separation techniques, cell synchronization, Cell counting methods, cryopreservation, Cell banking procedures. Biology of cultured cells- Apoptosis and cell death.

UNIT - III

Transfection of cells in culture- Animal viral vectors for transfection, Physical methods of transfection, HAT selection, selectable markers. Micro manipulation of cells, Gene targeting, gene silencing and Gene knockout and their applications.

UNIT - IV

Protein production by genetically engineered mammalian cell lines, Stem cells and their applications-; Cell culture as a source of valuable products -Transgenic Animals. Transgenic animals, Merits and demerits - Ethical issues in animal biotechnology

UNIT - V

Collection and preservation of embryos, Semen banking, AI, IVF and ICSI. Case Study-any two relevant studies.cytokines, Plasminogen activators, Blood clotting factors, Growth hormones

Text Books

1. B.Singh,SKGautam and MS Chauhan. 2013. Textbook of Animal biotechnology. The Energy and Research Institute.
2. M.K. Sateesh. 2010. Biotechnology: V: (Including Animal Cell Biotechnology, Immunology and Plant Biotechnology). 2nd Edition. New Age International.

References

1. Ashish S. Verma (Editor), Anchal Singh 2013, Animal Biotechnology: Models In Discovery and Translation 1st Edition, Kindle Edition Academic Press.
2. Renga MM.2013, Animal Biotechnology, Agrobios Publication.
3. Freshney, E.D. 2000. Animal Cell Culture: A practical approach. John Wiley Pub. New York.
4. Mather, J.P. and Barnes, D. (Eds.). 1998. Animal Cell Culture Methods (Methods in Cell Biology. Vol. 57). Academic Press, London.
5. Butler, M. (Ed.). 1990. Mammalian Cell Biotechnology - A Practical Approach. Oxford Univ. Press, Oxford.
6. Singer, M. and P. Berg. (Ed.). 1997. Exploring Genetic Mechanisms. University Science Books, Sausalito, CA, USA.
7. E.J. Murray (Ed). 1991. Gene Transfer and Expression Protocols – Methods in Molecular Biology Vol.7. Humana Press, Totowa, NJ.
8. Watson, J.D., N.H. Hopkins, T.W. Roberts, J.A. Steitz and A.M. Weiner. 1987. Molecular Biology of Gene. Benjamin Cummings, San Francisco.
9. Watson, J.D., M. Gilman, J. Witkowski and M. Zoller. 1992. Recombinant DNA. Scientific American Books, New York.

Web Source

<https://velhightech.com/wp-content/uploads/2019/04/BT-6007-Animal-Biotechnology.pdf>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
V	23UBT5CC10	Animal Biotechnology					5	5			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO2	✓	✓	✓	✓	✓	✓	✓		✓	✓	
CO3	✓	✓		✓	✓	✓	✓	✓	✓	✓	
CO4	✓	✓		✓	✓	✓	✓	✓		✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 46 Relationship: Very High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER - V

Course Code: 23UBT5CC11P

Instruction Hours: 5

Credits: 4

Exam Hours: 3

Internal Marks: 25

External Marks: 75

CORE PRACTICAL – V PLANT AND ANIMAL BIOTECHNOLOGY (P)

Objectives

1. Demonstrate the experiments of plant biotechnology.
2. Practically analyze the process of animal biotechnology.

Course outcomes

1. This course is to give hands on training on plant & animal tissue culture and biotechnology
2. Explain the basis for formulation of plant tissue culture medium for growth and differentiation of plants
3. Discuss the importance and applications of different techniques employed in tissue culture and storage of plant germplasm
4. Illustrate the preparation of mesophyll protoplasts and analyze their fusing using PEG.
5. To know Animal cell culture and different type of cell culture and application of cell culture.

Plant Biotechnology

1. Introduction to Safety Practices for plant cell culture laboratory (Theory & Demo).
2. A septic culture techniques for establishment and maintenance of cultures (Handson).
3. Plant tissue culture media preparation & sterilization techniques.
4. Callus induction
5. Isolation of plant protoplast & viability test.
6. Localization of nucleus using nuclear stain.
7. Isolation of plant DNA and plant RNA(Demo)
8. Isolation of Agrobacterium plasmid DNA (Demo)

Animal Biotechnology

1. Isolation of DNA from Animal liver
2. Isolation of DNA from human cheek cells
3. Isolation of DNA from blood
4. Preparation of Animal Tissue culture medium and membrane filtration
5. Preparation of Single Cell Suspension & Cell counting
6. Cell viability Test
7. Trypsinization of monolayer and subculturing (Demo)
8. Measurement of phagocytic activity (Demo)
9. MTT Assay (Demo)
10. Cryopreservation and thawing (Demo)

References

1. S S Purohit, 2006, A Laboratory Manual of Plant Biotechnology, Agrobios (India).
2. Chawla, 2008, Plant Biotechnology: Laboratory Manual For Plant Biotechnology Oxford & Ibh Publishing Company Pvt. Ltd.
3. Ss.Purohit 2010, A Laboratory Manual Of Plant Biotechnology, Agrobios (India).
4. Amit Gupta, 2019, Immunology And Animal Biotechnology - A Laboratory Manual , Lap Lambert Academic Publishing.

5. Sunil D Purohit & Neelu Joshi,2017, Molecular Biology & Biotechnology (A Practical Manual) Agrobios (India).

Web Source

https://www.academia.edu/21781061/Lab_in_Industrial_Plant_and_Animal_Biotechnology_Students_Manual

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
V	23UBT5CC11P	Plant and Animal Biotechnology (P)					5	4			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓		✓	✓	✓	✓	✓	
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO3	✓		✓	✓	✓	✓	✓		✓	✓	
CO4	✓	✓	✓		✓	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 46 Relationship: Very High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER - V

Course Code: 23UBT5CC12PW

Instruction Hours: 5

Credits: 4

Maximum Marks: 100

Evaluation: 80 Marks

Viva voce: 20 Marks

PROJECT WITH VIVA-VOCE

1. All UG final year students have to carry out their project in various institutes/research centers.
2. The objective of the project is to enable the students to work as Individual
3. Projects must be implemented using latest technology.

SEMESTER - V

Course Code: 23UBT5DE1 1
Instruction Hours: 4
Credits: 4

Exam Hours: 3
Internal Marks: 25
External Marks: 75

DISCIPLINE SPECIFIC ELECTIVE COURSE-I

NANO BIOTECHNOLOGY

Objectives

1. Obtain the knowledge on the basics on nanomaterials and their properties based on size.
2. Make them understand the process of synthesizing nanoparticles with different source/materials.

Course outcomes

1. The students will get an outline about Nanobiotechnology and its research in India.
2. To know about nanoparticles and their analysis using Advanced Instrumentation.
3. To get an insight about nanodevices
4. The students will know about the Applications of Nanobiotechnology.
5. The students will know about the Nano Biosensors and their applications.

UNIT - I

Glimpse of Nanotechnology based material in ancient India: Wootz steel (iron carbide) and the Delhi iron pillar (anticorrosive nanomaterial), Bhasma (nanomaterial as medicine). Contributions of Indian Research Institutes in the field of nanobiotechnology.

UNIT - II

Metals: Silver nanoparticle synthesis and its analyses by UV-spectroscopy and FTIR. Self-Assembly nanomaterial: Cell membrane and its analyses by SEM

UNIT - III

Nano-thin films: Chitosan thin film, Nanodevices (nanorobots), Nanotubes: Microtubules assembly and its importance, Nanoshells- Dendrimers: Liposomes, Nanofibers: Collagen, Fibronectin & elastin, nanofluidics: Extracellular matrix assembly and its importance.

UNIT - IV

Agriculture: Crop production- Nanofertilizers technology, Biomaterial to improve shelf life of vegetables. Medicine: Collagen thin films in wound healing mechanism, Nanoscale devices – DNA microarray for disease diagnosis, Antibodies and Targeted drug delivery system.

UNIT - V

Nanobiosensors (Firefly-luciferase) and its applications, Introduction to Biomimetics (Gecko foot effect, Lotus leaf effect: Paint and fabrics, Box fish based Car).

Text Books

- Christef M. Niemeyer, C. A. Mirkin. 2004. Nanobiotechnology: Concepts, Application and Properties. Wiley – VCH Publishers, New York.
- Tuan Vo-Dinh.2007. Nanotechnology in Biology and Medicine: Methods, Devices and Applications.

References

- Ratner M, Ratner D, “Nanotechnology: A Gentle Introduction to the next Big idea” Prentice Hall, 2005.
- H.S. Nalwa, “Encyclopedia of Nanoscience & Nanotechnology”, McGraw Hill, 2004.
- CNR Rao, “The chemistry of Nanomaterials: Synthesis, Properties & Application”, Springer 2006.
- Viola Vogel, “Nanomedicine & Nanotechnology”, John Willey & Sons Ltd, 2008.
- Goodshell, “ Nanobiotechnology”, John Willey & Sons Ltd,3rd edition, 2004.
- Ralph S. Greco, “Nanoscale Technology in Biological systems”, CRC Press, 2005.

Web Source

<https://lecturenotes.in/subject/563/introduction-to-nanotechnology>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
V	23UBT5DE1	Nanobiotechnology					4	4			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO2	✓	✓		✓	✓	✓		✓	✓	✓	
CO3	✓	✓	✓		✓	✓	✓		✓	✓	
CO4	✓	✓	✓	✓		✓	✓	✓		✓	
CO5	✓		✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 43 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER - V

Course Code: 23UBT5DE1 2

Instruction Hours: 4

Credits: 4

Exam Hours: 3

Internal Marks: 25

External Marks: 75

DISCIPLINE SPECIFIC ELECTIVE COURSE-I GOOD LABORATORY PRACTICES

Objectives

1. GLP is a quality system of management controls for research laboratories.
2. To ensure the uniformity, consistency, reliability, reproducibility, quality, and integrity of products in development for human or animal health

Course outcomes

1. The student will know the types of labs associated with Biotechnology
2. Will know to use and maintain lab Instruments
3. Will know the calculations needed in a laboratory
4. Will know about good lab Guidelines
5. Will know how to safely dispose bio waste

UNIT-I

Types of labs associated with Biotechnology (General lab, microbial culture lab, plant tissue culture lab, Fermentation lab, computational stimulation lab), Types of Chemical (Analytical grade, molecular grade) and its various arrangement (Arrangement of basic chemicals, solvent, acid and base, fine chemicals like dyes, protein and enzyme storage units), Physical chemical characteristics: hygroscopic, corrosive, volatile properties; Fire and explosion hazard data, Health hazards (how to use UV-illuminator), Fumigation technique.

UNIT-II

Methods and types of documentation (pre-lab writes, result recording and post lab report: interpretation of result), Dilution factor calculation, Molarity, percentage, dilution of concentrated solution, metric units (kg to gms and vice -versa).

UNIT-III

Principles, use and maintenance of laboratory instruments like Autoclave, hot air oven, Incubators, Water bath, Refrigerator, Centrifuge, Calorimeter, pH meter, Haemocytometer, Microtomes, Electronic balances, Biosafety cabinets. SOP preparation for instrumentation.

UNIT-IV

Good Laboratory guidelines, Elements of GLP, Standard Operating Procedures and its importance, Quality Assurance & Quality control, Internal audit basics, ISO, BIS and HACCP standards.

UNIT-V

Definition of waste, types of waste: Biological and chemical waste, methods of Safe Disposal of biological and chemical waste: treatment methods of Ethidium Bromide solutions, Electrophoresis Gels, Contaminated Gloves, debris, Wastes containing sodium azide, Silver staining solutions, Perchloric acid, Nanoparticle wastes, Spill management, Awareness and

training for personnel.

Text Books

1. WHO training manual on Good Laboratory Practices, 2nd Edition.

2. Milton A. Anderson GLP Essentials: A Concise Guide to Good Laboratory Practice, Second Edition 2nd Edition, Published by CRC press.

Web Resources

<https://www.who.int/tdr/publications/documents/glp-trainer.pdf>"tdr

<https://www.who.int/tdr/publications/documents/glp-trainer.pdf>'>publications > documents

<https://www.who.int/tdr/publications/documents/glp-trainer.pdf>"glp

<https://www.who.int/tdr/publications/documents/glp-trainer.pdf>"-trainer

www.who.int/tdr/publications/documents/glp-handbook.pdf

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
V	23UBT5DE12	Good Laboratory Practices					4	4			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO2	✓	✓		✓	✓	✓		✓	✓	✓	
CO3	✓	✓	✓		✓	✓	✓		✓	✓	
CO4	✓	✓	✓	✓		✓	✓	✓		✓	
CO5	✓		✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 43 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER - V

Course Code: 23UBT5DE2 1

Instruction Hours: 4

Credits: 4

Exam Hours: 3

Internal Marks: 25

External Marks: 75

DISCIPLINE SPECIFIC ELECTIVE COURSE-II

IPR, BIOETHICS & BIOSAFETY

Objectives

1. Obtain the knowledge on the basics on IntellectualProperty rights.
2. Outline the characterization of the concept of bioethics.

Course outcomes

1. The students learn about important concepts in Bioethics and Biosafety.
2. The students will know about Gene cloning and Bioethics.
3. The students will know about the Ethical Clearance.
4. The students will get knowledge about Patents.
5. The students will know about Biosafety and GLP.

UNIT - I

Human Rights: Definition, Classification and Scope of Human Rights. United Nations Commission for Human Rights, National and State Human Rights Commission. Article 21 of Indian Constitution – UDHR. Social issues of Human rights.

UNIT - II

Impact of gene cloning & Bioethics-Issues concerning reproduction, Birth, life and Death (Artificial insemination, egg donation, IVF, embryo transplants, Prenatal diagnosis and sex selection & Abortion).

UNIT - III

Bioethics of IPR - ethical criteria in biotechnology- animal ethics; Licensing of animal house - Human cloning - Ethical issues - Ethical clearance norms for conducting studies on human subjects.

UNIT - IV

Patents - Introduction - Treaties and Conventions of Patents, Patent Cooperation Treaty - TRIPS Basis of Patentability - Non Patentable Inventions - Patent Application Procedure in India. Other Forms of IP: Copyright - Trade Mark – Industrial designs – Farmer's Rights. Patenting of Biotechnology products and processes.

UNIT - V

Biosafety - General guidelines - DBT guidelines on biosafety in conducting research in biology / biotechnology - Risk assessment studies- Hazardous materials used in Biotechnology- Handling and Disposal - Good manufacturing practices & Good Laboratory practices, Containment facilities and Biosafety practices - Regulation on field experiments and release of GMO's - Labelling of GM foods - Guidelines for research in transgenic plants and Animals.

Text Books

1. Bioethics - by Ellen Frankel Paul, Fred D. Miller, Jeffrey Paul, Fred Dycus Miller Cambridge University Press, 2002.
2. Bioethics & Science, John A. Bryant, Linda Baggott La Velle, John F. Searle .a2002.

References

1. Jose B. Cibelli, Robert P. Lanza, Keith H. S. Campbell, Michael D. West. 2002. Principles of Cloning, Academic Press, San Diego, Gurdon.
2. Hoosetti, B.B. 2002. Glimpses of Biodiversity. Daya, New Delhi.
3. Martin. M.W. and Schinzinger.R. 2003. Ethics in engineering. 3rd Edition, Tata McGraw-Hill, New Delhi.
4. BAREACT. 2007. Indian Patent Act 1970 Acts & Rules. Universal Law Publishing Co. Pvt.Ltd.
5. Kankanala, K. C. 2007. Genetic Patent Law & Strategy. 1st Edition. Manupatra Information Solution Pvt. Ltd. Noida, India.

Web Source

https://lecturenotes.in/subject/2036/iprbiosafety-bioethics-iprb/note?utm_source=subject_links&utm_medium=web&utm_campaign=subjectpage

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits				
V	23UBT5DE21	Bioethics and Biosafety					4	4				
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO2	✓	✓		✓	✓	✓		✓	✓	✓		
CO3	✓	✓	✓	✓		✓	✓		✓	✓		
CO4	✓	✓	✓		✓	✓	✓	✓	✓	✓		
CO5	✓	✓	✓	✓		✓	✓	✓	✓	✓		
Number of Matches(✓) = 44 Relationship: High												

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER - V

Course Code: 23UBT5DE2 2

Instruction Hours: 4

Credits: 4

Exam Hours: 3

Internal Marks: 25

External Marks: 75

DISCIPLINE SPECIFIC ELECTIVE COURSE-II BIOTECHNOLOGY FOR HUMAN WELFARE

Objectives

1. Make them understand the process of ecotechnological applications
2. Obtain the knowledge on the basics on the role of biotechnology in relation to Human welfare

Course outcomes

1. This paper provides an in-depth scope and significance of various ecotechnological applications.
2. The student will gain knowledge about the role of biotechnology in relation to Human welfare.
3. The student will get an idea about the exploitation of readily available resources and issues associated with product development, which will be useful for developing entrepreneurship skills
4. To know the basic concept and issues of environmental pollution biotechnological treatment.
5. To clean up polluted environments and to create valuable resources for the human society.

UNIT - I Agricultural Biotechnology

Organic farming- Integrated farming- Vermicompost-Crop Improvement- Crop conservation

UNIT - II Food & Dairy Biotechnology

Microbes as food- feed Prebiotics, Probiotics, Algae-SCP, Beta carotene, Fungi as food - Mushroom, Fermented food products- Natural colours additives.

UNIT - III Biotechnology for disease diagnosis

Clinical diagnosis- Lab diagnosis - Microscopy, Macroscopy, Biochemical, serological & Molecular diagnosis of diseases - PCR, RT ,PCR, RAPD, RFLP, Karyotyping- DNA finger printing- Applications of DNA amplification.

UNIT - IV Biotechnology for treatment & prevention of diseases

Treatment - Symptomatic therapy, specific therapy, antimicrobials, Prevention - Active immunization, passive immunization, combined immunization, herd immunity- Chemotherapy.

UNIT - V Environmental Biotechnology

Waste management-Solid, liquid, sewage, municipal waste Bioremediation,

Bioremediation, Biodegradation.

Text Books

1. D.Balasubramanian, C.F.A.Bryce, K.Dharmalingham, J.Green and K.Jayaraman.1996. Concepts in Biotechnology. Universities Press.
2. Ashok K. Chauhan. 2009. A Textbook of Molecular Biotechnology. I.K. International Publishing house Pvt. Ltd.
3. Chandrakant Kokate, SS Jalalpure, Pramod H.J. 2011.Textbook of Pharmaceutical Biotechnology. A division of Reed Elsevier India Pvt. Ltd.

References

1. B.C. Bhattacharyya and Rintu Banerjee. 2007. Environmental Biotechnology. Oxford Higher Education Publication.
2. Krishna B Ghimire. 2000. Social change and conservation. London Earthscan Publ.
3. P.J.Delves,I, S.J.Artin,,I.D.R.Burtonand II.M.Roitt.2006. Essential Immunotechnology.12th Edition. Wiley & Blackwell.

Web Source

<https://lecturenotes.in/download/note/20305-note-for-biotechnology-b-by-arun-sharma>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits				
V	23UBT5DE22	Biotechnology for human welfare					4	4				
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓	✓		✓	✓	✓		✓	✓	✓		
CO2	✓	✓	✓	✓	✓	✓	✓		✓	✓		
CO3	✓	✓	✓		✓	✓	✓	✓	✓	✓		
CO4	✓	✓		✓	✓	✓		✓	✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Number of Matches(✓) = 44 Relationship: High												

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER - VI

Course Code: 23UBT6CC13

Instruction Hours: 6

Credits: 5

Exam Hours: 3

Internal Marks: 25

External Marks: 75

CORE COURSE - XIII ENVIRONMENTAL & INDUSTRIAL BIOTECHNOLOGY

Objectives

1. This course is planned to provide the learner an idea about Global environmental changes.
2. Biotechnological methods of handling recent environmental problems and the students to explore the beneficial potentials of microbes in the fermentation industry.

Course Outcomes:

1. Know about the environment, its issues and management of the environment.
2. Explain the process of waste water treatment, drinking water treatment and solid waste management in various industries.
3. Illustrate the significance of bioreactors in bioprocess engineering and culture methods.
4. Explain downstream processing, Fermented Products production and advanced methods.
5. Speculate the role and importance of microorganisms behind the ore leaching, production of food products and Biofertilizer.

UNIT - I

Environmental Pollution – Sources and types - Water, Air, Thermal, Industrial and Radiation - Global environmental changes. Global warming, Greenhouse effect, acid rain, ozone depletion, and photochemical smog. Environmental issues, management strategies and safety, Biotechnological approaches for management.

UNIT – II

Waste water treatment: Aerobic and anaerobic methods (Primary, Secondary and Tertiary) –Use of aquatic plants in waste water treatment. Solid waste management. Bioenergy and SCP from waste. Drinking water treatment. Biotechnological approach to industrial effluent (Paper, Tannery, Textile) Pesticide waste disposal.

UNIT - III

Bioprocess Engineering-Steps in bioprocess development. Design of bioreactors - Basic objective of fermenter design, aseptic operation & containment, body construction, agitator and sparger design, baffles, stirrer glands and bearings. Bioreactor configurations and types: Bubble column, airlift reactor, packed bed, fluidized bed, trickle bed, Membrane reactor, Photo bioreactor, Animal and plant cell bioreactors. Factors affecting broth viscosity, Mixing in Fermenter. Fermentation systems Batch culture, Continuous culture, Fed-batch culture.

UNIT - IV

Downstream processing Filtration, Centrifugation, Cell disruption, Liquid-liquid extraction, Chromatography, membrane processes, Drying, Crystallization, Whole broth processing. Different types of fermented foods produced from microorganisms- Idli, Sauerkraut - Dairy products- Cheese and Yoghurt. Microbial biomass, Microbial enzymes– Amylase & protease, Immobilization of enzymes: Methods, Properties, Applications, Advantages and Disadvantages of Immobilization, Biosensors and Biochips -Types and

applications. Microbial Polysaccharide production: Xanthan, Dextran.

UNIT - V

Bioremediation and Bio leaching-Environmental impact of pollution and measurement methods-Ore leaching (methods and examples), MEOR, Production of antibiotics – Penicillin - streptomycin. Alcoholic beverages: Wine, Beer –Biofertilizers- Rhizobium & Azotobacter. Biopesticides – *Bacillus thuringiensis* and microbial toxin production and their applications - Biosurfactants, Vitamins- Folic acid & Vitamin B12, Organic acids.

Text Books

1. Chatterji, A.K., 2002. Introduction to Environmental Biotechnology, Prentice-Hall of India, New Delhi.
2. Anil Kumar De., 2000. Environmental Chemistry, 4th Edition. New Age International, New Delhi.

Reference Books

1. Alan Scragg, 1999. Environmental Biotechnology, Pearson Education Limited, England,
2. Peter F. Stanbury, Allan Whitaker, Stephen J. Hall (2013). Principles of Fermentation Technology Second Edition, .Elsevier Science Ltd
3. Michael J. Waites, Neil L. Morgan, John S. Rockey Gary Higton (2001.), Industrial Microbiology: An Introduction. . Blackwell Science Ltd
4. Nduka Okafor, Modern Industrial Biotechnology & Microbiology ((2017, Science Publishers, Edenbridge Ltd.
5. Waites, Morgan, Rockey and Higton, Industrial Microbiology: An Introduction, Blackwell Science (2001).

Web Source

https://www.brainkart.com/subject/Environmental-Biotechnology_242/

<https://nptel.ac.in/courses/120/108/120108004/>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits				
VI	23UBT6CC13	Environmental and Industrial Biotechnology					6	5				
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO2	✓	✓		✓	✓	✓	✓	✓	✓	✓		
CO3	✓	✓	✓		✓	✓	✓	✓	✓	✓		
CO4	✓	✓	✓	✓		✓	✓	✓		✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Number of Matches(✓) = 46 Relationship: Very High												

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER - VI

Course Code: 23UBT6CC14

Instruction Hours: 6

Credits: 5

Exam Hours: 3

Internal Marks: 25

External Marks: 75

CORE COURSE - XIV PHARMACEUTICAL BIOTECHNOLOGY

Objectives

1. Students will understand the series of processes involved in drug development.
2. To patenting and drug approval.

Course outcomes

1. Discuss about the drugs, its development and Concepts involved in Pharmacokinetics & Pharmacodynamics
2. Describe the formulation and production of biotechnology products
3. Understand the different biotechnology products of the pharma industry.
4. Evaluate drug toxicity and prevention of drug abuse and management.
5. Determine the national and international drug approval agencies and pharmaceutical industries.

UNIT - I

Objectives of Pharmaceutical Biotechnology - Generic and Biogeneric drugs. Stages in the drug development process -Drug discovery - Drug designing - Drug production - Preclinical trials - Clinical trials - Pharmacokinetics and Pharmacodynamics - Patenting & Drug Approval - Drug Marketing - Post clinical trials.

UNIT - II

Production of recombinant proteins - Development of Nucleic acid based therapies - Biopharmaceutical considerations - Pharmaceutical regulations - Formulation of Biotechnology products - Drug delivery - Pharmacognosy .

UNIT - III

Human Insulin (Humulin), Growth hormones (Humatrope) - Blood coagulating factor (factor VIII - Kogenate) - Erythropoietin - (Epogen) Granulocyte colony stimulating factors (Neulasta) - Interferons (Avonex) - Antimicrobial peptides (β - defensin 2) - Vaccines (Pentavac), Biologics (Humira - Adalimumab), - Cancer based biologics (rituximab).

UNIT - IV

Drug toxicity analysis - Common side effects of drugs and managements - Drugs of abuse - Life changing complications - Prevention and management

UNIT - V

National and International Drug approval agencies - Top National and International pharmaceutical industries - Scope and career opportunities in pharmaceutical sectors.

Text Books

1. Chandrakant Kokate and Pramod H.J 1st Edition (2011), Text Book of Pharmaceutical Biotechnology, Elsevier
2. Crommelin, Dean J. A., Sindelar, Robert, Meobohm, Bernd (Eds.) (2019), Pharmaceutical Biotechnology: Fundamentals and Applications, Springer.

- Ashish Dixit, Pawan Tiwari and Vivekanand Kishan Chatap (2015), Textbook of Pharmaceutical Biotechnology, Studium Press (India) Pvt. Ltd.

Reference Books

- Gary Walsh (2003), Biopharmaceuticals ; biochemistry and Biotechnology, John Wiley & Sons Ltd.
- Oliver Kayser and Heribert Warzecha (2012), Pharmaceutical Biotechnology: Drug Discovery and Clinical Applications, Wiley - Blackwell.
- Simon Wills, 2nd Edition (2005), Drugs of abuse, Pharmaceutical Press

Web Source

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5178364/>

https://www.patentdocs.org/biotech_news/

<https://www.pharmamanufacturing.com/>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits				
VI	23UBT6CC14	Pharmaceutical Biotechnology					6	5				
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)						
	PO 1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓	✓	✓	✓		✓	✓	✓	✓	✓		
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO3	✓		✓	✓	✓	✓	✓		✓	✓		
CO4	✓	✓	✓		✓	✓	✓	✓	✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Number of Matches(✓) = 46 Relationship: Very High												

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER - VI

Course Code: 23UBT6CC15P
Instruction Hours: 6
Credits: 4

Exam Hours: 3
Internal Marks: 25
External Marks: 75

CORE PRACTICAL - VI

ENVIRONMENTAL AND INDUSTRIAL BIOTECHNOLOGY (P)

Objectives

1. Students will be able to perform microbial, water and raw milk analysis.
2. Biofertilizer production and efficiency test.

Course outcomes

1. Isolate the microorganisms and determine their growth curve, generation time.
2. Analyze the water samples, perform immobilization and compost production.
3. Develop skills in biofertilizer production and microbial identification.
4. Gain basic skills to analyze raw milk and determine the pasteurization efficacy.
5. Develop skills to perform efficiency tests of biofertilizers and biopesticides, microbial polysaccharide production.

Practical Contents

1. Isolation of Air borne Pathogens
2. Study of Growth Curve and Generation time of Bacteria/ Yeast using turbidometry.
3. Water analysis – MPN and BOD.
4. Immobilization of whole yeast cells/ enzyme by Alginate beads.
5. Production of wine
6. Production of Biogas – *In vitro* & Compost Making.
7. Biofertilizer production/Spirulina production - field visit. (Report should be included in the record)
8. Isolation and identification of starter organisms from Idli batter/ curd
9. Grading of raw milk (Dye reduction test).
10. Determination of efficiency of Pasteurization by quantitative phosphatase test.
11. Preparation and Efficiency testing of Biofertilizer/ Biopesticide. (Demo)
12. Production of microbial Polysaccharide. (Demo)

Reference Book

1. Aneja K R, *Laboratory Manual of Microbiology and Biotechnology*, MEDTECH, 2014. ISBN-13 : 978-9381714553
2. Vijaya Ramesh, (2007), *Food Microbiology*, MJP Publishers, Chennai, ISBN-13 : 978-8180940194
3. Raghuramulu, N., Madhavan Nair, K., and Kalyanasundaram, S. Ed., (1983), *A Manual of Laboratory Techniques*, National Institute of Nutrition, ICMR, Hyderabad.

Web Source

<https://www.youtube.com/watch?v=3UafRz3QeO8>

<https://www.youtube.com/watch?v=jpuNYpvBmDM> Relationship Matrix for COs, POs and PSOs

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
VI	23UBT6CC15P	Environmental And Industrial Biotechnology (P)					6	4			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓		✓	✓	✓	✓	✓	
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO3	✓		✓	✓	✓	✓	✓		✓	✓	
CO4	✓	✓	✓		✓	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 46 Relationship: Very High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER - VI

Course Code: 23UBT6DE31

Instruction Hours: 6

Credits: 4

Exam Hours: 3

Internal Marks: 25

External Marks: 75

DISCIPLINE SPECIFIC ELECTIVE COURSE-III MEDICAL BIOTECHNOLOGY

Objectives

1. Medical biotechnology is a branch of medicine that uses living cells and cell materials to research and then produce pharmaceutical and diagnosing products.
2. These products help treat and prevent diseases.

Course outcomes

1. Student will be able to obtain knowledge on Vaccines, Antibody therapy and diagnostics
2. Will know the Molecular basis of diseases
3. Will know about cytokines and interferons
4. Will learn about clinical trials
5. Will learn about ethics in clinical trials

UNIT-I

Antibodies and vaccines - Therapeutic production of antibodies, antibody mediated drug delivery of vaccines, different kind of vaccines and applications of recombinant vaccines. Diagnosis - Biochemical diagnostics, inborn errors of metabolism, haemoglobinopathies.

UNIT-II

Molecular basis of disease, Recombinant DNA Technology in medicine, gene probes as molecular diagnostic reagents. Polymerase Chain Reaction in clinical diagnostics, DNA sequencing of representative clones to detect mutations.

UNIT-III

Diagnosis of infectious diseases, Viral diseases – HIV, influenza; bacterial diseases - enteric diseases, mycobacterium diseases; immune arrays. FACs immunocytochemical staining, ELISA, FISH techniques.

UNIT-IV

Immunoblot analysis of antigens and allergens. Production of therapeutic agents – Productions and application of therapeutic agents, Production of cytokines and interferons.

UNIT-V

Principles of project management in Clinical trials and its application. Principles of research ethics; Ethical issues in clinical trials; Animal rights and use of animals in the advancement of medical technology. Use of humans in Scientific Experiments; Introduction to ethical codes and conduct.

Text Books

- 1.Roli, M. (2017). National Ethical Guidelines for Biomedical and Health Research Involving Human Participants,ISBN: 978-81-910091-94
- 2.Lela, B. and Maribeth, L. F. (2011). Molecular Diagnostics: Fundamentals, Methods and Clinical Applications, (1st Edition) . Philadelphia, USA. F A Davis Company. ISBN-13: 978-0803626775
- 3.Clinical Applications, (1st Edition) . Philadelphia, USA. F A Davis Company. ISBN-13: 978-0803626775

Reference Books

- 1.Bernard, R. G. Terry, L.D. and Cheryl, L.P. (2014). Medical Biotechnology, (2nd edition).
- 2.Patrick, R.M. Kenneth, S.R. and Michael, A.P. (2016). Medical Microbiology, (8th edition). USA. Elsevier Publishers, eBook ISBN: 9780323388504
- 3.Pamela, G. Michelle, M, (2009). Molecular Therapeutics: 21st century medicine, (1st Edition). Hoboken, New Jersey. Wiley Publishers.

Web Resources

- 1.<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2881260/>
- 2.<https://www.nature.com/articles/s41577-021-00542-x>
- 3.<https://www.ncbi.nlm.nih.gov/books/NBK26837/>
- 4.<https://www.sciencedirect.com/topics/medicine-and-dentistry/dna-sequencing>
- 5.<http://aquafind.com/articles/Elisa.php>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
VI	23UBT6DE31	Medical Biotechnology					6	4			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓		✓	✓	✓		✓	✓	✓	
CO2	✓	✓	✓		✓	✓	✓	✓	✓	✓	
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO4	✓		✓	✓	✓	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓		✓	✓	✓	✓	✓	
Number of Matches(✓) = 45 Relationship: Very High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER - IV

Course Code: 23UBT6DE32
Instruction Hours: 6
Credits: 4

Exam Hours: 3
Internal Marks: 25
External Marks: 75

DISCIPLINE SPECIFIC ELECTIVE COURSE-III MARINE BIOTECHNOLOGY

Objectives

1. To understand the basic concepts in Marine science
2. Students will gain knowledge about Marine Ecosystem and Resources.

Course outcomes

1. Will learn about bioactive compounds from Marine sources
2. Understand the basis of Marine Biotechnology.
3. Will know about Marine biotech products
4. Will learn about medicinal seaweeds.
5. Analyse various case studies.

UNIT - I

Marine Ecosystems & Its functioning, Ocean currents, Physical & chemical properties of seawater, Ecological divisions of the Sea- Euphotic-Mesopelagic- Bathopelagic- Benthos- Intertidal, Estuarine- Salt Marsh- Mangrove- Coral Reef.

UNIT - II

Marine microbial habitats- Screening for Secondary metabolites from marine microbes (Bacteria, Fungi, Actinomycetes and marine microalgae). Biofouling, Biofilm, Antifouling, Anticorrosion. Probiotic bacteria and their importance in aquaculture.

UNIT - III

Definitions- Medicinal compounds from flora (Seaweeds, Seagrass and Mangrove) and fauna (Sponges, Sea anemone and Corals)- marine toxins- antiviral and antimicrobial agents.

UNIT - IV

Culture aspect-Seaweed (*Kappaphycus alvarezii*), Fish chromosome manipulation in aquaculture- Hybridization- Gynogenesis- Androgenesis- Polyploidy, Artificial Insemination, Eyestalk ablation- Transgenesis and Cryopreservation.

UNIT - V

Agar- Agarose - Alginate- Carrageenan- Chitin- Chitosan- Heparin.

Text Books

1. Italy, E (Eds). 1998, New Developments in Marine Biotechnology, Plenum Pub. Corp.
2. Milton Fingerman and Rachakonda Nagabhushanam, 1996, Molecular Genetics of Marine Organisms, Science Pub Inc.
3. Y. Le Gal and H.O. Halvorson 1998, New Developments in Marine Biotechnology. Springer.
4. David H. Attaway, 2001. Marine Biotechnology, Volume 1, Pharmaceutical and Bioactive Natural Products.
5. Rita R. Colwell 1984. Biotechnology in the Marine Sciences (Advances in Marine Science & Biotechnology) Wiley Interscience

Reference Books

1. Scheupr, P.J. (Ed.), 1984. Chemistry of Marine Natural Products, ,Chemical and Biological Perspectives. Vol. I III, Academic Press, New York
2. Marine Biology- Lalli C.M. and T.R. Parsons., 1997. Biological Oceanography - An Introduction, Elsevier, 314 pp
3. Marine Pollution- Clark, R. B. 2001. Marine pollution, Fifth edition. Oxford University press, New York Inc., 231pp
4. Gloria Sanchez, Elizabeth Hernandez,(2019), Environmental Biotechnology and cleaner Bioprocess, (1st edition), CRC Press, ISBN 9780367455552
5. Kirchman, D.L.Gasol, J.M. (2018), Microbial ecology of the oceans, (3rd edition), Wiley – Blackwell.

Web Resources

1. <http://coe.genomics.org.cn/>
2. <http://www.bcb.iastate.edu/>
3. <http://www.nwfsc.noaa.gov/protocols/bioinformatics.html>
4. [http://www.ebi.ac.uk/ ExpASY.org/](http://www.ebi.ac.uk/ExpASY.org/)
5. <http://www.expasy.org/>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits				
IV	23UBT6DE32	MARINE BIOTECHNOLOGY					6	4				
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓	✓	✓		✓	✓	✓	✓	✓	✓		
CO2	✓		✓	✓	✓	✓	✓		✓	✓		
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO4	✓	✓		✓	✓	✓	✓		✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Number of Matches(✓) = 45 Relationship: High												

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER - VI

Course Code: 23UBT6DE41
Instruction Hours: 6
Credits: 4

Exam Hours: 3
Internal Marks: 25
External Marks: 75

DISCIPLINE SPECIFIC ELECTIVE COURSE-IV CANCER BIOLOGY

Objectives

1. Medical biotechnology branch of medicine that uses living cells and cell materials to research to produce pharmaceutical and diagnosing products.
2. These products help treat and prevent diseases.

Course outcomes

1. The students will understand the Basics of Cancer Biology.
2. The students will comprehend the Cancer at the Molecular level.
3. The students will learn about the types of Cancer.
4. The students will realize the different techniques of Detection and Treatment of Cancer.
5. The students will know about the Prevention of Cancer.

UNIT-I

Cancer: Introduction; Origin of Cancer- The Mutation Concept, The Epigenetic Concept, Viral Concept, Unified genetic concept of cancer; Difference between Normal and Cancer cells; Signs and symptoms.

UNIT-II

Cancer as a genetic disease; Genetic Alterations in Cancer cells, Point mutation, splice mutation, alternate splicing; Mutation in regulatory sequences, deletions, Insertion, Chromosome abnormalities, Genetic defects and the time course of hereditary cancer.

UNIT-III

Types of Cancer: - Blood & Lymph – Leukemia, Malignant lymphoma, Bone- Soft tissue Sarcoma, Thorax- Breast cancer, Male genitalia- Prostate cancer, Female genitalia- Cervical cancer; Tumor suppressor genes; Classification of Tumor suppressor genes.

UNIT-IV

Detection and Treatment:- Early detection, Molecular detection of Carcinomas, Cancer warning signals; Markers in blood urine; Therapies- Chemotherapy, Gene therapy, Radiotherapy, Biological therapy(Immuno therapy).

UNIT-V

Prevention:- Tobacco smoking, sunlight, diet, ionizing radiation, alcohol drugs, promiscuity, lifestyle and cancer prevention, Environmental factors and cancer, potentially carcinogenic substances for humans.

Text Books

- 1.A. Sarkar, 2011, Biology of Cancer, Discovery Publishing House, New Delhi.
- 2.Ranajit Sen,2004, Principles and Management of Cancer, B.I. Publications Pvt Ltd, New Delhi.
- 3.Dr M.R.Ahuja, 1997, Cancer- Causes and Prevention, UBS Publishers Distributors Pvt. Ltd.
- 4.A. Sarkar, 2011, Biology of Cancer, Discovery Publishing House, New Delhi.
- 5.Ranajit Sen,2004, Principles and Management of Cancer, B.I. Publications Pvt Ltd, New Delhi.

Reference Books

- 1.Francesco Pezzella, Mahvash Tavassoli, David J. Kerr, 2019, Oxford Textbook of Cancer Biology, Oxford University Press
- 2.Albert DeNittis, MD, Joel W. Goldwein, MD, and Thomas J. Dilling, MD, 2002, The Biology of Cancer.
- 3.Robin Hesketh, 2012, Introduction to Cancer Biology, Cambridge University Press
- 4.Francesco Pezzella, Mahvash Tavassoli, David J. Kerr, 2019, Oxford Textbook of Cancer Biology, Oxford University Press
- 5.Albert DeNittis, MD, Joel W. Goldwein, MD, and Thomas J. Dilling, MD, 2002, The Biology of Cancer.

Web Resources

- 1.<http://csbl.bmb.uga.edu/mirrors/JLU/DragonStar2017/download/introduction-to-cancer-biology.pdf>
- 2.<http://webserver1.oneonta.edu/faculty/bachman/cancer/207lectures.htm>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits				
VI	23UBT6DE41	CANCER BIOLOGY					6	4				
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓	✓		✓	✓	✓		✓	✓	✓		
CO2	✓	✓	✓		✓	✓	✓	✓	✓	✓		
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO4	✓		✓	✓	✓	✓	✓	✓	✓	✓		
CO5	✓	✓	✓	✓		✓	✓	✓	✓	✓		
Number of Matches(✓) = 45 Relationship: Very High												

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER - VI

Course Code: 23UBT6DE42
Instruction Hours: 6
Credits: 4

Exam Hours: 3
Internal Marks: 25
External Marks: 75

DISCIPLINE SPECIFIC ELECTIVE COURSE-IV STEM CELL BIOLOGY

Objectives

1. Analyze the importance of stem cells.
2. Implementing the guidelines of stem cell technology.

Course outcomes

1. To strengthen the knowledge of students on Stem cell basics and their applications for the benefit of mankind
2. To acquire knowledge about Embryonic Stem Cells and Adult stem cell
3. To impart knowledge about stem cell culturing and stem cell signaling
4. To know about Stem cell policy, ethics and stem cell research.
5. To acquire knowledge about Gene therapy

UNIT - I Stem Cells

Introduction: Tissue organization - Stem cells- Sources - Unique properties of stem cells classification-Embryonic stem cells adult stem cells - Prenatal stem cells-Induced pluripotent stem cells-similarities and differences between adult and embryonic stem cells - Functional characterization- Stem cell preservation methods.

UNIT- II Embryonic Stem Cells

Stem cells and their developmental potential-In vitro fertilization-culturing of embryos- Recent trends in stem cell development-Blastocyst- inner cell mass- isolation and growing ES cells in lab- Identification and characterization of human ES cells- Cloning and controlled -differentiation of human embryonic stem cells- Applications of Embryonic stem cells - Gene knock in -Gene knock out-Ethical issues.

UNIT - III Adult Stem Cells

Somatic stem cells-test for identification of adult stem cells- adult stem cell differentiation-trans differentiation plasticity- different types of adult stem cells- liver stem cells-skeletal muscle stem cells- bone marrow derived stem cells - Stem cell specific -transcription factors - Induced pluripotent cells.

UNIT - IV Cancer Stem Cell Signalling

Introduction: Tumor stem cells -Breast Cancer Stem Cells- Identification-Signalling pathways: Notch signaling - Wnt signaling in stem cells and cancer cells.

UNIT - V Stem Cells In Tissue Engineering

Introduction: Biomaterials - Cell and biomaterial interactions -Haematopoietic Stem Cells -Mesenchymal stem cells - Bone tissue engineering - Cartilage tissue engineering-Cardiovascular tissue engineering - Neural tissue engineering, Therapeutic applications.

Text Books

1. Kursad Turksen, Embryonic Stem cells - Protocols, 2nd Edition, Humana Press, 2002.
2. Stem cell and future of regenerative medicine. By committee on the Biological and Biomedical applications of Stem cell Research. National Academic press, 2002.

References

1. AriffBongso, EngHin Lee “Stem Cells: From Bench to Bedside” World Scientific Publishing Company. 2005.
2. Eapen Cherian,2011,Stem Cells, Jaypee Brothers Medical Publishers.
3. Dr. Indumathi Somasundaram, Dr. Dhanasekaran Marappagounder, Dr. Pankaj Kaingade, 2019,Stem Cell Biology. Evincepub Publishing.
4. Mary Clarke, Jonathan Frampton,2020 ,Stem Cells Biology And Application, Taylor and Francis

Web Source

<http://mcb.berkeley.edu/courses/mcb41/Stem%20Cell%20Lecture.pdf>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
VI	23UBT6DE42	Stem Cell Biology					6	4			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓		✓	✓	✓	✓	✓		✓	✓	
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO4	✓	✓	✓	✓	✓	✓	✓	✓		✓	
CO5	✓		✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 46 Relationship: Very High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High