

B.Sc. BIOTECHNOLOGY

SEM	Course Code	Part	Course	Course Title	Ins. Hrs /Week	Credit	Marks		Total		
							CIA	ESE			
I	20U1LT1/LA1/LF1/LH1/LU1	I	Language – I		6	3	25	75	100		
	20UCN1LE1	II	English - I		6	3	25	75	100		
	20UBT1CC1	III	Core – I	Essential Biodiversity	5	5	25	75	100		
	20UBT1CC2P		Core – II	Essential Biodiversity – Practical	3	2	25	75	100		
	20UBT1AC1		Allied –I	Microbiology - I: Bacteriology and Virology	5	4	25	75	100		
	20UBT1AC2P		Allied –II	Microbiology - I: Bacteriology and Virology - Practical	3	2	25	75	100		
	20UCN1AE1	IV	AEC-I	Value Education	2	2	-	100	100		
		TOTAL			30	21			700		
II	20U2LT2/LA2/LF2/LH2/LU2	I	Language – II		6	3	25	75	100		
	20UCN2LE2	II	English – II		6	3	25	75	100		
	20UBT2CC3	III	Core – III	Cytology and Cell Biology	6	5	25	75	100		
	20UBT2CC4P		Core – IV	Cytology and Cell Biology - Practical	3	2	25	75	100		
	20UBT2AC3		Allied – III	Microbiology – II: Applied Microbiology	4	3	25	75	100		
	20UBT2AC4P		Allied –IV	Microbiology – II: Applied Microbiology – Practical	3	2	25	75	100		
	20UCN2SE1	IV	Skill Enhancement Course -I @	Soft Skills Development	2	2	-	100	100		
		TOTAL			30	20			700		
III	20U3LT3/LA3/LF3/LH3/LU3	I	Language– III		6	3	25	75	100		
	20UCN3LE3	II	English – III		6	3	25	75	100		
	20UBT3CC5	III	Core– V	Genetics and Evolution	4	4	25	75	100		
	20UBT3CC6		Core– VI	Genetics and Evolution - Practical	3	2	25	75	100		
	20UBT3AC5		Allied– V	Biochemistry - I: Biomolecules	4	3	25	75	100		
	20UBT3AC6P		Allied–VI	Biochemistry – I: Biomolecules - Practical	3	2	25	75	100		
	20UBT3GE1	IV	Generic Elective – I #		2	2	-	100	100		
	20UCN3AE2		AEC-II	Environmental Studies	2	2	-	100	100		
		TOTAL			30	21			800		
IV	20U4LT4/LA4/LF4/LH4/LU4	I	Language–IV		6	3	25	75	100		
	20UCN4LE4	II	English– IV		6	3	25	75	100		
	20UBT4CC7	III	Core– VII	Molecular Biology and Recombinant DNA Technology	5	5	25	75	100		
	20UBT4CC8P		Core - VIII	Molecular Biology and Recombinant DNA Technology - Practical	3	2	25	75	100		
	20UBT4AC7		Allied– VII	Biochemistry - II: Bioenergetics and Metabolism	5	3	25	75	100		
	20UBT4AC8P		Allied–VIII	Biochemistry - II: Bioenergetics and Metabolism- Practical	3	2	25	75	100		
	20UBT4GE2	IV	Generic Elective – II #		2	2	-	100	100		
	20UCN4EA	V	Extension Activities	NCC, NSS, etc.	-	1	-	-	-		
		TOTAL			30	21			700		
V	20UBT5CC9	III	Core – IX	Plant and Animal Physiology	6	5	25	75	100		
	20UBT5CC10		Core – X	Enzymology	5	5	25	75	100		
	20UBT5CC11		Core – XI	Immunology	5	5	25	75	100		
	20UBT5CC12P		Core - XII	Plant and Animal Physiology, Enzymology, Immunology - Practical	5	5	25	75	100		
	20UBT5DE1	IV	DSE – I **		5	4	25	75	100		
	20UBT5SE2		Skill Enhancement Course -II @		2	2	-	100	100		
	20UBT5SE3		Skill Enhancement Course -III @		2	2	-	100	100		
	20UBT5EC1			Extra Credit Course - I	General Intelligence for competitive examinations	-	4*	--	100*	100*	
		TOTAL			30	28			700		
VI	20UBT6CC13	III	Core– XIII	Plant Biotechnology	5	5	25	75	100		
	20UBT6CC14		Core– XIV	Animal Biotechnology	5	5	25	75	100		
	20UBT6CC15		Core - XV	Bioinformatics and Biostatistics	5	5	25	75	100		
	20UBT6CC16P		Core - XVI	Plant Biotechnology, Animal Biotechnology and Bioinformatics and Biostatistics- Practical	5	5	25	75	100		
	20UBT6DE2	IV	DSE – II **		5	4	25	75	100		
	20UBT6DE3		DSE – III **		4	4	25	75	100		
	20UCN6AE3		AEC-III	Gender Studies	1	1	-	100	100		
	20UBT6EC2			Extra Credit Course - II	Biotechnology for competitive examinations	-	4*	--	100*	100*	
			20UBTAECA		Extra Credit Course for all	Online Course	-	1*	--	-	-
		TOTAL			30	29			700		
		GRAND TOTAL			180	140	-	-	4300		

@ Skill Enhancement Courses

SEMESTER	COURSE CODE	COURSE TITLE
V	20UBT5SE2A	Environmental Biotechnology
	20UBT5SE2B	Basics of Forensic Science
	20UBT5SE3A	Industrial Fermentations
	20UBT5SE3B	Molecular Diagnostics

**** Discipline Specific Electives**

SEMESTER	COURSE CODE	COURSE TITLE
V	20UBT5DE1A	Genomics and Proteomics
	20UBT5DE1B	Ecology and Environment Management
VI	20UBT6DE2A	Bioanalytical tools
	20UBT6DE2B	Medical Microbiology
	20UBT6DE3A	IPR, Biosafety and Bioethics
	20UBT6DE3B	Cancer and Stem Cell Biology

Generic Elective for other major department

SEMESTER	COURSE CODE	COURSE TITLE
III	20UBT3GE1	Edible Mushroom Cultivation Technology
IV	20UBT4GE2	Biofertilizer and Organic Farming

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20UBT1CC1	Core – I	ESSENTIAL BIODIVERSITY	5	5	100	25	75

Course Outcomes

At the end of the course, students will be able to:

1. Ensure imparting the knowledge on a concept of biodiversity and its advantages.
2. Describe the evolutionary relationship of microorganisms, plants and animal.
3. Demonstrate web resources in biodiversity and its conservation using modern tools.
4. Develop the conservation strategies to the beginners for improvement of natural resources.
5. Appraise the scientific attitude using modern tools for conserving biodiversity.

Unit I Biodiversity and Conservation:

15 hours

Concepts and components of Biodiversity, Genetic diversity, Species diversity, Ecosystem diversity, Biodiversity and climate change, Hot spots and biodiversity in India. Conservation of biodiversity: *In-situ* conservation and *Ex-situ* conservation. Strategies to conserve biodiversity, Organizations involved for conservation - CBD, IUCN, UNESCO, NBPGR, WWF and FAO. #JFM- Joint Forest Management and Chipko movement#.

Unit II Microbial and plant diversity:

15 hours

Microbial diversity: an overview, Whittaker's five kingdom classification. #Origin of earth, Levels of Microbial Biodiversity#, *Plant Biodiversity*: Characteristics and an outline classification of Algae (F.E. Fritsch), Fungi (Ainsworth, 1972), Bryophyta (Rothmaler, 1951), Pteridophyta (Reimer's System, 1954), Gymnosperms (Sporne, 1965), Angiosperm – Artificial & Natural system of classification.

Unit III Animal Diversity:

15 hours

Outline classification of kingdom Animalia; Study of invertebrates upto class level for protozoa, Coelenterata, Platyhelminthes, Aschelminthes, Mollusca, Annelida, and Arthropoda. General classification and characteristics of vertebrates : Fishes, amphibians, Reptiles, Aves and Mammals and #minor phyla#.

Unit IV Insect Diversity:

15 hours

Outline of classification of Insects, characters and types; Apis (Honeybee) – Bombyx (Silkworm) – Termites (White ants) – Lepidoptera (Butterfly) and Musca (House fly), Beetle (Rhinoceros), key pest of paddy. Economic importance of insects. Integrated pest management (IPM). #Bio-insecticide and repellants#.

Unit V: Modern Tools and Web Resources for Biodiversity Studies:

15 hours

Assessment of mapping of biodiversity; GIS/Remote sensing, GBIF, Catalogue of Life, OBIS, Avibase, Fishbase, Fishnet, UNEP-WCMC, ITIS, FAO, IBIS, Vertnet, ATCC, PCC, NCBI Taxonomy, AVIS, Indian Biodiversity Portal, Western Ghats Biodiversity Portal, #Biodiversity Information System#.

##Self-study portion

Text Books:

- T.B. 1. Gangulee Das and Datta. College Botany (Vol- II). New central Book Agency P. Ltd. 6th Edition, (2007).
- T.B. 2. J.D. Aber and J.M. Melillo, Terrestrial Ecosystems: W.B. Saunders, 2011.
- T.B. 3. Eugene P. Odum, Fundamentals of Ecology, Philadelphia, Saunders, 2003.
- T.B. 4. Ekambaranatha Ayyar, Outlines of Zoology. Vol – I: S. Viswanathan (Printers and Publishers) Pvt.Ltd. Chennai. 2015.

Books for Reference:

1. M. Ingrowille, Diversity and Evolution of land plants, Chapman and Hall, 2012.
2. E.L. Jordan, and P.S.Verma, Invertebrate Zoology, S. Chand and Company Ltd., New Delhi. 2010.

Web Source

1. <https://nptel.ac.in/courses/102104068/>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Paper					Hours	Credits			
I	20UBT1CC1	ESSENTIAL BIODIVERSITY					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= 44, Relationship : High											

Prepared by:

1. Dr. J. Sebastin Raj

-

Checked by:

1. Dr. T. Nargis Begum

Note:

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	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20UBT1CC2P	Core – II	ESSENTIAL BIODIVERSITY– PRACTICAL	3	2	100	20	80

Course Outcomes

At the end of the course, students will be able to:

1. Acquire basic knowledge on animal and plant organization.
2. Describe the basic knowledge of evolutionary relationship living organisms.
3. Ensure imparting the knowledge on a concept of biodiversity and its advantages.
4. Analyse the status of endangered flora and fauna.
5. Generate the knowledge through field visit of botanical garden and zoological park.

List of Practicals:

FAUNA

1. **Study of following specimens:** *Euglena, Noctiluca, Paramecium, Physalia, Metridium, Taenia, Ascaris, Nereis, Aphrodite, Leech, Peripatus, Limulus, Daphnia, Millipede, Centipede, Beetle, Chiton, Octopus.*
2. **Dissections/ Virtual demonstration:** Digestive system of Cockroach; Mouthparts, ovary of cockroach; Mosquito mouth parts; Unstained mount of Placoid scales.
3. **Study of following specimens:** *Balanoglossus, Amphioxus, Petromyzon, Pristis, Hippocampus, Salamander* any three common birds, Squirrel and Bat.
4. Study of a few endangered species of amphibians, reptiles, birds and mammals of India.
5. To study the faunal composition (insects and mites) of soil samples (Berley's funnel).
6. To study faunal composition of water samples (Lucky drop method)
7. Report on visit to National Park/Wild life sanctuary/Botanical garden.

FLORA

8. Study through specimens/photographs/slides of
 - a. Key stones species
 - b. Ecads, Ecotypes, Ecophenes
9. Study through permanent slides and specimens (vegetative and reproductive structures) of *Coleachete, Vaucheria, Polysiphonia, Rhizopus, Penicillium and Agaricus; Riccia, Anthoceros, Funaria; Selaginella, Pteris; Cycas, Pinus, Gnetum.*
10. Study of the characteristic features of any one flower for each family
 - a. Malvaceae / Fabaceae / Cruciferae / Ranunculaceae (any one family)
 - b. Compositae
 - c. Euphorbiaceae,
 - d. Poaceae / Liliaceae (any one family)

Text Books:

1. Gangulee Das and Datta. College Botany (Vol- II). New central Book Agency P. Ltd. 6th Edition, 2007.
2. J.D. Aber, and J.M. Melillo, Terrestrial Ecosystems: W.B. Saunders, 2010.
3. Eugene P. Odum, Fundamentals of Ecology, Philadelphia, Saunders, 2013.
4. EkambaranathaAyyar, Outlines of Zoology. Vol – I: S. Viswanathan (Printers and Publishers) Pvt. Ltd. Chennai. 2015.

Books for Reference:

1. P. C. Vasishta, A.K. Sinha and Anilkumar, Botany for degree students, 2015.
2. M. Ingrowille, Diversity and Evolution of land plants, Chapman and Hall, 2012.

Web Source

1. <https://nptel.ac.in/courses/102104068/>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Paper					Hours	Credits			
I	20UBT1CC2P	ESSENTIAL BIODIVERSITY– PRACTICAL					3	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= 44, Relationship : High											

Prepared by:

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Checked by:

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Note:

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Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20UBT1AC1	Allied – I	MICROBIOLOGY I – BACTERIOLOGY & VIROLOGY	5	4	100	25	75

Course Outcomes

At the end of the course, students will be able to:

1. Develop an understanding on the different aspects of Bacteria, fungi, Virus and its history.
2. Relate, identify and discriminate among Prokaryotic and Eukaryotic organisms.
3. Explain the properties, structure and cultivation of Bacteria and Virus.
4. Describe the theory behind the practical parts in this course.
5. Analyse the different aspects of viral, bacterial diseases and research findings in the areas of Bioinformatics in microbial technology.

UNIT I

15 hours

History and Classification: History of Microbiology, Concepts of Domain: Haeckel's three kingdom, #Whittaker's five kingdom#, Cavalier-Smith's six kingdom and outline of Bergey's Manual of Systematic Bacteriology. Early development of Virology, Nomenclature and Taxonomy of Eukaryotic viruses, Principles of virus taxonomy. Classification of Fungi (Alexopoulos), Microscope – Bright field, Dark field, Phase contrast.

UNIT II

15 hours

Structure and Organization: Overview of Prokaryotic & Eukaryotic cell structure - Inclusion bodies – Endospores - Cell wall – Flagella & Pili – Glycocalyx. General properties of viruses, Structure of viruses, Capsids, Viruses with capsids of complex symmetry, viral envelopes, Classification of Bacterial and Archaeal viruses; #virulent double stranded DNA phages – Lytic and Lysogenic cycle#.

UNIT III

15 hours

Cultivation of Bacteria and Virus: Macronutrients and micronutrients, nutritional types of microorganisms and growth factors. Culture media - chemical and physical types; functional types; #Isolation of pure culture#; Growth curve and Mathematics of Growth; Measurement of microbial growth – cell number and cell mass. Cultivation of viruses, Virus purification and assays.

UNIT IV

15 hours

Bacterial / Viral Detection & Antimicrobial agents: Staining techniques: Acid-Fast Staining, Capsule Staining and Flagella Staining, Antimicrobial Susceptibility Testing – Kirby-Bauer method, Etest, Multidrug-resistant organisms. Viral assay – focus forming, endpoint dilution (TCID₅₀), Tunable resistive pulse sensing, and fluorescent-antibody assay. #Antibacterial drug: penicillin and cephalosporin#. Antiviral drug: Acyclovir and Tamiflu.

UNIT V

15 hours

Disease and Treatment: Airborne diseases – Diphtheria and Mycobacterium tuberculosis; Food-borne and waterborne diseases – Typhoid Fever, Staphylococcal Food Poisoning, cholera and Botulism; Influenza (Flu), AIDS; Viroids and virusoids; Prion diseases. #Control of Microorganisms#; Bioinformatics in microbial Biotechnology.

Self Study Portion

Text Books:

- T.B. 1. M. Joanne, Willey, M. Linda, Sherwood and J. Christopher, Woolverton, Prescott, Harley, and Klein's Microbiology, 7th edition, McGraw Hill, Colin Wheatley/Janice Roerig-Blong, 2008.
- T.B. 2. Stuart Hogg, Essential Microbiology, John Wiley & Sons, Ltd, 2005.
- T.B. 3. Uma Shankar Singh and Kiran Kapoor, Microbial Biotechnology, Oxford Book Company, 2010.

UNIT I Part I Section 1.1 -1.3, Part VII Section 19.4, 19.6 – 19.7, Part VI Section 16.1, 16.7, 18.1 **T.B-1**

UNIT II Part I Chapter 3 **T.B-2** & Part VI Section 16.2 – 16.4, Section 17.1 – 17.2 **T.B-1**

UNIT III Part II Section 5.1 – 5.8 Section 6.2 – 6.3, Part VI Section 16.5, 16.6, **T.B-1**

UNIT IV Part X Chapter 34, **T.B-1** & Part V Chapter 14 **T.B-2**

UNIT V Part X Section 38.1 – 38.4, Section 37.1 – 37.6, Part II Section 7.4 – 7.6 T.B-1; Chapter 3 **T.B.3.**

Books for Reference:

1. J.M. Pelczar, E.C.S. Chan, and N.R. Krieg, Microbiology, 5th Edition Tata McGraw Hill Publishing Company, 2006.
2. R. Anantha Narayanan and C.K.J. Panikar, 6th Edition, General Microbiology, Orient Longman Pvt. Ltd., 2002.

Web Source

1. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1182391/>
2. <https://nptel.ac.in/courses/102103015/#>
3. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6428495/>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Paper					Hours	Credits			
I	20UBT1AC1	MICROBIOLOGY I – BACTERIOLOGY & VIROLOGY					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= 44, Relationship : Moderate											

Prepared by:

1. Dr. Y. ArsiaTarnam

Checked by:

1. Dr. J. Sebastin Raj

Note:

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	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20UBT1AC2P	Allied – II	MICROBIOLOGY I – BACTERIOLOGY & VIROLOGY - PRACTICAL	3	2	100	20	80

Course Outcomes

At the end of the course, students will be able to:

1. Describe the basic principles of sterilization and media preparation.
2. Differentiate organisms based on structural and biochemical properties.
3. Develop skills associated with isolating and enumerating microorganisms from various sources.
4. Apply knowledge and skills gained in this course to be useful in further research.
5. Develop an understanding on the various aspects of Bacteria and Viruses.

List of Practicals:

1. Isolation & Enumeration of Microorganism from air.
2. Isolation & Enumeration of Microorganism from water and soil.
3. Pure culture techniques - pour plate; spread plate, streak plate.
4. Staining Techniques – Gram’s staining, Negative staining, Spore’s staining
5. Motility - Hanging drop method
6. Catalase and oxidase test.
7. Biochemical characterization of microorganisms – carbohydrate utilization and IMViC tests.
8. Measurement of Growth - Spectrophotometry
9. Isolation of Bacteriophage (that infect *E. coli*) from sewage
10. Quantitation of phage in sewage sample by phage plaque assay.
11. Demonstration of mechanical transfer of viruses in plants by sap inoculation.
12. Study of virus infected plant samples.
13. Burst size determination - A one step growth curve of Bacteriophage T4

Text Books:

1. Cappuccino and Sherman. Microbiology – A Laboratory Manual. 7th Edition, Dorling Kindersley (India) Pvt. Ltd., New Delhi. 2012.
2. P. Gunasekaran, Laboratory Manual in Microbiology, New Age International (P) Ltd. Publishers, New Delhi. 2008.

Books for Reference:

1. W. Harry, J.R. Seeley, J. Paul, Van Demark and John J Lee, Microbes in Action – A Laboratory Manual of Microbiology. W.H.Freeman and Company, New York. 1997.
2. Kanika Sharma. Manual of Microbiology – Tools and Techniques. 2nd edition, Ane Books Pvt. Ltd., New Delhi. 2009.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Paper					Hours	Credits			
I	20UBT1AC2P	MICROBIOLOGY I – BACTERIOLOGY & VIROLOGY - PRACTICAL					3	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= 44, Relationship : Moderate											

Prepared by:

1. Dr. Y. ArsiaTarnam

Checked by:

1. Dr. J. Sebastin Raj

Note:

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	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
II	20UBT2CC3	Core – III	CYTOLOGY AND CELL BIOLOGY	6	5	100	25	75

Course outcomes

At the end of the course, students will be able to:

1. Gain Information literacy in basic concepts of cell biology and properties of cells.
2. Gain Knowledge in cell cycle, Cellular membranes and matrices.
3. Analyze and interpret the behavior of cells in their microenvironment in multi-cellular organisms with emphasis on cell-cell interactions,
4. Understand the chemical and molecular processes that occur inside cells.
5. Attain mastery in identifying the sub cellular organelles and describing their structure and function.

Unit I Fundamentals of cell biology: 18 hours

History and Discovery of cells, physiological properties of cells, Cell theory, Overview of Prokaryotic and Eukaryotic Cells, Plant and Animal cells, Cell cycle and its regulation; Cell division: mitosis; meiosis, #binary fission#.

Unit II Cellular membranes and matrices: 18 hours

Membrane models; chemical composition of membranes; transportation across cell membrane- active and passive transport, proton pumps associated (Na-K, Ca-calmodulin); extracellular matrices – structure and function; #cytoskeleton – structure and function#.

Unit III Cellular organelles and its function: 18 hours

structure and functions of endoplasmic reticulum – smooth & rough; golgi complex; Lysosomes; vacuoles; ribosomes, microbodies, microtubules, microfilaments; centrosome, #cilia and flagella#; Mitochondria – structure and function; chloroplast – structure and function.

Unit IV Nucleic Acids and Cell Signalling: 18 hours

Structure and function of Nucleus, Nucleolus, DNA and RNA, chromosome structure and function, special type of chromosome. Cell signaling and receptors: Signaling molecules and their receptors; intracellular signal transduction pathways, Structure, #mechanism and action of receptors#.

Unit V Tools and techniques in cell biology: 18 hours

Microtome, cytochemical staining of cells and tissues, micrometry, Microscopy - Fluorescent Microscope, Electron microscopy - Scanning Electron Microscope, Transmission Electron Microscope, Confocal Laser Scanning Microscope, Atomic Force Microscope.

##Self-study portion

Text Books:

T.B.1H. Lodish, Arnold Berk, S Lawrence Zipursky, Paul Matsudaira, David Baltimore, and James Darnell. Molecular Cell Biology, 6th edition, W.H. Freeman and Company, 2013.

T.B.2 N.Arumugam, Cell Biology, 5th edition, SARAS Publication, 2017.

T.B.3 Aruna Sarangi, Principles of Cell Biology, 5th edition, Pacific Publication, Delhi, 2010.

Unit I	Chapter IV, pg. 60-75, T.B-2.
Unit II	Chapter X, Pg. 443-445, T.B-1.
Unit III	Chapter XI-XV, Pg. 167-218, T.B-2.
Unit IV	Chapter IV, Pg. 97-120, T.B-3.
Unit V	Chapter II, Pg. 16-29, T.B-2.

Books for References:

1. T. A. Brown, Introduction to genetics: A molecular approach. 2nd Edition. Garland Science. 2016.
2. J. D. Watson Tania, A. Baker, Stephen P. Bell, Michael Levine and Richard Losick. Molecular Biology of the Gene. 7th Edition. Benjamin/Cummings Publ. Co., Inc., 2015.
3. Benjamin Lewin. Genes XI. 9th Edition. Jones & Bartlett Learning, 2011.

Web Source

1. <https://ocw.mit.edu/courses/biology/7-06-cell-biology-spring-2007/>
2. https://swayam.gov.in/nd1_noc20_me04/preview
3. <http://www.di.uq.edu.au/sparqglossary#b>
4. <https://micro.magnet.fsu.edu>
5. <https://cellbiology.med.unsw.edu.au>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code		Title of the Paper			Hours	Credits			
II	20UBT2CC3		CYTOLOGY AND CELL BIOLOGY			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= 40, Relationship : High										

Prepared by:

1. Dr.B.NazeemaBanu

Checked by:

1.Dr. J. Sebastin Raj

Note:

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	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
II	20UBT2CC4P	Core – IV	CYTOLOGY AND CELL BIOLOGY - PRACTICAL	3	2	100	20	80

Course outcomes

At the end of the course, students will be able to:

1. Explain the structure of cells using microscopy and other analytical techniques.
 2. Develop their skills in the preparation and identification of cell structures and their functions using staining techniques.
 3. Gain expertise in cytochemical methods.
 4. Identify the different stages of mitosis and meiosis
 5. Design experiments to investigate a scientific problem and present advanced knowledge in the specialized fields of cell biology.
1. Microscopy–Observation of a typical plant (onion peel, Hydrilla leaf) and animal cell(Cheek cells with a cotton swab) by Simple and compound microscope.
 2. Measurement of cells using ocular and stage micrometer
 3. Study of structure of cell: Structure observation of Prokaryotic and Eukaryotic cell.
 4. Analysis of transverse sections of stem, root and leaf for parenchyma, collenchyma, sclerenchyma cells
 5. Cell count - Experiment on Count of Erythrocytes (Red Blood Corpuscles)
 6. Experiment on Count of Leucocytes (White Blood Corpuscles)
 7. Cell Staining and Cytochemical methods-Demonstration of Cellular and sub-cellular components of plant and animal cells.
 8. Staining of fresh tissues like Squamous Epithelium/ Ciliated Epithelium
 9. Experiment on Haemin Crystals.
 10. Cell division: Study of different stages of meiosis by temporary preparation/ permanent slides of *Tradescantia* Flower bud.
 11. Cell division: Study of different stages of mitosis by temporary preparation/ permanent slides of onion root tips.
 12. Cell division: Binary fission of yeast

Text Books:

1. H. Lodish, Arnold Berk, S Lawrence Zipursky, Paul Matsudaira, David Baltimore, and James Darnell. Molecular Cell Biology, 6th edition, W.H. Freeman and Company, 2013.
2. N.Arumugam, Cell Biology, 5rd edition, SARAS Publication, 2017.

Books for Reference:

1. P.Gunasekaran. Laboratory Manual in Microbiology.2nd edition, New Age International, 2007.
2. ZsoltFazekas, Cell Biology Laboratory Manual, 8th edition, university press, 2011.

Web Source

1. <https://www.youtube.com/watch?v=wMgXsrpVrJg>
2. <https://www.youtube.com/watch?v=k1O9jBHgsxs>
3. <https://www.youtube.com/watch?v=5V52RzM84TM>
4. <https://www.youtube.com/watch?v=VJ678ceijV0>
5. <https://www.youtube.com/watch?v=1wiQsGNg0T0>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Paper					Hours	Credits			
II	20UBT2CC4P	CYTOLOGY AND CELL BIOLOGY - PRACTICAL					3	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= 40, Relationship : High											

Prepared by:

1. Dr. B. NazeemaBanu1.H.F.SyedMafiyaHaniff

Checked by:

Note:

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	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
II	20UBT2AC3	Allied – III	MICROBIOLOGY – II: APPLIED MICROBIOLOGY	4	3	100	25	75

Course Outcomes

At the end of the course, students will be able to:

1. Describe the basics of soil microbes and their role in biogeochemical cycle.
2. Discuss the domains of microbiology and their applications in various industries.
3. Evaluate methods of microbial control and apply the proper methods necessary in a given scenario.
4. Explain about the medical and practical uses of microorganisms for the production of pharmaceutical products.
5. Employ basic laboratory skills for research in microbiology using scientific methods to explore natural phenomena.

Unit I Soil Microbiology:

12 hours

Introduction to soil microorganisms – bacteria (cyanobacteria and actinobacteria), algae, fungi, protozoans, nematodes and viruses. Role of microorganisms in biogeochemical cycling - carbon cycle, nitrogen cycle and sulphur cycle. # Mycorrhiza- Role of Mycorrhizal fungi in plants#. Organic and inorganic nutrients in soil - phosphorous uptake, # nitrogen fixation#, Biofertilizers – definition, importance – types and their application methods.

Unit II Food Microbiology:

12 hours

Food as a substrate for microorganisms – microorganisms important in food microbiology: molds, yeasts and bacteria. Principles and methods of food preservation - high temperature, low temperature, drying, # irradiation and chemical preservatives#. Spoilage of fruits, vegetables, meat, poultry, fish and sea food. Microbes as foods - SCP production.

Unit III Industrial Microbiology:

12 hours

Industrial products derived from microbes: Production of yeast, ethyl alcohol, beer and vinegar. Citric acid production, lactic acid production. Production of antibiotic – penicillin and streptomycin, Vitamin production – riboflavin, # vitamin C and vitamin B12#. Role of microbes in biogas production, petroleum industry and mining.

Unit IV Clinical Microbiology:

12 Hours

Epidemiology of infectious diseases, Hospital acquired infections, Infections of various organs and systems of the human body, Rapid diagnostic techniques for microbial diseases, Vaccinology : principle, methods of preparation, administration of vaccines, Treatment and diagnostic methods of Corona virus, SARS, H1N1, Dengue, Swine Flu, Biological warfare.

Unit V Pharmaceutical microbiology:

12 hours

Probiotics and nutraceuticals – economic and legal considerations in pharmaceutical biotechnology, Vaccine design and production, classification, genetically recombinant vaccines- advantages and disadvantages. Chemical and physicochemical deterioration of pharmaceuticals, Preservation of medicines using antimicrobial agents. Types of sterile pharmaceutical products and its sterilization consideration, # quality control and quality assurance of sterile products#.

##Self study portion

Text Books:

1. Moshrafuddin Ahmed, Basumatary S.K., Applied Microbiology, MJP Publishers, 2006.
2. Lansing M Prescott, John P Harley and Donald A Klein, Microbiology, 7th Edition, McGraw Hill publishers, New York, 2007.
3. A. H. Patel, Industrial Microbiology, Lakshmi publications, New Delhi, 2005.
4. Hugo and Russells, Pharmaceutical Microbiology, edited by Stephen P. Denyer, Norman A. Hodges, Sean P. Gorman, Brendan F. Gilmore, 8th edition, Wiley-Blackwell publications, 2008.

Books for Reference:

1. David Greenwood, Richard C.B. Slack and John. F. Peutherer; Medical Microbiology, 7th Edition, Elsevier India Private Ltd., New Delhi, 2008.
2. Bernard R. Glick and Jack J. Pasternak. Molecular Biotechnology. Indian edition. Panima Publishing Corporation. 2002
3. R. Y. Stainer, J. L. Ingra Ham, M. L. Wheelis and P. R. Painter. General Microbiology. Macmillan, 1992.

Web Source

1. <https://link.springer.com/book/10.1007/0-306-46888-3>
2. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1529671/>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Paper					Hours	Credits			
II	20UBT2AC3	MICROBIOLOGY – II: APPLIED 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= 37, Relationship : High											

Prepared by:

1. Dr. S. Benazir Begum

Checked by:

1.H.F.SyedMafiyaHaniff

Note:

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	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
II	20UBT2AC4P	Allied – IV	MICROBIOLOGY – II: APPLIED MICROBIOLOGY PRACTICAL	3	2	100	20	80

Course Outcomes

At the end of the course, students will be able to:

1. Technical know-how on versatile techniques in applied microbiology.
2. Proficiency in designing and conducting experiments involving microbes.
3. Demonstrate the safe methods for isolation of bacteria, fungi and determination of their antibacterial and antifungal activity.
4. Illustrate the application of microbes in industries.
5. Apply technical skills necessary to support microbiology research study.

List of Practicals:

1. Isolation of VAM from the soil.
2. Study of Rhizobium from legume root nodules.
3. Isolation and identification of Actinomycetes.
4. Isolation and identification of bacteria and fungi from fruits and vegetables.
5. Isolation and identification of bacteria and fungi from fermented and stored foods.
6. Isolation of lactic acid bacteria from curd.
7. Detection of Bacteria in milk by
 - Methylene blue reductase test.
 - Phosphatase test.
8. Antibiotic sensitivity test: Kirby Bauer's method.
9. Antifungal tests.
10. Media formulation.
11. Wine production by yeast.
12. Extracellular activities of microorganisms – amylase, cellulase and lipase.

Text Books:

1. James G. Cappuccino and Natalie Sherman. Microbiology: A laboratory Manual. 10th Edition. Benjamin Cummings. 2013.
2. R. H. Baltz, A. L. Demain and J. E. Davies, Manual of Industrial Microbiology and Biotechnology, 3rd edition, ASM Publishers, 2010.

Book for Reference:

1. K.R. Aneja., Laboratory Manual of Microbiology & Biotechnology, 2nd edition, Scientific International Pvt. Ltd, New Delhi, 2013.

Web Source

1. <https://www.tandfonline.com/doi/full/10.1080/21553769.2015>
2. <https://microbiologyonline.org/file/7926d7789d8a2f7b207.pdf>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Paper					Hours	Credits			
II	20UBT2AC4P	MICROBIOLOGY – II: APPLIED MICROBIOLOGY -PRACTICAL					3	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= 40, Relationship : High											

Prepared by:

Checked by:

1. Dr. S. Benazir Begum
1. H.F.SyedMafiyaHaniff

Note:

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	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
III	20UBT3CC5	Core - V	GENETICS AND EVOLUTION	4	4	100	25	75

Course Outcomes

At the end of the course, students will be able to:

1. Explain the basic concept of principles of genetics and evolutionary concepts in plants, animals and microorganisms.
2. Demonstrate the linkage and crossing over in genetics studies of living organisms.
3. Develop skills associated with transposons and transposable elements.
4. Understand the Genetics and evolutionary significance
5. Understand the evolutionary concepts in living organisms.

12 hours

UNIT I Introduction to Genetics: Mendel's Law of inheritance - Mono and Dihybrid cross, Tri and Poly hybrid crosses, Incomplete dominance, Back cross, Test cross, Phenotype and Genotype; Interaction of Genes – Complementary factors, supplementary factors, inhibitory and lethal factors, #Multiple Alleles in *Drosophila*#.

12 hours

UNIT II Linkage and Crossing Over: Linkage in *Drosophila* – Morgan's experiments, theories of linkage, factors affecting linkage, Crossing over, Types, mechanisms, Cytological evidence for crossing over and significance. #Chromosome mapping and its significance#.

12 hours

UNIT III Genetics of Bacteria and virus: Overview of genetic exchange in bacteria – Conjugation, discovery, F^+ x F^- matings, Hfr conjugation, sexduction, Determining linkage from interrupted mating experiments. Transduction –Transformation - the process and competency.#Bacterial viruses – discovery, genetic fine structure#.

12 hours

UNIT IV Transposons and Transposable Elements: IS Elements- composite transposons- Tn5- Tn 9- Tn10 elements - Eukaryotes – Ac and Ds elements in maize, P elements in *Drosophila*. #Genetic and evolutionary significance of transposable elements#.

12 hours

UNIT V Evolution: Origin of the Universe, Origin of earth, Theories of Origin of Life, Urey and Miller experiment, formation of first cell. Evolution of life forms, Adaptive radiation, Biological evolution (Lamarck and Darwin's theory); Hardy-Weinberg principle, origin and evolution of man. The Geological Records –Geological time - Fossils: Lead and Carbon Method, Living fossils. #Genetic Drift – Evolutionary Significance, Fossil Record#.

Self-study portion

Text Books:

1. T.A. Brown, Genetics. A Molecular Approach, Chapman Hall, London, 2010.
2. E.J. Gardner, M.J. Simmons, and D.P. Snusted. Principles of Genetics, John Wiley and Sons, New York, 2001.
3. J.W. Saunders. Developmental Biology – Patterns and Principles, Macmillan, New York, 2005.

Books for Reference:

1. M.W. Strickberger. Genetics, Macmillan publishing Co., New York, 2008.
2. P.S. Verma and V.K. Agarwal. Genetics, S.Chand& Company Ltd, New Delhi, 2003.
3. R.F. Weaver and , P.W. Hedrick. Genetics, W.M.C. Brown Publishers, London, 2005.
4. P.Hotter. Textbook of Genetics, IVY Publishing House, New Delhi, 2002.
5. W.S. Klug, M.R. Cummings, C.A. Spencer and M.A. Palladino. Concepts of Genetics, 10th Edition, Pearson International Publishers, 2015.

Web Source

1. <https://nptel.ac.in/courses/102/104/102104052/>
2. https://swayam.gov.in/nd1_noc20_bt06/preview
3. https://swayam.gov.in/nd2_cec20_bt06/preview

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code		Title of the Paper			Hours	Credits			
III	20UBT3CC5		GENETICS AND EVOLUTION			4	4			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO53	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓		✓			✓		✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓		✓	✓	✓
CO4	✓	✓	✓	✓		✓		✓	✓	✓
CO5	✓		✓		✓	✓	✓	✓	✓	✓
Number of Matches= 41, Relationship : High										

Prepared by:

1. Dr. J. Sebastin Raj

Checked by:

1. Dr. Y. Arsia Tarnam

Note:

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	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
III	20UBT3CC6P	Core - VI	GENETICS AND EVOLUTION - PRACTICAL	3	2	100	20	80

Course Outcomes

At the end of the course, students will be able to:

1. Acquire basic knowledge through genetics using Mendel's experiments.
2. Ensure imparting the knowledge on the principles of genetics and evolutionary theories.
3. Analyze the gene transformation, Transduction, Conjugation in bacteria and viruses.
4. Generate the knowledge through model experimental flow chart and modules.
5. Describe the basic knowledge of evolutionary importance in living organisms.

List of Practicals:

I. Genetics Practical

1. Watson and Crick double helical DNA model.
2. Inheritance Patterns – Mendelian and modified Mendelian ratios
3. To prepare stained temporary mounts of human cheek cell
4. Linkage Mapping.
5. Estimation of allele frequency in natural (random mating) populations.
6. Isolation and display of polytene chromosomes.
7. Extraction of human genomic DNA from saliva
8. Estimation of DNA (Colorimetric)
9. Human Karyotypes : Normal, Down's, Klinefelters and Turner's syndrome.
10. Effect of UV light on bacteria.
11. Experiments with *lac* operon- induction and assay of *beta*-galactosidase.

II. Evolution Practical (spotters)

1. Animals of evolutionary importance: Peripatus, Limulus, Archaeopteryz.
2. Homologous organs: Forelimbs of Frog, Pigeon and Whale.
3. Analogous organs: Wings of Insects and Birds.
4. Fossils: Trilobite, Nautilus.
5. Mimicry: Leaf insects, Stick insects, Monarch and Viceroy butterfly.
6. Colouration: Chameleon, Lycodon.
7. Geological time table

Text Books:

1. T.A. Brown, Genetics. A Molecular Approach, Chapman Hall, London, 2005.
2. E.J. Gardner, M.J. Simmons, and D.P. Snusted. Principles of Genetics, John Wiley and Sons, New York, 2005.
3. J.W. Saunders. Developmental Biology – Patterns and Principles, Macmillan, New York, 2001.

Books for Reference:

1. M.W. Strickberger. Genetics, Macmillan publishing Co., New York, 2008.
2. P.S. Verma and V.K. Agarwal. Genetics, S.Chand& Company Ltd, New Delhi, 2003.
3. R.F. Weaver and , P.W. Hedrick. Genetics, W.M.C. Brown Publishers, London, 2001.
4. Weaver R.F. and Hedrick PW. Genetics, 3rd Edition, W.M.C. Brown Publishers, London, 2004.
5. P.Hotter. Textbook of Genetics, IVY Publishing House, New Delhi, 2002.
6. W.S. Klug, M.R. Cummings, C.A. Spencer and M.A. Palladino. Concepts of Genetics, 9th Edition, Pearson International Publishers, 2009.

Web Source

1. <https://nptel.ac.in/courses/102/104/102104052/>
2. https://swayam.gov.in/nd2_cec20_bt17/preview

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code		Title of the Paper			Hours	Credits			
III	20UBT3CC6P		GENETICS AND EVOLUTION-PRACTICAL			3	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= 40, Relationship : High										

Prepared by:

1. Dr. J. Sebastin Raj

-

Checked by:

1. Dr. T. Nargis Begum

Note:

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	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
III	20UBT3AC5	Allied - V	BIOCHEMISTRY-I: BIOMOLECULES	4	3	100	25	75

Course Outcomes

At the end of the course, students will be able to:

1. Understand the classification and structure of carbohydrates.
2. Ensure students gain knowledge about the structure, properties and functions of amino acids and proteins.
3. Gain the knowledge about the classification, properties and biochemical functions of lipids.
4. Enable the students to learn the basic functions, structures and biological importance of nucleic acids, vitamins and minerals.
5. On successful completion of the course the students should have understood the significance of the complex bio-molecules, polysaccharides, lipids, proteins, nucleic acids, vitamins and minerals.

12 hours

Unit I: Carbohydrates Definition and classification: Isomerism, anomeric form and mutarotation. Classification of monosaccharides - Structure, occurrence, chemistry and functions of glucose, Disaccharides - Structure, occurrence, chemistry and functions of sucrose. Homopolysaccharides - Occurrence, structure, chemistry and functions of starch and glycogen. #Heteropolysaccharides - Occurrence, types, composition and functions of peptidoglycan and agarose#.

12 hours

Unit II: Amino Acids and Proteins Amino acids: Classification of amino acids based on charge and polarity. Essential and non-essential amino acids. Stereoisomerism, zwitter-ion in aqueous solutions, physical and chemical properties, titration of amino acids, Isoelectric p_H. Peptides, Peptide bond.

Proteins: Introduction, classification based on solubility, shape, composition and function. Structure of proteins - Primary, secondary, tertiary and quaternary. Behaviour of proteins in solutions, salting in and salting out of proteins. #Denaturation and renaturation of proteins#.

12 hours

Unit III: Lipids: Definition, basic ideas about the biochemical functions of lipids. Classification of lipids with examples, classification of fatty acids, physical and chemical properties of fatty acids. Essential and non-essential fatty acids. Compound lipids: storage and membrane lipids. Structure and functions of phospholipids and glycolipids, #Steroids: Structure of steroid nucleus, cholesterol and ergosterol#.

12 hours

Unit IV: Nucleic acids: Structure of purine and pyrimidine base, structure of nucleoside and nucleotide. DNA: Watson and Crick model and forms of DNA. #Properties of DNA#. RNA- Structure and types of RNA: t-RNA, r-RNA and m-RNA.

12 hours

Unit V: Vitamins and Minerals: Vitamins - Source, structure, biological role, daily requirement and deficiency manifestation of vitamin A, B, C, D, E and K, #Minerals: Requirements, macro and micro minerals - source and functions#.

Self-study portion

Texts Books:

1. L. Lehninger. 2004. Principles of Biochemistry, 4th Edition. W.H Freeman and Company.
2. Stryer. 2002. Biochemistry. 5th Edition. W.H. Freeman and Company.
3. M.N. Chattergea Rana Shinde. 2011. Text book of Medical Biochemistry. 8th Edition. J.P. Medical Ltd.

4. J.L. Jain, Sunjay Jain, Nitin Jain. 2005. Fundamentals of Biochemistry. S. Chand and Company, New Delhi.

Books for Reference:

1. Allan Fershi, Enzyme structure and mechanism. 2nd Edition. W.H. Freeman & Co. Ltd., USA, 1984.
2. Trevor Palmer, Understanding of Enzymes. Ellis, Horwood Limited, 2010.
3. Victor W. Rodwell, David A Bender, Kathleen M. Botham, Peter J. Kennelly and Anthony P. Weli. Harper's Illustrated Biochemistry 30th Edition. Mc Graw Hill Lange Medical Books, 2015.
4. Donald Voet and Judith G. Voet, Biochemistry. 3rd Edition. John Wiley, New York, 2004

Web Source

1. <https://nptel.ac.in/courses/102/105/102105034/>
2. https://nptel.ac.in/content/storage2/courses/126104004/LectureNotes/Week-1_06-Carbohydrate.pdf

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Paper					Hours	Credits			
III	20UBT3AC5	BIOCHEMISTRY-I: BIOMOLECULES					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= 41, Relationship : High											

Prepared by:

1. Dr. T. Nargis Begum

Checked by:

1. Dr. J. Sebastin Raj

Note:

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	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
III	20UBT3AC6P	Allied –VI	BIOCHEMISTRY-I: BIOMOLECULES - PRACTICAL	3	2	100	20	80

Course Outcomes

At the end of the course, students will be able to:

1. Understand the principles, theory and calculations of each experiment.
2. Gain hands on preparation of all the solutions and to standardize solutions individually.
3. Acquire the concept of p^H meter and preparation of Buffer solution.
4. Asses the qualitative analysis of carbohydrates, amino acids and lipids.
5. Ensure students to gain practical knowledge about the chromatographic technique.

List of Practicals:

1. General guidelines and laboratory safety measure for working in Biochemistry laboratory.
2. Units of volume, weight, density and concentration measurements and their range in biological measurements.
3. Demonstration of proper use of volume and weight measurement devices.
4. Determination of pH - pH meter.
5. Preparation of buffer –titration of a strong acid and a weak base.
6. Qualitative tests for carbohydrates – distinguishing reducing from non-reducing sugars
7. Qualitative analysis of amino acids (Tryptophan, Tyrosine, Arginine, Proline and Histidine)
8. Qualitative analysis of Lipids-Solubility, acrolein test for unsaturation, LibermannBurchard test for cholesterol.
9. Paper and Thin layer Chromatography (Separation of amino acids).
10. Column chromatography.
11. Preparation of starch from potato.
12. Preparation of casein from milk.
13. Preparation of albumin from egg.

Text Books:

1. Dr. J. Jayaraman, Manuals in Biochemistry, New Age International Pub, Bangalore 2011.
2. Plummer, Practical Biochemistry, New Delhi: Tata Mcgraw Hill Publishing Company, 2000.

Books for Reference:

1. S. Sadasivam, V.A Manickam , Biochemical methods –2 ed New Age International Publishers, 2006.
2. Anil Kumar, Sarika Garg and Neha Garg , Biochemical Tests – Principles and Protocols.. \ Vinod Vasishtha Viva Books Pvt Ltd, 2012.

Web Source

1. <https://nptel.ac.in/courses/104/105/104105102/>
2. <https://nptel.ac.in/content/storage2/courses/102103047/PDF/mod1.pdf>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Paper					Hours	Credits			
III	20UBT3A6P	BIOCHEMISTRY-I: BIOMOLECULES - PRACTICAL					3	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= 42, Relationship : High											

Prepared by:

1. Dr. T. Nargis Begum

Checked by:

1. Dr. Y. Arsia Tarnam

Note:

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	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
III	20UBT3GE1	NME– I	EDIBLE MUSHROOM CULTIVATION TECHNOLOGY	2	2	100	--	100

Course Outcomes

At the end of the course, students will be able to:

1. Relate, identify and discriminate edible mushroom from poisons.
2. Develop an understanding on the different source of raw material for aseptic cultivation and mass production of mushroom.
3. Explain the medicinal and nutritional value of mushroom.
4. Describe the commercial importance of edible mushroom cultivation.
5. Describe the marketing value and research findings of mushroom cultivation technology.

UNIT I

6 hours

Introduction - History - scope of edible mushroom cultivation - Types of edible wild and poisonous mushrooms available in Tamil Nadu and India, structure and characteristics features of *Pleurotuscitrinopileatus* and *Agaricusbisporus*. #Magic mushroom and its chemical properties#.

UNIT II

6 hours

Pure culture - Preparation of medium (PDA and Oatmeal agar medium) sterilization - preparation of test tube slants to store mother culture – culturing of *Pleurotus* mycelium on petriplates, #preparation of mother spawn in saline bottle and polypropylene bag and their multiplication#.

UNIT III

6 hours

Cultivation Technology: Infrastructure: substrates (locally available) Polythene bag, vessels, Inoculation hook, inoculation loop, low cost stove, sieves, culture rack, mushroom unit (Thatched house) water sprayer, tray, small polythene bag. Mushroom bed preparation - paddy straw, sugarcane trash, marine straw and banana leaves. #Factors affecting the mushroom bed preparation - Low cost technology#.

UNIT IV

6 hours

Storage and nutrition: Short-term storage (Refrigeration - upto 24 hours) Long term Storage (canning, pickles, papads), drying, storage in salt solutions. Nutrition - Proteins - amino acids, mineral elements nutrition - Carbohydrates, Crude fibre content - #Vitamins#.

UNIT V

6 hours

Food Preparation: Types of foods prepared from mushroom; Soup, Cutlet, Omelette, Samosa, Pickles, Curry. Research Centres - National level and Regional level. Cost benefit ratio - Marketing in India and abroad, #Export Value#.

Note: Field visit nearby any Mushroom Cultivation Centre.

Self -study portion

Text Books:

1. T. Marimuthu, A.S. Krishnamoorthy, K. Sivaprakasam, and R. Jayarajan. Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore, 2001.
2. M. Swaminathan. Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore, 2005.

Books for Reference:

1. Tewari and S.C. Pankaj Kapoor. Mushroom cultivation, Mittal Publications, Delhi. 2001.
2. Nita Bahl. Hand book of Mushrooms, II Edition, Vol. I & Vol. II. 1984-1988.

Web Source

1. https://swayam.gov.in/nd2_cec19_ag03/preview
2. <https://sites.google.com/site/bscmicrobiologycbcs/microbiology-courses-in-swayam-portal>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Paper					Hours	Credits				
III	20UBT3GE1	EDIBLE MUSHROOM CULTIVATION TECHNOLOGY					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= 44, Relationship : High												

Prepared by:

1. Dr. J. Sebastin Raj

Checked by:

1. Dr. T. Nargis Begum

Note:

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	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
IV	20UBT4CC7	Core – VII	MOLECULAR BIOLOGY AND RECOMBINANT DNA TECHNOLOGY	5	5	100	25	75

Course Outcomes

At the end of the course, students will be able to:

1. Describe the mechanism of action and the use of restriction enzymes in Biotechnology research.
2. Develop the skills associated with PCR, blotting techniques and its types.
3. Develop the skills associated with plasmid preparations, DNA sequencing and how they are performed.
4. Demonstrate practical and theoretical knowledge essential for pursuing higher studies.
5. Analyse sequence data, gene expression data using Bioinformatics and to discuss the mechanisms associated with regulation of gene expression at the level of transcription and translation.

UNIT I: GENES, GENOMES & DNA

15 hours

DNA as a genetic material, coding and noncoding DNA, satellite DNA, Minisatellites and VNTRs, Selfish DNA and Junk DNA, Palindromes; supercoiling of bacterial DNA, Topoisomerases and DNA Gyrase, Histones in Eukaryotes. Structure of DNA & its functions; various classes of RNA & its functions; #protein structure and functions#.

UNIT II: DNA, RNA & PROTEIN

15 hours

DNA replication, Prokaryotes & Eukaryotes - Transcription of genes, protein synthesis, Decoding the Genetic Code and Post-Translational Modifications. Mutation – major types of mutation, Recombination & repair – homologous recombination, site specific recombination; Mismatch Repair, Excision Repair, Photoreactivation, Recombination repair, #SOS repair, double strand repair#.

UNIT III: RECOMBINANT DNA TECHNOLOGY

15 hours

Restriction Endonuclease, Restriction/Modification of DNA, Cutting & joining of DNA - DNA ligase; Properties of Cloning Vectors, Plasmid vectors, insertion & detection of genes in vector, shuttle vector, cosmid vector & YAC; TA cloning vectors, DNA library & screening; cDNA library; #chromosome walking; expression vector#.

UNIT IV: PCR & DNA SEQUENCING

15 hours

Isolation & purification of DNA, PCR – reaction & cycling, degenerate primers, Types of PCR – inverse, RT, Differential Display, RAPD, Rapid Amplification of cDNA Ends; DNA sequencing - Chain Termination Method, Automated Sequencing, Pyrosequencing and shotgun sequencing; #Blotting techniques – southern, northern, western and zoo#.

UNIT V: ANALYSIS OF SEQUENCE DATA AND GENE EXPRESSION **15 hours**

Analysis & annotation, data bank, sequence comparisons – DNA and Protein, Analyzing transcription – RNase protection assay & primer extension assay; comparing transcriptomes – differential screening & differential display; #Translational analysis – two dimensional electrophoresis & proteomics#.

Self-study portion

Text Books:

1. P. David , Clark, Molecular Biology, Academic Press, 2010.
2. A. Lizabeth, Allison, Fundamental Molecular Biology, Blackwell Publishing, 2007.
3. W. D.Jeremy and Malcom von Schantz, From Genes to Genomes: Concepts and Applications of DNA Technology, John Wiley & Sons, Ltd. 2002.

Books for Reference:

1. T.A. Brown, Gene cloning and DNA analysis: an Introduction. John Wiley & Sons. 2016.
2. S.B. Primrose, and Twyman R Principles of Gene Manipulation and Genomics. John Wiley & Sons. 2013.
3. J.W. Dale, Von Schantz M and Plant N From genes to Genomes: Concepts and Applications of DNA Technology. John Wiley & Sons. 2012.
4. V.A Saunders, Microbial Genetics Applied to Biotechnology: Principles and Techniques of Gene Transfer and Manipulation. Springer Science & Business Media. 2012.
5. D. Freifelder, Molecular Biology, 2nd Edition, Jones and Bartlett Publishers, USA. 2004.

Web Source

1. <https://geneticscertificate.stanford.edu/courses/genetic-engineering-and-biotechnology>
2. <https://genomebiology.biomedcentral.com/articles/10.1186/s13059-018-1586-y>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Paper					Hours	Credits				
IV	20UBT4CC7	MOLECULAR BIOLOGY AND RECOMBINANT DNA 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= 43, Relationship : High												

Prepared by:

1. Dr. Y. Arsia Tarnam

Checked by:

1. Dr. J. Sebastin Raj

Note:

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	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
IV	20UBT4CC8P	Core – VIII	MOLECULAR BIOLOGY AND RECOMBINANT DNA TECHNOLOGY-PRACTICAL	3	2	100	20	80

Course Outcomes

At the end of the course, students will be able to:

1. Comprehend the skills involved in isolation of genomic and plasmid DNA.
2. Develop skills associated with isolation, restriction and ligation of the isolated DNA
3. Explain the steps of a bacterial transformation.
4. Acquire skills on selection of recombinants and analysis of cloned genes by sequencing methods.
5. Understand the principles and applications of Polymerase Chain Reaction(PCR).

List of Practicals:

1. Isolation of genomic DNA from *E. coli*.
2. Isolation of plasmid DNA from *E. coli*.
3. Analysis of genomic DNA by agarose gel electrophoresis.
4. DNA extraction from agarose gel.
5. Study the effects of mutagen in Bacteria.
6. Isolation of Antibiotic Resistant bacteria.
7. Restriction digestion of DNA.
8. Ligation.
9. Transformation.
10. Selection / screening of transformants - Blue White screening.
11. Primer designing.
12. Amplification of DNA by Polymerase Chain reaction.

Text Books:

1. Joseph Sambrook, Michael R Green, Molecular cloning: A Laboratory Manual by. Cold Spring Harbor publication. 2015.
2. J. Saxena, M. Baunthiyal, I. Ravi, Laboratory Manual of Microbiology, Biochemistry and Molecular Biology, Scientific Publishers. 2012.

Books for Reference:

1. B.John, Laboratory manual for Genetic Engineering, PHI Learning publication. 2010.
2. Ashok Kumar ,Molecular Biology and Recombinant DNA Technology: A Practical Book. Narendra Publishing House. 2011.
3. K. V. Chaitanya, Cell and Molecular biology : A Lab Manual – 1st edition, 2013.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Paper					Hours	Credits			
IV	20UBT4CC8P	MOLECULAR BIOLOGY AND RECOMBINANT DNA TECHNOLOGY - PRACTICAL					3	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= 42, Relationship : High											

Prepared by:

1. Dr. Y. Arsia Tarnam

Checked by:

1. Dr. J. Sebastin Raj

Note:

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	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
IV	20UBT4AC7	Allied-VII	BIOCHEMISTRY-II: BIOENERGETICS AND METABOLISM	5	3	100	25	75

Course Outcomes

At the end of the course, students will be able to:

1. Understand the energy transformation in living system.
2. Acquire knowledge on mechanism of oxidative phosphorylation.
3. Asses the metabolism of carbohydrates.
4. Enable the students to learn about lipid metabolism.
5. Gain the adequate exposure in amino acids, nucleic acid and porphyrins metabolism.

15 hours

Unit I Bioenergetics: Free energy and entropy changes in biological system, coupling of endergonic and exergonic processes. High energy phosphate compounds-Structure and importance of ATP. Biological oxidation-Enzymes involved in oxidation and reduction-oxidases, dehydrogenases, hydroperoxidase and oxygenases. #Cytochrome P-450 monooxygenases system#.

15 hours

Unit II Mechanism of oxidative phosphorylation- Chemiosmotic theory, ATPases. Oxidative phosphorylation – uncouplers, inhibitors, ionophores. Electron transport chain. Inhibitors of ETC. #Malate and glycerophosphate shuttles#.

15 hours

Unit III Carbohydrate metabolism: Glycolysis and its energetic. gluconeogenesis, oxidation of pyruvate to acetyl CoA, TCA cycle and its energetics -anaplerotic reactions; Hexose monophosphate pathway, glycogenesis and glycogenolysis, glucuronic acid cycle; glyoxalate cycle; #metabolism of galactose and fructose#.

15 hours

Unit IV Lipid metabolism: Biosynthesis of fatty acids- biosynthesis and catabolism of triglycerides, phospholipids and glycolipids. Oxidation of fatty acids - α , β and γ oxidation; Cholesterol- synthesis and degradation. Ketogenesis; #plasma lipoproteins#.

15 hours

Unit V Amino acids, nucleic acid and porphyrins metabolism: catabolism of amino acids - Deamination, decarboxylation, transamination-Glycogenic and ketogenic amino acids, urea-biosynthesis. Metabolism of purine and pyrimidine nucleotides.#Biosynthesis and degradation of porphyrins#, Heme.

Self-study portion

Text Books:

1. D. Voet and J.G.Voet, "Biochemistry", 3rd Edition, John Wiley & Son,2004.
2. Lehninger, Principles of Biochemistry – 7th edition,Nelson& Cox, Macmillan worth Publishers, 2013.

Books for Reference:

1. Robert Harper's ,Biochemistry 29th edition, McGraw Hill, 2012.
2. Donald Voet, J.G. Voet, John Wiley,Biochemistry, 5th edition, Stryer W.H Freeman. J O H NWI VP & Publisher Kaye Pace, 2005.
3. A.I. Jain, Essentials of Biochemistry –.2nd edition, S.Chand publications, 2004.
4. Christopher B. Scott, Primer for the Exercise and Nutrition Sciences: Thermodynamics, Bioenergetics, Metabolism,. 2010.

Web Source

1. https://nptel.ac.in/content/syllabus_pdf/104105040.pdf
2. https://nptel.ac.in/content/storage2/courses/126104004/LectureNotes/Week-1_06-Carbohydrate.pdf

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Paper					Hours	Credits				
IV	20UBT4AC7	BIOCHEMISTRY-II: BIOENERGETICS AND METABOLISM					5	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= 41, Relationship : High												

Prepared by:

1. Dr. T. Nargis Begum

Checked by:

1. Dr. Y. ArsiaTarnam

Note:

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	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
IV	20UBT4AC8P	Allied– VIII	BIOCHEMISTRY-II: BIOENERGETICS AND METABOLISM - PRACTICAL	3	2	100	20	80

Course Outcomes

At the end of the course, students will be able to:

1. To acquire the knowledge about the estimation of Carbohydrates.
2. To enable the students to understand the basic principle and estimation of proteins.
3. To evaluate the saponification number, Acid number and Iodine value of an edible oil.
4. To assess the content of various biomolecules in food substances
5. Ensure students to gain practical knowledge about the activity of Antioxidant enzymes in our body.

List of Practicals:

1. Estimation of reducing sugar by DNS method.
2. Estimation of protein by Lowry's method in food samples.
3. Estimation of amino acid by Ninhydrin method.
4. Estimation of ascorbic acid by titrimetric method using 2,6 - dichlorophenol indophenol.
5. Estimation of fat content in food samples (wheat, rice flour, gram flour and milk)
6. Estimation of DNA by Diphenylamine method.
7. Estimation of RNA by Orcinol method.
8. Estimation of Urea by DAM-TSC method.
9. Estimation of acid number of Edible oil.
10. Determination of saponification number of edible oil.
11. Estimation of Iodine value of oil.
12. Determination of specific activity, substrate concentration , pH and temperature of antioxidant enzymes.

Text Books:

1. Dr. J. Jayaraman, Manuals in Biochemistry , New Age International Pub, Bangalore, 2011.
2. Plummer, Practical Biochemistry, New Delhi: Tata Mcgraw Hill Publishing Company, 2000.

Books for Reference:

1. S.Sadasivam, V.A Manickam , Biochemical methods –2 ed New Age International Publishers, 2006.
2. Anil Kumar, Sarika Garg and Neha Garg , Biochemical Tests – Principles and Protocols.. Vinod Vasishtha Viva Books Pvt Ltd, 2012.

Web Source

1. <https://nptel.ac.in/content/storage2/courses/102103044/module1/lec1/1.htm>
2. <https://nptel.ac.in/content/storage2/courses/102103047/PDF/mod1.pdf>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Paper					Hours	Credits			
IV	20UBT4AC8P	BIOCHEMISTRY-II: BIOENERGETICS AND METABOLISM-PRACTICAL					3	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= 40, Relationship : High											

Prepared by:

1. Dr. T. Nargis Begum

Checked by:

1. Dr. J. Sebastin Raj

Note:

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	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
IV	20UBT4GE2	Non Major Elective-II	BIOFERTILIZER AND ORGANIC FARMING	2	2	100	-	100

Course Outcomes

At the end of the course, students will be able to:

1. Acquire knowledge on the properties of soil and soil pollution.
2. Gaining the knowledge of different types of biofertilizer.
3. To understand organic farming and kinds integrated Pest Management.
4. Describing the manure and waste management.
5. To find out animal based organic manure production and its importance.

UNIT I

6 hours

Soil – Physical and chemical properties. Soil fertility- essential nutrients- function, deficiency and toxicities. Concept and methods of soil fertility evaluation. #Route causes of pollution#.

UNIT II

6 hours

Bio fertilizers - classification, nitrogen fixers-*Rhizobium*, *Azotobacter*, *Cyanobacteria*, *Azolla*, *Frankia*, *Azospirillum* and *Vasicular Mycorrhizae*.

UNIT III

6 hours

Organic farming-definition, basic concept of organic farming, integrated plant nutrient supply management, integrated insect pest management- sustainable agricultural practice, crop rotation, crop diversification, mixed cropping, #biological nitrogen fixation#.

UNIT IV

6 hours

Management of organic waste and green manure- Farm manures, composts, Mulches, Tillage and control. Organic manures-organic residue, chemical nature of organic manure, #green manure and its importance#.

UNIT V

6 hours

Animal based organic manure-cow dung, poultry waste, Production of vermicompost and #PanchakavyaProduction# and commercialization of Organic products – conversion period, Inspection and certification (National and International Level).

Note: Field visit nearby any organic farming.

Self-study portion

Text Books:

1. A.K.Sharma, Biofertilizers for sustainable agriculture, Agrobios. (2003).
2. Aravind Kumar, Verms and Vermitechnology, APH Publishing Corporation, New Delhi, (2005).

Books for References:

1. G.K.Veeresh, Organic Farming, Foundation Pvt.Ltd., (2006).

Web Source

1. <http://ec.europa.eu/agriculture/organic/organic-farming/what-organic-en>.
2. <http://attra.ncat.org/organic.html#list>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Paper					Hours	Credits			
IV	20UBT4GE2	BIOFERTILIZER AND ORGANIC FARMING					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= 37, Relationship : High											

Prepared by:

1.H.F.Seyed Mafiya Haniff

Checked by

1. Dr. J.Sebastin Raj

Note:

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

B.Sc. BIOTECHNOLOGY

SEM	COURSE CODE	PART	COURSE	COURSE TITLE	INS. HRS /WEEK	CREDIT	MARKS		TOTAL
							CIA	ESE	
I	20U1LT1/LA1/LF1/LH1/LU1	I	Language – I		6	3	25	75	100
	20UCN1LE1	II	English - I		6	3	25	75	100
	20UBT1CC1	III	Core – I	Essential Biodiversity	5	5	25	75	100
	20UBT1CC2P		Core – II	Essential Biodiversity – Practical	3	2	20	80	100
	20UBT1AC1		Allied –I	Microbiology I - Bacteriology and Virology	5	4	25	75	100
	20UBT1AC2P		Allied –II	Microbiology I - Bacteriology and Virology - Practical	3	2	20	80	100
	20UCN1AE1	IV	AEC-I	Value Education	2	2	100	-	100
TOTAL					30	21			700
II	20U2LT2/LA2/LF2/LH2/LU2	I	Language – II		6	3	25	75	100
	20UCN2LE2	II	English – II		6	3	25	75	100
	20UBT2CC3	III	Core – III	Cytology and Cell Biology	6	5	25	75	100
	20UBT2CC4P		Core – IV	Cytology and Cell Biology - Practical	3	2	20	80	100
	20UBT2AC3		Allied – III	Microbiology II - Applied Microbiology	4	3	25	75	100
	20UBT2AC4P		Allied –IV	Microbiology II - Applied Microbiology – Practical	3	2	20	80	100
	20UCN2SE1	IV	Skill Enhancement Course - I @	Soft Skills Development	2	2	100	-	100
TOTAL					30	20			700
III	20U3LT3/LA3/LF3/LH3/LU3	I	Language– III		6	3	25	75	100
	20UCN3LE3	II	English – III		6	3	25	75	100
	20UBT3CC5	III	Core– V	Genetics and Evolution	4	4	25	75	100
	20UBT3CC6P		Core– VI	Genetics and Evolution - Practical	3	2	20	80	100
	20UBT3AC5		Allied– V	Biochemistry I - Biomolecules	4	3	25	75	100
	20UBT3AC6P		Allied–VI	Biochemistry I - Biomolecules - Practical	3	2	20	80	100
	20UBT3GE1	IV	Generic Elective – I #		2	2	-	100	100
	20UCN3AE2		AEC-II	Environmental Studies	2	2	100	-	100
TOTAL					30	21			800
IV	20U4LT4/LA4/LF4/LH4/LU4	I	Language–IV		6	3	25	75	100
	20UCN4LE4	II	English– IV		6	3	25	75	100
	20UBT4CC7	III	Core– VII	Molecular Biology and Recombinant DNA Technology	5	5	25	75	100
	20UBT4CC8P		Core - VIII	Molecular Biology and Recombinant DNA Technology - Practical	3	2	20	80	100
	20UBT4AC7		Allied– VII	Biochemistry II - Bioenergetics and Metabolism	5	3	25	75	100
	20UBT4AC8P		Allied–VIII	Biochemistry II - Bioenergetics and Metabolism-Practical	3	2	20	80	100
	20UBT4GE2	IV	Generic Elective – II #		2	2	-	100	100
20UCN4EA	V	Extension Activities	NCC, NSS, etc.	-	1	-	-	-	
TOTAL					30	21			700
V	20UBT5CC9	III	Core – IX	Plant and Animal Physiology	6	5	25	75	100
	20UBT5CC10		Core – X	Enzymology	5	5	25	75	100
	20UBT5CC11		Core – XI	Immunology	5	5	25	75	100
	20UBT5CC12P		Core - XII	Plant and Animal Physiology, Enzymology, Immunology - Practical	5	5	20	80	100
	20UBT5DE1 A/B	IV	DSE – I **		5	4	25	75	100
	20UBT5SE2 A/B		Skill Enhancement Course - II @		2	2	-	100	100
	20UBT5SE3 A/B		Skill Enhancement Course - III @		2	2	-	100	100
	20UBT5EC1		Extra Credit Course - I	General Intelligence for competitive examinations	-	4*	--	100*	100*
TOTAL					30	28			700
VI	20UBT6CC13	III	Core– XIII	Plant Biotechnology	5	5	25	75	100
	20UBT6CC14		Core– XIV	Animal Biotechnology	5	5	25	75	100
	20UBT6CC15		Core - XV	Bioinformatics and Biostatistics	5	5	25	75	100
	20UBT6CC16P		Core - XVI	Plant Biotechnology, Animal Biotechnology and Bioinformatics and Biostatistics - Practical	5	5	20	80	100
	20UBT6DE2 A/B		DSE – II **		5	4	25	75	100
	20UBT6DE3 A/B		DSE – III **		4	4	25	75	100
	20UCN6AE3	IV	AEC-III	Gender Studies	1	1	100	-	100
	20UBT6EC2		Extra Credit Course - II	Biotechnology for competitive examinations	-	4*	--	100*	100*
20UBTAECA		Extra Credit Course for all	Online Course	-	1*	--	-	-	
TOTAL					30	29			700
GRAND TOTAL					180	140			4300

* Not Considered for Grant Total and CGP

GENERIC ELECTIVE FOR OTHER MAJOR DEPARTMENT

SEMESTER	COURSE CODE	COURSE TITLE
III	20UBT3GE1	Edible Mushroom Cultivation Technology
IV	20UBT4GE2	Biofertilizer and Organic Farming

@ SKILL ENHANCEMENT COURSES

SEMESTER	COURSE CODE	COURSE TITLE
V	20UBT5SE2A	Environmental Biotechnology
	20UBT5SE2B	Basics of Forensic Science
	20UBT5SE3A	Industrial Fermentations
	20UBT5SE3B	Molecular Diagnostics

**** DISCIPLINE SPECIFIC ELECTIVES**

SEMESTER	COURSE CODE	COURSE TITLE
V	20UBT5DE1A	Genomics and Proteomics
	20UBT5DE1B	Ecology and Environment Management
VI	20UBT6DE2A	Bioanalytical tools
	20UBT6DE2B	Medical Microbiology
	20UBT6DE3A	IPR, Biosafety and Bioethics
	20UBT6DE3B	Cancer and Stem Cell Biology

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
V	20UBT5CC9	Core – IX	PLANT AND ANIMAL PHYSIOLOGY	6	5	100	25	75

Course Outcomes

At the end of the course, students will be able to:

1. Ensure students to understand the metabolic activities of plants.
2. Describe the role of enzymes in various metabolic activities of plants.
3. Relate the integration of the cardiovascular and respiratory systems and their overall control.
4. Comprehend the functions of different organs involved in human digestive and excretory system.
5. Understand the reproductive cycles with hormonal control.

Unit I:

18 Hours

Plant - Water relationship: Structure, properties and significance of water - osmotic and non-osmotic uptake of water. Ascent of sap-cohesion theory: root pressure, transpiration, physiology of stomatal action, Translocation of solutes and assimilates. Role of hormones in flowering, senescence and abscission- Photoperiodism, #Vernalization and seed dormancy#.

Unit II:

18 Hours

Photosynthesis: Absorption spectrum, Action spectrum, Role of pigments, enhancement effect, Photosystems I & II, Photophosphorylation, Carbon Assimilation: Calvin cycle, Hatch & Slack pathway, CAM pathway. Photorespiration. Respiration: Aerobic and anaerobic. Glycolysis, #Kreb's Cycle and oxidative phosphorylation#, Energetics of respiration.

UNIT III:

18 Hours

Circulatory and Respiratory system: Human Circulatory system - Structure and functions, Circulatory organs, circulation, Hemoglobin, Components and functions of blood. Respiratory system- Structure, types and functions; Respiratory organs, Mechanism of Respiration, CO₂ and O₂ transport, #Regulation of respiration#.

UNIT IV:

18 Hours

Digestive and Excretory system: Human Digestive system - Organization, Digestive glands and enzymes, Absorption of Nutrients. Excretory system - Excretory organs and products, Mechanism of Urine and Urea formation, # Kidney stones #.

UNIT V:

18 Hours

Nervous and Reproductive system: Human Nervous Coordination: Central and peripheral nervous systems, structure and functions of neurons and brain, Conduction of Nerve impulse. Reproduction - Male and Female Reproductive systems, Fertilization, Estrus and Menstrual cycles, # Pregnancy and Parturition #.

##Self study portion

Texts Books:

1. F.B. Salisbury and C.W. Ross, Plant Physiology. CBS Publishers and Printers, New Delhi, 1999.
2. E. Roger and D. Randall., Animal Physiology, CBS Publishers and Distributors Pvt Ltd, India, 2005.
3. A. Mariakuttikan and N. Arumugam., Animal Physiology, Saras Publication, Nagercoil, India. 2011.

Books for Reference:

1. V.K. Jain, Fundamentals of Plant Physiology. S. Chand & Co., New Delhi, 1990.
2. S.N. Pandey, Plant Physiology. Vikas Publishing House (P) Ltd., New Delhi, 1991.
3. S.C. Rastogi, Essentials of Animal Physiology. New Age International Publishers., 2001.

Web Source

1. <https://nptel.ac.in/content/storage2/courses/102103044/Physiology/lec1/1.html>
2. <https://nptel.ac.in/content/storage2/courses/102103047/PDF/mod1.pdf>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code		Title of the Paper			Hours	Credits				
V	20UBT5CC9		PLANT AND ANIMAL PHYSIOLOGY			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= 37, Relationship : High											

Prepared by:

Dr. S. Benazir Begum

Checked by:

Dr. J. Sebastin Raj

Note:

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	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
V	20UBT5CC10	Core- X	ENZYMولوجY	5	5	100	25	75

Course outcomes

At the end of the course, students will be able to:

1. Understand the basic concepts of enzymes and coenzymes.
2. Acquire the knowledge on enzyme actions.
3. Study the mechanism of enzyme kinetics.
4. Ensure the basic knowledge on characterization of enzymes.
5. Appraise the significance of enzymes.

UNIT I

15 Hours

Enzymes

Nomenclature, classification, chemical nature and UNITs of enzyme activity. Structure, properties and functions of coenzymes-NAD, FAD, CoA. Metallo enzymes and metal activated enzymes. Isoenzymes of lactate dehydrogenase. Multienzyme complex-pyruvate dehydrogenase complex and fatty acid synthase complex enzyme. # Non protein enzymes-Ribozymes and abzymes#.

UNIT II

15 Hours

Mechanism of Enzyme Action

Active site, models of enzyme-substrate complex formation- Lock and Key model, induced fit model and Substrate strain model. Mechanism of enzyme catalysis: Acid-Base catalysis covalent catalysis, Substrate strain and Entropy effect. # Enzyme specificity-group specificity and optical specificity #. Mechanism of action of chymotrypsin and lysozyme.

UNIT III

15 Hours

Enzyme Kinetics

Theories of enzyme kinetics- Derivation and significance of Michaelis-Menton equation. Transformation of MM equation - Line weaver-Burk plot, the Eadie-Hofstee plot and the Hanes Woolf plot. Factors influencing enzyme activity. # Enzyme inhibition- types of inhibition - Competitive, Noncompetitive, Uncompetitive,# Feedback and Allosteric inhibition .

UNIT IV

15 Hours

Characterization of Enzymes

Identification of sources of enzymes, methods of isolation of enzymes- use of hydrolytic enzymes, homogenization by homogenizer, use of hypotonic solutions, ultrasonic vibrations. Methods of purification- methods depending on size or mass, methods depending upon charge, methods based on changes in solubility and methods based on specific binding sites. # Criteria of purity of enzymes. Preservation of purified enzymes#.

UNIT V

15 Hours

Applications of enzymes

Immobilization of enzymes-methods and applications. Diagnostic importance of enzymes: Diagnosis of plasma functional and Non-functional enzymes. Serum enzymes in the diagnosis of diseases. Enzymes in diagnosis of myocardial infarction, liver diseases, muscle diseases and cancers. # Industrial applications of enzymes. Biosensors and Biochips#.

##Self study portion

Text Books:

1. RenukaHarikrishnan, Introduction to Biomolecules Enzymes, ,Indraji Pub,1995.
2. Croom Helm, Understanding Enzymes-Fourth Edition, Trevor Palmer, New Delhi: Prentice Hall of India Foster, Nature of Enzymology, 1979.
3. Nicholas.C. Price, Fundamentals of Enzymology, Oxford University Press1989.

Books for Reference:

1. Samuel Devlin Sarup, Enzymes, 2005.
2. Stryer, Biochemistry – 4th Edition, 1995.
3. J.L. Jain, Sanjay Jain and Nitin Jain, Fundamentals of Biochemistry. (6th ed.). New Delhi: S. Chand& company Ltd. 1997.

Web Source

1. https://onlinecourses.swayam2.ac.in/cec21_bt20/preview
2. <https://nptel.ac.in/courses/102/102/102102033/>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code		Title of the Paper			Hours	Credits			
V	20UBT5CC10		ENZYMOLGY			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= 41 Relationship : High										

Prepared by:

1. Dr.T.Nargis Begum

Checked by:

1. Dr. J. Sebastin Raj

Note:

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	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
V	20UBT5CC11	Core – XI	IMMUNOLOGY	5	5	100	25	75

Course Outcomes

At the end of the course, students will be able to:

1. Describe the function of the major components and mechanism of the immune system to protect the body from the pathogens.
2. Familiar with the immunologic responses involved in preventing, combating infections and the concepts of nonspecific and specific immunity.
3. Resourceful in the structure, function and characteristics of immunoglobulins.
4. Intellectual literacy in the common immune diseases in terms of the underlying basic principles and preventive measures.
5. Familiar in the modern techniques that aids human protection.

UNIT I:

15 Hours

Overview of the Immune system: Historical perspectives in development of immunology, Immune system - innate and adaptive immunity and, Haematopoiesis, Cells of the immune system - lymphoid cells (T and B lymphocytes, NK cells), Macrophages, Granulocytes, #Organs of the immune system - Primary and secondary lymphoid organs#.

UNIT II:

15 Hours

Antigens and Antibodies: Antigens - Properties and Classes, Epitopes, Haptens, Adjuvants. Antibodies - structure, biological functions and different classes. #Organization and expression of immunoglobulin genes#.

UNIT III:

15 Hours

Immune response and activation of B cell, T cell and Complement: B cell - Activation, proliferation and humoral response, T cell - Activation, differentiation and Cell mediated response, # Cytokines #, Complement - Functions and activation pathways.

UNIT IV:

15 Hours

Antigen Presentation, Hypersensitivity and Immune response to infectious diseases: Major Histocompatibility complex - class I and class II, T cell receptors, Processing and Presentation pathways - Cytosolic and Endocytic, Hypersensitive reactions - types, HLA antigens #Immune response to viral(HIV), bacterial(Tuberculosis) and protozoan(Malaria) infections#.

UNIT V:

15 Hours

Antigen - Antibody interactions and Vaccines: Precipitation and Agglutination reactions, Blood grouping, ELISA, RIA, Western blotting and FACS, Autoimmune Disorders, Vaccines - active and passive, purified, recombinant, subunit and DNA vaccines #COVID Vaccines (Covaxin and Covishield)#.

Self - study portion.

Text Book:

1. R. A. Goldsby, T. J. Kindt, B. A. Osborne, J. Kuby. Immunology, 5th Edition, W.H. Freeman and Company, New York, 2003.
2. A. K. Abbas, A. H. Lichtman, S. Pillai. Cellular and Molecular Immunology, 7th Edition, Elsevier Health Sciences., 2011
3. P. M. Latha. A Text Book of Immunology, 1st Edition, S.Chand & Company Ltd, New Delhi, 2003.

Books for Reference:

1. I. Roitt. Essential Immunology, 10th Edition. Blackwell Scientific Publication, 2002.
2. M. R. Pandian and B. S. Kumar. Immunology and Immunotechnology, Panima Publishing corporation, New Delhi, 2007.
3. D. M. Weir and J. Stewart. Immunology, 10th Edition. Churchill Livingstone, New York, 2000.

Web Source:

1. <https://www.immunology.org/public-information/what-is-immunology>
2. <https://en.wikipedia.org/wiki/Immunology>
3. <https://www.nature.com/subjects/immunology>
4. <https://www.immunology.org/public-information/bitesized-immunology>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Paper					Hours	Credits				
V	20UBT5CC11	IMMUNOLOGY					5	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= 40, Relationship : High												

Prepared by:

Mrs.H. F.SeyedMafiyaHaniff

Checked by:

Dr. S. Benazir Begum

Note:

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	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External Marks
V	20UBT5CC12P	Core – XII	PLANT AND ANIMAL PHYSIOLOGY, ENZYMOLOGY, IMMUNOLOGY - PRACTICAL	5	5	100	20	80

Course Outcomes

At the end of the course, students will be able to:

1. Gain fundamental knowledge of animal physiology.
2. Execute the roles of a biology teacher or medical lab technicians with training as they have basic fundamentals.
3. Discuss the basic knowledge of enzymes, its components and their functional properties.
4. Exposure of wide applications of enzymes and their future potential.
5. Develop their skills in the understanding of immunological reactions.

Plant and Animal Physiology

1. Diffusion, imbibition and osmosis; concept & components of Water potential.
2. Absorption and transport of water.
3. Transpiration – structure and opening and closing mechanism of stomata.
4. O₂ consumption in aquatic animal (fish).
5. Identification of Nitrogenous waste products.

Enzymology

1. Extraction and estimation of enzymes (peroxidase and catalases) from either plant or microbial source.
2. Determination of effect of pH on the activity of enzyme.
3. Determination of effect of temperature on the activity of enzyme.
4. Determination of effect of substrate concentration on the activity of enzyme.

Immunology

1. Blood Grouping.
2. Total Leukocytes Count using Hemocytometer.
3. Ouchterlony double diffusion.
4. Immunoelectrophoresis.
5. Demonstration on ELISA and FACs.

Text Books:

1. S. C Rastogi. Essentials of Animal Physiology. Wiley Eastern Limited. New Delhi.1979.
2. A. K Berry., A Text book of Animal Physiology. Emkay Publications.1st Edition, 1998.
3. F.C Steward.: Plants at Work (A summary of Plant Physiology) Addison- Wesley Publishing Co., Inc. Reading, Massachusetts, Palo alto, London. 1964
4. R.M.Devlin.: Plant Physiology, Holt, Rinehart & Winston & Affiliated East West Press (P) Ltd., New Delhi.1969 .

Books for Reference:

- 1.R. A. Goldsby, T. J. Kindt, B. A. Osborne, J. Kuby. Immunology, 5th Edition. W.H.Freeman and Company, 2003.
2. Hans Bisswanger, Practical Enzymology, Second Edition, Wiley-VCH Verlag GmbH & Co.2012.

Web Source:

1. <https://www.kau.edu.sa/Files/0016333/Subjects/Enzymology%20BIOC231.pdf>.

2. <https://www.youtube.com/watch?v=-jKzLLHjRfs>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Paper	Hours	Credits						
V	20UBT5CC12P	PLANT AND ANIMAL PHYSIOLOGY, ENZYMOLGY, IMMUNOLOGY - PRACTICAL	5	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= 38, Relationship : High										

Prepared by:
Mrs.H.F.SyedMafiyaHaniff

Checked by:
Dr.S. Benazir Begum

Note:

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	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
V	20UBT5DE1A	DSE – I	GENOMICS AND PROTEOMICS	5	4	100	25	75

Course Outcomes

At the end of the course, students will be able to:

1. Identify the concepts and techniques applied in genomics, transcriptomics and proteomics.
2. Gain the knowledge of fundamentals of genomics and proteomics.
3. Analyse the biological techniques of genomic and proteomic
4. Ability to discuss the key technological developments that enabled modern genomic and proteomic studies.
5. Determine the category of experimental design for solving theoretical problems.

Unit I: Introductory genomics:

15 Hours

Introduction to Genomics, Anatomy of prokaryotic and eukaryotic genome, content of genome, Cvalue paradox, CoT curve analysis, repetitive DNA, tools to study. #genome diversity (PCR/RFLP)#.

Unit II: Human Genome Databases:

15 Hours

Online Mendelian Inheritance in Men (OMIM), Genome Data Bank, Vertebrate Genome Databases. Plant Genome Databases, TIGR Plant Genomics, AGI-TAIR, Insect Genome Databases: Drosophila, Flybase, #Fungus Genome Database: Yeast SGD, YPD#.

Unit III: Applied Genomics:

15 Hours

Strategies for major genome sequencing projects, approaches and assembly methods, NGS methods and advantages, gene analysis and annotation., RNA content and profiling, genetic mapping, #Microarray (cDNA and protein microarray)#.

Unit IV: Introductory proteomics:

15 Hours

Importance of proteomics, strategies in analysis of proteome: 2-D PAGE, Mass spectrometry, Protein sequencing method (Edman degradation, MALDI TOF/TOF). Structure of protein and formation of oligomers, #Protein solubility and interaction with solvents and solutes, activity of proteins #.

Unit V: Applied proteomics:

15 Hours

Databases and search engines in proteomics, Post translational protein modifications, protein localization Protein: protein interaction: phage display, GST pull down, affinity based methods, Disease related proteins and drug discovery, Disease diagnosis,# identification and characterization of novel proteins, protein engineering principles#.

##Self –study portion

Text Books:

1. M. Schena. DNA microarrays: A practical Approach Edited by, Oxford University press, Oxford. 1999.
2. C. Cantor and C.L Smith, Wiley. Genomics: The Science and technology behind the human genome project Edited -Interscience. NewYork. 2000.
3. R.M. Twyman, Principles of proteomics. Bios Scientific Publishers, New York, 2004.

Books for Reference:

1. J.M. Davis Genome Analysis- A practical Approach by Oxford University press, Oxford. 1995.
2. P.H. Dea, Genome mapping a practical Approach by, Oxford University.1997.
3. C.L Smith, Wiley. Genomics the science and technology behind the human genome project Edited by -Interscience. NewYork.2000.

Web Source

1. <http://www.di.uq.edu.au/sparqglossary#b>
2. <https://genomic.magnet.fsu.edu>
3. [https://genomic and proteomic.med.unsw.edu.au](https://genomic.and.proteomic.med.unsw.edu.au)

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Paper					Hours	Credits				
V	20UBT5DE1A	GENOMICS AND PROTEOMICS					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= 37, Relationship : High												

Prepared by:
Dr.K.Gobalan

Checked by:
Dr. S. Benazir Begum

Note:

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	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
V	20UBT5DE1B	DSE-I	ECOLOGY AND ENVIRONMENT MANAGEMENT	5	4	100	25	75

Course Outcomes

At the end of the course, students will be able to:

1. Ensure imparting the knowledge on ecology and ecological dynamics.
2. Acquire basic Knowledge on the effect of environmental pollution.
3. Understand the principles and operation of waste water treatment using microbes and plants.
4. Systematically understand the collection, transportation and Management of hazardous wastes.
5. Describe the principles of various Environmental Acts and regulations.

UNIT I:

15 Hours

Importance and Scope of ecology: Concept of ecosystem, concept of energy, food chain and food web, ecological pyramids, Biogeochemical cycles: Carbon, Nitrogen, Phosphorus and sulphur cycle, #Geographical classification and biomes#.

UNIT II:

15 Hours

Environmental pollution and Conservation strategy: Causes of pollution, classification of environmental pollution (Air, Water, Soil and noise pollution), Environmental problems-Global warming, depletion of Ozone layer, #Acid rain formation and its effect #. Principles of conservation and major approaches to management.

UNIT III:

15 Hours

Effluent treatment systems: Sewage and waste water treatments systems; Primary, secondary and tertiary treatments; Biological treatments - aerobic versus anaerobic treatments. Biofilms in treatment of waste water. Phytoremediation. #Development of new biocatalysts to be applied in waste water biotechnology#.

UNIT IV:

15 Hours

Management of Hazardous waste: Physicochemical characteristics and treatment strategies for effluent generated by Distillery and fermentation industry; pesticide manufacturing industries and textile industries. Recycling of waste, Environmental pollution control- Bio plastics and Bio pesticides, #Eco labelling and carbon trading#.

UNIT V:

15 Hours

Concept of environmental management: Sustainable development, conservation of culture Heritage, Concept of Environmental Impact Assessment (EIA), Methods of assessment of environmental quality, Impacts of genetically engineered microbes, plants and animals, #Environmental Acts and regulations for prevention of pollution#.

Self study portion

Texts Books:

1. A.L.Bhatia., Text book of Environmental Biology, I K International Publishing, 2010.
2. D.K. Asthana., and A. Meera Asthana. Textbook of Environmental Studies. S. Chand Publication, New Delhi, 2014.
3. R. Primack., Essentials of Conservation Biology. Sinauer Associates, Inc., USA, 2014.

Books for Reference:

1. G.Singh, Environmental law in India, Macmillan India Ltd, New Delhi, 2005.
2. M.C. Dash and S.P. Dash. Fundamentals of Ecology, Mcgraw Hill, 2009
3. E. Anne., A. Magurran. Biological Diversity Frontiers in Measurement and Assessment. Oxford University Press, 2010.
4. D.K. Choudharay., Waste Management and Bioremediation. Oxford Book Company, 2012.

Web Source

1. https://www.ugc.ac.in/pdfnews/9294493_LOCF-Environmental-Science.pdf
2. https://onlinecourses.nptel.ac.in/noc19_ce32/preview
3. <http://www.bdu.ac.in/academics/syllabi/2016/Science/Pg/MSc-Enivronmental-Science-updated-on-17-10-2018.pdf>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code		Title of the Paper			Hours	Credits			
V	20UBT5DE1B		ECOLOGY AND ENVIRONMENT MANAGEMENT			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= 37, Relationship : High										

Prepared by:

Dr. S. Benazir Begum

Checked by:

Dr. J. Sebastin Raj

Note:

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	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
V	20UBT5SE2A	SEC-II	ENVIRONMENTAL BIOTECHNOLOGY	2	2	100	--	100

Course Outcomes

At the end of the course, students will be able to:

1. Acquire basic knowledge of fundamental concepts of environmental Biotechnology.
2. Identify the importance of environmental biotechnology involved in treatment of pollutants and resource recovery.
3. Ability to understanding biodegradation and bioremediation process.
4. Gain the knowledge about microbial treatment of waste water.
5. Determine the category of microbial life in extreme environmental microorganism.

Unit I

06 Hours

Basic Concepts and Issues:Types of pollution methods for measurement of pollution, methodology of environmental management- the problem solving approach and its limitations. Global environmental problems Ozone depletion, climate change, #Green house effect# , Acid rain, global warming, sea level raising, El Nino Southern Oscillation.

Unit II

06 Hours

Pollution: Primary, secondary and tertiary methods for water pollution treatment. Waste water treatment of some industries: Waste water treatment for tannery, dairies, distillery, textile, pulp, #paper and medical waste treatment, e-waste#.

Unit III

06 Hours

Biodegradation: Biodegradation and xenobiotics in environment: Ecological considerations, decay behavior and degradative plasmids, hydrocarbons, substituted hydrocarbons, oil pollution, surfactants. Biodegradation of plastics, # Biosensors#.

Unit IV

06 Hours

Phytoremediation: Process of phytoremediation - Rhizofiltration, Phytostabilization, phytodegradation, phytovolatilization, phytoaccumulation, phytochelation, biotransformation, Cellular and subcellular compartmentalization. Phytoremediation of heavy metals from soil, Phytoremediation of heavy metal from water, #phytoremediation of soil polluted with herbicides and pesticides#.

Unit V

06 Hours

Bioleaching: Leaching of ores by microorganisms (gold, copper and uranium). Environmental significance of genetically modified (GM) microbes, plants and animals. #Waste disposal and management, legislation of environmental problems# . Microbial association in environment.

##Self –study portion

Text Books:

- 1.A.K. Chatterji. Environmental Biotechnology, Prentice Hall of India Pvt. Ltd., 2007.
- 2.K. Pradipta.Environmental Microbiology, I.K International Publishing House Pvt. Ltd., 2008.
- 3.V. Kumaresan.A Text Book of Biotechnology, Saras Publication., 2009.

Books for Reference:

- 1.J. Olguin and Taylor and Francis. Environmental Biotechnology and Bioprocesses, 2000.
2. A.K. Chatterji, Introduction to Environmental Biotechnology, Prentice-Hall of India. 2002.
3. P. Conningham and Mary Ann Conningham. Principle Environmental Science, Tata McGraw-Hill publishing Company. 2003.
4. K.V. Agarwall, Environmental Biotechnology, Nidhi Publishers., 2005.

Web Source

1. <https://www.environmentalbiotechnology.ca/course/15958/environmental/-distance>
2. <https://biotechnology.mit.edu/>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific outcomes:

Semester	Code	Title of the Paper					Hours	Credits			
V	20UBT5SE2A	ENVIRONMENTAL BIOTECHNOLOGY					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= 42, Relationship : High											

Prepared by:

Dr.K.Gobalan

-

Checked by:

Dr. Y. Arsia Tarnam

Note:

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	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External Marks
V	20UBT5SE2B	SEC- II	BASICS OF FORENSIC SCIENCE	2	2	100	-	100

Course Outcomes

At the end of the course, students will be able to:

1. Discuss about the working and functioning of Forensic science laboratories.
2. Learn the crime science its role in criminal investigation and Prevention of crime.
3. Describe how the Principles of Forensic science used to solve criminal cases.
4. Execute reports on different cases. Will learn the importance of various evidences and how they used to solve the criminal cases.
5. Apply the Laboratory skills to participate in the career needs of Forensic community and work with different R&D organizations.

Unit I:

6 Hours

Crime Scenario in India: Introduction to crime, Laboratory organization of Forensic lab, Forensic science laboratory in India and globe. Types of crime and its causes – property crimes, public order crimes, violent crimes, #cyber-crimes#, Carrier opportunity in Forensic Science.

Unit II:

6 Hours

Forensic Examination of Body and Semen Fluids: Molecular mechanisms for identification of the evidences from the criminal.

Unit III:

6 Hours

Forensic Examination of Hair, nail and Tissue: Molecular mechanisms for identification of the evidences from the criminal.

Unit IV:

6 Hours

Personal Identification: Personal identification techniques as somatoscopy, somatometry, #osteometry and craniometry their importance in determination of age and sex. #Role of insects in Forensic Science#

Unit V:

6 Hours

Techniques and Applications: New and future technologies - # DNA chips #- SNPs and limitations of DNA profiling. Application of forensic science in various fields.

Text Books:

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

Books for Reference:

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

Web Source:

1. https://en.wikipedia.org/wiki/Forensic_science

2. <https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/forensic-sciences>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code		Title of the Paper			Hours	Credits			
V	20UBT5SE2B		BASICS OF FORENSIC SCIENCE			2	2			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	✓	✓		✓	✓		✓	✓		✓
CO2	✓			✓	✓		✓	✓	✓	✓
CO3	✓		✓	✓	✓		✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓			✓	✓	✓	✓	✓	✓
Number of Matches= 40, Relationship : High										

Prepared by:
Mrs. H.F.SeyedMafiyaHaniff

Checked by:
Dr.S. Benazir Begum

Note:

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	Code	Course	Title of the Course	Hours	Credits	Max. Marks	Internal marks	External marks
V	20UBT5SE3A	SEC - III	INDUSTRIAL FERMENTATIONS	2	2	100	-	100

Course Outcomes

At the end of the course, students will be able to:

1. Comprehend the microbial exploitation in bioconversion technology.
2. Understand the use of microorganism for industrial purposes and food production.
3. Describe the microbial synthesis of primary metabolites.
4. Explain about microbial synthesis of secondary metabolites.
5. Demonstrate the downstream process and enzyme production.

UNIT I:

6 Hours

Introduction and Microbiology of Fermentation: Fermentation Microbiology - Historical Perspectives, Microbial biomass, Microbial enzymes and metabolites, Growth cycle, Diauxic growth, cultivation of microbes, Current advances and innovations in fermentation industry.

UNIT II:

6 Hours

Fermentation kinetics and Bioreactors: Kinetic models - Unstructured, Compartment, Single-cell, Molecular mechanistic models. Bioreactors - Batch operation, Continuous operation, Fed - batch culture, Oxygen transfer, Different types of bioreactors, Aeration and Agitation systems, Selection of the reactor, #Reactors in Industry#.

UNIT III:

6 Hours

Microbial synthesis of Primary metabolites: Technical Processes, Control of Primary metabolism - Induction, Catabolite repression, Source regulation - Nitrogen, Phosphorus and Sulfur, Feedback regulation, Products - Organic acids, Amino acids, Polysaccharides, Vitamins, #Alcohols and solvents#.

UNIT IV:

6 Hours

Microbial synthesis of Secondary metabolites and Strain Improvement: Process of Secondary metabolite production, Nutrient limitation. Strain Improvement - Media formulation. Antibiotics and Secondary metabolites - Penicillins, Cephalosporins, Aminoglycosides and Tetracyclines.

UNIT V:

6 Hours

Downstream Processing and Enzyme Production: Product Recovery and Purification - Microbial cell removal, Foam Separation, Precipitation, Filtration, Centrifugation, Cell disruption, Chromatography, Ultrafiltration, Crystallization. Challenges during Fermentation. Enzymes - sources, surface and submerged cultures, Industrial enzymes - Proteases, Amylases, Pectinases, Cellulases, β -galactosidase, Challenges in Fermentation process.

Self-study portion

Text Books:

1. P.F. Stanbury, A. Whitaker, S.J. Hall., Principles of Fermentation Technology, 2nd Edition, Aditya Books (P) Ltd, New Delhi, 1997.
2. P. Prave, U. Faust, W. Sittig, D.A. Sukatsch., Fundamentals of Biotechnology, Panama Publishing Corporation, Bangalore, 2005.
3. U. Sathyanarayana, Biotechnology, Books and allied P. Ltd., Kolkata, 2005.

Books for References:

1. A.N. Glazer, H. Nikaldo, Microbial Biotechnology, W H Freeman and company

Network, 1995.

2. M.C. Flickinger, S.W. Drew., Encyclopedia of Bioprocess Technology, John Wiley & Sons, 1999.

3. A.L. Demain, & J.E. Davis. Industrial Microbiology & Biotechnology, ASM Press, 2004.

Web Source

1. <https://nptel.ac.in/courses/102/105/102105058/>

2. <https://www.classcentral.com/course/swayam-industrial-biotechnology-14122>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code		Title of the Paper			Hours		Credits		
V	20UBT5SE3A		INDUSTRIAL FERMENTATIONS			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= 44, Relationship : High										

Prepared by:

Dr. J. Sebastin Raj

Checked by:

Dr. S. Benazir Begum

Note:

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	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
V	20UBT5SE3B	SEC -III	MOLECULAR DIAGNOSTICS	2	2	100	--	100

Course Outcomes

At the end of the course, students will be able to:

1. Ensure students to understand the clinical applications of molecular diagnostic in patients with infectious disease.
2. Compare and contrast structure and functions of DNA and RNA.
3. Understand the concept of chromosome banding pattern and cytogenetic analysis of various chromosomal disorders.
4. Develop the skills associated with PCR based amplification techniques and its types
5. Demonstrate practical and theoretical knowledge of DNA sequencing and Blotting techniques.

UNIT I: Introduction to Molecular Diagnostics:

6 Hours

History of diagnostics, Age of molecular diagnostics, Significance, Scope, Rise of diagnostic industry in Indian and global scenario. Traditional methods for identification of metabolic errors.

UNIT II: Chromosomes, Human disorders, and Cytogenetic analysis

6 Hours

Chromosome organization; Chromosome banding and nomenclature; Structural and Numerical aberrations and its consequences. Sex determination and Y chromosome- function and diseases. Genomic Imprinting and disorders. #FISH, CGH #, Flow Cytometry techniques and clinical diagnostics.

UNIT III: PCR based amplification techniques

6 Hours

PCR Principle, procedure, types and applications. cDNA synthesis and cloning, DNA primers, linkers, adapters, cDNA library construction and screening. #Personalised Medicine- Pharmacogenomics (ADMET)#

UNIT IV: Omics in Diagnostics

6 Hours

Role of transcriptomic, proteomic and metabolomic profiles as diagnostic markers. DNA finger printing, chromosome walking and chromosome jumping. #SCAR (Sequence characterized amplified region) #.

UNIT V: Hybridization techniques and DNA sequencing methods

6 Hours

Southern, Northern and Western Blot, in-situ (including FISH), Microarrays – types and applications; Automated DNA sequencing- Principles, Methods and Instrumentation- Advances in DNA sequencing- New Generation sequencing Methods. Pyrosequencing,

Self study portion

Text Books:

1. P. David., Clark, Molecular Biology, Academic Press, 2010.
2. A. Lizabeth., S. Allison., Fundamental Molecular Biology, Blackwell Publishing, 2007.
3. W. D. Jeremy, and V. S. Malcom, From Genes to Genomes: Concepts and Applications of DNA Technology, John Wiley & Sons, Ltd. 2002.

Books for Reference:

1. T.A. Brown, Gene cloning and DNA analysis: an Introduction. John Wiley & Sons. 2016.
2. S.B. Primrose, and R.Twyman, Principles of Gene Manipulation and Genomics. John Wiley & Sons. 2013.
3. J.W. Dale, M. Von Schantz and N. Plant, From genes to Genomes: Concepts and Applications of DNA Technology. John Wiley & Sons. 2012.
4. V.A. Saunders, , Microbial Genetics Applied to Biotechnology: Principles and Techniques of Gene Transfer and Manipulation. Springer Science & Business Media. 2012.
5. Freifelder, D., Molecular Biology, 2nd Edition, Jones and Bartlett Publishers, USA. 2004.

Web References

1. https://nptel.ac.in/content/syllabus_pdf/104105040.pdf
2. https://nptel.ac.in/content/storage2/courses/126104004/LectureNotes/Week-1_molecular_diagnostics.pdf

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Paper					Hours	Credits			
V	20UBT5SE3B	MOLECULAR DIAGNOSTICS					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= 36, Relationship : High											

Prepared by:

Dr. S. Benazir Begum

Checked by:

Dr. K. Gobalan

Note:

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	Code	Course	Title of the Course	Hours	Credits	Max. Marks	Internal marks	External marks
VI	20UBT6CC13	Core – XIII	PLANT BIOTECHNOLOGY	5	5	100	25	75

Course Outcomes

At the end of the course, students will be able to:

1. Describe the basic principles and techniques involved in plant tissue culture Laboratory.
2. Develop the skills associated with conservation and the importance of cell culture techniques in plant tissue culture research.
3. Demonstrate industry appropriate applications of plant biotechnology in agricultural field.
4. Develop the gene transformation techniques in modern agricultural practices and beneficiaries in genetically modified foods.
5. Analyse the achievements in modern agriculture industry.

UNIT I

15 Hours

Introduction: History of plant tissue culture – lab facility and operation – aseptic techniques – nutritional requirements and Murashige and Skoog medium preparation– Plant Growth Regulators - Types of cultures – Solid – Liquid, Germplasm conservation and Cryopreservation – cold storage, low pressure and low oxygen storage, Application of germplasm storage, Limitation of germplasm storage, #Green house and green home technology#.

UNIT II

15 Hours

Direct and Indirect organogenesis: Micropropagation – Shoot tip, Node, Axillary bud culture, Rapid production of plantlets with suitable hormone supplemented medium – meristem culture for virus elimination - #hardening and mist chambers – techniques for maintaining plantlets in the field# – Callus induction –somatic embryogenesis and artificial seed production – production and exploitation of haploids and triploid – embryo rescue – protoplast culture, Somaclonal variations, somatic hybridization and cybridization.

UNIT III

15 Hours

Genetic Engineering of Plants: Gene transfer methods; vector mediated gene transfer - Agrobacterium mediated DNA transfer- Ti plasmid - Technique of hairy root disease – Ri plasmid. Direct or vectorless DNA transfer - Physical and chemical methods of gene transfer – #DNA imbibition by cells/tissues#.

UNIT IV

15 hours

Transgenic plants: Insect (pest) resistance – Herbicide resistance – Plant disease resistance – Plant pathogen interaction, genetic engineering for extended shelf life of fruits – Genetic engineering for prevention of discoloration –flower pigmentation – male sterility. Transgenic plants with improved nutrients – Golden rice – #increase vitamins and minerals# - Application and Limitation of genetically modified plants- Ethical Concerns in Plant Biotechnological Research. Status of Transgenic Plant in the Globe.

UNIT V

15 hours

Molecular Marker aided Plant Breeding: Molecular markers – basic principles of molecular marker detection - markers based on DNA hybridization, RFLP, PCR amplification, #RAPD, AFLP#, molecular marker assisted selection.

Self-study portion

Text Books:

1. Kalyankumar De. An Introduction to Plant Tissue Culture Techniques. New Central Book Agency, Kolkata. 2007.
2. U. Sathyanarayana, Biotechnology, Books and allied P. Ltd., Kolkata, 2005.
3. Adrian Slater, Nigel W. Scott and Mark R. Fowler., Plant Biotechnology (The genetic manipulation of plants). Oxford University press, UK. 2003.

Books for Reference:

1. Donald Grierson and S.V. Convey.. Plant Molecular Biology. Blackie and Son Limited. New York, 2010.
2. M.J. Chrispeels and D.F. Sadava. Plants, genes and agriculture, The American Scientific Publishers, USA. 2010.
3. S.H. Mantell, and H. Smith. Plant Biotechnology by. Cambridge University press, UK. 2001.
4. Mathews and Mickee. An introduction to genetic engineering in plants, Blackwell Scientific Publishers. London. 2015.
5. R.J. Henry. Practical Application of Plant Molecular Biology. Chapman and Hall. 2013.

Web Source

1. <https://nptel.ac.in/courses/102/103/102103016/>
2. <https://nptel.ac.in/courses/102/103/102103013/>
3. https://www.ripublication.com/ijbbr_spl/ijbbrv4n3spl_06.pdf

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code		Title of the Paper			Hours	Credits			
VI	20UBT6CC13		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= 44, Relationship : High										

Prepared by:

Dr. J. Sebastin Raj

Checked by:

Dr. S. Benazir Begum

Note:

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	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
VI	20UBT6CC14	Core– XIV	ANIMAL BIOTECHNOLOGY	5	5	100	25	75

Course outcomes

At the end of the course, students will be able to:

1. Understand the basic techniques in animal cell culture and organ culture.
2. Acquire the knowledge on genetic engineering in animals.
3. Analyse the production of transgenic animal and its significance.
4. Develop an understanding on embryo technology and animal breeding.
5. Appraise the significance of sericulture and aquaculture.

UNIT I

15 Hours

Basic techniques in animal cell culture and organ culture: Cell lines- types and isolation, Culture media-types and supplements, Cell fusion, Cell differentiation, Equipment's and materials for animal cell culture technology. Laboratory design and practice. Aseptic Technique for cell cultures- Identification and characterization of contaminations. #Maintenance and preservation of cell lines- Cryopreservation#.

UNIT II

15 Hours

Genetic engineering in animals: Methods of DNA transfer into animal cells- calcium phosphate coprecipitation, micro-injection, electroporation, Liposome encapsulation, Biological vectors - Plasmid, λ -phage, shuttle vectors, Expression vector, Bacterial artificial chromosome and# Yeast artificial chromosomal vector#. Hybridoma technology, Vaccine production.

UNIT III

15 Hours

Transgenics: Transgenic animal production and application; transgenic animals as models for human disease; transgenic animals in livestock improvement; transgenic in industry; chimera production; xenografting; # ethical issues in animal biotechnology #. DNA based diagnostics.

UNIT IV

15 Hours

Embryo Technology and Animal Breeding: *In vitro* fertilization, Embryo transfer, ICSI, Embryo splitting, Fertility control and regulation, test tube babies. Animal cell cloning, #Transgenic animals-sheep, goat, Mice, fish#.

UNIT V

15 Hours

Sericulture and Aquaculture: Types of silk, Stages of Production, life cycle of silkworm and Biotechnological applications in sericulture. Aquaculture, principles, methods and culturable species, Freshwater and marine Aquaculture, Aquaculture nutrition- live and supplementary nutrition, Value added fishery products, #Genetic modifications in aquaculture#.

Text Books:

1. John and Masters, R.W., "Animal Cell Culture - Practical Approach", 3rd Edition. Oxford University Press. (2000).

2.Pillay, T.V.R. and Kutty, M.N., “Aquaculture; principles and practices” Blackwell publication Pvt. Ltd., (2005).

Books for Reference:

1. Holland, A.J., Johnson, A. Animal Biotechnology and Ethics. Springer.(1998).
2. Ian Freshney, R., “Culture of Animal Cells – A manual of Basic techniques”. Wiley Publication Pvt. Ltd., (2005).
3. Mehta, V., Animal Biotechnology. Campus Books International, New Delhi,India.(2006).
4. Yadav, P.R. and Rajiv Tyagi., “Biotechnology of Animal Tissue”, Discovery Publishing House, New Delhi. (2008).
5. Ramadass. P., Animal Biotechnology: Recent Concepts and Developments.MJP Publishers, India. (2008).

Web References

1. <https://nptel.ac.in/content/storage2/courses/102103045/download/mod6.pdf>
2. <https://nptel.ac.in/courses/102/104/102104059/>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code		Title of the Paper			Hours	Credits			
VI	20UBT6CC14		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= 40 Relationship : High										

Prepared by:
Dr. T. Nargis Begum

Checked by:
Dr. J. Sebastin Raj

Note:

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	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
VI	20UBT6CC15	Core -XV	BIOINFORMATICS AND BIOSTATISTICS	5	5	100	25	75

Course Outcomes

At the end of the course, students will be able to:

1. Generate knowledge scope and history of Bioinformatics.
2. Gain the knowledge of biological databases and information.
3. Understand the biological information retrieval methods for DNA sequence.
4. Design programs with interactive input and output program C.
5. Determine the category of measures of central tendency, dispersion and correlation for analysis of data.

Unit I

15 Hours

Structural Biology: Introduction to Bioinformatics scope and history, factors determining primary – secondary- tertiary and quaternary structure of proteins - protein information resources- biological databases, primary sequence databases, secondary database. #Composite protein sequence database#.

Unit II

15 Hours

Databases Management System: Introduction to databases - Types of databases. Flat file database - Relational databases - Object oriented databases - Database software- Overview of Sequence Retrieval System – Oracle - MySQL. Database design. #visualization of databases and software#.

Unit III

15 Hours

Biological Sequence analysis: Retrieval sequence from NCBI Dynamics programming – FASTA, and BLAST. Multiple sequence alignments -Phylogenetic alignment. Protein structure visualization tools - RasMol, Swiss PDB Viewer Protein identification programs- Mascot. Protein interaction. #Molecular docking - AutoDock#.

Unit IV

15 Hours

ProgrammingIn C & Perl: C-language-Introduction - variables- input output statements- control statements- function- arrays- pointers- structures- unions- file handling and case studies. Introduction to PERL- variables- strings and numbers- lists conditional loops- strings- pattern matching- #applying PERL to bioinformatics#.

Unit V

15 Hours

Biostatistics: Measures of central Tendency - mean arithmetic's- harmonic and geometric median and mode - measures of dispersion - standard deviation and standard error; correlation coefficient- simple linear regress- #Basic idea of significance test- hypothesis test – SPSS Packages#.

##Self –study portion

Text Books:

- 1.N.Mendiratta, P.Rastogi., Bioinformatics Methods and Application Genomics, Proteoics and Drug Discovery. 2004.
2. R.S.N. Pillai and V. Bagavathi., Statistics – Theory and Practice. New Delhi. 2006.
3. M. Glovery and Mitchell. An Introduction to Biostatistics. 2009.

Books for Reference:

1. R.R.Miller and G.S.A. Myers (Eds.). Internet for the Molecular Biologist, Horizon Scientific Press,1999.
2. A. Manuela Helmer-Citterich. The Internet for Cell and Molecular Biologists (2nd Edn.), Horizon scientific Press, Norwich, 2004.

Web Source:

- 1.https://www.epictraining.ca/course/15958/biological_databases/- 2. distance
- 2.<https://bioinformatics.mit.edu/>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific outcomes:

Semester	Code	Title of the Paper					Hours	Credits				
VI	20UBT6CC15	BIOINFORMATICS AND BIostatISTICS					5	5				
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						
	PO 1	PO2	PO3	PO4	PO5	PSO1	PSO 2	PSO3	PSO4	PSO5		
CO1	✓		✓	✓	✓	✓	✓	✓	✓	✓		
CO2	✓	✓	✓		✓			✓	✓	✓		
CO3	✓	✓	✓		✓	✓		✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Number of Matches= 44, Relationship : High												

Prepared by:
Dr. K. Gobalan

Checked by:
S. Benazir Begum

Note:

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	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External Marks
VI	20UBT6CC16P	Core - XVI	PLANT BIOTECHNOLOGY, ANIMAL BIOTECHNOLOGY AND BIOINFORMATICS AND BIOSTATISTICS - PRACTICAL	5	5	100	20	80

Course Outcomes:

At the end of the course, students will be able to:

1. Develop the skills of pilot scale production of secondary metabolites.
2. Understand the processes involved in the planning, conduct and execution of Plant and animal biotechnology experiments.
3. Employing the processes include traditional fermentation procedures and also those involving organisms modified by recombinant DNA technology.
4. Design the programs with interactive Input and Output in C program.
5. Understand the biological information and retrieval methods for DNA sequence.

PLANT BIOTECHNOLOGY

1. Laboratory organization and Introduction to plant tissue culture techniques.
2. Plant tissue culture media preparation.
3. *In vitro* Seed Germination.
4. Micropropagation- Shoot induction- multiplication- root induction and hardening.
5. Callus induction – leaf and stem.
6. Haploid plant production using anther explants.

ANIMAL BIOTECHNOLOGY

1. Preparation of animal cell culture medium.
2. Preparation of single cell suspension from animal tissue.
3. Preparation of animal cell monolayer.
4. Sub culturing of cell lines.
5. Cell counting- quantitation of cells in culture.
6. Cell viability assay.

BIOINFORMATICS AND BIOSTATISTICS

1. Study of Internet resources in Bioinformatics- eg. NCBI.
2. Sequence alignment by BLAST.
3. Phylogenetic analysis using web tools.
4. Pair wise Sequence Alignment.
5. Multiple alignments- using CLUSTAL W
6. Program to convert DNA to RNA.
7. Web Publishing: Create a web page for your University / College using HTML. The opening page should provide hyperlinks to other pages (add animation and sound effects appropriately)

Text Books:

1. E.Balaguruswamy, Programming in ANSI C- Tata McGraw Hill. 1992.
2. TK- Parry Smith DJ., Introduction to bioinformatics- Pearson Education Asia. 2001.
3. S.C.Rastogi, NamitaMendiratta, Parag Rastogi., Bioinformatics Concepts, Skills & Applications, 2003

Books for Reference:

1. Kalyankumar De. An Introduction to Plant Tissue Culture Techniques. New Central Book Agency, Kolkata. 2007.
2. K.C.Agrawal, Environmental Biotechnology, Nidhi Publishers (India), Bikaner. 2004.
3. Nigel Jenkins, "Animal cell biotechnology methods and protocols", 1st Edition 1, Humana press, 1997.
4. R.W. John Masters., "Animal cell culture", 3rd Edition, Oxford university press. 2004.

Web Reference:

1. https://www.researchgate.net/publication/306018037_A_Plant_Biotechnology_Laboratory_Manual
2. https://www.austincc.edu/awheeler/Files/BIOL%201414%20Fall%202011/BIOL1414_Lab%20Manual_Fall%202011.pdf
3. https://ocw.mit.edu/courses/computer_program/7-06--spring-2007/
4. https://ocw.mit.edu/courses/biology/7-06-computer_application-spring-2010/

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Paper					Hours	Credits				
VI	20UBT6CC16P	PLANT BIOTECHNOLOGY, ANIMAL BIOTECHNOLOGY AND BIOINFORMATICS AND BIostatISTICS - PRACTICAL					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= 37, Relationship : High												

Prepared by:

Mrs. H. F. SeyedMafiyaHaniff

Note:

Checked by:

Dr. S. Benazir Begum

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
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Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
VI	20UBT6DE2A	DSE-II	BIOANALYTICAL TOOLS	5	4	100	25	75

Course Outcomes

At the end of the course, students will be able to:

1. Develop the skills to understand the theory and practice of bio analytical techniques.
2. Understand the various approaches employed in spectroscopic characterization
3. Study the working principle, techniques and applications of microscopy.
4. Gain knowledge and apply the concept of electrophoretic techniques, their procedure, principle and applications
5. Describe the concept of partition coefficient and perform various chromatographic techniques

Unit I: General approaches to biochemical investigations:

15 Hours

Cell disruption methods and subcellular fractionation. Centrifugation techniques: Basic principles of sedimentation, Svedberg's constant and RCF. Types of rotors, Principle, technique and applications of preparative centrifugation-differential and density gradient centrifugation. #Analytical ultracentrifugation#.

Unit II: Spectroscopy:

15 Hours

Laws of absorption and absorption spectrum. CD, ORD, Principle, instrumentation and applications of UV-visible spectrophotometry, ESR, NMR, IR and spectrofluorimetry. Basic principles of turbidimetry and nephelometry. Atomic spectroscopy – principle and applications of atomic flame and flameless spectrophotometry. Use of lasers for spectroscopy. #MALOF TOF#

Unit III: Microscopy:

15 Hours

Basic principles, instrumentation and applications of Light microscopy, Bright and dark Field Microscopy, Fluorescence microscopy, Phase contrast microscopy, Electron microscopy- SEM and TEM.

Unit IV: Electrophoretic techniques:

15 Hours

General principle, technique and applications Gel electrophoresis. Factors affecting electrophoresis. Agarose gel electrophoresis. Polyacrylamide gel electrophoresis (PAGE): Native and SDS-PAGE. 2D-Gel, #Isoelectric focusing#.

Unit V: Chromatographic techniques:

15 Hours

Principles of chromatography, technique and applications of Paper chromatography, Thin Layer chromatography (TLC), Adsorption, Partition, Size exclusion chromatography, Ion exchange, Gel filtration and Affinity chromatography. Principle, components and applications of Gas chromatography (GC), #High performance liquid chromatography (HPLC) #.

Self study portion

Text Books:

1. G. Sabari and A.K. Srivastava., Fundamentals of Bio Analytical Techniques and Instrumentation, PHI Learning Pvt. Ltd. India, 2009.
2. B. Istvan., Modern analytical techniques in the pharmaceutical- and bioanalysis, 2011.
3. S. Ghosal and Srivastava, Fundamentals of Bioanalytical Techniques and Instrumentation, PHI Learning Pvt. Ltd, 2009.

Books for Reference:

1. K. Wilson and J. Walker., Principles and Techniques of Practical Biochemistry, Cambridge University Press, India. 2005.
2. A. Upadhyay, K. Upadhyay and N. Nath., Biophysical Chemistry (Principles and Techniques) 4th Edition, Himalaya Publishing House, India, 2014.
3. A. Shourie and S.S. Chapadgaonkar., Bioanalytical Techniques, the Energy and Resources Institute, TERI, India, 2015.
4. C.R. Kothari., Methods and Techniques, 2nd ed, Research Methodology, New Age International Publishers. India, 2004.
5. R.P. Braun., Introduction to Instrumental Analysis, Tata McGraw Hill, India, 1987.

Web Source

1. <https://nptel.ac.in/courses/102/103/102103044/>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code		Title of the Paper			Hours	Credits			
VI	20UBT6DE2A		BIOANALYTICAL TOOLS			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= 36, Relationship : High										

Prepared by:

Dr. S. Benazir Begum

Checked by:

Dr. J. Sebastin Raj

Note:

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	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
VI	20UBT6DE2B	DSE-II	MEDICAL MICROBIOLOGY	5	4	100	25	75

Course Outcomes

At the end of the course, students will be able to:

1. Impart the knowledge of medically important human diseases with respect to their causative agent.
2. Enable the students to study clinical symptoms and treatment of bacterial disease in various organ system
3. Gain the knowledge on study of mode of transmission of viral diseases.
4. Enable the students to study clinical symptoms and treatment of fungal and protozoan diseases.
5. Evaluate the methods to identify infectious agents in the clinical microbiology lab.

Unit I : Introduction to Medical Microbiology

15 Hours

History, Koch's and River's postulates - A brief account on the normal microbial flora of the healthy human body - Host-pathogen interactions: Definitions of infection, invasion, primary and opportunistic pathogens, pathogenicity, virulence, toxigenicity, carriers, endemic, epidemic # pandemic diseases and epidemiology #

Unit II: Medical Bacteriology

15 Hours

Diseases of various organ systems: Causative agent, clinical symptoms, pathogenesis, mode of transmission, prevention and treatment of the following bacterial diseases (a) Streptococcal infections, (b) Staphylococcal infections, (c) Leprosy, (d) Respiratory diseases: Tuberculosis (e) Gastrointestinal disorders: typhoid and cholera, (f) Sexually transmitted diseases: syphilis, gonorrhoea.

Unit III: Medical Virology

15 Hours

Diseases of various organ systems: Causative agent, clinical symptoms, pathogenesis, mode of transmission, prevention and treatment of the following viral diseases (a) Respiratory diseases: common cold, influenza, SARS-CoV-2 (b) Neurological diseases: Dengue, Rabies (c) Liver diseases: Viral hepatitis (d) Immunodeficiency disease: - AIDS. #A brief account on Prion diseases#.

Unit IV: Medical Mycology

15 Hours

Causative agent, clinical symptoms, pathogenesis, mode of transmission, prevention and treatment of the following fungal and protozoan diseases (a) Fungal – superficial and subcutaneous mycoses, (b) Protozoan: Amoebiasis, Malaria (c) Helminths – Filariasis, Ascariasis, Zoonotic diseases, # Nosocomial and community acquired infections#.

UNIT V : Medical Diagnosis

15 Hours

Steps in the isolation and identification of pathogens from an infected patient: Collection and transport of various clinical specimens for diagnosis – General methods of isolation and identification of bacterial, fungal and viral pathogens and protozoan parasites.

Self study portion

Texts Books :

1. S. Rajan, Medical Microbiology, MJP Publishers Chennai. 2007.
2. Prescott, Harley and Klein's. Microbiology, 7th edition McGraw Hill Medical Publication division. 2007.

Books for Reference:

1. D.Greenwood., M. Barer., R. Slack and W. Irving., Medical Microbiology. A Guide to Microbial Infections: Pathogenesis, immunity, Laboratory investigation and Control, 18th edition, Churchill Livingstone. 2012.
1. J. Melnickand and Adelberg's ., Medical Microbiology, 22nd edition McGraw Hill Medical Publication division. 2001.
2. D. Greenwood, R. CB Slack and J. Peutherer., Medical Microbiology, 16th edition, Church Hill Living stone Publication. 2002.

Web Source

1. <http://n/academics/syllabi/2016/Science/PG/MSc-Microbiology.pdf>
2. <http://www.bdu.ac.in/academics/syllabi/2016/Science/UG/BSc-Microbiology.pdf>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code		Title of the Paper			Hours	Credits			
VI	20UBT6DE2B		MEDICAL MICROBIOLOGY			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= 36, Relationship : High										

Prepared by:

Dr. S. Benazir Begum

Checked by:

Dr. Y. Arsia Tarnam

Note:

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	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External Marks
VI	20UBT6DE3A	DSE-III	IPR, BIOSAFETY AND BIOETHICS	4	4	100	25	75

Course Outcomes:

At the end of the course, students will be able to:

1. Analyze different types of intellectual property rights in general and protection of products derived from biotechnology research and issues related to application and obtaining patents
2. Organize policy of companies and other technology-intensive organizations to build, manage and govern technology based business
3. Differentiate systemic and cross-functional identification, control and governance of IP assets in sourcing, collaboration and exploitation.
4. Distinguish knowledge of biosafety and risk assessment of products derived from recombinant DNA research and environment release of genetically modified organisms, national and international regulations.
5. Analyze ethical aspects related to biological, biomedical, health care and biotechnology research

UNIT –I

12 Hours

Meaning and Justification of patenting an invention: Introduction to Intellectual Property, Concept of IPR, Designs, Trademarks TM, Trade secret, Domain names, geographical indications and copyright. Evolution of patent laws, History of Indian patent system, International conventions and treaties, patent law in other countries.

UNIT –II

12 Hours

Classification of Patents: Classification of patents in India, WIPO, Categories of patents, special patents, provisional patents, patenting biological product. Grant of patent and patenting authorities: Invention, eligible criteria, patentable and non-patentable inventions in India and abroad, patent office and patent authorities.

UNIT –III

12 Hours

Introduction to Biosafety & Regulatory mechanism for GMO: Overview of Biosafety, risk assessment, Cartagena protocol on biosafety. International regulatory bodies, National regulatory bodies, regulatory measures for biosafety. Biosafety guidelines in India evolved by DBT, rules for the manufacture, storage and disposal of hazardous microorganisms, genetically modified organisms and biosafety management.

UNIT –IV

12 Hours

Biosafety of genetically engineered products: Genetically engineered products and Recombinant DNA Technology (RDT), risk assessment of RDT products, regulating RDT, permit for movement and import of GMOs, development of products using RDT and their biosafety issues, #biosafety in gene therapy and ecological safety assessment of recombinant organisms#.

UNIT –V

12 Hours

Introduction to Bioethics: Bioethics and its scope, different approaches to ethics, their social and ethical implications, public and private sector organizations for biosafety and bioethics, Web-

based information of biosafety on GMO – Introduction, biosafety database, importance of good laboratory practices. Myriad’s case on gene patenting – Btbrinjal, Bt cotton and golden rice, #Biosafety Committee and its significance #.

Self -study portion

Text Books:

1. DeepaGoel and ShominiParashar., “IPR, Biosafety and Bioethics”, Dorling Kindersley Pvt. Ltd. (2013).
2. M.W. Martin. Ethics in engineering, and Schinzinger.R. III Edition, Tata McGraw-Hill, New Delhi. 2003.
3. BAREACT, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., 2007.
4. Kankanala, K . C. 2007. Genetic Patent Law & Strategy, 1st Edition. Manupatra Information Solution Pvt. Ltd.,Noida, India.

Books for References:

1. F.K.Beier, Crespi R.S., and Straus, T., “Biotechnology and Patent protection”, Oxford and IBH Publishing Co. New Delhi, (2007).
2. “Biosafety issues related to transgenic crops” - DBT guidelines, Biotech Consortium India Limited, New Delhi, (2010).

Web Reference:

1. https://www.researchgate.net/publication/329170462_IPR_Biosafety_Bioethics
2. <https://www.elsevier.com/books/an-introduction-to-ethical-safety-and-intellectual-property-rights-issues-in-biotechnology/nambisan/978-0-12-809231-6>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code		Title of the Paper			Hours	Credits			
VI	20UBT6DE3A		IPR, BIOSAFETY AND BIOETHICS			4	4			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO 1	PO 2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO 4	PSO5
CO1	✓	✓		✓	✓		✓	✓		✓
CO2	✓			✓	✓		✓		✓	✓
CO3	✓		✓		✓		✓	✓	✓	
CO4		✓	✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓			✓	✓	✓	✓	✓	✓
Number of Matches= 36, Relationship : High										

Prepared by:
Mrs.H.F.SyedMafiyaHaniff

Checked by:
Dr. S. Benazir Begum

Note:

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	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
VI	20UBT6DE3B	DSE-III	CANCER AND STEM CELL BIOLOGY	4	4	100	25	75

Course Outcomes

At the end of the course, students will be able to:

1. Gain deep understanding on the basic processes related to the cancer, growth, causes, and its differentiation.
2. Understand the multistep, genetic alterations which enable the transformation of a normal cell to a cancer.
3. Describe the multipotent and pluripotent stem cells from various sources, its application and regulation.
4. Understanding the basic concepts of stem cells, types and its present and future challenges
5. Elucidate the clinical applications of stem cells culture.

Unit I: Cancer:**12 Hours**

Definition, Description of cancer, Basic facts about cancer, cancer is clonal in origin, Hallmarks of Cancer, general classification of human cancers, microscopic and macroscopic features of neoplasm's, Grade and stage of neoplasm – Histologic grade of malignancy and tumor staging.

Unit II: Causes of Cancer:**12 Hours**

Theory of HITS, Chemical carcinogenesis – metabolic activation of chemical carcinogens (donors of simple alkyl group, cytochrome P-450 mediated activation), Mechanism of tumor initiation, promotion and progression. Irradiation carcinogenesis and viral carcinogenesis (Epstein Barr virus and Hepatitis virus).

Unit III: Molecular Genetics of Cancer**12 Hours**

Oncogenes, Oncogene families, cell transforming ability of onc gene, functional classes of oncogenes, Characteristics of individual oncogene (ras and erbA). Tumor suppressor genes – suppressor genes (rb and p53). Cancer diagnosis – categories of tumor markers (nucleic acid based markers and gene expression microarray). Cancer prevention#.

Unit IV: Stem cells:**12 Hours**

Introduction to stem cells, Definition, potency of stem cells, general classification and Sources (adult stem cell, hematopoietic stem cells, mesenchymal stem cells, umbilical cord stem cell and iPSC). Embryonic stem cells (ES) – Origins of mouse embryonic stem cells, derivation of embryonic stem cells, factors influencing ES cell derivation and #uses of embryonic stem cells#.

Unit V: Stem cell therapy:**12 Hours**

Stem cell therapy, Role of stem cells (spinal cord injury, myocardial infarction and heart failure), Comparison of different sources of stem cells, Role of stem cells in basic research, Regulations of

stem cell therapy – current regulatory system in India and permissive regulations in other countries, Stem cell ethics – religious and other ethical issues.

Self study portion

Text Books:

1. W. Raymond and R. Ruddle, Cancer Biology,. Oxford University Press, USA, 2007.
2. A. Sarkar, Stem cell culture,. Discovery publishing house Pvt. Ltd., 2009.
3. S. Li, N.L'Heureux, Jennifer Elisseff, Stem cell and tissue engineering. World scientific Publishing Co Pvt Ltd., 2011.
4. A.Sharma, Stem cell therapy in neurological disorders. Surekha Press., 2015.

Books for Reference:

1. M. Hejmadi, Introduction to cancer biology. MomnaHejmadi&Ventus Publishing ApS., 2010
2. P. J. Quesenberry, Stem Cell Biology and Gene Therapy, 1st Edition, Willy-Less, 1998.

Web Source

1. <https://nptel.ac.in/courses/104/105/104105102/>
2. <https://nptel.ac.in/content/storage2/courses/102103047/PDF/mod1.pdf>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code		Title of the Paper			Hours	Credits			
VI	20UBT6DE3B		CANCER AND STEM CELL BIOLOGY			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= 36, Relationship : High										

Prepared by:

Dr. S. Benazir Begum

Checked by:

Dr. J. Sebastin Raj

Note:

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	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
VI	20UBT6EC2	EC - II	BIOTECHNOLOGY FOR COMPETITIVE EXAMINATIONS	-	4*	100	-	100

Course Outcomes

At the end of the course, students will be able to:

- 1.Ensure the molecules and their interaction relevant to biology.
- 2.Describe the developmental biology of plants and animals.
- 3.Discuss the Inheritance Biology of plants and animals.
- 4.Gain the knowledge in Applied Biology
- 5.Understand what are all the methods used in Biology.

Unit I:

MOLECULES AND THEIR INTERACTION RELAVENT TO BIOLOGY:Structure of atoms, molecules and chemical bonds, Composition, structure and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins), Stablizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.), Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties). Bioenergetics pathways.

Unit II:

DEVELOPMENTAL BIOLOGY: Production of gametes, cell surface molecules in sperm-egg recognition in animals;; zygote formation, cleavage, blastula formation, gastrulation; Morphogenesis and organogenesis in animals: Cell aggregation and differentiation in Dictyostelium; axes and pattern formation in Drosophila, amphibia and chick. Morphogenesis and organogenesis in plants: embryo sac development and double fertilization in plants Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy; transition to flowering, floral meristems and floral development in Arabidopsis and Antirrhinum.

UNIT III:

INHERITANCE BIOLOGY: Mendelian principles : Dominance, segregation, independent assortment, Concept of gene : Allele, multiple alleles, pseudoallele, complementation tests. Extensions of Mendelian principles: Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters. Gene mapping methods in plants. Human genetics : Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders.

UNIT IV:

APPLIED BIOLOGY:Microbial fermentation and production of small and macro molecules.Application of immunological principles, vaccines, diagnostics. Tissue and cell culture methods for plants and animals. Transgenic animals and plants, molecular approaches to diagnosis and strain identification. Genomics and its application to health and agriculture, including gene therapy. Bioresource and uses of biodiversity. Breeding in plants and animals, including marker – assisted selection. Bioremediation and Phytoremediation, Biosensors.

UNIT V:

METHODS IN BIOLOGY:Biophysical Method-Molecular analysis using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy. Radiolabeling techniques-Detection and measurement of different types of radioisotopes normally used in biology, incorporation of radioisotopes in biological tissues and cells, molecular imaging of radioactive material, safety guidelines.Electrophysiological methods-Single neuron recording, patch-clamp recording, ECG, Brain activity recording, lesion and stimulation of brain, pharmacological testing, PET, MRI, fMRI, CAT .

Texts Book:

1. David L. Nelson, Michael M. Cox. Lehninger Principles of Biochemistry , 7th Edition, WH Freeman Publishers, 2017
2. Richard Twyman&S.B.Primose, Principles of gene manipulation and genomics, 7th Edition, Blackwell Publishing, 2007.

Books for Reference:

1. D. Peter Snustad, Michael J. Simmons, Principles of genetics, John Wiley & Son Inc., 2017.
2. Dr. Ashed Iqbal Dar, Applied and developmental biology, 1st Edition, Himalaya Publishing House, 2016.

Web Source:

3. <https://acetheraceonline.com/wp-content/uploads/2014/11/Unit-1-Molecules-their-interaction-relevant-to-biology-CSIR-UGC-NET-Life-Sciences.pdf>
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Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code		Title of the Paper			Hours	Credits				
VI	20UBT6EC2		BIOTECHNOLOGY FOR COMPETITIVE EXAMINATIONS			-	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= 36, Relationship : High											

Prepared by:

Mrs. H.F. Seyed Mafia Haniff

Checked by:

Dr. J. Sebastin Raj

Note:

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
