MOHAN BABU UNIVERSITY

SreeSainath Nagar, Tirupati – 517 102

MBU
MOHAN BABU
UNIVERSITY
DREAM. BELIEVE. ACHIEVE

SCHOOL OF LIBERAL ARTS AND SCIENCES

M.Sc. – Biotechnology

CURRICULUM AND SYLLABUS

(For 2022-23 Admitted Students)

FULLY FLEXIBLE CHOICE BASED CREDIT SYSTEM(FFCBCS)

MOHAN BABU UNIVERSITY

Vision

To be a globally respected institution with an innovative and entrepreneurial culture that offers transformative education to advance sustainability and societal good.

Mission

- Develop industry-focused professionals with a global perspective.
- Offer academic programs that provide transformative learning experience founded on the spirit of curiosity, innovation, and integrity.
- Create confluence of research, innovation, and ideation to bring about sustainable and socially relevant enterprises.
- Uphold high standards of professional ethics leading to harmonious relationship with environment and society.

SCHOOL OF LIBERAL ARTS AND SCIENCES

Vision

To be the ideal culmination for the edification of liberal arts and sciences recognized for excellence, innovation, entrepreneurship, environment and social consciousness.

Mission

- Infuse the essential knowledge of liberal arts and sciences, skills and an inquisitive attitude to conceive creative and appropriate solutions to serve industry and community.
- Proffer a know-how par excellence with the state-of-the-art research, innovation, and incubation ecosystem to realise the learners' fullest entrepreneurial potential.
- Endow continued education and research support to working professionals in liberal arts and sciences to augment their domain expertise in the latest technologies
- Entice the true spirit of environment and societal consciousness in citizens of tomorrow in solving challenges in liberal arts and sciences.

DEPARTMENT OF BIOLOGICAL AND CHEMICAL SCIENCES

Vision

To become a leading center of excellence in the Biological and Chemical Sciences through adapting advanced methods in teaching and research.

Mission

- Inspire science students of tomorrow to take on the challenges in the scientific field and build sustaining society that is free from Biological and Chemical science apprehensions.
- Provide students with an education that combines academics with diligent practical training in a dynamic, research-oriented environment to serve Industry and Societal needs.
- Encourage faculty and staff to achieve bigger goals in their respective fields and exhibit the best of their abilities via continuing education and research.

M.Sc. – Biotechnology

PROGRAM EDUCATIONAL OBJECTIVES

PEO1. Employed as a productive and valued professional in industry/teaching/ research.

PEO2. Demonstrate excellent professional skills with ethics as a member or leader of a team.

PEO3. Engaged in innovation and deployment as a successful entrepreneur.

PEO4. Adapt advanced technologies in their profession with social awareness and responsibility.

PROGRAM OUTCOMES

On successful completion of the Program, the graduates of M.Sc.Biotechnologywill be able to:

PO1. **Knowledge:** To study as well as apply concepts, theories, and practices across the disciplines to gain foundational knowledge.

PO2. **Problem Analysis:** To identify, analyze and evaluate various experiences and perspectives using foundational disciplinary knowledge for substantiated conclusions.

PO3. **Design/Development of solutions:** To design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.

PO4. **Modern tool usage:**To create, select, and apply appropriate techniques, resources and modern tools with an understanding of the limitations.

PO5. **Environment and Sustainability:** Understand the issues of environmental contexts and demonstrate the knowledge for sustainable development.

PO6. **Ethics and Society:**Apply the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities under moral dimensions.

PO7. **Individual and teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, to manage projects and finance in multidisciplinary settings.

PO8. **Effective Communication:**To develop proficiency and efficiency in communicating by connecting people, ideas, books, media, and technology.

PO9. **Life-long learning:**Recognize the need for and acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.

PROGRAM SPECIFIC OUTCOMES

On successful completion of the M.Sc. Biotechnology program, the students will be able to:

PSO1. Demonstrate fundamentals of Biotechnology and apply their practical skills in the production of various industrial products as well as in the preparation of Genetically modified organisms and vaccines.

PSO2. Apply Biochemistry knowledge for understanding the health and disease condition of Plants and Animals.

PSO3. Use appropriate techniques to culture the microbes, identify the pathogenic microbes responsible for disease conditions and useful microbes in the production of different products.

PSO4. Demonstrate mastery in biosciences, bioprocesses to synthesize drugs and bioinformatics tools to design drugs.

M.Sc. – Biotechnology

Basket Wise - Credit Distribution

Sl. No.	Baskets	Credits (Min.- Max.)
1	SCHOOL CORE	24-30
2	PROGRAM CORE	21-26
3	PROGRAM ELECTIVE	33-42
4	UNIVERSITY ELECTIVE	6-9
	TOTAL CREDITS	**Min. 90**

School Core (24-30 Credits)

Course Code	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
		L	T	P	S	C	
22BS201001	Environment and the Society	2	-	-	-	2	-
22BS206001	Basics of Computer forChemist and Biologist	-	-	2	4	2	-
22BS201002	Bio-safety, IPR and Bioethics	2	-	-	-	2	-
22BS201003	Patenting in Biotechnology	3	-	-	-	3	-
22BS201004	Advanced Clinical and Pharmaceutical techniques	4	-	-	-	4	-
22EE201001	Research Methodology	3	-	-	-	3	-
22BS211001	Internship	-	-	-	-	2	-
22BS208001	Capstone Project	-	-	-	-	10	-
Mandatory Courses (Min. 4 Credits to be earned, Earned Credits will not be considered for CGPA)							
22BS207601	Ecology	2	-	-	-	2	-
22MG201601	Project Management	2	-	-	-	2	-

Program Core (21-26Credits)

Course Code	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
		L	T	P	S	C	
22BS202001	General Microbiology	3	-	3	-	4.5	-
22BS202002	Microbial Geneticsand RDNA Technology	3	-	3	-	4.5	General Microbiology
22BS202003	Biomolecules and Cell	3	-	3	-	4.5	-
22BS201015	Intermediary Metabolism	3	1	-	-	4	Biomolecules and Cell
22BS202005	Enzymology	3	-	3	-	4.5	-

Program Elective (33 – 42 Credits)

Course Code	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
		L	T	P	S	C	
22BS202006	Bioprocess Technology	3	-	3	-	4.5	-
22BS202007	Bioinformatics and its Applications	3	-	3	-	4.5	-
22BS201007	Cell Biology and Introduction to Cancer Biology	3	-	-	-	3	Biomolecules and Cell
22BS201008	Plant and Animal Biotechnology	3	-	-	-	3	Microbial Geneticsand RDNA technology
22BS201009	Applied Environmental Biotechnology	3	-	-	-	3	Biomolecules and Cell
22BS202008	Agri-Food Biotechnology	3	-	3	-	4.5	Microbial Geneticsand RDNA technology
22BS202009	Immunology and Immunotechnology	3	-	3	-	4.5	-
22BS202010	Molecular Biology	3	-	3	-	4.5	Biomolecules and Cell
22BS201010	Virology& its Applicationsin Biotechnology	3	-	-	-	3	General Microbiology
22BS201011	Pharmaceutical Biotechnology	3	-	-	-	3	Biomolecules and Cell
22BS201006	Nano-Biotechnology	3	-	-	-	3	Microbial Geneticsand RDNA technology
22BS202012	Applications in Molecular Diagnostics	3	-	3	-	4.5	-
22BS201012	Introduction to CRISPR Technology and Medical Biotechnology	3	-	-	-	3	Plant Biochemistry and Molecular Biology
22BS201013	Advances in Biochemistry	3	-	-	-	3	Biomolecules and Cell
22BS201016	Proteomics and Genomics	2	-	-	-	2	Bioinformatics & its Applications
22BS201017	Cell – Signaling	2	-	-	-	2	Biomolecules and Cell
22BS202013	Plant Biotechnology for crop improvement	3	-	3	-	4.5	-
22BS201018	Molecular systematics	3	-	-	-	3	-

Course Code	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
22BS201019	DNA and Protein Sequence Analysis	2	-	-	-	2	Microbial Geneticsand RDNA technology
22BS201020	Model organisms in Biotechnology	2	-	-	-	2	-
22BS206002	Medical Writing	-	-	2	4	2	-

UNIVERSITY ELECTIVE (6-9 Credits)

Course Code	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
		L	T	P	S	C	
22CE201701	Disaster Management	3	-	-	-	3	
22SS201701	Value Education	3	-	-	-	3	
22SS201702	Pedagogy Studies	3	-	-	-	3	
22EC101701	AI in Healthcare	3	-	-	-	3	
22CB101703	Forensic Science	3	-	-	-	3	
22LG201701	Personality Development	3	-	-	-	3	
22SS101706	Women Empowerment	3	-	-	-	3	

Note:

1. If any student has chosen a course or equivalent course from the above list in their regular curriculum then, he/she is not eligible to opt the same course/s under University Elective.
2. The student can choose courses from other disciplines offered across the schools of MBU satisfying the pre-requisite other than the above list.

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22BS201001	**ENVIRONMENT AND THE SOCIETY**	2	-	-	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion onatmospheric science, toxicological science, air, water, soil pollution, environmental reforms in india and the ways of building safe environment.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the effect of pollution on the environment and atmosphere.

CO2. Analyze the impact of toxic materials on environment.

CO3. Understand the types of impurities and their impacts on the environment.

CO4. Gain awareness on the Indian laws and policies for the protection of the environment.

CO5. Design the ways to build sustainable environment by using modern science and technology.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	3	-	-	-	2	-	-	-	2
CO2	2	3	-	-	2	-	-	-	2
CO3	3	-	-	-	2	-	-	-	2
CO4	3	-	-	-	-	2	-	-	3
CO5	3	-	-	1	2	-	-	-	2
Course Correlation Mapping	**3**	**3**	**-**	**1**	**2**	**2**	**-**	**-**	**2**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: ATMOSPHERIC SCIENCE ***(06 Periods)***

Chemical reactions in the atmosphere, types, production and distribution of Aerosol, Aerosols and radiation, Atmospheric turbidity and related environmental problems, Global climate and photochemical reactions,Nuclear accidents, Global warming, Greenhouse effect, Ozone depletion, Acid rain,Factors effecting corrosion.

Module 2: TOXICOLOGICAL SCIENCE ***(06 Periods)***

Introduction to toxicology and toxicological Science, Toxicants, Dose-Response Relationships, Toxic chemicals in the environment, Biochemical aspects of As, Cd, Pb, Hg, CO, O_3, PAN, Pesticides, MIC and carcinogens in air.

Module 3 ENVIRONMENTAL POLLUTION ***(07 Periods)***

Air:Types and major sources of air pollutants, effects of air pollutants on physico-chemical and biological properties surrounding atmosphere.
Water:Types and major sources of water pollutants, effects of water pollutants on physico-chemical and biological properties of water bodies, Potable water and water quality standards.
Soil:Types and major sources of soil pollutants, effects of soil pollutants on physico-chemical and biological properties of soil. Solid waste disposal and its effects on surrounding environment.

Module 4 ENVIRONMENTAL REFORMS IN INDIA ***(05 Periods)***

Environmental Acts: Wildlife (Protection) Act, 1972,Water (Prevention and control of pollution) Act, 1974, Forest (Conservation) Act, 1980, Air (Prevention and control of pollution) Act, 1981, Environmental Protection Act, 1986.
National Green Tribunal: Structure, composition and functions.

Module 5 WAYS OF BUILDING SAFE ENVIRONMENT ***(06 Periods)***

Biodegradable polymers*:* Definition, properties, classification, mechanism of degradation of biodegradable polymers and their applications.
Biodiesel: Introduction, Synthesis (Trans esterification method), advantages, disadvantages and applications.
Role of technology:Green computing, Green construction, Green manufacturing Systems.

Total Periods: 30

EXPERIENTIAL LEARNING

1. Prepare a document on the eco-friendly traditional practices for sustainable environment.
2. Discuss the effect of toxic chemicals released from the Triupathi Industrial area on the Tirupathi.
3. How to maintain the sustainable environment in this modern world?
4. Study and analyze the impact of environmental reforms in India
5. Explain the ways to maintain the industry in an eco-friendly way
6. Discuss the water harvesting system in your institution
7. Present your plan to improve ground water levels in your institutions surround villages
8. Submit a report to maintain the kitchens (Home/hotel/hostel) in green way
9. Prepare a document on the role of technology to maintain the environment in safer way
10. Submit a document on the conversion of waste into money.

RESOURCES

TEXT BOOKS:

1. ErachBrarucha, Textbook of environmental studies, UGC
2. Basu, M. and Xavier, S., Fundamentals of Environmental Studies, Ist Edition, Publisher: Cambridge University Press, 2016.

REFERENCE BOOKS:

1. Trivedi, R.K. (1994) Environment and Natural Resources Conservation,.
2. Cuttler S, Environmental Risk and Hazards, Publisher: Prentice Hall of India, New Delhi, 1994.

VIDEO LECTURES:

1. https://www.digimat.in/nptel/courses/video/105107176/L01.html
2. https://nptel.ac.in/courses/105106119
3. https://archive.nptel.ac.in/courses/127/106/127106004/
4. https://www.digimat.in/nptel/courses/video/123105001/L31.html

Web Resources:

1. https://en.wikipedia.org/wiki/Environmental_policy_of_India
2. https://iclg.com/practice-areas/environment-and-climate-change-laws-and-regulations/india
3. https://www.unep.org/news-and-stories/story/5-ways-make-buildings-climate-change-resilient
4. https://www.niehs.nih.gov/health/topics/science/toxicology/index.cfm

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22BS206001	**BASICS OF COMPUTER FOR CHEMIST AND BIOLOGIST**	-	-	2	4	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on the usage of chemdraw and Chem sketch

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Familiarize to use the computers in drawing various chemical strictures using chemdraw and Chem sketch

CO2 Illustrate chemical and biological concepts.

CO3 Analyse reports on the synthesis methods used

CO4 Work independently and in teams to solve problems with effective communications.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes										Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	3	-	-	-	-	-	-	-	-	3	-	-	3
CO2	2	3	-	-	-	-	-	-	-	3	-	-	3
CO3	3	3	-	-	-	-	-	-	-	3	-	-	3
CO4	-	-	-	-	-	-	3	3	-	-	-	-	-
Course Correlation Mapping	**3**	**3**	**-**	**-**	**-**	**-**	**3**	**3**	**-**	**3**	-	-	**3**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT (EXPERENTIAL LEARNING)

Minimum 10 exercises to be performed

1. **PAGE LAYOUT-1** (The Drawing Area, The Document Type, Printing, Saving Page Setup Settings)
2. **PAGE LAYOUT-2** (Slide Boundary Guides Viewing Drawings, Tables)
3. **PREFERENCES AND SETTINGS-1** (Setting Preferences, Customizing Toolbars)
4. **PREFERENCES AND SETTINGS-2** (Document and Object Settings, Customizing Hotkeys)
5. **PREFERENCES AND SETTINGS-3** (Working with Color, Document Settings)

6. **BASIC DRAWINGS-1** (Bonds, Atoms, Captions)
7. **BASIC DRAWINGS-2** (Drawing Rings, Chains, Objects, Clean Up Structure)
8. **BASIC DRAWINGS-2** (Checking Structures, Chemical Warnings)
9. **DESIGNING OF MOLECULES-1** (simple two- dimensional representations of organic molecules)
10. **DESIGNING OF MOLECULES-2** (Structure to Name, Name to Structure, drawing chemical reactions)
11. **BIODRAW-1** (BioDraw Templates, BioDraw of simple molecules)
12. **BIODRAW-2** (proteins, amino acids, polymers, 3D strictures)

PROJECT BASED LEARNING

1 Prepare a document on the application of Chemdraw / Chemsketch in Chemistry and biology

2 Present a chemical reaction on PPT using Chemdraw / Chemsketch

3 Draw various organic molecules using Chemdraw / Chemsketch

4 Draw simple polymer molecules using Chemdraw / Chemsketch

Complete details will be provided in the CHO.

RESOURCES

TEXT BOOKS:

1 ChemDraw 16.0 User Guide,

2 Stephen Wilson, Chemistry by Computer: An Overview of the Applications of Computers in Chemistry, Springer, 2011.

REFERENCE BOOKS:

1. http://media.cambridgesoft.com/support/manuals/16/ChemDrawHelp.pdf

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=a9r4Ofnc-Ro
2. https://www.youtube.com/watch?v=pccebQuLr9k
3. https://www.youtube.com/watch?v=a9r4Ofnc-Ro

Web Resources:

1. https://www.lib.ncsu.edu/faq/what-chemdraw-and-how-do-i-access-it
2. https://bitesizebio.com/31511/chemdraw-molecule-sketching-for-biochemists/
3. https://cen.acs.org/articles/92/i33/Reflections-ChemDraw.html

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22BS201002	**BIOSAFETY, IPR AND BIOETHICS**	2	-	-	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Bio-safety, Intellectual property rights, Patents, Copyright, trademark and geographic indication and Bioethics.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Understand the role of different Biosafety levels and identify the best BSL labs suited for handling different Microorganisms and for GMO research.

CO2 Analyze different types of IPRs

CO3 Understand the various types of patents and acquire knowledge about patent filing

CO4 Understand and identify Copyright law and consequences of Copyright violations.

CO5 Acquire knowledge about policies, guidelines and laws governing ethical practices in biological sciences.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	-	3	-	-	-	3	-	-	-
CO2	3	3	-	-	-	-	-	-	-	3	-	-	-
CO3	2	3	-	-	-	-	-	-	-	3	-	-	-
CO4	3	3	-	-	-	-	-	-	-	3	-	-	-
CO5	3	3	-	-	-	3	-	-	-	3	-	-	-
Course Correlation Mapping	**3**	**3**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**3**	**-**	**-**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: BIOSAFETY ***(05 Periods)***

Introduction to biosafety; biosafety guidelines in India; biosafety levels; Cartagena Protocol on Biosafety; implementation of biosafety guidelines; institutional biosafety committee; biosafety implications in GMO research.

Module 2: INTELLECTUAL PROPERTY RIGHTS ***(05 Periods)***

Introduction to intellectual property rights; requirements and utility of IPRs; different types of IPRs; features of World Intellectual Property Organization (WIPO); TRIPS agreement; international treaties and conventions on intellectual property.

Module 3 PATENTS ***(05 Periods)***

Fundamentals of patent; conditions for the grant of patents; what can be and what cannot be patented; types of patents; patenting agencies; filing patents in India; procedure for grant of patents; patenting of biological material; patenting of transgenic, isolated genes and DNA sequences.

Module 4 COPYRIGHT, TRADEMARK AND GEOGRAPHIC INDICATION ***(06 Periods)***

Introduction to copyright and its applicability; copyright registration in India; laws and policies regarding copyright (Berne convention and Copyright (Amendment) Act, 2012); fundamental concepts and importance of trademark; relevance of geographical indication.

Module 5 BIOETHICS ***(09 Periods)***

Need of bioethics; definitions of bioethics; applications of bioethics and its relations with other branches of studies; ethical issues in genetically modified organisms; bioethical implications of human genome project; ethical issues in stem cell research and use; ethical issues in biodiversity management; case study on ethical issues surrounding vaccines in food.

Total Periods: 30

EXPERIENTIAL LEARNING

1.Assignment regarding Intellectual property rights

2. Seminars on topic Bioethics
3. Seminars on Biosafety
4. Preparation of short reports on Lab visits.
5. Visit to nearby Diagnostic Lab and prepare a report on safety measures.
6. Preparation of report on Copyright violations.
7. Preparation of report on Patented product from the patent website
8. Report preparation on Patent filing.

9. Visit to the Microbiology labs in the campus and preparation of report.

RESOURCES

TEXT BOOKS:

1. Pandey, N and Dharni, K. 2014. Intellectual Property Rights
2. Sateesh, MK. 2008. Bioethics and Biosafety.

REFERENCE BOOKS:

1. Ganguli, P. 2001. Intellectual Property Rights: Unleashing the Knowledge Economy. Tata McGraw-Hill Publishing Company.
2. Thomas, J and Fuchs, R. 2002. Biotechnology and Safety Assessment. 3rd ed. Academic Press.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=GigAmtRf41U
2. https://www.youtube.com/watch?v=LrdyjPAyKnE
3. https://www.youtube.com/watch?v=d0CF-gCX1w0

WEB RESOURCES:

1. http://ecoursesonline.iasri.res.in/mod/page/view.php?id=5103
2. https://onlinecourses.nptel.ac.in/noc22_hs59/preview
3. https://plato.stanford.edu/entries/intellectual-property/

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22BS202001	**GENERAL MICROBIOLOGY**	3	-	3	-	4.5

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to Microbiology, Microbial diversity, Microbial nutrition, microbial growth and host-microbe interactions, and hands on training on Bacterial cell culture techniques, kinetics of growth curve and screening of microbes.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Identify the different tools required to study the microbes.

CO2 Understand classification, characteristics of major microbe categories and their characteristic features.

CO3 Understand the diversity of microbes and identitydifferent types of culture techniques used for Microbial growth

CO4 Analyze the effects of different Microbes on other living organisms and influence of environmental factors on microbes, and vice versa.

CO5 Screen microbes and understand optimum conditions for different microbes using different techniques. Also work independently as well as in team to solve problems with effective communications.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	-	-	-	-	-	-	-	3	-
CO2	3	3	-	-	-	-	-	-	-	-	-	3	-
CO3	3	3	-	-	-	-	-	-	-	-	-	3	-
CO4	3	3	-	-	-	-	-	-	-	-	-	3	-
CO5	3	3	-	3	-	-	3	3	-	-	-	3	-
Course Correlation Mapping	**3**	**3**	**-**	**3**	**-**	**-**	**3**	**3**	**-**	**-**	**-**	**3**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO MICROBIOLOGY *(06 Periods)*

Scope, relevance, discovery and origin of microbial world, theories spontaneous generation and conflict, germ theory of diseases. Interaction of light with objects. Microscopy and its applications. Types and applications of microscopy, Bright field, Dark field, Fluorescence, Phase contrast, Confocal microscopy, Scanning and Transmission electron microscopy.

Module 2: MICROBIAL DIVERSITY *(09 Periods)*

Early evolution, complex metabolism and microbial diversity based on energy and carbon sources and distribution of microbes. Phylogeny of prokaryotes and eukaryotes. Classification of Microorganisms (bacteria, algae and fungi). General characteristics of virus, groups of viruses, viroids, prions, bacteriophage structure and its life cycle.

Module 3 MICROBIAL NUTRITION *(10 Periods)*

Organization:Types, Merits and demerits of different types of organization, LabourMicrobialnutrition:Heterotrophs, autotrophs. Macro and micro nutritionalrequirements. Nutritional sources and types. Enrichment culture techniques-Isolation and selection of specific groups such as sporulatingbacteria, propionicbacteria, chemoheterotrophs, chemoautotrophs and photosynthetic microbes. Transformation of elements. Microbial transformation. Carbon, Nitrogen, Phosphorous and Sulphur cycles.

Module 4 MICROBIAL GROWTH *(10 Periods)*

Growth phases: Measurement, Mean Generation time, Factors affecting growth. Effect of temperature, pH, osmotic pressure, hydrostatic pressure and radiation on microbial growth.Synchronous culture. Kinetics of microbial growth; Batch culture, continuous culture, types of continuous culture system-turbidostat, chemostat.

Module 5 HOST-MICROBE INTERACTIONS *(10 Periods)*

Microbial ecology, molecular plant microbe interaction, molecular biology of disease resistance, gene-for-gene interaction, plant chemicals and defence pathways. Biological control of microbes. Plant growth-promoting rhizobacteria and their mechanisms for growth promotion and antagonism.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXEPERIMENTS:

1. Microbial isolation techniques. Isolation of bacteria and fungi
2. Establishment of pure cultures - streak, pour and spread plating techniques
3. Identification of microbes. Simple, differential, negative staining and spore staining methods
4. Establishment of bacterial growth curve
5. Bacteriophage plaque assay to enumerate phage titre

6. Test for in vitro antibiosis
7. Screening of microbes for the production of enzymes and hormones
8. Biochemical and genetic fingerprinting of microbes
9. Phylogenetic analysis of microbes
10. Microbial preservation techniques- patch plate, slant, water stock, glycerol stock andLyophilization

RESOURCES

TEXT BOOKS:

1. Pelczar, M.J., Reid, R.D. & Chan, E. C. Microbiology (5th Ed.). New York: McGraw-Hill. 2001
2. Willey, J. M., Sherwood, L., Woolverton, C. J., Prescott, L. M., & Willey, J. M. (2011). Prescott's microbiology. New York: McGraw-Hill.

REFERENCE BOOKS:

1. Madigan, MT, Bender, K.S., Buckley, D.H., Sattley, W.M. & Stahl, D.A., Brock Biology ofMicroorganisms (15thEd.). Pearson/ Benjamin Cummings. 2018.
2. Sequeira, M., Kapoor, K.K., Yadav, K.S. &Tauro, P., An Introduction to Microbiology (3rd Ed.). NewAge International Publishers. 2019.
3. Bergey's Manual of Systematic Bacteriology. 2005. Ed. Brenner, Don, J. Vol. 2, SpringerPublisher, USA.
4. Basic Practical Microbiology : A Manual (2006). Society for General Microbiology (SGM),ISBN0 95368 383
5. Handbook of Microbiological Media (2010). Ed.Atlas, Ronald, CRC Press, USA.
6. Microbiology: A Laboratory Manual (2013). Eds. James G. Cappuccino and Natalie Sherman.Publisher-Pearson Benjamin Cummings; 10th Edition.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=prTsBspXotg
2. https://www.youtube.com/watch?v=fU0XO1X1tAE
3. https://archive.nptel.ac.in/courses/102/103/102103015/

WEB RESOURCES:

1. https://microbe.net/resources/microbiology-web-resources/
2. https://microbiologysociety.org/members-outreach-resources/links.html
3 http://microbewiki.kenyon.edu/
4 https://pubmed.ncbi.nlm.nih.gov/
5. http://www.microbes.info/
6. https://www.cellsalive.com/
7. http://www.microbiol.org/
8. http://www.textbookofbacteriology.net/

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22BS202003	**BIOMOLECULES AND CELL**	3	-	3	-	4.5

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to Carbohydrates and Lipids, Amino acids and proteins, Nucleic acids, Porphyrins and Vitamins, Cell structure and function, and hands on training mentioned in the Experiential learning techniques.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Understand different types of carbohydrates, proteins and lipids, identify their function and analyze the key role played by carbohydrates, lipids and proteins in deriving energy required for living organisms.

CO2 Gain knowledge on the structure, role of DNA as genetic material, functions of RNA's and analyze DNA, RNA sequences to predict the role of these nucleic acids.

CO3 Analyze Porphyrins and Vitamins for the anomalies related to the deficiency of these biomolecules.

CO4 Understand different structure and functions of different sub cellular organelle present in the cell.

CO5 Analyze different Biomolecules by extracting and characterizing them from different sources and work individually and in team to solve problems with effective communications.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes										Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	-	-	-	-	-	-	3	-	-
CO2	3	3	-	-	-	-	-	-	-	-	3	-	-
CO3	3	3	-	-	-	-	-	-	-	-	3	-	-
CO4	3	3	-	-	-	-	-	-	-	-	3	-	-
CO5	3	3	-	3	-	-	3	3	-	-	3	-	-
Course Correlation Mapping	**3**	**3**	**-**	**3**	**-**	**-**	**3**	**3**	**-**	**-**	**3**	**-**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: CARBOHYDRATES AND LIPIDS *(11 Periods)*

Carbohydrates: Definition and classification of carbohydrates, Reaction of Monosaccharides, Acid derivatives of Monosaccharides amino-sugars, structure, function and properties of di and trisaccharides, and importance of heteropolysaccharides.

Lipids: Classification, Physical and chemical properties of Lipids. Characterization of natural fats & oils, structure and biological role of phospolipids, sphingolipids, Gangliolipids, Prosta-glandins, Thromboxanes, Leukotrienes and steroids.

Module 2: AMINO ACIDS AND PROTEINS *(09 Periods)*

Aminoacids and peptides: Classification of amino acids, chemical reactions of amino acids, non-protein amino acids, Peptide bond – Structure and conformation. Synthesis of peptides.

Proteins: Classification of proteins,purification and isolation of proteins, criteria of purity of proteins, physico-chemical properties, structural organization of proteins, Denaturation& renaturation of proteins. Outlines of Proteomics.

Module 3 NUCLEIC ACIDS *(09 Periods)*

Structure of nucleic acids – structural components –purine and pyramidine bases, nucleosides, nucleotides, polynucleotides; secondary & Tertiary structure of DNA.

Structure of RNAs – Secondary and Tertiary structure; Analysis of stability to nucleic acid

structures. DNA denaturation and renaturation kinetics, Nucleic acid sequencing methods

Higher orders of DNA & RNA Structure, chromatin structure; Gene analysis – southern blot technique and its variance. Introduction to Genomics.

Module 4 PORPHYRINS AND VITAMINS *(08 Periods)*

Porphyrins: Structure of porphyrins; Protoporphyrin, porphobilinogen, properties and Identification of Porphyrins. Structure of metalloporphyrins– Heme, cytochromes and chlorophylls, Phorphyria.

Vitamins: Chemistry and functions of water and fat soluble vitamins.

Module 5 CELL STRUCTURE AND FUNCTION *(08 Periods)*

Prokaryotic and Eukaryotic cells: Structure, Composition and functions of nucleus, mitochondria,plastids, endoplasmic reticulum, golgi, lysomes, vacuole, micro bodies, ribosomes, cytoskeleton. Membrane composition and theories. Cell theories.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS:

1. General reactions of carbohydrates. Specific reactions of different sugars: Xylose, Glucose, Fructose, Galactose, Sucrose, Maltose and Lactose, Starch and Cellulose.
2. General reactions of proteins and amino acids. Precipitation reactions of albumins andglobulins
3. General reactions of lipids and cholesterol
4. Isolation and estimation of cholesterol (from egg yolk) .
5. Isolation and estimation of glycogen/starch
6. Preparation of Casein from milk
7. Estimation of proteins in biological samples by Biuret/Folin-Lowry method
8. Estimation of aminoacid by Ninhydrin method
9. Extraction of Egg albumin
10. DNA extraction of Biological sources

RESOURCES

TEXT BOOKS:

1. Lehninger-Principles of Biochemistry, D. L. Nelson and M. M. Cox, Pub: W.H.Freeman, 5th Edition, 2008.
2. Fundamentals of Biochemistry-Life at molecular level, Donald Voet, Judith D Voet and Charlotte. W. Pratt, Pub: Wiley, Fifth edition, 2016.
3. Text book of Biochemistry, E. S. West, W. R. Todd, H. S. Mason and J. T. Vanbruggen, pub: Macmilan, 4th Edition, 1966.

REFERENCE BOOKS:

3. The Biochemistry of Nucleic acids, Adams et al., Pub: Springer, 11th Edition, 1992
4. An Introduction to Practical Biochemistry, Pub: McGraw Hill Education, W. T. Plummer, 3rd Edition, 2017

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=iuW3nk5EADg
2. https://www.youtube.com/watch?v=Fp1wKo72b2A
3. https://www.youtube.com/watch?v=OQfb6VTUGaY

WEB RESOURCES:

1. https://archive.nptel.ac.in/content/storage2/courses/104103071/pdf/mod11.pdf
2. https://www.youtube.com/watch?v=apaP9a079po

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22BS202005	**ENZYMOLOGY**	3	-	3	-	4.5

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to Introduction to Enzymes, Enzyme Kinetics, Enzyme Inhibition, Mechanism of Enzyme action, coenzymes, monomeric, oligomeric and allostearic enzymes, and hands on training mentioned in the Experiential learning techniques.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Understand the nature of enzyme, nomenclature of enzymes and mechanism of enzyme action

CO2 Analyze enzyme activity with the help of enzyme kinetics.

CO3 Identify different types of enzyme Inhibition, methods of inhibiting enzyme activity through which controlling of metabolic pathways involved in different disease states.

CO4 Gain knowledge in cofactors that help in enzyme action, different types of enzymes and their catalytic mechanisms.

CO5 Apply modern tools to assay enzyme activities and through which applications of enzymes in different fields. Also work independently and as well as in team to solve problems with effective communications.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes										Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	-	-	-	-	-	-	2	-	-
CO2	3	3	-	-	-	-	-	-	-	-	2	-	-
CO3	3	3	-	-	-	-	-	-	-	-	3	-	-
CO4	3	3	-	-	-	-	-	-	-	-	3	-	-
CO5	3	3	-	3	-	-	3	3	-	-	3	-	-
Course Correlation Mapping	**3**	**3**	**-**	**3**	**-**	**-**	**3**	**3**	**-**	**-**	**3**	**-**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO ENZYMES *(08 Periods)*

Nomenclature and classification of enzymes according to I.U.B. Convention, enzyme specificity and active site. Definition of Zymogen, Apoenzyme, Coenzyme, Cofactor and Zymogen activation. Reaction rates transition state theories free energy change

Module 2: ENZYME KINETICS *(07 Periods)*

Enzyme kinetics of single substrate reactions, study state assumption, Derivation of Michales-Menten (Briggs-Haldane) constant, Lineweavar Burk, EadieHofstee, Hanes plots. Effect of pH and temperature on enzyme activity.

Module 3 ENZYME INHIBITION *(10 Periods)*

Enzyme inhibition: Different types of Inhibition - Types of reversible inhibitors – competitive, non-competitive, un-competitive mixed inhibition and partial inhibition. Substrate inhibition, Feedback inhibition and allostearic inhibition.

Irreversible inhibition. Bi-substrate reactions, Sequential mechanism compulsory order and random order mechanism, non-sequential mechanism, Ping-pong mechanism.

Chemical nature of enzyme catalysis: General acid – base catalysis, electrostatic catalysis, covalent catalysis, intermolecular-catalysis, metal ion catalysis, and proximity and orientation.

Module 4 MECHANISM OF ENZYME ACTION AND COENZYMES *(10 Periods)*

Mechanism of reactions catalyzed by the following enzymes – Chymotrypsin, Trypsin, Carboxypeptidase, Ribonuclease and Lysozyme. Co-enzymes – the mechanistic role of the following co-enzymes in enzyme catalyzed reactions –Nicotinamide nucleotides, Flavin nucleotides, Co-enzymes A, Lipoic acid, Thiamine pyrophosphate,Biotin, Tetrahydrofolate and Co-enzyme B12. Modern concepts of evaluation of catalysis-catalytic RNA(Ribozyme), abzymes (catalytic antibodies), Synzymes (Synthetic enzymes), Site-directed mutagenesis.

Module 5 MONOMERIC, OLIGOMERIC AND ALLOSTEARIC ENZYMES *(10 Periods)*

Monomeric enzymes – the Serine proteases, Zymogen activation, Oligomeric enzymes – Isoenzymes, Lactate dehydrogenase (LDH) and multienzyme complexes (pyruvate dehydrogenase complex).

Covalent modification (Glycogen phosphorylase and Chymotrypsin).

Allosteary of enzyme action; Binding of ligands to proteins Co-operativity, the Hill Plot for Myoglobin and Hemoglobin, Study of ATCase a typical allostearic enzyme,

Sigmoidal kinetics: The MWC and KNF models. Significance sigmoidal behavior.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS:

1. Assay of Salivary Amylase
2. Kinetics of Salivary Amylase
3. Isolation and Assay of Urease from Horse-gram
4. Isolation and Assay of Acid Phosphatase from Potato
5. Alkaline Phosphatase assay from serum
6. Assay of Invertase from Yeast
7. Study of effect of temperature, pH, activators and inhibitors on enzyme activity
8. Assay of Trypsin
9. Assay of Liver SDH
10. Assay of LDH from Serum
11. Demonstration of Immobilization of enzymes

RESOURCES

TEXT BOOKS:

1. Understanding enzymes: Palmer T., Ellis Harwood ltd., 2001.
2. Enzyme structure and mechanism. Alan Fersht, Freeman & Co. 1998
3. Lehninger's Principles of Biochemistry. David L. Nelson and Michael M. Cox, W. H. Freeman publisher, 2004.

REFERENCE BOOKS:

1. Principles of enzymology for food sciences: Whitaker , John R. Routledge publisher, 2018.
2. Methods in enzymology Ed. Colowick and Kaplan, Academic Pr (Continuing series)
3. Enzyme kinetics Siegel interscience– Wiley 1976.
4. Practical Biochemistry by T Plummer

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=KCG5fDKr9HQ
2. https://www.youtube.com/watch?v=sa4QVjTpnF0
3. https://www.youtube.com/watch?v=6cGdWi_DSGk
4. http://bcs.whfreeman.com/WebPub/Biology/hillis1e/Animated%20Tutorials/at0302/at_0302_enzyme_catalysis.html

WEB RESOURCES

1. https://www.birmingham.ac.uk/teachers/study-resources/stem/biology/stem-legacy-enzymes.aspx

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22EE201001	RESEARCH METHODOLOGY	3	-	-	-	3

Pre-Requisite --

Anti-Requisite --

Co-Requisite --

COURSE DESCRIPTION:
The course is developed for the students' to understand the underlying concepts of research methodology and a systematic approach for carrying out research in the domain of interest. The course is emphasized on developing skills to recognize and reflect the strength and limitation of different types of research; formulation of the research hypothesis and its systematic testing methods. The course also emphasizes on interpreting the findings and research articulating skills along with the ethics of research.

COURSE OUTCOMES:*After successful completion of the course, students will be able to:*

CO1. Demonstrate the underlying concepts of research methodology, types of research and the systematic research process.

CO2. Demonstrate the philosophy of research design, types of research design and develop skills for a good research design.

CO3. Demonstrate the philosophy of formulation of research problem, methods of data collection, review of literature and formulation of working hypothesis.

CO4. Analyze the data and parametric tests for testing the hypothesis.

CO5. Interpret the findings and research articulating skills along with the ethics of research.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	-	-	-	-	-	-	2
CO2	3	3	-	-	-	-	-	-	2
CO3	3	3	-	-	-	-	-	-	2
CO4	3	3	-	-	-	-	-	-	3
CO5	3	3	-	3	-	-	3	3	2
Course Correlation Mapping	**3**	**3**	**-**	**3**	**-**	**-**	**3**	**3**	**2**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: Introduction to Research Methodology (08 Periods)

Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Research Process, Criteria of Good Research.

Module 2: Research Design (08 Periods)

Research design—Basic Principles, Need of research design, Features of good design, Important concepts relating to research design, Different research designs, Basic principles of experimental designs, Developing a research plan.

Module 3: Research Formulation (08 Periods)

Defining and formulating the research problem - Selecting the problem - Necessity of defining the problem - Importance of literature review in defining a problem – Data collection – Primary and secondary sources; Critical literature review – Identifying gap areas from literature review; Hypothesis— Types of hypothesis, Development of working hypothesis.

Module 4: Analysis of Data and Hypothesis Testing (14 Periods)

Quantitative Tools: Testing and Significance of Measures of Central Tendency, Dispersion; correlation, Principles of least squares—Regression; Errors-Mean Square error, Mean absolute error, Mena absolute percentage errors.
Testing of Hypothesis: Hypothesis Testing Procedure, Types of errors, Parametric testing (t, z and F), Chi-Square Test as a Test of Goodness of Fit; Normal Distribution- Properties of Normal Distribution; Analysis of Variance.

Module 5: Interpretation and Report Writing (07 Periods)

Interpretation: Meaning of interpretation; Techniques of interpretation; Precautions in Interpretation.
Report Writing –Significance, Different Steps, Layout, Types of reports, Mechanics of Writing a Research Report, Precautions in Writing Reports; Research ethics—Plagiarism, Citation and acknowledgement.

Total Periods: *45*

EXPERIENTIAL LEARNING

1. Should conduct a survey based on a hypothesis, analyze the data collected and draw the inferences from the data.
2. Should review the literature on the given topic and should identify the scope/gaps in the literature and develop a research hypothesis.
3. Should study a case, formulate the hypothesis and identify an appropriate testing technique for the hypothesis.
4. Study an article and submit a report on the inferences and should interpret the findings of the article.

RESOURCES

TEXT BOOKS:

1. C.R. Kothari, Research Methodology: Methods and Techniques, New Age International Publishers, 2nd revised edition, New Delhi, 2004.
2. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. *An introduction to Research Methodology*, RBSA Publishers.

REFERENCE BOOKS:

1. R. Panneerselvam, Research Methodology, PHI learning Pvt. Ltd., 2009.
2. Singh, Yogesh Kumar. *Fundamental of research methodology and statistics*. New Age International, 2006.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/121106007
2. https://onlinecourses.nptel.ac.in/noc22_ge08/preview
3. https://www.youtube.com/watch?v=VK-rnA3-41c

Web Resources:

1. https://www.scribbr.com/category/methodology/
2. https://leverageedu.com/blog/research-design/
3. https://prothesiswriter.com/blog/how-to-formulate-research-problem
4. https://www.formpl.us/blog/hypothesis-testing
5. https://www.datapine.com/blog/data-interpretation-methods-benefits-problems/
6. https://leverageedu.com/blog/report-writing/

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE201701	**DISASTER MANAGEMENT**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion ondisaster prone areas in India, repercussions of disasters and hazards, disaster preparedness and management, risk assessment and disaster management.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyze the vulnerability of an area to natural and man-made disasters/hazards as per the guidelines to solve complex problems using appropriate techniques ensuring safety, environment and sustainability.

CO2. Analyze the causes and impacts of disasters using appropriate tools and techniques and suggest mitigation measures ensuring safety, environment and sustainability besides communicating effectively in graphical form.

CO3. Suggest the preparedness measures using appropriate tools and techniques and suggest mitigation measures ensuring safety, environment and sustainability.

CO4. Analyze the Risk Assessment using appropriate tools and techniques and suggest mitigation measures ensuring safety, environment and sustainability.

CO5. Design disaster management strategies to solve pre, during and post disaster problems using appropriate tools and techniques following the relevant guidelines and latest developments ensuring safety, environment and sustainability besides communicating effectively in graphical form.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	-	2	2	2	2	2	-	-	-	-
CO2	3	3	-	2	2	2	2	-	-	2	-	-
CO3	3	3	-	2	2	2	2	-	-	-	-	-
CO4	3	3	-	3	2	2	2	-	-	-	-	-
CO5	3	2	3	2	2	2	1	2	-	1	3	2
Course Correlation Mapping	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**-**	**2**	**3**	**2**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: DISASTER PRONE AREAS IN INDIA ***(09 Periods)***

Introduction: Disaster: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types And Magnitude.**Disaster Prone Areas:**Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics.

Module 2: REPERCUSSIONS OF DISASTERS AND HAZARDS ***(09 Periods)***

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

Module 3: DISASTER PREPAREDNESS AND MANAGEMENT ***(11 Periods)***

Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

Module 4: RISK ASSESSMENT ***(08 Periods)***

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

Module 5: DISASTER MANAGEMENT ***(08 Periods)***

Disaster management organization and methodology, Disaster management cycle, Disaster management in India – Typical cases and Cost–benefit analysis, Disaster management programs implemented by NGOs and Government of India, Usage of GIS and Remote sensing techniques in disaster management, Leadership and Coordination in Disaster management, Emerging trends in disaster management.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Perform hazard assessment and vulnerability analysis for any nearby town/city and prepare a detailed report of possible impacts of various disasters on environment, infrastructure and development.
2. Prepare a detailed report on the causes and effects of Tsunami that was occurred in the year 2004. Also discuss various advancements in Tsunami warning systems.
3. Identify the major causes of urban floods in cities like Chennai, Hyderabad & Mumbai. Also list various mitigation strategies to reduce the impact of floods.
4. Prepare a detailed report on how various man-made activities are directly/indirectly related to the occurrence of landslides that occurred in recent days in India.
5. Visit AP State Disaster Response and Fire Services Department and record about various methods used by them in mitigating disasters and their management.

RESOURCES

TEXT BOOKS:

1. Sharma V. K., *Disaster Management, Medtech Publishing, 2nd Edition, 2013*.
2. Anand S. Arya, AnupKaranth, and Ankush Agarwal, *Hazards, Disasters and Your Community: A Primer for Parliamentarians*, GOI–UNDP Disaster Risk Management Programme, Government of India, National Disaster Management Division, Ministry of Home Affairs, New Delhi, Version 1.0, 2005

REFERENCE BOOKS:

1. Donald Hyndman and David Hyndman, *Natural Hazardsand Disasters*, Cengage Learning, USA, 5th Edition, 2015.
2. *Disaster Management in India,* A Status Report, Ministry of Home Affairs, Govt. of India, May 2011.
3. Rajendra Kumar Bhandari, *Disaster Education and Management: A Joyride for Students, Teachers, and Disaster Managers*, Springer India, 2014.
4. Singh R. B., *Natural Hazards and Disaster Management*, Rawat Publications, 2009.
5. R. Nishith, Singh AK, *Disaster Management in India: Perspectives, issues and strategies,* New Royal book Company.
6. Sahni, PardeepEt.Al. (Eds.), *Disaster Mitigation Experiences And Reflections*, Prentice Hall of India, New Delhi.
7. Goel S. L. , *Disaster Administration And Management Text And Case Studies*, Deep &Deep Publication Pvt. Ltd., New Delhi

VIDEO LECTURES:

1. https://nptel.ac.in/courses/105104183
2. https://www.digimat.in/nptel/courses/video/124107010/L01.html

Web Resources:

1. https://egyankosh.ac.in/handle/123456789/25093
2. https://www.egyankosh.ac.in/handle/123456789/25912
3. https://www.nios.ac.in/media/documents/333courseE/12.pdf
4. https://ndmindia.mha.gov.in/images/public-awareness/Primer%20for%20Parliamentarians.pdf

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22BS202007	**BIOINFORMATICS AND ITS APPLICATIONS**	3	-	3	-	4.5

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to Bioinformatics and Biological databases, nucleotide sequence analysis, RNA structure analysis, protein sequence analysis and modelling of proteins and statistical methods in bioinformatics and hands on training in the different sequence and structural analysis tools used for different biomolecules.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Understand databases, genomics, proteomics and identify databases to search for data related to sequences and structures.

CO2 Analyze nucleotide sequences to find polymorphism related abnormalities which help in better treatment strategies.

CO3 Understand different types of RNA's and analyze RNA structures to know their role in gene regulation.

CO4 Evaluate Protein sequences, structures and also model structures using different tools for understanding their function.

CO5 Evaluate sequences to identify Phylogenetic relationship between different organisms and species. Also work independently and in team to perform practical.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3
CO2	3	3	-	3	-	-	-	-	-	-	-	-	3
CO3	3	3	-	3	-	-	-	-	-	-	-	-	3
CO4	3	3	-	3	-	-	-	-	-	-	-	-	3
CO5	3	3	-	3	-	-	3	3	-	-	-	-	3
Course Correlation Mapping	**3**	**3**	**-**	**3**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**3**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO BIOINFORMATICS AND BIOLOGICAL DATABASES ***(08 Periods)***

Introduction to Bioinformatics, Emerging areas of Genomics and Proteomics, Biological databases and their management – Protein Sequence databases, Protein structure databases, DNA databases, Restriction enzyme databases, drug databases.

Module 2: NUCLEOTIDE SEQUENCE ANALYSIS ***(10 Periods)***

Nucleotide Sequence Analysis**-**Introduction to whole genome analysis, restriction site checks, Sequence assembly, finding overlaps and contigs, shotgun projects, walking primers, ORF analysis, Identification of transcription signals and other sequence patterns, Coding region identification, EST analysis, SNP analysis.

Module 3: RNA STRUCTURE AND ANALYSIS ***(08 Periods)***

Different types of RNA, si-RNA design and development, micro RNA identification strategies, RNA secondary structure, RNA structure Prediction Methods, Introduction to Small nuclear RNAs, Applications of Small nuclear RNA.

Module 4: PROTEIN SEQUENCE ANALYSIS AND MODELING OF PROTEINS ***(10 Periods)***

Protein sequence analysis. Structural properties- Secondary structures, Hydrophobic patterns, structural motifs, Post translational modifications, Folding domain motifs, protein families. Principles of Protein Structure - Secondary Structure prediction methodologies, Threading methods Protein Folds, protein domains, Tertiary structure prediction, Modelling Of Proteins **-** Homology Modelling of proteins- methodology and applications Ab initio-protein structure prediction.

Module 5: STATISTICAL METHODS IN BIOINFORMATICS ***(9 Periods)***

Dynamic programming methods- derivation and algorithms, Sequence Alignment concepts, Pair-wise alignment, Heuristic alignments, Multiple alignment, Matrices (PAM, BLOSUM) Statistics and Scoring systems.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Introduction to Databases and Database searching
2. Sequence searching and analysis
3. Pair wise sequence analysis and Multiple sequence analysis
4. Color scheme for Multiple sequences
5. Identification of Genes using different programs
6. Secondary structure prediction tools.
7. Molecular viewers
8. Different tools used for Docking.
9. Primer Design and Tm prediction tools.
10. Protein Characterization tools-Molecular weight, PI, Hydrophobicity.

RESOURCES

1. Zoe Lacroix and Terence Critchlow, Bioinformatics, Morgan Kaufmann Publishers, 1st edition, 2003.
2. OrpitaBosu, Bioinformatics, Oxford University press, 1st edition, 2007.

REFERENCE BOOKS:

1. David W Mount, Bioinformatics: Genome and sequence analysis, , CBS Publications, New Delhi,2nd edition, 2004.
2. Igor F. Tsigelny, Protein Structure Prediction, Bioinformatics approach, , TBS the Book service Ltd., 1st edition, 2002.

VIDEO LECTURES:

1. http://www.nitttrc.edu.in/nptel/courses/video/102106065/L24.html
2. http://www.nitttrc.edu.in/nptel/courses/video/102106065/L14.html
3. https://nptel.ac.in/courses/102101076
4. https://www.youtube.com/watch?v=MX6lOh-KYXo

WEB RESOURCES:

1. https://www.youtube.com/watch?v=TZaA_-4j19w
2. https://www.youtube.com/watch?v=mMS6ZZVeB_8

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22BS202002	**MICROBIAL GENETICS ANDRDNA TECHNOLOGY**	**3**	**-**	**3**	**-**	**4.5**

Pre-Requisite 22BS202001 - GENERAL MICROBIOLOGY

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Nucleic acids, DNA Replication and Genetic exchange, Mutation, Plasmids & Transposable elements, Gene expression in Prokaryotes, Introduction to rDNA technology and Tools and applications of rDNA technology, and hands on training in the different methods used in rDNA technology.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Understand basics of Nucleic acid structure and function.

CO2 Explain the processes behind mutations and other genetic changes.

CO3 Identify and distinguish genetic regulatory mechanisms at different levels

CO4 Learn the Technical know-how on versatile techniques in recombinant DNA technology.

CO5 Understand and identify different tools used for rDNA technology, perform experiments related to rDNA technology. Also work independently and in team to perform practicals

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	-	-	-	-	-	-	3	-	3	-
CO2	3	3	3	-	-	-	2	-	-	3	-	3	-
CO3	3	3	-	-	-	-	-	-	-	3	-	3	-
CO4	2	3	3	-	-	-	-	2	-	3	-	3	-
CO5	3	3	-	-	-	-	-	3	-	3	-	3	-
Course Correlation Mapping	**3**	**3**	**3**	**-**	**-**	**-**	**2**	**2**	-	**3**	-	**3**	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: Nucleic Acids, DNA Replication & Genetic Exchange ***(06 Periods)***

Nucleic Acids: Structure, physical and chemical properties of DNA and RNA, extra-chromosomal DNA profile, function and evolution. DNA replication, damage and repair, spontaneous and induced mutation, reversion of mutation. Transformation- Discovery, mechanism of natural competence. Conjugation-discovery, mechanism, Transformation of E.coli (xl1-blue) cells by the plasmid DNA (puc-19), Transduction-Types of transduction

Module 2: Mutation, Plasmids& Transposable elements ***(14 Periods)***

Mutation: Genome organization of Escherichia coli, Saccharomyces. Mutations and mutagenesis: Definition and types of Mutations; Physical and chemical mutagens; Molecular basis of mutations; Functional mutants (loss and gain of function mutants); Uses of mutations & Ames Test. Plasmid genetics: Types of plasmids- F plasmid, R Plasmids, Ti plasmids, linear plasmids, Plasmid replication, amplification and Regulation of copy number. Prokaryotic transposable elements-Insertion Sequences, composite and non-composite transposons, Replicative and Non replicative transposition.

Module 3 Gene expression in Prokaryotes ***(11 Periods)***

General aspects of Gene Regulation, Expression of cloned genes in prokaryotes, factors influencing gene expression of cloned genes. Problems associated with heterologous gene expression. Design of Vectors for the over expression of recombinant proteins: Selection of suitable promoter sequences, fusion protein tags, protease cleavage sites and enzymes, inducible expression systems; Expression vectors (pET-based Vectors &pBAD Vectors), Protein purification, His-tag, gst-tag etc.Signal transduction in microbes.

Module 4 Introduction to rDNA Technology ***(7 Periods)***

Cloning tools and DNA modifying enzymes, Cloning vectors; expression vectors, bacteriophage lambda vectors &Mammalian expression vectors. Gene conversion.Genomic and cDNA libraries: construction and uses.

Module 5 Tools &Applications of rDNA Technology ***(7 Periods)***

DNA Sequencing, Chemical synthesis of DNA by Phosphoramidite method. Labeling of DNA. Products of recombinant DNA technology: Products of human therapeutic interest - insulin, hGH, antisense molecules. Bt transgenic - Cotton, Gene therapy, recombinant vaccines.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS:

1. Preparation of Master and Replica Plates
2. Study survival curve of bacteria after exposure to ultraviolet (UV) light
3. Isolation of Plasmid DNA from E.coli
4. Study different conformations of plasmid DNA through Agarose gel electrophoresis.
5. Demonstration of Bacterial Conjugation
6. Demonstration of bacterial transformation and transduction
7. Demonstration of AMES test
8. Study the effect of chemical (HNO_2) and physical (UV) mutagens on bacterial cells

RESOURCES

TEXT BOOKS:

1. Krebs J, Goldstein E, Kilpatrick S (2013). Lewin's Essential Genes, 3rd Ed., Jones and Bartlett Learning.
2. Watson JD, Baker TA, Bell SP et al. (2008) Molecular Biology of the Gene, 6th Ed.

3. Experimental techniques in bacterial geneticsBy Stanley R. Maloy · 1990
4. Recombinant DNA Techniques Lab Manual. Lisa McDonnell*et al*., 2021

REFERENCE BOOKS:

1. Klug WS, Cummings MR, Spencer, C, Palladino, M (2011). Concepts of Genetics, 10th Ed., Benjamin Cummings
2. Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press.

VIDEO LECTURES:

1. https://onlinecourses.swayam2.ac.in/cec22_bt05/preview
2. https://onlinecourses.nptel.ac.in/noc22_bt59/preview
3. https://www.youtube.com/watch?v=mg6tXQaiBaI

WEB RESOURCES:

1. http://faculty.collin.edu/mweis/Microbiology/Lecture/Micro%20Lecture%20Notes/micro_lecture_notes_genetics_BITC.htm
2. https://bio.libretexts.org/Bookshelves/Microbiology/Microbiology_(Boundless)/07%3A_Microbial_Genetics
3. https://pubmed.ncbi.nlm.nih.gov/
4. http://www.microbes.info/
5. http://www.microbiol.org/
6. https://open.oregonstate.education/generalmicrobiology/chapter/microbial-genetics/

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22BS202006	**BIOPROCESS TECHNOLOGY**	3	-	3	-	4.5

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to bioprocesses, General concepts and application of fermentation, Media design, Role of diffusion in Bioprocessing and Kinetics of microbial growth and product formation.It also highlights the application of fermentation in biotechnological industry.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Understand the overview of traditional and modern applications of biotechnology industry including integrated bioprocess and its different unit of operations.

CO2 Understand and remember the general concepts and application of fermentations process; kinetics of sterilization

CO3 Design the fermentation media based on different bioprocess operations; and analysis different types of quantitative analysis to study the microbial growth.

CO4 Analysis and interpret the role of diffusion in bioprocessing and different microbial growth expressions

CO5 Apply modeling and simulation of bioprocesses so as to reduce costs and to enhance the quality of products and systems.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	-	-	-	-	-	-	3	-	-
CO2	3	3	-	-	-	-	-	-	-	-	3	-	-
CO3	3	3	-	-	-	-	-	-	-	-	3	-	-
CO4	3	3	-	-	-	-	-	-	-	-	3	-	-
CO5	3	3		3	-	-	3	-	-	-	3	-	-
Course Correlation Mapping	**3**	**3**	**-**	**3**	-	-	**3**	**-**	-	**-**	**3**	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO BIOPROCESSES ***(08 Periods)***

An overview of traditional and modern applications of biotechnology industry, outline of an integrated bioprocess and the various (upstream and downstream) unit operations involved in bioprocesses, generalized process flow sheets.

Module 2: GENERAL CONCEPTS AND APPLICATION OF FERMENTATION ***(10 Periods)***

Fermentation- general concepts, applications, and structure of a fermenter; Range of fermentation process- microbial biomass, enzymes, metabolites, recombinant products, transformation process; Components of fermentation process. Types of fermentations- aerobic and anaerobic fermentation, submerged and solid-state fermentation, factors affecting submerged and solid-state fermentation, substrates used in solid-state fermentation and its advantages; Sterilization and its kinetics: Batch and continuous sterilization

Module 3: : MEDIA DESIGN ***(07 Periods)***

Medium requirements for fermentation processes, oxygen requirements, medium formulation for optimal growth and product formation, commercial media for industrial fermentations, Media Preparation, Media design and optimization. Microbial growth patterns and kinetics in batch culture, Microbial growth parameters, and Environmental conditions affect growth kinetics, Kinetics of thermal death of microorganisms, Heat Generation by microbial growth, Quantitative analysis of microbial growth by direct & indirect methods.

Module 4: ROLE OF DIFFUSION IN BIOPROCESSING ***(10 Periods)***

Convective mass transfer, Gas-liquid mass transfer, Oxygen uptake in cell cultures, Factor affecting cellular oxygen demand, Oxygen transfer in bioreactors, Measurement of volumetric oxygen transfer coefficient, Oxygen transfer in large bioreactor.

Module 5: Kinetics of microbial growth and product formation ***(10 Periods)***

Phases of cell growth in batch cultures, Simple unstructured kinetic models for microbial growth, Monod model, Growth of filamentous organisms. Growth associated (primary) and non – growth associated (secondary) product formation Kinetics. Leudeking – Piret models, substrate and product inhibition on cell growth and product formation. Introduction to Structured Models for growth and product formation.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXPERIEMNTS

1. Culture transfer techniques, Isolation of pure cultures
2. Microbial isolation and screening
3. Bacterial staining
4. Bacterial growth curve studies
5. Bacterial growth curve studies
6. Citric Acid Production and Quantification
7. Production of Wine
8. Determination of KLa by Sulphite Oxidation methods.

RESOURCES

TEXT BOOKS:

1. Principles of Microbe and cell cultivation- John S.P. Blackwell Scientific Publications. xford Press, London. 1975.
2. Bioprocess Engineering Principles. Doran P.M. 2nd Ed. Academic Press.Waltham. USA. 2012.
3. Hand Book of Bioengineering- Skalak R & Shu Chien, 4th ed.

REFERENCE BOOKS:

1. Principles of fermentation technology. Stanbury P.F. & Whitaker A. Pergamon press. Oxford. 1984.
2. Biotechnology: A Textbook of Industrial Microbiology. WulfCruger& Anneliese C. Panima Publishing Corporation New Delhi, India. 2003.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=SsozxmGX6cM&t=29s
2. https://www.youtube.com/watch?v=sa4QVjTpnF0
3. https://www.youtube.com/watch?v=mUDXupn2Dhk
4. https://www.youtube.com/watch?v=5eKdZ0dVCCo&t=195s
5. https://www.youtube.com/watch?v=p2kK-mrtXzw&t=744s

WEB RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc21_bt27/preview
2. https://onlinecourses.nptel.ac.in/noc22_bt36/preview

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22BS202009	**IMMUNOLOGY AND IMMUNOTECHNOLOGY**	3	-	3	-	4.5

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion onIntroduction to Immune system, Molecular Immunology and Major Histocompatibility complex, Cellular Immunology and Immunopathology, Therapeutic immunology and Immunotechnology, and hands on training mentioned in the Experiential learning techniques.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Understand Immune system, stem cells and its clinical uses

CO2 Understand and identify immune reactions and Major histocompatibility complex

CO3 Identify the cells involved in Immunity and reasons for immune disorders

CO4 construct the knowledge of immunology into clinical decision-making through case studies

CO5 Gain knowledge tojjustify the experiments and techniques employed in relevant fields of immunological research and disease diagnosis.Also work independently and as well as in team to perform practical.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	3	3	-	-	-	-	-	-	-	3	3	-	-
CO2	3	3	-	-	-	-	-	-	-	3	3	-	-
CO3	3	3	-	-	-	-	-	-	-	3	3	-	-
CO4	3	3	-	-	-	-	-	-	-	3	3	-	-
CO5	3	3	-	-	-	-	3	-	-	3	3	-	-
Course Correlation Mapping	**3**	**3**	**-**	**-**	**-**	**-**	**3**	**-**	-	**3**	**3**	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: Introduction to the Immune System ***(06 Periods)***

Overview of the immune system, Innate and Adaptive immunity, Hematopoiesis, hematopoietic growth factors and regulation. Cells and organs of the immune system. Stem cells and its clinical uses.

Module 2: Molecular Immunology&Major Histocompatibility Complex ***(09 Periods)***

Antigens, structure of antigen and its different types. Antibody structure and types. Antigenprocessing and presentation, mechanism of antigen recognition

MHC organization – Class I, II and III and MHC restriction. Complement system, pathways.Biological consequences and diseases, Cytokines

Module 3 Cellular immunology& Immunopathology: ***(10 Periods)***

Biology of T and B-lymphocytes, T helper cells, Cytotoxic T cells.molecules associated with membrane immunoglobulin and T cells. Importance of co-stimulatory molecules involved in B and T cell activation.

Autoimmunity and autoimmune disorders, Hypersensitivity reactions, transplantation and tumor. Immunology, Immunotherapy for tumors and autoimmune disorders, immunodeficiency diseases.

Module 4 Therapeutic Immunology: ***(10 Periods)***

Vaccines, active and passive immunization, DNA and plant based vaccines, AIDS vaccine,

Recombinant antigen as vaccine, Monoclonal antibodies and their use in diagnosis.

Module 5 Immunotechnology: ***(10 Periods)***

Antigen Antibody Reactions: In Vitro Tests- Precipitation, Immune-Electrophoresis,Heamagglutination, Labeled Antibody (RIA ELISA And Immuno – Fluroscent Techniques)ABO Blood Grouping RHTyping. Application Of Immunological Techniques: Hybridoma Technology: Fusion Of MyelomaCells With Lymphocytes, Production Of Monoclonal Antibodies And Their Applications. HumanMonoclonals Catalytic Antibodies And Plantibodies

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXPERIEMNTS

1. Blood Grouping
2. Differential Leukocyte Count
3. Total Leukocyte Count
4. Widal Test
5. Rapid Plasma Reagin (RPR) Test
6. Single Radial Immunodiffusion (SRID)
7. Ouchterlony Double Diffusion
8. Rocket Immuno Electrophoresis
9. Counter Current Immunoelectrophoresis
10. Enzyme Linked Immunosorbent Assay (ELISA) – DOT
11. Enzyme Linked Immunosorbent Assay (ELISA) – Plate
12. Immunoprecipitation
13. Western Blotting

RESOURCES

TEXT BOOKS:

1. Immunology, 7th edition. By Owen, Punt and Stranford Textbook, Janis Kuby (2013). W.H freeman and company.
2. Roitt's Essential Immunology (Essentials), Peter Delves, Seamus Martin, Dennis Burton, Ivan Roitt (2006). Wiley-Blackwell.

REFERENCE BOOKS:

1. Chapel H, Haeney M, Misbah S and Snowden N,(2014) Essentials of Clinical Immunology 6th Edition, Wiley Blackwell
2. Kenneth Murphy and Casey Weaver (2016), Janeway' s Immunobiology – The Immune system in Health and disease, 9th edition, Garland Science Publishing (Taylor and Francis Group).
3. Abbas AK, Lichtman AH, Pillai S (2011) Cellular and molecular immunology, 8th edition, Elsevier Health Sciences
4. Laboratory Manual on Immunology and Molecular Biology (2013). Deepak Dwivedi, Lambert Academic Publishing, ISBN10: 3659455806
5. Immunology: Overview and Laboratory Manual (2021). Tobili Y. Sam-Yellowe, Springer Cham, 978-3-030-64686-8

VIDEO LECTURES:

1. Fundamentals of Basic Immunology Specialization – Coursera https://www.coursera.org/specializations/immunology
2. Immunology – Swayam https://onlinecourses.swayam2.ac.in/cec19_bt14/preview

WEB RESOURCES:

1. https://archive.nptel.ac.in/content/storage2/courses/102103038/download/module1.pdf
2. https://archive.nptel.ac.in/content/storage2/courses/102103038/download/module2.pdf
3. https://archive.nptel.ac.in/content/storage2/courses/102103038/download/module3.pdf
4. https://microbenotes.com/category/immunology/

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22BS206002	**MEDICAL WRITING**	-	-	2	4	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: The main objective of Medical Writing course is to improve the job prospects for students of Life sciences thereby enabling them to meet the growing demand of skilled manpower for the Pharma, Healthcare, Life Sciences, and Biomedical industries.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Students should be able to impart knowledge about Medical Writing and new drug development process.

CO2 Students will be awareabout Clinical Research and the latest techniques and trends in the industry.

CO3 Students will learn regulations governing clinical trials and should develop the potential of Scientific writing.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Specific Outcomes									Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	-	-	-	-	-	-	3	-	3	-
CO2	3	3	3	-	-	-	2	-	-	3	-	3	-
CO3	3	3	-	-	-	-	-	-	-	3	-	3	-
Course Correlation Mapping	**3**	**3**	**3**	**-**	**-**	**-**	**2**	**2**	-	**3**	-	**3**	-

Correlation Levels: 3: High; 2: Medium; 1: Low

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS:

1. Reports on Healthcare communication and Medical Writing
2. Researching for the content, Copyrights, Plagiarism & Scientific Writing.
3. Regulatory writing/Clinical trial writing&Drug Development Process – Clinical Design
4. Clinical drug development phases (Case studies – Phase 0)
5. Clinical drug development phases (Case studies – Phase 1)
6. Clinical drug development phases (Case studies – Phase 2)
7. Clinical drug development phases (Case studies – Phase 3)
8. Clinical drug development phases (Case studies – Phase 4)
9. Regulations Governing Clinical Trials.

10. Medical/Clinical Trail Document writing.
11. Case study – Mini Project
12. Publication writing.

PROJECT BASED LEARNING:

Projects relevant to the contents of the course will be provided by the course instructor at the beginning.

RESOURCES

TEXT BOOKS:

1. Julia Lloyd and Ann Raven, Handbook of clinical research. Ed. Churchill Livingstone c. 1994
2. Effective Medical Writingby Buckingham 2017

REFERENCE BOOKS:

1. Recent Central Drugs Standard Control Organization. Good Clinical Practices-Guidelines for Clinical Trials on Pharmaceutical Products in India. New Delhi: Ministry of Health; 2013,2017.
2. Ethical Guidelines for Biomedical Research on Human Subjects 2000, 2014, 2017. Indian Council of Medical Research, New Delhi.

VIDEO LECTURES:

1. https://www.coursera.org/learn/sciwrite?trk_location=query-summary-list-link
2. https://www.youtube.com/watch?v=Ly7v-Zul9uY
3. https://www.youtube.com/watch?v=E0f7tt3bsgY

WEB RESOURCES:

1. https://www.hilarispublisher.com/open-access/essentials-of-medical-writing-2157-7420-1000186.pdf
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3149406/
3. https://www.nih.gov/health-information/nih-clinical-research-trials-you/basics
4. https://www.fda.gov/patients/clinical-trials-what-patients-need-know/basics-about-clinical-trials
5. https://www.bumc.bu.edu/endo/research/clinical-research-basics/
6. https://www.henryharvin.com/blog/medical-writer-interview-questions-and-answers/

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22BS201004	ADVANCED CLINICAL AND PHARMACEUTICAL TECHNIQUES	4	-	-	-	4

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion Drug discovery, Drug development, Drug commercialization, Design and conducting trials and Molecular spectroscopy.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Understand methods of drug discovery and key concepts in Drug delivery.

CO2 Gain knowledge on thedifferent phases in the drug development process.

CO3 Identify methods used for commercialization of drugs and marketing strategies.

CO4 Understand the design of conducting clinical trials and ethical aspects.

CO5 Familiarize with basic principle, instrumentation and applications of various spectroscopic techniques.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Specific Outcomes									Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	3	3	-	1	-	-	1	-	1	3	3	3	1
CO2	3	3	-	1	-	-	1	-	1	3	2	3	1
CO3	3	3	-	1	-	-	1	-	1	3	3	3	1
CO4	3	3	-	1	-	-	1	-	1	3	3	3	1
CO5	3	3	-	1	-	-	1	-	1	3	3	3	1
Course Correlation Mapping	**3**	**3**	**-**	**1**	**-**	**-**	**1**	**-**	**1**	**3**	**3**	**3**	**1**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: DRUG DISCOVERY *(12 Periods)*

Pharmaceutical and Biotechnology industry Landscape, Drug discovery- Proteomics and Genomics, Compound selection and Preclinical studies, Challenges in Fragment based drug discovery for Protein Kinases, Key concepts in Drug delivery.

Module 2: DRUG DEVELOPMENT *(12 Periods)*

Regulatory considerations during filing of Investigational New drug Application, Clinical study and startup activities, Clinical trial Phase I, Clinical trial Phase II, Clinical trials Phase III, New drug application filing, product labeling.

Module 3: DRUG COMMERCIALIZATION ***(12 Periods)***

Pharmacoeconomics in drug development, Intellectual property strategy, Marketing Pharmaceuticals and Biotechnology drugs, Managing Market and sales strategy, Stragetic alliance between Industry and Academia, Business Models and Portfolio management from startup to success in Biotech.

Module 4: DESIGN AND CONDUCTING CLINICAL TRIALS ***(12 Periods)***

Types of trial designs, Randomization and masking, Outcomes and analysis, Regulatory affairs and trial misconduct, standardization, transparency and research reproducibility, Clinical trial sample size, trial monitoring, Analyzing trials and advanced topics.

Module 5: INTRODUCTION TO MOLECULAR SPECTROSCOPY ***(12 Periods)***

UV-Visible spectroscopy: Principle, instrumentation and applications.
Infrared-spectroscopy: Principle, Instrumentation, and Applications.
NMR: Basic principles, elementary ideas and instrumentation, chemical shifts, spin-spin coupling, and applications

Total Periods: 60

EXPERIENTIAL LEARNING

1. Prepare a document on the Clinical trials carrying by India pharmaceutical
2. Quiz regarding IPR and drug marketing strategies
3. Seminars on the current drug development strategies
4. Outline the methods used in the development of COVID vaccine
5. The role of Indian scientists in the drug development
6. Submit a document on role of instrumental techniques in drug designing

RESOURCES
TEXT BOOKS:

1. K. Stromgaard, P. Krogsgaard and U. Madsen. Drug design and discovery, 5th edition, CRC Press, 2022.
2. K. Wilson and J. Walker, Principles and techniques of Biochemistry and Molecular Biology,7th edition, Cambridge University press, 2010.

REFERENCE BOOKS:

1. R. G. Hill and D. Richards, Drug discovery and development, 3rd edition, Elsevier publications, 2021.
2. G.Gauglitz, and D. S. Moore, Handbook of Spectroscopy: Wiley publications 2nd, Enlarged Edition, 2014

VIDEO LECTURES:

1. https://nptel.ac.in/courses/102106070
2. https://nptel.ac.in/courses/104105120
3. https://archive.nptel.ac.in/courses/104/101/104101135/
4. https://www.youtube.com/watch?v=CcQfJXlAlbw
5. https://archive.nptel.ac.in/courses/104/101/104101135/

Web Resources:

1. https://nptel.ac.in/courses/103108100
2. https://archive.nptel.ac.in/courses/103/108/103108100/

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22LG201701	**PERSONALITY DEVELOPMENT**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course gives awareness to students about the various dynamics of personality development.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate knowledge in Self-Management and Planning Career

CO2. Analyze the functional knowledge in attitudes and thinking strategies

CO3. Learn and apply soft skills for professional success.

CO4. Function effectively as an individual and as a member in diverse teams

CO5.Communicate effectively in public speaking in formal and informal situations.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	2	1	-	-	-	-	-	-	-
CO2	2	3	-	-	-	-	-	-	-
CO3	2	2	-	-	3	-	-	-	-
CO4	1	1	-	-	-	-	-	-	3
CO5	-	-	-	-	-	-	-	-	-
Course Correlation Mapping	**2**	**2**	**3**	**-**	**3**	**-**	**-**	**-**	**3**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: SELF-ESTEEM & SELF-IMPROVEMENT ***(09 Periods)***

Know Yourself – Accept Yourself; Self-Improvement: Plan to Improve - Actively Working to Improve Yourself- Exercises- case studies

Module 2: DEVELOPING POSITIVE ATTITUDES ***(09 Periods)***

How Attitudes Develop – Attitudes are Catching – Improve Your Attitudes – Exercises- case studies

Module 3 SELF-MOTIVATION & SELF-MANAGEMENT ***(09 Periods)***

Show Initiative – Be Responsible Self-Management; Efficient Work Habits – Stress Management – Employers Want People Who can Think – Thinking Strategies- Exercises- case studies

Module 4 GETTING ALONG WITH THE SUPERVISOR ***(09 Periods)***

Know your Supervisor – Communicating with your Supervisor – Special Communication with your Supervisor – What Should you Expect of Your Supervisor? – What your Supervisor expects of you - Moving Ahead Getting Along with your Supervisor- Exercises- case studies

Module 5 WORKPLACE SUCCESS ***(09 Periods)***

First Day on the Job – Keeping Your Job – Planning Your Career – Moving Ahead- Exercises- case studies

Total Periods: 45

EXPERIENTIAL LEARNING

1. List out the self-improvements in you on the charts and explain in detail.
2. Discuss different famous personalities and their attitudes.
3. Describe different personalities with respect to self-motivation and self-management.
4. Imagine you are a supervisor and illustrate different special communications.
5. Assume and Interpret different experiences on the first day of your job.

RESOURCES

TEXTBOOK:

1 Harold R. Wallace and L. Ann Masters, *Personal Development for Life and Work*, Cengage Learning, Delhi, 10th edition Indian Reprint, 2011. (6th Indian Reprint 2015)

2 Barun K. Mitra, *Personality Development and Soft Skills,* Oxford University Press, 2011.

REFERENCE BOOKS:

1 K. Alex, *Soft Skills*, S. Chand & Company Ltd, New Delhi, 2nd Revised Edition, 2011.

2 Stephen P. Robbins and Timothy A. Judge*, Organizational Behaviour*, Prentice Hall, Delhi, 16th edition, 2014

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=6Y5VWBLi1es
2. https://www.youtube.com/watch?v=H9qA3inVMrA

Web Resources:

1. https://www.universalclass.com/.../the-process-of-perso...
2. https://www.ncbi.nlm.nih.gov/pubmed/25545842
3. https://www.youtube.com/watch?v=Tuw8hxrFBH8

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22MG201601	**PROJECT MANAGEMENT**	2	-	-	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite

COURSE DESCRIPTION: To understand the importance of decision-making while implementing any project and interpret and discuss the results of qualitative and quantitative analysis

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Understand the basic introduction to project management

CO2 Apply the methods of project identification and selection.

CO3 Understand project allocation methods and evaluation.

CO4 Analyse the techniques for project time, review, and cost

CO5 Understand the factors of risk and quality of a project.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	2	1	2	1	-	-	-	-	-
CO2	1	1	2	2	-		2		1
CO3	2	2	1	2	1	-	-	1	-
CO4	3	1	2	2	1	-	-	-	-
CO5	2	2	1	2	1	1	-	-	-
Course Correlation Mapping	**2**	**2**	**2**	**2**	**1**	**1**	**2**	**1**	**1**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: Introduction ***(05 Periods)***

Concept of project management, project definition and key features of projects, project life cycle phases, typical project management issues, basic project activities

Module 2: Project Identification and Selection ***(06 Periods)***

Identification and screening (brainstorming, strength and weakness in the system, environmental opportunities and threats), Project evaluation methods- Payback period, Net present value, Internal rate of return and project evaluation under uncertainty.

Module 3: Project Resource Management ***(07 Periods)***

Scheduling resources, resource allocation methods, project crashing and resource leveling, working of systems, design of systems, project work system design, project execution plan, project procedure manual project control system, planning scheduling and monitoring

Module 4: Time and Cost Management ***(05 Periods)***

Time Management-Network diagram, forward and backward pass, critical path, PERT and CPM, AOA and AON methods, tools for project network, Cost management-earned value method

Module 5: Risk and Quality Management ***(07 Periods)***

Risk identification, types of risk, risk checklist, risk management tactics, risk mitigation and contingency planning, risk register, communication management, Quality assurance and quality control, quality audit, methods of enhancing quality

Total Periods: 30

EXPERIENTIAL LEARNING

1. Refer to any video lecture on project evaluation methods and give a brief seminar using PPT
2. Select any company wherein you will get the details of activities and time and draw the project network diagram and submit a report.
3.

Activity	Predecessor Activity	Normal Time (Weeks)	Crash Time (Weeks)	Normal Cost (Rs.)	Crash Cost (Rs.)
A	-	4	3	8,000	9,000
B	A	5	3	16,000	20,000
C	A	4	3	12,000	13,000
D	B	6	5	34,000	35,000
E	C	6	4	42,000	44,000
F	D	5	4	16,000	16,500
G	E	7	4	66,000	72,000
H	G	4	3	2,000	5,000

   Determine a crashing scheme for the above project so that the total project time is reduced by 3 weeks
4. Collect any case study that discusses the process of probability calculation of success of the project and submit a report

RESOURCES

TEXT BOOKS:

1. R.Panneerselvam and P.Senthil Kumar (2013), Project Management, PHI Learning Private Limited.
2. Prasanna Chandra (2014), Projects: Planning, Analysis, Selection, Financing, implementation, and Review.

REFERENCE BOOKS:

1. A Guide to the Project Management Body of Knowledge: (PMBOK Guide) by Project Management Institute, 2013.
2. Gopala Krishnan & Rama Murthy, A Text book of Project Management, McMillan India.
3. S. Choudhary (2004), Project Management, Tata McGraw Hill Publication.

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc19_mg30/preview
2. https://archive.nptel.ac.in/courses/110/104/110104073/

Web Resources:

1. https://www.pmi.org/about/learn-about-pmi/what-is-project-management
2. https://www.manage.gov.in/studymaterial/PM.pdf

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22BS207601	**ECOLOGY**	2	-	-	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

Objectives: This course providesbroad umbrella that covers levels of biological organization from individuals to entire ecosystems. Students will explore ecological concepts across these different levels of organization, and gain an understanding of general ecological concepts. The course will focus particularly on population and community ecology, which aims to understand the processes which govern the abundance and diversity of species.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Understand and explain foundational ecological concepts

CO2 Distinguish the structure, organization and processes in various ecosystems

CO3 Understand and analyse the concept of biological community, changes and interactions within community.

CO4 Develop a knowledge on the structural and functional aspects of a population as an ecological unit

CO5 Apply the above skills to address novel ecological questions.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Specific Outcomes									Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	3	3	-	-	-	-	-	-	-	-	2	2	-
CO2	3	3	-	-	-	-	-	-	-	-	2	2	-
CO3	3	3	-	-	-	-	-	-	-	-	3	-	-
CO4	3	3	-	-	-	-	-	-	-	-	3	-	-
CO5	3	3	-	3	-	-	-	3	-	-	3	-	-
Course Correlation Mapping	**3**	**3**	**-**	**3**	**-**	**-**	**-**	**3**	**-**	**-**	**3**	**2**	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: Introduction to Environment ***(07 Periods)***

Basic concepts of Environment – Multidisciplinary approach, Basic concepts - Science, Matter and Energy, Evolution of earth, origin of species, diversity and distribution of species, Global environmental issues – an introduction

Module 2:Basics concepts of Ecology *(06 Periods)*

Definition, History of ecology, Subdivisions, Ecology and other subjects, Fundamental ecological variables, Ecosystems: Definition, Components, Structure and function and size, Classification of ecosystems, Comparative Ecosystem Ecology.

Module 3: Population Ecology ***(06 Periods)***

Definition, Structure and Measures, Definition, Structure and Measures, Regulation strategies of species, Survivability Population genetics, Human population.

Module 4: Community Ecology ***(05 Periods)***

Concepts, Community gradients, Characters of community, Ecological Succession and climax Community, Organization -interactions between species, Stress ecology and adaptation

Module 5: Applied Ecology ***(06 Periods)***

Estimating abundance, species diversity measures, Diversity indices, Mathematical ecology: Eco-informatics, Museology, Taxonomy and Biosystematics, Biomass productivity and estimation techniques.

Total periods: 30

EXPERIENTIAL LEARNING

1. Assignment submission on the topic "Learning Ecology. A New Approach to Learning and Transforming Ecological Consciousness".
2. A case study submission on the topic "Ecosystem-based Theoretical Models for Learning in Environments of the 21st Century".

RESOURCES

TEXT BOOKS:

1. Brewer,R.(1994), The Science of Ecology, Saunders College Publishing, New York.
2. Chapman, J. L. And Reiss, M. J. (1990), Ecology: Principles and Application, Cambridge University Press, Cambridge.
3. Groombridge, B. (ed) 1992. Global Biodiversity: Status of the Earth's Living Resources, Chapman and Hall, London.
4. Hughes, J, D. (2001). An Environmental History of the World. Routledge, London.

REFERENCE BOOKS:

1. Michael, P. (1990). Ecological methods for Laboratory and Field Investigations, Tata McGrew Hill Publishing Company Ltd, New Delhi.
2. Odum, E.P.(1971). Fundamentals of ecology 7. Sutherland, W. J. 2004. 1997. Ecological Census Techniques - A Handbook. CambridgeUniversityPress.P336

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=3vDQi1_z2Ac&pp=ygUIZWNvbG9neSA%3D
2. https://www.youtube.com/watch?v=wcwPdLcPAhc&pp=ygUIZWNvbG9neSA%3D
3. https://www.youtube.com/watch?v=v4HHR8eCGOA&pp=ygUIZWNvbG9neSA%3D

WEB RESOURCES:

1. https://archive.nptel.ac.in/courses/127/106/127106004/
2. https://onlinecourses.nptel.ac.in/noc21_ge16/preview

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22BS201015	**INTERMEDIARY METABOLISM**	3	1	-	-	4
Pre-Requisite	BIOMOLECULES AND CELL					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on Carbohydrate, lipid, Amino acid, Protein and Nucleic acid metabolisms

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Understand different types of metabolic cycles such as Glycolysis, TCA and mechanism of Oxidative phosphorylation.
CO2 Identify disorders resulting from defective carbohydrate metabolism and also metabolism of carbohydrate derivatives.
CO3 Gain knowledge on Lipid metabolism and disorders of lipid metabolism.
CO4 Analyze different metabolic cycles of Protein and Aminoacid metabolism and metabolic disorders resulting from these metabolisms.
CO5 Evaluate the role of synthesis and degradation of purines and pyramidines in the synthesis of Nucleotides and its regulation.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	-	-	-	-	-	-	3	-	-
CO2	3	3	-	-	-	-	-	-	-	-	3	-	-
CO3	3	3	-	-	-	-	-	-	-	-	3	-	-
CO4	3	3	-	-	-	-	-	-	-	-	3	-	-
CO5	3	3	-	-	-	-	-	-	-	-	3	-	-
Course Correlation Mapping	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: CARBOHYDRATE METABOLISM ***(09 Periods)***

Outlines of Intermediary metabolism, carbohydrate Metabolism: Glycolysis, Fermentation, TCA cycle, HMP shunt, Regulation of glycolysis, pyruvate dehyraogenage complex, and TCA cycle. . Mechanism of oxidative phosphorylation. Miotrochondrial transport system.

Module 2: CARBOHYDRATE METABOLISM II ***(09 Periods)***

Uronic acid pathway, metabolism of glycogen, starch, sucrose, lactose, glycoproteins. Gluconeogenesis, glyoxylate cycle. Regulation of glycogen metabolism and gluconeogenesis. Futile cycles in carbohydrate metabolism. Disorders of carbohydrate metabolism – Glycogen, lactose, Fructose.

Module 3 LIPID METABOLISM ***(10 Periods)***

Biosynthesis and degradation of fatty acids (Saturated and unsaturated) regulation, metabolism of TAG,Glycerol and sphingolipids, cholesterol, prostaglandins. Biosynthesis and degradation of cholesterol and its regulation. Metabolism of lipoproteins and Ketone bodies.

Module 4 PROTEIN AND AMINOACID METABOLISM ***(09 Periods)***

Degradation and biosynthesis of individual amino acids in animal, plant, and microbial systems. End products of amino acid metabolism - Krebs Haslett urea cycle. Regulation of amino acid biosynthesis

Module 5 NUCLEIC ACID METABOLISM ***(08 Periods)***

Metabolism of Nucleic Acids: Synthesis and Degradation of Purines and Pyrimidines, Synthesis of Nucleotides and its regulation.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Prepare a List of Carbohydrate disorders
2. Discussion on Diabetes is a Metabolic disorder.
3. Assignment related to Lipid metabolic disorders.
4. Correlate Cholesterol metabolism and Cardio vascular diseases.
5. Deliver a seminar on Lipid metabolism and Obesity.
6. Prepare a report on Amino acid biosynthesis regulation and its importance
7. Group discussion on Importance of Amino acid metabolism in Plants
8. Prepare assignment on Nucleic acid metabolism regulation.
9. Debate Metabolic cycles and their importance
10. Compare different Metabolic cycles and prepare a report.

RESOURCES

TEXT BOOKS:

1. Lehninger-Principles of Biochemistry, D. L. Nelson and M. M. Cox, Pub: W.H. Freeman, 5th Edition, 2008.
2. Fundamentals of Biochemistry-Life at molecular level, Donald Voet, Judith D Voet and Charlotte. W. Pratt, Wiley Publisher, Fifth edition, 2016.
3. Text book of Biochemistry, E. S. West, W. R. Todd, H. S. Mason and J. T. Vanbruggen, Macmilan publisher, 4th Edition, 1966.
4. Outlines of Biochemistry, E.E. Conn, P.K. Stumpf, G. Brueining and R. H. Doi, Wiley Publisher, 5th Edition, 2006.

REFERENCE BOOKS:

1. The Biochemistry of Nucleic acids, Adams et al., Pub: Springer, 11th Edition, 1992
2. Harper's Illustrated Biochemistry, Robert K., and Granner, Daryl K., and Mayes, Peter A. Murray, Mc-Graw-Hill Medical publisher, 26th Edition,2003.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=BYiNUOdbEk4
2. https://www.youtube.com/watch?v=2_ceHsFmLVk
3. https://www.youtube.com/watch?v=0M-B2dOfcUo
4. https://archive.nptel.ac.in/courses/104/105/102105034/

WEB RESOURCES:

1. https://archive.nptel.ac.in/content/storage2/courses/104103071/pdf/mod11.pdf
2. https://archive.nptel.ac.in/courses/103/105/103105054/

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22BS202010	**MOLECULAR BIOLOGY**	3	-	3	-	4.5

Pre-Requisite BIOMOLECULES AND CELL

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to Classical and modern genetics, Structural and numerical aberrations, Chromosome organization and replication, Expression of gene, Gene silencing and gene expression analysis and hands on training mentioned in the Experiential learning techniques.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Understand concepts of genetics, interaction of genes

CO2 Understand variations in chromosome and genes and how it brought

CO3 Gain knowledge how two identical genome DNA copied before the cell division

CO4 Construct the knowledge on expression of a gene into protein and control of gene express with suitable examples.

CO5 Gain knowledge to how to make gene silencing of a diseases causing gene and know about its expression of gene through analysis.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	3	3	-	-	-	-	-	-	-	3	3	-	-
CO2	3	3	-	-	-	-	-	-	-	3	3	-	-
CO3	3	3	-	-	-	-	-	-	-	3	3	-	-
CO4	3	3	-	-	-	-	-	-	-	3	3	-	-
CO5	3	3	-	-	-	-	3	-	-	3	3	-	-
Course Correlation Mapping	**3**	**3**	**-**	**-**	**-**	**-**	**3**	**-**	-	**3**	**3**	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: Classical and Modern genetics ***(08 Periods)***

History of genetics, Mendelian principles, monohybrid and dyhybrid crosses, dominance, codominance and incomplete dominance, gene interaction and epistasis, concept of gene and cistron, cis-trans complementation experiment, lethal, selfish and pseudogenes, structure of genes, types of genes.

Module 2: Structural and numerical aberrations ***(07 Periods)***

Ploidy level, euploidy and aneuploidy, INDELs, inversion and replacement mutations, spontaneous and induced mutation, mutagens, crossing over and linkage.

Module 3 Chromosome organization and replication ***(10 Periods)***

Organization of eukaryotic chromosome, gene concept, eukaryotic and prokaryotic gene architecture, Replication of DNA in prokaryotes, DNA damage and repair, Comparison of DNA replication between prokaryotes and eukaryotes.

Module 4 Expression of gene ***(12 Periods)***

Gene expression in eukaryotes: Transcription, general and specific transcription factors, regulatory elements and mechanism of regulation, processing of transcripts. Ttranslation - formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNAsynthetase, translational proof-reading, translational inhibitors, posttranslational modification of proteins.

Operon concept in prokaryotes, induce operon -lac, attenuator operon -trp, ara operon. comparison of gene expression mechanism between eukaryotes and prokaryotes.

Module 5 Gene silencing and gene expression analysis ***(08 Periods)***

Gene silencing approaches: cosuppression, antisense RNA techniques, ribozyme (Hammer head, hairpin ribozymes) mediated methods, dsRNA (microRNA and small interfering RNA).

Total Periods: 45

EXPERIENTIAL LEARNING

1. Isolation of Genomic DNA from E.coli
2. Isolation of plasmid DNA from E.coli
3. Isolation of Total RNA from bacteria
4. Isolation of Protein from yeast
5. Estimation of DNA by spectrophotometry
6. Analysis of DNA by Agarose Gel Electrophoresis
7. Analysis of Protein by Polyacrylamide Gel Electrophoresis
8. Elution DNA from agarose gel.
9. Preparation of competent cells and transformation
10. Polymerase Chain Reaction
11. Restriction Digestion of DNA
12. Synthesis of cDNA by Reverse transcription polymerase chain reaction

RESOURCES

TEXT BOOKS:

1. Molecular cell Biology, (1994) Darnell, Lodish, Baltimore, Scientific American Books,Inc.
2. Molecular Biology, Freifelder D (2012). 5th edition. Narosa Publishing House, India

REFERENCE BOOKS:

1. Molecular Biology of the Gene (4th Edition), J.D.Watson, N.H.Hopkins, J.W.Roberts, J.A. Steitz and A.M.Weiner, The Benjamin/Cummings Publ. Co., Inc., California,1987.
2. Fundamental Molecular Biology, Allison A. Lizabeth (2012) 2nd Edition. J Willey and Sons, Hoboken,New Jersey.
3. Molecular Biology LabFax, T.A. Brown (Ed.), Bios Scientific Publishers Ltd., Oxford,1991.
4. Lewin' GENES XI, Krebs JE., Kilpatrick ST and Goldstein ES. (2013). Jones & Bartlett Learning. Burlington, MA.
5. Cell and Molecular Biology. Rastogi SC.(2012) New age international publication.

VIDEO LECTURES:

1. https://youtu.be/8wAwLwJAGHs
2. https://www.youtube.com/watch?v=qIwrhUrvX-k

WEB RESOURCES:

1. https://archive.nptel.ac.in/courses/102/104/102104052/Module1
2. https://archive.nptel.ac.in/courses/102/104/102104052/ Module2
3. https://archive.nptel.ac.in/courses/102/104/102104052/Module3
4. https://archive.nptel.ac.in/courses/102/104/102104052/Module4

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22BS201006	**NANO-BIOTECHNOLOGY**	3	-	-	-	3

Pre-Requisite MICROBIAL GENETICS AND RDNA TECHNOLOGY

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides detailed discussion onIntroduction to nano-biotechnology, Nanomaterials synthesis and their characterization, Nanobiology and Nanomolecular Diagnostics, Biomedical and Life Sciences Applications, and Nanotechnology: social Issues and Challenges in Future.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Develop a fundamental understanding of basic concepts of Nano-biotechnology and its uses in the field of life sciences.

CO2 Understand and learn the principles of synthesis and characterization of Nano-based materials.

CO3 Understand the correlation between Nano biology and Nano moleculardiagnostics related prospective

CO4 Evaluate applications of various concepts & techniques of Nano-biotechnology to facilitate biotechnological advancement and innovations.

CO5 To understand and remember the societal related issues related with Nano-based materials.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	-	3	-	-	-	3	-	-	-
CO2	3	3	-	-	-	-	-	-	-	3	-	-	-
CO3	2	3	-	-	-	-	-	-	-	3	-	-	-
CO4	3	3	-	-	-	-	-	-	-	3	-	-	-
CO5	3	3	-	-	-	3	-	-	-	3	-	-	-
Course Correlation Mapping	**3**	**3**	**-**	**-**	**-**	**3**	-	-	-	**3**	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO NANOBIOTECHNOLOGY ***(07 Periods)***

Definition- history & concepts- Economic status of Nano-biotechnology- Bio-nanoparticles & Nano-composites-Classification of nanoparticles by size - Stability of nanoparticlesSelection of nanoparticles for various applications- different types of nanomaterials and classes – nanocomposites, nanorobots.

Module 2: NANOMATERIALS SYNTHESIS AND THEIR CHARACTERIZATION ***(09 Periods)***

Synthesis of nanomaterials - Physical approaches- Chemical approaches -Biological approaches

Fullerenes - Buckyballs, carbon nanotubes, Carriers, Dendrimers, Nanoparticles, Nanocomposites, Nanoshells, Quantum Dot, Principle, Instrumentation and applications of UV, FTIR, Raman shift, Surface Plasmon resonance (SPR), SEM, TEM, Atomic force microscopy Dynamic light scattering (DLS), XRD

Module 3: NANOBIOLOGY AND NANOMOLECULAR DIAGNOSTICS ***(09 Periods)***

Biological Nano-objects –DNA- DNA based nanostructures, Protein based nanostructures building blocks and templates –lipid based nanostructures - drug conjugates- micelles-liposomes. Nanopore technology, Nano arrays. Nanobiosensors: cantilever, carbon nanotube, nanowires. Pathogen detection by magnetic nanoparticle-based techniques.

Module 4: BIOMEDICAL AND LIFE SCIENCES APPLICATIONS ***(10 Periods)***

Introduction to nanomedicine, nanocapsules, nanorobots, nanopharmacology. Use of micro needles and nanoparticles for local highly controlled drug delivery. Nanotechnology products and applications in ocular, oncology, neurology and cardiology. Functions and applications of DNA based nanostructures, Biomimetic fabrication of DNA based metallic nanowires and networks, Biomolecularnanomotors (ATP synthase complex and flagella).

Module 5: NANOTECHNOLOGY:SOCIAL ISSUES-CHALLENGES IN FUTURE ***(10 Periods)***

Nanomaterials and their toxicity- Evaluation of nano - specific health risks and hazards - Cyto-toxicity- Geno-toxicity- Bio-persistence- In vivo tests/assays etc.- (ii) Safety standards- Nanoparticle transportation- Environmental impact- measurement of eco-toxicity- Occupational risk assessment and management- Bioethics and legal aspects-future of nano-biotechnology

Total Periods: 45

EXPERIENTIAL LEARNING

1. Prepare a report on advance application of nano-based materials.
2. Case study: Based on recent research papers
3. Role of Nano biotechnology in Biomedical field-case study

RESOURCES:

TEXT BOOKS:

1. C. M. Niemeyer- C. A. Mirkin- (2004)- Nanobiotechnology: Concepts- Applications and Perspectives‖- Wiley – VCH
2. J. Twidell and T. Weir- Renewable Energy Resources- E & F N Spon Ltd- London- (1986)

REFERENCE BOOKS:

1. Kewal K. Jain - The Handbook of Nanomedicine- Humana Press- (2008)
2. Lynn J. Frewer- WillehmNorde- R. H. Fischer and W. H. Kampers- Nanotechnology in the Agri-food sector- Wiley-VCH Verlag- (2011)
3. M. Zafar Nyamadzi- —A Reference handbook of nanotoxicology- Dominant publisher (2008)
4. P. J. Brown and K. Stevens- Nanofibers and Nanotechnology in Textiles- Woodhead Publishing Limited- Cambridge- (2007)
5. T. Pradeep- —Nano: The Essentials‖- McGraw – Hill education- (2007)

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=C0RSb1dTzrA
2. https://www.youtube.com/watch?v=ANTn1W51DDg
3. https://www.youtube.com/watch?v=AEWqAcSeQm4&list=PLLy_2iUCG87DM7AYx1j3CaKcliTmYV6Z2

WEB RESOURCES:

1. https://archive.nptel.ac.in/courses/118/107/118107015/
2. https://onlinecourses.nptel.ac.in/noc22_bt46/preview
3. https://onlinecourses.nptel.ac.in/noc23_mm37/preview

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22BS202008	**AGRI-FOOD BIOTECHNOLOGY**	3	-	3	-	4.5

Pre-Requisite MICROBIAL GENETICS AND RDNA TECHNOLOGY

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides detailed discussion on introduction to food Biotechnology, starter culture and advancement, GM foods, Nutrigenomic and Value added products.Also competencies in the field of Food Processing so that student is properly equipped to take up gainful employment.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Understand and remember the basic principles of food biotechnology

CO2 Identify and analysis the concept of GM food now and in future

CO3 Develop and apply the optimal processing condition for transformed of foods.

CO4 Understand the concept and principle of nutrogenomics and its application in various field

CO5 Analysis and understand the production of various value-added food products.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	-	3	-	-	-	3	-	-	-
CO2	3	3	-	-	-	-	-	-	-	3	-	-	-
CO3	2	3	-	-	-	-	-	-	-	3	-	-	-
CO4	3	3	-	-	-	-	-	-	-	3	-	-	-
CO5	3	3	-	-	-	3	-	-	-	3	-	-	-
Course Correlation Mapping	3	3	-	-	-	3	-	-	-	3	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO FOOD BIOTECHNOLOGY *(09 Periods)*

Introduction & Applications; Methods for the microbiological examination of water and foods; Control of Microbiological quality and safety; Food borne illnesses and diseases; Microbial cultures for food fermentation, their maintenance, strain development

Module 2: STARTER CULTURE AND ADVANCEMENT *(09 Periods)*

Starter cultures–types, designing and development, micro encapsulation and packaging, scopes and challenge; Development and formulation of novel products such as probiotic foods. Biosensors and novel tools and their application in food science & Technology

Module 3: GM FOODS *(09 Periods)*

Introduction and controversies related to GMOs. Ethical issues concerning GM foods; testing for GMOs; current guidelines for the production, release and movement of GMOs; labelling and traceability; trade related aspects; biosafety; risk assessment and risk management. Public perception of GM foods. IPR. GMO Act–2004. New products and processes in various food commodities including plant and animal products.

Module 4: NUTRIGENOMIC *(09 Periods)*

Introduction to Nutraceuticals and Nutrigenomics, Nutrogenomics-concept, working, significance and relevance Epigenetics, Foodomics, DNA testing Crisper technology Nutrigenomics and public health Personalized Nutrition, Microbiome, Functional Foods, Medical Foods, and GMO Foods

Module 5: VALUED-ADDED FOOD PRODUCTS *(09 Periods)*

Production of organic acids (vinegar, lactic acid), alcoholic beverages (beer, wine, and distilled alcoholic beverages such as whiskey, rum, vodka), glycerol; Propagation of baker's yeasts.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Ammonium sulphate precipitation of proteins
2. Isolation and Preservation of industrial important Microorganism
3. Assay for detecting Food contamination
4. Vinegar production
5. Study of Adulteration test of food products
6. Assay of quality of milk by methylene blue reduction test

RESOURCES

TEXT BOOKS:

1. ByongH.Lee, (2015), Fundamentals of food biotechnology. Wiley-Blackwell.
2. Anthony Pometto, Kalidas Shetty, GopinadhanPaliyath, Robert E. Levin, (2005) Food biotechnology. CRC Press.

REFERENCEBOOKS:

1. Roger Angold, Gordon A. Beech, John Taggart, (1989), Food Biotech. Cambridge University Press.
2. Lee B.H, (1996), Fundamentals of food biotech. Wiley-Interscience.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=4RCpXTrNKU4&pp=ygUiZm9vZCBiaW90ZWNobm9sb2d5IGxlY3R1cmUgc2Vzcmllcw%3D%3D
2. https://www.youtube.com/watch?v=qK_lxg7kTYE&pp=ygUiZm9vZCBiaW90ZWNobm9sb2d5IGxlY3R1cmUgc2Vzcmllcw%3D%3D
3. https://www.youtube.com/watch?v=3uXiu1AEi4M&pp=ygUNbnV0cmlnZW5vbWljcw%3D%3D

WEB RESOURCES:

1. https://nptel.ac.in/courses/102105058
2. https://onlinecourses.nptel.ac.in/noc22_ag03/preview

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22BS201007	**CELL BIOLOGY AND INTRODUCTION TO CANCER BIOLOGY**	3	-	-	-	3

Pre-Requisite BIOMOLECULES AND CELL

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to Cell Biology, protein trafficking, cytoskeleton, cell signaling and Cell division and cancer biology.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Understand about cell, cell organelles and its transport.

CO2 Understand how the protein fold and reach to their target organelle through the signal recognition and know about export and import of protein between the organelles

CO3 Gain knowledge in structure and functions of cell cytoskeleton and cell surface appendage

CO4 construct the knowledge on cell – cell interaction through a receptor

CO5 Gain knowledge on cell cycle and its regulation and know how the cell become cancer cell by switch on oncogenes.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	3	3	-	-	-	-	-	-	-	3	3	-	-
CO2	3	3	-	-	-	-	-	-	-	3	3	-	-
CO3	3	3	-	-	-	-	-	-	-	3	3	-	-
CO4	3	3	-	-	-	-	-	-	-	3	3	-	-
CO5	3	3	-	-	-	-	3	-	-	3	3	-	-
Course Correlation Mapping	**3**	**3**	**-**	**-**	**-**	**-**	**3**	**-**	-	**3**	**3**	-	-

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1: Introduction to the Cell: ***(08 Periods)***

Cell types – prokaryotes & eukaryotes, cell organelles, cell wall, cell membrane, cytoplasmic organelles, structure of nuclear envelope, nuclear pore, transport across envelope, regulation of nuclear import.

Module 2: Protein trafficking ***(09 Periods)***

Targeting proteins to endoplasmic reticulum, signal recognition particle, signal recognition particle receptor, protein folding and processing in ER, protein export from ER, Protein sorting and export from Golgi apparatus; SNARE hypothesis; Protein import into Mitochondria, Import and sorting of chloroplast protein.

Module 3 Cytoskeleton ***(08 Periods)***

Structure and organization of cell skeleton; Microfilaments and Microtubule-structure and assembly, actins, myosin muscle contraction, cilia, flagella-structure and function.

Module 4 Cell signaling ***(10 Periods)***

Cell-cell interaction, modes of cell signaling, steroid hormone receptors, peptide hormones and growth factor, plant hormones, G-protein coupled receptors; receptor –protein tyrosine kinase, c- AMP pathway of signal transduction; c GMP, phospholipids and calcium ions, MAP kinase pathway, JAK – STAT pathway, Integrin signaling , Hedgehog and Wnt pathways.

Module 5 Cell division and cancer biology ***(10 Periods)***

Cell Cycle and cell division - Interphase and M phase (mitosis and meiosis), Cell cycle regulation, checkpoints in cell cycle; regulators of cell cycle, Apoptosis: intrinsic and extrinsic pathways.

Types of cancer; development of cancer, Oncogenes, protooncogenes, function of oncogene products, tumor suppressor genes, function of tumor suppression gene products, role of oncogene and tumor suppressor gene in development, molecular diagnosis of cancer.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Submit a document how the cell regulation is going to taking place.
2. Visit a Cancer Hospital, enquire the patients about causes of cancer and submit a report on your observation
3. Submit a document how the protein trafficking happened in the eukaryotes
4. List any two factors in detail how the cell cycle check points controls the causes of cancer
5. Group discussion on different Cancers and therapies
6. Prepare a report on Mechanism of Cancer
7. Submit a survey report on Cervical cancer.

RESOURCES

TEXT BOOKS:

1. The Cell: A Molecular Approach. Cooper GM and Hausman, RE. (2009) 5 th Edition. ASM Press & Sunderland, Washington, D.C.,Sinauer Associates, MA.
2. Cell and Molecular Biology. De Robertis, EDP and De Robertis EMF. (2006) 8th edition..Lipincott Williams and Wilkins, Philadelphia

REFERENCE BOOKS:

1. Cell and Molecular Biology. Rastogi SC.(2012) New age international publication.
2. Cell and Molecular Biology: Karp G. (2010) Concepts and Experiments. 6th edition. John Wiley & Sons. Inc.
3. Molecular and cellular Biology (1993)StephenL.Wolfe, Wadsworth Publishing Company.
4. Molecular cell Biology, (1994) Darnell, Lodish, Baltimore, Scientific American Books,Inc.
5. Genes VI (6th Edition) Benjamin Lewin, Oxford University Press, U.K.,1998

VIDEO LECTURES:

1. https://www.coursera.org/learn/basic-principles-of-cell-signaling.
2. https://www.coursera.org/lecture/contemporary-biology/cell-membrane-and-transport-keyKh

WEB RESOURCES:

1. https://nptel.ac.in/courses/102103012
2. https://nptel.ac.in/courses/102108086 Lect No.5
3. https://nptel.ac.in/courses/102108086Lect No.6
4. https://nptel.ac.in/courses/102108086Lect No.7

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22BS201008	**PLANT AND ANIMAL BIOTECHNOLOGY**	3	-	-	-	3

Pre-Requisite MICROBIAL GENETICS AND RDNA TECHNOLOGY

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to Plant Biotechnology, Genetic Engineering of Plants, Plant cell culture and Tissue Engineering, Transgenic animals, Animal Cell culture and Tissue engineering and Ethical issues.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Understand tools involved in plant and animal biotechnology.
CO2 Gain knowledge about the different genetic engineering principles that will help them to genetic Engineering of Plants.
CO3 Identify advanced tools in plant and animal tissue engineering techniques, such that to become product development specialist.
CO4 Understand applications of transgenic animals and be able to gain insights on regulatory affairs in Biotechnology.
CO5 Students will be able to apply the knowledge on ethical issues and regulatory affairs of plant and animal biotechnology in industries and various government sectors.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	2	3	3	-	-	-	-	-	-	3	-	3	-
CO2	3	3	3	-	-	-	2	-	-	3	-	3	-
CO3	3	3	-	-	-	-	-	-	-	3	-	3	-
CO4	2	3	3	-	-	-	-	2	-	3	-	-	-
CO5	3	3	3	-	-	-	-	2	-	3	-	-	-
Course Correlation Mapping	**3**	**3**	**3**	**-**	**-**	**-**	**2**	**2**	-	**3**	-	**3**	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO PLANT BIOTECHNOLOGY ***(09Periods)***

History of plant biotechnology: Early plant breeding, The Green Revolution, The rise of biotechnology, Basic principles of plant biotechnology, Transgenesis, Tools and techniques of plant biotechnology, Plant cell culture, Tissue engineering, Applications of plant biotechnology in agriculture (Biofuels), food production, and environmental protection, Improved crop yields, New crop varieties, Resistance to pests and diseases, Tolerance to abiotic stresses, Reduced environmental impact.Safety concerns of genetic engineering, Potential risks to human health, Potential risks to the environment.

Module 2: GENETIC ENGINEERING OF PLANTS ***(10 Periods)***

Genetic transformation methods and gene delivery systems: Agrobacterium-mediated transformation, Particle bombardment, Microinjection, Gene gun, Liposome-mediated transformation, Electroporation, Viral-mediated transformation.
Gene editing technologies (CRISPR/Cas9) and their applications in plants:CRISPR/Cas9 system, Applications of CRISPR/Cas9 in plants, Safety concerns of CRISPR/Cas9-mediated gene editing in plants.Introduction to synthetic biology concepts and applications in plants.

Module 3 PLANT CELL CULTURE AND TISSUE ENGINEERING ***(10 Periods)***

Principles of plant cell culture: Cell division, Differentiation, Organogenesis. Tools and techniques of plant cell culture:Media, Growth regulators, Sterilization. Applications of plant cell culture in plant breeding, crop improvement, and production of secondary metabolites:Plant breeding, Crop improvement, Production of secondary metabolites.

Module 4 TRANSGENIC ANIMALS ***(07 Periods)***

Principles of transgenic animals: Transgenesis, Gene transfer with examples. Tools and techniques of transgenic animal production: Vectors, Promoters, Terminators with examples. Applications of transgenic animals in agriculture, medicine, and environmental protection: Improved livestock production, New drug therapies, Environmental remediation.

Module 5 ANIMAL CELL CULTURE AND TISSUE ENGINEERING AND ETHICAL ISSUES ***(09 Periods)***

Animal cell culture: Principles of animal cell culture (Cell division, differentiation & organogenesis), Tools & techniques of animal cell culture. (media, growth regulators & sterilization) &Tissue engineering. Applications of animal cell culture in animal breeding, livestock production, and production of secondary metabolites: Animal breeding, Livestock production, Production of secondary metabolites.Ethical Issues in Plant and Animal Biotechnology.

Total Periods: 45

EXPERIMENTAL LEARNING:

1. Submit a report on Plant cell culture
2. Assignment regarding Tissue engineering
3. Genetic engineering
4. Discussion on Bio-fuels and significance
5. Bioremediation is importance to remediate soils - seminar
6. Food safety and regulations assignment
7. Prepare a short report on Nutritional values of food stuff we regularly consume
8. Environmental sustainability-series of seminars
9. Find Ethical issues in Genetic Engineering
10. Public policy

RESOURCES

TEXT BOOKS:

1. Principles of Plant Biotechnology, 2nd Edition by John P. Gustafson
2. Transgenic Animals, 2nd Edition by Jeffrey F. Dice.

REFERENCE BOOKS:

1. Genetic Engineering of Plants, 2nd Edition by Michael A. Gleba and Michael R. Freeling.
2. Plant Cell Culture and Tissue Engineering, 2nd Edition by Michael A. Shuler and George R. Stewart.
3. Ethical Issues in Plant and Animal Biotechnology by Michael J. Sandøe and John A. Dewar.

VIDEO LECTURES:

1. https://video.ucdavis.edu/media/Animal+biotechnology+1+Lecture/0_8xmpwywh
2. https://nptel.ac.in/courses/102103016
3. https://www.youtube.com/watch?v=lFcF4DsuC9A

WEB RESOURCES:

1. https://thescientificreporters.com/
2. https://www.whatisbiotechnology.org/index.php/
3. https://dbtindia.gov.in/about-us/introduction
4. https://pubmed.ncbi.nlm.nih.gov/
5. https://www.nature.com/nbt/volumes/41/issues/5
6. https://www.cell.com/trends/biotechnology/home
7. https://ami-journals.onlinelibrary.wiley.com/journal/17517915
8. https://www.isaaa.org/resources/publications/pocketk/16/

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22BS201011	**PHARMACEUTICAL BIOTECHNOLOGY**	3	1	-	-	4
Pre-Requisite	BIOMOLECULES AND CELL					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: The main objective of "Pharmaceutical Biotechnology" course is to Gain a comprehensive understanding of various aspects of pharmaceutical biotechnology, ranging from foundational knowledge to advanced topics and practical applications in the pharma industry.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Understand fundamental concepts of pharmaceutical biotechnology.

CO2 Gain knowledge about the process of drug discovery, from target identification to clinical trials.

CO3 Understand cell culture techniques, upstream downstream process and purification techniques in biopharmaceuticals production and manufacturing.

CO4 Gain knowledge on various therapeutic proteins and vaccines production techniques in pharma industry.

CO5 Apply the knowledge on ethical issues and regulatory affairs of pharmaceutical biotechnology industries and various government sectors.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	3	3	-	-	-	-	-	-	1	1	2	2	2
CO2	3	3	-	-	-	-	-	-	2	1	2	2	2
CO3	3	3	-	-	-	-	-	-	2	1	1	2	2
CO4	3	3	-	-	-	-	-	-	2	1	2	2	2
CO5	3	3	-	-	-	-	-	-	2	1	1	2	2
Course Correlation Mapping	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**2**	**2**	**2**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1:	**INTRODUCTION TO PHARMACEITICAL BIOTECHNOLOGY**	***(10 Periods)***
Introduction to biotechnology in the pharmaceutical industry, Historical development and milestones in pharmaceutical biotechnology, overview of regulatory and ethical considerations in pharmaceutical biotechnology, Enzyme Biotechnology- Methods of enzyme immobilization and applications, Use of microbes in industry. Production of Enzymes- General consideration - Amylase, Catalase, Peroxidase, Lipase, Protease, Penicillinase.		
Module 2:	**DRUG DISCOVERY AND DEVELOPMENT**	***(08 Periods)***
Target identification and validation, High-throughput screening and rational drug design, Preclinical development: In vitro and in vivo studies, Clinical trial phases and regulatory approval processes, personalized medicine and pharmacogenomics in drug development.		
Module 3	**Biopharmaceutical production and manufacturing**	***(07 Periods)***
Cell culture techniques for biopharmaceutical production, upstream and downstream processing of biologics, fermentation technologies and optimization, purification methods: Chomatography, filtration, and centrifugation, formulation, fill-finish operations, and quality control.		
Module 4	**Therapeutic Proteins and Vaccines**	***(10 Periods)***
Types of therapeutic protein: Monoclonal antibodies, enzymes, growth factors, Recombinant DNA technology and protein expression systems, Protein engineering and modification techniques, Vaccine development strategies: Live attenuated, subunit, mRNA vaccines, Immunology and adjuvants in vaccine design, Immuno blotting techniques- ELISA, Western blotting, Southern blotting.		
Module 5	**Biopharmaceutical Regulation and Market trends**	***(10 Periods)***
Regulatory agencies: FDA, EMA, ICH guidelines, Good Manufacturing Practices (GMP) in biopharmaceutical production, Intellectual property and patent considerations in biotechnology, Biosimilars and their impact on the biopharmaceutical market, Emerging trends in pharmaceutical biotechnology: Gene therapies, cell-based therapies.		
		Total Periods: 45

EXPERIENTIAL LEARNING:

1. Prepare an assignment on Enzymes as drugs
2. Seminar presentation on FDA approval
3. Prepare a chart on Vaccine preparation
4. List out few Pharmaceutical drugs and their compositions
5. Prepare list of drugs and their generic and trade names
6. Submit a assignment regarding drugbank and other drug databases
7. How a drug related information is searched in the databases?

RESOURCES

TEXT BOOKS:

1. Biopharmaceuticals: Biochemistry and Biotechnology by Gary Walsh
2. Pharmaceutical Biotechnology: Fundamentals and Applications by Daan J.A Crommelin,

Robert D. Sindelar, and Bernd Meibohm

REFERENCE BOOKS:

1. Introduction to Biotechnology and Genetic Engineering by A.J. Nair
2. Pharmaceutical Biotechnology: Concepts and Applications by Gary Walsh
3. Biotechnology for Beginners by ReinhardRenneberg, Arnold L. Demain, and DietmarSchomburg

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=RMbzj5zopuQ
2. C:\Users\acer\Desktop\syllabusbooksfinal\https://www.youtube.com/watch?v=LCC43WLLVD0

WEB RESOURCES:

1. https://www.youtube.com/results?search_query=1.%09Monoclonal+antibodies+%7C+Summary+(whatisbiotechnology.org)
2. https://scholar.google.co.in/scholar?q=2.+Pharmaceutical+Biotechnology+-+PubMed+(nih.gov)&hl=en&as_sdt=0&as_vis=1&oi=scholart
3. https://pubmed.ncbi.nlm.nih.gov/11480419/
4. https://scholar.google.co.in/scholar?q=Pharmaceutical+biotechnology+-+concepts+and+applications+-+PMC+(nih.gov)&hl=en&as_sdt=0&as_vis=1&oi=scholart
5. https://scholar.google.co.in/scholar?q=Production+and+Purification+of+Recombinant+Proteins+%7C+SpringerLink&hl=en&as_sdt=0&as_vis=1&oi=scholart

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22BS201009	**APPLIED ENVIRONMENTAL BIOTECHNOLOGY**	3	-	-	-	3
Pre-Requisite	Biomolecules and Cell					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: The course is designed to analyze environmental pollution and to develop suitable technologies to solve the problems; Understand the basics for microbial metabolism of environmental contaminants; and apply scientific concepts to environmental problems and their correlation with technological concepts.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Apply biological treatment processes to treat solid waste.

CO2 Appraise the microbial potential for degradation of organic pollutants.

CO3 Outline the types of bioremediation involved in wastewater treatment.

CO4 Discover the role of microorganisms in processes such as bio-pulping and bio-mining and also in producing bio products.

CO5 Understand the applied aspects of environmental biotechnology

CO-PO-PSO Mapping Table:

Learning Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	-	-	-	-	-	-	2	-	-
CO2	3	3	-	-	-	-	-	-	-	-	2	-	-
CO3	3	3	-	-	-	-	-	-	-	-	3	-	-
CO4	3	3	-	-	-	-	-	-	-	-	3	-	-
CO5	3	3	-	3	-	-	3	-	-	-	3	-	-
Course Correlation Mapping	**3**	**3**	**-**	**3**	**-**	**-**	**3**	**-**	**-**	**-**	**3**	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: BIOREMEDIATION, BIOTRANSFORMATION AND BIODEGRADATION ***(10 Periods)***

1. Should conduct a Hospital survey to understand how the hospital waste is disposed and write your report on whether the safety measures are followed for disposal of Biomedical waste.

Bioremediation, in situ and ex situ bioremediation, constrains and priorities of bioremediation, Evaluating Bioremediation, Bioremediation of VOCs; Biodegradation, Factors affecting on process of biodegradation. Methods in determining biodegradability. Contaminant availability for biodegradation; Xenobiotics, Persistence and biomagnification of xenobiotic molecules, Microbial interactions with xenobiotics,

Module 2: WATER POLLUTION MONITORING ***(08 Periods)***

Methods of monitoring; Biological methods- Detection methods for DO, BOD, Pathogen monitoring by heterotrophic plate count, multiple tube method, membrane filtration methods, Other emerging techniques such as enzyme detection, hybridization, PCR, gene probe technology etc. Strategies for controlling pathogen transfer;

Module 3 EFFLUENT TREATMENT SYSTEM ***(07 Periods)***

Sewage and waste water treatments systems. Primary, secondary and tertiary treatment,. Measurement of treatment efficiencies, Biological treatments- aerobic versus anaerobic treatments, Environmental pollution control- Bioremediation, Bioaugmentation and Biostimulation; Biofilms in treatment of waste water, Biofilm development and biofilm Kinetics, Aerobic Biofilms; Bioreactors for waste water treatments, Reactors types and design,

Module 4 BIOTECHNOLOGICAL APPLICATION OF HAZARDOUS WATE MANAGEMENT ***(10 Periods)***

Use of microbial systems; Phytoremediation. Waste water treatment using aquatic plants, root zone treatment; Development of new biocatalysts to be applied in waste water biotechnology; Need for management of resources. Role of environmental biotechnology in management of resources, Reclamation of wasteland, biomass production, Biogas and biofuel production, Development of environmentally friendly processes such as integrated waste manageme

Module 5 APPLICATION OF ENVIORNMENTAL BIOTECHNOLOGY ***(10 Periods)***

Application of biotechnology in environmental aspects : Bioremediation: Degradation organic pollutants, hydrocarbons and agricultural wastes, Superbug Bioplastics and Biofuels.

Total Periods: 45

2. Should write a report on different remediation methods for soil pollution and compare them to identify the better approach

3. Should visit a Industry and write a report on Industrial pollutants that spoil environment

4. Deliver a seminar on Environmental aspects related to Biotechnology.

EXPERIENTIAL LEARNING

RESOURCES

TEXT BOOKS:

1. Bruce Rittman, Perry L. McCarty. Environmental Biotechnology: Principles and Applications. McGraw-Hill 2nd edition (July 25, 2000) ISBN: 0072345535.
2. Raina M. Maier , Ian L. Pepper, Charles P. Gerba. Environmental Microbiology. Publisher: Academic Press; (February 23, 2000).

REFERENCE BOOKS:

1. Martin Alexander. Biodegradation and Bioremediation. Academic Press; 2nd edition (April 15, 1999) ISBN: 0120498618.
2. Gabriel Bitton (Author). Wastewater Microbiology, 2nd Edition. Wiley-Liss; 2nd edition (February 16, 1999) ISBN: 0471320471.
3. Milton Wainwright. An Introduction to Environmental Biotechnology

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=oTgXXxQruKs
2. https://www.youtube.com/watch?v=YR5fvTCMeUs
3. https://www.youtube.com/watch?v=LBfKdRwAr_Q
4. https://www.youtube.com/watch?v=NmdaXb_OCLQ

WEB RESOURCES:

1 https://archive.nptel.ac.in/content/syllabus_pdf/102105088.pdf

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22BS201010	**VIROLOGY AND ITS APPLICATIONS IN BIOTECHNOLOGY**	3	-	-	-	3

Pre-Requisite **General Microbiology**
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Viruses as unique genetic resources and as model systems in Molecular Biology, Viruses in phage therapy: Viruses as bio-pesticides, bio-control agents and their role in biological warfare, Role of Viruses in Recombinant DNA technology, Virus-based nanotechnology, Virus resistant crops and Ethics in Virology.

COURSE OUTCOMES: After successful completion of the course, students will be able to:
CO1. Understand the use of viruses as unique genetic resources and as model systems in molecular biology.
CO2. Identify Viruses used for phage therapy, and its use as bio-pesticides and bio-control agents and their role in biological warfare
CO3. Gain knowledge about the role of viruses in recombinant DNA technology
CO4. Understand Nanotechnology based on Viruses.
CO5. Gain knowledge on Virus resistant crops and Ethics in Virology.

CO-PO-PSO Mapping Table:

Learning Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	3	3	-	-	-	-	-	-	-	-	-	3	-
CO2	3	3	-	-	-	-	-	-	-	-	-	3	-
CO3	3	3	-	-	-	-	-	-	-	-	-	3	-
CO4	3	3	-	-	-	-	-	-	-	-	-	3	-
CO5	3	3	-	-	-	3	-	-	-	-	-	3	-
Course Correlation Mapping	**3**	**3**	-	**-**	-	**3**	**-**	-	-	-	-	**3**	-

Correlation Levels: 3: High; 2: Medium;1: Low

COURSE CONTENT

Module 1 Viruses as unique genetic resources and as model systems in Molecular Biology ***(09 Periods)***

Exploitation of viruses as model systems in understanding the replication of nucleic acids and regulation of gene expression strategies and cancer biology (SV-40, adenoviruses); exploitation of viral genes / sequences in the construction of varied types of gene vectors (cloning, shuttle, expression and transcription) and their applications; virus genes as a source of novel enzymes, gene expression activators and silencers; Exploitation of viruses (retro-, adeno- and parvoviruses) as functional gene delivery systems (gene therapy); Display of foreign peptides on virion surface and applications**.**

Module 2: Viruses in phage therapy. Viruses as biopesticides, biocontrol agents and their role in biological warfare ***(08 Periods)***

Exploitation of bacteriophages for peptide display and therapy. Viral bio-pesticides: Mass production and applications of bacterial, fungal and insect viruses and their application as biocontrol agents. Viruses as biological warfare, bio-crime and bioterrorism agents: Small poxvirus (Variola), viral encephalitis and viral hemorrhagic fevers, HIV, viral hemorrhagic fevers, corona, Ebola and yellow fever virus

Module 3 Role of Viruses in Recombinant DNA technology ***(10 Periods)***

Recombinant antibodies: In vitroproduction of rDNA technology-based antibodies (monoclonal antibodies, scFv) to viruses and their applications. Modern vaccines to viruses: designing of modern vaccines, modern vaccines—recombinant proteins, subunits, DNA vaccines, peptides, immunomodulators (cytokines), vaccine delivery & adjuvants, large scale manufacturing-QA/QC issues, Animal models and vaccine potency testing.

Module 4 Virus-based nanotechnology ***(08 Periods)***

Virus-based nanotechnology: Viral nanoparticles (VNPs), virus-like particles (VLPs), plant virusderived nanoparticles (PVNs), biodistribution and pharmacokinetics, application of plant viruses as biotechnological tools in medicine, industry and agriculture

Module 5 Virus resistant crops and Ethics in Virology ***(10 Periods)***

Virus resistant crops: Production of virus resistant/tolerant crops through transgenic technology by exploiting virus or non-viral genes, guidelines for testing and releasing the transgenic lines in India.

Biosafety and biosecurity: Biosafety Levels and Risk group, Classification, Containment, Good microbiological practices, Good Laboratory practices (GLP), Disinfection, Decontamination and Sterilization procedures, safety rules, preparedness, and response for the emergency conditions in the laboratory.

Ethics in Virology: Ethics in virus-related research, ethical and regulatory issues in animal experiments, issues related to Good Manufacturing Practices (GMP), basics in Intellectual Property Rights, Indian patenting system

Total Periods: 45

EXPERIENTIAL LEARNING:

Students will be asked to

1. Prepare a report on Beneficial viruses and their use in rDNA technology
2. Present Viruses that are used in warfare.
3. Submitt an assignment on Virus based Nano-technology
4. Prepare a report on recent SARS-CoV2 outbreak and lessons learnt from it.
5. Write assignment on virus resistant crops.
6. Write dissertation report on GMP.

RESOURCES

TEXT BOOKS:

1. S.J. Flint, L.W.Enquist, R.M. Krug, V.R. Racaniello and A.M. Skalka. ASM press.
2. Medical Virology. (1994). 4th ed. D.O. White and F. Fenner. Academic Press.
3. Veterinary Virology. (1993). 4th ed. F. Fenneret al., Academic Press (Part-II).

REFERENCE BOOKS:

1. S. Primrose, R. Twyman and B. Old,Principles of gene manipulation. 6th edition. (2002). By.Blackwell Science.
2. S. J. Flint, L. W. Enquist, R. M. Krug and V. R. Racaniello, Principles of Virology- Molecular biology, pathogenesis and control. (2000). American society of Microbiology Publishers.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=Dic8PJ8kPLU
2. https://www.youtube.com/watch?v=W-b2n5cUVYU

Web Resources:

1. https://www.classcentral.com/course/swayam-virology-20019
2. https://onlinecourses.swayam2.ac.in/cec21_bt18/preview

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22BS201012	**INTRODUCTION TO CRISPR TECHNOLOGY AND MEDICAL BIOTECHNOLOGY**	3	-	-	-	3
Pre-Requisite	Plant Biochemistry and Molecular Biology					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This intensive introduction delves into the revolutionary CRISPR technology and its diverse applications in medical biotechnology. We'll explore the fundamentals of CRISPR editing, analyze its potential for treating human diseases, and discuss ethical considerations surrounding its use

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Identify different types of Cas9 enzymes and their characteristics and explain the basic principles of CRISPR-Cas9 editing.
CO2 Evaluate the potential of CRISPR for gene therapy in treating human diseases.
CO3 Analyze the use of CRISPR for diagnostic purposes and disease detection.
CO4 Discuss responsible research practices for CRISPR research and clinical applications.
CO5 Evaluate the therapeutic benefit, technical feasibility, and ethical implications of different approaches.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	3	-	-	-	-	-	-	-	-	3	-	-
CO2	3	3	-	-	-	-	-	-	-	-	3	-	-
CO3	3	3	-	-	-	-	-	-	-	-	3	-	-
CO4	3	3	-	-	-	-	-	-	-	-	3	-	-
CO5	3	3		3	-	-	3	-	-	-	3	-	-
Course Correlation Mapping	**3**	**3**	**-**	**3**	-	-	**3**	**-**	-	**-**	**3**	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO CRISPR TECHNOLOGY ***(09 Periods)***

History and discovery of CRISPR-Cas9, Components of the CRISPR system: Cas9 protein, guide RNA, Mechanism of CRISPR-Cas9 mediated DNA cleavage, Types of Cas9 enzymes and their specificities, Guide RNA design strategies and considerations

Module 2: THERAPEUTIC APPLICATIONS OF CRISPR ***(09 Periods)***

Gene therapy using CRISPR: correcting disease-causing mutations, CRISPR for editing hematopoietic stem cells for sickle cell anemia and other diseases, Generating disease models using CRISPR-Cas9, Ethical considerations of CRISPR-based gene therapy

Module 3: CRISPR BEYOND GENE THERAPY ***(09 Periods)***

CRISPR for high-throughput genetic screening and functional genomics, CRISPR-based diagnostics: rapid and sensitive detection of genetic diseases, CRISPR for agricultural biotechnology: improving crop yields and resistance to pests, Environmental applications of CRISPR: bioremediation and gene drives

Module 4: ETHICAL CONSIDERATIONS AND RESPONSIBLE RESEARCH ***(09 Periods)***

Off-target effects and unintended consequences of CRISPR editing,Gene editing and designer babies: ethical considerations of germline editing, Equity and access to CRISPR-based therapies, Public engagement and responsible communication about CRISPR

Module 5: THE FUTURE OF CRISPR AND MEDICAL BIOTECHNOLOGY ***(09 Periods)***

Medical biotechnology and its history, gene therapy,Principles of gene editing technologies (CRISPR-Cas9, TALENs), Viral and non-viral vector delivery systems for gene correction, stem cell therapy, tissue engineering, biomaterials

Total Periods: 45

EXPERIENTIAL LEARNING

1. Write a report on CRISPR technology applications
2. Deliver a seminar on Ethical aspects of CRISPR technology
3. Submitt a report on latest developments in the CRISPR technology
4. Write a report on Stem cell technology.
5. Take a case study of CRISPR gene editing and submit your inputs on the technology.

RESOURCES

TEXT BOOKS:

1. Sander, I. E., Joung, J. K., & Gilson, L. H. (2021). *CRISPR-Cas9 systems in human gene editing*. Humana Press.
2. Lanza, R., Cibelli, J. B., Melton, D. A., & Odorico, J. S. (2018). *Principles of regenerative medicine, second edition*. Elsevier.

REFERENCE BOOKS:

1. R. Bansal, CRISPR-Cas: (2023) Applications in gene editing & beyond, publisher: Roohi Bansal
2. R. Barrangou, E. J. Sontheimer and L. A. Marraffin (2022) CRISPR: Biology and applications, 1st Edition, ASM press.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=2pp17E4E-O8
2. https://www.youtube.com/watch?v=TdBAHexVYzc
3. https://www.youtube.com/watch?v=Hb4iep3RYtA

WEB RESOURCES:

1. http://acl.digimat.in/nptel/courses/video/102103093/L22.html
2. http://acl.digimat.in/nptel/courses/video/102103093/L42.html

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22BS202012	APPLICATIONS IN MOLECULAR DIAGNOSTICS	3	-	3	-	4.5
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction molecular diagnostics, Molecular diagnostics in infectious diseases, Molecular diagnostics in Oncology, Molecular diagnostics in other fields and advanced topics in Molecular diagnostics and and hands on training mentioned in the Experiential learning techniques.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Describe the basic principles of molecular diagnostics.
CO2 Discuss the various applications of molecular diagnostics in different fields.
CO3 Explain the techniques used in molecular diagnostic assays.
CO4 Analyze and interpret molecular diagnostic results.
CO5 Design and troubleshoot basic molecular diagnostic assays

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	-	-	-	-	-	-	3	-	-
CO2	3	3	-	-	-	-	-	-	-	-	3	-	-
CO3	3	3	-	-	-	-	-	-	-	-	3	-	-
CO4	3	3	-	-	-	-	-	-	-	-	3	-	-
CO5	3	3	-	-	-	-	-	-	-	-	3	-	-
Course Correlation Mapping	**3**	**3**	**-**	**-**	-	-	**-**	**-**	-	**-**	**3**	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO MOLECULAR DIAGNOSTICS ***(09 Periods)***

History and evolution of molecular diagnostics, Basic principles of nucleic acid amplification techniques (PCR, LAMP, etc.), Hybridization techniques (Southern blot, Northern blot, Western blot), Detection methods (ELISA, chemiluminescence, fluorescence), Ethical considerations in molecular diagnostics, Regulatory aspects of molecular diagnostics

Module 2: MOLECULAR DIAGNOSTICS IN INFECTIOUS DISEASES ***(09 Periods)***

Molecular diagnosis of bacterial infections (e.g., MRSA, TB), Molecular diagnosis of viral infections (e.g., HIV, influenza), Molecular diagnosis of parasitic infections (e.g., malaria, leishmaniasis),Emerging infectious diseases and molecular diagnostics, Importance of rapid and accurate diagnosis of infectious diseases,Antibiotic resistance and molecular diagnostics, Public health applications of molecular diagnostics in infectious diseases

Module 3: MOLECULAR DIAGNOSTICS IN ONCOLOGY ***(09 Periods)***

Molecular diagnosis of cancer (e.g., breast cancer, lung cancer), Personalized medicine and molecular diagnostics, Molecular markers for cancer prognosis and treatmentPharmacogenomics and molecular diagnostics, Importance of early detection and diagnosis of cancer, Role of molecular diagnostics in improving cancer treatment outcomes, Ethical considerations in personalized medicine

Module 4: MOLECULAR DIAGNOSTICS IN OTHER FIELDS ***(09 Periods)***

Molecular diagnostics in prenatal diagnosis, Molecular diagnostics in forensic science, Molecular diagnostics in food safety, Environmental applications of molecular diagnostics, Emerging applications of molecular diagnostics in different fields, Challenges and opportunities in the future of molecular diagnostics

Module 5: ADVANCED TOPICS IN MOLECULAR DIAGNOSTICS ***(09 Periods)***

Next-generation sequencing (NGS) and its applications in diagnostics, Microfluidics and lab-on-a-chip technologies, Biomarkers and their role in molecular diagnosticsArtificial intelligence and machine learning in molecular diagnostics, Future trends in molecular diagnostics, The impact of molecular diagnostics on healthcare, Career opportunities in molecular diagnostics

Total Periods: 45

EXPERIENTIAL LEARNING

1. Basic pipetting techniques
2. DNA extraction from biological samples
3. PCR amplification of a specific viral or bacterial DNA sequence
4. Gel electrophoresis analysis of PCR products
5. Analysis of mutations in cancer-associated genes
6. Case studies: Applying molecular diagnostics to solve real-world problems
7. Introduction to bioinformatics tools for analyzing NGS data

RESOURCES

Text Books:

1. **Buckingham. L, (2019) Molecular Diagnostics: Fundamentals, Methods, and Clinical Applications, 3rd edition, F. A. Davis Company publisher**
2. Decker. J, Reischl. U (2004), **Molecular Diagnosis of Infectious Diseases, Second edition, Human Press Inc, Germany.**
3. Coleman. W. B, Tsongalis, G. J. (2002) The Molecular Basis of Human Cancer, Human press Inc, Germary.

Reference Books:

1. Grewal, P. S. (2010). *Handbook of Molecular Technologies for Biomedical Research*. John Wiley & Sons.
2. Lakich, R., Bashir, R., Saliba, A. E., & Landry, L. F. (2017). *Introduction to microfluidics and nanofluidics*. CRC Press

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=uI_WwTq4giI
2. https://www.youtube.com/watch?v=JAkHTMiTAsg
3. https://www.youtube.com/watch?v=Zbs1bFI5yq0
4. https://www.youtube.com/watch?v=gfGV8WI0LIU

WEB RESOURCES:

1. https://archive.nptel.ac.in/content/storage2/courses/102103047/PDF/mod3.pdf
2. http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000002BI/P001354/M023605/ET/1507020196Southern_Blotting_e_content_23-7-17.pdf

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22BS201013	ADVANCES IN BIOCHEMISTRY	3	-	-	-	3

Pre-Requisite Biomolecules and Cell

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This advanced course delves deep into contemporary biochemical frontiers, highlighting recent breakthroughs and their potential applications in medicine, biotechnology, and beyond. We'll primarily focus on wet-lab approaches and cutting-edge techniques

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Understand the role of protein dynamics in cellular processes.
CO2 Explain the unique structural features and functions of membrane proteins and understand the role of membrane proteins in human health and disease.
CO3 Analyze the ethical considerations of metabolic engineering and synthetic biology.
CO4 Understand the principles of chemical proteomics and target identification.
CO5 Understand the mechanisms of RNA interference (RNAi) and its therapeutic potential.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	-	-	-	-	-	-	3	-	-
CO2	3	3	-	-	-	-	-	-	-	-	3	-	-
CO3	3	3	-	-	-	-	-	-	-	-	3	-	-
CO4	3	3	-	-	-	-	-	-	-	-	3	-	-
CO5	3	3	-	-	-	-	-	-	-	-	3	-	-
Course Correlation Mapping	**3**	**3**	**-**	**-**	-	-	**-**	**-**	-	**-**	**3**	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: PROTEIN DYNAMICS AND ALLOSTERY ***(09 Periods)***

Intrinsically disordered proteins (IDPs) and their moonlighting functions, Protein folding dynamics and misfolding diseases, Allosteric modulation of enzyme activity and signal transduction, Single-molecule fluorescence spectroscopy and FRET for studying protein dynamics, Cryo-electron microscopy (cryo-EM) to visualize protein conformational states

Module 2: MEMBRANE PROTEIN STRUCTURE AND FUNCTION ***(09 Periods)***

G protein-coupled receptors (GPCRs) and their signaling pathways, Ion channels and transporters: structure, function, and regulation, Membrane protein engineering and design for therapeutic applications, Cryo-EM for elucidating membrane protein structures and interactions, Membrane protein diseases and their potential treatments

Module 3: Metabolic Engineering and Synthetic Biology ***(09 Periods)***

CRISPR-Cas9 for targeted metabolic pathway editing, Metabolic engineering for biofuel production and sustainable chemicals, Synthetic biology approaches for creating artificial cells and circuits.

Module 4: CHEMICAL BIOLOGY TOOLS FOR PROBING BIOLOGICAL SYSTEMS ***(09 Periods)***

Small-molecule inhibitors and activators of enzymes and protein-protein interactions, Fluorescent probes for imaging cellular targets and dynamics, Chemical proteomics for identifying protein targets of small molecules

Module 5: FRONTIERS IN RNA BIOLOGY AND THERAPEUTICS ***(09 Periods)***

Long non-coding RNAs (lncRNAs) and their regulatory roles in development and disease,MicroRNAs (miRNAs) and their involvement in cancer, neurodegenerative diseases,

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXPERIEMNTS

1. Prepare a report on Membrane protein crystallization and Structure determination.
2. Identify the reasons for why membrane proteins are difficult to purify compared to soluble proteins and submit a report.
3. How drug analogues are prepared and identified as potential drugs
4. Seminars on Advances in Biochemistry
5. Prepare assignment on various Biochemical methods used in the Industries.

RESOURCES

Text Books:

1. Stryer, L. (2022). Biochemistry (9th ed.). W.H. Freeman publishers.
2. K S Mehta (2009) Advanced Biochemistry, 1st edition, Campus books international publishers.
3. O. Stone (2015) Advances in Biochemistry, 1st edition, Callisto Reference Illustrated edition publishers.

Reference Books:

1. Keith Wilson and John Walker (2018) Principles and techniques of Biochemistry and molecular biology,
2. I S Krey and J C Gumnbart (2021) Structure and function of membrane proteins, Springer protocols, Humana press publishers.

VIDEO LECTURES:

1. **https://www.youtube.com/watch?v=jKwZAPpqzl4**
2. **https://www.youtube.com/watch?v=kSiqOzy966Y**
3. **https://www.youtube.com/watch?v=GoiHNClZ-Wc**
4. **https://www.youtube.com/watch?v=iYG_GH1EdEc**
5. **https://www.youtube.com/watch?v=M5r8cYjdMBo**

WEB RESOURCES:

1. **https://videocast.nih.gov/watch=31807**
2. **https://archive.nptel.ac.in/content/storage2/courses/102103017/pdf/lecture%201.pdf**

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22BS201016	PROTEOMICS AND GENOMICS	2	-	-	-	2

Pre-Requisite Bioinformatics and its applications

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to Proteomics, Gene Identification and expression, Proteomics and tools, Analysis of Proteomics, and Applications of Genomics and Proteomics, and hands on experience on different Genomics and Proteomics tools.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the basic concepts of Proteomics and Genomics.

CO2. Identify different tools used to study Genomics.

CO3. Gain knowledge in Proteomics and Proteomics tools.

CO4. Analyze Proteomics data and Identify applications of Microarrays.

CO5. Identify the applications of Genomics and Proteomics.

CO-PO-PSO Mapping Table:

Learning Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	-	-	3	-
CO2	3	3	-	-	-	-	-	-	-	-	3	-
CO3	3	3	-	-	-	-	-	-	-	-	3	-
CO4	3	3	-	-	-	-	-	-	-	-	3	-
CO5	3	3	-	3	-	-	3	-	-	-	3	-
Course Correlation Mapping	**3**	**3**	-	**3**	-	-	**3**	-	-	-	**3**	-

Correlation Levels: 3: High; 2: Medium;1: Low

COURSE CONTENT

Module 1 INTRODUCTION TO PROTEOMICS AND GENOMICS *(06 Periods)*

Introduction to Genome, Genome structure in viruses and prokaryotes, Introduction to Proteomics – The Proteome, Mining proteomes, Bridging Genomics and Proteomics. Proteomics and the new biology.

Module 2: GENE IDENTIFICATION AND EXPRESSION *(06 Periods)*

Genome annotation, traditional routes of gene identification, ORF, ORF identification, Tools for finding genes, Identifying the function of a new gene, gene ontology, Brief description of types of Genomics, determining gene function by sequence comparison..

Module 3 PROTEOMICS AND PROTEOMIC TOOLS *(06 Periods)*

Introduction to Proteome and Proteomics, Techniques used in Proteomics, Two-dimensional polyacrylamide gel electrophoresis, Sample Preparation, Solubilisation, 2-dimensional gel electrophoresis, analysis of 2-D gel images.

Module 4 ANALYSIS OF PROTEOMICS DATA *(06 Periods)*

Mass spectrometry based methods for protein identification- MALDI-TOF, De novo sequencing using mass spectrometric data- 2-DE gel electrophoresis coupled with mass spectrometry.

Module 5 GENOMICS AND PROTEOMICS APPLICATIONS *(06Periods)*

Analysis of Genomes – Human, Mouse, Plasmodium falsiparum,Saccharomyces cerevisiae, Mycobacterium tuberculosis. Application of proteome analysis- drug development, Proteomics in drug Discovery.

Total Periods: 30

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EXPERIENTIAL LEARNING:

LIST OF EXERCISES:

1. Assignment on latest techniques in Genomics
2. Assignment on latest techniques in Proteomics
3. Analysis of Proteomics data from different organisms
4. Identify Genes for the Genome sequence provided
5. Analyze the mass spectroscopy data from cellular proteins
6. Write report on Human genome projects
7. Select any important fruit or vegetable genomes and identify the key genes
8. Group discussion on Latest applications of Proteomics and Genomics
9. Prepare a report on Proteomics and drug design.
10. Prepare report on Genomics of rare plants.

RESOURCES

TEXT BOOKS:

1. S. B. Primrose and R.M. Twyman - Principles of Genome Analysis and Genomics, 7 th Edition,
   Blackwell Publishing, 2006.
2. S. Sahai - Genomics and Proteomics, Functional and Computational Aspects, Plenum Publication, 1999

REFERENCE BOOKS:

1. Andrezej K Konopka and James C. Crabbe, Compact Hand Book - Computational Biology, Marcel Dekker, USA, 2004
2. Pennington & Dunn - Proteomics from Protein Sequence to Function, 1 st edition, Academic Press, San Diego, 1996.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/102/101/102101007/
2. https://archive.nptel.ac.in/courses/102/101/102101007/
3. https://archive.nptel.ac.in/courses/102/104/102104056/

Web Resources:

1. https://www.youtube.com/watch?v=rg-e_fbJ6iw
2. https://www.youtube.com/watch?v=jEJp7B6u_dY
3. https://www.youtube.com/watch?v=F4LfSsnPwUs
4. https://www.youtube.com/watch?v=k_1YSdmBmo0

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22BS201017	CELL – SIGNALING	2	-	-	-	2

Pre-Requisite Biomolecules and Cell
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This delves deep into structure of cell, Host parasite interactions, Cell signaling, cellular communication and regulation and Innate and adaptive immune systems.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Understand structure and function of cell and cellular organelle
CO2 Identify interactions between Host and parasites
CO3 Gain knowledge on Cellular signaling.
CO4 Understand Cellular communication and regulation
CO5 Know Immunity, Innate and adaptive immune systems.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	-	-	-	-	-	-	3	-	-
CO2	3	3	-	-	-	-	-	-	-	-	3	-	-
CO3	3	3	-	-	-	-	-	-	-	-	3	-	-
CO4	3	3	-	-	-	-	-	-	-	-	3	-	-
CO5	3	3	-	-	-	-	-	-	-	-	3	-	-
Course Correlation Mapping	**3**	**3**	**-**	**-**	-	-	**-**	**-**	-	**-**	**3**	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: STRUCTURE AND FUNCTION OF CELLULAR ORGANELLE ***(06 Periods)***

Introduction to different types of Cells, Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility. Theories explaining the structure of Cell membrane.

Module 2: HOST-PARASITE INTERACTIONS. ***(06 Periods)***

Host parasite interaction Recognition and entry processes of different pathogens like bacteria, viruses into animal and plant host cells, alteration of host cell behavior by pathogens, virus-induced cell transformation, pathogen-induced diseases in animals and plants, cell-cell fusion in both normal and abnormal cells

Module 3: CELL SIGNALING ***(06 Periods)***

Cell signaling, Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, bacterial and plant two- component systems, light signaling in plants, bacterial chemotaxis and quorum sensing

Module 4: CELLULAR COMMUNICATION AND REGULATION ***(06 Periods)***

Cellular communication, Regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation

Module 5: INNATE AND ADAPTIVE IMMUNITY ***(06 Periods)***

Innate and adaptive immune system Cells and molecules involved in innate and adaptive immunity, antigens, antigenicity and immunogenicity. B and T cell epitopes, structure and function of antibody molecules. generation of antibody diversity, monoclonal antibodies

Total Periods: 30

EXPERIENTIAL LEARNING

1. Prepare a report on Cell and functions of cellular oranelle.
2. Should prepare a report on receptors for different hormones and their functions.
3. Analyze different receptors and how they are responsible for cell signaling
4. Seminars on advances in immunotechnology
5. Prepare assignment on various methods used for understanding cell-cell interactions.

RESOURCES

TEXT BOOKS:

1. J. T. Hancock, Cell signaling (2016), 4th Edition, OUP Oxford publisher.
2. F Marks, U. Kling Muller and K M Decker. Cellular signal processing: An Introduction to the Molecular mechanisms of Signal Transduction (2017), Second edition, Garland science publishers.
3. B. Alberts, R. Heald, A. Johnson et al., Molecular Biology of Cell (2022), 7th edition, W.W. Norton and Co publishers.

REFERENCE BOOKS:

1. R. A. Bradshaw and E. A. Dennis (2009) Hand book of Cell signaling, second edition, Academic press publishers.

VIDEO LECTURES:

1. https://www.digimat.in/nptel/courses/video/102103056/L19.html
2. https://www.youtube.com/watch?v=EVIKFGB97_U
3. https://www.youtube.com/watch?v=bYpPMzzyZZ4
4. https://www.youtube.com/watch?v=4P54VIgAiR8

WEB RESOURCES:

1. https://application.wiley-vch.de/books/sample/3527333665_c01.pdf
2. https://www.youtube.com/watch?v=yjAZXlMpw3k

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22BS202013	**PLANT BIOTECHNOLOGY FOR CROP IMPROVEMENT**	3	-	3	-	4.5

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Overview of Plant biotechnology, Crop trait improvement through biotechnology, Molecular breeding and marker assisted selection, Commercialization and total impacts and recent advances and future impacts. Also, hands-on experience on different methods for crop improvement.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the historical development, applications, and key techniques in plant biotechnology, enabling them to appreciate the significance of genetic engineering in crop improvement

CO2. Evaluate and discuss the impact of genetically modified crops on agronomic traits, nutritional content, disease resistance, and post-harvest characteristics, demonstrating a nuanced understanding of the diverse strategies employed for crop improvement

CO3. Acquire knowledge in marker-assisted selection and genome editing techniques, enabling them to apply molecular tools in plant breeding. Additionally, they will gain insight into the technologies for crop improvement, fostering a holistic approach to molecular breeding

CO4. analyze the commercialization of biotech crops, assess the ethical and societal considerations associated with plant biotechnology, and understand the regulatory and intellectual property frameworks..

CO5. Explore other recent advancements in plant biotechnology and their future potential in crop improvement

CO6. Analyze different laboratory techniques related to plant biotechnology for crop improvement.

CO-PO-PSO Mapping Table:

Learning Outcomes	Program Outcomes										Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	3	-	-	-	-	-	-	-	-	3	-	-	-
CO2	3	3	-	-	-	-	-	-	-	3	-	-	-
CO3	3	3	-	-	-	-	-	-	-	3	-	-	-
CO4	3	3	-	-	-	-	-	-	-	3	-	-	-
CO5	3	3	-	-	-	-	-	-	-	3	-	-	-
CO6	3	3	-	-	-	-	3	-	-	3	-	-	-
Course Correlation Mapping	**3**	**3**	-	**-**	-	-	**3**	-	-	**3**	-	-	-

Correlation Levels: 3: High; 2: Medium;1: Low

COURSE CONTENT

Module 1: OVERVIEW OF PLANT BIOTECHNOLOGY ***(09 Periods)***

Definition and historical context, Applications in agriculture and crop improvementPlant Genetic Engineering, Transformation methods: Agrobacterium-mediated, particle bombardment, Selectable markers and reporter genes, Restriction enzymes, DNA ligases, and PCRMolecular markers for plant breeding, Micropropagation, somatic embryogenesis, and protoplast cultureApplications in crop improvement

Module 2: CROP TRAIT IMPROVEMENT THROUGH BIOTECHNOLOGY ***(08 Periods)***

Improved Agronomic Traits: Herbicide tolerance, insect resistance, and abiotic stress tolerance, Biofortification strategies, Increased vitamin and mineral content in crops, Disease Resistance in Crops, Genetic engineering for disease resistance, Strategies against viral, bacterial, and fungal diseases, Post-Harvest Traits:Delayed ripening and extended shelf life, Reduction of post-harvest losses

Module 3 MOLECULAR BREEDING AND MARKER ASSISTED SELECTION ***(10 Periods)***

Principles and applications in crop improvement, Marker types: SSRs, SNPs, and others Genomic Tools for Crop Improvement:Genomic sequencing, bioinformatics, and genomic selection, CRISPR-Cas9 for targeted genome editing, Transcriptomics, proteomics, and metabolomics, Applications in understanding plant traits and responses, Strategies for developing crops resistant to environmental stresses, Integration of molecular breeding techniques

Module 4 COMMERCIALIZATION AND TOTAL IMPACTS ***(10 Periods)***

Commercialization of Biotech Crops: Global trends in the adoption of GM crops, Economic considerations for farmers and industry perspectives, Ethical and Societal Considerations, Public perceptions of biotechnology, Ethical issues in plant biotechnology and public engagement, Intellectual Property and Patents, Patenting of biotech inventions, Access and benefit-sharing agreements

Module 5 RECENT ADVANCES AND FUTURE PROSPECTS ***(08 Periods)***

Gene editing technologies (CRISPR-Cas9) and their application in crop improvement. Synthetic biology and metabolic engineering. Nanotechnology and its potential in plant biotechnology. Future directions and challenges of plant biotechnology.

Total Periods: 45

EXPERIENTIAL LEARNING: (Minimum 5 experiments shall be conducted)

LIST OF EXPERIMENTS

1. Agrobacterium-mediated transformation,
2. PCR-based marker analysis
3. Tissue culture and micropropagation
4. Introduction to genomic databases and basic bioinformatics analysis
5. Visits to biotechnology research laboratories
6. Demonstrations of GM crop field trials

RESOURCES

TEXT BOOKS:

1. C. Neal Stewart Jr, (2018) Plant Biotechnology and Genetics: Principles, Techniques, and Applications" by. Publisher: Wiley
2. G.E. Legwaila, S.A. Muhammad, and S. S. Koroma (2020) Genetically Modified Crops: Their Development, Uses, and Risks" CRC Press Publisher.

REFERENCE BOOKS:

1. Reinhard Renneberg, Arnold L. Demain, and Dieter Antranikian, (2007) Biotechnology for Beginners" by Publisher: Academic Press.
2. S. N. R. Naik, (2018), Practical Manual of Plant Biotechnology" by Publisher: CRC Press.
3. Buchanan, B.B., Gruissem, W., & Jones, R.J. (2015). **Biochemistry & Molecular Biology of Plants**. John Wiley & Sons

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=8ATRfaiaOLg
2. https://www.youtube.com/watch?v=d3ofquD4b9M
3. https://www.youtube.com/watch?v=Ll57lm9Xs6U

Web Resources:

1. https://archive.nptel.ac.in/courses/102/103/102103015/

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22BS201018	MOLECULAR SYSTEMATICS	3	-	-	-	3

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to Molecular Systematics, Molecular techniques in Systematics, Molecular Evolution and phylogenetics, Molecular markers in Systematics and Applications of Molecular Systematics.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Understand basics of Molecular Systematics.
CO2 Identify Molecular techniques that are performed for sequencing and analysis of Nucleic acids and proteins.
CO3 Gain knowledge in studying the evolutionary relationship and creating phylogenetic trees.
CO4 Identify Molecular markers in systematics.
CO5 Gain knowledge in the Applications of Molecular systematics

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	-	-	-	-	-	-	3	-	-
CO2	3	3	-	-	-	-	-	-	-	-	3	-	-
CO3	3	3	-	-	-	-	-	-	-	-	3	-	-
CO4	3	3	-	-	-	-	-	-	-	-	3	-	-
CO5	3	3	-	-	-	-	-	-	-	-	3	-	-
Course Correlation Mapping	**3**	**3**	**-**	**-**	-	-	**-**	**-**	-	**-**	**3**	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO MOLECULAR SYSTEMATICS ***(08 Periods)***

Overview of Molecular Systematics, Historical perspectives and development, Importance and applications in biology, Basic principles of molecular evolution
Molecular markers: DNA, RNA, and protein sequences

Module 2: MOLECULAR TECHNIQUES IN SYSTEMATICS ***(09 Periods)***

DNA extraction and purification, Polymerase Chain Reaction (PCR) and its variations, DNA sequencing methods (Sanger sequencing, Next-Generation Sequencing), Bioinformatics tools for sequence analysis, In-silico methods for phylogenetic analysis.

Module 3: MOLECULAR EVOLUTION AND PHYLOGENETICS ***(10 Periods)***

Models of molecular evolution, Phylogenetic tree construction methods (Neighbor-Joining, Maximum Likelihood, Bayesian Inference), Assessing tree reliability and statistical support, Molecular clocks and divergence time estimation, Coalescent theory and population genetics.

Module 4: MOLECULAR MARKERS IN SYSTEMATICS ***(10 Periods)***

Nuclear, mitochondrial and chloroplast markers, Single-locus and multi-locus approaches, Protein-coding and non-coding regions, High-throughput sequencing and genome-scale data, Challenges and considerations in marker selection.

Module 5: APPLICATIONS OF MOLECULAR SYSTEMATICS ***(08 Periods)***

Species delimitation and identification, Conservation genetics, Comparative genomics and molecular ecology, Evolutionary developmental biology (Evo-Devo), Integrating molecular data with other systematics approaches

Total Periods: 45

EXPERIENTIAL LEARNING

1. Prepare a report on various techniques used in the Molecular systematics.
2. Deliver a seminar on PCR and other techniques used in the molecular Systematics.
3. Assignment preparation regarding Molecular markers and their importance.
4. Identify the applications of Molecular systematics.
5. Visit a lab and prepare a report on Molecular systematics available in that lab

RESOURCES

Text Books:

1. Hillis D. M., Moritz, C., & Mable, B. K. (1996). *Molecular Systematics: Second Edition.* sinauer associates Inc, US publishers
2. Hall, B. G. (2017*).* Phylogenetic Trees Made Easy: A How-To Manual for Molecular Biologists. Fifth Edition, Oxford University Press.
3. Nei, M., & Kumar, S. (2000). Molecular Evolution and Phylogenetics. Oxfor University Press.

Reference Books:

1. Avise, J. C., & Hamrick, J. L. (Eds.). (2004). Molecular Markers, Natural History, and Evolution. 2nd edition, Sinauer associates Inc, US publisher

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=jt4oRUYKTiw
2. https://www.youtube.com/watch?v=fblWo5sN_sw
3. https://www.youtube.com/watch?v=rAA7-6BksGg
4. https://www.youtube.com/watch?v=jFCD8Q6qSTM

WEB RESOURCES:

1. https://iipr.icar.gov.in/wp-content/themes/ICAR-wp/images/pdf/molecularbulletins2may13.pdf
2. https://archive.nptel.ac.in/courses/102/106/102106065/

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22BS201019	DNA AND PROTEIN SEQUENCE ANALYSIS	2	-	-	-	2

Pre-Requisite **Bioinformatics and its applications**

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to DNA and Nucleotide sequence, gene identification and expression, Introduction to protein and protein sequence, Protein sequence analysis and sequence analysis tools.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the basic concepts of Nucleic acids and sequencing methods.
CO2. Identify different tools used to for prediction of genes and ORF.
CO3. Gain knowledge in Protein sequence and protein databases.
CO4. Analyze Protein sequence secondary structure data.
CO5. Identify the applications of Sequence analysis tools.

CO-PO-PSO Mapping Table:

Learning Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	3	3	-	-	-	-	-	-	-	-	3	-	-
CO2	3	3	-	-	-	-	-	-	-	-	3	-	-
CO3	3	3	-	-	-	-	-	-	-	-	3	-	-
CO4	3	3	-	-	-	-	-	-	-	-	3	-	-
CO5	3	3	-	3	-	-	3	-	-	-	3	-	-
Course Correlation Mapping	**3**	**3**	-	**3**	-	-	**3**	-	-	-	**3**	-	-

Correlation Levels: 3: High; 2: Medium;1: Low

COURSE CONTENT

Module 1 INTRODUCTION TO DNA AND NUCLEOTIDE SEQUENCE*(07 Periods)*

Introduction to types of Nucleic acids, Difference between DNA and RNA. Traditional methods of DNA sequencing. New generation sequencing technologies. Genome and Gene databases.

Module 2: GENE IDENTIFICATION AND EXPRESSION *(06 Periods)*

Genome and Gene structure, Identification of Genes, Genscan, ORF and Identification of ORF, Advanced Nucleic acid analysis tools.

Module 3 INTRODUCTION TO PROTEIN AND PROTEIN SEQUENCE *(06 Periods)*

Introduction to Proteins, Structural organization of proteins, Amino acids and their codes, Sequencing of Proteins. Protein sequence and structure databases.

Module 4 PROTEIN SEQUENCE ANALYSIS *(05 Periods)*

Analysis of Protein sequences, Prediction tools for Secondary structures, Protein structural motif prediction, domain prediction tools. Protein families.

Module 5 SEQUENCE ANALYSIS TOOLS *(06Periods)*

Pair wise sequence alignment, Dynamic programming methods, Heuristic methods, BLAST, FASTA, BLAT. Multiple sequence alignment methods.

Total Periods: 30

EXPERIENTIAL LEARNING:

LIST OF EXERCISES:

1. Assignment on latest techniques in Genome sequencing methods
2. Assignment on latest techniques in Protein secondary structure prediction
3. Analysis of sequences of given proteins.
4. Identify Genes for the Genome sequence provided
5. Analyze the mass spectroscopy data from cellular proteins
6. Write report on Human genome projects
7. Select any important fruit or vegetable genomes and identify the key genes

RESOURCES

TEXT BOOKS:

1. S. B. Primrose and R.M. Twyman - Principles of Genome Analysis and Genomics, 7 th Edition,
   Blackwell Publishing, 2006.
2. S. Sahai - Genomics and Proteomics, Functional and Computational Aspects, Plenum Publication, 1999

REFERENCE BOOKS:

1. Andrezej K Konopka and James C. Crabbe, Compact Hand Book - Computational Biology, Marcel Dekker, USA, 2004
2. Pennington & Dunn - Proteomics from Protein Sequence to Function, 1 st edition, Academic Press, San Diego, 1996.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/102/101/102101007/
2. https://archive.nptel.ac.in/courses/102/101/102101007/
3. https://archive.nptel.ac.in/courses/102/104/102104056/

Web Resources:

1. https://www.youtube.com/watch?v=rg-e_fbJ6iw
2. https://www.youtube.com/watch?v=jEJp7B6u_dY
3. https://www.youtube.com/watch?v=F4LfSsnPwUs
4. https://www.youtube.com/watch?v=k_1YSdmBmo0

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22BS201003	PATENTING IN BIOTECHNOLOGY	3	-	-	-	3

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to Biotechnology patents, Types of Biotechnology patents, Patentable criteria in Biotechnology, Challenges and controversies in Biotechnology patenting and Practical aspects of Biotechnology patenting.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Gain knowledge on Patenting in Biotechnology

CO2. Identify different types of Patents in the Biotechnology patenting
CO3. Understand patenting criteria while filing for Biotechnology patents.
CO4. Analyze challenges in Biotechnology patenting to overcome controversies.

CO5. Learn how to draft Patenting application and filing it.

CO-PO-PSO Mapping Table:

Learning Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	3	-	-	-	-	-	-	-	-	3	-	-	-
CO2	3	3	-	-	-	-	-	-	-	3	-	-	-
CO3	3	3	-	-	-	-	-	-	-	3	-	-	-
CO4	3	3	-	-	-	-	-	-	-	3	-	-	-
CO5	3	3	-	-	-	-	-	-	-	3	-	-	-
CO6	3	3	-	-	-	-	-	-	-	3	-	-	-
Course Correlation Mapping	**3**	**3**	-	**-**	-	-	**-**	-	-	**3**	-	-	-

Correlation Levels: 3: High; 2: Medium;1: Low

COURSE CONTENT

Module 1: : **INTRODUCTION TO BIOTECHNOLOGY PATENTS** ***(09 Periods)***

Overview of Intellectual Property (IP) and its significance in biotechnology, Introduction to patents and their role in protecting biotechnological inventions, Historical perspectives on biotechnology patents, Understanding the patent application process, Ethical considerations in biotechnology patenting

Module 2: TYPES OF BIOTECHNOLOGY PATENTS ***(09 Periods)***

Utility patents in biotechnology, Plant patents and the protection of genetically modified crops, Design patents for biotechnological inventions, Process patents and their application in biotechnology, Comparative analysis of different types of patents in biotech

Module 3 PATENTIBLE CRITERIA IN BIOTECHNOLOGY ***(09 Periods)***

Novelty, non-obviousness, and utility requirements, The role of prior art in patent examinations, Patent searching and landscape analysis, Determining the patentability of biotechnological inventions, Case studies on successful biotech patent applications

Module 4 CHALLENGES AND CONTROVESIES IN BIOTECH PATENTING ***(09 Periods)***

Patent infringement issues in biotechnology, Patent litigation and its impact on the biotech industry, Ethical concerns and the role of patents in restricting access to technology, Patentability of naturally occurring organisms and genes, Global perspectives on biotech patenting and international treaties

Module 5 PRACTICAL ASPECTS OF BIOTECHNOLOGY PATENTING ***(09 Periods)***

Drafting a biotech patent application: Tips and best practices, Patent prosecution and responding to office actions, Commercialization strategies for patented biotechnological inventions, Licensing and technology transfer in the biotech sector, Case studies and real-world examples in biotech patenting

Total Periods: 45

EXPERIENTIAL LEARNING: (Minimum 5 experiments shall be conducted)

LIST OF EXPERIMENTS

1. Write report on steps in Biotechnology patenting
2. Deliver a seminar on Patenting with one new product as an example.
3. Draft a example application of patenting.
4. Presentation on Ethical aspects of Patenting
5. Write assignment regarding New Biotech products in the Market
6. Group discussion on legal issues related in Biotechnology patenting

RESOURCES

TEXT BOOKS:

1. K. Kumari, (2020), Intellectual property in Biotechnology: From Patenting to licensing, Publisher: SPringer.
2. M. A. Goldman (2017), Biotechnology and Law: A guide to patent law in the Biotech Industry, Publisher: Routledge.

REFERENCE BOOKS:

1. H. J. Knight, (2013), Patent strategy for Researchers and Research Managers, Publisher: Wiley
2. M. Kingsley and P. H. Gannet, (2018) Biotechnology and Patents: A practical guide, Publisher: Academic Press.
3. P.K. Gupta and S. N. Raina, (2019), Intellectual property rights in Agricultural Biotechnology, Publisher: Springer.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=PBDqtonfmI0
2. https://www.youtube.com/watch?v=nhIDxD3AsdU
3. https://www.youtube.com/watch?v=b_1xiEJP4tM

Web Resources:

1. http://ecoursesonline.iasri.res.in/mod/page/view.php?id=5103

UNIVERSITYELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC101701	**AI IN HEALTHCARE**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Concepts of Artificial Intelligence (AI) in Healthcare; The Present State and Future of AI in Healthcare Specialties; The Role of Major Corporations in AI in Healthcare; Applications of AI in Healthcare.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Understand the fundamental concepts of AI in Healthcare sector.

CO2 Analyse the present state and future of AI in Healthcare specialties for different scenarios.

CO3 Apply design concepts and metrics for AI in Healthcare.

CO4 Demonstrate basic concepts and terminologies of future applications of Healthcare in AI.

CO5 Develop AI applications through AI techniques for healthcare

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	2	2	-	-	-	-	-	-	-	-
CO2	2	3	-	2	-	2	2	-	-	-	-	-
CO3	2	-	2	2	-	-	-	-	-	-	-	-
CO4	2	-	-	-	2	2	-	-	-	-	-	-
CO5			3									
Course Correlation Mapping	2	-	3	2	2	2	2	-	-	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO ARTIFICIAL INTELLIGENCE IN HEALTHCARE ***(08 Periods)***

Introduction to AI in Healthcare, Benefits & Risks, AI in the health sector, AI versus human intelligence, The future of AI in health sector, AI & Neural networks.

Module 2: THE PRESENT STATE & FUTURE OF AI IN HEALTHCARE SPECIALTIES ***(10 Periods)***

Artificial Intelligence in: preventive healthcare, Radiology, Pathology, Surgery, Anesthesiology, Psychiatry, Cardiology, Pharmacy, Dermatology, Dentistry, Orthopedics, Ophthalmology.

Module 3: THE ROLE OF MAJOR CORPORATIONS IN AI IN HEALTHCARE ***(08 Periods)***

IBM Watson, The role of Google & Deep mind in AI in Healthcare, Baidu, Facebook & AI in Healthcare, Microsoft & AI in Healthcare.

Module 4: FUTURE OF HEALTHCARE IN AI ***(10 Periods)***

Evidence-based medicine, personalized medicine, Connected medicine, Virtual Assistants, Remote Monitoring, Medication Adherence, Accessible Diagnostic Tests, Smart Implantables, Digital Health and Therapeutics, Incentivized Wellness, Block chain, Robots, Robot-Assisted Surgery, Exoskeletons, Inpatient Care, Companions, Drones, Smart Places, Smart Homes, Smart Hospitals.

Module 5: APPLICATIONS OF AI IN HEALTHCARE ***(09 Periods)***

Case Study 1: AI for Imaging of Diabetic Foot Concerns and Prioritization of Referral for Improvements in Morbidity and Mortality.

Case Study 2: Outcomes of a Digitally Delivered, Low-Carbohydrate, Type 2 Diabetes Self-Management.

Case Study 3: Delivering A Scalable and Engaging Digital Therapy.

Case Study 4: Improving Learning Outcomes for Junior Doctors through the Novel Use of Augmented and Virtual Reality for Epilepsy.

Case Study 5: Big Data, Big Impact, Big Ethics: Diagnosing Disease Risk from Patient Data.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Analyze how the artificial intelligence is used to predict the disease result and Prognosis Assessment of a patient.
2. How does drug discovery happen and how does AI is helping in drug discovery and Labs.
3. Justify that artificial intelligence provide engineering solutions for early detection andDiagnosis of diseases.
4. Demonstrate the prediction of bladder volume of a patient.

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. Dr. Parag Mahajan, *Artificial Intelligence in Healthcare*, MedManthra Publications, First Edition 2019.
2. Arjun Panesar, *Machine Learning and AI for Healthcare Big Data for Improved Health*, Apress Publications, 2019.

REFERENCE BOOKS:

1. Michael Matheny, Sonoo Thadaney Israni, Mahnoor Ahmed, and Danielle Whicher, *Artificial Intelligence in Health Care: The Hope, the Hype, the Promise, the Peril*, National Academy of Medicine Publication, First Edition 2019.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=-aHBwTQQyNU
2. https://intellipaat.com/blog/artificial-intelligence-in-healthcare/

Web Resources:

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6616181/
2. https://www.ibm.com/topics/artificial-intelligence-healthcare
3. https://builtin.com/artificial-intelligence/artificial-intelligence-healthcare

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CB101703	**FORENSIC SCIENCE**	3	-		-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Concepts of Forensic Science, Tools and Techniques in Forensic Science, Forensic Photography, Crime Scene Management, Crime Scene Management Laws and Forensic Science.

COURSE OUTCOMES: *After successful completion of the course, students will be able to*:

CO1 Understand the basic concepts of Forensic science.
CO2 Apply various tools and techniques in forensic science for crime investigation.
CO3 Understand Forensic Photography fundamentals.
CO4 Perform Crime scene investigation, scene reconstruction and prepare reports.
CO5 Understand Legal aspects of Forensic Science.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3											
CO2	3	3	2	2	2							
CO3	3	3										
CO4	3	3	2	2	2							
CO5	3	3	2	2	2							
Course Correlation Mapping	**3**	**3**	**2**	**2**	**2**							

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT

Module 1: INTRODUCTION ***(09 Periods)***

Introduction, Need, Scope, Concepts and Significance of Forensic Science, History and Development of Forensic Science, Laws and Basic principles of Forensic Science, Branches of forensic science, Organizational set-up of a Forensic Science Laboratory. Investigative strategies. Expert testimony and eye-witness report.

Module 2: TOOLS AND TECHNIQUES IN FORENSIC SCIENCE ***(09 Periods)***

Basic principles of microscopy, spectroscopy, chromatography, Electrophoresis,

Enzyme_Linked Immunosorbent Assay (ELISA), Radio Immuno Assay (RIA). Measuring and optical instruments. Research methodologies; Formation of research design on a specific problem. Central tendency and Dispersion. Test of significance. Analysis of variance, Correlation and Regression.

Module 3: FORENSIC PHOTOGRAPHY ***(8 Periods)***

Basic principles of Photography, Techniques of black & white and color photography, cameras, lenses, shutters, depth of field, film; exposing, development and printing techniques; Different kinds of developers and fixers; UV, IR, fluorescence illumination guided photography; Modern development in photography- digital photography, working and basic principles of digital photography; Surveillance photography. Videography and Crime Scene & laboratory photography.

Module 4: CRIME SCENE MANAGEMENT ***(11 Periods)***

Crime scene investigations, protecting and isolating the crime scene; Documentation, sketching, field notes and photography. Searching, handling and collection, preservation and transportation of physical evidences, Chain of custody and Reconstruction of scene of crime. Report writing.

Module 5: LAW AND FORENSIC SCIENCE ***(8 Periods)***

Legal aspects of Forensic Science: Forensic Science in the Criminal Justice System, The Criminal Investigation Process, Production of Evidence: The Subpoena, The Rules of Evidence, Authentication of Evidence: The Chain of Custody, The Admissibility of Evidence, Laboratory Reports, Examples of Analysis and Reports, Expert Testimony, Getting into Court, Testifying, Being a Witness and an Expert, Considerations for Testimony.

Total Periods: 45

EXPERIENCIAL LEARNING

1. Study of Computer Forensics and different tools used for forensic investigation
2. **Identify and list the steps for hiding and extract any text file behind an image file/ Audio file using Command Prompt**

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Houck M.M and Siegel J.A, *Fundamentals of Forensic Science*, Elsevier, 2nd edition, 2010.
2. Sharma B.R, *Forensic Science in Criminal Investigation and Trials*, Universal Publishing Co., New Delhi, 2003.

REFERENCE BOOKS:

1. Nanda B.B and Tewari, R.K, *Forensic Science in India- A vision for the Twenty First Century*, Select Publisher, New Delhi, 2001.
2. James, S.H and Nordby, J.J, *Forensic Science- An Introduction to Scientific and Investigative Techniques*, CRC Press, USA, 2003.
3. Saferstein, Criminalistics, *An Introduction of Forensic Science*, Prentice Hall Inc, USA,2007.
4. Barry, A.J. Fisher, *Techniques of Crime Scene Investigation*, CRC Press, NewYork, 7th edition, 2003.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/106106178
2. https://www.youtube.com/watch?v=X5fo1H7bc0g

WEB RESOURCES:

1. https://www.nist.gov/forensic-science
2. https://www.coursera.org/learn/forensic-science

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22SS101706	**WOMEN EMPOWERMENT**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Concept & Framework, Status of Women, Women's Right to Work, International Women's Decade, and Women Entrepreneurship.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Demonstrate the knowledge of the characteristics and achievements of empowered women and women's empowerment techniques by analyzing women's legal and political status.

CO2 Apply the knowledge of women's rights by analyzing various societal issues and obstacles in different fields, including science and technology.

CO3 Demonstrate the knowledge of the significance of women's participation in policy debates, National conferences, and common forums for equality and development by identifying and analyzing issues.

CO4 Analyze the concept of women's entrepreneurship, government schemes, and entrepreneurial challenges and opportunities.

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	-	-	1	3	-	1	–	–	-	-
CO2	3	1	-	-	-	2	-	-	-	–	-	-
CO3	3	1	-	-	-	2	-	-	-	3	-	-
CO4	3	1	-	-	-	-	-	-	-	-	2	-
Course Correlation Mapping	3	1	-	-	1	3	-	1	–	3	2	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: CONCEPT & FRAMEWORK ***(09 Periods)***

Introduction– Empowered Women's Characteristics – Achievements of Women's Empowerment **Concept of Empowerment:** Meaning & Concept – Generalizations about Empowerment – Empowerment Propositions – Choices women can make for empowerment – Women's participation in decision making, development process & in Governance. **Framework for Empowerment** – Five levels of equality – Tenets of Empowerment– Elements – Phases and aspects – Techniques – Categories and Models – Approaches.

Module 2: STATUS OF WOMEN ***(09 Periods)***

Legal Status: Present Scenario – Call for Social Change – Significant Trends – Legal & Schemes – Personal Law – Joint Family – Criminal Law – Shift towards Dowry – Deterrent Punishment – Criminal Law (II Amendment) – Discrimination in Employment.

Political Status: Present Scenario – Political Participation & its NatureSocio–economic Characteristics – Political Mobilization: Mass Media – Campaign Exposure – Group Orientation – Awareness of issues and participation – Progress & Future Thrust.

Module 3: WOMEN'S RIGHT TO WORK ***(09 Periods)***

Introduction – Present Scenario – Changes in Policy & Programme – National Plan of Action– Women's Cells and Bureau – Increase in the work participation rate – Discrimination in the labour market – Women in unorganized sector – Issues and Obstacles– Women in Education – Women in Science & Technology – Case Study: Linking Education to Women's Access to resources.

Module 4: WOMEN'S PARTICIPATORY DEVELOPMENT ***(09 Periods)***

Dynamics of social change – conscious participation – Information Explosion – Organized Articulation – National Conference – Common Forums – Participatory Development – New Issues Identified – Role of other Institutions.

Module 5: WOMEN ENTREPRENEURSHIP ***(09 Periods)***

Introduction – Definition – Concept – Traits of women Entrepreneurs – Role of Women Entrepreneurs in India – Reasons for Women Entrepreneurship – Government schemes & Financial Institutions to develop Women Entrepreneurs – Key policy recommendations – Project Planning – Suggestions and measures to strengthen women entrepreneurship – Growth & Future challenges – Training and Opportunities – Case Study: Training Women as Hand–pump Mechanics– Case Study: Literacy for Empowering Craftswomen

Total Periods: 45

EXPERIENTIAL LEARNING

1. Prepare poster presentation on "impact of women's self-help groups on their empowerment and socio-economic development."
2. Prepare a comparative analysis chart on the status of women in various countries.
3. Prepare a presentation on women and cultural responsibilities in different societies.
4. Prepare a presentation on the women of the past, present and future in terms of responsibilities and duties.
5. Prepare a presentation on the great women entrepreneurs of India.

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. SahaySushama,*Women and Empowerment,*Discovery Publishing House, New Delhi, 2013.
2. NayakSarojini, Jeevan Nair,*Women's Empowerment in India*, Pointer Publishers, Jaipur, 2017.

REFERENCE BOOKS:

1. Baluchamy. S,*Women's Empowerment of Women*, Pointer Publishers, Jaipur, 2010.
2. Khobragade Grishma,*Women's Empowerment: Challenges and Strategies Empowering Indian Women*, Booksclinic Publishing, Chhattisgarh, 2020.

Web Resources:

1. https://www.economicsdiscussion.net/entrepreneurship/women–entrepreneurs–in–india
2. https://www.businessmanagementideas.com/entrepreneurship–2/women entrepreneurs