

**DHANALAKSHMI SRINIVASAN COLLEGE OF ARTS & SCIENCE
FOR WOMEN (AUTONOMOUS)**

**Affiliated to Bharathidhasan University
(Nationally Re Accredited with 'A' Grade by NAAC)
PERAMBALUR 621212.**



M.Sc., SYLLABUS FOR THE ACADEMIC YEAR 2022 - 2023



DHANALAKSHMI SRINIVASAN COLLEGE OF ARTS & SCIENCE FOR WOMEN (AUTONOMOUS)
 Re accredited with "A" Grade by NAAC, (Affiliated to Bharathidasan University)
 Perambalur-621 212.



M.Sc. BIOTECHNOLOGY

(For the candidates admitted from the academic year 2022-2023)

SEM	COURSE	COURSE TITLE	COURSE CODE	INSTRUCTION PERIOD PER WEEK	CREDIT	EXAM HOURS	MARKS		TOTAL
							INT	EXT	
SEM I	CC- I	Biochemistry and Biophysics	22PBT1C1	6	5		25	75	100
	CC -II	Cell and Molecular Biology	22PBT1C2	6	5		25	75	100
	CC-III	Microbiology	22PBT1C3	6	5		25	75	100
	CP-IV	Lab I Cell and Molecular Biology and Immunology	22PBT1C4P	6	4		40	60	100
	CEC-I	A) Pharmaceutical Biotechnology	22PBT1E1A	6	3		25	75	100
			B) Immunology	22PBT1E1B					
VAC*	Biofertilizer	22PBT1V1		2*				100*	
TOTAL				30	22				500
SEM II	CC-V	Enzyme Technology and Bioinstrumentation	22PBT2C5	5	5		25	75	100
	CC-VI	rDNA Technology	22PBT2C6	5	5		25	75	100
	CC-VII	Microbial Technology	22PBT2C7	4	5		25	75	100
	CC-VIII	IPR, Biosafety and Bioethics	22PBT2C8	4	5		25	75	100
	CP-IX	Lab II Enzyme Technology and Recombinant DNA Technology	22PBT2C9P	6	4		40	60	100
	NME-I	Advances in Biotechnology	22PBT2N1A	3	2		25	75	100
			Herbal medicine	22PBT2N1B					
IBC	Bioentrepreneurship	22PBT2I1	3	3		25	75	100	
TOTAL				30	29				700
SEM III	CC-X	Plant Biotechnology	22PBT3C10	6	5		25	75	100
	CC -XI	Animal Biotechnology	22PBT3C11	6	5		25	75	100
	CC-XII	Environmental Biotechnology	22PBT3C12	6	5		25	75	100
	CP-XIII	Lab III Plant, Animal & Environmental biotechnology	22PBT3C13P	6	4		40	60	100
	NME-II	Bioremediation	22PBT3N2A	3	2		25	75	100
			Food Biotechnology	22PBT3N2B					
	SB	Soft Skill	22P3SB	3	3		25	75	100
ES	Employability Skills	22P3ES	-	2*		-	-	100*	
TOTAL				30	24				600
SEM IV	CC-XIV	Research Methodology	22PBT4C14	6	5		25	75	100
	CEC-II	Bioinformatics	22PBT4E2A						
		Marine biotechnology	22PBT4E2B	6	3		25	75	100
PW	Project Work	22PBT4PW	18	7		40	60	100	
TOTAL				30	15				300
GRAND TOTAL				120	90(4)	-			2100

PROGRAMME OBJECTIVES

- Graduates will be able to accomplish professional standards in the global environment.
- Graduates will be able to uphold integrity and human values.

PROGRAMME OUTCOMES

- Graduates will be able to analyse and interpret data
- Graduates will be able to engage in socially relevant research
- The graduates will acquire the skills in approaching and solving challenges related to healthcare, agriculture and environmental sectors through Biotechnological approaches.
- It will provide the students to develop independent learning skills in all biochemical and biotechnology studies.
- This course will help in contributing to the education of academics which impart its effect for university to play an active role in other advanced studies.

PROGRAMME SPECIFIC OUTCOMES

- Post graduates will acquire knowledge in the domain of Biotechnology with respect to emerging concepts and techniques.
- Post Graduates will be able to identify, understand, design, perform experiments and apply the acquired skills in solving complex biotechnology problems using modern tools and techniques.
- Post graduates will gain the theoretical and practical exposure to the basic and the advanced fields of biotechnology.
- Post graduate will develop confidence for self-education and ability for life-long learning.

SEMESTER – I (CORE COURSE- I)

BIOCHEMISTRY AND BIOPHYSICS

Course Code: 22PBT1C1

Hours/ Week: 6

Credits: 5

Max Marks: 100

Internal Marks: 25

External Marks: 75

COURSE OBJECTIVES

- To gain a basic knowledge about the chemical bonding in biological system.
- To have a detailed knowledge about the function and properties of biomolecules and to learn about the basic metabolic reactions of living organisms.
- To have a basic knowledge about the enzymes and biological energy transducers
- Thorough understanding of the analytical techniques and equipment used in biological science and to have a fundamental knowledge regarding the Microscopy and Spectroscopy.
- To acquaint the students with various techniques used in biological sciences and the emerging areas of biotechnology along with underlying principles.

UNIT I - Chemical bonding in biological system

Percentage solution, molarity, normality, molality, properties of water- hydrogen bonding, hydrophobic interactions, acids bases and their concepts, buffers, Henderson-Hasselbatch Equation & biological buffers, and electrolytes & their functions – acidity, alkalinity and pH determination - Basic Thermodynamics, laws of thermodynamics - Enthalpy and Entropy relations.

UNIT II: Biomolecules

Carbohydrates, Lipids, Amino acids, Proteins and Nucleic acids, Biomolecules – Introduction - classification, function and properties. Carbohydrate Metabolism: Glycolysis & TCA cycle and its Energetics. Transamination and oxidation domination reactions of amino acids. Amino acids catabolisms (phenylketonuria, albinism). Protein metabolism – Urea cycle and its significance, pathway controlling protein degradation. Metabolic disorders associated with protein metabolism. Lipid Metabolism: Biosynthesis of Fatty acids; Triglycerides; Phospholipids; Sterols. β -oxidation of fatty acids

UNIT III: Enzymes

Classification and nomenclature of enzymes - physico chemical nature of enzymes – enzyme kinetics – mechanism of enzyme action – factors affecting enzyme activity, industrially important enzymes.

UNIT IV: Basic Instruments

pH meter, isoelectric focusing. Principles and application of light microscopy, phase Contrast, Bright and Dark field Microscopy fluorescence Microscopy, Electron Microscopy- TEM, SEM, Confocal microscopy and atomic absorption microscopy.

Diffraction Methods: Principles, Components and applications of X-ray crystallography. Braggs equation, Reciprocal lattice concept, Miller index and Unit cell, Determination of crystal structure, colorimeter, Spectroscopy – Raman effect, UV-Visible, Mass spectroscopy, Atomic Absorption spectroscopy, NMR –Experimental techniques and instrumentation, ESR. LASER and MASER - Principle and applications.

UNIT V: Tracer Techniques

Radioactive and stable isotopes: Pattern and rate of radioactive decay isotope-Half life, GM counter, solid and liquid scintillation counter, Radiation dosimetry, Radio tracer technique, Autoradiography. Application of isotopes in Biology.

UNIT VI: Latest Learning's (For CIA Purpose only)

Latest development related to the course during the semester concerned

TEXT BOOKS

- Biochemistry, Sathyanarayanan.U and Chakrapani.C, (2013), Books and allied (P) Ltd
- Fundamentals of Biochemistry, Deb,A.C., (7th Edition). New central agency.
- Fundamentals of Biochemistry, Jain, J.L., (2005), (6th Edition), S.Chand Publications
- Enzymes, Ashokan.P, 2006, Chinna Publications
- Molecular Biology, Freifelder. D, 1996, II Edition, Narosa Publishing House, New Delhi.
- Biophysical chemistry – principles and techniques, Upadhyay, Upadhyay and Nath, 3rd edition, 2002, Himalaya publishing home.
- Laboratory manual in biochemistry, J.Jayaram 1981, Wiley publisher.
- Bioinstrumentation, L. Veerakumari, 1st edition 2011, MJP publishers.

REFERENCE BOOKS

- Principles and techniques of practical biochemistry, Keith Wilson and John walker, 5th edition 2000, Cambridge University press.
- Analytical biochemistry, D. Holme and H.Peck, 3rd edition 1998, longman.
- Physical biochemistry- application to biochemistry and molecular biology, Freifelder, 2nd edition, 1982, W. H.Freeman and company, San Fransisco.
- Introduction to Protein Structure, Carl Branden and John Tooze, 1999, Second Edition, Garland Publishing.
- Biochemistry, Garrett.R and Grisham.C, 2010, 4th Edition, Saunders College Publishing.
- Principles of Biochemistry, Lehninger, Nelson, David.L and M.M.Cox, 2013. 6th Edition, W.H.Freeman & Co.

NET REFERENCE

[NPTEL: Chemistry and Biochemistry - NOC:Essentials of Biomolecules : Nucleic Acids and Peptides](#)

<https://archive.nptel.ac.in/content/storage2/courses/104103018/pdf/mod3.pdf>

[Enzyme Definition and Classification - Creative Enzymes \(creative-enzymes.com\)](#)

[Microscopy: Intro to microscopes & how they work \(article\) | Khan Academy](#)

[Tracer Technique - YouTube](#)

<https://www.pursuitphysics.in/2020/08/radiation-detectors-part-1.html>

<https://microscopiaiwm.com/2021/03/18/autoradiography>

https://onlinecourses.nptel.ac.in/noc20_mm22/preview

https://onlinecourses.nptel.ac.in/noc20_bt18/preview

https://onlinecourses.nptel.ac.in/noc21_cy13/preview

COURSE OUTCOMES		Knowledge Level
Upon Completion of course the students will be able to		
CO - 1	Knowledge for preparation of different buffers	K1
CO - 2	Students will be imparted complete knowledge about structure and function of different biomolecules (proteins, lipids, nucleic acids, and carbohydrates) found in living cells.	K4
CO - 3	Evaluating the mechanism of enzyme action	K5
CO - 4	Understand the principles of instruments	K2
CO - 5	Apply the concepts of bioanalytical techniques in biotechnology research	K3

SEMESTER – I (CORE COURSE- II)

CELL & MOLECULAR BIOLOGY

Course Code: 22PBT1C2

Hours/ Week: 6

Credits: 5

Max Marks: 100

Internal Marks: 25

External Marks: 75

COURSE OBJECTIVES

- Familiarize students with the cell and molecular biology of both Prokaryotes and Eukaryotes.
- Students will acquire basic fundamental knowledge and explore skills in molecular biology and become aware of the complexity and harmony of the cells.
- This course will emphasize the molecular mechanism of DNA replication, repair, transcription, protein synthesis and gene regulation in various organisms.
- Understand the essentials of molecular biology: replication, transcription and translation; enzymes involved in the central dogma of life, proofreading, inhibitors and post modifications.
- Knowledgeable in mutant and its types, genetic recombination, linkage, multifactor crosses; mutation: causative agents, types and the mechanism of repair; complementation and intragenic complementation.

UNIT I: Cell Theory

Cell as a basic unit - classification of cell types - cell theory - organization of plant and animal cells - comparison of microbial, plant and animal cells. An Overview of Cells: prokaryotic and eukaryotic cells, cell size and shape, Phage's, Viroid's and Mycoplasma. Structure of Cell and its organelles: Molecules of cell, Plasma membranes (Structure, models, functions, channels, pumps and receptors) Membrane lipids, proteins and carbohydrates - Plasmodesmata. Ultra structure of organelles: ribosome, ER and Golgi body. Nucleus - Nuclear Envelope- structure of nuclear pore complex, nuclear lamina, Transport across Nuclear Envelope, Chromosomes and its types.

UNIT II: DNA Replication and Repair

Overview of Central dogma. Organization of prokaryotic and eukaryotic chromosomes. DNA replication: Meselson & Stahl experiment, bi-directional DNA replication, Okazaki fragments, Proteomics of DNA replication, Fidelity of DNA replication, Inhibitors of DNA replication, Overview of differences in prokaryotic and eukaryotic DNA replication, Telomere replication in eukaryotes. D-loop and rolling circle mode of replication. Mutagens, DNA mutations and their mechanism, various types of repair mechanisms.

UNIT III: Transcription

Structure and function of mRNA, rRNA and tRNA. Characteristics of promoter and enhancer sequences. RNA synthesis: Initiation, elongation and termination of RNA synthesis, Proteins of RNA synthesis, Fidelity of RNA synthesis, Inhibitors of transcription, Differences in prokaryotic and eukaryotic transcription. Basic concepts in RNA world: Ribozymes, RNA processing: 5'-Capping, Splicing-Alternative splicing, Poly 'A' tail addition and base modification.

UNIT IV: Translation

Introduction to Genetic code: Elucidation of genetic code, Codon degeneracy, Wobble hypothesis and its importance, Prokaryotic and eukaryotic ribosomes. Steps in translation: Initiation, Elongation and termination of protein synthesis. Inhibitors of protein synthesis. Post-translational modifications and its importance.

UNIT V: Regulation of Gene Expression

Organization of genes in prokaryotic and eukaryotic chromosomes, Hierarchical levels of gene regulation, Prokaryotic gene regulation –lac and trp operon, Regulation of gene expression with reference to λ phage life cycle.

UNIT VI: Latest learnings (For CIA Purpose only)

Latest development related to the course during the semester concerned

TEXT BOOKS

- JFriefelder, David. "Molecular Biology." Narosa Publications, 1999.
- Weaver, Robert F. "Molecular Biology" 2nd Edition, Tata McGraw-Hill, 2003.
- Karp, Gerald "Cell and Molecular Biology: Concepts and Experiments" 4th Edition, John Wiley, 2005.
- Friefelder, David and George M. Malacinski "Essentials of Molecular Biology" 2nd Edition, Panima Publishing, 1993.
- Lewin's GENES XI, Published by Jones & Bartlett Learning; 11 edition (January 15, 2013).

REFERENCES

- Molecular Biology: Genes to Proteins" Tropp, Burton E. 3rd Edition. Jones and Bartlett, 2008.
- Molecular Biotechnology: Principles and Applications of Recombinant DNA" Glick, B.R. and J.J. Pasternak. 4th Edition. ASM, 2010

NET REFERENCES

[NPTEL: Biotechnology - NOC:Cell Biology: Cellular organization, division and processes](#)

[Cell Biology: Cellular organization, division and processes - Course \(nptel.ac.in\)](#)

<https://youtu.be/WsofH466lqk>

<https://youtu.be/QcBYTA7uVXk>

<https://youtu.be/vqY-PvUKm8Q>

<https://youtu.be/AmleIPS62NY>

CO. No.	COURSEOUTCOMES	Cognitive Level (K-Level)
On completion of this course, the students will be able to		
CO-1	Describe the basic structure and functioning of the genetic elements.	K1
CO-2	Explain the molecular mechanisms of bacterial & eukaryotic transcription, and translation respectively.	K2
CO-3	Examine the causative factors of genetic related disorder.	K3
CO-4	Compare and contrast the mechanisms of bacterial and eukaryotic DNA replication and DNA repair.	K4
CO-5	Create appropriate DNA profiling tools and inspect the efficacy of particular techniques in their research projects.	K5 & K6

SEMESTER – I (CORE COURSE- III)

MICROBIOLOGY

Course Code: 22PBT1C3

Hours/ Week: 6

Credits: 5

Max Marks: 100

Internal Marks: 25

External Marks: 75

COURSE OBJECTIVES

- To introduce the students to the field of microbiology with special emphasis on microbial diversity, morphology, physiology and nutrition; methods for control of microbes and host-microbe interactions.
- To know about the Microorganisms, its structure and classification.
- To learn about the isolation and general characteristics of Microorganisms.
- To study about the pathogens, its diagnostic methods, prevention and treatment for the diseases.
- Motivate the students to become a successful Entrepreneur.

UNIT I: Basic Microbiology

Introduction to Microbiology: Scope of microbiology and emerging avenues, Development of microbiology, Microbial taxonomy and detailed classification of the microbial world as per Bergey's manual of classification (Bacteria, Archaea, Eukarya),

UNIT II: Ultra structure of Prokaryotic and Eukaryotic

Ultra structure of Prokaryotic and Eukaryotic cell- The Prokaryotic Cell: Size, shape and arrangement of bacterial cells; structure of cell wall, and structures external (glycocalyx, flagella, pili, etc.,) and internal (plasma membrane, cytoplasm, inclusion bodies, etc.,) to the cell wall. The Eukaryotic Cell: Cilia, flagella, cytoskeleton, cytomembrane systems, mitochondria and chloroplast Comparison of Prokaryotic and Eukaryotic cell.

UNIT III: Microbial Nutrition, Growth and reproduction of microorganisms

Cultivation of microorganisms; culture media and types of culture media. Nutritional requirements of microorganisms - nutritional classification of bacteria. Growth curve, Mathematical expression of growth; Measurement of growth and growth yields, counting of bacteria, Synchronous growth, and continuous culture, growth as affected by environmental factors. Reproduction - sexual and asexual.

UNIT IV: Sterilization and Preservation of Microorganisms:

Sterilization - Physical methods, chemical methods and Radiation methods, Antimicrobial agents, Antibiotics and their mode of action, Biosafety and levels of biosafety, Types of microbiological safety cabinets, GLP and GMP, Preservation of Microorganisms- lyophilisation and Cryopreservation.

UNIT V: Medical Microbiology:

Disease causing bacteria, virus, fungi, and protozoan's; Fungal diseases, Host parasite interaction-recognition and entry process of different pathogens in plants and animals, Toxins produced, Vaccines, Anti-microbial agents, Antibiotics and disinfectants, National Immunization Programme

UNIT VI: Latest Learning's (For CIA Purpose only)

Latest development related to the course during the semester concerned

TEXT BOOKS

- A text book of Microbiology – R. C. Dubey, Dr. K. Maheswari, 2012, M. Chand Publishers 1st Edition.
- Prescott's Microbiology, 10th, 6 Edition *Authors: Joanne Willey, Linda Sherwood and Christopher J. Woolverton*
- Text book of Microbiology – D. R. Arora and B. Arora, 2008, CBS Publications; 3rd Edition
- Marine Microbial Diversity, Karl, D & Buckley, M, 2005, American academy of microbiology, Washington.
- Brock Biology of Microorganisms, 14th Edition *Authors: Michael T. Madigan, John M. Martinko, Kelly S. Bender, Daniel H. Buckley, David A. Stahl and Thomas Brock.*
- Microbiology: An Introduction, 13th Edition. *Authors: Gerard J. Tortora, Berdell R. Funke and Christine L. Case*

REFERENCES

- General Microbiology Vol. II – Dr. CB Powar and Dr. H.F. Dagainawala, 2010, Himalaya Publishing House.
- Biological Oceanography, Miller, C., Wheeler, P.A, 2012, Wiley-Blackwell Scientific Publications.

NET REFERENCE:

<https://youtu.be/3Vmsan6oq8E>

https://onlinecourses.swayam2.ac.in/cec22_bt20/preview

<https://youtu.be/TAZgW6222fs>

<https://microbenotes.com/scope-and-applications-of-microbiology/>

<https://youtu.be/H0qPVxRCI5o>

<https://youtu.be/xjYdOcT6s1Y>

<https://thebiologynotes.com/microbial-growth-and-nutrition/#microbial-growth-and-nutrition>

<https://microbenotes.com/category/basic-microbiology/>

<https://youtu.be/YIKLpQEWILg>

CO. No.	CO-Statements	Cognitive Level (K-Level)
On completion of this course, the students will be able to		
CO-1	Basic knowledge on different structure and characteristics of microbes	K1&K2
CO-2	Understand the applied aspects of microbiology	K2
CO-3	Understand the role of beneficial microorganisms in the environment and the application to benefit mankind.	K2
CO-4	List and describe the mechanisms of action of major chemotherapeutic agents that control microorganisms	K4
CO-5	Explain about factors responsible for the virulence of different pathogenic microorganisms.	K5

SEMESTER – I (LAB - I)

CELL & MOLECULAR BIOLOGY, IMMUNOLOGY

Course Code: 22PBT1C4P

Hours/ Week: 6

Credits: 4

Max Marks: 100

Internal Marks: 25

External Marks: 75

CELL AND MOLECULAR BIOLOGY

- Prokaryotic & eukaryotic cell - structure observation.
- Identification of –
Parenchyma, collenchyma, sclerenchyma, columnar epithelium, squamous epithelium.
- Leishman Staining and Giemsa Staining.
- Staining for different stages of mitosis and meiosis.
- Total (WBC, RBC) & differential count of human blood cells.
- Extraction of DNA and RNA
- Estimation of DNA and RNA.
- Isolation of Plasmid DNA.
- Mutagenesis in Bacteria: The Ames test
- Transformation in E. coli.

IMMUNOLOGY AND IMMUNOTECHNOLOGY

- Agglutination test-ABO blood grouping, Rh Typing
- Agglutination test -WIDAL test, CRP and ASO
- Double Immuno diffusion
- Radial Immuno diffusion
- Immuno electrophoresis
- Rocket immuno electrophoresis
- Total count of RBC
- Total count of WBC
- Differential staining of WBC
- Demonstration of ELISA
- Demonstration of Lymphoid organs in rat
- Demonstration of Western blotting.

REFERENCE BOOKS

- Practical Immunology, F. C. Hay, M. R. Olwyn. P. N. Westwood. N. L. Hudson, 2002, 4 Ed, UK: Blackwell Company Ltd.
- Hand Book of Practical and Clinical Immunology. G. P. Talwar. 2009, 2 Ed, Vol. II, New Delhi: CBS Publishers and Distributors.
- Molecular Cloning: A Laboratory Manual J. Sambrook and M. Green. 2012. 4 Ed. (3 Volume set). New York: spring Harbor Laboratory Press.
- Laboratory Manual for Genetic Engineering. J. Vennison, 2009, New Delhi: PHI learning Private ltd.

SEMESTER – I (ELECTIVE COURSE – I)
PHARMACEUTICAL BIOTECHNOLOGY

Course Code: 22PBT1E1A

Hours/Week: 6

Credits: 3

Max Marks: 100

Internal Marks: 25

External Marks: 75

COURSE OBJECTIVES

- To study about the drug formulation.
- Designing and action on living system.
- To study the active ingredients like incipient and excipients.
- To study the application of biopharmaceuticals in industries.

UNIT I: Introduction:

Pharmaceutical industry & development of drugs-Drug development process, Research and discovery, Contribution of scientific knowledge to drug discovery. Drug screening, Strategies for drug design and production, Structure-activity relationship Computer-aided design of drugs, Drug Regulation and Approval, Drug approval processes. Drug applications, Safety testing in animals; types of therapeutic agents and their uses- Designing a Therapeutic Regimen, Therapeutic measures of nutrition, Biological Therapy Drug Therapy; economics and regulatory aspects.

UNIT II: Drug Action, Metabolism and Pharmacokinetics:

Mechanism of drug action-Membrane Transport, Intracellular Activation, Drug Targets, Repair of Drug-Induced Injury; physico-chemical principles of drug metabolism; radioactivity; Pharmacokinetics-Basic Pharmacodynamics Concepts, Therapeutic Drug Monitoring, Pharmacokinetic Models, Compartmental Models.

UNIT III: Manufacture of Drugs, Process and Applications:

Types of reaction process and special requirements for bulk drug manufacture - Hazardous Industrial Chemicals and Drug-related Substances, Industrial chemicals, Drug-related substances, Pharmaceutical Operations, Related Hazards and Workplace Control Measures, Fermentation, Biological and natural extraction, pharmaceutical manufacturing of dosage forms, Facility design and process-engineering issues, pharmaceutical unit operations, Environmental Issues.

UNIT IV: Principles of Drug Manufacture:

Compressed tablets; dry and wet granulation; slugging or direct compression; tablet presses; coating of tablets; capsule preparation; oval liquids–vegetable drugs–topical applications; preservation of drugs; analytical methods and other tests used in drug manufacture; packing techniques; quality management.

UNIT V: Biopharmaceuticals:

Various categories of therapeutics like vitamins, laxatives, analgesics, contraceptives, antibiotics, hormones and biological-Functions and uses.

UNIT VI: Latest Learning's (For CIA Purpose only)

Latest development related to the course during the semester concerned

TEXT BOOKS

- Gareth Thomas. Medicinal Chemistry. An Introduction. John Wiley. 2000.
- Katzung B. G. Basic and Clinical Pharmacology, Prentice Hall of Intl. 1995.
- Prasan R.Bhandari. Text book of Pharmacology. 1st Edition 2021. Medical and Scientific Publishers Pvt. Ltd.
- N.Murugesh. A concise text book of Pharmacology 7th Ed 2021.
- R.S. Saloskar, N.N.Rege, Raakhi K.Tripathi, S.D.Bhandarkar. Pharmacology and Pharmacotherapeutics. Elsevier india. 25th Ed.2017.

REFERENCE BOOKS

- Chandrakant kokare. Pharmaceutical Biotechnology, 1st Edition 2019
- Oliver Kayser and Heribert Warzecha. Pharmaceutical Biotechnology: Drug Discovery and clinical applications. Wiley- Blackwell 2nd Edition 2012.
- L.Shargel ., S.Wu-pong., A.B.C.Yu. Applied biopharmaceutics and pharmacokinetics. 5th Ed. 2004. Hanvith Company.
- John W. Dailey, pharmaceutical industry. 1st Edition 2022

NET REFERENCES:

<https://youtu.be/zLISlgi0KUg>

<https://youtu.be/e2pM930x9xw>

<https://youtu.be/3G10gAcW8rw>

<https://youtu.be/KM4E8NT71Dg>

[The Pharmaceutical Industry and the Future of Drug Development \(RSC Publishing\)](#)

[DOI:10.1039/9781782622345-00001](#)

CO. No.	CO-Statements	Cognitive Level (K-Level)
On completion of this course, the students will be able to		
CO-1	Basic knowledge of pharmaceutical and drug discovery process	K1
CO-2	Evaluating the mechanism of drug action	K5
CO-3	To understand the significance of industrial application of pharmaceutical biotechnology in human health-care.	K3
CO-4	To understand the implications of epidemiology from the subject area concepts, theory, experimental, research, drug discovery and health-care perspectives	K4
CO-5	Explain the biopharmaceuticals, functions and uses.	K1

SEMESTER – I (ELECTIVE COURSE – I)
IMMUNOLOGY

Course code: 22PBT1E1B

Hours/ Week: 6

Credits: 3

Max Marks: 100

Internal Marks: 25

External Marks: 75

COURSE OBJECTIVES

- This course is designed to impart the students to understand the importance of immunology and its theoretical aspects and on the principles of immunology.
- It also explains the various antigen-antibody reactions involved in diseases, Concept of Monoclonal antibodies and vaccine development.
- To learn the various human haematological techniques.
- Understand human and animal cell culture methods.
- Study about the recent advancement in immunology and know about the diagnostic methods for human infectious diseases.

UNIT I: Immune system and Immune Response

Innate and acquired immunity, structure and functions of immune cells- T cells, B cells, Macrophages, NK cells and dendritic cells, Eosinophil's, Neutrophils, Mast cells. Organs of immune system- Primary and secondary lymphoid organs. Primary and secondary immune response, Clonal selection theory.

Unit II: Antigens and Antibodies

Structure and properties of antigens –Iso and alloantigen's-antigen specificity, Haptens and adjuvants- structure and properties. Immunoglobulin's-Structure and properties, types and subtypes. Generation of immunological diversity. Complement system- component, properties and functions. Complement pathways and biological significance.

UNIT III: Major Histocompatibility Complex, Allergy and Autoimmunity

Structure and functions of MHC and HLA systems. Genetic control of immune response. Tissue transplantation- Tissue typing methods for tissue and organ transplantations. Graft versus host reaction and rejection, xenotransplantation, immunosuppressive therapy.

Hypersensitivity Reactions: Allergy, Hypersensitivity reactions- types (I, II, III, and IV), Autoimmunity, Autoimmune diseases- Hashimoto's disease, Systemic lupus erythematosus, AIDS.

Unit IV: Immunological Techniques

Agglutination-Blood grouping, Widal test, precipitation-Immunodiffusion-Single, Double, Radial and Rocket Immunoelectrophoresis, immune- fluorescence, immunoblotting, ELISA, RIA, Flow cytometry. Production and purification of Monoclonal antibodies, Coomb's test

UNIT V: Immunization

Vaccines- conventional, adjuvants, viral vaccines, vaccines to other infectious agents, tumour vaccines, Peptide vaccines, subunit, DNA vaccines. Toxoids, antisera, edible vaccines, plantibodies, ISCOMs, recombinant antibodies, Immune stimulatory complexes. Common immunization programmes and role of WHO in immunization programs - BCG, small pox, DPT, polio, measles, Hepatitis-B.

UNIT VI: Latest Learning's (For CIA Purpose only)

Latest development related to the course during the semester concerned

TEXT BOOKS

- Immunology by I.M. Roitt, J.Brostoff and D.K Male(1993) Gower medical publishing, London
- Immunology – short course by E.Benjamini, G.sunshine and Leskpwitz willy-liss 1996.
- Richard M.hyde 1995 Immunology III edition ELBS London
- J.Kuby, 2003, Immunology 5th edition, W.H. Freeman and Company, Newyork.
- Ferencik, Miroslav (2013). Handbook of Immunochemistry. Netherlands: Springer.

REFERENCES

- An Introduction to Immunology, Narosa Publishing House, Chennai. 3. K.M.Pavri. 1996, Challenge of AIDS, National Book Trust, India.
- I.R.Tizard, 1995, Immunology: An Introduction, 4th edition, Saunders College Publishers, New York. 5.
- I.Roitt, 1994, Essential Immunology, Blackwell Science, Singapore.
- A. Bul and K.Abbas, 1994, Cellular and Molecular immunology.
- Roitt's Essential Immunology, 13th Edition Peter J. Delves, Seamus J.Martin, Dennis R. Burton, Ivan M. Roitt (2017)
- Immunology 9th Edition David Male, Stokes Peebles, Victoria Male (2020)

NET REFERENCES

https://onlinecourses.nptel.ac.in/noc22_bt40/preview

<https://microbenotes.com/immunological-techniques/>

https://en.wikipedia.org/wiki/Antigen-antibody_interaction

<https://www.sigmaaldrich.com/IN/en/technical-documents/technical-article/protein-biology/elisa/antigens-epitopes-antibodies>

<https://www.toppr.com/guides/biology/human-health-and-diseases/antigen-and-antibody/>

COURSE OUTCOMES		Knowledge Level
Upon Completion of course the students will be able to		
CO - 1	Get a deep foundation in the immunological processes.	K2
CO - 2	Students will gain knowledge on how the immune system works and also on the immune system network and interactions during a disease or pathogen invasion	K4
CO - 3	Explain role of immune cells and their mechanism in preventing the body from foreign attack and infectious disease, cancer and other disease development.	K1
CO - 4	Apply the knowledge of immune associated mechanisms in medical biotechnology research.	K3
CO - 5	Design experiment to see effect of drug molecule on immune response	K5

SEMESTER I: VAC
BIO-FERTILIZERS

Course Code: 22PBT1V1

Hours/Week: 2

Credits: 2

Max Marks: 100

Internal Marks: 25

External Marks: 75

Objectives

- To understand the microorganisms are used as biofertilizers.
- To have knowledge on technologies for production of bio inoculum.
- To get full confident to become an entrepreneur.

Unit- I

Introduction to Biofertilizers: Microbes used as bio-fertilizer – Classification – Symbiotic N₂ Fixers: Rhizobium – Isolation, characterization, and Identification- application – large scale production.

Unit – II

Symbiotic N₂ fixers: Isolation, Identification large scale production, crop response, and field application of *Cyanobacteria* and *Azolla*. Isolation and characterization of Frankia – Actinorhizal nodules – non-leguminous crop symbiosis.

Unit –III

Non symbiotic N₂ fixers: Isolation, Identification large scale production, crop response, and field application of *Azospirillum*, *Azotobacter*, *Clostridium*, *Klebsella* and *Anabaena*

Unit – IV

Phosphate solubilizers: Isolation, characterization, mass inoculums production, field application of *Bacillus* sps. and *Pseudomonas*- Phosphate solubilization mechanism.

Unit- V

Mycorrhizal Biofertilizers: Classification, Isolation, Identification, Mass inoculums production, field application of Ecto and Endo mycorrhizae – VAM

Text Books

1. Kannaiyan S, 2003. Biotechnology of Biofertilizers, CHIPS, Texas (Unit- I-V).
2. Subbu Rao, N.S, 2000. Biofertilizers in Agriculture, Oxford & IBH Publishing Co, New Delhi (Unit- 1-II).
3. http://www.fnca.mext.go.jp/english/bf/bfm/pdf/4_4_Phosphate_Solubilizers0403.pdf (Unit- III- V)
4. Free e-Book: http://www.fnca.mext.go.jp/english/bf/bfm/pdf/Biofertilizer_Manual.pdf

References

1. Himadri Panda, Dharamvir Hota, 2007. Biofertilizers and Organic Farming, 2007, Gene-Tech Books (Unit- I-V).
2. H. A. Modi, 2012. Microbial Inoculants and Biofertilizer Technology, Neha Publishers & Distributors (Unit- I-V)
3. H.C. Lakshman, Channabasava A, Biofertilizers and Biopesticides, 2014. Neha Publishers & Distributors (I-II).

COURSE OUTCOMES		Knowledge Level
Upon Completion of course the students will be able to		
CO - 1	Get a deep foundation about microorganisms.	K2
CO - 2	Students will gain knowledge on uses of biofertilizers	K4
CO - 3	Explain technologies for production of bio inoculum.	K1
CO - 4	Gain knowledge about how the microorganisms are used as biofertilizers.	K3
CO - 5	Apply the knowledge to become an entrepreneur.	K5

SEMESTER – II (CORE COURSE - V)
ENZYME TECHNOLOGY & BIOINSTRUMENTATION

Course Code: 22PBT2C5

Hours/ Week: 5

Credits: 5

Max Marks: 100

Internal Marks: 25

External Marks: 75

COURSE OBJECTIVES

- To have a basic knowledge about the enzymes and biological energy transducers
- Describe the various metabolic pathways involved in cells for its normal functioning.
- Thorough understanding of the analytical techniques and equipment used in biological science.
- To have a fundamental knowledge regarding the Microscopy, Spectroscopy, Centrifugation.
- To acquire knowledge on the Chromatographic method for the separation of biological products
- To acquaint the students with various techniques used in biological sciences and the emerging areas of biotechnology along with underlying principles.
- To make students learn about modern instruments for various analytical works

UNIT I: Enzymes

Structure, classification and nomenclature of enzymes - physico chemical nature of enzymes – enzyme kinetics – mechanism of enzyme action – factors affecting enzyme activity.

UNIT- II: Enzyme Technology

Industrial uses of enzymes - sources of industrial enzymes, thermophilic enzymes, amylases, glucose isomerases, cellulose degrading enzymes, lipases, proteolytic enzymes in meat and leather industry, detergents and cheese production. Clinical enzymology - Enzymes as thrombolytic agents, anti-inflammatory agents, digestive aids. Therapeutic use of asparaginase, streptokinase. Diagnostic enzymes. Immobilization of enzymes and their applications. Abzymes.

UNIT III: Separation Techniques

Basic principle of centrifugation, and its types - Ultra Centrifugation (Preparative and analytical), Density gradient Centrifugation, Rate zonal centrifugation, Differential centrifugation. Standard Sedimentation coefficient. Chromatography: Chromatography - Principle, instrumentation and application of Paper Chromatography, Adsorption chromatography, Ion exchange Chromatography, Thin layer Chromatography, Affinity chromatography, HPLC and GC.

UNIT IV: Diffraction Methods

Principles, Components and applications of X-ray crystallography. Braggs equation, Reciprocal lattice concept, Miller index and Unit cell, Determination of crystal structure, colorimeter, Spectroscopy – Raman effect, UV-Visible, Mass spectroscopy, Atomic Absorption spectroscopy, NMR –Experimental techniques and instrumentation, ESR. LASER and MASER - Principle and applications.

UNIT V: Electrophoretic Techniques

Electrophoresis- Agarose Gel Electrophoresis, SDS-PAGE, Native Gel, 2D gel and gradient Gel Electrophoresis, Pulsed field Gel Electrophoresis (PFGE).

UNIT VI: Latest Learnings (For CIA Purpose only)

Latest development related to the course during the semester concerned.

TEXT BOOKS

- Enzymes Technology, Ashokan. P, 2022.
- Biophysical chemistry – principles and techniques, Upadhyay, Upadhyay and Nath, 3rd edition, 2002, Himalaya publishing home.
- Bioinstrumentation, L. Veerakumari, 1st edition 2011, MJP publishers.

REFERENCE BOOKS

- Buchholz, Klaus, Volker Kasche, and Uwe Theo Bornscheuer. Biocatalysts and enzyme technology. John Wiley & Sons, 2012.
- Analytical biochemistry and separation techniques-A laboratory manual, P. Palanivelu 2nd edition 2001 tulusi books centre.
- Principles and techniques of practical biochemistry, Keith Wilson and John walker, 5th edition 2000, Cambridge University press.

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www.chemguide.co.uk.

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<https://archive.nptel.ac.in/content/storage2/courses/104103018/pdf/mod3.pdf>

<https://archive.nptel.ac.in/content/storage2/courses/102103047/PDF/mod3.pdf>

COURSE OUTCOME

ENZYME TECHNOLOGY & BIOINSTRUMENTATION Course Code: 22PBT2C5		
S. No.	Course Outcome	Knowledge Level
Upon completion of the course, the students will be able to		
CO - 1	Helps to remember the basics of enzymes	K1
CO - 2	To understand the industrial uses and application of enzymes	K2 & k3
CO - 3	Analyzing how to isolate cellular constituents	K4
CO - 4	Realize the need of centrifuges and their uses in research	K5
CO - 5	Apply the concepts of bio analytical techniques in biotechnology research	K6

SEMESTER – II (CORE COURSE – VI)
RECOMBINANT DNA TECHNOLOGY

Course Code: 22PBT2C6

Hours/ Week: 5

Credits: 5

Max Marks: 100

Internal Marks: 25

External Marks: 75

OBJECTIVES:

- This paper is aimed to study the various principles underlying genetic engineering that forms the basis of rDNA technology.
- To study the methodologies, and in brief the applications and related issues of rDNA technology.

UNIT – I Basic Concepts

Introduction to Recombinant DNA technology - Enzymes in molecularbiology-Restriction endonuclease, Ligases, Reverse transcriptase, Nucleases, Polymerase, Alkaline phosphatase, Terminal transferase, T4polynucleotide kinase; Linker, Adaptors, Homopolymers. Chromatin immunoprecipitation, DNA - protein interactions.

UNIT – II Cloning Vectors

Expression Cassette & Viral vectors: Promoters (Constitutive, Inducible, Tissue specific), Terminators, Reporters, Markers (Antibiotic resistant, Herbicide resistant, Antimetabolite); Vectors in gene cloning – Plasmids (pBR322, pUC), Bacteriophages (Phage lamda and M13), Cosmids, Phagemids, Yeast plasmid vector, Viral vectors (Adenovirus, Adeno associated virus, Baculovirus, Herpes virus, Retrovirus, Cauliflower mosaic virus, Tobacco mosaic virus, Potato virus. Artificial chromosome (BAC, YAC, HAC), Shuttle vector, Expression vector.

UNIT – III Gene Transfer

Gene transfer Methods – Transformation – Physical method (Electroporation, Electropushon, Microinjection, Particle bombardment, Liposome mediated transfer); Chemical method (PEG mediated, DEAE Dextran mediated, CaPO₄ mediated genetransfer); Biological method (Agrobacterium mediated gene transfer). Expression systems – Prokaryotes (Bacteria) and Eukaryotes (Yeast, Mammalian and Insect cell lines).

UNIT – IV Genetic Engineering

Screening & Selection methods – Insertional inactivation, Blue-White selection, colony– insitu hybridization, In vitro selection, In vitro translation, Radioactive antibody test, DNA labelling, dotblot hybridization, Gene Silencing, RNA interference and antisense therapy. Gene Knockout. Blotting techniques – Southern, Northern, Western and South-Western.

UNIT – V Molecular techniques

Molecular Techniques – RFLP, RAPD, AFLP, DNA Finger printing, DNA Foot printing, Microarray (DNA & Non-DNA). Libraries - Genomic library; C-DNA library & its types; BAC library; YAC library. Bioethics & Biosafety in genetic engineering; IPR & Patenting. Applications of genetic engineering in medicine, agriculture, veterinary and industry.

UNIT VI: Latest Learning's (For CIA Purpose only)

Latest development related to the course during the semester concerned

TEXT BOOKS REFERENCES

1. Glick R. and J. J. Pasternak. 2003. Molecular Biotechnology (Ed:3). ASM Press, Washington.
2. Old RW and SB Primrose. 2014. Principles of gene manipulation (Ed:4). Blackwell scientific publications, London.
3. Alberts, B., Johnson, A., Lewis, J., M., Roberts, K., and P. Walter. Molecular Biology of the Cell, Fourth Edition. Garland & Co. 2002.
4. Harvey Lodish, Arnold Berk, et al. 2016. Molecular Cell Biology

REFERENCE BOOKS

1. Brown T. A. 2016. Gene cloning – An introduction. VNR (UK) co. Ltd, England.
2. James D Watson et al., 2007. Recombinant DNA (Ed:2) WH freeman and co., New York.
3. Lodish H et al., Molecular Cell Biology, Sixth edition, W.H Freeman & Co. 2007.
4. Keya Chaudhur, 2012. Recombinant DNA Technology,
5. Muhammad Sarwar Khan, Iqrar Ahmad Khan, et al. 2019 Applied Molecular Biotechnology: The Next Generation of Genetic Engineering

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1. <https://www.canada.ca>
2. <https://www.britanica.com>
3. <https://archive.nptel.ac.in>
4. <https://nptel.ac.in/courses/102106025>
5. <https://archive.nptel.ac.in/courses/102/106/102106025/>

COURSE OUTCOME

RECOMBINANT DNA TECHNOLOGY Course Code: 20PBT2C6		
S. No.	Course Outcome	Knowledge Level
Upon completion of the course, the students will be able to		
CO-1	To get introduced to the basic concepts of Recombinant DNA Technology	K1
CO-2	Acquired skills on techniques of construction of recombinant DNA- cloning vectors	K2 & K3
CO-3	Introduction of rDNA into bacterial cells-gene transfer methods	K4
CO-4	Realize the screening and selection methods in genetic engineering	K5
CO-5	Construction of genomic DNA library and cDNA library	K6

SEMESTER – III - CORE COURSE-VII
MICROBIAL TECHNOLOGY

Course Code: 22PBT2C7

Hours/Week: 4

Credit: 5

Max Marks: 100

Internal Marks: 25

External Marks: 75

COURSE OBJECTIVES

- To acquire knowledge on the basic principles of fermentation.
- To obtain knowledge on selection of microorganisms for industrial application.
- To acquire new ideas in the utilization of alternative microorganisms for the improvement in product yield

Unit – I FERMENTATION TECHNOLOGY

Introduction to fermentation technology: Interaction between chemical engineering, Microbiology and Biochemistry. History of fermentation. Introduction to fermentation processes, Media formulation and optimization. Basic concepts- batch, Continuous and fed batch culture, selection methods for industrially important microorganisms. Strain improvement, preservation, and properties of industrial strains. Immobilization: different matrices, whole cell and enzyme immobilization.

Unit – II FERMENTOR AND ITS TYPES

Fermenter – Design & Types: Gaden's Fermentation classification, Design and operation of Fermenters, Basic concepts for selection of a bioreactor, Impellers, baffles and sparger, sterilization. Types of reactors- submerged reactor – mechanically stirred draught- tube reactor- continuous flow stir type reactor – airlift reactor- jet loop reactor, surface reactor, packed bed reactor, Fluidized bed reactor.

Unit – III CONTROL OF BIOPROCESS PARAMETERS

Bioprocess control and monitoring variables – O₂ requirement and uptake, Foam and antifoams, their effect on oxygen transfer, factors affecting K_La. Flow measurement and control, control system – manual and automatic. Application and the role of computers in bioprocess. Fermentation economics. Biosensors: construction and application.

Unit – IV DOWNSTREAM PROCESSING

Down-stream processing: Introduction, recovery of microbial cells, precipitation, filtration-theory of filtration, batch and continuous filters. Centrifugation. Cell disruption – physical and chemical methods. Extraction liquid-liquid extraction and aqueous-two phase extraction. Chromatography, membrane processes, drying and crystallization.

Unit – V PRODUCTION STRATEGIES OF INDUSTRIAL PRODUCTS

Production strategies for industrial products: (Lactic acid and Ethanol), therapeutics (Insulin and Interferon), antibiotics (Cephalosporin), Microbial enzymes (Chitinase, Glucose Oxidase, Lipase), Exopolysaccharides (Pullulan). Use of immobilized cells, enzymes to produce protease, Use of fungi in industry including food industry: fuel cells, Use of fungi in agriculture and environmental applications: Biofertilizers, Bioremediation and Biological control. Animal cell culture technology to produce recombinant vaccines.

Unit VI: Latest Learnings (For CIA Purpose only)

Latest development related to the course during the semester concerned.

Books for study

- Stanbury P.F. *et al.*, 2016. Principles of Fermentation Technology, Butterworth-Heinemann, UK. (Unit I, Unit II, Unit III and Unit IV)
- Principles and Applications of Fermentation Technology, Vinay Sharma Arindam Kuila (2018)
- Principles of Fermentation Technology Reginald franco-2022.
- Modern Technologies and Their Influence in Fermentation Quality. Santiago Benito - 2020.
- Vikas Mishra *et al.*, 2017. Fermentation Microbiology & Biotechnology.

Books for References

- Bailey J and D.F. Ollis. 2017. Biochemical Engineering Fundamentals (Ed: 2) Indian Edition: McGraw-Hill, NY
- Cinar A *et al.*, 2013. Batch Fermentation - Modeling, Monitoring and Control. Dekker. USA.
- Optimization of Enzymatic kinetics by Fed Batch Fermentation- Praveena J.Jadeja-2015
- Fed-Batch Fermentation: A Practical Guide to Scalable Recombinant Protein Production in Escherichia Coli: 42 (Woodhead Publishing Series in Biomedicine)G.G.Moulton-2014.

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1. www.britannica.com/science/fermentation
2. <https://microbenotes.com/fermentation>
3. <https://www.biologydiscussion.com/industrial-microbiology-2/fermentor>
4. <https://www.biotechnologynotes.com/industrial-biotechnology/>
5. <https://www.youtube.com/watch?v=Uut1cUs6GpA>
6. <https://www.sciencedirect.com/topics/engineering/downstream-processing>
7. <https://www.youtube.com/watch?v=pHYI8C-8sIk>

CO. No.	CO-Statements	Cognitive Level (K-Level)
On completion of this course, the students will be able to		
CO-1	Acquire knowledge on the basic principles of fermentation and technologies used in the development of fermented food products.	K1
CO-2	Examine and classify the microbial growth kinetics, different types of fermentation, selection of microorganisms for industrial application and production of different fermented food products.	K2
CO-3	Analyze the importance of ethics in fermentation technology in the selective production of commercial products.	K4
CO-4	Evaluate the outcomes of fermentation methods when employing specific group of microorganisms in correlation with the substrate.	K5
CO-5	Assess new ideas in the utilization of alternative microorganisms for the improvement in product yield and design a protocol for the operation of basic bioprocess operation.	K5 & K6

SEMESTER – III - CORE COURSE-VIII
IPR, BIOSAFETY AND BIOETHICS

Course Code: 22PBT2C8

Hours/Week: 4

Credit: 5

Max Marks: 100

Internal Marks: 25

External Marks: 75

COURSE OBJECTIVES

- This course is planned to give an understanding about Biostatistics, Bioethics, IPR and Legal Protection, Patent Filing and Infringement and Biosafety.
- To introduce the biosafety regulations and ethical concepts in biotechnology.
- To emphasize on IPR issues and need for knowledge in patents in biotechnology.
- Interpret the basics of biosafety and bioethics and its impact on all the biological sciences and the quality of human life.
- Recognize the importance of biosafety practices and guidelines in research.

UNIT I INTELLECTUAL PROPERTY RIGHTS

Introduction to IPR, Types of IPR- Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge and Geographical Indications. Importance of IPR - patentable and non patentables, patenting life, legal protection of Biotechnological inventions. Introduction to History of GATT, WTO, WIPO and TRIPS

UNIT II CONCEPT OF 'PRIOR ART' AND BASICS OF PATENTS

Invention in context of "prior art"; Patent databases; Searching International Databases; Country wise patent searches (USPTO, EPO, India etc.); Analysis and report formation, Types of patents; Indian Patent Act 1970; Recent Amendments; Filing of a patent application; Precautions before patenting-disclosure/non-disclosure; WIPO Treaties; Budapest Treaty; Madrid agreement; Hague agreement; PCT and Implications; Role of a Country Patent Office; Procedure for filing a PCT application

UNIT III PATENT FILING AND INFRINGEMENT

Patent application- forms and guidelines, fee structure, time frames; Types of patent applications: provisional and complete specifications; PCT and convention patent applications; International patenting-requirement, procedures and costs; Financial assistance for patenting-introduction to existing schemes; Publication of patents - Patent infringement- meaning, scope, litigation, case studies and examples

UNIT IV BIOETHICS

Introduction to ethics and bioethics, framework for ethical decision making. Benefits and risks of genetic engineering – ethical aspects of genetic testing – Reproductive cloning , therapeutic cloning ; Ethical, legal and socioeconomic aspects of gene therapy, germ line, somatic,

embryonic and adult stem cell research-GM crops and GMO's – biotechnology and biopiracy
– Ethical implications of human genome project, human cloning, designer babies, biowarfare

UNIT V BIOSAFETY AND GUIDELINES

Introduction- biosafety issues in biotechnology – historical background- Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals; **Biosafety guidelines** –Guidelines and regulations (National and international including Cartagena Protocol) Definition of GMOs & LMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture

OUTCOME OF THIS PAPER:

- On completion of this unit of study, students should be able to: Apply intellectual property law principles (including copyright, patents, designs and trademarks)
- To real problems and analyse the social impact of intellectual property law and policy
- Analyses ethical and professional issues which arise in the intellectual property law context

TEXT BOOKS:

- 1.Goel and Parashar 2013.IPR, Biosafety and Bioethics.
- 2.Senthil Kumar Sadhasivam and Mohammed, Jaabir. 2008. IPR, Biosafety and Biotechnology Management. Jasen Publications, Tiruchirapalli, India.

REFERENCES:

1. Goel And Parashar, 2013.IPR, Biosafety and Bioethics
2. BAREACT, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., 2007
3. Kankanala, K . C. 2007. Genetic Patent Law & Strategy, 1st Edition. Manupatra Information Solution Pvt. Ltd.,Noida, India.
4. Jose B. Cibelli, Robert P. Lanza, Keith H. S . Campbell, Michael D.West. 2013. Principles of Cloning, Academic Press, SanDiego, Gurdon.
5. Dipak Konwar,2021. A Glimpse of Biodiversity in India.

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<https://www.biologydiscussion.com/biotechnology/intellectual-property-rights/...>

<https://www.youtube.com/watch?v=avSdoMz6OuA>

<https://www.youtube.com/watch?v=Wyjn4WpxS90>

<https://www.youtube.com/watch?v=8PBVzjr1D9A>

CO. No.	CO-Statements	Cognitive Level (K-Level)
On completion of this course, the students will be able to		
CO-1	Distinguish and explain various forms of IPR	K1
CO-2	Identify criteria's to fit one's own intellectual works in particular forms of IPR	K2
CO-3	Analyse rights and responsibilities of holder of patent, copyright, trademark, industrial design etc.	K4
CO-4	Identify procedure to protect different forms of IPRs national and international level	K5
CO-5	Develop skill of making search using modern tools and technics.	K5 & K6

SEMESTER – II - PRACTICAL

LAB IN ENZYME TECHNOLOGY AND RECOMBINANT DNA TECHNOLOGY

Course Code: 22PBT2C9P

Hours/Week: 6

Credits: 4

Max Marks: 100

Internal Marks: 40

External Marks: 60

COURSE OBJECTIVE

- To understand the various techniques.
- Students will be able to perform varieties of techniques.

Enzyme Technology

1. Isolation of industrially important microorganisms.
2. Screening of industrial microorganisms
3. Factors influencing and affecting the growth of microorganisms.
4. Microbial products: Ethanol, Citric acid, Lactic acid and Amylase.
5. Production of organic acids - Citric acid production & estimation
6. Screening Production and assay for lipase producing organisms
7. Penicillin production and estimation

Recombinant DNA Technology

1. Agarose gel electrophoresis
2. Isolation of genomic and plasmid DNA from bacteria
3. Isolation of total RNA from plant tissue
4. Isolation of genomic DNA from Plant tissue
5. Restriction digestion
6. Ligation of DNA
7. Transformation of bacteria by Calcium chloride method
8. Blue-White screening method
9. Gel elution of DNA

References

- Laboratory Manual for Genetic Engineering. J. Vennison, 2019, New Delhi: PHI learning Private ltd,
- Analytical biochemistry and separation techniques-A laboratory manual, P. Palanivelu, 2nd edition 2011, Tulsi books center.
- Principles and techniques of practical biochemistry, Keith Wilson and John walker, 5th edition 2014, Cambridge University Press.

SEMESTER - II -NME- I

ADVANCES IN BIOTECHNOLOGY

Course Code: 22PBT2N1A

Hours/Week: 3

Credits: 2

Max Marks: 100

Internal Marks: 25

External Marks: 75

COURSE OBJECTIVES

- To impart basic concepts of stem cell.
- To understand structural and functional genomics approaches.
- To design the experiments using various techniques of genome sequencing.
- To formulate and assess experimental problems in omics fields.
- To get knowledge about drug discovery.

UNIT I- Basic concepts of Stem cells

Definition, History; unique properties – proliferation and differentiation; Potency definitions: totipotent, pluripotent, multipotent and unipotent. Stem cell plasticity, Regulators of pluripotency. The isolation, expansion, genetic manipulation, genomic reprogramming, and cloning of stem cells. Stem Cells and imprinted genes.

UNIT II- Functional genomics

Genetic interaction mapping, Transcriptome profiling: (Microarray, ChIP, SAGE), RNAi - Studying gene function through protein-protein interaction (Phage display and yeast two hybrid), Loss of function techniques (mutagenesis and RNAi). Functional annotation of genes. Metagenomics: Prospecting for novel genes from metagenomes and their biotechnological applications.

UNIT III- Proteomics

Protein sequencing, Protein expression analysis by 2-DE, 2DMALDI-TOF MS, LC-MS/MS, Quantitative proteomics. Tandem Mass spectrometry, Peptide mass fingerprinting. Mining the proteome, Protein expression profiling, Protein tags; protein arrays and antibody arrays.

UNIT IV- Metabolomics

Introduction to metabolomics: Metabolome, Metabolomics, Metabolite profiling, Metabolome fingerprinting, Role of Biomarker in metabolomics, Metabolome projects of plant and human, Future prospective of metabolomics.

UNIT V- Clinical Research in Drug Discovery

New Drug Application and Approval - Pharmaceutical Industry - Global and Indian Perspective - Clinical Trial market. Selection of drugs - Threats behind self-medication - Monitoring the prescribed drug advised, Clinical data management, Ethical issue in clinical studies.

UNIT VI- Latest learnings (For CIA Purpose only)

Latest development related to the course during the semester concerned.

TEXT BOOKS

- D. Watson A. Baker Tania, P. Bell Stephen, Gann Alexander, Levine Michael, Losick Richard 2017 Molecular Biology Of The Gene
- SK Gupta , 2011 Drug Discovery and Clinical Research
- Tanner Perry, 2017 Proteomics: A Comprehensive Study of Proteins
- Babak Arjmand, 2020 Genomics, Proteomics, and Metabolomics: Stem Cells Monitoring in Regenerative Medicine (Stem Cell Biology and Regenerative Medicine)
- Abhishek Dwivedi , 2020 Metabolomics; An Powerful approach

REFERENCES

- Verma IM and Gage FH. 2002. (Ed) Regenerative Medicine, Natl, Acad. Sci. & Engg, USA
- Yanhong Shi, Dennis O. Clegg. Stem Cell Research and Therapeutics. Springer edition. 2010
- John Lindon Jeremy Nicholson Elaine Holmes. 2006. The Handbook of Metabonomics and Metabolomics (Ed: 1), Elsevier Science.
- Brown T.A. 2007. Genomes 3. Garland Science Publishing.
- Cullis C.A. 2004. Plant Genomics and Proteomics. John Wiley & Sons, Inc., Hoboken, New Jersey.

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<https://archive.nptel.ac.in/courses/102/104/102104056/>

https://onlinecourses.nptel.ac.in/noc20_bt20/preview

<https://www.studocu.com/in/document/sant-gadge-baba-amravati-university/bioinformatics/what-is-metabolomics-lecture-notes-1-3/21182799>

<https://www.youtube.com/watch?v=Kdhqc8MVfNI>

COURSE OUTCOME

ADVANCES IN BIOTECHNOLOGY Course Code: 22PBT2N1A		
S. No.	Course Outcome	Knowledge Level
Upon completion of the course, the students will be able to		
CO - 1	On completion of this course, the students will be able to describe the basic concepts of stem cell.	K1
CO - 2	Apply structural and functional genomics approaches on newly sequenced genome for functional characterization of genes.	K2
CO - 3	Design the experiments using various techniques of genome sequencing as well as organization of biological data.	K3
CO - 4	Formulate and assess experimental problems in omics fields.	K4
CO - 5	Gives knowledge about drug discovery.	K6

SEMESTER – II (NON-MAJOR ELECTIVE COURSE – I)

HERBAL MEDICINE

Course Code: 22PBT2N1B

Max Marks: 100

Hours/ Week: 3

Internal Marks: 25

Credits: 2

External Marks: 75

Unit I Herbal medicines

Herbal medicines – definition, history and its scope – Indian system of medicines-Siddha, Ayurvedha and Unani systems. Application of Herbal medicines

Unit II Importance of medicinal plants

Importance of medicinal plants – role in human health care – health and balanced diet (Role of proteins, carbohydrates, lipids and vitamins). Quality control and Quality Assurance of Herbal medicines.

Unit III Tribal medicine

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

Unit IV Utility of some medicinal plants

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

Unit V Plants in day today life

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

UNIT VI: Latest Learning's (For CIA Purpose only)

Latest development related to the course during the semester concerned

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- Ethnobiology – R.K.Sinha & Shweta Sinha. Surabhe Publications – Jaipur.2001
- Tribal medicine – D.C. Pal & S.K. Jain Naya Prakash, 206, Bidhan Sarani, Calcutta , 1998
- Contribution to Indian ethnobotany – S.K. Jain, 3rd edition, Scientific publishers, B.No. 91, Jodhpur, India. 2001

- A Manual of Ethnobotany – S.K.Jain, 2nd edition, 1995.
- H.Panda .2017.Hand book on Herbal Medicine.
- Andrew Chevallier 2016.Encyclopedia Of Herbal Medicine

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<https://www.slideshare.net/siddharthanand5/herbal-medicine-29034823>

<https://www.youtube.com/watch?v=-rD5mBomyWU>

https://www.youtube.com/watch?v=wrB8LG8K-_M

<https://www.youtube.com/watch?v=akU2We1Dw1E>

https://www.youtube.com/watch?v=PqyUOyIaI_M

<https://www.youtube.com/watch?v=cy7145Qn8to>

<https://www.youtube.com/watch?v=o9MOfCP5wJc>

COURSE OUTCOME

HERBAL MEDICINE Course Code: 22PBT2N1B		
S. No.	Course Outcome	Knowledge Level
Upon completion of the course, the students will be able to		
CO-1	Scope and history of herbal medicine	K1
CO-2	Importance of herbal Medicine	K2 & K3
CO-3	Disease and diagnosis and treatment of tribal medicine	K4
CO-4	Traditional knowledge and utility of some medicinal plants in Tamil Nadu	K5
CO-5	Plants in day today life	K6

SEMESTER – II - IBC
BIOENTREPRENEURSHIP

Course Code: 22PBT2I1

Hours/Week: 3

Credit: 3

Max Marks: 100

Internal Marks: 25

External Marks: 75

COURSE OBJECTIVES

- To learn the basics of Entrepreneurship
- To know the various kinds of entrepreneurs
- To develop knowledge on business ideas
- To understand about business environment
- To aware of business risks

Unit I

Introduction to Entrepreneurship – Meaning and concept of entrepreneurship; Need and Importance of entrepreneurship; The history of entrepreneurship development; Skills and characteristic of successful entrepreneurs; Entrepreneurship process; Factors impacting emergence of entrepreneurship; Role of entrepreneurship in economic development; Evolution and Growth of Entrepreneurship in India.

UNIT II

Types of Entrepreneurs; Ethical Entrepreneurship; Entrepreneurial Value: Values, Attitudes and Motivation; The entrepreneurial decision process, and role models; Self-Assessment of Qualities; Skills, Resources and Dreams; Roles of society and family in the growth of an entrepreneur.

UNIT III

Generating business idea; Sources of new ideas; Methods of generating ideas; Creative problem solving; Opportunity recognition and assessment; Environmental scanning; Competitor and industry analysis; Feasibility study - Market feasibility, Marketing plan; marketing research for the new venture, Steps in preparing marketing plan; Technical/operational feasibility; Financial feasibility.

UNIT IV

Introduction to Business and its Environment; Components of a business plan; Meaning and significance of a business plan; Challenges of New Venture Strategies; Start-up Policy Framework and Incentives; drawing business plan; Preparing project report; Business Plan Preparation; Presenting business plan to investors; Execution of Business Plan; Business Incubation Centers.

UNIT V

Entrepreneurs - as problem solvers; Risk taking-Concept; types of business risks; Barriers to Entrepreneurship; Support structure for promoting entrepreneurship (various government schemes); Entrepreneurial Culture; Entrepreneurial Society; Women Entrepreneurship; Rural Entrepreneurship.

REFERENCES

1. Entrepreneurship - Hisrich, Robert D., Michael Peters and Dean Shepherded, , Tata McGraw Hill, ND.2009.
2. Entrepreneurship - Brace R., and R., Duane Ireland, Pearson Prentice Hall, New Jersey (USA).2022
3. Entrepreneurship - Lall, Madhurima, and Shikha Sahai, Excel Book, New Delhi. 2008
4. Entrepreneurship Development and Small Business Enterprises - Charantimath, Poornima, Pearson Education, New Delhi.2009
5. Entrepreneurship- New Venture Creation – David H. Holt 1992.

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<https://eduardicle.medium.com/growth-of-entrepreneurship-in-india-8887fb557f0b>

COURSE OUTCOMES

BIOENTREPRENEURSHIP Course Code: 22PBT211		
S. No.	Course Outcome	Knowledge Level
Upon completion of the course, the students will be able to		
CO - 1	Understand about the fundamentals of Entrepreneurship	K1
CO - 2	Categorize the entrepreneurs	K3
CO - 3	Understand and develop business ideas	K2
CO - 4	Gain knowledge on business environment	K4
CO - 5	Acquire knowledge on various risks in business	K4

SEMESTER – III - CORE COURSE-X

PLANT BIOTECHNOLOGY

Course Code: 22PBT3C10

Max Marks: 100

Hours/Week: 6

Internal Marks: 25

Credit: 5

External Marks: 75

COURSE OBJECTIVES

- It gives introduction to the plant tissue culture, maintenance of its lab and production of plants by employing various tissue culture technique.
- It describes the study of microscopical technique for cytological analysis
- It discusses about various plant transformation technique.
- The techniques of animal cell culture and its industrial applications are described.
- Describe the secondary metabolite production and its application.

PLANT BIOTECHNOLOGY

UNIT-I Applications of Plant Biotechnology in Crop Improvement

Introduction to plant tissue culture, lab facilities and operations, tissue culture media: preparation and handling, establishing aseptic cultures; Micropropagation via axillary and adventitious shoot proliferation; Somatic embryogenesis; production of artificial seeds; Double haploid production by androgenesis and gynogenesis; triploid production by endosperm culture; production of virus free plants by meristem, shoot-tip culture; Cell Suspension cultures; protoplast isolation and regeneration, somatic hybridization and cybridization; protoclonal, somaclonal and gametoclonal variation for crop improvement; Cryopreservation.

UNIT-II Micro techniques

Cytology and various staining procedures for ploidy analysis; microscopy with special emphasis on confocal, scanning and transmission electron microscopy; Principles and applications of flow cytometry and cell sorting; histological techniques

UNIT-III Plant Genetic Engineering and Production of Transgenic Plants

Genetic material of plant cells with an introduction to chloroplast and mitochondrial DNA; Restriction enzymes; Transformation of plant cells; different type of vectors including viral vectors and their benefits; Modes of gene delivery in plants: Particle bombardment, electroporation, microinjection; *Agrobacterium* mediated gene transfer, Ti and Ri plasmids; Screening and selection of transformants, Generation and maintenance of transgenic plants, Bt cotton, golden rice and some others as examples.

UNIT-IV Molecular Farming and Applications

Aims and scope, production of industrial enzymes, biodegradable plastics, polyhydroxybutyrate, antibodies, edible vaccines; manipulation of metabolic pathways for production of fatty acids, industrial oils, terpenoids, flavanoids etc.

UNIT-V Pathogenesis related Proteins and Bioactive compounds

PR proteins- Bacterial resistant genes and fungal resistant genes. Defense mechanism: Biology of plant-pathogen interaction. Phytochemical compounds produced in plants: Nitrogen containing compounds, Alkaloids, Phenolics (Anthocyanins, Benzofurans, Coumarins, Flavones and Tannins), Plant pigments and terpenoids (Monoterpenoids, Diterpenoids, Triterpenoids, Phytosterols, Carotenoids) Quantitative and qualitative estimation of phytochemicals, Methods for separation of phytochemicals- HPLC. Plant cell culture-based bioreactor production of plant secondary metabolites.

UNIT VI: Latest Learnings (For CIA Purpose only)

Latest development related to the course during the semester concerned.

Text Books:

1. Avinash sharma, Megha Ragavan *etal* Plant Tissue Culture: Theory and Practice, a Revised Edition, Elsevier Science, 2020
2. Nirmala- 2022 -Plant Biotechnology-
3. H.K.Das, 2017. Plant biotechnology - the genetic manipulation of plants, 2nd edition
4. Chawla HS, 2020. Introduction to Plant Biotechnology (3rd edition) CRC Press
5. Nigel Halford, 2014. Plant Biotechnology – Current and Future Applications of Genetically Modified Crops. Wiley Publishers.
6. Zingare AK, 2013. Biotechnology in Plant Improvement. Satyam Publishers
7. Nigel Halford, 2014. Plant Biotechnology – Current and Future Applications of Genetically Modified Crops. Wiley Publishers.
8. Zingare AK, 2013. Biotechnology in Plant Improvement. Satyam Publishers

Reference Books:

1. Kari Herrmann Ndumann *etal* 2020, Plant Cell and Tissue Culture – A Tool in Biotechnology: Basics and Application
2. Sant saran Bhojwan-, Prem kumar Dantu -2016 Plant Tissue Culture: An Introductory Text.
3. Bhatia, Sharma, Dahiya, Bera, 2015. Modern Applications of Plant Biotechnology in Pharmaceutical Sciences, 1st edition, Academic Press.

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<https://www.onlinebiologynotes.com/plants-transformation-methods-and-applications/>

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COURSE OUTCOME:

CO. No.	CO-Statements	Cognitive Level (K-Level)
On completion of this course, the students will be able to		
CO-1	describe the basic idea on plant culture techniques.	K1
CO-2	outline the mechanism of genetic engineering technology in the production of transgenic plants.	K2
CO-3	experiment with the various plant tissue culture media for the plant regeneration.	K3
CO-4	compare and interrogate with new ideas in techniques in plant biotechnology & interpret them to solve complex problems.	K4
CO-5	inspect and plan for the production of artificial seeds and hardening of plants.	K5 & K6

SEMESTER – III - CORE COURSE- XI
ANIMAL BIOTECHNOLOGY

Course Code: 22PBT3C11

Hours/Week: 6

Credit: 5

Max Marks: 100

Internal Marks: 25

External Marks: 75

COURSE OBJECTIVES

- It gives introduction to the various transformation techniques employed in animal systems.
- It also describes the application of genetically modified animals in the various fields of science.
- The techniques of animal cell culture and its industrial and medical applications are described.
- Understand the basic properties of cancer cells.
- Describe the principle and application of gene manipulation.
- Illustrate how transgenic animals can be produced with a specific gene of interest and their clinical advantages.

UNIT I: Animal cell culture

Introduction, cell culture laboratory-design, layout and maintenance. Equipment and Instrumentation. Methods of sterilization, types of culture media, composition, preparation and metabolic functions. Culture and maintenance of primary and established cell lines. Cell adhesion, Cell proliferation and differentiation. Characterization of cultured cells, viability, cytotoxicity, growth parameters, cell death and Apoptosis.

UNIT II: Stem cells and Tissue Engineering

Scope of tissue engineering, embryonic and adult stem cells, properties, identification, stem cells culture, techniques and their applications in modern clinical sciences. Tissue engineering, biomaterials used in tissue engineering, three dimensional culture and transplantation of engineered cells. Tissue engineering - skin, bone and neuronal tissues.

UNIT III: Transgenic Animals and Animal cloning

Methods involved in the production of transgenic animals, importance and applications of transgenic animals. Gene knock out and mice models for tackling human diseases. Animal cloning: methods of cloning and their importance with reference to domestic animals. IVF-technology for livestock and humans.

UNIT IV: Applications of Animal Biotechnology

Improvement of biomass, disease resistant, recombinant vaccines for poultry, livestock-pharming products. Pharmaceutical products produced by mammalian cells - plasminogen

activator, erythropoietin, blood clotting factors, glycoprotein hormones, interleukins, Interferons, and Cell culture based vaccines.

UNIT V: Animal models

Use of cell lines as alternative for animal models for research. Testing of drugs on human volunteers, use of animals for research and testing; animal and human cloning- ethical and social issues, organ transplantation and xeno transplantation.

UNIT VI: Latest Learnings (For CIA Purpose only)

Latest development related to the course during the semester concerned.

TEXT BOOKS

- Animal Biotechnology, M. M. Ranga, 2nd Edition, 2003, Agrobios India.
- Animal Cell Culture: A practical approach, Freshney, E.D., 2000, John Wiley Pub., NewYork.
- Animal Biotechnology, Surya Prakash Mishra,2018 Sri Padmavathi Publications
- Animal Biotechnology, V. Kumaresan,2019.

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- Animal Biotechnology, Ballinic C.A., Philips J.P and Moo Young M. Pergamon press, New York. 1989.
- Molecular Biology of Gene, Watson J.D.et al. (6th Ed.) Publisher Benjamin Cummings, 2007.
- Methods in Enzymology guide to molecular cloning techniques, Berger S. L. and A.R. Kimmel. (Vol 152). Academic Press Inc. San Diego.1996
- Molecular Biotechnology, Glick, B.R. and Pasternak J.J.ASM Press, Washington DC.2003.
- Methods in Cell Biology, Jenni, P, Mather and David Barnes, (Vol 57) Academic Press, 2001.
- Molecular Biology of the Gene, Watson J.D et al. (6th Ed), the Benjamin Cummings Pub.Co.Inc.USA.2008

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<https://www.digimat.in/nptel/courses/video/113108071/L18.html>

COURSE OUTCOME

ANIMAL BIOTECHNOLOGY Course Code: 22PBT3C11		
S. No.	Course Outcome	Knowledge Level
Upon completion of the course, the students will be able to		
CO - 1	The students will gain an insight into the concepts and techniques of animal biotechnology and its wide industrial and medicinal applications.	K2 & k3
CO - 2	Describe the mechanism of gene therapy and its uses.	K1
CO - 3	Illustrate how different blood products like antibodies, hormones and vaccines are produced industrially.	K5
CO - 4	Describe the features of stem cell and their application.	K4
CO - 5	Differentiate between the different methods adopted for generating transgenic animals.	K6

SEMESTER – III - CORE COURSE- XII
ENVIRONMENTAL BIOTECHNOLOGY

Course Code: 22PBT3C12

Hours/Week: 6

Credit: 5

Max Marks: 100

Internal Marks: 25

External Marks: 75

COURSE OBJECTIVES

- This course will give a knowledge about the environmental issues of water pollution, solid waste management and their treatment.
- Environmental biotechnology is the conservation of resources via the recycling of waste materials.
- The recoveries of more valuable products such as metals, oils, and vitamins are important aspects of this technology.
- Environmental biotechnology in particular is the application of processes for the protection and restoration of the quality of the environment.
- Environmental biotechnology can be used to detect, prevent and remediate the emission of pollutants into the environment in a number of ways.

UNIT – I: INTRODUCTION

Environment - basic concepts and issues, global environmental problems - ozone depletion, greenhouse effect and acid rain due to anthropogenic activities, their impact and biotechnological approaches for management. An overview of atmosphere, hydrosphere, lithosphere and anthrosphere - environmental problems.

UNIT – II: ENVIRONMENTAL POLLUTION

Environmental pollution - types of pollution, sources of pollution, measurement of pollution, methods of measurement of pollution, fate of pollutants in the environment, Bioconcentration, bio/geomagnification.

UNIT – III: WASTE WATER TREATMENT

Microbiology of waste water treatment, aerobic process - activated sludge, oxidation ponds, trickling filter. Anaerobic process - anaerobic digestion, anaerobic filters, up-flow anaerobic sludge blanket reactors. Treatment schemes for waste waters of dairy, distillery, tannery, sugar and antibiotic industries

UNIT – IV: SOLID WASTE MANAGEMENT

Types of solid wastes - Solid waste characteristics and its impact on environment. Solid waste disposal; land filling, incineration. Xenobiotic compounds - organic (chlorinated hydrocarbons, substituted simple aromatic compounds, poly aromatic hydrocarbons, pesticides, surfactants) and inorganic (metals, radio nuclides, phosphates, nitrates).

UNIT – V: BIOLOGICAL PROCESS

Role of immobilized cells/enzymes in treatment of toxic compounds. Biopesticides, bioreactors, bioleaching, biomining, biosensors, biotechniques for air pollution abatement and odour control, Bioremediation of xenobiotics in environment - ecological consideration, decay behaviour and degradative plasmids. Molecular techniques in bioremediation.

OUTCOME OF THIS PAPER

- Knowledge in various fields of environment and its pollution, waste water treatment, solid waste treatment and biological process like immobilization, bioremediation.
- Evaluate the potential for biodegradation of organic pollutants, taking microbial and physical/chemical environment

TEXT BOOK

1. Environmental Biotechnology: Biodegradation, Bioremediation, and Bioconversion of Xenobiotics for Sustainable Development Jeyabalan Sangeetha, Devarajan Thangadurai, et al.2016.
2. Environmental Biotechnology, 2nd: Basic Concepts and Applications, Indu Shekhar Thakur,2019.

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1. Alan Scragg. 1999. Environmental Biotechnology. Pearson Education Limited, England.
- 2 Jogdand, S.N. 1995. Environmental Biotechnology. Himalaya Publishing House, Bombay.
3. Technoglous, G., Burton,F.L. and Stensel, H.D. 2004. Wastewater Engineering – Treatment, Disposal and Reuse. Metcalf and Eddy, Inc.,Tata Mc Graw Hill, NewDelhi.
4. De, A.K. 2004. Environmental Chemistry. Wiley Eastern Ltd. NewDelhi.
5. Allsopp, D. and K.J. Seal. 1986. Introduction to Biodeterioration. ELBS/Edward Arnold, London.
6. Athie, D. and C.C. Cerri. 1990. The Use of Macrophytes in Water Pollution Control, Pergamon Press, Oxford.
7. Chin, K.K. and K. Kumarasivam. 1986. Industrial Water Technology Treatment, Resuse and Recycling . Pergamon Press, Oxford.

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<https://www.youtube.com/watch?v=nL354fxAfBk>

COURSE OUTCOME

ENVIRONMENTAL BIOTECHNOLOGY Course Code: 22PBT3C12		
S. No.	Course Outcome	Knowledge Level
Upon completion of the course, the students will be able to		
CO - 1	The students will gain an insight into the concepts and techniques of Environmental biotechnology and its wide industrial applications.	K2 & k3
CO - 2	Apply the concepts of biotechnology in Environmental biotechnology	K1
CO - 3	Describe the concept of pollution management	K5
CO - 4	Bioremediation and biodegradation principles, processes and applications will be discussed along with advanced applications in wastewater, oil recovery, biohydrometallurgy, biofuel, carbon storage and capture, etc.	K4
CO - 5	This course will offer the students a broad sense of understanding on how modern biotechnology is developed to achieve better environmental protection and sustainability through the use of microbes and microbial communities in pollution abatement to mitigation of climate change, bioenergy, biomaterial to enzyme discovery.	K6

SEMESTER – III - PRACTICAL III (COVERING CC10, CC11 & CC12) CP-XIII

PLANT, ANIMAL & ENVIRONMENTAL BIOTECHNOLOGY

Course Code: 22PBT3C13P

Hours/Week: 6

Credits: 4

Max Marks: 100

Internal Marks: 40

External Marks: 60

COURSE OBJECTIVE

Encourage the students to get self-employability by learning all these techniques.

PLANT BIOTECHNOLOGY

1. Preparation of plant tissue culture media and Organ culture (Shoot tip, nodal and leaf culture)
2. Callus culture: Initiation and regeneration.
3. Anther culture for the production of haploids.
4. Isolation, culture and fusion of protoplasts.
5. Isolation of plant genomic DNA from plant by CTAB method
6. Synthetic seeds (Entrapment method).
7. Establishment and maintenance of suspension culture.
8. Separation and estimation of secondary metabolites β -carotene from carrot and anthocyanin from beetroot
9. Extraction & Separation of Chlorophyll A & B using Column Chromatography.

ANIMAL BIOTECHNOLOGY

1. Preparation of Media for cell culture.
2. Trypsinization.
3. Cell viability test.
4. Cell counting.
5. Cytotoxicity testing
6. Animal Handling and care

ENVIRONMENTAL BIOTECHNOLOGY

1. Determination of total dissolved solids, BOD and COD of water sample.
2. Estimation of Chromium in Industrial effluent by colorimetry.
3. Estimation of Calcium & Chloride in water sample by titration method.
4. Isolation of bacteriophages from sewage.
5. Sludge analysis (a) Organic matter, (b) Nitrogen (c) Phosphorous (d) Potassium.
6. Biodegradation of industrial aromatic compounds.
7. Determination of Phosphate and nitrate from sewage samples.
8. Microbial analysis of water-MPN technique.
9. Assessment of air quality – Enumeration of microbes.

REFERENCES

- Animal Cell Culture: A practical approach, Freshney, E.D., 2000, John Wiley Pub., New York.
- Plant Tissue culture theory & practical, Bhojwani and Razdan, M.K, 2004.
- Tissue culture, methods and application, Hurse P.I. and Patterson.
- Handbook of cell and Organ culture M.K Marchan, D, J. (2ndEd). Burgess Pub. Co., Minneapolis, USA. (1964).
- Plant cell culture – A Practical Approach, Dixon, L.A. and R.A. Gonzales. , Revan Press, New York.
- Plant Tissue Culture Methods and Applications in Agriculture, Quak, F. Academic Press, New York. (1981)

SEMESTER – III NME - II

BIOREMEDIATION

Course Code: 22PBT3N2A

Hours/Week: 3

Credits: 2

Max Marks: 100

Internal Marks: 25

External Marks: 75

COURSE OBJECTIVES:

- To impart basic concept of bioremediation and its types
- To understand the bioremediation technologies.
- To focus the advance molecular techniques to facilitate bioremediation technology.
- To focus on advanced nuclear remediation program.
- To apply the concepts of bioremediation technology to the real time problems

UNIT I BIOREMEDIATION

Introduction to Bioremediation: Types of Bioremediation, Factors affecting Bioremediation. Microbes for Bioremediation: Essential Characteristics of Microbes for Bioremediation, Microbial Adaptation for Adverse conditions. Microbes involved in Bioremediation. Metabolic process involved in bioremediation. Bioremediation Techniques : In situ & Ex situ bioremediation techniques.

UNIT II SPECIFIC TECHNOLOGIES OF BIOREMEDIATION

specific advantages and disadvantages of specific bioremediation technologies - land farming, biopiles, prepared beds, biosparging, composting, pump and treat method, bioventing, constructed wet lands use of bioreactors for bioremediation.

UNIT III BIOREMEDIATION OF CHLORINATED COMPOUNDS AND MOLECULAR TECHNIQUES

Bioremediation of phenols, chlorinated phenols, heterocyclic compounds, chlorinated aliphatic compounds, cyanides, dyes; Rhizoremediation: a beneficial plant-microbe interaction;

Molecular techniques in bioremediation- Enhanced biodegradation through pathway engineering; Biodegradation of polyhalogenated compounds by genetically engineered bacteria.

UNIT IV NUCLEAR WASTE BIOREMEDIATION

Spent fuel characterization, storage and disposal; Partitioning, transmutation and conditioning; Measurement of Radioactivity in the environment; Basic actinide research.

UNIT V HEAVY METAL AND OIL SPILL BIOREMEDIATION

Heavy metal pollution & sources; Accumulation and concentration of metals. Microbial interactions with heavy metals – resistance & tolerance; Microbial transformation; Biosorption of heavy metals by microbial biomass and secondary metabolites and Biosurfactants. Advantages of biosurfactants over chemical surfactants.; Biotechnology and oil spills; Improved oil recovery.

UNIT VI: Latest Learnings (For CIA Purpose only)

Latest development related to the course during the semester concerne

REFERENCES

1. Bruce E. Rittmann, Perry L. McCarty, Environmental Biotechnology: Principles and Applications, 2nd Edition, 2020
2. Deepak Kumar Yadav, Pradeep Kumar, Pardeep Singh, Daniel Vallero Hazardous Waste Management, 2021
3. Milind Mohan Naik , Santosh Kumar Dubey Marine Pollution and Microbial Remediation 1st ed 2017
4. Phillip L. Buckingham , Jeffrey C. Evans,” Hazardous Waste Management” Waveland Pr Inc; Reissue edition 1, 2010.
5. Singh A., Kuhad R.C. and Ward O.P. (2009). Advances in Applied Bioremediation. Springer-Verlag Berlin Heidelberg, Germany.
6. P. Rajendran, P. Guansekaran, “Microbial Bioremediation”, Mjp Publishers, 2011.

NET REFERENCES:

NPTEL :: Civil Engineering - NOC:Environmental Remediation of Contaminated Sites

152396579624QuadrantIE-TEXT.pdf (inlibnet.ac.in)

e-PGPathshala (inlibnet.ac.in)

Types of bioremediation (slideshare.net)

Biodegradation and Bioremediation of Organic Compounds by Lawrence Wackett, PhD - YouTube

Bioremediation || Environment || Science and Technology - YouTube

COURSE OUTCOME

BIOREMEDIATION Course Code: 22PBT3N2A		
S. No.	Course Outcome	Knowledge Level
Upon completion of the course, the students will be able to		
CO - 1	On completion of this course, the students will be able to describe the basic concepts of Bioremediation	K1
CO - 2	Apply the bioremediation technologies.	K2
CO - 3	Design the experiments using various molecular techniques of Bioremediation	K3
CO - 4	Formulate and assess experimental problems in nuclear waste bioremediation.	K4
CO - 5	Gives knowledge about heavy metals and its	K6

SEMESTER – III – NME-II

FOOD BIOTECHNOLOGY

Course Code: 22PBT3N2B

Max Marks: 100

Hours/Week: 3

Internal Marks: 25

Credit: 2

External Marks: 75

COURSE OBJECTIVES

- It gives introduction of the composition and nutritional value present in the food.
- It describes the study of microbes associated with food and about food spoilage and intoxication.
- It discusses about steps of food processing and preservation.
- It describes about the production and utilization of food
- Describe the steps involved in packaging.

Unit-I Food Nutrition

Introduction, general aspects of food industry, world food demand and Indian scenario, constituents of food, quality and nutritive aspects Food additives, standards, deteriorative factors and their control, preliminary processing methods, conversion and preservation operation. Food groups classification; Composition and nutritive value of cereals, millets and pulses; milk and animal products (meat, poultry and fish products). Constituent of food – contribution to texture, flavour and organoleptic properties of food;

Unit-II Food Microbiology

Sources and activity of microorganisms associated with food; food fermentation; food chemicals; food additives – intentional and non-intentional and their functions. Food borne diseases – infections and intoxications, Food spoilage – causes.

Unit-III Food processing and Preservation

Raw material characteristics; cleaning, sorting and grading of foods; physical conversion operations – mixing, emulsification, extraction, filtration, centrifugation, membrane separation, crystallization, heat processing. Use of high temperatures – sterilization, pasteurization, blanching, canning – concept, procedure & application; Low temperature storage – Factors affecting quality of frozen foods; irradiation preservation of foods.

Unit-IV Production and utilization of food products

Soft and alcoholic beverages, dairy products, meat, poultry and fish products, treatment and disposal of food processing wastes. Bread and baked goods, dairy products – milk processing, cheese, butter, ice-cream, vegetable and fruit products; edible oils and fats; confectionery, beverages.

Unit – V Packaging

Introduction, Food Protection, Product Containment, Product Communication, Product Convenience, Mass Transfer in Packaging Materials. Innovations in Food Packaging, Food Packaging and Product Shelf-life, Food canning technology, fundamentals of food canning technology. Heat sterilization of canned food, containers metal, glass and flexible packaging. Canning procedures for fruits, vegetables, meats, poultry marine products

UNIT VI: Latest Learnings (For CIA Purpose only)

Latest development related to the course during the semester concerned

TEXT BOOK

- P.J. Fellows. 2009. Food processing technology. Principles and practice. (Ed: 3). Woodhead Publishing Series in Food Science, Technology and Nutrition.
- Sivasankar B. 2002. Food processing and preservation, Prentice Hall, New Delhi. (Unit III and Unit IV)

REFERENCES

1. James G. Brennan. 2006. Food processing handbook, 2nd Edition. Wiley Publishers.
2. Desrosier, N.W. 2006. The Technology of Food Preservation, CBS Publishers and Distributors, New Delhi.
3. Janet D. Ward. 2013. Principles of Food Science. 4th Edition. Goodheart-Willcox
4. Fundamentals of Food Engineering by Stanley Charm.
5. Introduction to Food Engineering - R. Paul Singh, Dennis R.
6. Heid, J.L. and Joslyn, M.A., Fundamentals of Food Processing Operation, The AVI Publishing Co; Westport, 1967.
7. Heldman, D.R., Food Process Engineering, The AVI Publishing Co; Westport, 1975.
8. Hall, C.W; Farall, A.W. & Rippen, A.L; Encyclopedia of Food Engineering, Van Nostrand – Reinhold

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

<https://biologyreader.com/food-preservation-techniques.html#:~:text=Food%20preservation%20maintains%20asepsis%2C%20which%20means%20%E2%80%9Ckeeping%20out,destroys%20microorganisms%20by%20methods%20like%20pasteurization%2C%20irradiation%20etc.>

<https://www.britannica.com/topic/food-additive>

<https://www.youtube.com/watch?v=ExZJDU1yN2I>

<https://video.search.yahoo.com/search/video?fr=mcafee&ei=UTF-8&p=food+borne+disease+youtube&type=E211US826G0#id=1&vid=500bdb28dc6df2709665ceb6391e45e1&action=click>

COURSE OUTCOME

CO. No.	CO-Statements	Cognitive Level (K-Level)
On completion of this course, the students will be able to		
CO-1	acquire understanding on the chemical nature and association of microbes with food.	K1
CO-2	explain the principles and different methods used in food processing and preservation.	K2
CO-3	classify different methodologies and approaches involved in the production of different food products.	K3
CO-4	evaluate and identify a food science issue or problem.	K4, K5
CO-5	critical thinking and problem-solving skills to address current challenges in the food industry.	K5

EMESTER – III - SKILL ORIENTED COURSE-SB

SOFT SKILLS

Semester-III
Course Code: 22P3SB
Total Periods: 45

Max.Marks:75
Credit: 3
Exam Hrs: 3

OBJECTIVE:

- To Develop Students' Effective communication skills (LSRW) and presentation skills.
- To make the students as self-confident individuals by mastering inter-personal skills, team management skills, and leadership skills.
- To develop the students' personalities with a mature outlook to function effectively in different circumstances.

UNIT I: Communication Skill

Principles of communication: LSRW in communication. What is meant by LSRW Skills – Why it is important – How it is useful – How to develop the skills? Oral – Speaking words, articulation, speaking clearly. Written communication – Generating ideas/ gathering data organizing ideas.

UNIT II: Personality Enrichment

Goal Setting and Managing Time - The basis of effective goals – steps to be followed to obtain optimum results from goal setting – Identifying the reasons for procrastination – guidelines to overcome procrastination – priority management at home and college.

UNIT III: Interview Skill

Interviews – Types of Interviews, preparing for interviews, facing interviews, reviewing performance, participating in mock interviews. Team work and participating in group discussions – Team building and Team work, Team briefing, Role of Team leader, Conflict resolution, Methods of Group discussions, Role Functions in Group Discussion, Types of Non – functional Behavior, Improving group performance. Participating in Mock group discussions.

UNIT IV: Computing Skill

Basic Microsoft word- Basic Microsoft Excel- **Formulas and Functions in Microsoft Excel-Microsoft PowerPoint- Graphics- Multimedia - Spreadsheets - Databases**-Search tools- Blog creation

UNIT V: Presentation Skill

Presentations – Non-verbal communication – Body language, Signs and symbols, Territory/Zone, Object language. Preparing successful presentations, thinking about audience, making effective use of visual aid, Delivering presentation, using prompts, dealing with questions and interruptions, Mock presentations.

REFERENCE BOOK

1. Peter, Francis. Soft Skills and Professional Communication. New Delhi: Tata McGraw Hill. 2012. Print.
2. Sherfield, R. M. ; Montgomery, R.J. and Moody, P, G. (2010). Developing Soft Skills. 4th ed. New Delhi: Pearson.
3. Working In Microsoft office 2011– Ron Mansfield , Tata Mc-Graw Hill, India.

SEMESTER -III

EMPLOYABILITY SKILLS-ES

Sem: III

Coursecode:22P3ES

Total Hr:- 2 hrs.

Max mark: 75

Credit : 02

Exam Hrs :3hrs

Objectives

1. To enable the students to know and understand the concepts related to employability.
2. To develop and provide basic analytical and reasoning skills of the students to improve their ability
3. To increase the competence level and ability to interact effectively both at the work place and outside the work place.

UNIT -I

Introduction To Employability Skills – Meaning-Employability skills and employment skills- Employability attributes-vocational skills and Employability skills- purposes and examples.

UNIT –II

Behavioral Skills -English Literacy Skills -It Literacy Skills - Entrepreneurship Skills -Maintaining Efficiency at Workplace- Communication.

UNIT –III

Essential Skills for Success -Reading and Writing Skills – Dimension Of Competency- Task Skills-Task Management skills-contingency management skills -job role environment skills

UNIT -IV

Inter-relationships of employability -team work-problem solving -relationship building skills - creative thinking and influencing skills- leadership skills-success stories of individuals.

UNIT – V

Resume writing -cv and resume-meaning -difference-features of a good resume – etiquettes -employment sickly-meaning -process- steps-job-search websites.

TEX BOOKS

- 1.WINNING interview skills, Compiled and edited by j.k chopra.
- 2.A modern approach to verbal and non- verbal reasoning, R.S. Aggarwal.

3. Developing graduate employability skills your pathway to employment by MERCI. V. CHAITA

REFERENCE BOOKS

- Soft Skills - Enhancing Employability: Connecting Campus with Corporate by M. S. Rao.
- Enhancing Employability @ Soft Skills by Shalini Verma Pearson Education
- Resume To HR Interview Prep (Employability Enhancement Series) by Rajesh Vartak

COURSE OUTCOME

EMPLOYABILITY SKILLS Course Code: 22P3ES		
S. No.	Course Outcome	Knowledge Level
Upon completion of the course, the students will be able to		
CO - 1	Get knowledge and skills required for obtaining and keeping employment.	K1
CO - 2	To help students explore their values and career choices through individual skill assessments	K2
CO - 3	To make realistic employment choices and to identify the steps necessary to achieve a goal	K3
CO - 4	To explore and practice basic communication skills	K4
CO - 5	Emphasize individual skill assessments, interpersonal communication skills	K6

SEMESTER - IV - CORECOURSE- XIV

RESEARCH METHODOLOGY

Course Code: 22PBT4C14

Hours/Week: 6

Credits: 5

Max Marks: 100

Internal Marks: 25

External Marks: 75

COURSE OBJECTIVES

- To impart scientific, statistical and analytical knowledge for carrying out research work effectively.
- To understand science frameworks for scientific inquiry
- To understand the various methods for conducting empirical research
- To examine trends and patterns in the use of various research methods
- To get knowledge to prepare research documents for publication
- To screen and select the correct journals to publish their research findings
- To articulate informed opinion about the value of empirical research

Unit I: Biosafety

Biosafety regulations - Good laboratory practices - Good manufacturing practices in industry. Storage and disposal of hazardous wastes: radioactive materials – pathogenic strains. GMO's and their release in environment. Experimental protocol approvals -Levels of containment - Environmental aspects of biotech applications.

Unit II: Research in Biological Sciences

Research: research in Biological sciences- Objective – thrust areas and research priorities in Biotechnology to meet global competency- Origin of the research problem - Collection of literature: Internet –library – index card preparation - Experimental approach. Setting up of a Laboratory: laboratory administration – collaborations - inventories and inspections – personnel – Recruitment hiring – mentoring - promoting and terminating.

Unit III: Manuscript Preparation

Scientific communication: Introduction – manuscript preparation: Original – review – short communication. Thesis writing - Proof correction – symbols used for correction- preparation for Oral and poster presentation – preparation of Power Point presentations - communication skills for effective presentation.

Unit IV: Research Publications

Standards of journals: national and international – online and printed – paid and unpaid – peer reviewed journal – SCI journals – impact factor- h-index.

Research engines: Elsevier, Springer, Pubmed, Google scholar, Academic journals, online digital library- Social network for research community: Research gate, Research Pages, Frontiers Research Network, Elsevier Lab.

Unit V: Research Proposal

Writing research proposal for getting financial support – Sponsoring agencies – (DST, DBT, UGC, CSIR, ICMR, MoEF, MoEs, DRDO, DRDE, TNSCTE, TNSCST and NABARD).
Research ethics – Intellectual property Rights – Overcome the difficulties in biological research.

UNIT VI: Latest learnings (For CIA Purpose only)

Latest development related to the course during the semester concerned.

TEXT BOOKS

- Research methodology for biological science, Gurumani N, 2009, MIP publisher.
- Essentials of Research Design & Methodology, Geofferey R, Marczyk, David De Mattea, David Festinga, 2005, John Wiley & Sons Publisher.
- Handbook of research methodology 2017, Shanti Bhushan Mishra, Shashi Alok.
- Biological Safety: Principles and Practices, 5th Edition , 2017 Dawn P. Wooley, Karen B. Byers

REFERENCES

- Guide to publish a scientific paper, Ann M. Korner, 1996, Bioscript Press.
- How to write and Publish a scientific paper, Rober A. Day, 1996, Cambridge Univeristy Press.
- Bio-Statistics, Arora, PN and Malhan, PK, Himalaya Publishing House.
- Fundamentals of Bio-Statistics Veer Bala Rastogi, Ane Book India.

NET REFERENCES

1. <https://archive.nptel.ac.in/courses/102/104/102104061/>
2. https://onlinecourses.nptel.ac.in/noc20_hs06/preview
3. <https://youtu.be/E2gGF1rburw>
4. <https://www.youtube.com/watch?v=BECG9ban4rs>

COURSE OUTCOME

RESEARCH METHODOLOGY Course Code: 22PBT4C14		
S. No.	Course Outcome	Knowledge Level
Upon completion of the course, the students will be able to		
CO - 1	Get knowledge on research proposal preparation and apply to the sponsoring agencies.	K1
CO - 2	Benefits through socio-research networks.	K2
CO - 3	Understanding of the history and methodologies of scientific research, applying these to recent published papers	K3
CO - 4	Understanding and practicing scientific reading, writing, presentations	K4
CO - 5	Appreciating scientific ethics through case studies.	K6

SEMESTER – IV (ELECTIVE COURSE – II)
BIOINFORMATICS

Course Code: 22PBT4E2A

Hours/ Week: 6

Credits: 3

Max Marks: 100

Internal Marks: 25

External Marks: 75

OBJECTIVE

- To organize vast reams of molecular biology data in an efficient manner.
- To develop tools that aid in the analysis of such data. To interpret the results accurately and meaningfully.
- Knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics.
- Existing software effectively to extract information from large databases and to use this information in computer modeling.

UNIT – I Introduction to Bioinformatics

History of Bioinformatics; Role of Bioinformatics in biological sciences; Scope of Bioinformatics; Types of biological databases; Data mining and its techniques; Data warehousing. Application of Bioinformatics- gene prediction in prokaryotes, eukaryotes; other applications in the areas of health, food and medicine.

UNIT – II Databases

Nucleic acid databases – Genbank, NCBI, EMBL, DDBJ; Primary protein databases – PIR, SWISSPROT, TrEMBL; Secondary protein databases – PROSITE, PROFILES, PRINTS, Pfam; Structural classification databases – SCOP, CATH; Literature databases – PubMed, Medline; Bibliographic databases – OMIM, PubMed.

UNIT – III Sequence Annotation

Sequence Annotation – Principles and tools; Sequence retrieval system – Entrez, SRS; Sequence submission tool – BANKIT, SEQUIN, WEBIN, SAKURA. Molecular phylogeny – Concepts of tree – rooted and unrooted trees; Clustering and Phenetic method, Cladistic method, Molecular Clocks; Steps in constructing phylogenetic analysis; Softwares used for phylogeny construction, Bootstrapping strategies. Molecular viewers - Rasmol, Chime and Spdb viewer.

UNIT – IV Sequence Alignment

Sequence alignment – concepts in alignment, Local & Global; Pairwise & Multiple; Tools for sequence alignment – BLAST, FASTA, Clustal W; Substitution matrices; Scoring matrices – PAM & BLOSUM; Dot plot; EST Clustering and analyses, Codon bias detection,

UNIT – V Phylogenetic Analysis

Phylogenetic tree, Neighbour joining, UPGMA. Use of Hidden Markov model (HMM) in assigning homology. Advantages and disadvantages of various sequence analysis methods.

UNIT VI: Latest Learning's (For CIA Purpose only)

Latest development related to the course during the semester concerned

COURSE OUTCOME

- To give students knowledge of and competence in use of bioinformatical methods central to conduction of molecular biological research projects.
- Give students basic competences in the use of bioinformatical tools.
- Emphasis on bioinformatics related to exploration of proteins and includes analyses of sequences, database searches, and sequence comparison.
- Give an introduction to analysis of DNA sequences, genes and genomes, gene expression and systems biology.

TEXT BOOKS

1. Arthur M Lesk. 2005. Introduction to Bioinformatics(Ed:2). Oxford university press, New York.
2. Attwood, T.K. and Parrysmith, D.J. 2001. Introduction to Bioinformatics Pearson Education (Singapore) Pvt. Ltd., New Delhi.
- 3.N. Mendiritta, P. Rastogi, et al. 2013 Bioinformatics: Methods and Applications: Genomics, Proteomics and Drug Discovery
4. Harisha S. 2019 Fundamentals of bioinformatics
5. R. Singh 2014 Bioinformatics: Genomics And Proteomics

REFERENCES

1. Andreas D. Baxevanis and B. F. Francis Ouellette. 2005. Bioinformatics - A Practical guide to the analysis of Genes and Proteins (Ed:3). John Wiley & Sons, Inc., Publications, US.
2. David W Mount. 2004. Bioinformatics: sequence and Genome analysis(Ed:2). Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York.
3. Rastogi, S.C., Menderatta, M. and Rastogi, P. 2004. Bioinformatics - concepts, skills and applications. CBS Publishers & Distributors, New Delhi.

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1. <https://www.ebi.ac.uk>
2. PCB_Lect11_Phylogen_Trees.ppt (nih.gov)
3. <https://www.youtube.com/watch?v=qQ7rIpB4oOw>
<https://www.northeastern.edu/graduate/blog/what-is-bioinformatics>
<https://www.youtube.com/watch?v=A5HJDTdf9yM>
4. <https://nptel.ac.in/courses/102106065>
5. https://archive.nptel.ac.in/content/storage2/courses/pmrf/102106065/noc22-bt12_week2.pdf

COURSE OUTCOME

BIOINFORMATICS		
Course Code: 22PBT4E2A		
S. No.	Course Outcome	Knowledge Level
Upon completion of the course, the students will be able to		
CO-1	To get introduced to the basic concepts of Bioinformatics	K1
CO-2	To understand the databases uses and application of bioinformatics	K2 & K3
CO-3	Classify different types of Biological Databases	K4
CO-4	Introduction to the basics of sequence alignment and analysis	K5
CO-5	Explain about phylogenetic analysis and sequence submission tools	K6

SEMESTER - IV - CEC- II

MARINE BIOTECHNOLOGY

Course Code: 22PBT4E2B

Hours/Week: 6

Credits: 3

Max Marks: 100

Internal Marks: 25

External Marks: 75

COURSE OBJECTIVES

- To provide information about the microbes available in aquatic environment.
- To study their role and interaction with the marine environment
- To explain the principle features of marine ecosystems.
- To study the microbial diversity in oceans
- Describe the physiological capability and their biogeochemical role.

Unit I:

Classification of the marine environment. Marine microbial habitats, Estuarine Ecosystems: Rocky shores, Sand dunes, Salt marshes, Deep sea, hydrothermal vents, mangroves and coral reefs.

Unit II:

Diversity of Marine microorganisms: Archaea, Bacteria, Cyanobacteria, Algae, Fungi, viruses, viroids and prions. Characteristics of marine microorganisms. Specialized microorganisms: Extremophiles: barophiles, thermophiles, psychrophiles, halophiles actinomycetes, polyextremophiles, and anaerobes.

Unit III:

An overview of the organization and cell structure of prokaryotes and archaea: i) cell wall ii) outer membrane iii) cytoplasmic membrane iv) flagella & specialized movements in microbes v) cell inclusions iv) differences among the groups.

Unit IV:

Techniques in Marine microbiology: Sampling: Water, Sediments. Direct observation and enumeration of microbes: Light and electron microscopy to study morphology and structure of microbes. Culture based methods for isolation and identification of microbes. Phenotypic and Genotypic testing, polyphasic methods of identification. Chemotaxonomy, Metagenomics. Bergey's manual & identification of marine bacteria.

Unit V:

Microbial nutrition: i) autotrophic & heterotrophic modes, ii) defining culture media to support growth, iii) selective and differential culture media. Bacterial growth kinetics: i) growth curve, the mathematical expression of growth & measurement of growth ii) synchronous growth iii) factors affecting growth iv) chemostat & turbidostat. Flagella and specialized moments in microbes, Chemotaxis, Phototaxis, Bioluminescence and indicator species and Biological Rhythms.

UNIT VI: Latest learnings (For CIA Purpose only)

Latest development related to the course during the semester concerned.

REFERENCES

- Munn, C.B. , (2019) Marine Microbiology: Ecology and Applications, BIOS Scientific Publisher.
- Josep M Gasol and David L Kirchman (2018) Marine ecology of the oceans, (3rd edition), John Wiley and Sons. Inc.
- Surajit Das Hirak Dash (2018) Microbial Diversity in the Genomic Era, Elsevier.
- Horikoshi K, Antranikian G, Bull A T, Robb F T and Stetter, K O (2011) Extremophiles Handbook, Springer.
- Madigan, Martinko, Bender, Buckley & Stahl and Thomas Brock (2017) Brock Biology of Microorganisms, Pearson.

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1. <https://www.studocu.com/in/document/amity-university/microbiology/microbial-nutrition/4680387>
2. <https://youtu.be/7W3Nq-xjBO4>
3. <https://unacademy.com/content/kerala-psc/study-material/general-microbiology/bergeys-manual-of-systematic-bacteriology/>

COURSE OUTCOME

MARINE BIOTECHNOLOGY		
Course Code: 22PBT4E2B		
S. No.	Course Outcome	Knowledge Level
Upon completion of the course, the students will be able to		
CO - 1	Get knowledge on microbes available in aquatic environment.	K1
CO - 2	Get information about their role and interaction with the marine environment.	K2
CO - 3	Understanding of principle features of marine ecosystems.	K3
CO - 4	Understanding microbial diversity in oceans.	K4
CO - 5	Knowledge on physiological capability and their biogeochemical role.	K6