Dr. N.G.P. ARTS AND SCIENCE COLLEGE

(An Autonomous Institution, Affiliated to Bharathiar University, Coimbatore)
Approved by Government of Tamil Nadu and Accredited by NAAC with 'A++' Grade (3rd Cycle-3.64 CGPA)
Dr. N.G.P. - Kalapatti Road, Coimbatore-641048, Tamil Nadu, India
Web: www.drngpasc.ac.in |Email: info@drngpasc.ac.in | Phone: +91-422-2369100

2024-25 for Post Graduate Programme

(Outcome Based Education model with Choice Based Credit System)

M.Sc. Biotechnology Degree

(For the students admitted during the academic year 2024-25 and onwards)

Programme: Biotechnology

Eligibility:

A candidate who has passed in Higher Secondary Examination with any Academic Stream or Vocational Stream as one of the subjects under Higher Secondary Board of Examination and as per the norms set by the Government of Tamil Nadu or an Examination accepted as equivalent thereto by the Academic Council, subject to such conditions as may be prescribed thereto are permitted to appear and qualify for the **M.Sc. Biotechnology Examination** of this College after a programme of study of three academic years.

Programme Educational Objectives:

The Curriculum is designed to attain the following learning goals which students shall accomplish by the time of their graduation:

1. This programme will enable students to acquire knowledge on the fundamentals of Biochemistry, Cell biology, Microbiology and Molecular biology. It helps them to understand emerging and advanced concept in modern biology and guide them to take up their carrier in this field.

2. This programme will facilitate the students to acquire knowledge in fields such as Genetic Engineering, Protein Engineering and Molecular Therapeutics.

3. The programme will aid the students to learn the recent developments in the field of Genomics, Proteomics, Stem cell biology and Tissue Engineering approach.

PROGRAMME OUTCOMES:

On the successful completion of the program, the following are the expected outcomes.

PO Number	PO Statement
PO1	Impart quality biotechnology education to students and to develop young minds as outstanding scholars/teachers/entrepreneurs and responsible citizens.
PO2	Apply their understanding of the commercialization processes to biotechnology products or services in future.
PO3	Graduates of the course will have strong background in the interface of biotechnology and be able to use the tools in industry and/or institutes wherever necessary.
PO4	Ability to design and carry out experiments (safely) and to interpret experimental data and apply the scientific method by developing valid hypotheses, designing experiments, gathering relevant data using current technology, and interpreting quantitative and qualitative data.
PO5	Develop an awareness of ethical issues in biochemical research and careers options along with understanding of the area of biotechnology chosen.

TOTAL CREDIT DISTRIBUTION

Courses	Credits	Total Marks		Credits	Cumulative Total credits
Core Theory	4	13 X 100 =	1300	52	78
Core Theory	3	1 X 100 =	100	03	
Core Lab	3	3 X 100 =	300	09	
Core Lab	2	3 x100 =	300	06	
Project and Viva Voce	8	1 X 200=	200	08	
Elective	4	4X 100 =	400	12	12
Internship	2	1X100 =	100	02	2
		Total	**2700**	**92**	**92**

PG CURRICULUM

BIOTECHNOLOGY
AY 2024- 2025

Course Code	Course Category	Course Name	L	T	P	Instruction Hours		Exam (h)	Max Marks			Credits
						Week	Total		CIA	ESE	Total	
First Semester												
24BTP1CA	Core -I	Molecular Biology & Genetics	4	-	-	4	48	3	25	75	100	4
24BTP1CB	Core -II	Biochemistry	4	-	-	4	48	3	25	75	100	4
24BTP1CC	Core -III	Microbiology	4	-	-	4	48	3	25	75	100	4
24BTP1CD	Core - IV	Biodiversity & Bioprospecting	4	-	-	4	48	3	25	75	100	4
24BTP1CP	Core Practical - I	Core Practical-I: Molecular Biology, Genetics and Biochemistry	-	-	5	5	60	6	40	60	100	2
24BTP1CQ	Core Practical - II	Core Practical – II: Microbiology and Biodiversity & Bioprospecting	-	-	5	5	60	6	40	60	100	2
24BTP1DA	DSE-I	Applied Biotechnology	3	1	-	4	48	3	25	75	100	3
24MBP1DA		Microbial Technology										
24BCP1DA		Cancer Biology, Diagnosis and Therapy										
Total			**19**	**1**	**10**	**30**	**360**				**700**	**23**

Chairman/HoD
Department of Biotechnology
Dr. N. G. P. Arts and Science College
Coimbatore – 641 048

Dr.N.G.P. Arts and Science College
APPROVED
BoS- 17th 6/4/24
AC - 17th 17/4/24
GB -

Academic Council
CHAIRMAN
Dr.N.G.P. Arts and Science College

Course Code	Course Category	Course Name	L	T	P	Instruction Hours		Exam (h)	Max Marks			Credits
						Week	Total		CIA	ESE	Total	
Second Semester												
24BTP2CA	Core - V	Immunotechnology	4	-	-	4	48	3	25	75	100	4
24BTP2CB	Core -VI	Genetic Engineering	4	-	-	4	48	3	25	75	100	4
24BTP2CC	Core -VII	Environmental Biotechnology	4	-	-	4	48	3	25	75	100	4
24BTP2CD	Core -VIII	Bioprocess Technology	4	-	-	4	48	3	25	75	100	4
24BTP2CP	Core Practical – III	Immunotechnology and Bioprocess Technology	-	-	4	4	48	6	40	60	100	2
24BTP2CQ	Core Practical – IV	Genetic Engineering and Environmental Biotechnology	-	-	6	6	72	6	40	60	100	3
24BTP2DA	DSE- II	Forensic Biotechnology	3	1	-	4	48	3	25	75	100	3
24MBP2DA		Bionanotechnology										
24BCP2DA		Biochemistry of Toxicology										
		Total	**19**	**1**	**10**	**30**	**360**	**-**	**-**	**-**	**700**	**24**

Course Code	Course Category	Course Name	L	T	P	Instruction Hours		Exam (h)	Max Marks			Credits
						Week	Total		CIA	ESE	Total	
Third Semester												
24BTP3CA	Core - IX	Research Methodology and IPR	4	-	-	4	48	3	25	75	100	4
24BTP3CB	Core - X	Genomics and Proteomics	4	-	-	4	48	3	25	75	100	4
24BTP3CC	Core -XI	Marine Biotechnology	4	-	-	4	48	3	25	75	100	3
24BTP3CD	Core -XII	Plant Biotechnology	4	-	-	4	48	3	25	75	100	4
24BTP3CE	Core -XIII	Animal Biotechnology	4	-	-	4	48	3	25	75	100	4
24BTP3CP	Core Practical - V	Plant, Animal, Marine Biotechnology, Genomics and Proteomics	-	-	6	6	72	6	40	60	100	3
24BTP3DA	DSE -III	Molecular Therapeutics	3	1	-	4	48	3	25	75	100	3
24MBP3DA		Medical Laboratory Techniques										
24BCP3DA		Free Radicals and Antioxidant System										
24BTP3CT	Internship		-	-	-	-	-	3	40	60	100	2
		Total	**23**	**1**	**6**	**30**	**360**	**-**	**-**	**-**	**800**	**27**

Course Code	Course Category	Course Name	L	T	P	Instruction Hours		Exam (h)	Max Marks			Credits
						Week	Total		CIA	ESE	Total	
Fourth Semester												
24BTP4CA	Core - XIV	Pharmaceutical Biotechnology	4	-	-	4	48	3	25	75	100	4
24BTP4CP	Core Practical - VI	Pharmaceutical Biotechnology	-	-	6	6	72	6	40	60	100	3
24BTP4CV	Core - XV	Project and Viva Voce	-	-	16	16	192	-	80	120	200	8
24BTP4DA	DSE - IV	Stem Cell Technology	3	1	-	4	48	3	25	75	100	3
24MBP4DA		Molecular Diagnostics and Bioinformatics										
24BCP4DA		Neurobiology										
Total			**7**	**1**	**22**	**30**	**360**	-	-	-	**500**	**18**
Grand Total											**2700**	**92**

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Academic Council
17/04/2024
CHAIRMAN
Dr.N.G.P. Arts and Science College

Date 17.4.24

DISCIPLINE SPECIFIC ELECTIVE

Students shall select the desired course of their choice in the listed elective course during Semesters I - IV

Semester I (Elective I)

List of Elective Courses

S. No.	Course Code	Name of the Course
1.	24BTP1DA	Applied Biotechnology
2.	24MBP1DA	Microbial Technology
3.	24BCP1DA	Cancer Biology, Diagnosis and Therapy

Semester II (Elective II)

List of Elective Courses

S. No.	Course Code	Name of the Course
1.	24BTP2DA	Forensic Biotechnology
2.	24MBP2DA	Bionanotechnology
3.	24BCP2DA	Biochemistry of Toxicology

Semester III (Elective III)

List of Elective Courses

S. No.	Course Code	Name of the Course
1.	24BTP3DA	Molecular Therapeutics
2.	24MBP3DA	Medical Laboratory Techniques
3.	24BCP3DA	Free Radicals and Antioxidant System

Semester IV (Elective IV)

List of Elective Courses

S. No.	Course Code	Name of the Course
1.	24BTP4DA	Stem Cell Technology
2.	24MBP4DA	Molecular Diagnostics and Bioinformatics
3.	24BCP4DA	Neurobiology

EXTRA CREDIT COURSES

The following are the courses offered under self study to earn extra credits:

S. No.	Course Code	Course Title
1.	24BTPSSA	Food Biotechnology
2.	24BTPSSB	Developmental Biology

Semester - I
MOLECULAR BIOLOGY & GENETICS

Semester	Course Code	Course Name	Category	L	T	P	Credits
I	24BTP1CA	MOLECULAR BIOLOGY & GENETICS	CORE	48	-	-	4

Preamble	This course has been designed for students to learn and understand • The replication and repair mechanism in prokaryotic and eukaryotic cells • The Transcription, translation and Translational inhibitors. • The concept of human genetics, disorders and inheritance pattern
Prerequisite	Knowledge on basic Molecular biology and Genetics

Course Outcomes (COs)

CO Number	Course Outcomes (COs) Statement	Bloom's Taxonomy Knowledge Level
CO1	Understand the mode of DNA replication and repair mechanisms	K2
CO2	Study the mechanism of transcription	K2
CO3	Infer translational events and its role in gene expression.	K3
CO4	Integrate the human genetics and various genetic disorders	K4
CO5	Generalize the inheritance pattern and population genetics	K4

Mapping with Program Outcomes:

COs / POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓		✓
CO2	✓	✓	✓		
CO3		✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	

24BTP1CA - MOLECULAR BIOLOGY & GENETICS

Syllabus

Unit	Content	Hours	E-Contents / Resources
I	Introduction and history of molecular biology, Central Dogma, Replication & experimental proof for semiconservative method. Enzymes & accessory proteins involved in DNA replication. DNA replication and regulation mechanism in prokaryotes & eukaryotes. DNA Repair mechanism - Nucleotide excision, Base excision, Mismatch repair, Double-strand breakage repair, Photo-reactivation, SOS and Recombination repair. Recombination: Homologous and site-specific recombination.	12	Text Book
II	Importance of DNA binding proteins, RNA polymerase. Mechanism of transcription in prokaryotes & eukaryotes. Transcriptional and post- transcriptional gene silencing. mRNA stability and localization. RNA processing - r-RNA & t- RNA processing, mRNA 5' capping, 3'-end processing and polyadenylation, RNA splicing, RNA editing, Nuclear export of mRNA and mRNA-based therapeutics.	09	Reference Book
III	Overview of Genetic code, codon, anticodon and wobble hypothesis. The translation machinery, role of tRNA & ribosome. Mechanism of translation in Prokaryotes & Eukaryotes. Post translational modifications of proteins- Phosphorylation, Deformylation, Glycosylation, Acetylation, Amidation, Lipid attachment, S - Nitrosylation and Disulfide bond formation. Translation regulation- translational inhibitors, control of gene expression at translational level.	08	Reference book
IV	Overview on mendelian and non-mendelian inheritance. Human Genetics - Introduction to human genetics. Chromosomal changes resulting in abnormal phenotype: Numerical (Aneuploidy) changes resulting in genetic syndromes eg: Turner, Down & Klinefelter Syndromes. Structural changes resulting in genetic diseases: eg: Cri-du-chat syndrome. Genetic Diseases and Inheritance Pattern: Autosomal inheritance – Dominant (Eg: Adult polycystic kidney, Achondroplasia); Autosomal inheritance – Recessive (Eg: Albinism, Sickle Cell Anemia, Phenyl Ketonuria); X-linked: Recessive (Eg: Duchenne muscular dystrophy – DMD); X-linked: Dominant (eg. Xg blood group); Y-linked inheritance (Holandric – eg. Testes determining factor); Mitochondria disorders like LHON, DAD, MERRF and MELAS. Cancer genetics.	09	Reference Book
V	Pedigree analysis- Diagnosis of disease: Molecular cytogenetics, DNA markers - VNTR, STR, microsatellite, SNP and their detection techniques - RFLP genotyping, RAPD, AFLP. Prevention of disease: Prenatal diagnosis; Genetic counseling.	10	Reference Book

	Population genetics: Organization and measure of genetic variation: Random mating population, Hardy-Weinberg principle, sources responsible for changes in gene frequencies: Mutation, selection, migration and isolation, random genetic drift, insights into human migration, natural selection and evolution.		
	Total	**48**	

Text Book	1.	George M Malacinski, 2015, "Freifelders Essentials of Molecular Biology", 4th Edition, Jones & Bartlett Publisher. USA.
Reference Books	1.	Harvey Lodish, Arnold Berk, Chris A Kaiser, Monty Krieger, Anthony Bretscher, 2021, "Molecular Cell Biology", 9th Edition, W H Freeman & Co. USA.
	2.	David L Nelson and Michael Cox, 2021, "Lehninger Principles of Biochemistry", 8th Edition, W.H. Freeman & Co Ltd., USA
	3.	Eldon John Gardner, Peter Sunstad D and Michael J Simmons,1991, "Principles of Genetics", 8th Edition, Johnn Wiley & Sons Inc, USA.
	4.	Tamarin Robert H, 2002, " Principles of Genetics", 7th Edition, Tata McGraw- Hill Publishing Company Limited, New Delhi.

Journal and Magazines	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3883366/ https://ncert.nic.in/textbook/pdf/kebt108.pdf
E-Resources and Website	https://learn.genetics.utah.edu https://www.cdc.gov/genomics/about/basics.htm https://www.dnaftb.org/#organization

Learning Methods	Chalk and Talk/Assignment/Seminar/Video presentation

Focus of the Course	Skill Development/Employability

Semester - I
CORE: BIOCHEMISTRY

Semester	Course Code	Course Name	Category	L	T	P	Credits
I	24BTP1CB	BIOCHEMISTRY	CORE	48	-	-	4

Preamble	This course has been designed for students to learn and understand • The Structure of Biomolecules. • The Function and Biosynthesis of the Biomolecules. • The metabolism and their regulatory pathways.
Prerequisite	Knowledge on Biomolecules and its functions

Course Outcomes (COs)

CO Number	Course Outcomes (COs) Statement	Bloom's Taxonomy Knowledge Level
CO1	Experiment the physical properties, classification, metabolism and disorders of carbohydrates	K4
CO2	Interpret the concepts of structure and functions, metabolism and disorders of lipids and fatty acids	K4
CO3	Summarize the biosynthesis of amino acids and disorders related to amino acids	K4
CO4	Integrate the mechanism, kinetics and inhibition of enzymes and coenzymes	K5
CO5	Appraise the regulatory mechanism of different metabolism activities and their disorders of nucleic acid	K5

Mapping with Program Outcomes:

COs / POs	PO1	PO2	PO3	PO4	PO5
CO1	✓		✓		✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

Syllabus

Unit	Content	Hours	E-Contents / Resources
I	Classification and reactions: occurrence, properties and biological reactions. Structural features of carbohydrates and Conjugated carbohydrates (Glycoproteins and Glycolipids), Glycolysis and TCA cycle; Glycogen breakdown and synthesis; Gluconeogenesis; interconversion of hexoses and pentoses. Carbohydrate metabolic disorders. Glycogen storage diseases. Lectins – characteristics and functions in biological system.	10	Text Book
II	Classification, Structure, functions and reactions of Lipids, Biosynthesis of fatty acids, Triglycerides, phospholipids and Sterols, Catabolism of Fatty acids - Oxidation (α, β and ω), Catabolism of triglycerides and phospholipids, Essential fatty acids and their physiological functions. Disorders associated with lipid metabolism and its therapeutic intervention - ketone bodies and ketosis; fatty liver, atherosclerosis.	10	Text Book
III	Classification and Biosynthesis. Peptides, Classification of Protein, Primary structure of proteins, structural comparison at secondary and tertiary levels (Ramachandran Plot), quaternary and domain structure and architecture. Motifs, functional relationship between domains and function of protein. Regulation of Protein metabolism. Protein metabolism in prolonged fasting. Disease related to protein folding – Alzheimer's and mad cow disease.	8	Reference Book
IV	IUBMB classification of enzymes, active site, Lock and key Model and induced fit hypothesis. Factors affecting enzyme activity, Mechanism of enzyme catalysis: Lysozyme, Enzyme kinetics- Michaelis – Menten (MM) equations, Transformations of MM equation and their significance, Enzyme inhibition: Reversible – Competitive, Noncompetitive, Uncompetitive, Irreversible inhibition, Kinetics of Enzyme inhibition. Isoenzymes, allosteric enzymes, ribozymes, abzymes and artificial enzymes. Diseases Caused By Deficiency Of Digestive Enzymes- Obesity, Galactosemia, Maple Syrup Urine Disease.	10	Reference Book
V	Nucleic acids: Structural characteristics of A, B and Z-DNA. 3D structure of t-RNA, ribozymes and riboswitches. Biosynthesis of Nucleotides –De nova and Salvage pathway, Regulations of Purines and Pyrimidine, Metabolism of Purine and Pyrimidine. Disorders of nucleic acids metabolism- Gout, Lesch-Nyhan syndrome, oroticaciduria, and xanthinuria.	10	Text Book
	Total	**48**	

Text Book	1.	Lehninger AL and Cox M M, 2013, "Principles of Biochemistry", 6th edition, W. H. Freeman and Company, New York.
Reference Books	1.	Rodwell VW, Bender DA, Botham KM, Kennelly PJ, and Weil PA, 2018, "Harper's Illustrated Biochemistry", 31st edition, McGraw Hill publications, New Delhi.
	2.	Voet D and Voet J G, 2011, "Biochemistry". 4th edition. John Wiley and Sons Inc. USA.
	3.	Ramadevi K, 2016, "Ambika Shanmgam's Fundamentals of Biochemistry for Medical Students". 8th edition, Wolters Kluwer (India) Pvt, Ltd., New Delhi.
	4.	Fromm HJ and Hargrovem , 2012, "Essentials of Biochemistry", Springer publisher.

Journal and Magazines	Journal of Applied Biochemistry and Microbiology https://link.springer.com/journal/10438
E-Resources and Website	https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=MNhNzp1RQlU+6LM40KjY1Q==

Learning Methods	Chalk and Talk/Assignment/Seminar

Focus of the Course	Skill Development/Employability

Semester - I
CORE : MICROBIOLOGY

Semester	Course Code	Course Name	Category	L	T	P	Credits
I	24BTP1CC	MICROBIOLOGY	CORE	48	-	-	4

Preamble	This course has been designed for students to learn and understand • The applications of biotechnology in plant , animal and Environmental field the basic concept of sequence and series • The applications of biotechnology in health care sector • The interaction of microbes with host and the control measures
Prerequisite	Knowledge on basic Microbiology

Course Outcomes (COs)

CO Number	Course Outcomes (COs) Statement	Bloom's Taxonomy Knowledge Level
CO1	Interpret the Microbial classification and their preservation	K4
CO2	Infer the techniques used in Microbial identification	K4
CO3	Relate the role of microbes in agricultural field	K5
CO4	Analyze the causes for various infections	K5
CO5	Find the solutions to control the spread of infections	K5

Mapping with Program Outcomes:

COs / POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓	✓	
CO2	✓	✓	✓	✓	
CO3	✓	✓	✓	✓	✓
CO4	✓	✓		✓	✓
CO5	✓	✓	✓	✓	✓

24BTP1CC - MICROBIOLOGY

Syllabus

Unit	Content	Hours	E-Contents / Resources
I	Concepts of species and hierarchical taxa – Bacterial nomenclature– Bergey's system of Classification, Classification of Fungi and Viruses, Polyphasic taxonomy, Preservation and maintenance of microbes, Microbial Culture Collection centers – India and International organizations, Modern methods to study microbial diversity: NGS.	08	Text Book
II	Microbial Identification through physiological and biochemical methods (BIOLOG, Vitex). Techniques used in diversity analysis – Fatty Acid Methyl Ester (FAME), 16S rRNA & 18s rRNA gene sequencing. Mol % G+C analysis, DNA-DNA hybridization, Molecular methods to study complex microbial communities: DGGE, SSCP, T-RFLP and FISH.	10	Text Book
III	Spoilage of food – Principles and types; Food preservation: physical and chemical- Food sanitation – Food poisoning – Food borne pathogens – Quality control and Food laws. Role of microorganisms in soil fertility – Role of nif gene in Biological nitrogen fixation, Plant microbe interaction: Biopesticides (*B. thuringiensis* and NPV) - Biofertilizers - PGPR –mycorrhiza	10	Reference Book
IV	Bacterial Diseases: Host-parasite relationship, epidemiology, pathogenesis, prevention and treatment – Mycobacterium, Salmonella and Yersinia. Viral Diseases: Epidemiology, pathogenesis, prevention and Treatment - H1N1, HIV, SARS-COV-2. Fungal Diseases: Infections caused by yeast: Candida. Filamentous Fungi: *Aspergillus* sp. Protozoan Diseases: Malaria, Leishmaniasis.	10	Reference Book
V	Concept of sterilization and disinfection. Physical and chemical methods of microbial control. Chemotherapeutics, susceptibility test (broth procedures and diffusion methods), mode of action of antibiotics, narrow and broad spectrum (Penicillin, ampicillin, sulfonamide, vancomycin, tetracycline, chloramphenicol), antifungals(clotrimazole, fluconazole), antiretroviral (tenofovir, AZT).	10	Text Book
	Total	**48**	

Text Book	1.	Pelczar MJ Jr., Chan ECS and Kreig NR., 1993, "Microbiology", 5th Edition, Tata McGraw Hill, New Delhi.
	2.	Vijaya Ramesh, K, 2020, "Food Microbiology"1st Edition, MJP Publishers, Chennai
Reference Books	1.	Joanne Willey, Kathleen Sandman, Dorothy Wood, 2020, "Prescott's Microbiology", 11th Edition, McGraw Hill Education, New York.
	2.	David H. Persing, Fred C. Tenover, James Versalovic, Yi-Wei Tang, Elizabeth R. Unger, David A. Relman, Thomas J. White, 2004, "Molecular Microbiology-Diagnostic Principles and Practice, 1st Edition, ASM Press, Washington, DC.
	3.	William C. Frazier, Dennis C. Westhoff, 2021, "Food Microbiology", 1st Edition, McGraw Hill Education, India.
	4.	David Greenwood, Richard C.B. Slack, John F Peutherer, 2002, "Medical Microbiology – A Guide to Microbial Interactions: Pathogenesis, Immunity, Laboratory Diagnosis and Control", 16th Edition, Churchill Livingstone, Edinburgh.

Journal and Magazines	International Journal of Microbiology
E-Resources and Website	American Society for Microbiology https://youtu.be/5iz6Ar2nTVU

Learning Methods	Chalk and Talk/Assignment/Seminar

Focus of the Course	Entrepreneurial Development /Employability

Semester - I
CORE: BIODIVERSITY & BIOPROSPECTING

Semester	Course Code	Course Name	Category	L	T	P	Credits
I	24BTP1CD	BIODIVERSITY & BIOPROSPECTING	CORE	48	-	-	4

Preamble	This course has been designed for students to learn and understand • The importance of biodiversity and various methods of conservation • The bioprospecting potentials of available natural resources • The regulations related with biodiversity and Bioprospecting
Prerequisite	Knowledge on Different types of Biodiversity

Course Outcomes (COs)

CO Number	Course Outcomes (COs) Statement	Bloom's Taxonomy Knowledge Level
CO1	Articulate the types of biodiversity, the threats to the biodiversity and Biodiversity hotspots	K2
CO2	Illustrate the discovery of medicinal compounds from natural products and their significance	K2
CO3	Infer the sustainable utilization of microbial resources and benefit sharing	K3
CO4	Report the screening and purification process of various bioactive substances	K4
CO5	Formulate regulations and laws for Bioprospecting	K3

Mapping with Program Outcomes:

COs / POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓	✓	✓
CO2		✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓		
CO5	✓	✓	✓		✓

24BTP1CD - BIODIVERSITY & BIOPROSPECTING

Syllabus

Unit	Content	Hours	E-Contents / Resources
I	Biodiversity- Facts about global & Indian biodiversity- Hot spots of Indian Biodiversity- Types of Biodiversity- Measures of Biodiversity (alpha, beta & gamma)-Threats to Biodiversity, Endemic, threatened, Red List of IUCN-National biodiversity strategy and action plan (Initiatives to conservation (international & national)- Organization involved in Biodiversity conservation and research (NBA,BSI, and ZSI)- The biological diversity act 2002	10	Text Book
II	Drugs derived from plants, Antitumor agent - Etoposide, Colchicine, Taxol, Vinblastine, Vincristine. Cardiotonic – Convallatoxin, Acetyldigoxin, Adoniside. Antiinflammatory – Aescin, Bromelain. Choleretic – Curcumin. Laxatives, Antimalarial Quinine- Cinchona. Morphine-Opium plant-analgesic. Volatile, pigments and terpenes, Phenols, flavonoids.	10	Reference Book
III	Screening for bioactivity, antimicrobials, pharmacologically active agents of microbial origin, Bioprospecting for industrial enzymes, plant growth promoting agents, antifoulants and anti-biofilm agents from microbes. Bioprospecting of marine organisms. Bio piracy issues	10	Text Book
IV	Drug discovery and product development: Discovery from traditional medicine. Modern tools in drug discovery. Role of chromatography in drug analysis including HPLC, GC and LC and GC Mass spectrometry, FTIR, -NMR their principles and merits. Product development procedures and policies	10	Text Book
V	Regulations on bio-prospecting, access and benefit-sharing (National Environmental Management: Biodiversity act, 2004)- Rules and regulations in patenting and Intellectual Property Rights of Bio-Prospecting products in India	08	Text Book
	Total	**48**	

Text Book	1.	Russell Paterson, Nelson Lima, 2016, "Bioprospecting: Success, Potential and Constraints", 1st edition, Springer International Publications.
Reference Books	1.	Santosh Kumar Upadhyay, Sudhir P. Singh, 2021, "Bioprospecting of Plant Biodiversity for Industrial Molecules", 1st edition, John Wiley & Sons Ltd, USA.
	2.	Jeffries MJ, 2006, "Biodiversity and Conservation", 2nd edition, Routledge, USA.
	3.	Vanesha S, 2010, "Marine Bioprospecting and Natural Product Research", 1st edition, LAP Lambert Academic Publishing, Germany .
	4.	Dubey KN and Yadav GP, 2011, "Biodiversity - Threats to Conservation", 1st edition, Axis Publication, India.

Journal and Magazines	Home | Biodiversity and Conservation (springer.com) https://link.springer.com/journal/13659
E-Resources and Website	Microsoft Word - Frisvold FINAL.doc (arizonalawreview.org) https://portals.iucn.org/library/sites/library/files/documents/2003-025.pdf

Learning Methods	Chalk and Talk/Power Point Presentation/Assignment/Seminar

Focus of the Course	Skill Development/Employability/ Intellectual Property Rights/ Social Awareness/ Environment

24BTP1CP	CORE PRACTICAL - I : MOLECULAR BIOLOGY, GENETICS AND BIOCHEMISTRY	SEMESTER I

Total Credits: 2
Total Instructions Hours: 60 h

S.No	Contents
1	Isolation of genomic DNA from human blood sample
2	Bacterial conjugation
3	Bacterial Transformation
4	Molecular analysis using RAPD
5	RFLP analysis
6	Estimation of total Protein and albumin from serum
7	Estimation of glucose from serum
8	Estimation of Vitamin C from Citrus fruit
9	Estimation of total amino acids from serum
10	Estimation of DNA & RNA
11	Determination of blood cholesterol
12	Separation of amino acids from serum Paper Chromatography

References

1 Sambrook, J. and Green, M.R., 2012, "Molecular Cloning: A Laboratory Manual", 4th Edition, Cold Spring Harbor, USA

2 Mertens, T.R., and Hammersmith, R.L., 1997, "Genetics Laboratory Investigations", 11th edition, Benjamin Cummings, USA

3 Sadasivam, S. and Manickam, A, 1996, "Biochemical Methods", 4th edition, New Age International, India

4 Varghese, N., 2014, "Microbiology Laboratory Manual", 1st edition, Aromatic and Medicinal Plant Research Station, India

24BTP1CQ	CORE PRACTICAL - II: MICROBIOLOGY AND BIODIVERSITY & BIOPROSPECTING	SEMESTER I

Total Credits: 2
Total Instructions Hours: 60 h

S.No	Contents
1	Isolation of enzyme producing Bacteria from soil
2	Isolation of Antibiotic producing microorganisms against pathogen
3	Isolation of Fungi from spoiled food
4	Sampling and analysis of microbial load on food contact surfaces.
5	Morphological Analysis of Microbes using stereomicroscope
6	Observation of fungal morphology using Phase contrast microscopy
7	Methylene blue reductase test for milk.
8	To identify and classify 5 different types of pollen and note the observation under stereomicroscope
9	Observation of bacterial growth curve
10	Phytochemical Analysis of same plant species grown in different geographic locations
11	TLC analysis of the secondary metabolites of same plant species grown in different geographic locations
12	To run column chromatography of a single phytochemical (alkaloid, flavonoid, tannin) obtained from different sources (fruits, vegetables, leaves etc)

References

1 Demain AL and Davies JE, 1999, " Manual of Industrial Microbiology and Biotechnology", ASM Press, Washington, D.C., USA.

2 Doyle MP, Beuchat LR and Montville TJ, 1997, "Food Microbiology: Fundamentals and Frontiers", ASM Press, Washington D.C., USA.

3 Paterson Russell and Lima Nelson, 2017, "Bioprospecting: Success, Potential and Constraints", Springer Publications.

4 Judith A Scheppler, Patricia E Cassin and Rosa M Gambier, 2014, "Biotechnology explorations: Applying the fundamentals", ASM Press

Semester - I
DSE I: APPLIED BIOTECHNOLOGY

Semester	Course Code	Course Name	Category	L	T	P	Credits
I	24BTP1DA	APPLIED BIOTECHNOLOGY	DSE	36	12	-	3

Preamble	This course has been designed for students to learn and understand • The applications of biotechnology in plant , animal and Environmental field the basic concept of sequence and series • The applications of biotechnology in health care sector • The products obtained from fermentation and its applications
Prerequisite	Knowledge on Applied Biotechnology

Course Outcomes (COs)

CO Number	Course Outcomes (COs) Statement	Bloom's Taxonomy Knowledge Level
CO1	Understand the fundamental applications of Biotechnology	K2
CO2	Know the basics and fundamentals of biotechnology applications in environment	K2
CO3	Discuss about the disease and disease prevention	K3
CO4	Discuss the applications of Enzymes in various fields	K4
CO5	Discuss the production and application of products obtained from fermentation technology	K2

Mapping with Program Outcomes:

COs / POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓		✓	
CO2	✓		✓	✓	✓
CO3			✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

24BTP1DA - APPLIED BIOTECHNOLOGY

Syllabus

Unit	Content	Hours	E-Contents / Resources
I	**Agricultural, Plant Biotechnology and Animal Biotechnology:** Applications of transgenic crop technology: Herbicide resistance (Glyphosate Resistance plants), Pest resistance (Bt Cotton) and Virus Resistance. Enhancement of micro-nutrients (Vitamin A). Delayed Fruit Ripening. Molecular pharming in plants. Transgenic animals (Transgenic mice and Transgenic cattle). Production and recovery of products from animal tissue cultures (Blood clotting factors, Growth hormones, insulin).	10	Text Book - 1
II	**Environmental Biotechnology:** Bioremediation- (Bioaugmentation and Biostimulation). Biodegradation of Xenobiotic componds. Bioleaching. Microbially Enhanced Oil Recovery. Biotechnological methods for hazardous waste management. Bioindicators –Biomarkers –Biosensors – Management of effluent toxicity, heavy metal pollution, thermal and radioactive pollution.	08	Reference Book - 2
III	**Health Care Biotechnology:** Disease prevention – vaccines: conventional vaccines, purified antigen vaccines, recombinant vaccines, DNA vaccines, synthetic vaccines. Disease Diagnosis – Probes, monoclonal antibodies and detection of genetic diseases. Disease treatment – interferons, monoclonal antibodies. Gene therapy, enzyme therapy and replacement. Forensic medicine.	10	Reference Book -3
IV	**Enzyme Biotechnology:** Enzymes used for diagnostic purpose- (acid phosphatase, alanine aminotransferase and alkaline phosphatase). Cardiac Biomarkers. Enzymes used for screening liver and kidney diseases. Enzymes used in food industry, leather industry, wool industry, dairy industry and textile industry.	10	Referece Book – 2 and NPTEL
V	**Fermentation Biotechnology:** Production, harvest, recovery and uses – enzymes, antibiotics (Tetracycline), vitamins (B2), aminoacids (glutamic acid), organic solvents (ethanol); organic acids (lactic acid). Single cell protein (algae), beverages (Wine). Formulation of Biofertilizer (Rhizobium), Biopesticides.	10	You Tube Videos and Reference Book - 4
	Total	**48**	

Text Book	1.	Bernard R Glick and Jack J Pasternak, 2010, "Molecular Biotechnology: Principles and Applications of recombinant DNA", 4th Edition, ASM Press
Reference Books	1.	Marwaha S S & Arora K, 2000, "Food processing: Biotechnological application", Asiatech Publishers INC, New Delhi.
	2.	Palmer T, Bonner PLR, 2014, "Enzymes: Biochemistry, Biotechnology and Clinical Chemistry", 2nd Edition, Woodhead Publishing Limited, Oxford..
	3.	Owen, Jenni Punt and Sharon A Stranford, 2013, "Kuby Immunology",7th Edition, W.H. Freeman and Company, New York.
	4.	Stanbury PF and Whitaker A, 2007, "Fermentation microbiology and Biotechnology", 2nd Edition, Taylor and Francis.

Journal and Magazines	https://www.macrothink.org/journal/index.php/jab, https://link.springer.com/journal/12010
E-Resources and Website	https://www.keaipublishing.com/en/journals/biotechnology-notes/ https://www.drishtiias.com/to-the-points/paper3/biotechnology-and-its-applications https://nptel.ac.in

Learning Methods	Chalk and Talk/Assignment/Seminar

Focus of the Course	Entrepreneurial Development /Employability

Semester – I

DSE I: MICROBIAL TECHNOLOGY

Semester	Course Code	Course Name	Category	L	T	p	Credits
I	24MBP1DA	MICROBIAL TECHNOLOGY	DSE	36	12	-	3

Preamble	This course has been designed for students to learn and understand • The production of Sustainable products using Microorganisms. • The importance of Microorganisms in Pharmaceutical sector. • How to explore the ideas in commercial level
Prerequisite	Knowledge on microbial products and their mass production

Course Outcomes (Cos)

CO Number	Course Outcomes (Cos) Statement	Bloom's Taxonomy Knowledge Level
CO1	Inculcate about microbial products and its scale up production through establishing a small scale industry	K2
CO2	Exemplify the ideas about the production and uses of Biofuel and Biofertilizer.	K3
CO3	Demonstrate the commercial production of Biopolymers using Microorganisms.	K4
CO4	Understand the way of cells and enzymes were immobilized for industrial uses.	K3
CO5	Explore the pharmaceutical products and possibilities of converting it to a commercial product.	K4

Mapping with Programme Outcomes

Cos/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓		✓	✓	✓
CO2	✓	✓		✓	✓
CO3	✓		✓	✓	✓
CO4	✓		✓		✓
CO5	✓	✓		✓	✓

24MBP1DA - MICROBIAL TECHNOLOGY

Syllabus

Unit	Content	Hours	E-Contents / Resources
I	**Single Cell Protein and its Economic Aspects:** Bacterial, Yeast, Fungal and Algal Proteins –Brewer's and Baker's yeast – Food and Fodder yeast – Mushroom (Agaricus, Oyster) and Products from Higher fungi (*Ganoderma lucidum*).	9	Text book Reference Book Journals
II	**Production of Biofuel & Biofertilizer:** Production, Methods and Uses of Bioethanol (*S. cerevisiae*) – Biodiesel (*Chlorella*) – Biohydrogen (*Chlamydomonas*) – Biogas (Methanobacteria). Biofertilizer - N_2 fixing, Phosphate Solubilizing, Phosphate Mobilizing, Plant Growth Promoting Rhizobacteria -Mass production and Applications.	9	Text book Reference Book
III	**Biopolymer production:** Production and Uses of Polyhydroxybutyrate (PHB) – Xanthan – Alginate – Cellulose –Cyanophycin – Levan - Melanin - Welan - Succinoglucan- Curdlan- Chitosan -Polyhydroxyalkanoates - Hyaluronic acid.	9	Text book Reference Book
IV	**Immobilization of Cells & Enzymes:** Cells – Surface attachment of cells – Entrapment - Hydrogel method, Preformed support materials – Containment behind a barrier: Microencapsulation, Immobilization using membranes – Self aggregation of cells –Methods for Enzyme immobilization – Carrier binding method, Intermolecular cross linking – Applications of Immobilized cells and Enzymes.	10	Text book Reference Book
V	**Microbial products with pharmaceutical importance**: Vaccines – Steps of Manufacturing – Growing the microbes and separation – Preparation of Live and killed vaccine – Preparation of Toxoid and uses – BCG Vaccine – Cholera vaccine – Rabies vaccine – Diptheria toxoid. Pharmaceutical industry - certification & accreditation required. Bioentreprenurship opportunities and Funding sources - Government funds, Venture capital, NGOs, Crowd funding and Incubation centers. Antimicrobial compounds from soil microbes -Case study.	11	Text book Reference Book Journals
	Total	**48**	

Text Book	1.	Patel A H, 2012, Industrial Microbiology, 2nd Edition, Trinity Press, New Delhi
Reference Books	1.	El-Mansi E M T, Bryce C F A, Dahhou B, Sanchez S, Demain A L and Allman A R, 2012, Fermentation Microbiology and Biotechnology, 3rd Edition, CRC Press, USA
	2.	Bernard R Glick, Jack J Pasternek and Cheryl L Patten, 2010, Molecular Biotechnology -Principles and Applications of Recombianant DNA, 4th Edition, ASM Publishers, USA]
	3.	Nidhi Goel, 2013, Pharmaceutical Microbiology, 1st Edition, Narosa Publishing House, New Delhi.
	4.	Puvanakrishnan R, Sivasubramanian S and Hemalatha T, 2012, Microbial Technology -Concepts and Applications, 1st Edition, MJP Publishers, New Delhi

Journal and Magazines	https://link.springer.com/ https://aem.asm.org/
E-Resource and Websites	https://www.microbialbiotechnology.com/ https://www.asmscience.org/content

Learning Methods	Chalk and Talk/ Seminar/ Assignment

Focus of the Course	Skill Development/Employability/Entrepreneurial Development/Innovations/Intellectual Property Rights

SEMESTER I

DSE I: CANCER BIOLOGY, DIAGNOSIS AND THERAPY

Semester	Course Code	Course Name	Category	L	T	P	Credits
I	24BCP1DA	CANCER BIOLOGY,DIAGNOSIS AND THERAPY	DSE	36	12	-	3

Preamble	This course has been designed for students to learn and understand • Molecular basis of cancer, mutations causing cancer, and repair mechanisms • The basic principles of cancer development and available therapeutic options • The different diagnostic and treatment methods for cancer.
Prerequisite	Basic knowledge about cell biology

Course Outcomes (COs)

CO Number	Course Outcomes (COs) Statement	Bloom'sTaxonomy Knowledge Level
CO1	Compare and contrast benign and malignant tumors and the morphological characteristics of cancer cells.	K4
CO2	Justify the molecular basis of cancer. Distinguish interdisciplinary areas in cancer biology.	K5
CO3	Evaluate the molecular mechanism of oncogenesis, tumor biology and the role of cell cycle in cancer.	K5
CO4	Validate the role of tumor suppressor genes and apoptosis. Explain about epigenetics.	K5
CO5	Summarize on the choice of diagnosis and therapy available for cancer patients.	K6

Mapping with Program Outcomes:

COs / POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

24BCP1DA - CANCER BIOLOGY, DIAGNOSIS AND THERAPY

Syllabus

Unit	Content	Hours	E-Contents / Resources
I	Introduction: Cancer cell-morphology and growth characteristics. Metastasis and cytoskeleton. Apoptosis. Types and prevalence of cancer. Nomenclature of neoplasms, classification based on origin/organ. Differences between benign and malignant tumors.	09	Text Book
II	Cancer epidemiology and endocrinology. Cancer causing agents-radiation, viruses, chemicals. Multistep carcinogenesis: Initiation, Promotion, Progression. Para-neoplastic syndromes. Mutation-definition, significance, rates and frequency. Mutagenic agents. Molecular basis of mutagenesis: induced and spontaneous mutations, crossing over and segregation.Cancer genetics. Chemical carcinogenesis-genetic and epigenetic carcinogens, pro- carcinogens and co-carcinogens, promoters and initiators, testing for carcinogenecity, Ames test. Aberrant metabolism during cancer development.	09	Reference Book
III	Oncogenes - RNA and DNA tumor viruses, retroviruses and viral oncogenes and abrupt activation. Src and Ras gene, mechanism and characteristic of cell transformation. Molecular mechanism of oncogenesis- protooncogenesis, oncoproteins, tumor suppressor genes involved in cancer. Radiation- effect of ionizing radiations on DNA, chromosomal aberrations. Cancer Markers: Genetic basis of cancer, use of tumor markers in detection and monitoring of cancer. Signal transduction in cancer: cell-cell interactions, cell adhesion, invasion and metastasis, VEGF signaling and angiogenesis; role of transcription factors. Growth factors-EGF, TNF-α and TGF-β and growth factor receptors. Free radicals and antioxidants in cancer. Diet and cancer.	10	Reference Book
IV	Cell Cycle Regulation cancer: control of the cell cycle - cyclins and CDKs, and tumor suppressor genes p53, p21Rb, BRAC1 and BRAC2. Telomeres, and Immortality; Epigenetics- role of DNA methylation in gene silencing-epigenetic silencing of tumor - suppressor genes.	10	NPTEL
V	Principles and methods of cancer diagnosis - biochemical, genetic, cytotoxic, cell growth and viability tests. Diagnosis of cancer by histopathology, MRI scans, PET scan, cytogenetics test, kariotype, FISH. Strategies of anticancer drug therapy–chemotherapy, gene therapy, immuno therapy, radiotherapy and surgical therapy. Principles of cancer biomarkers and their	10	You Tube Videos

	applications.		
	Total	**48**	

Text Book	**1.**	Mc Kinnell R.G et al, 2012, "The Biological Basis of Cancer", Second edition, Cambridge University Press, London.
Reference Books	**1.**	Weinberg R.A, 2014, "The Biology of Cancer", Second edition , Garland Science, New York & London.
	2.	Vincent T. De Vita M. D et al, 2020, "Principles and Practice of Oncology: Primer of Molecular Biology in Cancer", Third edition, Lippincott Williams and Wilkins, Philadelphia.
	3.	Pelengaris S and Khan M, 2010, "The Molecular Biology of Cancer - A bridge from bench to bed side", Second edition, Wiley Black well, London
	4.	Hesketh R, 2013, "Introduction to Cancer Biology", First edition, Cambridge University Press, London.
	5.	Pezzella F et al, 2019, "Oxford textbook of Cancer Biology", First edition, Oxford University Press, London

Journal and Magazines	https://journals.lww.com/amjclinicaloncology/pages/default.aspx
E-Resourcesand Website	https://www.cancer.gov>research>resources; https://nptel.ac.in

Learning Methods	Chalk and Talk/Assignment/Seminar

Focus of the Course	Skill Development/Employability

BoS Chairman/HoD
Department of Biotechnology
Dr. N. G. P. Arts and Science College
Coimbatore – 641 048

Dr.N.G.P Arts and Science College
APPROVED
BoS- 17th 06.04.24 | AC - 17th 17.04.24 | GB -

Academic Council CHAIRMAN 17/04/2024 Dr.N.G.P. Arts and Science College

Semester - II CORE: IMMUNOTECHNOLOGY							
Semester	**Course Code**	**Course Name**	**Category**	**L**	**T**	**P**	**Credits**
II	**24BTP2CA**	**IMMUNOTECHNOLOGY**	**CORE**	**48**	**-**	**-**	**4**

Preamble	This course has been designed for students to learn and understand • Mechanism of immune system • Various detection methods of antigen-antibody interaction • Milestones in vaccine development
Prerequisite	Knowledge on Immune system and its functions

Course Outcomes (COs)

CO Number	Course Outcomes (COs) Statement	Bloom's Taxonomy Knowledge Level
CO1	Understand about basis of immune response	K3
CO2	Know the antigen–antibody related tests	K3
CO3	Learn about new generation of antibody production techniques	K3
CO4	Aware on vaccine immunological types and its role in immune system	K5
CO5	Know about allergic reaction, tumour immunology and its effect on immune system	K5

Mapping with Program Outcomes:

COs / POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓	✓	✓
CO2		✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓		
CO5	✓	✓	✓		✓

24BTP2CA	CORE: IMMUNOTECHNOLOGY

Syllabus

Unit	Content	Hours	E-Contents / Resources
I	Cells and Organs of Immune System: History and scope of immunology. Types of Immunity - Passive, Active and Acquired immunity. MHC and its types. Humoral and Cell Mediated immunity. Cells and organs of immune systems – Bone marrow, Spleen, Lymph nodes and their functions. Antigens -Types, haptens, epitopes and factors influencing antigenicity. Antibody – Structure, types, properties and functions. Immunoglobin gene rearrangements.	10	Text Book
II	Antigen – Antibody interaction: Affinity, avidity, cross reactivity, specificity, epitope mapping; Agglutination and Precipitation reactions. Immunoassays– Immuno Diffusion and Immunoelectrophoresis, RIA, ELISA, Western blotting, ELISPOT assay, immunofluorescence – FISH and GISH, Biosensor assays for assessing ligand – receptor interaction.	10	https://www.youtube.com/watch?v=RYVV1R8ywXM
III	New Generation Antibodies: Antibody engineering; Hybridoma and monoclonal antibody (MCAb) techniques, Purification of MCAbs. Characterization of MCAbs / and Labelling of antibodies. Antibodies as *in-vitro* and *in-vivo* probes. Applications of monoclonal antibodies in diagnostics and therapeutics.	08	https://www.youtube.com/watch?app=desktop&v=U76Ll3OuBsU
IV	Vaccine Technology: Vaccine design based on clinical requirements: Active immunization; live, killed, attenuated, Sub unit vaccines; Recombinant DNA and protein-based vaccines, plant-based vaccines and reverse vaccinology; Peptide vaccines, conjugate vaccines; Passive Immunization; Antibody and immunocompetent cells transfusion; Cell based vaccines, edible vaccines, marker vaccines, viral like particles (VLPs), Dendritic cell-based vaccines, Vaccine against cancer, T Cell based vaccines and Therapeutic vaccines.	10	https://www.youtube.com/watch?v=bBtE5fg5ItU
V	Hypersensitivity and Transplantation: Hypersensitivity– Mechanism and Types. Auto immune disorders –Type I diabetes and Rheumatoid arthritis. Role and mechanism of CD4+ T cells, MHC and TCR in autoimmunity. Tumor	10	Reference Books

	immunology: tumor antigens, oncogenes, immune responses and tumor evasion of the immune system, detection of cancers and therapy-chemotherapy and radiation therapy. Machine Learning in Cancer Diagnostics. Transplantation Immunology – immunological basis of graft rejection, clinical transplantation and immunosuppressive therapy.		
	Total	**48**	

Text Book	**1.**	Rao CV, 2006, "Immunology - A Text book", 2nd Edition, Narosa Publishing House Pvt. Ltd, New Delhi.
Reference Books	**1.**	Kuby J,1997, "Immunology", 3rd Edition, W.H.Freeman and Company, New York
	2.	Peter J Delves, Seamus J Martin, Dennis R Buton and Ivan M Roitt, 2017, "Roitt's Essentials Immunology", 39th Edition, John Wiley & Sons, UK.
	3.	Hay FC, 2002, "Practical immunology", 4th Edition, Blackwell Scientific Publications, London.
	4.	Owen, Jenni Punt and Sharon A Stranford, 2013, "Kuby Immunology",7th Edition, W.H. Freeman and Company, New York.

Journal and Magazines	https://onlinelibrary.wiley.com/journal/1607#:~:text=Journal%20of%20Immunology%20Research%20is,a%20strong%20emphasis%20on%20integ
E-Resources and Website	https://www.youtube.com/watch?v=RYVV1R8ywXM https://www.youtube.com/watch?v=FVl7G5Zxb-I

Learning Methods	Chalk and Talk/Assignment/Seminar

Focus of the Course	Skill Development/Employability/Entrepreneurial Development

Semester - II CORE: GENETIC ENGINEERING							
Semester	**Course Code**	**Course Name**	**Category**	**L**	**T**	**P**	**Credits**
II	**24BTP2CB**	**GENETIC ENGINEERING**	**CORE**	**48**	**-**	**-**	**4**

Preamble	This course has been designed for students to learn and understand • Various types of vector host systems • Steps in creating recombinant DNA molecule • Various recombinant DNA techniques and their applications
Prerequisite	Knowledge on Basic of ecosystem and its functions

Course Outcomes (COs)

CO Number	Course Outcomes (COs) Statement	Bloom's Taxonomy Knowledge Level
CO1	Conclude the steps in recombinant DNA preparation and labeling	K3
CO2	Explain the features of various types cloning vectors for bacteria, yeast, animals and plants	K3
CO3	Compare the methods of gene transfer and hybridization	K3
CO4	Analyze various molecular techniques and its applications	K4
CO5	Evaluate the different types of sequencing and gene therapy	K5

Mapping with Program Outcomes:

COs / POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	
CO5	✓			✓	✓

24BTP2CB	CORE: GENETIC ENGINEERING

Syllabus

Unit	Content	Hours	E-Contents / Resources
I	DNA manipulative Enzymes – Nucleases, Ligases, Polymerases, DNA modifying Enzymes - Alkaline Phosphatase, Polynucleotide Kinase, Terminal deoxy nucleotidyl transferase. Enzymes for cutting DNA – Restriction and Ligation – Linkers, Adaptors, Homopolymer tailing.	10	https://www.sciepublish.com /journals/sbe
II	Vectors for Cloning – Plasmids - classification. Plasmids – pBR322 and pUC vectors, Bacteriophage vectors - M13 vectors, Lambda vectors (Insertion and Replacement vectors), Phagemids, Cosmids, Viral Vectors, Animal Viral vectors - SV-40, Baculovirus Vector, retroviral vectors, Plant vectors -Ti and Ri Plasmids. Yeast Vectors- BAC, YAC, YEP and Shuttle Vectors for Cloning.	12	https://www.sciepublish.com /journals/sbe
III	Gene transfer methods – Physical and Chemical, Construction of cDNA and genomic DNA libraries. Blotting techniques – Northern, Southern and Western Blotting. Microarray - DNA and Protein (Protein chips). Genome editing - CRISPR/Cas 9.	10	https://www.sciepublish.com /journals/sbe
IV	PCR & its types: Principle, steps and applications – Nested PCR, Reverse Transcriptase PCR, Colony PCR, Touchdown PCR, qRT PCR and Hot Start PCR. Genetic markers: Types and Applications - RAPD, RFLP, SSLP, AFLP, VNTRs and microsatellites.	08	https://www.genome.ucsc.edu/ https://dnalc.cshl. edu/
V	Production of recombinant pharmaceuticals: insulin, factor VIII and Recombinant Vaccines. Gene therapy for inherited diseases, Gene therapy for cancer, Gene silencing - antisense and RNA interference, Gene knock out.	08	https://www.genome.ucsc.edu/ https://dnalc.cshl. edu/
	Total	**48**	

Text Book	**1.**	Brown TA, 1998, "Introduction to Gene Cloning", 3rd Edition, Stanley Thornes Publishing Ltd, United Kingdom.
Reference Books	**1.**	Primrose SB, 2003, "Principles of Gene Manipulation", 6th Edition, Blackwell Science Ltd, United States.
	2.	Bernard Glick R and Jack Pasternak J, 2010, "Molecular Biotechnology: Principles and Applications of Recombinant DNA" 4th Edition, ASM press, United States.
	3.	Singh BD, 2008, "Text book of Biotechnology", 4th Edition, Kalyani Publishers, New Delhi
	4.	Sambrook J and Russel DW, 2001, "Molecular Cloning: A Laboratory Manual", 3rd Edition, CSHL, United States.

Journal and Magazines	https://www.sciepublish.com /journals/sbe
E-Resources and Website	https://www.genome.ucsc.edu/ https://dnalc.cshl. edu/

Learning Methods	PPT and ICT Tools

Focus of the Course	Skill Development and Employability

Semester - II Core: ENVIRONMENTAL BIOTECHNOLOGY							
Semester	**Course Code**	**Course Name**	**Category**	**L**	**T**	**P**	**Credits**
II	**24BTP2CC**	**ENVIRONMENTAL BIOTECHNOLOGY**	**CORE**	**48**	**-**	**-**	**4**

Preamble	This course has been designed for students to learn and understand • Basic concepts of environmental biotechnology • Biodegradation of industrial hazardous material • Impact of pollution on ecosystem and environmental laws
Prerequisite	Knowledge on Basic of ecosystem and its functions

Course Outcomes (COs)

CO Number	Course Outcomes (COs) Statement	Bloom's Taxonomy Knowledge Level
CO1	Illustrate the organization of ecosystem and its functions	K3
CO2	Distinguish the various toxic chemicals of environment and their biodegradation	K4
CO3	Infer the removal of heavy metals	K4
CO4	Explain the xenobiotics and bioremediation methods	K4
CO5	Grade the awareness on environmental monitoring and environmental laws	K5

Mapping with Program Outcomes:

COs / POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓	✓	✓
CO2		✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓		
CO5	✓	✓	✓		✓

24BTP2CC	CORE: ENVIRONMENTAL BIOTECHNOLOGY

Syllabus

Unit	Content	Hours	E-Contents / Resources
I	Ecosystem structure and functions: Abiotic and biotic components, energy flow, food chain, food web and tropic levels, ecological pyramids, N,P,C and S cycles in nature. Threats to environment - pollutions, waste materials and xenobiotics. Bioaccumulation and Biomagnification. Pollution and its types	09	Text Book
II	Environmental toxicology: Toxic chemicals in the environment (air and water) – their effects and biochemical interactions; Pesticides in water, biochemical aspects of arsenic, cadmium, lead, mercury, carbon monoxide, ozone and PAN pesticide. Mode of entry of toxic substances in environment, its breakdown and detoxification. Biotransformation of xenobiotics.	10	Reference Book
III	Biosorption and Bioleaching of heavy metals (Mercury, Chromium and Lead), Microbially enhanced Phosphorus and Nitrogen removal. Advantages and disadvantages of biosorption and bioleaching. Microbial Role in Carbon capture. Biosorption of Organic Compounds - polychlorinated biphenyls (PCBs), textile dyes and pharmaceuticals wastes.	10	Biosorption_A_Review_ of_the_Latest_Advances.pdf
IV	Xenobiotics and Bioremediation: Xenobiotics in environment - biodegradation of hydrocarbons, pesticides, lignin and synthetic dyes - azo dyes. Bioremediation & Phytoremediation: Applications of bioremediation. Application of biotechnology in xenobiotic bioremediation.	11	Reference Book
V	Environmental Monitoring: Environmental Monitoring Programme - Bioindicators of environment, Environment Management, Environment Laws (National and international) and National Environmental Policies. Government organizations in environmental monitoring, Sustainable Development Goals in Environment, Carbon emission management	08	https://www.youtube.com/watch?app=desktop&v=BYqLRGawoH0
	Total	**48**	

Text Book	**1.**	Prohit SS, 2003, "Ecology and environment and pollution", 1st Edition, Agrobios publications, India
Reference Books	**1.**	Dash MC, 1998, "Fundamentals of Ecology", 2nd Edition, Tata McGraw Hill, India.
	2.	Scragg A, 2007, "Environmental biotechnology", 2nd Edition, Oxford University Press, India.
	3.	Kumar R, 2017, "Advances in Environmental Biotechnology", 3rd Edition, Springer, USA.
	4.	Singh RL, 2016, "Principles and Applications of Environmental Biotechnology for a Sustainable Future", 1st Edition, Springer, USA.

Journal and Magazines	https://www.udspub.com/ajj/public/index.php/aeb
E-Resources and Website	https://pmc.ncbi.nlm.nih.gov/articles/PMC3741516/ https://www.youtube.com/watch?v=8ZoBy_ewLvc

Learning Methods	Chalk and Talk/Assignment/Seminar

Focus of the Course	Skill Development/Employability/Entrepreneurial Development

Semester - II CORE: BIOPROCESS TECHNOLOGY							
Semester	**Course Code**	**Course Name**	**Category**	**L**	**T**	**P**	**Credits**
II	**24BTP2CD**	**BIOPROCESS TECHNOLOGY**	**CORE**	**48**	**-**	**-**	**4**

Preamble	This course has been designed for students to learn and understand • Fundamentals of fermentation technology • Bioprocess paradigm and scale-up • Development of fermentation products and their regulations
Prerequisite	Knowledge on Microbiology

Course Outcomes (COs)

CO Number	Course Outcomes (COs) Statement	Bloom's Taxonomy Knowledge Level
CO1	Analyze the concepts of microbial culture collection and preservation	K4
CO2	Distinguish the types of fermentation process	K4
CO3	Evaluate the concept and mechanism of different types of fermenters	K5
CO4	Compare the purification of fermentation products	K5
CO5	Conclude the recent development in microbial product production	K5

Mapping with Program Outcomes:

COs / POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	
CO3	✓	✓	✓	✓	
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

24BTP2CD	CORE: BIOPROCESS TECHNOLOGY

Syllabus

Unit	Content	Hours	E-Contents / Resources
I	Bioprocess - Microbial biomass; Screening and selection of organisms for bioprocess; Strain improvement of industrially important microorganisms; Preservation of cultures after strain improvement programme. Fermentation inoculum preparation for bacterial and fungal processes.	09	Text Book
II	Fermentation media - Natural and synthetic. Sources of Carbon, Nitrogen, vitamins and other elements. Types of Fermentation: Solid state and Submerged - Batch, continuous and Fed-Batch fermentation. Optimization of fermentation process parameters: measurement of temperature, pressure, pH, dissolved oxygen and foam. Statistical optimization of media – RSM and CCD.	09	Reference Book
III	Types of reactors: Bubble column, airlift reactor, packed bed, fluidized bed, trickle bed, membrane reactor, photobioreactor, solid state fermenter, animal and plant cell bioreactors. Scale up and scale down studies of bioreactors. Phases of cell growth, Kinetic model for cell growth: Monod's model, Haldane's model and factors affecting cell growth.	10	Text Book
IV	Biomass separation by centrifugation, filtration, micro and ultrafiltration, flocculation. Cell disintegration: physical, chemical and enzymatic methods. Isolation and purification techniques for proteins and other products. Principles of bioprocess control, bioprocess automation and application of IoT in bioprocessing.	10	Reference Book
V	Pharmaceutical Products – Enzymes (Protease and amylase), Antibiotics (Penicillins and Tetracycline), Vitamins (B2, B12), Aminoacids (lysine, glutamic acid), Organic acids (acetic acid, lactic acid); Food Products - probiotics, cheese, cultured meat, Single Cell Protein (SCP). Agricultural Products - Biofertilizer (*Rhizobium* and *Pseudomonas*) and Biopesticides (*Bacillus thuringiensis*). Regulatory affairs – Policies, regulations, clearance and certifications.	10	Reference Book
	Total	**48**	

Text Book	**1.**	Peter F Stanbury, Allan Whitaker, Stephen J Hall, 2016, "Principles of Fermentation Technology", 3rd Edition, Butterworth-Heinemann, United Kingdom.
Reference Books	**1.**	Wulf Crueger, Anneliese Crueger and Aneja K R, 2017, "Crueger's Biotechnology: A Textbook Of Industrial Microbiology", 1st Edition, Scientific International, India.
	2.	Dorothy Wood, Joanne Willey, Kathleen Sandman, 2022, "Prescott's Microbiology", 12th Edition, McGraw-Hill Education, USA.
	3.	Casida L.E.J.R, 2019, "Industrial Microbiology", 2nd Edition, New Age International Private Limited, India.
	4.	Matthew DeLisa, Michael L. Shuler, Fikret Kargi, 2017, "Bioprocess Engineering: Basic Concepts", 3rd Edition, Pearson, United Kingdom.

Journal and Magazines	https://link.springer.com/journal/11947; https://www.bioprocessintl.com/
E-Resources and Website	https://archive.nptel.ac.in/courses/102/105/102105058/

Learning Methods	Chalk and Talk/Seminar/Assignment/ Group discussion/ Case Study

Focus of the Course	Employability, Entrepreneurial Development

Semester – II CORE PRACTICAL: IMMUNOTECHNOLOGY AND BIOPROCESS TECHNOLOGY							
Semester	**Corse Code**	**Course Name**	**Category**	**L**	**T**	**P**	**Credits**
II	**24BTP2CP**	**CORE PRACTICAL: IMMUNOTECHNOLOGY AND BIOPROCESS TECHNOLOGY**	**CORE**		**-**	**48**	**2**

Preamble	This course has been designed for students to learn and understand • the components of blood • the role of antigen, antibody and their interaction • the fermentation and its application
Prerequisite	Knowledge on immunology and fermentation

Course Outcomes (Cos)		
CO Number	**Course Outcomes (COs) Statement**	**Bloom's Taxonomy Knowledge Level**
CO1	Analyze the components of serum, plasma and their interactions	K3
CO2	Interpret the interaction of antigen and antibody	K3
CO3	Assess the purity of antibodies using chromatographic technique and diffusion	K4
CO4	Infer the role of immobilization in enzyme entrapment	K4
CO5	Show the role of bioprocess technology in entrepreneurship	K5

Mapping with Program Outcomes:					
Cos / POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	
CO3	✓	✓	✓	✓	
CO4	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓

24BTP2CP	CORE PRACTICAL: IMMUNOTECHNOLOGY AND BIOPROCESS TECHNOLOGY

S.No	Contents
1	Collection of Blood, separation of serum and plasma
2	Blood grouping and Rh Typing
3	Single Radial Immuno diffusion
4	Ouchterlony Double Immunodiffusion
5	Rocket Immunoelectrophoresis
6	Purification of IgG antibodies using affinity chromatography
7	Latex agglutination test
8	Immobilization of bacterial cells and enzyme assay
9	Production & estimation of biomass (SCP)
10	Wine production and estimation of alcohol content
11	Demonstration of acetic acid oxidation (vinegar production)

Manuals	1.	Frank C Hay, Olwyn MR and Westwood, 2002, "Practical Immunology", 4th Edition, Blackwell Publication, USA.
	2.	James G Cappucino and Natalie Sherman, 2014, "A Laboratory Manual on Microbiology", 1st Edition, Pearson Publication, USA

Learning Method	Demonstration/ Hands on Experiments/ Group Trials

Focus of the Course	Skill Development/ Employability/ Innovations

Semester – II CORE PRACTICAL: GENETIC ENGINEERING AND ENVIRONMENTAL BIOTECHNOLOGY							
Semester	**Corse Code**	**Course Name**	**Category**	**L**	**T**	**P**	**Credits**
II	**24BTP2CQ**	**CORE PRACTICAL: GENETIC ENGINEERING AND ENVIRONMENTAL BIOTECHNOLOGY**	**CORE**		**-**	**72**	**3**

Preamble	This course has been designed for students to learn and understand • the role of various enzymes in recombinant DNA technology • the development of recombinants • the analytical techniques in Environmental quality management
Prerequisite	Knowledge on molecular biology and environmental science

Course Outcomes (Cos)		
CO Number	**Course Outcomes (COs) Statement**	**Bloom's Taxonomy Knowledge Level**
CO1	Analyze the role of enzymes in Genomic DNA and Plasmid DNA extraction	K3
CO2	Interpret the role of enzymes in RNA isolation	K3
CO3	Assess the functions of endonuclease and ligases in DNA cutting and joining	K4
CO4	Infer the techniques to assess the water quality	K4
CO5	Show the role microbes in environmental cleanup	K5

Mapping with Program Outcomes:					
Cos / POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	✓		✓	✓	✓
CO2	✓		✓	✓	✓
CO3	✓	✓	✓	✓	
CO4	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	

24BTP2CQ	CORE PRACTICAL: GENETIC ENGINEERING AND ENVIRONMENTAL BIOTECHNOLOGY

S.No	Contents
1	Extraction of genomic DNA from bacteria
2	Extraction of DNA from Fungi
3	Extraction of DNA from goat liver
4	Extraction of DNA from Plant sample
5	Isolation of plasmid DNA from bacteria
6	Agarose gel electrophoresis & Estimation of DNA purity and Quantification
7	Restriction digestion and ligation of Lambda phage DNA
8	Isolation of RNA and separation in denaturing gel
9	Water quality Analysis–color, pH, MPN and acidity
10	Total Hardness by EDTA titrimetric method and chloride estimation
11	Estimation of total alkalinity, carbonate and bicarbonate
12	Determination of Chemical Oxygen Demand (COD)
13	Metal analysis from environment samples by flame photometry
14	Isolation and screening of dye degrading bacteria from industrial waste water

Manuals	1.	Sandhya Mitra, 1996, "Genetic Engineering Principles and Practice" 1st Edition, Macmillan, India.
	2.	Alan Scragg, 2007, "Environmental Biotechnology", 2nd Edition, Oxford university press, UK.

Learning Method	Demonstration/ Hands on Experiments/ Group Trials

Focus of the Course	Skill Development/ Employability/ Innovations

Semester – II DSE: FORENSIC BIOTECHNOLOGY							
Semester	**Course Code**	**Course Name**	**Category**	**L**	**T**	**P**	**Credits**
II	**24BTP2DA**	**FORENSIC BIOTECHNOLOGY**	**DSE**	**36**	**12**	**-**	**3**

Preamble	This course has been designed for students to learn and understand • Basics and fundamentals of the sample collection and examination in forensic aspects • Different types of DNA profiling and DNA databases used in Forensic analysis • Applications of Forensic Biotechnology in various fields
Prerequisite	Knowledge on techniques and applications of forensic Biotechnology

Course Outcomes (COs)

CO Number	Course Outcomes (COs) Statement	Bloom's Taxonomy Knowledge Level
CO1	Infer the sample collection for forensic examinations	K3
CO2	Know the methods to characterize the different samples on forensic prospective	K3
CO3	Interpret and examine forensic evidence by DNA profiling methods	K3
CO4	Analyze and interpret the forensic DNA Statistics and Database	K4
CO5	Conclude the significance and applications of Forensic Biotechnology	K5

Mapping with Program Outcomes

COs / POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓		✓	✓
CO2		✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓		✓	✓

24BTP2DA	DSE: FORENSIC BIOTECHNOLOGY

Syllabus

Unit	Content	Hours	E-Contents / Resources
I	Forensic science - History, scope, branches and functions. Forensic science in international perspectives- INTERPOL and FBI. Duties of forensic scientists. Forensic laboratories in India and worldwide. Collection and Preservation of biological samples-Blood, Semen, Saliva, Vomit, Hair, Fibers, Urine and Fecal matter from crime scene.	08	https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000016FS/P000699/ M011531/ET/1516257285FSC_P12_M5_e-text.pdf
II	Importance of Hair, Sperm and Blood in forensic characterization. Hair- morphology, tests for their identification. Blood- composition and properties, presumptive and confirmatory tests. Sperm- composition, morphology of spermatozoa, presumptive and confirmatory tests (including Azoospermic semen stains), seminal fluid isozymes typing.	10	1516257136FSC_P12_M2_e-text.pdf
III	Structure of DNA, DNA extraction-organic and inorganic extraction. Variations in DNA related to forensic Biotechnology, DNA profiling-history and applications. Methods used in DNA profiling- Restriction Fragment Length Polymorphism (RFLP), Polymerase Chain Reaction (PCR), RAPD, Short Tandem Repeat (STR) Analysis, Single Nucleotide Polymorphism (SNP) Analysis, Mitochondrial DNA (mtDNA) Profiling, Y-Chromosome STR (Y-STR) Analysis and Variable Number Tandem Repeats (VNTR) Analysis.	10	https://www.frontiersin.org/journals/ecology-and-evolution/articles/10.3389/fevo.2021.646130/full
IV	DNA Statistics- allele frequency, Random Match Probability (RMP), Paternity/Maternity index, Sibling index. Impact of Human genome project on Forensic Biotechnology. DNA forensic databases; Ethical, legal, and social issues associated with DNA data banking, potential benefits of DNA data banking, quality control, certification and accreditation.	10	https://wbja.nic.in/wbja_adm/files/dna%20profiling%20%20cfl.pdf
V	Forensic Biotechnology Applications –Criminal investigations, Disputed paternity cases, Child swapping, Disaster Victim Identification (DVI), Civil immigration, Veterinary, Wildlife,	10	https://www.walshmedicalmedia.com/open-access/application-of-dna-fingerprinting-in-an-

	Environment, Public Health and Epidemiology, Agriculture and Food safety. New and Future technologies for Forensic Biotechnology.		alleged-case-of-paternity-2161-1009-1000165.pdf
	Total	**48**	

Text Book	**1.**	Richard Saferstein E, 2020, "Forensic Science Handbook", 2nd Edition,Prentice Hall, New Delhi.
Reference Books	**1.**	William Tilstone J, Kathleen Savage A and Leigh Clark A, 2006, "Forensic Science: An Encyclopedia of History, Methods and Techniques", 1st Edition, ABC – CLINO Inc, California.
	2.	Allan Jamieson and Scott Bader, 2016, "A Guide to Forensic DNA Profiling",10th Edition, John Wiley & Sons, UK.
	3.	John Butler M, 2005, "Forensic DNA Typing - Biology, Technology, and Genetics of STR Markers", 2nd Edition, Academic Press, United States.
	4.	John Butler M, 2009, "Fundamentals of Forensic DNA Typing", 1st Edition, Academic Press, United States.

Journal and Magazines	Singh, Harendra Nath. (2021). Collection, Preservation and Transportation of Biological Evidence Forensic DNA Analysis. 9. 1123-1130.
E-Resources and Website	https://pmc.ncbi.nlm.nih.gov/articles/PMC3168143/ https://www.sciepublish.com/article/pii/279 https://blog.bccresearch.com/technology-trends-shaping-the-future-of-forensics-industry

Learning Methods	Learning Management System, PPT, Flipped Classroom

Focus of the Course	Skill Development/Employability/Entrepreneurial Development

Semester – II DSE : BIONANOTECHNOLOGY							
Semester	**Corse Code**	**Course Name**	**Category**	**L**	**T**	**P**	**Credits**
II	24MBP2DA	BIONANOTECHNOLOGY	DSE	36	12	-	3

Preamble	This course has been designed for students to learn and understand • the role of microbes and other eukaryotes in the synthesis of nanoparticles • advanced methods of characterization of nano particles • educate the potential applications of nano particles/ materials in a variety of areas.
Prerequisite	Knowledge on life science

Course Outcomes (Cos)		
CO Number	**Course Outcomes (COs) Statement**	**Bloom's Taxonomy Knowledge Level**
CO1	Explore the basics of Nanosciences and its applications	K3
CO2	Synthesize nanoparticles at the laboratory scale.	K4
CO3	Analyze the nanoparticles by spectral and electron microscopic techniques	K4
CO4	Apply bionanomaterials in drug development and delivery.	K4
CO5	Criticize the merits and demerits of nanomaterial applications.	K4

Mapping with Program Outcomes:					
Cos / POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	✓	✓	✓	✓	✓
CO2	✓	✓		✓	✓
CO3	✓	✓	✓	✓	
CO4	✓		✓	✓	✓
CO5		✓	✓	✓	✓

24MBP2DA | DSE: BIONANOTECHNOLOGY

Syllabus

Unit	Content	Hrs	Resources
I	Introduction to bionanotechnology History – concept and future prospects – application in Life Sciences. Terminologies – nanotechnology, bionanotechnology, nanobiomaterials, biocompatibility, nanomedicine, nano tube, nanowires, quantum Dots, nanocomposite, nanoparticles, nanosensors, Nanofiber, Dendrimeter. Emergence of Bionanotechnology.	10	Text Book 1 Reference book 1
II	Synthesis of nanoparticles Synthesis - Top-down approach & bottom-up approach - Types of nanoparticles production - principle and mechanism of synthesis – physical - Sonicator, Ball mill, ablation, evaporation-condensation; chemical - reducing method - chemical reduction, irradiation, electrochemical, photoreduction; biological - microbes, plants. Green synthesis	10	Text Book 2 Reference book 1
III	Characterization of Nanoparticles Physical and chemical properties of nanoparticles. Characterization– UV-Vis spectroscopy, particle size analyzer, Electron Microscopy – HRTEM, SEM, AFM, EDS, XRD. Other tools and techniques required for bionanotechnology: X-Ray crystallography, FTIR, NMR.	10	Text Book 1 Reference book 3
IV	Applications of bionanotechnology Targeted drug delivery, biosensors and biomarkers, food and agriculture, DNA nanotech, nanoviricides, tissue engineering, gene delivery. Antibacterial activities of nanoparticles. Toxicology in nanoparticles – Dosimetry. Molecular nanotechnology – nanomachines – collagen.	9	Text Book 2 Reference book 2
V	Merits and demerits of nanoparticles Health and safety implications from nanoparticles: Health issues – Environmental issues – Need for regulation – Societal implications - Possible military applicationsPotential benefits and risks for developing countries – Intellectual property issues. Bioinformatic tools in nanotechnology: molecular modeling, docking, computer assisted molecular design.	9	Text Book 2 Reference book 4
	Total	**48**	

	Case study- Merits and demerits of any two nanoparticles in health and environment safety)

Text book	1.	Parthasarathy BK. 2007, Introduction to Nanotechnology, Isha Publication.
	2.	Elisabeth Papazoglou and Aravind Parthasarathy. 2007,

		Bionanotechnology, Morgan and Claypool Publishers, New Delhi.
Reference Books	1.	Bernd Rehm, 2006, Microbial Bionanotechnology: Biological Self-assembly Systems and Biopolymer-based Nanostructures. Horizon Scientific Press.
	2.	David E Reisner and Joseph D Bronzino,2008, Bionanotechnology: Global Prospects. CRC Press, New Delhi.
	3.	Ehud Gazit, 2006, Plenty of Room for Biology at the Bottom: An Introduction to Bionanotechnology. Imperial College Press.
	4.	Kamali Kannangara, 2005, Nanotechnology: Basic science and Emerging technologies- Mick Wilson, Overseas Press.

Journal and Magazines	https://jnanobiotechnology.biomedcentral.com | https://nano-magazine.com
E-Resources and Website	https://archive.nptel.ac.in/courses/118/107/118107015 | https://www.coursera.org/learn/nanotechnology

Learning Method	Chalk and Talk/Assignment/Seminar/ Group Discussion/Case Study

Focus of the Course	Skill Development/ Employability/ Entrepreneurial Development/ Innovations

SEMESTER II
DSE: BIOCHEMISTRY OF TOXICOLOGY

Semester	Course Code	Course Name	Category	L	T	P	Credits
II	24BCP2DA	BIOCHEMISTRY OF TOXICOLOGY	DSE	36	12	-	3

Preamble	This course has been designed for students to learn and understand The biochemical basis of toxicology The effects and metabolism of toxins General toxicology, methods of toxicity testing, toxins from microbes, carcinogenic & teratogenic toxins, pesticide, metal and chemical toxicology
Prerequisite	Basic knowledge about Toxicity

Course Outcomes (COs)

CO Number	Course Outcomes (COs) Statement	Bloom's Taxonomy Knowledge Level
CO1	Explain the importance of toxicology	K2
CO2	Distinguish and evaluate the biochemical effects of toxic agents on cellular macromolecules and tissues	K4
CO3	Compare the different genetic methods used for testing toxicity	K4
CO4	Analyze the effects and metabolism of various microbial toxins, teratogens and carcinogens	K4
CO5	Assess the mode of action of toxic pesticides, heavy metals, chemicals and air pollutants	K5

Mapping with Program Outcomes:

COs / POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓			
CO2	✓	✓			✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

24BCP2DA	DSE: BIOCHEMISTRY OF TOXICOLOGY

Syllabus

Unit	Content	Hours	E-Contents / Resources
I	Introduction to Toxicology Definition and scope of toxicology, Classification of toxic agents. Dose-response relationship: Synergism and Antagonism, Determination of ED50 and LD50. Acute and chronic exposures, Factors influencing toxicity - Abiotic and Biotic factors, Chemical interactions - Bioaccumulation and Bio-magnification	9	Text Book, Reference book and E-Resources
II	Biochemical basis of Toxicology Toxicokinetics-ADME (Absorption, Distribution, Metabolism and Excretion) and Toxicodynamics. Mechanisms of Toxicity, Interaction of toxicant with target molecules - Disturbance of excitable membrane function. Altered calcium homeostasis. Blood brain barrier penetration. Organ Toxicology, Genetic and reproductive toxicology, Toxicogenomics.	9	Text Book and Reference Book
III	Principles and procedures of testing for acute toxic effects Toxicity testing - In-vitro test systems - Bacterial mutation tests: Fluctuation tests, Ames test, Eukaryotic mutation test: Micronucleus Test, Comet Assay, Chromosomal Aberration Test. In-vivo mammalian mutation tests - Host mediated assay and Dominant lethal test. Use of drosophila in toxicity testing. Toxicity testing in animals. Toxicological evaluation of Recombinant DNA-derived proteins.	10	Text book, Reference book, E-Resources and YouTube Videos
IV	Effects and Metabolism of toxins Fungal toxins, Mycotoxins - Aflatoxins, Bacterial toxins - Exotoxins and Endotoxins, Viral toxins, Algal toxins, Teratogens, Carcinogens, Mutagens, Snake venom toxin, Spider, Scorpion and Jellyfish toxins, Antivenom. Xenobiotic metabolism: Phase I– III reactions, Cytochrome-P450. Free radical theory of oxygen toxicity.	10	Text book, NPTEL, and E-resources
V	Pesticide toxicology, Metal toxicology, Chemical toxicology, Air and water pollutants Mechanism and site of action of Chlorinated organics (DDT, BHC), organophosphates and carbamates. Fungicides, Herbicides. Environmental consequences of pesticide toxicity. Biopesticides, Mode of action of toxic heavy metals - arsenic, mercury, cadmium and lead. Biochemical effects of	10	Text book, NPTEL and Reference book

	ozone, peroxyacetyl nitrate (PAN), carbon monoxide, nitrogen oxides, sulphur dioxide and cyanide. Drug induced toxicity-example- Paracetamol. Common air pollutants, water pollutants and their sources, air pollution due to methyl-isocyanate (MIC) and asbestos. Toxicology of food additives, Case studies.		
	Total	**48**	

Text Book	**1.**	*Klaassen Curtis, D., 2019,* **"Casarett and Doull's Toxicology - The basic Science of Poisons"**, *9th edition, McGraw Hill Education, London.*
	2.	*Cockerham, L.G. and Shane, B.S., 2019,* **"Basic Environmental Toxicology"**, *1st edition, CRC Press, New York*
Reference Books	**1.**	*Robert, S.M. and James, R.C., 2015,* **"Principles of Toxicology: Environmental and Industrial Applications"**, *3rd Edition, John Wiley and Sons, New York.*
	2.	*De, A.K., 2017,* **"Environmental Chemistry"**, *8th Edition, Newage International Publishers, New Delhi..*
	3.	*Gupta, P.K., 2016,* **"Fundamentals of Toxicology - Essential concepts and Applications"**, *1st edition, Academic Press, Cambridge, USA.*
	4.	*Gupta, R., 2019,* **"Biomarkers in Toxicology"**, *2nd Edition, Academic Press, Cambridge, USA.*

Journal and Magazines	https://www.sciencedirect.com/science/article/abs/pii/S014181302100354 https://www.europeanreview.org/wp/wp-content/uploads/1633-1653.pdf https://pmc.ncbi.nlm.nih.gov/articles/PMC10247286/ https://www.tandfonline.com/doi/full/10.1080/17435390.2020.1815886
E-Resources and Website	https://onlinecourses.swayam2.ac.in/ini24_bt04/ [NPTEL] https://byjus.com/biology/difference-between-biomagnification-and-bioaccumulation/

Learning Methods	Chalk and Talk/ Video tutorials/PPT/ GD/ Assignment/ Seminar

Focus of the Course	Skill Development/Employability/Entrepreneurial development/Innovations

8.11.24
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