M. Sc. Biotechnology

Syllabus

AFFILIATED COLLEGES

Program Code:*

2026 – 2027 onwards

BHARATHIAR UNIVERSITY

(A State University, Accredited with "A" Grade by NAAC,
Ranked 13th among Indian Universities by MHRD-NIRF,
World Ranking: Times -801-1000,Shanghai -901-1000, URAP - 982)

Coimbatore - 641 046, Tamil Nadu, India

Program Educational Objectives (PEOs)	
The **M. Sc. Biotechnology** program describe accomplishments that graduates are expected to attain within five to seven years after graduation	
PEO1	Graduates will establish themselves in various sectors of Biotechnology related industries such as Pharma, clinical diagnostics, Agriculture, Food, textiles etc
PEO2	Graduates will exhibit their effective skills in Research & Development in Biotechnology field at the National and International levels
PEO3	Graduates gain thorough knowledge in the subject, develop effective communication skills and be good academicians
PEO4	Graduates are encouraged and motivated to become entrepreneurs

Program Specific Outcomes (PSOs)	
After the successful completion of Biotechnology program, the graduates	
PSO1	Demonstrate the ability to design, conduct experiments and analyze data in the field of biotechnology
PSO2	Demonstrate the ability to independently carry out the research and development work in biotechnology
PSO3	Learn to apply appropriate modern tools and techniques in genome modifications for the welfare of mankind
PSO4	Acquire knowledge of norms and ethics in biotechnology/product development/patent writing
PSO5	Will develop effective entrepreneurial skills, winning business opportunity
PSO6	Develop skills to resolve scientific and technological problems in biotechnology based industries

Program Outcomes (POs)	
On successful completion of the M.Sc. Biotechnology program	
PO1	Acquires Scientific Knowledge on the various subjects related to Biotechnology field
PO2	Develops skills pertaining to various fields of Biotechnology
PO3	Trained to implement their knowledge in research
PO4	Understand the implications on the environment and society at large
PO5	Understand the ethical issues pertaining to the subject
PO6	Students will be able to design new biotechnological products or processes by applying innovative knowledge of different disciplines of biotechnology
PO7	Develops ability to successfully carry out advanced tasks and projects independently in various streams of biotechnology disciplines.
PO8	Demonstrate the ability to carry out the research projects independently
PO9	Develops the ability to conceptualize and carry out collaborative ventures across the disciplines
PO10	Develop skill sets for employability in diverse areas of biotechnology as well as for the higher studies

BHARATHIARUNIVERSITY: COIMBATORE 641 046

M.Sc., Biotechnology Curriculum (AFFILIATED COLLEGES)

(For the students admitted during the academic year 2026–27 onwards)

Course Code	Title of the Course		Hrs./week	Credits	Hours		Maximum Marks		
					Theory	Practical	CIA	ESE	Total
	FIRST SEMESTER								
13A	Paper–I	Molecular Biology and Genetics	4	4	3		25	75	100
13B	Paper–II	Biochemistry	5	4	3		25	75	100
13C	Paper–III	Applied Microbiology	4	4	3		25	75	100
13D	Paper-IV	Bioinstrumentation& Biostatistics	4	4	3		25	75	100
	Practical I		5	-	-	-	-	-	-
	Practical II		4	-	-	-	-	-	-
1EA/1EB	Elective paper I		4	4	3		25	75	100
	Total		**30**	**20**					**500**
	SECOND SEMESTER								
23A	Paper–V	Immunology& Immunotechnology	5	4	3		25	75	100
23B	Paper-VI	Bioethics, biosafety & IPR	4	4	3		25	75	100
23C	Paper–VII	Plant Biotechnology	4	4	3		25	75	100
23D	Paper-VIII	Animal Biotechnology	4	4	3		25	75	100
23P	Practical– I		5	4		6	40	60	100
23Q	Practical– II		4	4		6	40	60	100
2EA/2EB	Elective Paper II		4	4	3		25	75	100
	Industrial Training		-	-	-	-	-	-	-
	Total		**30**	**28**					**700**
	THIRD SEMESTER								
33A	Paper IX	Bioprocess Technology	4	4	3		25	75	100
33B	Paper X	Pharmaceutical Biotechnology	4	4	3		25	75	100
33C	Paper XI	Genetic Engineering	4	4	3		25	75	100
33D	Paper XII	Computational Biology	4	4	3		25	75	100
	Practical III		5	-	-	-	-	-	-
	Practical IV		5	-	-	-	-	-	-
3EA/3EB	Elective Paper III		4	4	3		25	75	100
33F	Health and Wellness		-	1	-	-	25*	-	25
36A	Industrial Training			1			25*		25
	Total		**30**	**22**					**550**
	FOURTH SEMESTER								
47V	Project		16**	8	-	-	-	-	200***
43P	Practical III		5	4		6	40	60	100
43Q	Practical IV		5	4		6	40	60	100
4EA/4EB	Elective Paper IV		4	4	3		25	75	100
	Total		**30**	**20**					**500**
	Grand Total		**120**	**90**					**2250**
	ONLINE COURSES (Optional)								

*Industrial Training has to be undergone during the II semester vacation period. Mark shall be given based on the training report and presentation.

* Health and Wellness

1. Attendance - 25% 2. Field trip / Any activity relevant to paper - 25 %

3.Report submission - 50 % 4.Only Internal evaluation with no university examination

** Sixteen hours should be allotted for Project Guidance to the respective guides. As per the university norms, 16 hours of project guidance should be considered equivalent to 8 hours of teaching while calculating the work load of respective guides.

*****For Project Report–100 Marks Viva-voce –100 Marks**

List of Group Elective papers (Colleges can choose any one of the Group papers as electives)

Paper/Sem	**GROUP A**	**GROUP B**
I	Environmental Biotechnology	Plant System Physiology
II	Nanobiotechnology	Animal System Physiology
III	Stem Cell Biology and Tissue Engineering	Developmental Biology
IV	Cancer Biology	Evolution and Behavior

PROJECT GUIDELINES

1) Project pertains to the field of Biotechnology

2) Three review meetings should be conducted at regular intervals in the presence of the HOD and respective guide. The evaluation for there view is as follows

Review	Maximum Marks
I Review	15
II Review	15
III Review	20

Dissertation evaluation by External Examiner	50
Viva-voce	100

ONLINE COURSES (NPTEL/SWAYAM):

Students can choose any one of the Courses offered by NPTEL/SWAYAM

- It's optional for the students to avail the online course
- On Successful completion of the course additional credits will be awarded

First Semester

Course code 13A	PAPER – I MOLECULAR BIOLOGY AND GENETICS	L	T	P	C
Core		4			4
Pre-requisite	Should have a basic knowledge on Molecular biology	Syllabus Version		2026 - 2027	

Course Objectives:

The main objectives of this course are to:

1. Introduce knowledge on basic concepts of molecular biology techniques
2. Implement, organize and design different vectors for gene cloning and expression

Expected Course Outcomes (CO) :

On the successful completion of the course, student will be able to:

1	Describe the genetic structure and types of chromatin	K1,K2
2	Elucidate the types, damage and repair of DNA, types of RNAs, genetic code	K1.K3
3	Understand the concept of mutations	K1,K2
4	Explicate the mechanism of gene regulation in prokaryotes	K1,K4
5	Understand the concept of gene expression in eukaryotes	K4,K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

UNIT: 1	CHROMATIN AND GENE COMPLEXITY	12 hours

Gene Structure: Fine Structure Of Gene, Split Genes, Pseudogenes, Overlapping Genes And Multigene Families. DNA And RNA As Genetic Material; Chemistry And Structure Of DNA. Chromosome-Structure, Organization, Banding, Karyotyping, And Labeling. Special Types Of Chromosome - Sex Chromosomes, B-Chromosome, Polytene and Lambrush Chromosomes; Numerical And Structural Changes In The Chromosome, Techniques In The Study Of Chromosomes And Applications.

UNIT: 2	REPLICATION, TRANSCRIPTION, TRANSLATION AND REGULATION OF GENE EXPRESSION	12 hours

DNA Replication In Prokaryotes And Eukaryotes: Mechanism Of Replication, Transcription: Initiation, Elongation And Termination (Rho-Dependent And Independent) Of RNA Synthesis; Eukaryotic Promoters, Enhancers, Transcription Factors, RNA Polymerases; Various Protein Motifs Involved In DNA-Protein Interactions During Transcription. Translation: Prokaryotes And Eukaryotes Translation And Their Regulation, Processing Of mRNA For Translation (E.G. 5' Capping And Splicing) And Involvement Of Different Translational Factors At Different Stages Of The Process. Regulation Of Gene Expression In Prokaryotes And Eukaryotes.

UNIT: 3	MUTATION AND DNA REPAIR MECHANISMS	12 hours

Gene Mutation And Its Mechanism; Types Of Mutation: Forward; Reverse; Intragenic Suppressor; Extragenic Suppressor; Point Mutations; Missense; Nonsense; Somatic Versus Germinal Mutation. Mutagenesis- Spontaneous And Induced. DNA Repair Mechanisms- Direct Reversal; Excision Repair (Base Excision, Nucleotide Excision And Mismatch); Recombinational Repair; SOS Response And SOS Bypass.

UNIT: 4	RECOMBINATION	11 hours
Recombination - Models; Rec A, Recbcd, Ruv Abc, And Molecular Mechanism Of Recombination. Conjugation; Transformation And Transduction. Transposons - Simple And Complex In Prokaryotic And Eukaryotic Systems.		
UNIT: 5	**GENE EXPRESSION**	**11 hours**
Introduction To Epigenetics: Gene Expression Without A Change In DNA Sequence Changes In Gene Expression Arising From Chemical Modification Of DNA Or Histone Proteins. Genes For Development In Drosophila, Genes For Development In Arabidopsis, Fertilization And Development; Genetic Control Of X Inactivation; In Vitro Fertilization And Embryo Transfer.		
UNIT: 6	**CONTEMPORARY ISSUES**	**2 hours**
Expert Lectures, Online Seminars - Webinars		
	Total Lecture hours	**60 hours**

Text Book(s)

1	Robert H. Tamarin, 2002. Principles Of Genetics, 7th Ed, TATA Mcgraw-Hill Edition, New Delhi, India
2	Daniel L. Hartl & Elizabeth W. Jones, 1999. Essential Genetics, 2nd Ed., Jones & Bartlett Publishers
3	Cell And Molecular Biology - Gerald Karp. Published By John Wiley, 2009 Edition: 6
4	Principles of Genetics – Gardner, MJ Simmons Published By John Wiley, 2012 Edition: 8

Reference Books

1	Molecular Cell Biology- Darnell, Lodish, Baltimore. Published By Scientific American Books, Inc., 1994
2	Molecular Cell Biology" By Harvey Lodish And James E Darnell
3	Genetics: A Conceptual Approach By Benjamin A Pierce. Published By Freeman and Company, New York. 2005. Edition: 2

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	Molecular Biology - Part 2: Transcription and Transposition in Edx https://www.edx.org/course/molecular-biology-part-2-transcription-and-transposition
2	Cell biology at MIT https://ocw.mit.edu/courses/biology/7-06-cell-biology-spring-2007/
3	Introduction to Genetics and Evolution – Coursera https://www.coursera.org/learn/genetics-evolution

Course Designed By:

Mr. T. Purushothaman, Head & Asst Prof, Dept. of Biotechnology, SNMV CAS Coimbatore

Dr. Vijayakumar, Asst. Prof, Dept. of Biochemistry & Biotechnology, Annamalai University, Chidambaram

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	M	S	S	S	M	L	M
CO2	S	S	M	M	S	M	S	S	M	M
CO3	S	S	M	S	M	M	S	L	L	M
CO4	M	S	S	S	S	S	S	M	M	S
CO5	S	S	S	S	L	L	S	M	M	S

*S-Strong; M-Medium; L-Low

Course code 13B	PAPER – II BIOCHEMISTRY	L	T	P	C
Core		5			4
Pre-requisite	Should have basic knowledge on Biochemistry	Syllabus Version		2026 - 2027	

Course Objectives:

The Main Objective Of This Course Is To:

1. Understand the Structure and Functions of Biomolecules

Expected Course Outcomes (CO) :

On the successful completion of the course, student will be able to:

1	Classify Carbohydrates Based On Their Structure, Characteristics And Various Metabolic Pathways	K1, K2
2	Describe The Structure, Properties And Metabolism Of Amino Acids And Proteins	K2, K3
3	Acquire The Knowledge On Categorization, Structure And Catabolism of Lipids	K1, K3
4	Explicate Classification Of Enzymes & Mechanism Of Their Action	K1, K2
5	Appreciate The Structure, Biosynthesis, Degradation Of Nucleic Acids; Types, Properties And Deficiency of Vitamins	K2, K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

UNIT: 1	BIOENERGETICS AND BIOLOGICAL OXIDATION	13 hours

Structure of atoms, molecules and chemical bonds; classes of organic compounds and functional groups. Covalent and non-covalent interactions - van der waals, electrostatic, hydrogen bonding and hydrophobic interactions; respiration and photosynthesis. Energy metabolism (concept of free energy); principles of thermodynamics; kinetics, dissociation and association constants; bioenergetics.

UNIT: 2	CARBOHYDRATES AND ITS METABOLISM	15 hours

Carbohydrates, Polysaccharides – Classification And Reactions: Occurrence, Isolation, Purification, Properties And Biological Reactions. Structural Features Of Homoglycans, Heteroglycans And Complex Carbohydrates Glycolysis And TCA Cycle; Glycogen Breakdown And Synthesis; Gluconeogenesis; Interconversion of Hexoses And Pentoses.

Unit: 3	LIPIDS, PROTEIN STRUCTURE AND PURIFICATION	15 Hours

Oxidation of fatty acids. Biosynthesis of fatty acids; triglycerides; phospholipids; sterols. Primary structure of proteins, structural comparison at secondary tertiary and quaternary levels (Ramchandran map). Purification and criteria of homogeneity-salting out, dialysis, column chromatography.

UNIT: 4	NUCLEIC ACID METABOLISM AND INBORN ERRORS OF METABOLISM	15 hours

Biosynthesis Of Purines and Pyrimidines, Nucleic Acids: Structure of Double Stranded DNA (B, A, C, D, T And Z DNA). Physical Properties of Double Stranded DNA, Types of RNAs and their Biological Significance. DNA Bending, DNA Supercoiling. Conformational Properties Of Polynucleotides, Secondary And Tertiary Structural Features And Their Analysis. Biochemistry and Molecular Basis Of Different Disorders Related To Carbohydrate, Protein, Fat and Nucleic Acids, Inborn Errors Of Metabolism.

UNIT: 5	ENZYME KINETICS AND COENZYMES	15 hours

Enzyme kinetics (negative and positive co-operativity); regulation of enzymatic activity; enzyme catalysis in solution, kinetics and thermodynamic analysis, effects of organic solvents on enzyme catalysis and structural consequences. Active sites; enzymes and coenzymes: coenzymes interactions: activators and inhibitors, kinetics of enzyme inhibitors, isoenzymes, allosteric enzymes; ribozyme, hammerhead, hairpin and other ribozymes. Abzyme: structure and drug targets (enzymes and receptors).

UNIT: 6	CONTEMPORARY ISSUES	2 hours

Expert Lectures, Online Seminars - Webinars

	Total Lecture hours	75 hours

Text Book(s)

1	Biochemistry- Donald Voet, Judith G. Voet, Published By J. Wiley & Sons, 2010, Edition: 4
2	Lehninger Principles Of Biochemistry- Albert L. Lehninger, David Lee Nelson, Michael M. Cox, Published By W.H. Freeman, 2008, Edition: 5
3	Enzymes: Biochemistry, Biotechnology And Clinical Chemistry-Trevor Palmer, Published By Horwood Publishing Limited, 2001, Edition: 5
4	Teitz Text Book Of Clinical Biochemistry 3rd Edition – Burtis Et Al., William Heinmann Medical Books, Ltd., 1999

Reference Books

1	Harper's Illustrated Biochemistry- Robert K. Murray, Darryl K. Granner, Peter A. Mayes, Victor W. Rodwell, Published By Mcgraw-Hill Professional, 2012, Edition: 29.
2	Clinical Chemistry – Principles, Procedures And Correlations, Bishop, Lipppincott, 2000

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	Principles Of Biochemistry By Harvard University – Edx https://online-learning.harvard.edu/course/principles-biochemistry-1?delta=0

Course Designed By:
Dr. P Bhuvaneswari, Asst. Prof, Biochemistry, Vellalar College for Women, Erode

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	S	S	S	M	S	M	S
CO2	S	M	S	L	S	M	M	S	M	L
CO3	S	S	S	S	M	M	S	S	M	L
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	M	M	S	L	L	S	S

*S-Strong; M-Medium; L-Low

Course code 13C	PAPER – III APPLIED MICROBIOLOGY	L	T	P	C
Core		4			4
Pre-requisite	Should have studied about Microbiology	Syllabus Version		2026 - 2027	

Course Objectives:

The main objectives of this course are to:

- Establish an understanding of the basic techniques (concept of aseptic work, cultivation and identification) in microbiology
- Describe different aspects of microbial nutrition and growth
- Describe microbial interactions and their significance in environment

Expected Course Outcomes (CO) :

On the Successful Completion of The Course, Student will be able To:

1	Identify microbiological techniques, the defining characteristics of the major groups of microorganisms and apply to study microbial phylogeny	K1, K2, K3
2	Classify The Nutritional Types of Microorganisms And Measure Microbial Growth	K1, K2
3	Evaluate How Microorganisms Interact with The Environment In Beneficial or Detrimental Ways	K3, K5
4	Assess Impact of Plant- Microbe Interaction On Agriculture in both beneficial and detrimental ways. Identify Industrially Important Microbes	K2, K3, K5
5	Determine Ways In Which Microorganisms Play An Integral Role In Disease, and The Microbial And Immunological Methodologies Are Used In Disease Treatment And Prevention	K4, K5, K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

UNIT: 1	INTRODUCTION TO MICROBIOLOGY	12 hours

History of microbiology - ultra structure of bacterial cell - growth phases - generation time. Kinetics of growth, batch culture, continuous culture, synchronous culture (definition and brief description). Physical factors influencing growth - temperature, pH, osmotic pressure, salt concentration. Classification of algae, protozoa and fungi. General properties and outline classification of viruses - structure and properties of t4 phage, tobacco mosaic virus and hiv. Pure culture techniques. Control of growth of microorganisms. Principle and construction of bright field, dark field, phase contrast and electron microscopy.

UNIT: 2	FOOD MICROBIOLOGY	12 hours

Normal microflora in milk, meat, poultry, eggs, fruits and vegetable; fresh food, canned food and stored grains; milk quality tests; preservation of food: high temperature (boiling, pasteurization, appertization), low temperature (freezing),dehydration, osmotic pressure. Chemical preservations, radiation. Microbiologically fermented food: cheese and yogurt. Microorganisms as food - scp: spirulina and edible mushroons; food borne diseases: salmonellosis - shigellosis.

UNIT: 3	INDUSTRIAL MICROBIOLOGY	12 hours
Primary screening & secondary screening of industrially important strains; strain improvement through random mutation (random & rational selection). Microbial production of organic acids - citric acid; antibiotics - penicillin & streptomycin; enzymes- amylase and lipase; vitamins - b12; alcoholic beverage - beer; production of recombinant proteins in bacteria and yeast - vaccine production in microbes		
UNIT: 4	**ENVIRONMENTAL MICROBIOLOGY**	**12 hours**
Brief account of microbial interactions (symbiosis, neutralism, commensalism, competition, ammensalism, synergism, parasitism, and predation); biological nitrogen fixation - symbiotic and asymbiotic; biofertilizers, biological pest control. Plant disease (brown spot of rice, black stem rust of wheat) dissemination and control. Different types of microorganisms in the air, aerosols, sampling techniques. Coliform test - detection of faecal and non-faecal coliform.		
UNIT: 5	**XENOBIOTICS**	**10 hours**
Ecological Considerations, Decay Behaviour And Degradative Plasmids; Hydrocarbons, Substituted Hydrocarbons, Oil Pollution, Surfactants, Pesticides. Bioremediation Of Contaminated Soils And Wastelands. Mineral Leaching By Microorganisms.		
UNIT: 6	**CONTEMPORARY ISSUES**	**2 hours**
Expert Lectures, Online Seminars - Webinars		
	Total Lecture hours	**60 hours**

Text Book(s)

1	Microbiology - Presscott L M, Harley J P And Klein D A, Tata Mc Graw Hill, New Delhi. 2005, Edition: 6
2	Principles Of Microbiology - Atlas R M, WCB Mcgraw Hill Publications, New Delhi, 1997, Edition: 2
3	A Textbook Of Basic And Applied Microbiology – K R Aneja 2008

Reference Books

1	Environmental Microbiology - Mitchell R., John Wiley And Sons, New York. 1992
2	Microbial Biotechnology: Fundamentals Of Applied Microbiology

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	Small and Mighty :Introduction To Microbiology Https://Www.Futurelearn.Com/Courses/Introduction-To-Microbiology

Course Designed By:

Mr. T. Purushothaman, Head, Asst. Prof, Dept. of Biotechnology, SNMV CAS, Coimbatore

Dr. Vijayakumar, Asst. Prof, Dept. of Biochemistry & Biotechnology, Annamalai University, Chidambaram

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	S	S	M	S	M	S
CO2	S	M	S	S	M	M	S	L	S	M
CO3	M	M	S	S	S	S	M	S	M	M
CO4	S	S	M	S	S	L	S	L	S	M
CO5	M	S	S	M	M	S	S	M	M	S

*S-Strong; M-Medium; L-Low

Course code 13D	PAPER - IV BIOINSTRUMENTATION & BIOSTATISTICS	L	T	P	C
Core		4			4
Pre-requisite	Should have a basic knowledge on Bioinstrumentation & statistics	Syllabus Version		2026 - 2027	

Course Objectives:

The main objectives of this course are to:

- To impart technical information on Instrumentation related to Biotechnology and statistical analysis
- Interpret differences in data distributions via visual displays

Expected Course Outcomes (CO) :

On the successful completion of the course, student will be able to:

1	Acquire the knowledge on basic principle, working and applications of Spectroscopy	K2, K3
2	Demonstrate the theoretical basis, procedure and uses of chromatography	K2, K4
3	Depict the principle and types of centrifugation and their applications in biological sciences	K2, K3
4	Acquire the knowledge on statistics in biology	K1,K2
5	Acquire and Apply suitable Statistical Methods for Research	K2,K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

UNIT: 1	SPECTROSCOPY	12 hours

pH, pK, acids, bases and buffers, Henderson - Hasselbach equation, pH meter, Colorimetry & Spectrophotometry: Principles, types and applications, UV-VIS double beam spectrophotometry, Spectroflurometry, Mass spectroscopy, IR spectroscopy, Flame photometry. NMR Spectroscopy, Circular Dichroism and X- ray diffraction studies

UNIT: 2	CHROMATOGRAPHY	12 hours

Principles, types and applications of chromatography, size exclusion, Ion Exchange chromatography, affinity chromatography. High performance liquid chromatography (HPLC), Gas chromatography (GC), Thin layer chromatography (TLC), Paper chromatography, Mass Spectrometry, MALDI TOF.

UNIT: 3	CENTRIFUGATION, ELECTROPHORESIS RADIOISOTOPE TECHNIQUES	12 hours

Centrifugation: Principles, types and applications of centrifuges; Principles, types and applications of Electrophoresis. Agarose gel electrophoresis PAGE (SDS/Native), Gradient gel, Isoelectric focusing, 2-D gel electrophoresis (2-D PAGE), cellulose, Capillary electrophoresis. Flow cytometry Nature & detection of radio isotopes; Applications of Radio isotope techniques; Detection based on gas ionization - Geiger Muller counter; Detection based on excitation - Liquid Scintillation counter; Supply, storage, purity, specific activity and safety aspects of radiolabelled compounds

UNIT: 4	**BIOSTATISTICS**	**10 hours**

Biostatistics – Scope of Biostatistics, Measures of Central tendency – Arithmetic mean, Median and Mode. Calculation of mean, median, mode in series of individual observation discrete series, continuous open end classes.

UNIT: 5	**BIOSTATISTICS TOOLS**	**12 hours**

Classification and tabulation of data – Graphical and diagrammatic representations – scale diagrams – Histograms – frequency polygon - Frequency curves. Measures of Dispersion – standard deviation and Range. Chi – square test, student t test, regression, correlation, one way and two way ANOVA. Application of statistical software for biological research

UNIT: 6	**CONTEMPORARY ISSUES**	**2 hours**

Expert lectures, online seminars - webinars

	Total Lecture hours	**60 hours**

Text Book(s)

1	Principles of Applied Biomedical Instrumentation- Gedder A and L. E. Balsar, John Wiley and Sons
2	Modern Experimental Biochemistry 2nd Edition- Boyer, Rodney F. Benjamin and Cummins
3	Introductory Biostatistics by chap. T. Lee (Wiley – Interscience)

Reference Books

1	Statistical methods edited by Stephen W. Looney (Humana publications)
2	Biostatistics: A Methodology for the Health Sciences, Second Edition, by Gerald Van belle (Wiley – Interscience publication)

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	Introduction to Biostatistics – Swayam https://onlinecourses.nptel.ac.in/noc20_bt28/preview

Course Designed By:

Dr. N.Vijayakumar, Asst. Prof, Dept. of Biochemistry & Biotechnology, Annamalai University, Chidambaram

NOTE: Question Paper Setter: 50% Problems and 50% theory should be asked from IV & V Units

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	S	S	S	S	S	S	L
CO2	S	L	S	S	S	L	S	S	M	M
CO3	S	S	S	S	M	M	S	S	L	S
CO4	M	M	M	L	S	S	L	S	S	L
CO5	S	M	S	S	M	S	S	M	L	S

*S-Strong; M-Medium; L-Low

Second Semester

Course code 23A	PAPER - V IMMUNOLOGY AND IMMUNOTECHNOLOGY	L	T	P	C
Core		5			4
Pre-requisite	Should have a basic knowledge on Immunology	Syllabus Version		2026 - 2027	

Course Objectives:

The main objectives of this course are to:

- To teach our students to have a concrete knowledge about immunology human system to study about the basis of the interaction as well as the genes involved in it.
- To recapitulate the previous knowledge of immunology and to establish thorough understanding of various structure & function at cellular and molecular level.

Expected Course Outcomes (CO) :

On the successful completion of the course, student will be able to:

1	Acquire knowledge on types and structure of immune systems and diversity of antibody	K2, K3
2	Elucidate cytokine and compliment based activation and regulation of immune mechanisms	K2, K3
3	Depict principles in diagnosis, HLA typing and Tumor immunology	K4, K5
4	Perceive knowledge on Immunodeficiency's	K1, K2. K3
5	To use the techniques, skills, and modern tools necessary for imbalances in various life processes, collect and analyze data, and interpret results	K3, K4, K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

UNIT: 1	TYPES OF IMMUNITY, ANTIGENS AND ANTIBODIES	15 hours

History And Scope Of Immunology. Types Of Immunity: Passive, Active And Acquired Immunity. Humoral, Cell Mediated Immunity. Cells And Organs Of Immune Response And Their Functions. Antigens Types, Haptens, Epitopes And Factors Influencing Antigenicity. Antibodies Structure Types, Properties And Functions of Immunoglobulins

UNIT: 2	IMMUNE CELL TYPES	15 hours

Cells Of Immune System. T-Cells, B-Cells, Antigen Presenting Cells, Cell Mediated Subset Of T-Cells Helper And Suppressor Cells, Natural Killer Cells. Lymphoid Organs (Primary And Secondary) MHC Molecules, Antigen Presentation, B Cell And T Cell Activation, Cytokines Complement System. Structure, Components, Properties And Functions

UNIT: 3	IMMUNOTECHNIQUES	15 hours

Antigen Antibody Reactions: In Vitro Tests- Precipitation, Immune-Electrophoresis, Heamagglutination, Labeled Antibody (RIA ELISA And Immuno – Fluroscent Techniques) Hypersensitivity And Allergic Reactions Blood Cell Components, ABO Blood Grouping RH Typing. Application Of Immunological Techniques: Hybridoma Technology: Fusion Of Myeloma Cells With Lymphocytes, Production Of Monoclonal Antibodies And Their Applications. Human Monoclonals Catalytic Antibodies And Plantibodies

UNIT: 4	HYPERSENSITIVITY, IMMUNE DISORDERS AND TRANSPLANTATION	14 hours

Hyper Sensitivity Reactions, Auto Immuno Disorders, Deficiencies (Primary And Secondary) And Immuno Tolerance. Tumor Immunology: Tumor Antigens, Immune Responses And Therapy, Tissue And Organ Transplant.

UNIT: 5	VACCINES	14 hours

Immunity To Bacteria, Viruses And Parasites Vaccines And Immunization: Passive And Active Immunization Types Of Vaccines – Inactivated, Attenuated And Recombinant Vaccines – Peptide And DNA Vaccines, Synthetic Vaccines, Epitope Mapping.

UNIT: 6	CONTEMPORARY ISSUES	2 hours

Expert lectures, online seminars - webinars

	Total Lecture hours	7 5 hours

Text Book(s)

1	Kuby Immunology. W. H. Freeman & Co. Fourth edition, 2000.
2	Immunology by Ivan Roitt, Jonathan Brostoff, and David Male. Mosby, London. 6th edition, 2001

Reference Books

1	Fundamental Immunology, Paul. 7th Edition, Wolters Kluwer, Lippincott Williams and Wilkins publication

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

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

Course Designed By:

Dr. N.Vijayakumar, Asst. Prof, Dept. of Biochemistry & Biotechnology, Annamalai University, Chidambaram

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	M	S	M	S	S	M	S
CO2	S	S	M	L	S	S	S	L	S	L
CO3	M	M	S	S	M	S	M	M	S	S
CO4	M	S	S	S	S	L	L	M	L	L
CO5	S	M	S	M	M	S	M	S	S	M

*S-Strong; M-Medium; L-Low

Course code 23B	PAPER – VI BIOETHICS, BIOSAFETY & IPR	L	T	P	C
Core		**4**			**4**
Pre-requisite	Should have a basic knowledge on Biosafety & IPR	**Syllabus Version**	**2026 - 2027**		

Course Objectives:

The main objectives of this course are to:

- The course has been designed to sensitize students about the importance of Personnel Protective Equipment (PPE), general biosafety rules and different biosafety levels.
- The course further aims to make students aware about the ethical issues involving biological material.
- The course further includes the different forms Intellectual Property, which a researcher could
- utilize to protect its intellectual output

Expected Course Outcomes (CO) :

On the successful completion of the course, student will be able to:

1	Interpret basics of biosafety and bioethics and its impact on all the biological sciences and the quality of human life	K1
2	Recognize importance of biosafety practices and guidelines in research	K2
3	Follow good laboratory procedures and practices	K4
4	Comprehend benefits of GM technology and related issues	K4
5	Understand the social and ethical issues related to plant, animal and modern biotechnology	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

UNIT: 1	BIOETHICS	**12 hours**

Social and ethical issues in biotechnology; the legal and socio-economic impacts of biotechnology; public education of the processes of biotechnology, public acceptance issues in biotechnology. Ethical conflicts in biotechnology – interference with nature, fear of the unknown, unequal distribution of risks and benefits of biotechnology

UNIT: 2	**BIOSAFETY ISSUES AND REGULATIONS**	**12 hours**

Biosafety for human health environment; perceptions of risks and benefits. The GM-food debate and biosafety assessment procedures for biotech foods & pharmaceutical products such as drugs/vaccines. Prudent biosafety practices in the laboratory/institution.

UNIT: 3	**RISK ANALYSIS**	**1 2 hours**

Cartagena protocol in biosafety. Laboratory-associated infections and other hazards, assessment of biological hazards and levels of biosafety; handling of recombinant DNA processes, and products in institutions & industries. Biosafety assessment procedures in India and Abroad. Bioterrorism and convention on biological weapons.

UNIT: 4	INTELLECTUAL PROPERTY RIGHTS	10 hours
Introduction to intellectual property rights (IPR) - Types: Patents, Copyrights, Trademarks, Design rights, Legal implications, disclosure requirements, collaborative research, and competitive research. IPR issues in Indian Context – Role of patent in pharmaceutical industry and agriculture.		
UNIT: 5	**NATURE OF PATENT**	**12 hours**
Patents – Definition, basic requirements, conditions for patentability. Test of the novelty of patents, the composition of a patent, patent claims, and the legal decision-making process. Indian patents and foreign patents in plant biotechnology, the Plant Variety Protection Act, the strategies for protecting plants, and plant breeder's rights. Recent developments in plant systems and patentability of biotechnological inventions		
UNIT: 6	**CONTEMPORARY ISSUES**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**60 hours**

Text Book(s)

1	Dr. Thomas JA and Dr. Fuch RL. Biotechnology and Safety Assessment – Academic Press publications, 3rd Edition, 2002.(UNIT 1,2&3).
2	Dr.Satheesh MK. Bioethics and Biosafety - I.K. International Pvt. Ltd., 2013.(UNIT 4&5).

Reference Books

1	Dr. O'Donell RW, Dr. O'Malley JJ, Dr. Huis RJ, and Dr. Halt GBJ. Intellectual Property in Food Technology Industry – Springer, 2008.
2	Dr. Flemming DA and Dr. Hunt DL. Biological Safety Principles and Practices – ASM Press Publication, 4th edition, 2006.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	Intellectual Property Rights and Competition Law–
2	Bioethics – NPTELhttps://nptel.ac.in/courses/109/106/109106092/

Course Designed By:
Dr. K. Abdhul, Associate Professor, Department of Biotechnology, Nandha Arts and Science College.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	M	L	S	M	S	L
CO2	S	L	S	M	M	S	M	L	S	M
CO3	S	S	S	S	S	M	M	M	M	S
CO4	S	M	S	S	S	S	S	S	S	M
CO5	S	S	M	S	S	M	M	M	M	S

*S-Strong; M-Medium; L-Low

Course code 23C	PAPER - VII PLANT BIOTECHNOLOGY	L	T	P	C
Core		4			4
Pre-requisite	Should have a basic knowledge on Plant biology & biotechnology	Syllabus Version	2026 - 2027		

Course Objectives:

The main objectives of this course are to:

- Learn the fundamentals of plant totipotency nature, culturing plant cells and tissues, designing of culture environment
- Acquire knowledge about molecular markers and their use in development of stress resistant crop plants.
- Impart the basics of nanoparticle synthesis, characterization and application

Expected Course Outcomes (CO) :

On the successful completion of the course, student will be able to:

1	Establish different types of plant cultures.	K3
2	Develop skill in raising transgenics resistant to biotic & abiotic stresses & quality characteristics and their role in crop improvement	K3
3	Apply the practical skills for entrepreneurial development.	K2, K3
4	Design and implement experimental procedures using relevant techniques	K4
5	Apply the concepts of Biotechnology in Environmental Management.	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

UNIT: 1	INTRODUCTION TO PLANT TISSUE CULTURE	12 hours

Tissues culture media - Composition and preparation; Plant Propagation - Conventional & Invitro techniques; Cell and tissue culture techniques for plants - Micro propagation, Callus culture, somatic embryogenesis, suspension culture, embryo culture, haploid culture, protoplast culture, protoplast fusion; Somaclonal variation; Artificial seeds; hardening.

UNIT: 2	TRANSFORMATION TECHNIQUES	12 hours

Genetic transformation techniques in plants: Gene transfer methods in plants – Direct DNA transfer methods, Agro bacterium mediated nuclear transformation. Ti and Ri plasmids, binary & co-integrated vector systems; genetic markers; reporter genes; genetic transformation techniques for overcoming biotic and abiotic stress. Green house and green home technology. Arid and semiarid technology.

UNIT: 3	APPLICATION OF TRANSFORMATION TECHNIQUES	12 hours

Role of genetic transformation techniques in production of Biodegradable Plastics, Therapeutic proteins, antibodies, plant vaccines, herbal drugs, bioethanol and biodiesel. Phytoremediation; Proteomics and Plant biotechnology: Proteomics in plant breeding and genetics.

UNIT: 4	INTRODUCTION TO NANOTECHNOLOGY	11 hours
Phytochemical Extraction & purification and nano particle synthesis: secondary metabolic pathways. Synthesis process and application, Role of plants in nanoparticle synthesis and Characterization Techniques X-ray diffraction, Scanning Probe Microscopy, SEM, TEM, and application for analysis of nanomaterials, UV-VIS-NIR Spectrophotometers		
UNIT: 5	**NANOTECHNOLOGY IN AGRICULTURE**	**11 hours**
Nanotechnology in Agriculture. Nanotechnology applications in weed management - plant parasitic, nematode, insect management - Assessing the efficacy and bio- safety to non-target organisms. Biosensors for toxins, pest and pathogens- Aflatoxin, biosensor for moisture and pesticide content- organophosphorous pesticides- nutrient content in soil.		
UNIT: 6	**CONTEMPORARY ISSUES**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**60 hours**

Text Book(s)

1	H. S. Chawla, 2017. Introduction to *Plant Biotechnology*, 3rd Edition. Oxford & Ibh Publishing
2	Ashutosh Shukla Siavash Iravani 2018, Green Synthesis, Characterization and Applications of Nanoparticles, 1st Edition, Elsevier

Reference Books

1	Abdin, M. Z., Kiran, U., Kamaluddin, M., Ali, A. (Eds.), 2017. Plant Biotechnology: Principles and Applications, Springer Publication
2	Neal Stewart, 2008. Plant Biotechnology and Genetics: Principles, Techniques, and Applications. John Wiley & Sons, Inc., Hoboken, New Jersey

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://swayam.gov.in/nd1_noc19_bt18/preview
2	https://swayam.gov.in/nd2_cec19_bt01/preview
3	https://nptel.ac.in/courses/102/103/102103016/

Course Designed By:

Dr. G. Rajalaskhmi, Head & Prof, Dept of Biotechnology, Hindusthan CAS, Coimbatore

Dr.P. Senthilkumar, Associate Prof, Dept of Biotechnology, Hindusthan CAS, Coimbatore

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	M	S	S	S	L	S
CO2	M	S	S	S	S	S	M	M	L	S
CO3	S	M	S	S	M	S	S	S	M	S
CO4	S	S	L	S	S	S	S	S	L	M
CO5	S	M	S	M	S	S	S	L	M	M

*S-Strong; M-Medium; L-Low

Course code 23D	PAPER - VIII ANIMAL BIOTECHNOLOGY	L	T	P	C
Core		4			4
Pre-requisite	Should have a basic knowledge on Animal biotechnology	Syllabus Version	2026 - 2027		

Course Objectives:

The main objectives of this course are to:

- To take learners through a captivating journey of fundamentals, cell culture and characterization of animal tissue culture.
- To orient learners about contaminations, understand significance of preservation of cell lines
- To teach learners about innovative and novel work transgenic animal and invitro fertilizations

Expected Course Outcomes (CO) :

On the successful completion of the course, student will be able to:

1	Remember fundamental techniques in animal tissue culture, and describe essential equipment employed, and types of media and methods	K1
2	Comprehend various features of primary cell culture, methods, and characterizations by discussing suitable examples	K2
3	Establish source and types of contamination and focus on methods of preservation to determine cytotoxicity	K3
4	Employ transgenic animal for various therapeutic purposes, as disease model and livestock improvement	K3
5	Analyze method invitro fertilizations to interpret embryonic stem cell culture to judge ethical issues pertaining to it.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

UNIT: 1	ANIMAL TISSUE CULTURE AND MEDIA PREPARATION	12 hours

Introduction to Animal Tissue Culture: Background, Advantages, Limitations and applications. Culture Environment, Cell Adhesion, Cell Proliferation and Cell differentiation. Essential Equipment's required for animal tissue culture, Aseptic Technique and general safety. Media: Physicochemical Properties, Balanced Salt Solutions, Complete Media, Serum, Disadvantages of Serum supplemented media, Serum-Free Media, Advantages of Serum-Free media

UNIT: 2	CELL CULTURE TECHNIQUES	12 hours

Primary Culture: Isolation of Tissue, Steps involved in primary cell culture, Cell Lines, Nomenclature, Subculture and Propagation, Immortalization of cell lines, Cell line designations, Routine maintenance. Characterization of Cell Line: Need for characterization, Morphology, Chromosome Analysis, DNA, RNA and Protein Content, Enzyme Activity and Antigenic Markers. Transformation of animal cell.

UNIT: 3	CONTAMINATION, PRESERVATION AND TISSUE ENGINEERING	12 hours

Contamination: Source of contamination, Type of microbial contamination, Monitoring, Eradication of Contamination, Cross-Contamination. Cryopreservation: Need of Cryopreservation. Apoptosis and its determination; Cytotoxicity assays. Application of animal cell culture; Vaccine production; Tissue engineering; Engineered cell culture as source of valuable products and therapeutic protein production.

UNIT: 4	**TRANSGENIC ANIMALS AND CLONING**	**12 hours**

Transgenic Animals: Production Methodology-Embryonic Stem Cell method, Microinjection method; Applications of transgenic animals - in therapeutic protein production; livestock improvement; Transgenic animals as disease models. Gene targeting, silencing and knockout technologies. Animal cloning.

UNIT: 5	**IN VITRO FERTILIZATION AND STEM CELL CULTURE**	**10 hours**

In vitro Fertilization and Embryo Transfer: Composition of IVF media, Steps involved in IVF, Fertilization by means of micro insemination, PZD, ICSI, SUZI, MESA. Stem cell culture, embryonic stem cell and their applications. Ethical issues in animal biotechnology

UNIT: 6	**CONTEMPORARY ISSUES**	**2 hours**

Expert lectures, online seminars - webinars

	Total Lecture hours	**60 hours**

Text Book(s)

1	Animal Biotechnology by N. Arumugam, V. Kumaresan from Saras Publication, 2019
2	Textbook of Animal Biotechnology by B. Singh, S.K. Gautam from The Energy and Resources Institute, TERI (1 December 2013)

Reference Books

1	Animal Biotechnology by Ashish Verma Anchal Singh,2nd Edition,© Academic Press 2020
2	Animal Biotechnology by P.K. Gupta from Rastogi publications, 2020

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://swayam.gov.in/nd1_noc20_me04/preview/
2	https://nptel.ac.in/courses/102/104/102104059/

Course Designed By:

Dr. G. Rajalakshmi, Head & Prof, Dept of Biotechnology, Hindusthan CAS, Coimbatore

Dr. S. G. Antony Godson, Asst. Prof, Dept of Biotechnology, Hindusthan CAS, Coimbatore

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	M	S	S	S	L	L
CO2	M	S	S	S	S	M	S	L	S	S
CO3	S	M	S	S	M	S	M	S	S	M
CO4	S	S	S	S	S	M	S	M	S	M
CO5	S	M	S	M	S	L	M	S	M	M

*S-Strong; M-Medium; L-Low

Third Semester

Course code 33A	PAPER - IX BIOPROCESS TECHNOLOGY	L	T	P	C
Core		4			4
Pre-requisite	This course gives an overview of the Bioprocess raw material to product. This also explicates the connection between microbial growth, product formation, mass transfer and environment	Syllabus Version		2026 - 2027	

Course Objectives:

The main objectives of this course are to:

- Acquire knowledge on historical perspectives of Bioprocess Engineering.
- Understand the basics of fermentation techniques and to enable them to learn about the Design of Bioreactor.
- Know about the principle involved in transport mechanisms and techniques involved upstream and downstream Bio-processing

Expected Course Outcomes (CO) :

On the successful completion of the course, student will be able to:

1	Recognize the basic principles of Bioprocess technology and historical perspectives of fermentation.	K1
2	Understand the different designs of Bioreactors	K2
3	Apply their scientific and technological knowledge of BPT	K3
4	Analyze the various types of processing techniques	K4
5	Evaluate and assessing the process involved in production	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

UNIT: 1	INTRODUCTION TO BIOPROCESS ENGINEERING	12 hours

Fermentation a Historical perspective. Biotechnology and bioprocess engineering, Bioprocess regulatory constraints, Basic of Biology - Microbiology of industrial fermentation, an engineering perspectives - cell construction, cell nutrients. Alteration in cellular information.

UNIT: 2	BIOREACTOR - DESIGNS	11 hours

Introduction to fermentation process. Sterilization. Thermal death kinetics. Design of continuous Sterilization process, Fibrous filters. Bioreactor design, parts and their functions, Alternative vessel designs - CSTR, Tower, Airlift, Loop jet, Bubble Column, Packed bed. Immobilized cells.

UNIT: 3	INSTRUMENTATION CONTROLS	12 hours

Different types of instrumentation, common measurement and control systems, Additional sensors, Feedback control, PID control, Computers in Bioprocess control systems, Biosensors in bioprocess monitoring and control.

UNIT: 4	UPSTREAM AND DOWNSTREAM PROCESSING	12 hours

Upstream processing**,** Removal of microbial cells, cell disruption – enzymatic, chemical and physical methods; purification of fermentation products - precipitation methods, membrane process, centrifugation – Ultracentrifugation; Chromatography -Ion exchange and gel permeation chromatography, HPLC; crystallization, drying, lyophilisation, packaging and quality assurance

UNIT: 5	**APPLICATIONS OF BIOPROCESS TECHNOLOGY IN INDUSTRY**	**11 hours**

Stochiometry of microbial growth and product formation, Process Involved in production, harvest, recovery and uses – Antibiotics & Vitamins, Baker's yeast, Single Cell Protein. Formulation of Biofertilizer - *Rhizobium Pseudomonas* and Biopesticides (*Bacillus thuringiensis*)

UNIT: 6	**CONTEMPORARY ISSUES**	**2 hours**

Expert lectures, online seminars - webinars

	Total Lecture hours	**60 hours**

Text Book(s)

1	The encyclopedia of Bioprocess Technology*:* Fundamentals and Applications, by Flickinger, Michael C.A Wiley-Interscience Publication
2	Bio-Process Technology an Introduction to Fermentors, October 2017, Publisher: Rajan Singh
3	Advanced Biotechnology, By R C Dubey, 2014

Reference Books

1	Principles of Fermentation Technology by Peter. F. Stanbury, Allan Whitaker, Stephen. J. Hall. Published by Elsevier Science Ltd., Edition: 3
2	Cruger and Cruger. A Biotechnology: A Textbook of Industrial Microbiology Science Tech. Incorporated. 2nd Edition, 1984
3	Prescott and Dunns, Industrial Microbiology. CBS Publishers & Distributors PVT. Limited. 4th Edition. 1982

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://online-learning.tudelft.nl/courses/industrial-biotechnology/
2	Principles of Downstream techniques in Bioprocess - NPTEL
3	https://www.classcentral.com/course/swayam-principles-of-downstream-techniques-in-bioprocess-3967
4	https://swayam.gov.in/nd1_noc19_bt20/preview

Course Designed By:
Dr. S. Jayashree, Associate Professor, Dept of Biotechnology, Nehru Arts & Science, Coimbatore

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	M	L	S	S	S	M	S
CO2	S	M	M	M	L	S	S	M	S	M
CO3	S	S	M	L	M	S	S	S	M	S
CO4	M	M	L	M	L	S	S	M	L	M
CO5	S	M	M	M	M	M	S	M	M	S

*S-Strong; M-Medium; L-Low

Course code 33B	PAPER - X PHARMACEUTICAL BIOTECHNOLOGY	L	T	P	C
Core		4			4
Pre-requisite	Should have a basic knowledge on pharmacology	Syllabus Version	2026 - 2027		

Course Objectives:

The main objectives of this course are to:

- To enable the students to learn about various drugs, its effects, drug metabolism, drug receptors, drug tolerance, dependence and resistance with therapeutic monitoring of drugs
- To offers the students comprehensive information and insights in pharmaceutical biotechnology and the development of biopharmaceuticals in pharmaceutical industry

Expected Course Outcomes (CO) :

On the successful completion of the course, student will be able to:

1	Understand the Knowledge of the drugs and its principles	K1. K2
2	Recollecting the concept, classification production and application of pharmaceutical substances	K2
3	Imparting a comprehension of basic skills necessary for employing biotechnology principles	K2, K3
4	The knowledge gained in this course would be used to understand and evaluate the different pharmaceutical parameters of the current and future biotechnology related products on the market	K2,K5
5	Understanding in both scientific knowledge of designing and mechanism of action of drugs	K2,K3, K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

UNIT: 1	FUNDAMENTAL PRINCIPLES OF PHARMACOLOGY	12 hours

History of pharmaceutical industry, Drugs discovery, Development phases and Drug- Manufacturing Process. Drugs and Cosmetics ACT and regulatory aspects. Definition: Generics and its advantages. Biogenerics and Biosimilars. Protein-based biopharmaceuticals

UNIT: 2	CONTEMPORARY APPROACHES TO DRUG DISCOVERY	12 hours

Introduction to pharmaceuticals of animal, plant and microbial origin. Hemotopoietic growth factors and coagulation factors. Interferons and cytokines for anti-infective and cancer therapy. Insulin and growth hormones. Vaccine: genetically improved vaccines, synthetic peptide based vaccines, nucleic acid vaccines.

UNIT: 3	PHARMACOLOGY, TOXICOLOGY AND THERAPEUTICS	12 hours

Recombinant thrombolytic agents: tissue type plasminogen activator, first and second generation of thrombolytic agents. Xenotransplantation in pharmaceutical biotechnology. Estimation of

toxicity: LD50 and ED50. Pre-clinical and clinical trails

UNIT: 4	FUNDAMENTALS OF DRUG EVALUATION AND PHARMACOGENOMICS	12 hours

Introduction to pharmacopoeia, good microbiological techniques and good laboratory practice (GLP). Basic principles of quality control (QA) and quality assurance (QC), Guidelines for QA and QC: raw materials, sterilization, media, stock cultures and products, Validation study and toxicity testing. Role of culture collection centre, public health laboratories and regulatory agencies Concept of biotech process validation, Cell lines culture process validation and characterization.

UNIT: 5	PROTEIN AND NUCLEIC ACID FORMULATION DEVELOPMENT	10 hours

Issues of DNA vaccines and plasmid DNA vaccines. Analytical methods in protein formulation: concentration, size, purity, surface charge, identity, structure/sequence, shape, activity. Introduction to drug designing and Search of database. Biosafety guidelines; Risk and risk assessment- Biosafety levels, laboratory biosecurity concepts Introduction to drug design- Pre-clinical and clinical trials. Basics of bioethics principles, international codes and guidelines in India. Ethics in post-genomic era.

UNIT: 6	CONTEMPORARY ISSUES	2 hours
Expert lectures, online seminars - webinars		
	Total Lecture hours	**60 hours**

Text Book(s)

1. Goodman & Gilman's The Pharmacological Basis of Therapeutics,11th edition, Mc Graw- Hill Medical Publishing Division New York, 2006
2. Rodney J Y Ho, MILO Gibaldi, Biotechnology & Biopharmaceuticals Transforming proteins and genes into drugs, 1st Edition, Wiley Liss, 2003

Reference Books

1. Pharmaceutical Biotechnology Fundamentals and Applications 5th Edition 2019 by Crommelin DJA, Springer

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. Drug Discovery – Coursera
   https://www.coursera.org/learn/drug-discovery
2. Drug Delivery: Principles and Engineering – SWAYAM
   https://onlinecourses.nptel.ac.in/noc19_bt23/preview

Course Designed By:

Mr. T. Purushothaman, Head, Asst Prof, Dept of Biotechnology, SNMV CAS, Coimbatore

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	M	L	S	S	S	S
CO2	M	M	S	S	S	L	S	M	M	S
CO3	S	S	M	S	L	M	M	M	S	L
CO4	S	M	S	M	M	L	S	L	M	L
CO5	S	M	M	S	M	M	M	S	M	S

*S-Strong; M-Medium; L-Low

Course code 33C	PAPER - XI GENETIC ENGINEERING	L	T	P	C
Core		4			4
Pre-requisite	Should have a studied Genetics in undergraduate	Syllabus Version		2026 - 2027	

Course Objectives:

The main objectives of this course are to:

- To make learners understand the importance of gene manipulation with reference to different nuclear enzymes
- To impart knowledge about source of vectors for their use in recombinant DNA technology and how effectively being employed as cloning vectors
- To educate learners about methods of creating c-DNA libraries to assess for genetic disorders and its cure means of recombinant products/gene therapy

Expected Course Outcomes (CO) :

On the successful completion of the course, student will be able to:

1	Recite key aspects of various enzymes in gene manipulation techniques to explore blotting techniques	K1
2	Construct plasmid vectors and illustrate them to comprehend more about its structure and functions	K2, K3
3	Assess methods of transformation and analyses cloned genes for their markers	K2, K3
4	Classify genomic C- DNA libraries and its significance in sequencing, mutagenesis and fingerprinting	K3,K5
5	Employ various gene therapyusing different vectors and recombinant products	K3, K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

UNIT: 1	GENETIC MANIPULATION	10 hours

Enzymes used in manipulation: Polymerases and types; nucleases: endonucleases, exonucleases and restriction enzymes; ligases; topoisomerases, methylases; other modifying enzymes. Electrophorosis. Blotting techniques- Southern, Northern, Western, Dot and Slot blot.

UNIT: 2	BIOLOGY OF CLONING VECTORS	12 hours

Biology and construction of plasmid vectors: pBR 322; pUC 18. Phages as vectors: Lambda phage; cosmids; phagemids. Expression vectors; shuttle vectors; artificial chromosomes: YAC, PAC, BAC, HAC.

UNIT: 3	BASIC RECOMBINANT DNA TECHNIQUES	12 hours
Construction of a recombinant molecule. Bacterial transformation: principle and methods; Physical methods of transformation. Analysis of cloned genes: direct and indirect methods. Molecular Marker techniques: RFLP, RAPD, STS, SSR, ISSR, SCAR, SSCP and AFLP. Importance of molecular markers, molecular marker assisted selection, aided plant breeding. Selectable marker and reporter genes		

UNIT: 4	ADVANCED RECOMBINANT TECHNIQUES	12 hours
Genomic and cDNA libraries; PCR: principle and types; Site directed mutagenesis; DNA sequencing. Microarrays - cDNA and protein chips. DNA fingerprinting; SNPs; VNTRs and microsatellites.		

UNIT: 5	APPLICATIONS OF GENE THERAPY	12 hours
Exvivo, Invivo, germ line and somatic gene therapy, Vectors in gene therapy. Viral gene delivery system- Adeno associated virus vector- Retero virus vector –HSV vector system; DNA forensics. Recombinant Products: blood products; vaccines; interferons; interleukins and therapeutic proteins. Molecular Pharming - Hirudin (Plant), Antibodies (Animal) and tissue plasminogen activator (Bacteria).		

UNIT: 6	Contemporary Issues	2 hours
Expert lectures, online seminars - webinars		

	Total Lecture hours	60 hours

Text Book(s)

1	Genetic Engineering A Primer by Yamagami T, Auris Publishing, 2017
2	Molecular Biology and Genetic Engineering by N. Arumugam, A. Thangamani, L.M. Narayanan, Padmalatha Singh from Saras Publication, 2012

Reference Books

1	Principles of Genetics Gardner, Wiley India, 2006
2	Genetic Engineering, By Smita Rastogi from Oxford University Press, 2009

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://swayam.gov.in/nd1_noc19_bt15/preview
2	https://nptel.ac.in/courses/102/103/102103013/

Course Designed By:

Dr. G. Rajalakshmi, Head & Prof, Dept of Biotechnology, Hindusthan CAS, Coimbatore

Dr. S. G. Antony Godson, Asst.Prof, Dept of Biotechnology, Hindusthan CAS, Coimbatore

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	L	S	M	M	M	S
CO2	M	S	M	M	M	M	S	S	S	L
CO3	L	S	S	M	M	S	M	S	S	M
CO4	M	S	M	S	M	M	S	S	M	S
CO5	S	M	M	L	L	M	L	S	M	L

*S-Strong; M-Medium; L-Low

Course code 33D	PAPER - XII COMPUTATIONAL BIOLOGY	L	T	P	C
Core		4			4
Pre-requisite	Basic Knowledge in Computer science and applications	Syllabus Version		2026 - 2027	

Course Objectives:

The main objectives of this course are to:

- Provide theory and practical experience of the use of common computational tools and databases which facilitate investigation of molecular biology and evolution-related concepts

Expected Course Outcomes (CO) :

On the successful completion of the course, student will be able to:

1	Understand the basic theory of these computational tools	K2
2	Explain computational tools and methods used in bioinformatics	K1, K2
3	Identify specific contemporary biological questions	K3
4	Analyze biological data using computational tools to identify patterns, relationships, and functional insights	K4, K5
5	Evaluate the quality, accuracy, and relevance of publicly available biological databases and interpret their applications in research	K4, K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

UNIT: 1	BIOLOGICAL DATA BASES	10 hours

The need for computation in Biology: An introduction to Bioinformatics, Historical overview, the principles involved, development of tools, internet based access. Introduction to Biological Databases, Database Browsing and Data Retrieval - Sequence databases, Structural databases, Literature and other databases

UNIT: 2	DNA SEQUENCE ANALYSIS	12 hours

Algorithm basics; databases and search tools: Handling Biological Sequences such as searching of databases similar sequence; DNA sequence analysis: Genbank sequence database; submitting DNA sequences to databases and database searching; sequence alignment; pairwise alignment techniques; BLAST; Types of BLAST; Importance of BLAST.

UNIT: 3	SEQUENCE ALIGNMENT	12 hours

Multiple sequence analysis; multiple sequence alignment; flexible sequence similarity searching with the FASTA program package; use of CLUSTAL W and CLUSTALX for multiple Sequence alignment; submitting DNA protein sequence to databases: where and how to submit, SEQUIN, genome centers; submitting aligned sets of sequences, updating submitted sequences, Basic methods in phylogenetic analysis

UNIT: 4	**PROTEIN MODELING & STRUCTURE PREDICTION**	**12 hours**

Protein structure prediction; Methods for modeling; Homology modeling; Threading and protein structure prediction; Structure-structure comparison of macromolecules with reference to proteins; Force fields; Molecular energy minimization; homology modelling: potential applications, description, Methodology, homologous sequence identification; align structures, align model sequence; construction of variable and conserved regions; evaluation of models; structure prediction on a mystery sequence; PDB (Protein Data Bank)and Swiss prot; Uniprot.

UNIT: 5	**IN SILICO DRUG DESIGN & VIRTUAL LIBRARY**	**12 hours**

Molecular Interaction Studies: Types of Docking; Docking Softwares; Ligand Preparations; Target Preparations; Searching Drug Databases; Searching PubMed, current content, science citation index and current awareness services, electronic journals, grants and funding information; Activity predictions

UNIT: 6	**CONTEMPORARY ISSUES**	**2 hours**

Expert lectures, online seminars - webinars

	Total Lecture hours	**60 hours**

Text Book(s)

1	Dr. Lesk A M. Introduction to Bioinformatics – Oxford University Press, 2014
2	Dr. R. Sundaralingam and Dr.V.Kumaresan. Bioinformatics – 4th Edition, Saras Publication, 2021.

Reference Books

1	Dr.Namita Mendiratta and Dr. Parag Rastogi. Bioinformatics: Methods and Applications: Genomics, Proteomics and Drug Discovery - PHI Learning, 5th Edition, 2022
2	Dr. Zhumur Ghosh and Dr.Bibekanand Mallick. Bioinformatics: Principles and Applications - 4th Edition, OUP India, 2018.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://onlinecourses.nptel.ac.in/noc25_bt06/preview

Course Designed By:
Dr S Karthi, Associate Professor, Department of Biotechnology, Nandha Arts and Science College, Erode

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	M	S	S	M	S	L
CO2	M	S	M	S	S	S	M	L	M	L
CO3	L	S	S	M	M	S	S	M	L	S
CO4	S	S	L	M	S	S	M	S	M	M
CO5	M	M	S	S	S	M	M	S	S	M

*S-Strong; M-Medium; L-Low

Elective Course

Course code 1EA	GROUP A PAPER -I ENVIRONMENTAL BIOTECHNOLOGY	L	T	P	C
Elective		4			4
Pre-requisite	Should have a basic principles of biotechnology and environmental science	Syllabus Version	2026 - 2027		

Course Objectives:

The main objectives of this course are to

- To understand the principles of environmental biotechnology and ecosystem dynamics.
- To study microbial processes involved in environmental management.
- To explore biotechnological approaches for pollution monitoring and control.
- To understand wastewater treatment and solid waste management technologies.
- 5. To learn advanced bioremediation and environmental sustainability strategies.

Expected Course Outcomes (CO) :

On the successful completion of the course, student will be able to:

1	Explain the fundamental concepts of environmental biotechnology, ecosystem dynamics and microbial roles in environmental processes.	K1
2	Analyze environmental pollution problems and evaluate suitable biotechnological approaches for monitoring and control of pollutants	K2
3	Apply biological principles and technologies for wastewater treatment, solid waste management and resource recovery.	K2, K3
4	Assess the mechanisms and effectiveness of bioremediation, phytoremediation and microbial degradation strategies for environmental cleanup.	K4
5	Evaluate advanced environmental biotechnology tools, renewable bioenergy technologies and sustainable environmental management practices for addressing global environmental challenges	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

UNIT: 1	FUNDAMENTALS OF ENVIRONMENTAL BIOTECHNOLOGY AND ECOSYSTEMS	10 hours

Introduction to Environmental Biotechnology – Scope, importance and applications. Ecosystem structure and functions – Energy flow, food chains and food webs, ecological pyramids, biogeochemical cycles (carbon, nitrogen, phosphorus and sulfur cycles). Biodiversity and conservation. Environmental pollution – sources, types and effects. Environmental monitoring and assessment

UNIT: 2	ENVIRONMENTAL MICROBIOLOGY AND BIOGEOCHEMICAL PROCESSES	12 hours

Microorganisms in the environment – distribution and diversity. Microbial interactions and ecological significance. Microbial metabolism in environmental processes. Carbon, nitrogen and sulfur transformations. Nitrogen fixation, nitrification, denitrification and ammonification. Methanogenesis and methane oxidation. Microbial indicators of environmental quality. Extremophiles and their environmental applications.

UNIT: 3	WASTEWATER TREATMENT AND SOLID WASTE MANAGEMENT	12 hours

Characteristics and analysis of wastewater. Primary, secondary and tertiary treatment processes. Activated sludge process, trickling filters, oxidation ponds and anaerobic digesters. Biological nutrient removal. Treatment of industrial effluents from dairy, textile, tannery, pulp and paper, and pharmaceutical industries. Municipal solid waste management. Vermicomposting, biomethanation and waste-to-energy technologies.

UNIT: 4	**BIOREMEDIATION AND ENVIRONMENTAL POLLUTION CONTROL**	**12 hours**

Principles and strategies of bioremediation. In situ and ex situ bioremediation techniques. Phytoremediation, rhizoremediation and mycoremediation. Biodegradation of hydrocarbons, pesticides, dyes and xenobiotic compounds. Oil spill remediation. Biosorption and bioaccumulation of heavy metals. Genetically engineered microorganisms for environmental cleanup. Case studies on environmental restoration

UNIT: 5	**ADVANCED ENVIRONMENTAL BIOTECHNOLOGY AND SUSTAINABILITY**	**12 hours**

Biosensors and bioindicators for environmental monitoring. Environmental genomics, metagenomics and microbial diversity analysis. Biofertilizers and biopesticides for sustainable agriculture. Renewable bioenergy: bioethanol and algal biofuels. Climate change and greenhouse gas mitigation. Carbon sequestration technologies. Environmental Impact Assessment (EIA), environmental management systems (EMS), ISO 14001 and environmental regulations. Sustainable development goals and circular bioeconomy.

UNIT: 6	**CONTEMPORARY ISSUES**	**2 hours**

Expert lectures, online seminars - webinars

	Total Lecture hours	**60 hours**

Text Book(s)

1. Rittmann, B. E., & McCarty, P. L. (2020). *Environmental Biotechnology: Principles and Applications* (2nd Edition). New York: McGraw-Hill Education.
2. Pepper, I. L., Gentry, T. J., Gerba, C. P., & Brooks, J. P. (2026). *Environmental Microbiology* (4th Edition). Amsterdam: Academic Press/Elsevier.

Reference Books

1. 1. Sobti, R. C., Arora, N. K., & Kothari, R. (Eds.). (2019). Environmental Biotechnology: For Sustainable Future. Singapore: Springer Nature.
   2. Yates, M. V., Nakatsu, C. H., Miller, R. V., & Pillai, S. D. (Eds.). (2016). Manual of Environmental Microbiology (4th Edition). Washington, DC: ASM Press/Wiley.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. 1. https://nptel.ac.in/courses/102105088
   2. https://onlinecourses.swayam2.ac.in/e-learning/preview/nou26_es09

Course Designed By:
Dr. P. Senthilkumar, Associate Professor, Department of Biotechnology, Hindusthan College of Arts & Science, Coimbatore

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	S	M	M	S	M	S	S
CO2	M	M	M	S	S	S	S	S	S	L
CO3	S	S	S	M	L	S	M	M	S	S
CO4	S	S	M	S	S	L	M	L	S	M
CO5	M	S	M	L	L	S	S	S	M	L

*S-Strong; M-Medium; L-Low

Course code 2EA	GROUP A PAPER - II NANOBIOTECHNOLOGY	L	T	P	C
Elective		**4**			**4**
Pre-requisite	Students should have a knowledge on chemistry, metals and biology	**Syllabus Version**		**2026 - 2027**	

Course Objectives:

The main objectives of this course are to:

- Understand nanotechnology principles including the unique properties and behaviors of materials at Nanoscale.
- Examine the use of nanobiotechnology in drug delivery, biosensors, imaging, and regenerative medicine.

Expected Course Outcomes (CO) :

On the successful completion of the course, student will be able to:

1	Understand concepts in nanotechnology, nanomaterials and its properties.	K1, K2
2	Learn the biosynthesis of nanoparticles	K2
3	Realize the working and principles of various analytical techniques in characterization of nanomaterials	K3
4	Analyze the role of nanomaterials and nanotechnology in healthcare and environmental problem	K4, K5
5	Explore the use of nanomaterials in various biotechnological applications	K3, K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

UNIT: 1	INTRODUCTION TO NANOBIOTECHNOLOGY	12 hours

Introduction to Nanobiotechnology, Historical perspective: Cellular Nanostructures: Nanopores: Biomolecular motors; Bioinspired Nanostructures. Properties of Nanomaterials: Structural properties, chemical properties, surface functionalization, Physical properties.

UNIT: 2	BIOSYNTHESIS OF NANOPARTICLES	12 hours

Biosynthesis of Nanoparticles – Silver, Gold, Zinc and Copper. Phytochemical Extraction & purification and nanoparticle synthesis: secondary metabolic pathways. Synthesis process and application, Role of plants and microbes in nanoparticle synthesis.

UNIT: 3	CHARACTERIZATION TECHNIQUES OF NANOPARTICLES	12 hours

Characterization Techniques X-ray diffraction, Scanning Probe Microscopy, SEM, TEM, AFM, High Resolution Imaging Techniques and application for analysis of nanomaterials, UV-VIS-NIR Spectrophotometers, XRD, DLS, FTIR.

UNIT: 4	NANOTOXICITY	11 hours
Introduction to safety of nanomaterials, Basics of nanotoxicity, Models and assays for Nanotoxicity assessment: Fate of nanomaterials in different strata of environment: Ecotoxicity models and assays: Life cycle assessment, Containment		
UNIT: 5	**APPLICATION OF NANOTECHNOLOGY**	**11 hours**
Nanopesticides, Nanofertilizers, Nanodevices – Nano Scaffolds, Nanobots and Biosensors for monitoring environmental changes and bioremediation. Nanotechnology in healthcare: Nano nutraceuticals and Pharmaceuticals. Nanotechnology in food industry.		
UNIT: 6	**CONTEMPORARY ISSUES**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**60 hours**

Text Book(s)

1	Dr. Niemeyer CM and Dr. Mirkin CA. Nanobiotechnology – John wiley & amp; sons, 2006. Dr. David S Goodsell, Bionanotechnology - John Wiley & Sons, 2004.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	Nanotechnology, Science and Applications: https://onlinecourses.nptel.ac.in/noc24_mm29/preview
2	https://onlinecourses.nptel.ac.in/noc19_mm21/preview

Course Designed By:
Dr. V.Senthil Kumar, Associate Professor, Department of Biotechnology, Nandha Arts and Science College, Erode.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	M	M	S	S	M	M
CO2	M	S	S	L	S	M	M	S	S	S
CO3	S	M	M	M	M	S	L	L	M	S
CO4	M	S	L	S	S	S	M	S	S	M
CO5	S	M	S	M	M	S	M	M	M	L

*S-Strong; M-Medium; L-Low

Course code 3EA	GROUP A PAPER - III STEM CELL BIOLOGY AND TISSUE ENGINEERING	L	T	P	C
Elective		**4**			**4**
Pre-requisite	Basic knowledge in Animal Tissue Culture	**Syllabus Version**	**2026 - 2027**		

Course Objectives:

The main objectives of this course are to:

- The course will provide students with knowledge of wide ranging topics related to stem cells, regenerative biology and tissue engineering.
- The course goal is to introduce students to updated fundamental knowledge, technological advancements and potential applications of stem cells and tissue engineering.

Expected Course Outcomes (CO) :

On the successful completion of the course, student will be able to:

1	Understand concepts of Stem cells	K2,K3
2	Learn the types of stem cell	K2
3	Describe the applications of stem cell	K2
4	Demonstrate knowledge of Tissue Engineering	K4,K1
5	Discuss the role of tissue engineering	K5,K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

UNIT: 1	INTRODUCTION TO STEM CELLS	11 hours

Introduction to Stem Cells – Definition, Classification, characteristics, Differentiation and dedifferentiation, Stem cell niche, stem cell Vs Somatic cells; Mechanism of pleuripotency in stem cells. Basic culture procedures: Isolation, culture methods, identification, stem cell markers, feeder layer; Instrumentations in stem cell biology.

UNIT: 2	TYPES OF STEM CELL	11 hours

Different kinds of stem cells – Adult Stem cells, Embryonic stem cells, Embryonic Germ cells, Heamtopoietic stem cell, Neural stem cells, muscle and cardiac stem cells, Umbilical cord blood stem cells, cancer stem cells, Mesenchymal stem cells, Induced pluripotent Stem cells.

UNIT: 3	APPLICATION OF STEM CELL	12 hours

Therapeutic applications: stem cells and neurodegenerative disorders, stem cells and diabetes, stem cells and cardiac disorders, regeneration of epidermis, Success stories of stem cell therapy. Stem cell banking around the world. Current status of Stem cell research; World federal fundings for stem cell research; Public view and ethical approaches on stem cells.

UNIT: 4	PRINCIPLES OF TISSUE ENGINEERING	12 hours

Principles of Tissue Engineering – History and scope, Basics of Tissue Engineering, Tissue Engineering triangle, Cell-ECM interaction, wound healing mechanism, Tissue Engineering Bioreactors, Models of Tissue Engineering, Biomaterials in Tissue Engineering.

UNIT: 5	**APPLICATIONS OF TISSUE ENGINEERING**	**12 hours**

Bioartificial organs – source of cells, choosing the right scaffold material, mode of transplantation. Epidermal Tissue engineering, Bladder reconstruction, Skin equivalents, Liver reconstruction, Bone regeneration through tissue engineering, Tissue Engineering and future perspectives – commercial products.

UNIT: 6	**CONTEMPORARY ISSUES**	**2 hours**

Expert lectures, online seminars - webinars

	Total Lecture hours	**60 hours**

Text Book(s)

1. Essentials of Stem cell Biology – Robert Lanza, John Gearhart, Brigid Hogan.
   Principles of Tissue Engineering – Robert Lanza.

Reference Books

1. Stem cells: Scientific progress and future research directions – NIH report.
   Available @ www.stemcells.nih.gov/index ; www.stembook.org

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. https://nptel.ac.in/courses/102106036

Course Designed By:
Dr.P.Ekambaram, Professor, Department of Biotechnology, Bharathiar University

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	S	S	M	M	M	M
CO2	M	M	M	L	L	M	S	S	L	S
CO3	S	S	M	L	L	S	M	L	L	L
CO4	S	S	S	M	M	M	S	S	S	L
CO5	M	S	M	S	S	S	M	S	M	S

*S-Strong; M-Medium; L-Low

Course code 4EA	GROUP A PAPER - IV CANCER BIOLOGY	L	T	P	C
Elective		**4**			**4**
Pre-requisite	Students should have a basic knowledge on cell biology and Immunology	**Syllabus Version**	**2026 - 2027**		

Course Objectives:

The main objectives of this courses:

- To understand the molecular basis of cancer, including its causes, progression and potential therapeutic interventions.

Expected Course Outcomes (CO) :

On the successful completion of the course, student will be able to:

1	Understand concepts of fundamentals of cancer.	K1, K2
2	Learn molecular biology of cancer cell	K2, K3
3	Describe the fundamental molecular processes underlying cancer initiation, progression and metastasis.	K4
4	Demonstrate knowledge of strategies for cancer diagnosis and therapeutics	K4, K5
5	Discuss the concept of personalized medicine in oncology and the development of targeted therapies.	K3,K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

UNIT: 1	FUNDAMENTALS OF CANCER	12 hours

Nature of cancer, classification of cancers and tumors, cancer epidemiology. Etiology: Tobacco and cancer development, cancer susceptibility syndrome, viruses and cancer (RNA and DNA viruses), inflammation and cancer, chemical and physical carcinogenesis, types of carcinogenesis, diet and cancer.

UNIT: 2	MOLECULAR BIOLOGY OF CANCER	12 hours

Cell cycle regulation and apoptosis, Molecular Biology of Cancer – Oncogenes, Tumor suppressor genes, Role of telomerases, epigenetics in cancer, Noncoding RNAs in cancer, Genomic stability and development of cancer.

UNIT: 3	INVASION, METASTASIS AND TUMOR IMMUNOLOGY	12 hours

Tumorigenesis – Multistep process (Stem cell theory, chronic inflammation), Angiogenesis and its implication in tumor progression, Pathogenesis of Metastasis. Tumor Immunology – Anti-tumor immune response of regulatory T cells & NK cells, Immune surveillance theory, Evasion of immune surveillance by cancer cells, Tumor antigens, Immunoediting .

UNIT: 4	CANCER DIAGNOSIS	10 hours
Methods of diagnosis – Blood Chemistry, Cytology, Biopsy, cytogenetic Immunophenotyping, Marker Studies, Imaging, sequencing technologies in detection of cancer causing alterations, Detection of recognized genetic aberrations. Conventional cancer treatment – Radiation, Chemotherapy and Surgery		
UNIT: 5	**CANCER THERAPEUTICS**	**12 hours**
Targeted therapy – Check point inhibitors, Hormone Therapy, Monoclonal antibodies; Immunotherapy, Natural products in cancer therapeutics, Current combination therapy approaches, Therapeutics in clinical trials, Predictive biomarkers for personalized oncotherapy. Cancer Epigenetics and Whole Genome Haplotyping.		
UNIT: 6	**CONTEMPORARY ISSUES**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**60 hours**

Text Book(s)

1	Dr. Mohammad A., Dr. Vasef MD, and Dr. Aaron Auerbach. Molecular Oncology – 3rd Edition, 2013
2	Dr. Howard L. Kaufman and Dr. Scott Wadler Karen Anthman. Molecular Targeting In Oncology – 1st Edition, Humana Press, 2008.

Reference Books

1	Dr. Edward P. Gelmann, Charles L. Sawyers, Dr. Frank J. Rauscher. Molecular Oncology - Cambridge University Press, 2013
2	Dr. Javier Camacho. Molecular Oncology: Principles & Recent Advances -2012.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	Molecular Biology of Cancer: https://www.online.drexel.edu/online-degrees/biomedical-degrees/cert-cancer-biology/index.aspx
2	https://www.coursera.org/courses?query=cancer%20biology

Course Designed By:
Dr S Karthi, Associate Professor, Department of Biotechnology, Nandha Arts and Science College, Erode

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	S	S	S	S	S	M	M
CO2	S	S	M	L	S	M	M	M	L	L
CO3	M	S	S	S	S	S	S	S	L	L
CO4	S	L	M	S	M	M	L	S	M	M
CO5	S	S	M	M	S	M	S	M	L	L

*S-Strong; M-Medium; L-Low

Course code 1EB	GROUP B PAPER - I PLANT SYSTEM PHYSIOLOGY	L	T	P	C
Elective		**4**			**4**
Pre-requisite	Should have a basic knowledge on plant system mechanism	**Syllabus Version**		**2026 - 2027**	

Course Objectives:

The main objectives of this course are to:

- To understand organisms, however, it is necessary to understand the functions of their cells and biological molecules.
- This course provides an introduction to basic principles of plant function, primarily covering physical processes in plants, metabolism,
- To understand secondary products, cell physiology, and introducing principles of growth and
- development of the plants.

Expected Course Outcomes (CO) :

On the successful completion of the course, student will be able to:

1	Impart an insight into the photosynthesis, respiration and photorespiration	K1, K2
2	Understand the mechanism of various metabolic processes in plants	K2
3	Acquire basic knowledge about growth and development in plants	K3
4	Take students to higher levels of learning about the secondary metabolites	K4
5	Understand the mechanism of various stress physiology in plants	K2, K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

UNIT: 1	PHOTOSYNTHESIS, RESPIRATION AND PHOTORESPIRATION	12 hours

Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO_2 fixation- C_3, C_4 and CAM pathways.
Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photo respiratory pathway

UNIT: 2	PLANT HORMONES & SENSORY PHOTOBIOLOGY	12 hours

Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action. Structure, function and mechanisms of action of Phytochromes, Cryptochromes and Phototropins; Stomatal movement; Photoperiodism and biological clocks.

UNIT: 3	SOLUTE TRANSPORT AND PHOTO ASSIMILATE TRANSLOCATION	12 hours

Uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photo assimilates.

UNIT: 4	SECONDARY METABOLITES	10 hours
Biosynthesis of Terpenes, phenols and nitrogenous compounds and their roles.		
UNIT: 5	**STRESS PHYSIOLOGY**	**12 hours**
Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses; mechanisms of resistance to biotic stress and tolerance to abiotic stress		
UNIT: 6	**CONTEMPORARY ISSUES**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**60 hours**

Text Book(s)

1	Frank. B. Salisbury and Cleon Wross. Plant Physiology CBS publishers and distributors, New Delhi
2	Malcolm S. Wilklins. Advanced Plant Physiology
3	Roy, G. Noggle and George J. Friltz., Introductory Plant physiology

Reference Books

1	Devlin and Barker, 1973 Photosynthesis. Reinhold affiliated east west press Pvt, Ltd, New Delhi
2	Introduction to Plant Physiology, 4th Edition William G Hopkins

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	Plant Physiology – SWAYAM https://onlinecourses.swayam2.ac.in/cec19_bt09/preview
2	Plant Physiology and Metabolism – UGC MOOCS http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_ug.php/55

Course Designed By:

Dr. K. Ramalashmi, Asst. Prof, Dept. of Biotechnology, SNMV CAS, Coimbatore

Dr. N.Vijayakumar, Asst. Prof, Dept. of Biochemistry & Biotechnology, Annamalai University, Chidambaram

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	M	S	M	S	L	S	M
CO2	M	S	S	S	S	M	L	S	M	M
CO3	S	M	L	S	M	S	S	M	L	S
CO4	M	S	S	M	M	M	L	M	M	M
CO5	M	L	S	S	S	M	M	S	M	M

*S-Strong; M-Medium; L-Low

Course code 2EB	GROUP B PAPER - II ANIMAL SYSTEM PHYSIOLOGY	L	T	P	C
Elective		**4**			**4**
Pre-requisite	Should have a basic knowledge on animal physiology & animal behaviour	**Syllabus Version**	**2026 - 2027**		

Course Objectives:

The main objectives of this course are to:

- To provide students with a basic understanding of the fundamental processes and mechanisms that serves and controls the various functions of the body.
- The major areas of study include excitable tissues, muscle, blood, the cardiovascular system and neurophysiology primary literature to develop the ability to think critically about issues in animal physiology and write about those in an effective manner.
- A comprehensive knowledge of functional physiological pathways common to all animals

Expected Course Outcomes (CO) :

On the successful completion of the course, student will be able to:

1	Have an enhanced knowledge and appreciation of mammalian physiology	K1,K2
2	Understand the functions of important physiological systems including the cardio-respiratory, renal, reproductive and metabolic systems	K2
3	Understand how these separate systems interact to yield integrated physiological responses to challenges such as exercise, fasting and ascent to high altitude	K2,K3
4	Will be able to recognize and identify principal tissue structures.	K2,K5
5	Will be able to perform, analyse and report on experiments and observations in physiology	K2,K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

UNIT: 1	**BLOOD AND CIRCULATION**	**12 hours**

Blood corpuscles, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, immunity, haemostasis. **Cardiovascular System:** Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure

UNIT: 2	**RESPIRATORY SYSTEM**	**10 hours**

Anatomy and structure transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration.

UNIT: 3	**NERVOUS SYSTEM**	**12 hours**

Neurons, action potential, gross Neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture. **Sense organs:** Vision, hearing and tactile response.

UNIT: 4	EXCRETORY SYSTEM	12 hours
Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, blood volume, blood pressure, electrolyte balance, acid-base balance.		
UNIT: 5	**DIGESTIVE SYSTEM, ENDOCRINOLOGY AND REPRODUCTION**	**12 hours**
Digestion, absorption, energy balance, BMR. Endocrine glands, basic mechanism of hormone action, hormones and diseases; reproductive processes, neuroendocrine regulation.		
UNIT: 6	**CONTEMPORARY ISSUES**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**60 hours**

Reference Books

1. Ganong, H, Review of Medial Physiology, 1989. 14th edition, Appleton &Lange publisher, New York
2. Physiology: A regulatory system approach, Fleur, and Strand, (1978). Macmillan Publishing Company, New York; Collier Macmillan Publishers, London
3. Animal Physiology, EcKert, R (5th edition), 2002. W.H.Freeman
4. Barrington, E.J.W. (1975): An Introduction to General & Comparative Endocrinology 2nd ed., Clarendon press, Oxford
5. Medical Physiology (4th Edition) Guyton Arthur C., Hall John E., W. B. Saunders

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. Animal Physiology – SWAYAM https://onlinecourses.nptel.ac.in/noc20_bt42/preview

Course Designed By:
Dr. K. Ramalashmi, Asst. Prof, Dept. of Biotechnology, SNMV CAS, Coimbatore
Dr. N.Vijayakumar, Asst. Prof, Dept. of Biochemistry & Biotechnology, Annamalai University, Chidambaram

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	S	M	L	S	S	L
CO2	S	L	S	S	S	S	S	S	S	M
CO3	M	S	M	M	M	L	L	S	M	S
CO4	S	S	M	S	M	S	S	M	M	L
CO5	M	M	S	M	M	L	S	L	S	S

*S-Strong; M-Medium; L-Low

Course code 3EB	GROUP B PAPER - III DEVELOPMENTAL BIOLOGY	L	T	P	C
Elective		**4**			**4**
Pre-requisite	Should have a basic knowledge on cell biology	**Syllabus Version**	**2026 - 2027**		

Course Objectives:

The main objectives of this course are to:

- To Know the broad phylogenetic relationships of animal phyla and some of the traits used to support our current understanding of these evolutionary relationships
- To be familiar with the events that leads up to and comprises the process of fertilization.
- To understand the difference between specification and determination

Expected Course Outcomes (CO) :

On the successful completion of the course, student will be able to:

1	Describe the main anatomical changes that occur during development	K2
2	Identify the cellular behaviors that lead to morphological change during development	K1, K2
3	Describe the main signaling pathways that play important roles in development	K3, K4
4	Understand how errors in development lead to congenital defects and spontaneous abortion	K4, K5
5	Describe the main signaling pathways that play important roles in programmed cell death	K2, K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

UNIT: 1	**BASIC CONCEPTS OF DEVELOPMENT**	**10 hours**

Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development.

UNIT: 2	**GAMETOGENESIS, FERTILIZATION AND EARLY DEVELOPMENT**	**12 hours**

Production of gametes, cell surface molecules in sperm-egg recognition in animals; embryo sac development and double fertilization in plants; zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; embryogenesis, establishment of symmetry in plants; seed formation and germination.

UNIT: 3	MORPHOGENESIS AND ORGANOGENESIS IN ANIMALS	13 hours
Cell aggregation and differentiation in *Dictyostelium*; axes and pattern formation in amphibia and chick; organogenesis – vulva formation in *Caenorhabditis elegans;* eye lens induction, limb development and regeneration in vertebrates; differentiation of neurons, post embryonic development-larval formation, metamorphosis; environmental regulation of normal development; sex determination.		
UNIT: 4	**MORPHOGENESIS AND ORGANOGENESIS IN PLANTS**	**13 hours**
Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy; transition to flowering, floral meristems and floral development in *Arabidopsis* and *Antirrhinum.*		
UNIT: 5	**APOPTOSIS**	**10 hours**
Programmed cell death, aging and senescence.		
UNIT: 6	**CONTEMPORARY ISSUES**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**60 hours**

Reference Books

1	Essential developmental biology – Jonathan Michael Wyndham slack, Wiley-Blackwell, 2006
2	Current topics in developmental biology – Geral P. Schatten, Academic press, 2006
3	The origin of animal body plans: a study in evolutionary developmental biology – Wallace Arthur, Cambridge university press, 2000

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	Introduction to Developmental Biology – SWAYAM https://onlinecourses.nptel.ac.in/noc20_bt35/preview

Course Designed By:

Dr. K. Ramalashmi, Asst. Prof, Dept. of Biotechnology, SNMV CAS, Coimbatore

Dr. N.Vijayakumar, Asst. Prof, Dept. of Biochemistry & Biotechnology, Annamalai University, Chidambaram

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	S	M	M	S	S	M	L
CO2	S	M	L	S	S	S	L	S	S	S
CO3	M	M	M	M	M	M	S	L	M	M
CO4	S	S	M	S	S	S	M	M	S	L
CO5	M	S	L	S	M	M	L	S	M	S

*S-Strong; M-Medium; L-Low

Course code 4EB	GROUP B PAPER - IV EVOLUTION AND BEHAVIOUR	L	T	P	C
Elective		**4**			**4**
Pre-requisite	Should have basic knowledge on Evolution & environmental biology	**Syllabus Version**	**2026 - 2027**		

Course Objectives:

The main objectives of this course are to:

- To provide comprehensive overview of Concept of Evolution
- To impart descriptive knowledge regarding Origin and Evolution of Man
- To develop comprehensive knowledge regarding various Sources of Variations and their role in evolution.

Expected Course Outcomes (CO) :

On the successful completion of the course, student will be able to:

1	The students will be able to learn most of the essential aspects of Evolutionary Biology in detail which will help them in acquiring better understanding regarding the subject.	K1
2	Able to recognise when behaviour poses difficulties for accepted wisdom and theory.	K1, K2
3	Able to understand and communicate problems and their solutions to both an intelligent public and a community of informed scientists.	K2, 3
4	Able to think strategically on how to formulate and test adaptive hypotheses.	K3
5	Students will be able to apply evolutionary concepts and findings to real-world questions.	K4, K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

UNIT: 1	**EMERGENCE OF EVOLUTIONARY THOUGHTS**	**10 hours**

Lamarck; Darwin–concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; spontaneity of mutations; the evolutionary synthesis.

UNIT: 2	**ORIGIN OF CELLS AND UNICELLULAR EVOLUTION**	**12 hours**

Origin of basic biological molecules; abiotic synthesis of organic monomers and polymers; concept of Oparin and Haldane; experiment of Miller (1953); the first cell; evolution of prokaryotes; origin of eukaryotic cells; evolution of unicellular eukaryotes; anaerobic metabolism, photosynthesis and aerobic metabolism.

UNIT: 3	PALEONTOLOGY AND EVOLUTIONARY HISTORY	12 hours
The evolutionary time scale; eras, periods and epoch; major events in the evolutionary time scale; origins of unicellular and multicellular organisms; major groups of plants and animals; stages in primate evolution including Homo.		
UNIT: 4	**BRAIN BEHAVIOR AND EVOLUTION**	**12 hours**
Approaches and methods in study of behavior; proximate and ultimate causation; altruism and evolution-group selection, kin selection, reciprocal altruism; neural basis of learning, memory, cognition, sleep and arousal; biological clocks.		
UNIT: 5	**BEHAVIOR**	**12 hours**
Development of behavior; social communication; social dominance; use of space and territoriality; mating systems, parental investment and reproductive success; parental care; aggressive behavior; habitat selection and optimality in foraging; migration, orientation and navigation; domestication and behavioral changes		
UNIT: 6	**CONTEMPORARY ISSUES**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**60 hours**

Text Book(s)

Reference Books

1	Carter. G.S. Animal Evolution, 1951, Sedgwick and Jackson, London, England.
2	Sobrig and Sobrig : Population biology and evolution ,1981 Addition Wiley
3	Stahl. V: vertebrate history: problems in evolution 1985, Mc GRAW-Hill, New Delhi
4	Mayer. S: Systematic and origin of species ,1942, University press, Colombia

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	Evolutionary Biology – SWAYAM https://onlinecourses.swayam2.ac.in/cec20_bt06/preview

Course Designed By:
Mr. T. Purushothaman, Head, Asst. Prof, Dept. of Biotechnology, SNMV CAS, Coimbatore
Dr. K. Ramalashmi, Asst. Prof, Dept. of Biotechnology, SNMV CAS, Coimbatore

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	L	S	M	S	S	S	M
CO2	S	M	M	S	M	S	S	L	M	S
CO3	M	M	S	S	S	L	M	L	L	M
CO4	M	S	S	S	L	S	S	M	S	S
CO5	M	S	M	M	S	M	S	L	M	M

*S-Strong; M-Medium; L-Low

Course code 23P	PRACTICAL I - LAB IN MICROBIOLOGY, BIOCHEMISTRY & GENETICS	L	T	P	C
Practical		**5**			**4**
Pre-requisite	Should have practical exposure in Microbiology, biochemistry and genetics	**Syllabus Version**		**2026 - 2027**	

Course Objectives:

The main objectives of this course are to:

- To get hands on experience and to learn the principles behind biochemistry and Microbiology
- To give hands on experience for assaying the compound both qualitatively and quantitatively and also to determine the concentration of unknown compound.
- To train the students on microbiological media preparation, isolation of microbes and staining
- techniques from various samples.

Expected Course Outcomes (CO) :

On the successful completion of the course, student will be able to:

1	Extending the hands on experience on standard solution preparation, Demonstrating the separation of various compounds using chromatographic techniques.	K1, K6
2	Developing and applying the skills gained through the biochemistry techniques for research as well as for in the various fields of applied science	K2, K4
3	Examining and to analyze the results behind the biotechnological techniques for the development of new techniques in future	K4, K5
4	Applying the practical knowledge to learn about the waste water treatment from the various environmental samples.	K5, K3
5	The students will investigate the different strategies and also resolve the problems encounter to remove heavy metal and hydrocarbons from the polluted samples.	K4, K5, K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

BIOCHEMISTRY

1. Estimation of reducing sugars by Nelson - Somogyi method
2. Estimation of total carbohydrates by Anthrone method
3. Estimation of acid value, saponification value, Iodine number of fat
4. Estimation of total free amino acids
5. Protein estimation by Absorbance at 280nm, Lowry's method .
6. Separation of LDH isozymes from serum by SDS-PAGE.
7. Thin Layer Chromatography - separation of amino acids
8. Extraction and purification of peroxidase from soy bean seeds
9. Assay of amylase activity and determination of enzyme kinetic parameters - Km, Vmax and Kcat
10. Estimation of ascorbic acid and riboflavin

MICROBIOLOGY

1. Staining of Bacteria: simple, negative, differential, microchemical staining
2. Staining of fungi - Lacto phenol cotton blue
3. Isolation, purification and biochemical identification of bacteria
4. Antibiotic sensitivity test

GENETICS

1. Study on sex linked inheritance in Drosophila.
2. To study about Chromosome mapping using three-point test cross
3. Study of polyploidy in onion root tip by colchicine treatment

REFERENCE

1. Laboratory Manual of Biochemistry by J. Jayaraman, Published by Willy Eastern. 1981. Edition: 2.
2. Protein Methods by Daniel M. Bollag *et al*. Published by Wiley-Liss, Inc. 1996. Edition: 2.
3. Biochemical Methods by S. Sadasivam and A. Manickam, Published by Reprint New age international (P) Ltd. 1996. Edition: 2.
4. Manual of Microbiology Tools and Techniques by Kanika Sharma, Published by Ane Books, 2007. Edition: 4.
5. Laboratory Manual on Biotechnology- Prof. P.M. Swamy, Published by Rastogi Publications

Course Designed By:
Dr K Abdhul, Associate Professor, Department of Biotechnology, Nandha Arts and Science College, Erode

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	S	S	L	M	S
CO2	M	S	S	L	S	S	M	S	L	S
CO3	S	M	S	M	L	M	L	M	S	L
CO4	M	S	S	S	S	S	S	S	L	S
CO5	M	S	M	M	S	M	M	L	S	L

*S-Strong; M-Medium; L-Low

Course code 23Q	PRACTICAL II – PLANT BIOTECHNOLOGY, ANIMAL BIOTECHNOLOGY & IMMUNOLOGY	L	T	P	C
Practical		**4**			**4**
Pre-requisite	Should have a basic practical exposure in Plant cells, animal cells and microbiology	**Syllabus Version**	**2026 - 2027**		

Course Objectives:

The main objectives of this course are to:

- The major objective of the course is to impart hands-on training in basic plant and animal biotechnology techniques.
- Students will be trained in basic palnt and animal cell culturing and as working in biosafety cabinet.
- Student will be trained to Immunological techniques

Expected Course Outcomes (CO) :

On the successful completion of the course, student will be able to:

1	To Learn the role of antibodies in disease defense mechanism	K1, K2
2	To learn the cell culture techniques of using body fluids	K2, K3
3	To isolate the DNA and RNA from plant	K4, K5
4	To learn the transformation techniques in genetic engineering	K4, K6
5	To evaluate role of antibodies and the immune blotting and its need	K4, K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

PLANT BIOTECHNOLOGY

1. Composition and preparation of media and sterilization
2. In vitro Seed Germination
3. Micropropagation - Nodal and apical meristems.
4. Callus induction , regeneration and Acclimatization
5. Somatic Embryogenesis and Synthetic Seeds
6. Suspension cultures and somatic embryogenesis
7. Embryo culture
8. Protoplast Isolation and Viability Testing
9. Isolation of plant genomic DNA
10. Qualitative and quantitative analysis of plant genomic DNA
11. Isolation of plasmid DNA from Agrobacterium spp.
12. Agrobacterium mediated transformation

ANIMAL BIOTECHNOLOGY

13. Sterilization techniques
14. Preparation of culture media and sera
15. Preparation of primary cell culture
16. Trypsinizing and subculturing cells from a monolayer
17. Passaging cells in suspension culture
18. Determining cell umber and viability with a hemocytometer and Trypan blue staining

IMMUNOLOGY

19. Immunization and generation of antiserum in animals against antigen
20. Separation of IgG using affinity chromatography
21. Blood grouping and counting of blood cells
22. Antigen-Antibody Interactions: Radial Immunodiffusion, Ouchterlony double diffusion Precipitin ring test
23. Immunoelectrophoresis and rocket immunoelectrophoresis.
24. Antibody Titre by ELISA

REFERENCE:

1. Animal Cell Culture: A Practical Approach- R. Ian Freshney, Published by IRL Press, 1986.
2. Practical Immunology - Leslie Hudson, F.C. Hay, Published by Blackwell Scientific Publications, 1981, Edition: 2.
3. Plant Tissue Culture Concepts and Laboratory Exercise - Robert Nicholas Trigiano, Dennis John Gray, Published by CRC Press, 1999 Edition: 2.
4. Introduction to Plant Tissue Culture - M. K. Razdan, Published by Science Publishers, 2003, Edition: 2.
5. An Introduction to Practical Biotechnology - S. Harisha, Published by Firewall Media, 2006.

Course Designed By:
Dr A G Rajalakshmi, Asst. Prof, Dept. of Biotechnology, SNMV CAS, Coimbatore
Mr. T. Purushothaman, Head, Asst. Prof, Dept. of Biotechnology, SNMV CAS, Coimbatore

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	M	S	M	S	M	M
CO2	S	M	M	L	S	M	S	L	L	S
CO3	M	S	M	L	M	S	M	L	M	L
CO4	S	S	S	M	S	M	L	S	M	S
CO5	S	M	S	S	M	M	S	M	M	L

*S-Strong; M-Medium; L-Low

Course code 43P	PRACTICAL - III GENETIC ENGINEERING & COMPUTATIONAL BIOLOGY	L	T	P	C
Practical		5			4
Pre-requisite	Should have a basic knowledge on rDNA Technology & computer knowledge	Syllabus Version		2026 - 2027	

Course Objectives:

The main objectives of this course are to:

- Understand and apply advanced genetic engineering techniques.
- Conduct molecular cloning and bacterial transformation experiments
- Provide hands-on training in the use of bioinformatics databases and software tools.
- Develop skills in sequence alignment, data retrieval, and similarity searching techniques.

Expected Course Outcomes (CO) :

On the successful completion of the course, student will be able to:

1	Understand the molecular cloning and transformation procedures.	K1,K2
2	Apply and gain knowledge on problem-solving skills in genetic engineering.	K2,K4
3	Analyze and apply theoretical knowledge in solving real-world problems.	K5,K6
4	Examine biological sequence data	K4,K6
5	Assess the accuracy, efficiency, and limitations of various bioinformatics algorithms and software tools.	K5,K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

GENETIC ENGINEERING

1. Isolation of genomic DNA from bacteria and animal tissue. Purification and Quantification.
2. Agarose gel electrophoresis
3. Isolation of plasmid DNA from bacteria
4. Restriction digestion and ligation of Lambda phage DNA and gel analysis
5. Transformation of plasmid DNA in E. coli, expression and selection
6. Polymerase chain reaction
7. Competent cell preparation (DH5).
8. Transformation of plasmid DNA in E. coli (DH5).

COMPUTATIONAL BIOLOGY

9. Retrieving sequence data from Entrez / Locating the chromosome of a Gene
10. Retrieve gene expression data from GEO / Retrieving articles using PubMed
11. Finding ORF of a Given Sequence / Retrieving structural data of a protein using PDB database
12. Designing a primer/ Global alignment of two sequences - Needleman- Wunsch Algorithm
13. Smith-Waterman Algorithm - Local Alignment of Sequences / Pairwise Sequence Alignment using BLAST
14. Pairwise sequence alignment using FASTA / Aligning Multiple Sequences with CLUSTAL W/ Construction of Cladogram
15. Phylogenetic Analysis using PHYLIP - Rooted trees / Phylogenetic Analysis using PHYLIP - Unrooted trees
16. Finding the Active Site Pockets of a given Protein Molecule / Primary Structure Analysis of a Protein Using ProtParam
17. Secondary structure analysis of a protein using SOPMA / Surface Analysis of a Protein Using CASTp
18. Homology Modeling using Modeller/Protein- Ligand Interaction

REFERENCE

Course Designed By:
Dr K Abdhul, Associate Professor, Department of Biotechnology, Nandha Arts and Science College, Erode
Dr S Karthi, Associate Professor, Department of Biotechnology, Nandha Arts and Science College, Erode

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	S	S	L	S	S	S	M	M	L
CO2	S	M	M	S	M	M	L	L	S	M
CO3	M	M	S	S	S	S	M	S	M	L
CO4	M	M	S	S	L	S	S	M	S	L
CO5	M	S	M	M	S	M	M	S	S	S
*S-Strong; M-Medium; L-Low										

Course code 43Q	PRACTICAL – IV PHARMACEUTICAL BIOTECHNOLOGY AND BIOPROCESS TECHNOLOGY	L	T	P	C
Practical		**5**			**4**
Pre-requisite	Students should have basic practical knowledge on Pharmacology and Bioprocess technology	**Syllabus Version**			**2026 - 2027**

Course Objectives:

The main objectives of this course are to:

- Broader overview on basics of pharmacology.
- Extensive research ideas in industrial setup towards drug discovery, development and production

Expected Course Outcomes (CO) :

On the successful completion of the course, student will be able to:

1	Learn various modes of administration of drugs	K1
2	Understand the phytochemical and its role in antioxidant	K3,K4
3	Understand the role of toxicity testing of drugs	K2,K3
4	Analyze the production of metabolites in industry	K4,K5
5	Student will apply practical knowledge for lab scale production enzymes and biofertilizers	K5,K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

PHARMACEUTICAL BIOTECHNOLOGY

1. Various modes of administration of drugs: Intravenous, Intramuscular, Intraperitoneal, Intradermal
2. Acute toxicity testing of drugs
3. Determination of analgesic and anti-inflammatory activity of a compound
4. Spectrophotometric determination of Allantoin and Griseofulvin
5. Microbial analysis of Pharamaceuticals (syrups)
6. Qualitative and Quantitative analysis of phytochemicals (any four)
7. Determination of antioxidant activity
   a) DPPH, b) SOD, c) H2O2
8. Determination of iron chelating activity of plant extract

BIOPROCESS TECHNOLOGY

9. Screening and Isolation of Industrially important microorganisms and strain improvement by mutation.
10. Growth curve - measure of bacterial population by turbidimetry and studying the effect of temperature, pH, carbon and nitrogen source in the media.
11. Determination of thermal death point and thermal death time of microorganisms
12. Lab scale fermentation of antibiotics
13. Production of alcohol
14. Production of citric acid from *Aspergillus niger*
15. Production of extracellular lipase from *Bacillus* spp.
16. Immobilization of bacteria
17. Immobilization of enzymes

REFERENCE

1. Manual of industrial Microbiology and Biotechnology by Davis J.E. and Demain A.L. Published by ASM publications, 1999. Edition: 2.

2. Microbial Technology: Fermentation technology - Henry J. Peppler, D. Perlman, Published by Academic Press, 1979. Edition: 2.

3. Quality control in the Pharmaceutical Industry by Murray S. Cooper Volume.II. Published by Academic Press New York

4. Manual of Clinical Laboratory and Immunology by Noel R. Rose, Published by ASM Publications, 2002, Edition: 6

Course Designed By:
Mr. T. Purushothaman, Head, Asst. Prof, Dept. of Biotechnology, SNMV CAS, Coimbatore
Dr. K. Ramalashmi, Asst. Prof, Dept. of Biotechnology, SNMV CAS, Coimbatore

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	L	S	M	L	S	M	L
CO2	S	M	S	M	M	S	M	M	S	M
CO3	M	M	S	S	S	M	S	S	M	L
CO4	S	M	S	S	M	M	M	L	S	M
CO5	M	S	M	M	S	M	S	S	M	S

*S-Strong; M-Medium; L-Low

Annexure

M. Sc. BIOTECHNOLOGY
(AFFILIATED COLLEGES)

Syllabus
(With effect from 2023-2024)

Program Code :

DEPARTMENT OF BIOTECHNOLOGY
Bharathiar University
(A State University, Accredited with "A" Grade by NAAC and
13th Rank among Indian Universities by MHRD-NIRF)
Coimbatore 641 046, INDIA