PAAVAI ENGINEERING COLLEGE, NAMAKKAL – 637018
(AUTONOMOUS)
REGULATIONS 2019
(CHOICE BASED CREDIT SYSTEM)
B.Tech. BIOTECHNOLOGY
(Applicable to the students admitted during the academic year 2020 – 2021 onwards)
CURRICULUM

SEMESTER V

S. No.	CATEGORY	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY							
1	PC	BT20501	Bioprocess Engineering	3	0	0	3
2	PC	BT20502	Plant and Animal Biotechnology	3	0	0	3
3	PC	BT20503	Molecular Biology	3	0	0	3
4	ES	BT20504	Thermodynamics for Biotechnologist	3	0	0	3
5	PE	BT2015*	Professional Elective I	3	0	0	3
PRACTICAL							
6	PC	BT20505	Bioprocess Engineering Laboratory	0	0	4	2
7	PC	BT20506	Cell and Molecular Biology Laboratory	0	0	4	2
8	EE	EN20501	Career Development Laboratory I	0	0	2	1
			TOTAL	**15**	**0**	**10**	**20**

SEMESTER VI

S. No.	CATEGORY	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY							
1	PC	BT20601	Bioinformatics	3	0	0	3
2	ES	BT20602	Chemical Reaction Engineering	3	0	0	3
3	PC	BT20603	Genetic Engineering	3	0	0	3
4	PC	BT20604	Enzyme Technology	3	0	0	3
5	PE	BT2025*	Professional Elective II	3	0	0	3
6	OE	BT2090*	Open Elective I	3	0	0	3
PRACTICAL							
7	PC	BT20605	Bioinformatics Laboratory	0	0	4	2
8	PC	BT20606	Genetic Engineering Laboratory	0	0	4	2
9	EE	EN20601	Career Development Laboratory II	0	0	2	1
			TOTAL	**18**	**0**	**10**	**23**

PROFESSIONAL ELECTIVE I

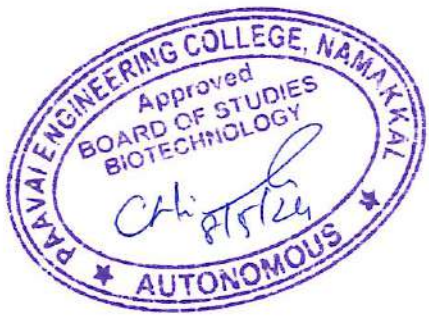
S. No.	CATEGORY	COURSE CODE	COURSE TITLE	L	T	P	C
1.	PE	BT20151	Food Processing and Technology	3	0	0	3
2.	PE	BT20152	Protein Engineering	3	0	0	3
3.	PE	BT20153	Marine Biotechnology	3	0	0	3
4.	PE	BT20154	Biosafety and Hazard Management	3	0	0	3

PROFESSIONAL ELECTIVE II

S. No.	CATEGORY	COURSE CODE	COURSE TITLE	L	T	P	C
1.	PE	BT20251	Biopharmaceutical Technology	3	0	0	3
2.	PE	BT20252	Tissue Engineering	3	0	0	3
3.	PE	BT20253	Forensic Science and Technology	3	0	0	3
4.	PE	BT20254	Artificial Intelligence for Biotechnology	3	0	0	3

OPEN ELECTIVE I (OE)

S. No.	CATEGORY	COURSE CODE	COURSE TITLE	L	T	P	C
1.	OE	BT20901	Bioenergy and Biofuels	3	0	0	3
2.	OE	BT20902	Agriculture Biotechnology	3	0	0	3



BT20501	BIOPROCESS ENGINEERING	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	learn the basics of bioreactor engineering.
2	design the rheological parameters and scale-up of fermentation process.
3	explore the immobilized enzyme reactors using various methods.
4	understand the modelling and stimulation of bioprocess.
5	understand the concepts of recombinant cell cultivation.

UNIT I CONFIGURATION OF BIOREACTORS 9

Ideal reactors and their characteristics Fed-batch cultivation, Cell recycle cultivation, Cell recycle cultivation in wastewater treatment, two-stage cultivation Packed bed reactor, airlift reactor,introduction to fluidized bed reactor bubble column reactors.

UNIT II BIOREACTOR SCALE – UP 9

Regime analysis of bioreactor processes, oxygen mass transfer in bioreactors – microbial oxygen demands; methods for the determination of mass transfer coefficients; mass transfer correlations. Scale-up criteria for bioreactors based on oxygen transfer, power consumption, and impeller tip speed.

UNIT III BIOREACTOR CONSIDERATION IN ENZYME SYSTEMS 9

Analysis of film and pore diffusion effects on kinetics of immobilized enzyme reactions; formulation of dimensionless groups and calculation of effectiveness factors. Design of immobilized enzyme reactors – packed bed, fluidized bed and membrane reactors.

UNIT IV MODELLING AND SIMULATION OF BIOPROCESSES 9

Study of structured models for analysis of various bioprocess – compartmental models, models of cellular energetics and metabolism, single cell models, plasmid replication and plasmid stability model. Dynamic simulation of batch, fed batch, steady and transient culture metabolism.

UNIT V RECOMBINANT CELL CULTIVATION 9

Different host-vector system for recombinant cell cultivation strategies and advantages. *E. coli*, yeast *Pichia pastoris / Saccharomyces cerevisiae*, Animal cell cultivation, plant cell cultivation, Insect cell cultivation. High cell density cultivation, process strategies, and reactor considerations in the above system.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course, the students will be able to		**BT MAPPED** (Highest Level)
CO1	describe various bioreactor configurations and operation modes.	Understanding (K2)
CO2	examine the knowledge of bioreactor for scale-up process.	Applying (K3)
CO3	detect the engineering methods of enzyme reactors for evaluation of effectiveness factors.	Analysing (K4)

CO4	utilize modelling approaches and simulation concepts for bioprocess estimations.	Applying (K3)
CO5	illustrate bioreactor considerations for the development of recombinant products.	Understanding (K2)

TEXT BOOKS

1. Shuler ML, Kargi F, DeLisa MP, "Bioprocess Engineering", 3rd Edition, Prentice Hal, 2017.
2. Doran PM, "Bioprocess Engineering Principles", 2ndEdition, Elsevier Science, 2013.

REFERENCES

1. Niazi SK, Brown JL, "Fundamentals of Modern Bioprocessing", Taylor and Francis, 2017.
2. Moser A, "Bioprocess Technology:Kinetics and Reactors", Springer Verlag, 2012.
3. Bailey JE, Ollis DF, "Biochemical engineering fundamentals", McGraw-Hill, 2018.
4. Blanch HW, Clark DS, "Biochemical Engineering", 3rd edition, CRC Press, 2021.

CO/PO MAPPING :

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	1	2	-	1	-	-	-	-	-	-	3	3	1
CO2	3	3	3	3	2	1	-	1	-	-	1	2	2	3
CO3	3	3	3	3	2	1	-	1	-	-	1	1	2	2
CO4	3	3	3	2	2	1	-	-	-	-	-	2	2	3
CO5	1	1	2	2	1	-	-	2	-	-	-	3	3	1

BT20502	PLANT AND ANIMAL BIOTECHNOLOGY	3	0	0	3

COURSE OBJECTIVES	
To enable the students to	
1	understand the basic principles of plant tissue culture.
2	know the current scope and limits to its industrial application.
3	explain implications of modern methods of genetic modification for plant industries.
4	understand the animal tissues, animal cell culture and its application in research.
5	apply the knowledge for genetic research to produce therapeutic products.

UNIT I	INTRODUCTION TO PLANT TISSUE CULTURE	9
Introduction, History, Applications of Plant tissue culture, Laboratory facilities and operations, Nutrition medium composition and preparation, Sterilization Techniques and Types of culture.		

UNIT II	MICROPROPAGATION, INVITRO PRODUCTION OF HAPLOIDS AND SOMATIC HYBRIDIZATION	9
Micro propagation techniques- different methods, Haploid plants -generation, significance, method, Protoplast preparation, isolation, purification, viability and culturing, somatic hybridization- techniques, methods to screen, methods of verification/ characterization. Somatic hybridization Applications.		

UNIT III	TRANSGENICS FOR CROP IMPROVEMENT AND METABOLITE PRODUCTION	9
Transgenic plant generation, Agrobacterium infection-Ti and Ri plasmid, plant vectors, methods of gene transfer, selection and screening, transgenics in crop improvement, terminator seed technology, transgenics in molecular farming, Cell suspension culture, secondary metabolite production, selection of high yielding line, Molecular farming.		

UNIT IV	INTRODUCTION TO ANIMAL TISSUE CULTURE	9
Background, Advantages, Limitations, Application, Culture Environment, Cell Adhesion, Cell Proliferation, Differentiation. Essential Equipment's, Aseptic Technique. Physicochemical Properties, Balanced Salt Solutions, Complete Media, Serum, Serum-Free Media, Primary Culture: Isolation of Tissue, Steps involved in primary cell culture, Cell Lines, Immortalization of cell lines. Need of Cryopreservation, Preservation, Cell banks, In Vitro Fertilization and Embryo Transfer.		

UNIT V	TRANSGENIC ANIMALS AND GENE THERAPY	9
Methodology, Embryonic Stem Cell method, Microinjection method, In vivo gene therapy, Viral gene delivery system, Retrovirus vector system, Adenovirus vector system, Adeno-Associated virus vector system, Herpes simplex virus vector system, non-viral gene delivery system, Prodrug activation therapy, Nucleic acid therapeutic agents.		

	TOTAL PERIODS	45

COURSE OUTCOMES		
At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	describe the theoretical knowledge in molecular, biochemical and plant sciences for plant biotechnology.	Understanding (K2)
CO2	relate the need of various physiochemical conditions in plant tissue culture.	Applying (K3)
CO3	choose the recent methodologies of plant tissue and cell culture to develop a whole plant.	Applying (K3)
CO4	apply the *in vitro* techniques to make animal tissue culture.	Applying (K3)
CO5	explore the basic research ideas into various interdisciplinary domains.	Applying (K3)

TEXT BOOKS

1. Murthy BRC, Sai VST, "Botany-Plant tissue culture and its biotechnological applications", Venkateswara Publications, 2017.
2. Ramadass P, "Animal Biotechnology: Recent concepts and developments", MJP Publishers, 2019.

REFERENCES

1. Razdon MK, Introduction to Plant Tissue Culture, 3rd Edition, Oxford andIBH Publishing Company,2019
2. Glick BR, Pasternak JJ, "Molecular Biotechnology- Principles and Applications of recombinant DNA", ASM Press, Washington, 2010.
3. Pullaiah T, Subba Rao MV, "Plant Tissue culture" 2nd Edition, Scientific Publishers, New Delhi, 2017.
4. Snustad DP, Simmons MJ, "Principles of Genetics", John Wiley and Sons, U.K. 5th Edition, 2012.

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	PO's												PSO's	
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CO1	1	2	1	1	3	2	1	1	1	-	-	2	3	2
CO2	3	3	2	2	2	1	-	-	-	-	-	3	3	2
CO3	3	3	3	3	3	1	-	1	1	-	-	1	3	3
CO4	3	3	3	3	3	3	-	-	-	-	-	1	2	3
CO5	3	3	3	3	3	1	1	1	1	-	1	2	2	2

BT20503	MOLECULAR BIOLOGY	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	acquire basic fundamental knowledge and explore skills in molecular biology.
2	emphasize the molecular mechanism of DNA replication and repair.
3	understand gene regulation in transcription in prokaryotes and eukaryotes.
4	discuss the regulation of gene expression in translation and protein synthesis.
5	illustrate the principles of cell division and cell cycle.

UNIT I **CHEMISTRY OF NUCLEIC ACIDS** **9**

Introduction to nucleic acids: Nucleic acids as genetic material, Structure and physicochemical properties of elements in DNA and RNA, Biological significance of differences in DNA and RNA. Primary structure of DNA: Chemical and structural qualities of 3',5'-Phosphodiester bond. Secondary Structure of DNA: Watson and Crick model, Chargaff's rule, X–ray diffraction analysis of DNA, Forces stabilizes DNA structure, Conformational variants of double helical DNA, Hogsteen base pairing, Triple helix, Quadruple helix, Reversible denaturation and hyperchromic effect. Tertiary structure of DNA: DNA supercoiling.

UNIT II **DNA REPLICATION AND REPAIR** **9**

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

UNIT III **TRANSCRIPTION** **9**

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

UNIT IV **TRANSLATION** **9**

Introduction to Genetic code: Elucidation of genetic code, Codon degeneracy, Wobble hypothesis and its importance, Prokaryotic and eukaryotic ribosomes. Steps in translation: Initiation, Elongation and termination of protein synthesis. Inhibitors of protein synthesis. Posttranslational modifications and its importance. Regulation of gene expression: lac- and trp-operon.

UNIT V **CELL DIVISION AND CELL CYCLE** **9**

Cell division: Mitosis, Meiosis and Cytokinesis. Cell cycle: Methods in cell cycle analysis. Regulation of

cell cycle – Cell cycle check points, molecules and mechanisms of cell cycle regulation. Cell cycle modulators.

	TOTAL PERIODS	45

COURSE OUTCOMES

At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	articulate the composition, structure and characteristics of nucleic acids.	Understanding (K2)
CO2	describe the chemical and molecular processes that occur in and between cells.	Understanding (K2)
CO3	discuss about gene organization and control mechanisms of the gene expression for transcription process.	Applying (K3)
CO4	utilize the basic mechanisms of gene expression through translation process.	Applying (K3)
CO5	employ the mechanisms of cell division to understand molecular events.	Applying (K3)

TEXT BOOKS

1. Friefelder, George Malacinski M, "Essentials of Molecular Biology" 4th Edition, Narosa Publications, 2015.
2. Robert Weaver F, "Molecular Biology" 4th edition, Tata McGraw-Hill, 2011.

REFERENCES

1. Cooper GM, Hausman RE, "The Cell: A Molecular approach", 7th Edition, 2015.
2. Krebs JE, Goldstein ES, Kilpatrick ST, "Lewin's Essential GENES XII", 12th Edition 2017.
3. Nelson DL, Cox MM, "Lehninger Principles of Biochemistry", 6th Edition, 2017.
4. Alberts B, Johnson A, Lewis J, Morgan D, Raff M, Roberts K, Walter P, "Molecular Biology of the cell", 6th Edition, 2014.

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CO1	3	3	2	1	1	1	-	-	-	-	-	2	3	3
CO2	3	3	2	2	1	1	-	-	-	-	-	2	2	3
CO3	3	2	2	1	1	1	-	-	-	-	-	2	3	2
CO4	3	2	2	3	2	1	-	-	-	-	1	3	3	2
CO5	3	2	3	3	3	1	-	-	-	-	1	2	2	3

BT20504	THERMODYNAMICS FOR BIOTECHNOLOGIST	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	introduce the basic thermodynamic relations and properties of fluids.
2	understand the thermodynamic properties of various solutions.
3	apply the thermodynamics to phase equilibria in single, multi-component systems.
4	use the thermodynamics calculations in single and multiple chemical reactions.
5	compute the thermodynamic principles in microbial growth and product formation.

UNIT I	THERMODYNAMIC LAW AND PROPERTIES OF FLUIDS	9

Zeroth Law of Thermodynamics, First Law of thermodynamics, a generalized balance equation and conserved quantities, Volumetric properties of fluids exhibiting non ideal behavior; residual properties; estimation of thermodynamic properties using equations of state; calculations involving actual property exchanges; Maxwell's relations and applications; Second law of thermodynamics.

UNIT II	SOLUTION THERMODYNAMICS	9

Partial molar properties; concepts of chemical potential and fugacity; ideal and non-ideal solutions; concepts and applications of excess properties of mixtures; activity coefficient; composition models; Gibbs-Duhem equation.

UNIT III	PHASE EQUILIBRIA	9

Criteria for phase equilibria; VLE calculations for binary and multi component systems; liquid-liquid equilibria and solid-solid equilibria.

UNIT IV	CHEMICAL REACTION EQUILIBRIA	9

Equilibrium criteria for homogeneous chemical reactions; evaluation of equilibrium constant; effect of temperature and pressure on equilibrium constant; calculation of equilibrium conversion and yields for single and multiple reactions.

UNIT V	THERMODYNAMIC DESCRIPTION OF MICROBIAL GROWTH AND PRODUCT FORMATION	9

Energetics of Metabolic Pathways; Energy Coupling (ATP and NADH); Stoichiometry and energetic analysis of Cell Growth and Product Formation - elemental Balances, Degree of reduction concepts; available-electron balances; yield coefficients; Oxygen consumption and heat evolution in aerobic cultures; Thermodynamics of microbial growth stoichiometry thermodynamics of maintenance.

	TOTAL PERIODS	45

COURSE OUTCOMES

At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	compute the thermodynamic principles in microbial growth and product formation.	Understanding (K2)
CO2	investigate the thermodynamic properties in various solution mixtures.	Understanding (K2)

CO3	calculate thermodynamic parameters involved in biochemical reactions.	Applying (K3)
CO4	analyze the equilibrium criteria for various reaction systems.	Applying (K3)
CO5	demonstrate the capability to analyze the energy conversion performance in applications in biological systems.	Applying (K3)

TEXT BOOKS

1. Smith JM, Van Ness HC, Abbot MM, "Introduction to Chemical Engineering Thermodynamics", 8th Edition, Tata McGraw-Hill, 2019.
2. Narayanan KV, "A Text Book of Chemical Engineering Thermodynamics", 2nd Edition, PHI, 2013.

REFERENCES

1. Elliott, "Introductory Chemical Engineering Thermodynamics", Pearson India, 2014.
2. Sandler SI, "Chemical and Engineering Thermodynamics", John Wiley, 2020.
3. Elias Franses I, "Thermodynamics with Chemical Engineering Applications", Cambridge University Press, 1st edition, 2014.
4. Kevin Dahm D, Donald Visco P, "Fundamentals of Chemical Engineering Thermodynamics" Routledge, Taylor and Francis Group, 2015.

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CO1	2	2	2	2	-	-	-	-	-	-	-	2	3	3
CO2	3	3	3	1	-	-	-	-	-	-	-	2	3	3
CO3	2	2	2	1	-	-	-	-	-	-	-	1	1	2
CO4	2	2	2	2	-	-	-	-	-	-	-	1	1	3
CO5	1	2	1	2	-	-	-	-	-	-	-	2	2	3

BT20505	BIOPROCESS ENGINEERING LABORATORY	0	0	4	2

COURSE OBJECTIVES

To enable students to

1	interpret the enzyme kinetics.
2	perform the immobilized enzyme techniques.
3	identify the growth kinetics of bacteria .
4	analyze the productivity in a bioreactor for the given metabolite.

LIST OF EXPERIMENTS

1. Enzyme kinetics – Determination of Michaelis - Menten parameters.
2. Enzyme activity – Effect of Temperature and Deactivation Kinetics.
3. Enzyme activity – Effect of pH.
4. Enzyme immobilization – Gel entrapment.
5. Enzyme immobilization –Cross-linking.
6. Enzymatic conversion in Packed bed Column.
7. Growth of Bacteria – Estimation of Biomass, Calculation of Specific Growth Rate, Yield Coefficient.
8. Optimization by Plackett Burman Design.
9. Optimization by Response Surface Methodology.
10. Estimation of KLa – Dynamic by different methods.

TOTAL PERIODS 60

COURSE OUTCOMES

At the end of this course, the students will be able to		**BT MAPPED** (Highest Level)
CO1	investigate kinetics and characterization of enzymes for practical applications.	Analyzing (K4)
CO2	evaluate the growth kinetics of microorganisms.	Evaluating (K5)
CO3	optimize medium formulation in bioprocess industry with better efficacy.	Applying (K3)
CO4	create mathematical models for microbial growth.	Evaluating (K5)

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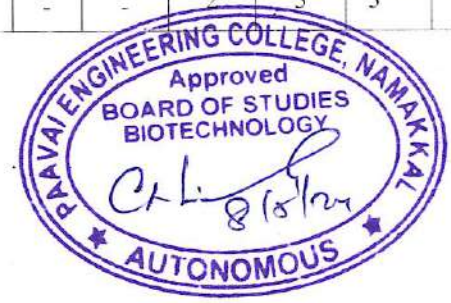
CO3	2	3	3	2	2	-	-	1	-	-	2	3	2	2
CO4	3	3	3	2	2	-	-	1	-	-	2	3	3	2



BT20506	CELL AND MOLECULAR BIOLOGY LABORATORY	0	0	4	2

COURSE OBJECTIVES

To enable students to

1	interpolate the hands-on experiment in basic molecular biology techniques.
2	exercise the DNA isolation techniques.
3	relate the identification and characterization of gene and protein.
4	describe the common applications of each methodology in biological research.

LIST OF EXPERIMENTS

1. Microscopy – Working and care of Microscope, phase contrast and fluorescent microscopy
2. Identification of cells by Giemsa Staining Techniques.
3. Identification of cells by Leishman Staining Techniques
4. Mitosis in onion root tip.
5. Separation of Peripheral Blood Mononuclear Cells from blood.
6. Isolation of DNA from plant cells .
7. Isolation of Plasmid DNA from bacterial cell.
8. Quantitative analysis of isolated genomic DNA using spectrophotometer.
9. Extraction of proteins from plant or animal tissue and confirmation with qualitative test.
10. Chromosome staining and Karyotyping (Demo).

TOTAL PERIODS 60

COURSE OUTCOMES

At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	examine the principles underlying in the techniques of cell biology and molecular biology.	Applying (K3)
CO2	experience basic techniques of DNA isolation and manipulation.	Analysing (K4)
CO3	establish the ability to carry out laboratory experiments and interpret the results.	Analysing (K4)
CO4	analyse basic techniques involved in analysis of gene expression at nucleic acids and proteins level.	Analysing (K4)

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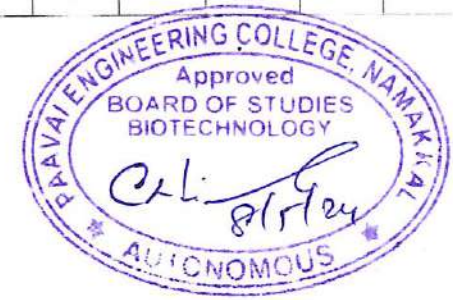
CO2	3	3	3	3	-	1	1	1	2	1	2	2	2	2
CO3	3	3	3	3	1	2	1	1	2	1	3	3	3	2
CO4	3	3	3	3	1	2	1	1	-	1	3	2	3	2



EN20501	CAREER DEVELOPMENT LABORATORY I	0	0	2	1

COURSE OBJECTIVES

To enable students to

1.	enhance their Writing Skills.
2.	evaluate their Presentation Skill to face the corporate world.
3.	solve the quantitative aptitude problems and improve their Mental ability.
4.	improve their reasoning skills.

UNIT I	WRITING SKILLS	7

Writing Skills: The Essentials of Writing; The Importance of Structure; Types of Writing- Common Mistakes in Writing.

Activities: Email Writing ; Paragraph writing ;Report Writing ; Story Writing - Story Telling Session: 2 – JAM Session 1

UNIT II	PRESENTATION SKILLS & GROUP DISCUSSION	7

Presentation Skills: Types of Presentation; Methods of Delivering Presentation; Ways to improve the Presentation – Presentation Aids- Group Discussion: Introduction –Types & Importance; Why GD; Types of GD- Evaluation Criteria – Do's & Don'ts of GD.

Activities: Presentation Session I ;Group Discussion Session I; Role Play Session (Team) Level II; Personality Profile Session II ;Company Profile Analysis Session II.

UNIT III	QUANTITATIVE APTITUDE	8

Simplification ;Cubes & Cube Roots ;Squares & Square Roots ;Boats & Streams ;Trains ;Profit & Loss – Pipes & Cisterns

UNIT IV	LOGICAL REASONING – I	8

Series Completion ; Letter Series ;Symbol Series; Number Series ;Arithmetic Reasoning; Blood Relations; Seating Arrangement ; Character Puzzle

TOTAL PERIODS	30

COURSE OUTCOMES

At the end of this course, students will be able to		BT Mapped (Highest Level)
CO1	demonstrate the Participative skills in Group Discussions	Analyzing (K4)
CO2	enhance their usage of audio and visual aids in their Presentation	Applying (K3)

CO3	problems based on quantitative aptitude	Applying (K3)
CO4	reveal their logical and verbal reasoning by scoring the expected percentage to get placed in reputed companies	Analyzing (K4)

TEXTBOOKS

1. Agarwal, R.S. "Objective General English", S.Chand & Co.2018.
2. Agarwal, R.S. " Objective General English", S.Chand&Co.2016.

REFERENCES

1. Abhijit Guha, "Quantitative Aptitude ", Tata-Mcgraw Hill.2015.
2. Word Power Made Easy By Norman Lewis ,Wr.Goyal Publications.2016.
3. Johnson, D.W. Reaching out – Interpersonal Effectiveness and self-actualization. Boston: Allyn and Bacon.2019.
4. Infosys Campus Connect Program – students' guide for soft skills.2015.

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	PO's												PSO's	
CO's	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	-	-	-	-	-	-	3	3	2	3	-	3	1	1
CO2	-	-	-	-	-	-	2	3	2	3	-	3	1	1
CO3	3	2	2	2	-	-	1	-	-	-	2	-	2	2
CO4	2	1	3	2	-	3	3	1	-	1	2	-	2	2

PAAVAI ENGINEERING COLLEGE, NAMAKKAL
Approved
BOARD OF STUDIES
English
12/8/22
AUTONOMOUS

BT20601	BIOINFORMATICS	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	provide knowledge on biological databases, sequence analysis, evolutionary analysis and applications of bioinformatics.
2	understand biological data resources, algorithms and alignment tools.
3	outline the principle of phylogenetic methods.
4	explain the bioinformatics core concepts for structural analysis.
5	illustrate the application in the analysis of biological data.

UNIT I BIOLOGICAL DATABASES 9

Introduction to Bioinformatics and Computational Biology, Biological sequences, Classification of biological databases - Sequence Databases, Structure Databases, Genome specific databases, Special Databases and applications- Microarray, Metabolic pathway, motif, and domain databases, Data file formats.

UNIT II SEQUENCE ANALYSIS 9

Sequence Alignment- Homology vs Similarity, Similarity vs Identity. Types of Sequence alignment - Pairwise and Multiple sequence alignment, Global alignment, Local alignment, Dotplot, Alignment algorithms- Needleman wunsch and Smith and waterman algorithm, Substitution matrices- PAM, BLOSUM. Multiple Sequence Alignment- Application of multiple alignments, Viewing and editing ofMSA and Scoring function. Database Similarity Searching- Basic Local Alignment Search Tool (BLAST), FASTA, PHI BLAST, PSI BLAST, BLAST algorithm.

UNIT III MOLECULAR PHYLOGENY 9

Phylogenetics Basics, Molecular clock theory, Ultrametric trees, Distance matrix methods UPGMA,NJ, Character based methods-Maximum Parsimony. Methods of evaluating phylogenetic methods-bootstrapping, jackknifing.

UNIT IV MACROMOLECULAR STRUCTURE ANALYSIS 9

Gene prediction, Conserved domain analysis, Protein structure visualization, Prediction of protein secondary structure, Tertiary structure prediction- Homology modeling, Threading, Ab-initio prediction. Validation of the predicted structure using Ramachandran plot, steriochemical properties, Structure-structure alignment.

UNIT V APPLICATIONS 9

Introduction to Systems Biology and Synthetic Biology, Microarray data analysis, DNA computing, Bioinformatics approaches for drug discovery, Applications of Bioinformatics in genomics and proteomics- Assembling the genome, STS content mapping for clone contigs, Functional annotation, Peptide mass fingerprinting.

TOTAL PERIODS 45

COURSE OUTCOMES		
At the end of this course, the students will be able to		**BT MAPPED** (Highest Level)
CO1	apply computational based solutions for biological perspectives	Applying (K3)
CO2	make use of bioinformatics tools for analysing data sequence	Understanding (K2)
CO3	assign the evolutionary relationship between the organisms	Applying (K3)
CO4	determine the macromolecule's structure prediction methods	Applying (K3)
CO5	process the applications of bioinformatics approach for drug discovery, genomics and proteomics.	Applying (K3)

TEXT BOOKS

1. Lesk, Arthur,"Introduction to bioinformatics", Oxford university press, 2019.
2. Su,Andreas D. Baxevanis, BF Francis Ouellette Chen. "Bioinformatics", John Wiley & Sons, 2020.

REFERENCES

1. Attwood TK, Parry Smith DJ, "Introduction to Bioinformatics", Pearson Education, 1st Edition, 11thReprint, 2005.
2. Mount DW, "Bioinformatics Sequence and Genome Analysis", Cold Spring Harbor, Laboratory Press, 1st Edition, 2004.
3. Durbin R, Eddy S, Krogh A, Mitchison G, "Biological Sequence Analysis Probabilistic Models of proteins and nucleic acids", Cambridge University Press, 2013.
4. Xinkun Wang, "Next Generation Sequencing Data Analysis", CRC Press, 2016.

CO/PO MAPPING :

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	1	1	1	-	-	-	-	-	-	-	2	1	1
CO2	2	1	1	1	1	-	-	-	-	-	-	3	1	1
CO3	3	2	2	3	1	-	-	-	-	-	-	1	2	3
CO4	3	3	2	1	-	-	-	-	-	-	-	1	2	3
CO5	3	2	2	1	-	-	-	-	-	-	-	1	1	1

BT20602	CHEMICAL REACTION ENGINEERING	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	impart the basic concepts in reaction kinetics.
2	develop knowledge for design of ideal reactors.
3	understand the practical aspects of non-ideal flow.
4	discuss the intermolecular and covalent catalysis in gas-liquid reactions.
5	apply the reaction engineering principles in biological systems.

UNIT I KINETICS OF HOMOGENOUS REACTIONS 9

Concentration and temperature dependent term of rate equation; searching for mechanism; predictability of reaction rate from theory; Interpretation of batch reactor data; constant volume and variable volume batch reactor; temperature and reaction rate; development of rate equations for different homogeneous reactions (up to second order reactions both reversible and irreversible reactions).

UNIT II REACTOR DESIGN 9

Ideal batch reactors; steady state MFR and PFR; holding time for flow systems; Design for single reactions; performance equations for single reactors; size comparison of single reactors – MFR vs PFR for first and second order reactions; multiple reactor systems with graphical comparison.

UNIT III NON-IDEAL FLOW 9

RTD; Conversion in non-ideal flow reactors; Compartment Models; Dispersion Model; Tanks-in-series Models; Convection Models; earliness of mixing, segregation and RTD.

UNIT IV GAS – LIQUID REACTION 9

Reactivity – Coenzymes – Proton transfer – metal ions – Intra molecular reactions – Covalent catalysis – Catalysis by organized aggregates and phases. Inclusion complexation.

UNIT V BIOCHEMICAL REACTION SYSTEMS 9

Bioreactor Systems Definitions; Differences and similarities between chemical and bioreactors; Classification of bioreactors; Reactor configurations; Description of a conventional bioreactor with all aspects; Design equations for enzyme reactors; batch growth of microorganism; Design equation of a plug flow reactor; Estimation of kinetic parameters.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course, the students will be able to		**BT MAPPED** (Highest Level)
CO1	solve the kinetics of homogeneous reactions	Applying (K3)
CO2	examine the design aspects for different ideal reactors	Applying (K3)
CO3	demonstrate non-ideal flow in chemical reactors	Understanding (K2)
CO4	analysis the reactivity in gas liquid reaction	Applying (K3)
CO5	outline the nature of biochemical reaction systems	Understanding (K2)

TEXT BOOKS

1. Levenspiel O, "Chemical Reaction Engineering", John Wiley, 3rd Edition, 2021.
2. Fogler HS, "Elements of Chemical Reaction Engineering", Prentice Hall of India, 6th Edition, 2020.

REFERENCES

1. Shaofen Li, Feng Xin, Lin Li, "Reaction Engineering", Elsevier Science, 2017.
2. Froment GF, Bischoff KB, "Chemical Reactor Analysis and Design", John Wiley and Sons, 3rd Edition, 2010.
3. Himadri Roy Ghatak, Reaction Engineering Principles, CRC Press, 2018.
4. Mikkola JP, Salmi TO, Warna JP, "Chemical Reaction Engineering and Reactor Technology", 2nd Edition, Routledge Taylor & Francis Group, 2019.

CO/PO MAPPING :

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	PO's												PSO's	
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CO3	3	3	3	1	-	-	-	-	-	-	-	1	3	1
CO4	3	3	1	1	-	-	-	-	-	-	-	3	1	2
CO5	3	1	1	3	-	-	-	-	-	-	-	3	1	3

BT20603	GENETIC ENGINEERING	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	understand the basics of Recombinant DNA.
2	explain the heterologous expression of cloned genes in different hosts.
3	learn the fundamentals of recombinant DNA technology and DNA manipulation techniques.
4	apply the fundamentals of genome organization in the development of genetic maps.
5	employ the application of genetic engineering in various fields.

UNIT I BASICS OF RECOMBINANT DNA TECHNOLOGY 9

Manipulation of DNA – Restriction and Modification enzymes, Design of linkers and adaptors.Characteristics of cloning and expression vectors based on plasmid and bacteriophage, Vectors forinsect, yeast and mammalian system, Prokaryotic and eukaryotic host systems, Introduction ofrecombinant DNA in to host cells and selection methods.

UNIT II DNA LIBRARIES 9

Construction of genomic and cDNA libraries, Artificial chromosomes – BACs and YACs, Chromosomal walking, Screening of DNA libraries using nucleic acid probes and antisera.

UNIT III SEQUENCING AND AMPLIFICATION OF DNA 9

Maxam Gilbert's and Sanger's methods of DNA sequencing. Inverse PCR, Nested PCR, AFLPPCR, Allele specific PCR, Assembly PCR, Asymmetric PCR, Hot start PCR, inverse PCR, Colony PCR, single cell PCR, Real-time PCR/qPCR – SYBR green assay, Taqman assay, Molecular beacons. Site directed mutagenesis.

UNIT IV ORGANIZATION AND STRUCTURE OF GENOMES 9

Organization and structure of genomes, Genome sequencing methods, Conventional and shot gun genome sequencing methods, Next generation sequencing technologies, Ordering the genome sequence, Genetic maps and Physical maps, STS content-based mapping, Restriction Enzyme Finger Printing, Hybridization mapping, Radiation Hybrid Maps, Optical mapping. ORF finding and functional annotation.

UNIT V CURRENT STATUS OF GENOME SEQUENCING PROJECTS 9

Current status of genome sequencing projects, Introduction to Functional genomics, Microarrays, Serial Analysis of Gene expression (SAGE), Subtractive hybridization, DIGE, TOGA, Yeast Two hybrid System, Comparative Genomics, Proteogenomics, Web resources for Genomics, Applications of genome analysis and genomics.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course, the students will be able to		**BT MAPPED** (Highest Level)
CO1	explain the rDNA technology for recombinant products.	Understanding (K2)

CO2	produce the commercially important recombinant proteins.	Applying (K3)
CO3	aware of gene and genome sequencing techniques to amplify and analyze DNA.	Applying (K3)
CO4	identify modern tools and techniques for manipulation and analysis of genomic sequences.	Understanding (K2)
CO5	illustrate research methodologies employing genetic engineering techniques.	Applying (K3)

TEXT BOOKS

1. Old RW, Primrose SB, Twyman RM, "Principles of Gene Manipulation, An Introduction To Genetic Engineering", 7th Edition, Wiley–Blackwell, 2006.
2. Primrose SB, Twyman RB, "Principles of Gene manipulation and Genomics", 7th Edition, Wiley-Blackwell, 2014.

REFERENCES

1. Ausubel FM, Brent R, Kingston RE, Moore DD, "Current Protocols in Molecular Biology", Current Protocols; 4th edition, 1999.
2. Berger Sl, Kimmer AR, "Methods In Enzymology", Vol 152, Academic Press.
3. Green MR, Sambrook J, "Molecular Cloning: A Laboratory Manual", 4th Edition, CSHL Press, 2012.
4. Brown TA, "Gene Cloning and DNA analysis: An introduction",8th Edition, Wiley Blackwell, 2020.

CO/PO MAPPING :

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's
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CO1	1	1	1	2	1	1	-	1	-	-	-	3	3	3
CO2	3	3	3	2	2	2	-	2	1	-	-	2	3	3
CO3	3	3	3	3	2	1	-	2	-	-	-	3	3	3
CO4	1	1	1	2	1	1	-	1	-	-	-	3	3	3
CO5	3	3	3	3	3	1	-	2	1	-	1	3	3	3

BT20604	ENZYME TECHNOLOGY	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	introduce the basic mechanism of enzyme action.
2	learn the kinetics of enzymatic reaction.
3	understand the concepts of enzyme immobilization and biosensors.
4	define the characterization and purification of enzymes.
5	gain knowledge on biotransformation and the applications of enzymes .

UNIT I	INTRODUCTION TO ENZYMES	9

Classification of enzymes. Mechanisms of enzyme action; concept of active site and energetics of enzyme substrate complex formation; specificity of enzyme action; principles of catalysis – collision theory, transition state theory; role of entropy in catalysis

UNIT II	KINETICS OF ENZYME ACTION	9

Kinetics of single substrate reactions; estimation of Michelis – Menten parameters, turnover number; types of inhibition and models –substrate, product. Allosteric regulation of enzymes, Koshland, Némethy,Filmer and Monod Changeux Wyman models, pH and temperature effect on enzymes and deactivation kinetics.

UNIT III	ENZYME IMMOBILIZATION AND BIOSENSORS	9

Physical and chemical techniques for enzyme immobilization – adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding etc., - examples, advantages and disadvantages, Introduction to Biosensors- design of enzyme electrodes and their application as biosensors in industry, healthcare and environment.

UNIT IV	ENZYMES FROM NATURAL SOURCES	9

Production and purification of crude enzyme extracts from plant, animal and microbial sources; methods of characterization of enzymes; development of enzymatic assays

UNIT V	BIOTRANSFORMATION APPLICATIONS OF ENZYMES	9

Hydrolytic- Ester bond, Amide, Epoxides, Nitriles, Reduction reactions–aldehydes, Ketones, C=C, Oxidation reactions – Alkanes, Aromatic, Baeyer-Villiger, Enzymes in organic synthesis– esters, amide, peptide, Modified and Artificial Enzymes, Catalytic antibodies

	TOTAL PERIODS	45

COURSE OUTCOMES

At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	describe enzyme and enzyme reactions that are the key step to proceed towards various concepts in biotechnology.	Understanding (K2)
CO2	learn the theoretical and practical aspects of kinetics that provide the importance and utility of enzyme kinetics towards research.	Remembering (K1)
CO3	perform the process of immobilization in food, pharmaceutical and chemical industries.	Applying (K3)

CO4	develop ideas on processing, production and purification of enzymes at an industrial scale	Applying (K3)
CO5	comprehend the biotransformation applications of enzymes	Applying (K3)

TEXT BOOKS

1. Palmer T, Bonner PL, "Enzymes: biochemistry, biotechnology, clinical chemistry", Horwood Publishing Ltd; 2014.
2. Faber K, "Biotransformations in organic chemistry: a textbook", Berlin, Heidelberg: Springer-Verlag, 2018.

REFERENCES

1. Blanch HW, Dunn IJ, "Modelling and simulation in biochemical engineering", In Advances in Biochemical Engineering, Berlin, Heidelberg: Springer, 2005.
2. Bailey JE and Ollis DF, "Biochemical engineering fundamentals" McGraw-Hill, 2018.
3. Yoo YJ, Feng Y, Kim YH, Yagonia CFJ, "Fundamentals of enzyme engineering", Springer, 2017.
4. Punekar NS, "Enzymes", Springer, 2018.

CO/PO MAPPING :

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	PO's												PSO's	
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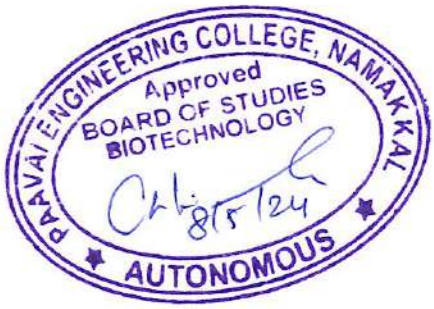
CO1	2	2	2	2	-	-	-	-	-	-	-	3	3	3
CO2	1	1	1	2	-	-	-	-	-	-	-	3	2	3
CO3	3	3	3	3	-	-	-	-	-	-	2	2	3	3
CO4	3	3	3	3	-	-	-	-	-	-	2	2	3	3
CO5	2	3	3	3	-	-	-	-	-	-	-	2	2	2



BT20605	BIOINFORMATICS LABORATORY	0	0	4	2

COURSE OBJECTIVES

To enable students to

1	understand the different biological database, tools and softwares.
2	analyze the genome sequences and carry out the sequence alignment.
3	examine the phylogenetic analysis.
4	develop skills in the analysis and interpretation of various *in silico* techniques.

LIST OF EXPERIMENTS

1. Biological databases and their uses- Sequence databases, Structure databases.
2. Sequence Analysis using BLAST, FASTA.
3. Multiple sequence alignment.
4. Generating Phylogenetic trees and Bootstrapping.
5. Protein secondary structure prediction.
6. Protein tertiary structure prediction- Homology modeling using automated tool and any open-source software.
7. Visualization tools, PyMol.
8. Lead molecule search using databases.
9. Molecular docking: Docking of macromolecules with ligands.
10. Tools for basic analysis of NGS data.

TOTAL PERIODS 60

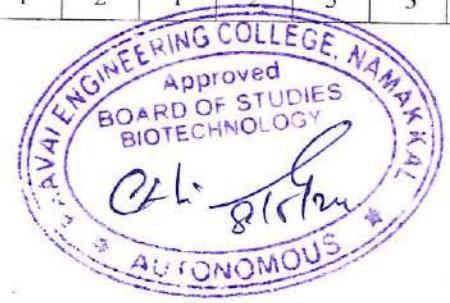
COURSE OUTCOMES

At the end of this course, the students will be able to		**BT MAPPED** (Highest Level)
CO1	analyse the basic commands and programming for database using bioinformatics tools	Analyzing (K4)
CO2	retrieve and analyze sequence and structure data for biological events	Analyzing (K4)
CO3	analyse the tools to predict the protein structure.	Applying (K3)
CO4	examine the sequence alignment and carry out phylogenetic analysis	Applying (K3)

CO/PO MAPPING :

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	3	3	-	-	2	3	2	3	3	3	3
CO2	3	3	3	3	3	-	-	1	3	2	3	2	3	3
CO3	2	3	3	2	2	-	-	1	2	1	2	3	2	2
CO4	3	3	3	2	2	-	-	1	2	1	2	3	3	2



BT20606	GENETIC ENGINEERING LABORATORY	0	0	4	2

COURSE OBJECTIVES

To enable students to

1	demonstrate basic molecular biology techniques.
2	learn the DNA isolation techniques
3	acquire the identification and characterization of gene and protein
4	compare the theory behind each technique and describe common applications of each methodology in biological research.

LIST OF EXPERIMENTS

1. Isolation of total DNA
2. Isolation of Plasmid DNA
3. DNA separation using Agarose gel electrophoresis
4. Separation of proteins by SDS-PAGE
5. Competent cells preparation
6. Transformation of DNA into competent cells
7. Polymerase Chain Reaction
8. Restriction enzyme digestion of DNA
9. DNA ligation
10. Southern Blot
11. Western blot (Theory)

TOTAL PERIODS 60

COURSE OUTCOMES

At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	examine the principles underlying in the techniques of genetic engineering.	Applying (K3)
CO2	illustrate the basic techniques of DNA isolation and manipulation.	Analysing (K4)
CO3	correlate the techniques to characterize genetic and protein materials.	Analysing (K4)
CO4	analysis of gene expression at nucleic acids and proteins level.	Analysing (K4)

CO/PO MAPPING :

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CO's	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	2	2	-	1	1	1	-	1	2	2	3	3
CO2	3	3	3	3	-	1	1	1	2	1	2	2	2	2
CO3	3	3	3	3	1	2	1	1	2	1	3	3	3	2
CO4	3	3	3	3	1	2	1	1	-	1	2	2	3	2

EN20601	CAREER DEVELOPMENT LABORATORY II	0	0	2	1

COURSE OBJECTIVES

To enable students to

1.	enhance their skills to manage stress to survive in corporate world
2.	evaluate their Interview skills
3.	solve the quantitative aptitude problems and improve their problem-solving skills
4.	improve their reasoning skills to get placed in reputed companies

UNIT I	Resume Writings	7

Resume Writing Skills; Curriculum Vitae & Resume; Things to do while writing a Resume ;Mistakes and Pitfalls to Avoid; Cover Letter: General Guidelines - The Content - Stress Management – Dressing Etiquette

Activities: Corporate Resume Building Session I ;JAM Session: Level III; Role Play Session (Individual): Level III - Company Profile Analysis Session III; Personality Profile Analysis Session III

UNIT II	INTERVIEW SKILLS	7

Interview Skills: Introduction- Before the Interview – During the Interview – After the Interview – Types of Interview

Activities: Presentation Session: Level II- Group Discussion Session: Level III ;Mock Interview Practice Session; Corporate Resume Building Session II

UNIT III	QUANTITATIVE APTITUDE	8

Permutation & Combination ; Probability: Dice; Colours, Coin Cards ; Partnership ;Ages; Calendars

UNIT IV	LOGICAL REASONING –I	8

Making Judgements ; Matching Definitions ; Cause & Effect- Directions ;Syllogism; Analogy; Statements & Arguments

TOTAL PERIODS	30

COURSE OUTCOMES

At the end of this course, students will be able to		BT Mapped (Highest Level)
CO1	demonstrate the interpersonal skills in Group Discussions	Analyzing (K4)
CO2	enhance their etiquettes	Applying (K3)
CO3	practice skills related to their thinking ability	Applying (K3)
CO4	reveal their logical and verbal reasoning by scoring the expected percentage to get placed	Analyzing (K4)

TEXTBOOKS

1. Agarwal, R.S." a modern approach to Verbal & Non Verbal Reasoning", S.Chand& Co Ltd, new delhi.2015.
2. Agarwal, R.S. " Objective General English", S.Chand&Co.2016.

REFERENCES

1. Abhijit Guha, "Quantitative Aptitude ", Tata-Mcgraw Hill.2015.
2. Word Power Made Easy By Norman Lewis ,Wr.Goyal Publications.2016.
3. Johnson, D.W. Reaching out – Interpersonal Effectiveness and self actualization. Boston: Allyn And Bacon.2019.
4. Infosys Campus Connect Program – students' guide for soft skills.2015.

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	PO's												PSO's	
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CO1	-	-	-	-	-	-	3	3	2	3	-	3	1	2
CO2	-	-	-	-	-	-	2	3	2	3	-	3	1	2
CO3	3	2	2	-	-	1	-	-	-	-	2	-	2	2
CO4	2	3	3	2	-	3	3	1	-	1	2	-	2	2

BT20151	FOOD PROCESSING AND TECHNOLOGY	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	learn about the various food constituents and its role in influencing food properties.
2	understand the different types of additives and its functional role.
3	articulate the various microbes associated with food.
4	relate the role of microorganisms in food processing and diseases.
5	customize different food processing and preservation techniques.

UNIT I	FOOD, ENERGY AND LAWS	9

Constituents of food – carbohydrates, lipids, proteins, water, vitamins and minerals, dietary sources, role and functional properties in food, contribution to organoleptic and textural characteristics. Inspection – Microbial Indicators of product quality – Indicators of food safety –Microbiological safety of foods - control strategies – Hazard Analysis Critical Point System (HACCP concept) - Microbiological criteria.

UNIT II	FOOD ADDITIVES	9

Classification, intentional and non-intentional additives, functional role in food processing and preservation; food colourants – natural and artificial; food flavours; enzymes as food processing aids.

UNIT III	MICROORGANISMS ASSOCIATED WITH FOOD	9

Bacteria, yeasts and molds – sources, types and species of importance in food processing and preservation; fermented foods and food chemicals, single cell protein.

UNIT IV	FOOD BORNE DISEASES	9

Classification – food infections – bacterial and other types; food intoxications and poisonings– bacterial and non-bacterial; food spoilage – factors responsible for spoilage, spoilage of vegetable, fruit, meat, poultry, beverage and other food products.

UNIT V	FOOD PRESERVATION	9

Principles involved in the use of sterilization, pasteurization and blanching, thermal death curves of microorganisms, canning; frozen storage-freezing characteristics of foods, microbial activity at low temperatures, factors affecting quality of foods in frozen storage; irradiation preservation of foods.

	TOTAL PERIODS	45

COURSE OUTCOMES

At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	defend the basic concepts of food constituents present in food and microorganisms involved in food processing	Understanding (K2)
CO2	detail the various food additives in food processing applications	Understanding (K2)
CO3	employ microorganisms in the foods processing to understand the principles in fermentation	Applying (K3)

CO4	acquire the knowledge of factors causing spoilage and infections in food products	Applying (K3)
CO5	investigate the methods and principles of food preservation techniques.	Applying (K3)

TEXT BOOKS

1. Coultate TP, "Food-The Chemistry of its Components", 2nd edition, Royal society, London, 2017.
2. Sivasanker B, "Food processing and preservation", Prentice-Hall of India Pvt. Ltd. New Delhi, 2010.

REFERENCES

1. Banwart G, "Basic food microbiology", Springer Science & Business Media, 2012.
2. Frazier WC, Westhoff DC, "Food Microbiology", 5th Ed., McGraw-Hill book Co., New York, 2017.
3. Goyal MR, Mishra SK, Birwal P, editors. Food Processing and Preservation Technology: Advances, Methods, and Applications. CRC Press; 2022.
4. Fellows PJ, "Food Processing Technology: Principles and practice", 5th Edition, Wood head Publishing limited, 2016.

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CO2	3	2	2	2	-	-	-	-	-	-	-	1	1	3
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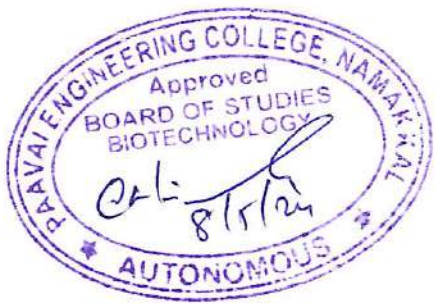
CO4	3	2	2	1	-	-	-	-	-	-	-	2	1	3
CO5	3	2	2	1	-	-	-	-	-	-	-	2	2	3



BT20152	PROTEIN ENGINEERING	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	study the importance of protein biomolecules.
2	learn about the different types in protein structure.
3	understand the folding mechanism in the tertiary structure of proteins.
4	express the binding and transcriptional concepts in proteins.
5	infer the immunoglobulins, enzymes and their commercial applications.

UNIT I BONDS, ENERGIES, BUILDING BLOCKS OF PROTEINS 9

Covalent, Ionic, Hydrogen, Coordinate, hydrophobic and Vander walls interactions in protein structure. Interaction with electromagnetic radiation and elucidation of protein structure. Amino acids and their molecular properties, Chemical reactivity in relation to post-translational modification (involving amino, carboxyl, hydroxyl, thiol, imidazole groups).

UNIT II PROTEIN ARCHITECTURE 9

Primary structure: peptide mapping, peptide sequencing - automated Edman method and mass spectroscopy, High-throughput protein sequencing setup Secondary structure: Alpha, beta and loop structures and methods to determine Super-secondary structure: Alpha-turn-alpha, beta-turn beta (hairpin), beta-sheets, alpha-beta-alpha, topology diagrams, up and down and TIM barrel structures nucleotide binding folds, prediction of substrate binding sites.

UNIT III TERTIARY STRUCTURE 9

Tertiary structure: Domains, folding, denaturation and renaturation, overview of methods to determine 3D structures. Quaternary structure: Modular nature, formation of complexes. Computer exercise on the above aspects

UNIT IV DNA-BINDING AND MEMBRANE PROTEINS 9

DNA-binding proteins: prokaryotic transcription factors, Helix-turn-Helix motif in DNA binding, Trp Repressor, Eukaryotic transcription factors, Zn fingers, helix-turn helix motifs in homeodomain, Leucine zippers. Membrane proteins: General characteristics, Transmembrane segments, prediction, bacteriorhodopsin and Photosynthetic reaction center.

UNIT V IMMUNOGLOBULINS AND ENZYMES 9

Immunoglobulins: IgG Light chain and heavy chain architecture, abzymes and Enzymes: Serine proteases, understanding catalytic design by engineering trypsin, chymotrypsin and elastase, substrate-assisted catalysis other commercial applications. Computer exercise on the above aspects.

TOTAL PERIODS 45

COURSE OUTCOMES		
At the end of this course, the students will be able to		**BT MAPPED (Highest Level)**
CO1	articulate the various interactions in protein makeup.	Understanding (K2)
CO2	acquire different levels protein structure to understand protein function.	Applying (K3)
CO3	determine the role of functional proteins at tertiary structure levels.	Applying (K3)
CO4	compute protein sequence data and binding pattern of proteins.	Applying (K3)
CO5	employ the latest application of protein science in their research.	Applying (K3)

TEXT BOOKS

1. Branden CI, Tooze J, "Introduction to protein structure", Garland Science, 2012.
2. Whitford D, "Proteins: structure and function", John Wiley & Sons, 2013.

REFERENCES

1. Pennington SR, Dunn MJ, "Proteomics: Protein Sequence to Function", BIOS Scientific Publishers Limited, 2002.
2. Liebler DC, "Introduction to Proteomics", Humana Press, 2002.
3. Voet D, Pratt CW, Voet JG, "Voet's principles of biochemistry", John Wiley & Sons, 2018.
4. Haggerty LM, "Protein Structure: Protein Science and Engineering", Nova Science Publications, 2012.

CO/PO MAPPING :

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	PO's												PSO's	
CO's	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	1	1	1	-	-	-	-	-	-	-	2	2	2
CO2	1	1	2	1	-	-	-	-	-	-	-	2	2	3
CO3	1	1	2	1	-	-	-	-	1	-	-	2	2	2
CO4	3	3	3	3	1	-	-	-	1	-	-	3	3	3
CO5	2	2	3	2	-	-	-	-	2	-	-	3	3	3

BT20153	MARINE BIOTECHNOLOGY	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	understand the abiotic and biotic components of the marine ecosystem.
2	learn the important marine organisms.
3	elucidate the bioremediation and biodegradation concepts in marine.
4	study the important compounds of marine and their applications.
5.	analyze the marine fishery resources and aquaculture techniques utilized for mass cultivation.

UNIT I INTRODUCTION TO MARINE ENVIRONMENT 9

World oceans and seas – ocean currents – physical and chemical properties of sea water – abiotic and biotic factors of the sea – ecological divisions of the sea – history of marine biology –bioecochemical cycles – food chain and food web.

UNIT II IMPORTANT MARINE ORGANISMS 9

Phytoplanktons – zoo planktons – nektons – benthos – marine mammals – marine algae –mangroves – coral reefs – deep sea animals and adaptation – intertidal zone – fauna and flora.

UNIT III MARINE ENVIRONMENTAL BIOTECHNOLOGY 9

Marine pollution – biology indicators (marine micro , algae) – biodegradation and bioremediation – marine fouling and corrosion.

UNIT IV MARINE PHARMACOLOGY 9

Seafood microbiology, Spoilage factors in seafood; Toxins influencing food spoilage; Single cell protein (SCP), marine based nutraceuticals, Medicinal compound from marine flora and fauna – marine toxins, antiviral and antimicrobial agents, Sea food processing and Preservation; Freezing and cold storage.

UNIT V AQUACULTURE TECHNOLOGY 9

Important of coastal aquaculture – marine fishery resources – common fishing crafts and gears – aquafarm design and construction, Bioremediation in Aquaculture system, Culture of seaweeds.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course, the students will be able to		**BT MAPPED (Highest Level)**
CO1	elaborate the physical and biological nature of the marine environment.	Understanding (K2)
CO2	describe the important microorganisms in the marine environment.	Understanding (K2)
CO3	distinguish the causes of marine pollution, impacts and management technologies.	Understanding (K2)
CO4	explore the active ingredients present in the marine system and their applications.	Applying (K3)
CO5	explore the marine fishery resources and aquaculture techniques utilized for its mass cultivation.	Applying (K3)

TEXT BOOKS

1. Munn CB, "Marine microbiology: ecology & applications", CRC Press, 2019.
2. Levinton JS, "Marine Biology: Function, Biodiversity, Ecology", 5th edition Oxford University Press, 2017.

REFERENCES

1. Naik MM, Dubey SK, "Marine pollution and microbial remediation" Springer, 2017.
2. Kim SK, ed. "Springer Handbook of marine biotechnology", Berlin/Heidelberg, Germany: Springer. 2015.
3. Gautam NC, "Aquaculture Biotechnology", Shree Publishers and Distributors. 2007.
4. Gal YL, Ulber R, Antranikian G, "Marine Biotechnology (Vol. 96)", 2005.

CO/PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	1	1	1	-	-	1	-	-	-	-	2	2	2
CO2	1	1	1	1	-	-	1	-	-	-	-	2	2	2
CO3	1	1	1	1	-	-	1	-	-	-	-	2	2	2
CO4	3	2	2	1	-	-	2	-	-	-	-	2	1	3
CO5	2	3	2	1	-	-	2	-	-	-	-	2	1	3

BT20154	BIOSAFETY AND HAZARD MANAGEMENT	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	outline the safety procedures and protocols for industrial hazard identification and assessment.
2	explore the awareness of biosafety and containment guidelines.
3	assess the risk analysis and the stringency requirements.
4	recognize the applicable legal requirements to obtain authorizations.
5	audit about the biorisk management program.

UNIT I	INTRODUCTION	9

Need for safety in industries; Safety Programmes – components and realization; Potential hazards – extreme operating conditions, toxic chemicals; safe handling.

UNIT II	QUALITY CHECKS	9

Implementation of safety procedures – periodic inspection and replacement; Accidents –identification and prevention; promotion of industrial safety.

UNIT III	RISK ANALYSIS	9

Overall risk analysis--emergency planning-on site and off-site emergency planning, risk management ISO 14000, EMS models case studies. Quantitative risk assessment – rapid and comprehensive risk analysis; Risk due to radiation, explosion due to over pressure, jet fire-fire ball.

UNIT IV	SAFETY AUDITS	9

Hazard identification safety audits, checklist, what if analysis, vulnerability models event tree analysis fault tree analysis, Hazan past accident analysis Fix borough-Mexico-Madras- Vizag Bopal analysis.

UNIT V	HAZARDOUS OPERATIONS	9

Hazop-guide words, parameters, derivation-causes-consequences-recommendation-coarse Hazop study-case studies-pumping system-reactor-mass transfer system.

	TOTAL PERIODS	45

COURSE OUTCOMES

At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	articulate the insights of biosafety guidelines.	Understanding (K2)
CO2	recognize the industry safety protocols for quality check.	Applying (K3)
CO3	correlate the possibilities of risk analysis for industrial safety assessment.	Analysing (K4)
CO4	apply the knowledge of working principles in a laboratory taking all safety measures.	Applying (K3)
CO5	illustrate the safety parameters for industrial sectors.	Applying (K3)

TEXT BOOKS

1. Kletz TA, "Critical aspects of safety and loss prevention" Butterworth-Heinemann, 2014.
2. Carson PA, "Hazardous chemicals handbook" Elsevier, 2002.

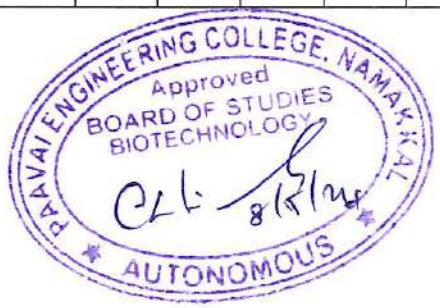
REFERENCES

1. CCPS (Center for Chemical Process Safety), Guidelines for engineering design for process safety. John Wiley and Sons, 2012.
2. Hyatt N, "Guidelines for process hazards analysis, hazards identification and risk analysis", Dyadem Press, 2004.
3. Wagenaar WA, Patrick TW Hudson, "Industrial safety." In A Handbook of Work and Organizational Psychology, pp. 65-87. Psychology Press, 2013.
4. Hollnagel, "Barriers and accident prevention", Routledge, 2016.

CO/PO MAPPING :

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1	1	2	-	2	1	2	-	-	-	1	1	3
CO2	3	3	3	3	-	3	1	2	-	-	-	1	1	3
CO3	3	2	1	2	-	3	-	-	-	-	-	1	2	3
CO4	3	1	2	2	-	3	1	2	-	-	-	2	2	3
CO5	3	2	2	2	-	3	1	2	-	-	-	2	3	3



BT20251	BIOPHARMACEUTICAL TECHNOLOGY	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	build strong foundation and advanced information on biopharmaceuticals.
2	relate the physicochemical properties, pharmacology and the formulation of commonly used biopharmaceuticals.
3	develop and monitor the drug preparation according to the norms.
4	summarize various modes of drug delivery.
5	associate the deeper understanding of application of biotechnology tools in the world of medicine.

UNIT I	INTRODUCTION	9

Pharmaceutical industry and development of drugs; types of therapeutic agents and their uses; economics and regulatory aspects.

UNIT II	DRUG ACTION, METABOLISM AND PHARMACOKINETICS	9

Mechanism of drug action; physico-chemical principles of drug metabolism; radioactivity; pharmacokinetics.

UNIT III	REGULATORY PRACTICES	9

Good manufacturing practices (GMP); Good clinical practices (GCP); Good laboratory practices (GLP); The Drugs and Cosmetics Act, 1940; Schedule M and Y; Applications monitoring quality control; types of validation.

UNIT IV	DRUG DOSAGE AND DELIVERY	9

Dosage form design: Need for dosage forms, General considerations in Dosage form design; Solid dosage forms: powders, granules, capsules and tablets; Semisolid dosage forms: ointments, creams and gels; transdermal drug delivery system; Pharmaceutical inserts: suppositories and inserts; Liquid dosage forms: solutions; Sterile dosage forms: parenteral (injections), Biologics (vaccine).

UNIT V	BIOPHARMACEUTICALS	9

Various categories of therapeutics like vitamins, laxatives, analgesics, contraceptives, antibiotics, hormones and biologicals.

	TOTAL PERIODS	45

COURSE OUTCOMES

At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	review the different dosage forms and their manufacture.	Understanding (K2)
CO2	clarify the pharmacokinetic parameters of drug action.	Understanding (K2)
CO3	illustrate the principles of drug manufacture.	Applying (K3)
CO4	choose the various categories of therapeutics in the modern pharmaceutical industries.	Applying (K3)
CO5	identify the need for formulation of biopharmaceuticals.	Applying (K3)

TEXT BOOKS

1. Remington, "Pharmaceutical sciences", 20th edition, Mack publishing and Co., PA, 2000.
2. Khar RK, "Lachman Liebermann's the theory and practice of Industrial Pharmacy", 4th Edition, CBS Publishers and Distributors, 2020.

REFERENCES

1. Thomas G, "Medicinal Chemistry. An introduction", John Wiley. 2011.
2. Whalen KL, Lerchenfeldt SM, Giordano MD, Chris R, "Lippincott's Illustrated Reviews Pharmacology" 8th Edition, Lippincott Williams and Wilkin, 2022.
3. Allen L, "Ansel's Pharmaceutical Dosage forms and Drug delivery systems", 11th Edition, Wolter Kluwer publishers, 2018.
4. Brahmankar DM, Jaiswal SB, "Biopharmaceutics and pharmacokinetics", Vallabh prakashan; 2019.

CO/PO MAPPING :

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	PO's												PSO's	
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CO1	1	1	1	1	-	-	1	-	-	-	-	2	2	2
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CO3	3	2	2	1	-	-	1	-	-	-	-	1	3	3
CO4	2	2	3	2	-	-	1	-	-	-	2	2	3	2
CO5	2	2	2	1	1	-	1	-	-	-	2	2	3	2

BT20252	TISSUE ENGINEERING	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	define the fundamentals of tissue engineering and tissue repairing.
2	relate the tissue architecture in tissue engineering for various applications.
3	classify the major components of tissue engineered scaffolds.
4	apply the basic concept behind tissue engineering focusing on the stem cells.
5	categorize the application of tissue engineering to worldwide diseases.

UNIT I INTRODUCTION 9

Introduction to tissue engineering: Basic definition; current scope of development; use in therapeutics, cells as therapeutic agents, cell numbers and growth rates, measurement of cell characteristics morphology, number viability, motility and functions. Measurement of tissue characteristics, appearance, cellular component, ECM component, mechanical measurements and physical properties.

UNIT II TISSUE ARCHITECTURE 9

Tissue types and Tissue components, Tissue repair, Engineering wound healing and sequence of events. Basic wound healing Applications of growth factors: VEGF/angiogenesis, Basic properties, Cell-Matrix and Cell-Cell Interactions, telomeres and Self-renewal, Control of cell migration in tissue engineering.

UNIT III BIOMATERIALS 9

Biomaterials: Properties of biomaterials, Surface, bulk, mechanical and biological properties. Scaffolds and tissue engineering, Types of biomaterials, biological and synthetic materials, Biopolymers, Applications of biomaterials, Modifications of Biomaterials, Role of Nanotechnology.

UNIT IV BASIC BIOLOGY OF STEM CELLS 9

Stem Cells: Introduction, hematopoietic differentiation pathway Potency and plasticity of stem cells, sources, embryonic stem cells, hematopoietic and mesenchymal stem cells, Stem Cell markers, FACS analysis, Differentiation, Stem cell systems- Liver, neuronal stem cells, Types and sources of stem cell with characteristics: embryonic, adult, haematopoetic, fetal, cord blood, placenta, bone marrow, primordial germ cells, cancer stem cells induced pleuripotent stem cells.

UNIT V CLINICAL APPLICATIONS 9

Stem cell therapy, Molecular therapy, In vitro organogenesis, neurodegenerative diseases, spinal cord injury, heart disease, diabetes, burns and skin ulcers, muscular dystrophy, orthopaedic applications, Stem cells and Gene therapy Physiological models, issue engineered therapies, product characterization, components, safety, efficacy. Preservation –freezing and drying. Patent protection and regulation of tissue-engineered products, ethical issues.

TOTAL PERIODS 45

COURSE OUTCOMES		
At the end of this course, the students will be able to		**BT MAPPED (Highest Level)**
CO1	articulate the basic components of tissue engineering and tissue repairing	Understanding (K2)
CO2	explain the components of the tissue architecture	Understanding (K2)
CO3	identify the properties and broad applications of biomaterials	Applying (K3)
CO4	illustrate the stem cell characteristics and their relevance in medicine	Applying (K3)
CO5	examine the role of tissue engineering and stem cell therapy for clinical applications	Analysing (K4)

TEXT BOOKS

1. Palsson BO, Bhatia SN, "Tissue Engineering", Pearson Education India, 2016.
2. Meyer U, Meyer T, Handschel J, Wiesmann HP, "Fundamentals of Tissue Engineering and Regenerative Medicine", Springer Science and Business Media, 2009.

REFERENCES

1. Kennedy BN, "Stem cell transplantation, Tissue engineering, and cancer applications", Nova Science Publishers, 2008.
2. Gorodetsky R, Schäfer R, "Stem cell-based tissue repair" RSC Publishing, 2011.
3. Lanza R, Verfaillie C, Weissman I, West MD, Blau H, Gearhart J, Hogan B, Melton D, Moore M, Pedersen R, Thomas ED, editors. Handbook of stem cells, two-volume set: volume 1-Embryonic stem cells; volume 2-Adult and fetal stem cells. Elsevier, 2004.
4. Lanza R, Gearhart J, Hogan B, Melton D, Pedersen R, Thomas E, Thomson J, Gearhart IW, "Essential of Stem Cell Biology", Elsevier Academic Press, 2nd Edition, 2014

CO/PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's
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CO's	PO's												PSO's	
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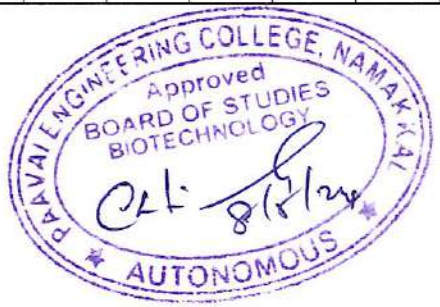
CO1	2	1	2	3	2	-	-	-	-	-	-	3	2	2
CO2	2	3	2	3	2	-	-	-	-	-	-	3	2	2
CO3	3	3	2	3	2	-	-	-	-	-	-	3	2	2
CO4	3	3	2	3	2	-	-	-	-	-	-	3	2	2
CO5	3	3	2	3	2	-	-	-	-	-	-	3	2	2



BT20253	FORENSIC SCIENCE AND TECHNOLOGY	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	explain the methods and principles of forensic investigations.
2	understand how forensic science can be applied in criminal investigations.
3	apply basic scientific principles of ballistics in forensic science .
4	examine the crime scenes using various patterns analysis.
5	utilize molecular analysis techniques for the identification of suspects.

UNIT I	INTRODUCTION TO FORENSIC SCIENCE	9

Introduction to Crime Laboratories, Responsibilities of the Forensic Scientist, Securing and Searching the Crime Scene, Recording and Collection of Crime Scene Evidence, Document Examination, Ethics and Integrity.

UNIT II	DISCOVERY AND RECOVERY OF HUMAN REMAINS	9

The Autopsy and Handling of a Dead Body, The Stages and Factors of Decomposition, determining the Age and Provenance of Remains, Asphyxia, Gunshot Wounds, Bite Marks.

UNIT III	BALLISTICS	9

Types, application, forensic ballistic procedures (internal, external and terminal ballistics) and identification of firearms, Available ballistic databases.

UNIT IV	PATTERN ANALYSIS	9

Human Tissues, Body Fluids and Waste Products, Fingerprints, Hair, Teeth, Blood, Detecting the Presence of Blood, Bloodstain Pattern Analysis, Forensic anthropology, Paleontology, Toxicology.

UNIT V	FINGER PRINTING AND RAPD IN FORENSICS	9

Mitochondrial, DNA, DNA Finger Printing- RFLP. STR Genotyping issues, VNTRS and STR, mt DNA analysis, Identification of suspects. RAPD in Forensics, Study of Kinnship by DNA Profiling, Case Studies.

	TOTAL PERIODS	45

COURSE OUTCOMES

At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	explain the principles of forensic science to infer forensic investigation.	Understanding (K2)
CO2	figure evidence with proper methods of investigation through biological samples.	Understanding (K2)
CO3	investigate the concepts, principles, and significance of ballistics in forensic sciences.	Applying (K3)
CO4	appraise the knowledge of various patterns analysis in forensics to examine the crime scenes.	Applying (K3)
CO5	discover the role of molecular based techniques in forensics to analyse disputes.	Applying (K3)

TEXT BOOKS

1. Lincoln PJ, Thomson J, "Forensic DNA Profiling Protocols", Humana Press, 2011.
2. Rudin N, Inman K, "An Introduction to Forensic DNA Analysis", 2nd Ed. CRC Press. 2002.

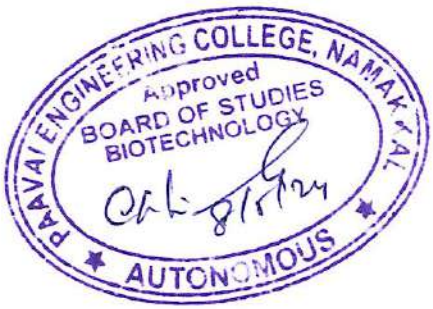
REFERENCES

1. Saferstein R, "Criminalistics: An Introduction to Forensic Science", 12th Edition. Pearson, 2017.
2. Butler JM, "Forensic DNA Typing, 2nd Edition, Biology, Technology, and Genetics of STR Markers", Imprint: Academic Press, 2005.
3. Siegel JA, "Forensic chemistry: fundamentals and applications", John Wiley and Sons, 2015.
4. Gall JA, Payne-James J, editors. Current Practice in Forensic Medicine, Volume 3. John Wiley and Sons; 2022.

CO/PO MAPPING :

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1	1	1	1	-	-	-	-	-	-	1	3	3
CO2	2	1	1	2	1	-	-	-	-	-	-	1	1	3
CO3	2	2	1	1	1	-	-	-	-	-	-	2	2	2
CO4	1	1	1	1	1	-	-	-	-	-	-	1	2	2
CO5	3	1	1	1	1	-	-	-	-	-	-	1	1	1



BT20254	ARTIFICIAL INTELLIGENCE FOR BIOTECHNOLOGY	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	infer the concepts of artificial intelligence.
2	extend the knowledge representation.
3	relate the expert systems in artificial intelligence.
4	choose the methods of solving problems using artificial intelligence.
5	identify the concepts of expert systems and machine learning on various applications.

UNIT I INTRODUCTION TO AI AND PRODUCTION SYSTEMS **9**

Introduction to AI-Problem formulation, Problem Definition -Production systems, Control strategies, Search strategies. Problem characteristics, Production system characteristics -Specialized production system-Problem solving methods – Problem graphs, Matching, Indexing and Heuristic functions -Hill Climbing-Depth first and Breath first, Constraints satisfaction – Related algorithms, Measure of performance and analysis of search algorithms.

UNIT II REPRESENTATION OF KNOWLEDGE **9**

Game playing – Knowledge representation, Knowledge representation using Predicate logic, Introduction to predicate calculus, Resolution, Use of predicate calculus, Knowledge representation using other logic Structured representation of knowledge.

UNIT III KNOWLEDGE INFERENCE **9**

Knowledge representation -Production based system, Frame based system. Inference – Backward chaining, Forward chaining, Rule value approach, Fuzzy reasoning – Certainty factors, Bayesian Theory Bayesian Network-Dempster – Shafer theory.

UNIT IV EXPERT SYSTEMS **9**

Expert systems – Architecture of expert systems, Roles of expert systems – Knowledge Acquisition – Meta knowledge, Heuristics. Typical expert systems – MYCIN, DART, XOON, Expert systems shells.

UNIT V AI FOR HEALTH CARE AND INDUSTRIAL APPLICATIONS **9**

Maintaining medical records and other data, doing repetitive jobs, Treatment design, Digital Consultation, Virtual Nurses, Medication Management, Drug Creation, Precision Medicine, Health Monitoring, and Health Care System Analysis. Application of AI in Pharmaceutical industry- Biofuel industry- Food industry- Water technology-Bio fertilizers- Bio control.

TOTAL PERIODS **45**

COURSE OUTCOMES

At the end of this course, the students will be able to		**BT MAPPED (Highest Level)**
CO1	describe the algorithms and apply in biotechnology	Applying (K3)
CO2	demonstrate knowledge representation and apply solve a given problem	Applying (K3)

CO3	formalize a given problem in the language/framework of different ai method	Applying (K3)
CO4	develop an understanding of knowledge inference and expert systems	Applying (K3)
CO5	develop an understanding of knowledge inference and expert systems formulate AI based solutions for industrial and healthcare applications	Applying (K3)

TEXT BOOKS

1. Knight K, Rich E, Nair B, "Artificial Intelligence (SIE)", 3rd Edition Tata McGraw Hill- 2009.
2. Patterson DW, "Introduction to AI and ES", Pearson Education, 2007.

REFERENCES

1. Peter Jackson, "Introduction to Expert Systems", 3rd Edition, Pearson Education, 2007.
2. Stuart Russel, Peter Norvig, "AI – A Modern Approach", 4th Edition, Pearson Education 2022.
3. Khemani D, "Artificial Intelligence", Tata Mc Graw Hill Education, 2013.
4. Preethi Kartan, "Artificial Intelligence in Biotechnology", Delve Publishing, 2020

CO/PO MAPPING :

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's
(1/23 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	PO's												PSO's	
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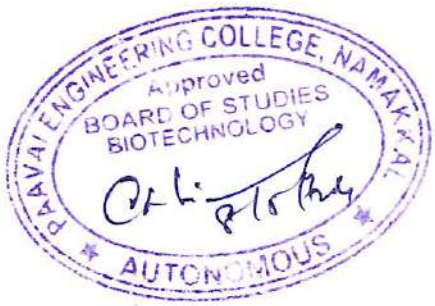
CO1	3	1	1	1	1	-	1	1	-	-	1	1	3	3
CO2	2	1	1	2	1	-	2	1	-	-	1	1	1	3
CO3	2	2	1	1	1	-	1	1	-	-	1	2	2	2
CO4	1	1	1	1	1	-	2	2	-	-	1	1	2	2
CO5	3	1	1	1	1	-	2	1	-	-	1	1	1	1



BT20901	BIOENERGY AND BIOFUELS	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	explore the scope of biofuels for newer generation.
2	describe the expertise in the technology of ethanol production
3	outline existing conventional fuels and strive them towards sustainable development
4	interpret the concept, advantages and limitations of fuels obtained from biological sources
5	utilize bolster green technology for various applications

UNIT I INTRODUCTION 9

Cellulosic Biomass availability and its contents. Lignocellulose as a chemical resource. Physical and chemical pretreatment of lignocellulosic biomass. Cellulases and lignin degrading enzymes.

UNIT II ETHANOL 9

Ethanol as transportation fuel and additive; bioethanol production from carbohydrates; engineering strains for ethanol production from variety of carbon sources to improved productivity.

UNIT III BIODIESEL 9

Chemistry and Production Processes; Vegetable oils and chemically processed biofuels; Biodiesel composition and production processes; Biodiesel economics; Energetics of biodiesel production and effects on greenhouse gas emissions Expanding biodiesel production.

UNIT IV OTHER BIOFUELS 9

Biodiesel from microalgae and microbes; biohydrogen production; biorefinery concepts, Biobutanol, Biopropanol, bioglycerol –Principles, materials and feedstocks-Process technologies and techniques-Advantages and Limitations.

UNIT V APPLICATIONS OF BIOFUELS 9

Life cycle environmental impacts of biofuels and co products – Environmental sustainability of biofuels – Energy security and supply, Economic sustainability of biofuels.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course, the students will be able to		**BT MAPPED (Highest Level)**
CO1	determine the important properties of biomass	Analysing (K4)
CO2	discuss the solutions for real world problems related to bioenergy.	Understanding (K2)
CO3	analyse bioenergy systems and their potential in future energy supply.	Analysing (K4)
CO4	apply the technology for production of biofuels.	Applying (K3)
CO5	experiment the fossil-based products with biodiesel.	Applying (K3)

TEXT BOOKS

1. Gupta VK, Tuohy MG, "Biofuel technologies. Recent Developments", Editorial Springer. 2013.
2. LuqueR, Campelo JM, Clark JH, "Handbook of biofuels production", Woodhead Publishing Limited 2011.

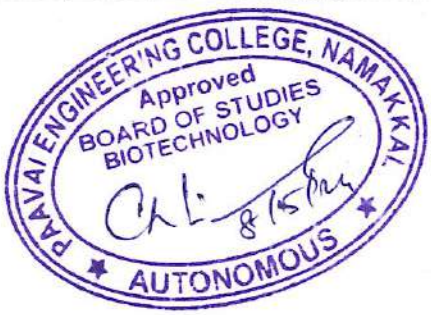
REFERENCES

1. Moheimani NR, Boer, Parisa A, Bahri, "Biofuel and Biorefinery Technologies, Volume 2", Springer, 2015.
2. Lee S, Shah, YT, "Biofuels and Bioenergy: processes and technologies.", CRC / Taylor & Francis, 2013.
3. Eckert CA, Trinh CT, "Biotechnology for Biofuel Production and Optimization", Elsevier. 2016.
4. Santos Bernardes MA, "Biofuel production – Recent Developments and Prospects", InTech, 2011.

CO/PO MAPPING :

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	PO's												PSO's	
CO's	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	3	3	2	-	1	3	1	-	-	1	1	2	3
CO2	2	3	3	3	-	1	2	1	-	-	1	1	2	2
CO3	3	3	3	3	-	1	2	2	-	-	2	1	2	3
CO4	3	2	2	2	-	1	1	1	1	-	1	1	1	1
CO5	2	2	2	2	-	1	1	1	1	-	1	1	1	2



BT20902	AGRICULTURE BIOTECHNOLOGY	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	define the concepts of genomic markers, and crop improvement with ethical values.
2	relate the knowledge in the plant metabolic pathways.
3	develop genetically modified crops for pest management.
4	select software tools in plant genome study.
5	identify the bioethics and global issues in agriculture sector.

UNIT I INTRODUCTION 9

History and scope of agricultural biotechnology- maps, markers and comparative genomics, cloning genes by Map-Based approach – dicot and monocot model- Gene discovery by expression analysis- gene discovery from orfeome to phenome.

UNIT II METABOLISM IN CROPS 9

General strategy for plant metabolic engineering- case studies: engineering of primary metabolic pathways - engineering of primary metabolic pathways - engineering of novel metabolic pathways.

UNIT III PEST MANAGEMENT BIOTECHNOLOGY 9

Pest discovery and development – case studies- development of target specific pesticides- pest tolerant genetically modified crops- transgenic insects – improvement of biological control agents.

UNIT IV BIOINFORMATICS IN AGRICULTURE 9

Plant genome initiatives- AGI, TIGR, ESSA, LIS- Plant ontology- plant pathogen genome sequencing- fungal plant pathogen database- agricultural information resources – FAO, AGRIS-AGORA-AGMARKNET.

UNIT V BIOETHICS AND GLOBAL ISSUES 9

Values of bioethics- Ethical, Logical and Social issues (ELSI) - climatic change –greenhouse effect -global warming – population density- impact on biosphere.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course, the students will be able to		**BT MAPPED (Highest Level)**
CO1	relate the agricultural genomics and gene discovery	Applying (K3)
CO2	illustrate the metabolic engineering of primary and secondary metabolites	Applying (K3)
CO3	apply pest management and control for crops	Applying (K3)
CO4	develop the pant genome sequencing and databases	Applying (K3)
CO5	explain the ethical values and global issues in agriculture sector	Understanding (K2)

TEXT BOOKS

1. Fett-Neto AG, "Biotechnology of plant secondary metabolism – Humana Press", 2016.
2. Altman A, Colwell RR, "Agricultural biotechnology" CRC Press, 1997.

REFERENCES

1. Joshi R, Agricultural Biotechnology, Gyan Publishing House; 2006.
2. Hakeem KR, Ahmad P, Ozturk M, "Crop Improvement: New Approaches and Modern Techniques", Springer Science & Business Media, 2013.
3. Singh BD, "Biotechnology", Kalyani Publication, 2021.
4. Purohit SS, "Biotechnology – Fundamentals and applications", Student Edition, 2023.

CO/PO MAPPING :

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	3	1	2	-	1	-	-	-	-	1	3	2
CO2	3	2	3	1	2	-	1	-	-	-	-	1	3	2
CO3	2	1	1	1	1	-	1	-	-	-	-	3	2	3
CO4	3	1	3	3	3	-	1	-	-	-	2	2	3	2
CO5	1	1	2	1	1	-	1	3	-	-	2	3	2	2