PAAVAI ENGINEERING COLLEGE, NAMAKKAL - 637 018
(AUTONOMOUS)
B.Tech. – BIOTECHNOLOGY
REGULATIONS 2019
(CHOICE BASED CREDIT SYSTEM)
(For the candidates admitted from the Academic Year 2022-2023)

SEMESTER VII

S. No.	CATEGORY	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY							
1.	PC	BT20701	Downstream Processing	3	0	0	3
2.	PC	BT20702	Immunology	3	0	0	3
3.	PE	BT2035*	Professional Elective – III	3	0	0	3
4.	PE	BT2045*	Professional Elective – IV	3	0	0	3
5.	OE	BT2090*	Open Elective-II	3	0	0	3
PRACTICALS							
6.	PC	BT20703	Downstream Processing Laboratory	0	0	4	2
7.	PC	BT20704	Immunology Laboratory	0	0	4	2
8.	EE	BT20705	Project Work (Phase I)	0	0	6	3
			TOTAL	**15**	**0**	**14**	**22**

SEMESTER VIII

S. No.	CATEGORY	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY							
1.	HS	BA20151	Entrepreneurship Development	3	0	0	3
2.	PE	BT2055*	Professional Elective –V	3	0	0	3
3.	PE	BT2065*	Professional Elective – VI	3	0	0	3
PRACTICALS							
4.	EE	BT20801	Project Work (Phase II)	0	0	12	6
			TOTAL	**9**	**0**	**12**	**15**

TOTAL CREDITS: 166

PROFESSIONAL ELECTIVE III, SEMESTER VII

S. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1.	BT20351	Genomics and Proteomics	3	0	0	3
2.	BT20352	Bioconjugate Technology and Applications	3	0	0	3
3.	BT20353	Cancer Biology	3	0	0	3
4.	BT20354	Creativity, Innovation and New Product Development	3	0	0	3

PROFESSIONAL ELECTIVE IV, SEMESTER VII

S. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1.	BT20451	Nano Biotechnology	3	0	0	3
2.	BT20452	Process Equipments and Plant Design	3	0	0	3
3.	BT20453	Neurobiology	3	0	0	3
4.	BT20454	Foundation Skills in Integrated Product Development	3	0	0	3

PROFESSIONAL ELECTIVE V, SEMESTER VIII

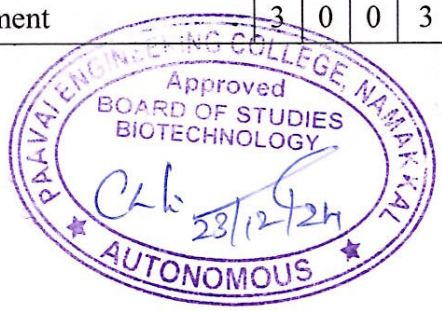
S. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1.	BT20551	Stem Cell Technology	3	0	0	3
2.	BT20552	Metabolic Engineering	3	0	0	3
3.	BT20553	Systems Biology	3	0	0	3
4.	BA20252	Total Quality Management	3	0	0	3

PROFESSIONAL ELECTIVE VI, SEMESTER VIII

S. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1.	BT20651	Molecular Therapeutics and Diagnostics	3	0	0	3
2.	BT20652	Mushroom cultivation and Biofertilizer production	3	0	0	3
3.	BT20653	Molecular Modeling	3	0	0	3
4.	BT20654	Energy Conservation and Management	3	0	0	3

OPEN ELECTIVE II (OE)

S. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1.	BT20903	Basics of Microbial Technology	3	0	0	3
2.	BT20904	Biotechnology for Waste Management	3	0	0	3



BT20701	DOWNSTREAM PROCESSING	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	understand the different steps of downstream processing.
2	conceptualize, prototype and develop each technique of bio separations.
3	understand requirement engineering and know how to analyze the requirements for biomolecular separation strategy.
4	understand the purification strategies applied in biotechnology and pharma industries.
5	develop the downstream processes required in multi-factorial manufacturing environment in a structured and logical fashion.

UNIT I INTRODUCTION 9

Introduction to downstream processing, principles, characteristics of bio-molecules and bioprocesses. Cell disruption for product release – mechanical, enzymatic and chemical methods. Pretreatment and stabilisation of bio-products.

UNIT II PHYSICAL METHODS OF SEPARATION 9

Unit operations for solid-liquid separation – Sedimentation, Flocculation, Coagulation, filtration and centrifugation.

UNIT III ISOLATION OF PRODUCTS 9

Adsorption, liquid-liquid extraction, aqueous two-phase extraction, membrane separation – ultrafiltration and reverse osmosis, dialysis, precipitation of proteins by different methods.

UNIT IV PRODUCT PURIFICATION 9

Chromatography – principles, instruments and practice, adsorption, reverse phase, ion exchange, size exclusion, hydrophobic interaction, bio-affinity and pseudo affinity chromatographic techniques.

UNIT V FINAL PRODUCT FORMULATION AND FINISHING OPERATIONS 9

Crystallization- Theory, practice, equipment's, drying- - Theoretical considerations, equipment's, lyophilization in final product formulation.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, the students will be able to		**BT MAPPED** (Highest Level)
CO1	articulate the fundamentals of downstream processing for product recovery.	Understanding (K2)
CO2	understand the requirements for successful operations of downstream processing.	Understanding (K2)
CO3	demonstrate the components of downstream equipment and explain the purpose of each equipment	Applying (K3)
CO4	apply principles of various unit operations used in downstream processing and enhance problem solving techniques.	Applying (K3)
CO5	propose new strategies for biomolecular separations.	Applying (K3)

TEXT BOOKS

1. Sivasankar B, "Bioseparations: Principles and Techniques", PHI, 2006.
2. Belter PA, Cussler EL, Wei-Houhu, "Bioseparations – Downstream Processing for Biotechnology", John Wiley, 2011.

REFERENCES

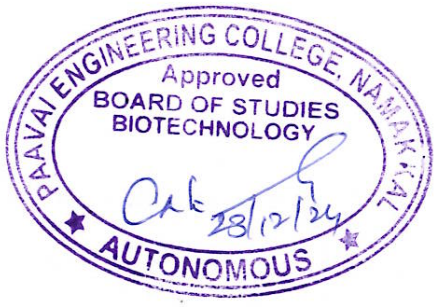
1. Nooralabettu Krishna Prasad, "Downstream Process Technology" A New Horizon in Biotechnology, Prentice Hall India, 2010.
2. Michael R, Ladisch "Bioseparations Engineering: Principles, practice and Economics", Wiley-Interscience, 1st Edition, 2001.
3. Raja Ghosh "Principles of Bioseparations Engineering", World Scientific, 2006.
4. "Product Recovery in Bioprocess Technology", (BIOTOL – Biotechnology by Open Learning Series). Butterworth – Heinmann, Elsevier, 2004.

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



BT20702	IMMUNOLOGY	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	discuss the structure, functions and integration of immune system.
2	explore the molecular and cellular basis of immunity and its role in health and disease.
3	explain the immune response and protective mechanism against various pathogens.
4	understand autoimmune diseases, immunodeficiencies, and vaccine development.
5	apply immune techniques for the diagnosis of various diseases to develop drugs.

UNIT I INTRODUCTION TO IMMUNE SYSTEM **9**

Organisation and classification of immune system – immune cells and organs; innate and acquired immunity; Toll receptors and responses, classification of antigens – chemical and molecular nature; haptens, adjuvants; cytokines; complement pathway, antigen presenting cells; major histocompatibility complex.

UNIT II HUMORAL AND CELLULAR IMMUNITY **9**

Development, maturation, activation, regulation, differentiation and classification of T-cells and B-cells, antigen processing and presentation, theory of clonal selection, TCR; antibodies: structure and functions; antibodies: genes and generation of diversity; antigen-antibody reactions.

UNIT III IMMUNITY AGAINST PATHOGENS AND TUMORS **9**

Inflammation; protective immune responses to virus, bacteria, fungi and parasites; tumor antigens, tumor immune response, tumor diagnosis, tumor immunotherapy.

UNIT IV IMMUNE TOLERANCE AND HYPERSENSITIVITY **9**

Immune tolerance, Immuno deficiencies; Transplantation – genetics of transplantation; laws of transplantation; Allergy and hypersensitivity – Types of hypersensitivity, Autoimmunity, Auto immune disorders and diagnosis.

UNIT V APPLIED IMMUNOLOGY **9**

Monoclonal antibodies, engineering of antibodies; T- Cell cloning -Types and Classification of Vaccines, methods of vaccine development, immunodiagnostic methods (Immuno diffusion ELISA, FACS), immune modulatory drugs.

TOTAL PERIODS **45**

COURSE OUTCOMES

At the end of this course, the students will be able to		**BT MAPPED** (Highest Level)
CO1	characterize the structure, functions and integration of immune system.	Understanding (K2)
CO2	elaborate the antigen-antibody interactions that offers defence mechanism.	Understanding (K2)
CO3	ascertain the immunoregulation in immunity development against pathogens.	Applying (K3)
CO4	Identify, diagnose and evaluate the immune tolerance and hypersensitivity	Applying (K3)
CO5	employ simple techniques to analyze cell and their morphology.	Applying (K3)

TEXT BOOKS

1. Peter J Delves, Seamus J Martin, Dennis R Burtn, Ivan M Roitt., "Roitts Essential Immunology", 13th Edition, Wiley –Blackwell, 2016.
2. Judith a Owen, Jenni Punt, Sharon A Stranford, Kuby "Immunology", Macmillan International, 7th Edition, 2012.

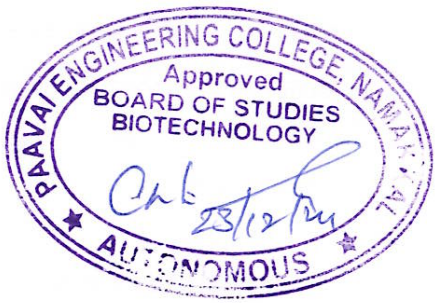
REFERENCES

1. Ashim K, Chakravarthy, "Immunology", Tata McGraw-Hill, 2006.
2. Coico, Richard, "Immunology: A Short Course", VIth Edition. John Wiley, 2008.
3. Khan, Fahim Halim, "Elements of Immunology", Pearson Education, 2009.
4. Robert R Rich, Thomas A Fleisher, William T Shearer, Harry Schroeder, Anthony J Frew, Cornelia Weyand M, "Clinical Immunology – Principles and Practive", Elsevier, 4th Edition, 2013.

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



BT20703	DOWNSTREAM PROCESSING LABORATORY	0	0	4	2

COURSE OBJECTIVES

To enable students to

1	provide hands on training in downstream processing through simple experimentations.
2	understand the nature of the end product, its concentration, stability and degree of purifications.
3	design processes for the recovery and subsequent purification of target biological products.
4	design a strategy for biomolecular separation.

LIST OF EXPERIMENTS

1. Centrifugation studies during settling of microbial cells.
2. Cell disruption by sonication.
3. Cell Disruption by Enzymatic Reaction.
4. Desalting of Proteins by Dialysis.
5. Isoelectric precipitation of Milk protein (Casein).
6. Fractionation of proteins from Egg by Ammonium Sulphate Precipitation.
7. Aqueous two phase extraction of biological samples.
8. Separation of proteins by Affinity Chromatography.
9. Separation of charged biomolecules by Ion Exchange Chromatography.
10. Separation of proteins by Size exclusion chromatography.

TOTAL PERIODS	**60**

COURSE OUTCOMES

At the end of this course, the students will be able to		**BT MAPPED** (Highest Level)
CO1	separate whole cells and other insoluble ingredients from the culture broth.	Applying (K3)
CO2	carry out the cell disruption techniques to release intracellular products.	Applying (K3)
CO3	perform various separation techniques for concentrating biological products.	Applying (K3)
CO4	perform the chromatography to purify the biological products and formulate the products for different end uses.	Applying (K3)

CO/PO MAPPING :

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

COs	Programmes Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	1	-	-	3	-	1	2	2	1
CO2	3	2	1	2	1	1	-	-	3	-	1	1	2	1
CO3	3	3	2	2	2	1	-	-	3	1	1	2	3	2
CO4	3	3	3	3	2	1	-	-	3	-	1	2	3	3

BT20704	IMMUNOLOGY LABORATORY	0	0	4	2

COURSE OBJECTIVES

To enable students to

1	give practical training in the functioning of immune system
2	handle biological samples, such as blood, for the isolation of serum, plasma, and immune cells.
3	gain laboratory training in different immunological and immunotechnological techniques
4	explore advanced immunological assays

LIST OF EXPERIMENTS

1. Animal Handling – Immunization – Bleeding techniques by Virtual methods
2. Identification of immune cells in a blood smear
3. Identification of blood group
4. Isolation of serum and plasma
5. Testing for typhoid antigens by Widal test
6. Immunodiffusion by Ouchterlony Double Diffusion
7. Immunoelectrophoresis – Rocket immunoelectrophoresis
8. Immunoelectrophoresis –Current immunoelectrophoresis
9. Enzyme Linked ImmunoSorbent Assay (ELISA) - Types
10. Isolation of peripheral blood mononuclear cells
11. Isolation of monocytes from blood

TOTAL PERIODS	60

COURSE OUTCOMES

At the end of this course, the students will be able to		**BT MAPPED** (Highest Level)
CO1	perform blood sample analysis, including immune cell identification, blood group determination, and antigen testing using the WIDAL test.	Applying (K3)
CO2	acquire proficiency in separating serum and plasma and isolating immune cells	Applying (K3)
CO3	perform and interpret results from immunological assays	Applying (K3)
CO4	apply and correlate techniques in research or diagnostic contexts.	Analyzing (K4)

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

BT20705	PROJECT WORK (PHASE I)	0	0	6	3

COURSE OBJECTIVES

To enable the students to

1	develop knowledge for solving technical problems through structured project research study.
2	improve the skills to formulate a technical project.
3	explain the various tasks of the project and standard procedures.
4	analyse the various procedures for validation of the product and analyse the cost effectiveness.

GUIDELINES

The student in a group of 3 to 4 works on a topic approved by the Head of the Department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL PERIODS 90

COURSE OUTCOMES

At the end of this project, the students will be able to		**BT MAPPED** (Highest Level)
CO1	identify the technical ideas, strategies and methodologies.	Applying (K3)
CO2	formulate the real-world problem, identify the requirements and develop the design solution.	Applying (K3)
CO3	use the new tools, techniques that contribute to obtain the solution to the project.	Applying (K3)
CO4	develop prototype and analysis the cost effectiveness.	Analysing (K4)

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

BA20151	ENTREPRENEURSHIP DEVELOPMENT	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	understand the management concepts
2	build the entrepreneurial competencies and analyse the support rendered by government and other agencies in entrepreneurship development.
3	understand the business opportunities and to prepare a feasibility report
4	propose a business plan.
5	appraise and comprehend the various factors to be considered for launching a small business.

UNIT I BASICS OF MANAGEMENT 9

Management: Meaning- Definition, Nature and Importance; Roles of management- Functions of Management, Levels of Management; Functionalareas of Management-Marketing, Finance, Production, HRM, IT, Research and development.

UNIT II ENTREPRENEURIAL COMPETENCE AND ENVIRONMENT 9

Entrepreneurial Competence: Entrepreneurship- Definition, Role and expectations, Entrepreneurial styles and types, Characteristics of the Entrepreneur, Entrepreneurial competencies, Functions of an Entrepreneur.

Entrepreneurial Environment: Role of Socio-Cultural, Economic and political environment - Institutional Support for Entrepreneurs, Assistance Programme for small scale units, Institutional Framework- Central and State Government Industrial Policies and Regulations.

UNIT III ENTREPRENEURIAL DEVELOPMENT 9

Ownership structures-Proprietorship, Partnership, Company, Co-operative, Franchise; Identification of Business Opportunity- Preparation of Feasibility Report, Financial and Technical Evaluation, Project Formulation- Common Errors in Project Formulation, Specimen Project Report Entrepreneurial Development Programmes;Role of SSI Sector in the Economy; IAS units- Failure, Causes and Preventive Measures; Turnaround strategies.

UNIT IV BUSINESS PLAN PREPARATION, FINANCING VENTURES 9

Business Plan: Business opportunities-SWOT, Business plan process, Feasibility Study, Functional plan-Marketing Plan- Operational plan, Organizational plan, financial plan, Evaluation criteria.

Financing ventures: sources of raising capital- seed funding, venture capital funding; funding opportunities for start-ups in India.

UNIT V WOMEN ENTREPRENEURSHIP AND ENTREPRENEURSHIP IN VARIOUS SECTORS 9

Women Entrepreneurship: Growth of Women Entrepreneurship- Problems faced by Women Entrepreneurs, Development of Women Entrepreneurship.

Entrepreneurship in Informal Sector: Rural Entrepreneurship- Entrepreneurship in Sectors like Agriculture, Tourism, Health Care, Transport and allied services.

		TOTAL PERIODS	45

COURSE OUTCOMES		
At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	implement the necessary managerial skills to become an entrepreneur.	Understanding (K2)
CO2	take up self-employment having been exposed to entrepreneurial environment.	Applying (K3)
CO3	select a best business idea by using appropriate methods to assess its viability.	Applying (K3)
CO4	formulate a business plan and deploy the resources for sustainable growth.	Applying (K3)
CO5	analyse channels and means of launching a small business in any sector	Applying (K3)

TEXT BOOKS

1. Khanka SS, "Entrepreneurial Development", S.Chand and Company Limited, New Delhi, 2016.
2. SaravanavelP, "Entrepreneurial Development", Ess Pee Kay Publishing House, Chennai, 2013.

REFERENCES

1. Donald LSexton, Raymond WSmilor, "The Art and Science of Entrepreneurship", Ballinger Publishing Company, 2008.
2. Gifford Pinchot, Intrapreneuring" Harper and Row Publishers, New York, 2005.
3. Mathew Manimala, "Entrepreneurship theory at the crossroads", Paradigms and Praxix, Biztrantra, 2nd Edition, 2015.
4. P.C.Jain, "Handbook for New Entrepreneurs", EDII, Oxford University Press, New Delhi, 2012.

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

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23/12/24

BT20801	PROJECT WORK (PHASE II)	0	0	12	6

COURSE OBJECTIVES

To enable the students to

1	develop student knowledge for solving technical problems through structured project research study.
2	improve the skills to formulate a technical project.
3	explain the various tasks of the project and standard procedures.
4	analyse the various procedures for validation of the product and analyse the cost effectiveness.

GUIDELINES

The student in a group of 3 to 4 works on a topic approved by the Head of the Department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL PERIODS	**180**

COURSE OUTCOMES

At the end of this project, the students will be able to		**BT MAPPED** (Highest Level)
CO1	identify the technical ideas, strategies and methodologies.	Applying (K3)
CO2	formulate the real-world problem, identify the requirements and develop the design solution.	Applying (K3)
CO3	use the new tools, techniques that contribute to obtain the solution to the project.	Applying (K3)
CO4	develop prototype and analysis the cost effectiveness.	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	3	3	3	3	2	2	1	1	2	2	1	3	2	3
CO2	3	3	3	3	2	2	1	2	2	2	1	3	2	3
CO3	3	3	3	3	3	2	1	2	1	2	2	3	3	3
CO4	3	3	3	3	3	3	1	3	2	2	3	3	3	3

BT20351	GENOMICS AND PROTEOMICS	3	0	0	3

COURSE OBJECTIVES	
To enable the students to	
1	understand the fundamental principles and techniques of genomics and proteomics.
2	explore genome sequence analysis and determination.
3	apply bioinformatics tools for analysing genomic data to determine its function.
4	discuss advancements in high-throughput protein sequencing technologies and their applications.
5	analyze the structure, function, and interactions of proteins using proteomic approaches.

UNIT I	INTRODUCTION	9
Introduction to genome, transcriptome, and proteome; Overview of genomes of bacteria, archae, and eukaryote; Genomes of organelles.		
UNIT II	**GENOME MAPPING AND SEQUENCING**	**9**
Genetic and physical mapping, Linkage analysis, RFLP, SNP, SSLP, Restriction mapping, STS mapping, FISH, Top-down and bottom-up sequencing strategies, Whole genome sequencing, Gap closure, Pooling strategies.		
UNIT III	**FUNCTIONAL GENOMICS**	**9**
Genome annotation, ORF and functional prediction, Gene finding, Substractive DNA library screening, Differential display and Representational difference analysis, SAGE, TOGA, Introduction to DNA microarray		
UNIT IV	**TECHNIQUES IN PROTEOMICS**	**9**
In-vitro and in vivo-labeling of proteins, One and two-dimensional gel electrophoresis, Detection of Proteins on SDS gels, Protein cleavage, Edman protein micro sequencing, Mass spectrometry-principles of MALDI-TOF, Peptide mass fingerprinting.		
UNIT V	**PROTEIN PROFILING**	**9**
Large-scale protein profiling using proteomics, Post-translational modifications, Phosphoprotein and glycoprotein analyses; Analysis of protein-protein interactions, Protein microarrays.		
	TOTAL PERIODS	**45**

COURSE OUTCOMES		
At the end of this course, the students will be able to		**BT MAPPED** (Highest Level)
CO1	understand the existence of various levels of genome and proteome structures	Understanding (K2)
CO2	apply the knowledge of mapping and sequencing to determine the genomic structures	Applying (K3)
CO3	investigate various strategies to correlate genomic structures with their functions	Applying (K3)
CO4	relate the knowledge of proteomic techniques in the characterization of proteins	Applying (K3)
CO5	utilize the knowledge to research areas such as drug discovery, personalized medicine, and biotechnology.	Applying (K3)

TEXT BOOKS

1. Suhai, Sandor, "Genomics and Proteomics: Functional and Computational Aspects", Springer, 2000.
2. Primrose SB, Twyman, "Principles of Genome Analysis and Genomics", 7th Edition, Blakwell Publishing, 2006.

REFERENCES

1. Pennington SR, Dunn MJ, "Proteomics: From Protein Sequence to Function", Viva Books Pvt, Ltd, 2002.
2. O'Connor, Hames CD BD, "Proteomics", Scion Publishing, 2008.
3. Daniel C, Liebler, "Introduction to Proteomics", Humana press, 2002.
4. Conard, Edward, "Genomics", Apple Academics, 2010.

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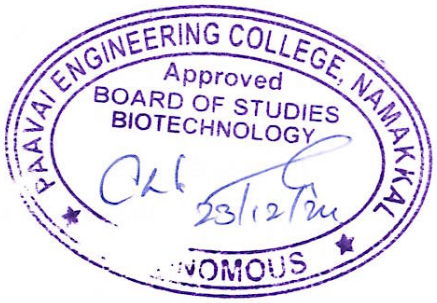
CO's	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	1	1	1	-	-	-	-	-	-	-	2	3	2
CO2	2	2	2	1	1	-	-	-	-	-	-	3	3	2
CO3	2	2	1	1	1	-	-	-	-	-	-	1	3	3
CO4	3	2	1	1	2	-	-	1	-	-	-	1	2	3
CO5	3	2	2	1	3	-	-	1	-	-	-	2	2	2



BT20352	BIOCONJUGATE TECHNOLOGY AND APPLICATIONS	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	provide theoretical knowledge on bioconjugate technologies.
2	learn about the biological and clinical applications of bioconjugate technology.
3	understand the modification of functional targets.
4	understand the role of reagents in bioconjugation.
5	gain knowledge on enzymes and nucleic acids modification.

UNIT I	MODIFICATION OF FUNCTIONAL TARGETS	9

Modification of amino acids, peptides and proteins – modification of sugars, polysaccharides and glycoconjugates – modification of nucleic acids and oligonucleotides.

UNIT II	CHEMISTRY OF ACTIVE GROUPS	9

Amine reactive chemical reactions – Thiol reactive chemical reactions – carboxyl reactive chemical reactions – hydroxyl reactive chemical reactions – aldehyde and ketone reactive chemical reactions - Photoreactive chemical reactions.

UNIT III	BIOCONJUGATE REAGENTS	9

Zero length cross linkers – Homo bifunctional crosslinkers – Hetero bifunctional cross linkers – Trifunctional cross linkers – Cleavable reagent systems – tags and probes.

UNIT IV	ENZYME AND NUCLEIC ACID MODIFICATION AND CONJUGATION	9

Properties of common enzymes neurobio– Activated enzymes for conjugation – biotinylated enzymes– chemical modification of nucleic acids – biotin labeling of DNA- enzyme conjugation to DNA – Fluorescent of DNA.

UNIT V	BIOCONJUGATE APPLICATIONS	9

Preparation of Hapten-carrier Immunogen conjugates - antibody modification and conjugation – immunotoxin conjugation techniques – liposome conjugated and derivatives-Colloidal – gold labeled proteins – modification with synthetic polymers.

TOTAL PERIODS:	45

COURSE OUTCOMES

At the end of this course, the students will be able to		**BT MAPPED** (Highest Level)
CO1	understand target bio-molecules and their active groups for conjugation.	Understanding (K2)
CO2	apply the knowledge of the chemistry of bio-conjugates to the type of reactions.	Applying (K3)
CO3	design and develop efficient conjugates through various cross linkers.	Applying (K3)
CO4	infer the reagent systems for the conjugation of enzymes, antibody and nucleic acid.	Applying (K3)
CO5	relate the knowledge gained about bioconjugates in various fields	Applying (K3)

TEXT BOOKS

1. Hermanson GT, "Bioconjugate Techniques", Academic Press, 3rd edition, 2013.
2. Sam Massa, Nick Devoogdt (eds.), "Bioconjugation: Methods and Protocols, Methods in Molecular Biology", vol. 2033, Springer Science and Business Media, LLC, part of Springer Nature, 2019.

REFERENCES

1. Ravin Narain (ed.), "Chemistry of bioconjugates: synthesis, characterization, and biomedical applications", Department of Chemical and Materials Engineering, University of Alberta, Edmonton, Alberta, Canada, 2014.
2. Sonny S Mark (ed.), "Bioconjugation Protocols: Strategies and Methods, Methods in Molecular Biology", vol. 751, Springer Science and Business Media, LLC 2011.
3. Chrostof M Niemeyer (Eds), "Methods in Molecular Biology", 283, Bioconjugation Protocols Strategies and Methods. Humana Press, 2004
4. Richard B Silverman, "Organic Chemistry of Enzyme-Catalyzed Reactions", Academic Press, 2002.

CO/PO MAPPING :

CO/PO Mapping

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

COs	Programmes Outcomes (POs)													
	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	-	1	-	-	-	-	-	-	-	2	3	3
CO2	3	3	-	3	-	-	-	-	-	-	-	3	-	3
CO3	3	3	3	2	-	-	-	-	-	-	-	2	2	3
CO4	3	3	3	1	1	-	-	-	-	-	-	-	1	1
CO5	2	3	3	2	1	-	-	1	-	-	-	3	3	2

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BT20353	CANCER BIOLOGY	3	0	0	3

COURSE OBJECTIVES	
To enable the students to	
1	understand the basics of cancer and cancerous cells.
2	discuss the significance of carcinogenesis in the development of cancer.
3	interpret the role of oncogenes and their growth factors.
4	make understanding on process of cancer metastasis and their dysregulation factors.
5	gain knowledge on the advancement in cancer treatment.

UNIT I	FUNDAMENTALS OF CANCER BIOLOGY	9

Introduction, historical perspective, classification carcinogenesis, cancer initiation, promotion and progression, pathways of spread- Epidemology Regulation of cell cycle, mutations that cause changes in signal molecules, effects on receptor, signal switches, tumour suppressor genes, modulation of cell cycle in cancer, different forms of cancers, diet and cancer. Cancer screening and early detection, Detection using biochemical assays, tumor markers, molecular tools for early diagnosis of cancer.

UNIT II	PRINCIPLES OF CARCINOGENESIS	9

Theory of carcinogenesis, Chemical carcinogenesis, metabolism of carcinogenesis, principles of Physical carcinogenesis, x-ray radiation-mechanisms of radiation carcinogenesis.

UNIT III	MOLECULAR BIOLOGY OF CANCER	9

DNA repair defects and genomic instability in cancer cells. Signal targets and cancer, activation of kinases; Oncogenes, identification and retroviruses. Detection of oncogenes and proto oncogene activity. Growth factors related to transformation. Telomerase.

UNIT IV	CANCER METASTASIS	9

Clinical significances of invasion, Molecular genetic of metastasis development, stromal microenvironment and carcinogenesis, dysregulation of cancer, associated genes Clinical significances of invasion, heterogeneity of metastatic phenotype, metastatic cascade, basement membrane disruption, three step theory of invasion, proteinases and tumour cell invasion.

UNIT V	ADVANCES IN CANCER THERAPY	9

Different forms of therapy, chemotherapy, radiation therapy, detection of cancers, prediction of aggressiveness of cancer, advances in cancer detection. Use of signal targets towards therapy of cancer; Gene therapy. Recent technology to detect cancer diseases and advanced technology to cure cancer diseases. Targeted drug delivery methods to cure cancer.

	TOTAL PERIODS:	45

COURSE OUTCOMES		
At the end of this course, the students will be able to		**BT MAPPED** (Highest Level)
CO1	explain the development and proliferation of cancer with specific causes.	Understanding (K2)
CO2	describe the influence of carcinogenesis in the cancer development.	Understanding (K2)
CO3	identify the pathways and therapeutic targets of cancer.	Applying (K3)
CO4	investigate the steps involved in metastasis and tumour cell invasion.	Applying (K3)
CO5	explore novel drugs and technologies for the treatment of cancer.	Applying (K3)

TEXT BOOKS

1. Pezzella F, Tavassoli M, Kerr D J (Eds.), "Oxford textbook of cancer biology", Oxford University Press, 2019.
2. Hejmadi M, "Introduction to cancer biology", Bookboon, 2014.

REFERENCES

1. Weinberg RA, "The Biology of Cancer" Garland Science, 2007
2. McDonald F etal., "Molecular Biology of Cancer" II Edition. Taylor and Francis, 2004.
3. Hejmadi M, "Introduction to cancer biology", Bookboon, 2014.
4. King Roger JB, "Cancer Biology", Addison Wesley Longman, 2007.

CO/PO MAPPING :

CO/PO Mapping

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

COs		Programmes Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	1	-	-	-	-	-	-	-	3	3	3
CO2	3	2	-	1	-	-	-	-	-	-	-	3	2	3
CO3	3	3	3	2	-	-	-	-	-	-	-	2	2	3
CO4	3	3	3	1	-	-	-	-	-	-	-	2	1	1
CO5	3	3	3	2	1	-	-	2	-	-	-	2	3	2

BT20354	CREATIVITY, INNOVATION AND NEW PRODUCT DEVELOPMENT	3	0	0	3

COURSE OBJECTIVES	
To enable the students to	
1	develop the creativity skills among the learners.
2	impart the knowledge of creative intelligence essential for entrepreneurs.
3	know the applications of innovation in entrepreneurship.
4	develop innovative business models for business.
5	gain knowledge on creative intelligence.

UNIT I	CREATIVITY	9

Creativity: Definition- Forms of Creativity-Essence, Elaborative and Expressive Creativities- Quality of Creativity-Existential, Entrepreneurial and Empowerment Creativities – Creative Environment- Creative Technology- Creative Personality and Motivation.

UNIT II	CREATIVE INTELLIGENCE	9

Creative Intelligence: Convergent thinking ability – Traits Congenial to creativity – Creativity Training-- Criteria for evaluating Creativity-Credible Evaluation- Improving the quality of our creativity – Creative Tools and Techniques - Blocks to creativity- fears and Disabilities- Strategies for Unblocking- Designing Creativity Enabling Environment.

UNIT III	INNOVATION	9

Innovation: Definition- Levels of Innovation- Incremental Vs Radical Innovation-Product Innovation and Process- Technological, Organizational Innovation – Indicators- Characteristics of Innovation in Different Sectors. Theories in Innovation and Creativity- Design Thinking and Innovation- Innovation as Collective Change-Innovation as a system.

UNIT IV	NEW PRODUCT PLANNING	9

Design of proto type - testing - quality standards - marketing research - introducing new products - Need for innovation in the field of medicine, environmental protection, agriculture, pharma, food etc.

UNIT V	PRODUCT DEVELOPMENT	9

Design and develop an innovative process, method or product in any field of biotechnology based on societal and scientific needs.

	TOTAL PERIODS:	45

COURSE OUTCOMES		
At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	summarize the basics of creativity for developing entrepreneurship.	Understanding (K2)
CO2	translate the importance of creative intelligence for business growth.	Understanding (K2)
CO3	observe the advances through innovation in industries.	Understanding (K2)
CO4	employ the applications of innovation in building successful ventures of biotechnology.	Applying (K3)
CO5	design and develop simple innovative methods and products.	Applying (K3)

TEXT BOOKS

1. Kankha, Sultan Chand, Pradip N, Khandwalla, "Creativity and Innovation in Entrepreneurship", Tata Mc Graw Hill, 2004.
2. Paul Trott, "Innovation Management and New Product Development", 4e, Pearson, 2018.

REFERENCES

1. Krishnamacharyulu CSG, Lalitha R, "Innovation Management", Himalaya Publishing House, 2010.
2. Lee JM, "Biochemical engineering" Englewood Cliffs, NJ: Prentice Hall, 2001.
3. Michael Michalko, "Thinkertoys: A Handbook of Creative-Thinking Techniques", Ten Speed Press, 2006.
4. Peter F Drucker, "Innovation and Entrepreneurship", Harper Business, 2006.

CO/PO MAPPING :

CO/PO Mapping

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

COs	Programmes Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	1	-	3	3	3	-	-	-	3	3	3
CO2	3	3	-	3	-	3	-	-	-	-	-	3	-	3
CO3	3	3	3	2	-	3	3	3	-	-	-	3	2	3
CO4	3	3	3	1	1	3	1	-	-	-	-	-	1	1
CO5	2	3	3	2	1	3	3	3	-	-	-	3	3	2

BT20451	NANO BIOTECHNOLOGY	3	0	0	3

COURSE OBJECTIVES	
To enable the students to	
1	understand the principles and methods in Nano biotechnology.
2	explore the structure and stability of biomaterials for nanotechnology applications.
3	learn techniques of protein nanoparticle synthesis and functionalization.
4	learn techniques of DNA nanoparticle synthesis and functionalization.
5	evaluate the applications of nano biotechnology in biomedical sectors.

UNIT I	NANOSCALE PROCESSES AND NANOMATERIALS	9

Overview of nanoscale processes and characterization of nanomaterials – Physicochemical properties of nanomaterials – Concepts in nanotechnology – Natural nanomaterials –Types of Nanomaterials (Quantum dots, Nanoparticles, Nanocrystals, Dendrimers, Polymeric nanoparticles, Bucky balls, Nanotubes)–Synthesis and assembly of nanoparticles and nanostructures using bioderived templates.

UNIT II	STRUCTURAL AND FUNCTIONAL PRINCIPLES OF NANOMATERIALS	9

Biomolecular structure and stability – Protein folding – Self-assembly – Self-organization – Information-Driven nano assembly – Biomaterials – Biomolecular motors – Traffic across membranes – Biomolecular sensing – Self-replication – Machine-phase bionanotechnology.

UNIT III	PROTEIN-BASED NANOTECHNOLOGY	9

Overview of protein nanotechnology – Nanotechnology with S-Layer protein – Engineered nanopores – Bacteriorhodopsin and its potential – Protein assisted synthesis of metal nanoparticles – Synthesis of protein-based nanoparticles – Protein nanoparticle-hybrids – Covalent and non-covalent protein nanoparticle conjugates – Protein-carbon nanotube conjugates.

UNIT IV	DNA-BASED NANOTECHNOLOGY	9

DNA-based nanostructures – Biomimetic fabrication of DNA based metallic nanowires and networks – Self assembling DNA structures – DNA-nanoparticle conjugates – DNA-carbon nanotube conjugates – DNA templated electronics – DNA nanostructures for mechanics and computing – DNA nanomachine.

UNIT V	APPLICATIONS OF NANOTECHNOLOGY	9

Promising nanobiotechnologies for applications in medicine –Liposomes in nanomedicine – Therapeutic applications of nanomedicine – Nano-Sized carriers for drug delivery and drug carrier systems – Protein and peptide nanoparticles, DNA based nano particles, Lipid matrix nanoparticles for drug delivery – Nano biosensors for imaging and diagnosis.

	TOTAL PERIODS	45

COURSE OUTCOMES		
At the end of this course, the students will be able to		**BT MAPPED** (Highest Level)
CO1	comprehend the fundamental processes and concepts of nano biotechnology.	Understanding (K2)
CO2	demonstrate the skills in nanoparticle synthesis and characterization.	Understanding (K2)
CO3	understand the synthesis of protein-based nanoparticles in biology.	Understanding (K2)
CO4	apply the various approaches for DNA based nanoparticles synthesis	Applying (K3)
CO5	correlate the potential applications in drug delivery, diagnostics, and environmental management.	Applying (K3)

TEXT BOOKS

1. Goodsell DS, "Bionanotechnology", John Wiley and Sons, 2004.
2. Niemeyer CM., Mirkin CA, "Nanobiotechnology: Concepts, Applications, and Perspectives", 2004.

REFERENCES

1. Sitharaman B, "Handbook of Nanobiotechnology", 2011.
2. Freitas RA Jr, Tokura T, "Nanomedicine: Principles and Perspectives", 2005.
3. Mirkin CA, Niemeyer CM, "Nanobiotechnology II: More Concepts and Applications", 2007.
4. Wu A, Khan WS, "Nanobiotechnology for Sensing Applications", From Lab to Field, 2020.

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

BT20452	PROCESS EQUIPMENTS AND PLANT DESIGN	3	0	0	3

COURSE OBJECTIVES	
To enable the students to	
1	understand the designing aspects of various equipment's used in biotech industry.
2	explore the design and construction of pressure vessel structures.
3	understand the construction details of extractors and absorption towers.
4	learn the types of pumps, seals, valves and switches.
5	design various types of piping and plant layout design.

UNIT I	HEAT EXCHANGERS, CONDENSERS, EVAPORATORS	9

Single and multi-process exchangers, double pipe, U tube heat exchangers, combustion details supporting structure. Single and vertical tube evaporation, Single and multi-effect evaporators, forced circulation evaporators.

UNIT II	STORAGE VESSEL FOR VOLATILE AND NON-VOLATILE FLUIDS	9

Design of the following equipments as per ASME, ISI codes, drawing according to scale; monoblock and multiplayer vessels, combustion details and supporting structure.

UNIT III	EXTRACTOR, DISTILLATION AND ABSORPTION TOWER	9

Construction details and assembly drawing; Plate and Packed Extraction Towers; Plate and Packed absorption Towers; Plate and Packed Distillation Towers.

UNIT IV	PUMPS, MECHANICAL SEALS, VALVES AND SWITCHES	9

Various types of pumps, Principle of working, construction, usages, advantages and disadvantages; Various types of seals, effectiveness, usages; Pneumatic Seals; Gate, Globe and Butterfly Valves, their material of construction; Pneumatically Controlled Valves.

UNIT V	PIPING, PLANT LAY OUT AND DESIGN	9

Various types of Piping, material of construction, their usage; Pipe lay out; Modern Plant Design and case Studies.

	TOTAL PERIODS	45

COURSE OUTCOMES		
At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	comprehend the design of heat exchangers and evaporators	Understanding (K2)
CO2	demonstrate the skills in the design of pressure and storage vessels.	Understanding (K2)
CO3	design the distillation column, absorption column, and extractors	Applying (K3)
CO4	understand the usage of different pumps, mechanical seals, valves and switches	Applying (K3)
CO5	apply the knowledge in the design layout of industrial plants	Applying (K3)

TEXT BOOKS

1. Brownell LE, Young EH, "Process Equipment Design", Wiley Eastern India Limited 2009.
2. Kern DQ, "Process Heat Transfer", McGraw-Hill, 2001.

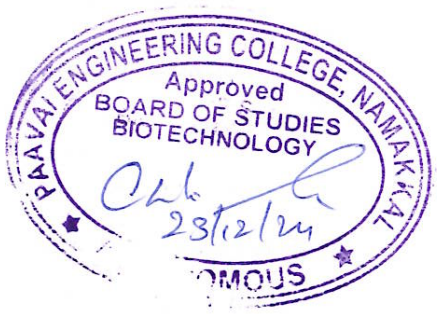
REFERENCES

1. McCabe WL, Smith JC, Harriott.P , "Unit Operations of Chemical Engineering", 6th Edition, McGraw-Hill, 2001.
2. Ray Sinnott and Gavin Towler "Chemical Engineering Design", 5th edition, Butterworth Heinemann, 2015.
3. Michael L Shuler, Fikret Kargi, "Bioprocess Engineering: Basic Concepts", 2nd Edition, Prentice Hall, 2002
4. Subhabrata Ray, Gargi Das, "Process Equipment and Plant Design: Principles and Practices", 1st Edition, Elsevier, 2020.

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



BT20453	NEUROBIOLOGY	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	understand the fundamentals on neuronal systems and outline of their mechanism of action
2	outline the mechanism of neurophysiology, potentials and neuronal function.
3	express the classification of neuronal drugs and its action.
4	illustrate the basic neurologic mechanism of sense organs
5	identify the fundamental relationships among neural activity, drug therapy, cognition and behaviour.

UNIT I	NEUROANATOMY	9

Classification of central and peripheral nervous systems; Structure and function of neurons; typesof neurons; cranial nerves, spinal nerves, glial cells; myelination; Brief anatomy of Brain and Spinal cord Blood Brain barrier; Meninges and Cerebrospinal fluid; Spinal Cord.

UNIT II	NEUROPHYSIOLOGY	9

Resting and action potentials; Mechanism of action potential conduction; Voltage dependent channels; nodes of Ranvier; Chemical and electrical synaptic transmission; information representation and coding by neurons, classification of neurotransmitters; neuropeptides; adrenergic and cholinergic transmission; hormones and their effect on neuronal function.

UNIT III	NEUROPHARMACOLOGY	9

Overview of drug mechanism of action and classification – parasympathetic and sympathetic drugs, neuroleptics, thymoleptics, analeptics, drugs used in Alzheimer's and Parkinson disease, drug addiction.

UNIT IV	APPLIED NEUROBIOLOGY	9

Basic neurologic mechanism of sense organs; research models for study and investigation in neurosciences and neuropharmacologic drug development.

UNIT V	BEHAVIOUR AND COGNITIVE SCIENCE	9

Basic mechanisms associated with motivation; behavioural studies – interpersonal interaction models, Transactional Analysis, neurology of memory; disorders associated with the nervous system.

	TOTAL PERIODS	45

COURSE OUTCOMES

At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	gain knowledge about the central and peripheral nervous systems	Understanding (K2)
CO2	apply the knowledge of neurophysiology in the mechanism of neuronal function	Applying (K3)
CO3	apply the mechanism of drug actions in the treatment of neurodegenerative diseases.	Applying (K3)

CO4	analyse various facts about brain function and experimental approaches, theories, and models to integrate neuroscience information cross their biotech discipline	Analysing (K4)
CO5	apply the basic mechanisms associated with neural system with behavioural studies principles and implications of neuroscience	Applying (K3)

TEXT BOOKS

1. Eric R Kandel (Editor), James H. Schwartz (Editor), Thomas M. Jessell (Editor), Steven A. Siegelbaum (Editor), AJ Hudspeth, "Principles of Neural Science", Fifth Edition, 2012.
2. Dale Purves, George J Augustine, David Fitzpatrick, William C Hall, Anthony-Samuel LaMantia, Leonard E White, "Neuroscience", 6 edition, October 12, 2017.

REFERENCES

1. Mark F Bear, Barry W Connors, Michael A Paradiso, "Neuroscience: Exploring the Brain" 4th Edition, Jones and Bartlett Learning, 4th edition, 2015.
2. Mathews GG, "Neurobiology: molecules, cells and systems", 2nd edition, Blackwell Science, UK, 2000.
3. Norman Doidge, "The Brain That Changes Itself: Stories of Personal Triumph from the Frontiers of Brain Science", Penguin USA, 2007.
4. Karen Whalen, "Lippincott Illustrated Reviews: Pharmacology", 6th edition, 2014.

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	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

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BT20454	FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	understand the global trends and development methodologies of various types of products and services.
2	conceptualize, prototype and develop product management plan for a new product.
3	understand how to collect, analyze and arrive at requirements for new product development.
4	understand system modeling and arrive at the optimum system specification and characteristics.
5	develop documentation, test specifications, validate and sustain up to the End of Life support activities.

UNIT I BASICS OF PRODUCT DEVELOPMENT **9**

Global Trends Analysis and Product decision - Social Trends - Technical Trends- Economic Trends - Environmental Trends - Political/Policy Trends - Introduction to Product Development Methodologies and Management - Overview of Products and Services - Types of Product Development - Overview of Product Development methodologies - Product Life Cycle – Product Development Planning and Management.

UNIT II REQUIREMENTS AND SYSTEM DESIGN **9**

Requirement Engineering - Types of Requirements - Requirement Engineering - traceability Matrix and Analysis - Requirement Management - System Design and Modeling - Introduction to System Modeling - System Optimization - System Specification - Sub-System Design - Interface Design.

UNIT III DESIGN AND TESTING **9**

Conceptualization - Industrial Design and User Interface Design - Introduction to Concept generation Techniques – Challenges in Integration of Engineering Disciplines - Concept Screening and Evaluation - Detailed Design - Component Design and Verification – Mechanical, Electronics and Software Subsystems - High Level Design/Low Level Design of S/W Program - Types of Prototypes, S/W Testing- Hardware Schematic, Component design, Layout and Hardware Testing – Prototyping - Introduction to Rapid Prototyping and Rapid Manufacturing - System Integration, Testing, Certification and Documentation

UNIT IV SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT **9**

Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation - Sustenance - Maintenance and Repair – Enhancements - Product EoL - Obsolescence Management – Configuration Management - EoL Disposal

UNIT V BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY **9**

The Industry - Engineering Services Industry - Product Development in Industry versus Academia –The IPD Essentials - Introduction to Vertical Specific Product Development processes - Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and Software Systems – Product Development Trade-offs - Intellectual Property Rights and Confidentiality – Security and Configuration Management.

TOTAL PERIODS: 45

COURSE OUTCOMES		
At the end of this course, the students will be able to		**BT MAPPED** (Highest Level)
CO1	define, formulate, and analyze a problem in product development.	Understanding (K2)
CO2	understand the requirement engineering and system modeling.	Understanding (K2)
CO3	utilize concept generation techniques and testing products.	Applying (K3)
CO4	work independently as well as in teams.	Applying (K3)
CO5	organise a project from start to finish as per industry need.	Applying (K3)

TEXT BOOKS

1. Karl T Ulrich, Stephen D Eppinger, "Product Design and Development", Tata McGraw Hill, 5th Edition, 2011.
2. John W Newstorm, Keith Davis, "Organizational Behavior", Tata McGraw Hill, 11th Edition, 2005.

REFERENCES

1. Hiriyappa B, "Corporate Strategy – Managing the Business", Author House, 2013.
2. Peter F Drucker, "People and Performance", Butterworth – Heinemann [Elsevier], Oxford, 2004.
3. Vinod Kumar Garg, Venkita Krishnan NK, "Enterprise Resource Planning – Concepts", 2nd Edition, Prentice Hall, 2003.
4. Mark S Sanders, Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, 7th Edition, 2013.

CO/PO MAPPING :

CO/PO Mapping

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

COs	Programmes Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	1	-	-	-	-	-	1	-	1	3	3
CO2	3	2	3	1	-	-	-	-	-	1	-	1	-	3
CO3	3	2	3	1	1	-	-	1	1	1	-	1	2	3
CO4	3	2	3	1	1	-	-	1	1	1	-	1	1	1
CO5	3	2	3	1	1	-	-	1	1	1	-	1	3	2

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BIOTECHNOLOGY
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BT20551	STEM CELL TECHNOLOGY	3	0	0	3

COURSE OBJECTIVES	
To enable the students to	
1	introduce the fundamental principles of stem cell biology.
2	identify and characterize human embryonic and adult stem cell.
3	familiarize with differentiation of stem cells into different cell types.
4	discuss ethical, legal, and societal considerations in stem cell research and therapy.
5	address challenges in clinical translation and ethical considerations in advanced stem cell technologies.

UNIT I	INTRODUCTION TO STEM CELLS	9

Stem cell Classification, Sources and Properties –Types of stem cells: methods of isolation, study of stem cells and their viability IPSC, embryonic stem cells, cancer stem cells. – Preservations of Stem cell. Embryonic stem cell: Isolation, Culturing, Differentiation, Properties – Adult stem cell: Isolation, Culturing, Differentiation, Trans-differentiation, Plasticity, and Properties.

UNIT II	HUMAN EMBRYONIC AND ADULT STEM CELL	9

Stem cells and their developmental potential. In vitro fertilization-culturing of embryos – blastocyst inner cell mass-isolation and growing ES cells in lab; Identification and characterization of human ES cells. Somatic stem cells-test for identification of adult stem cells- adult stem cell differentiation trans differentiation-plasticity-different types of adult stem cells-liver stem cells-skeletal muscle stem cells-bone marrow derived stem cells.

UNIT III	DIFFERENTIATION OF STEM CELLS INTO CELL TYPES	9

Factors influencing cell specialization – internal factors – asymmetric segregation, cell signaling mechanisms – diffusion, direct contact and gap junctions; environmental factors – temperature, drugs and injuries; mechanism of stem cell differentiation – errors in cell differentiation – anaplasia, dysplasia and metaplasia.

UNIT IV	STEM CELLS IN TISSUE ENGINEERING	9

Haematopoietic Stem Cells-Growth factors and the regulation of haematopoietic stem cells, clinical applications of haematopoietic stem cells; HLA matching, patient selection, peripheral blood and bone marrow transplantation; Mesenchymal stem cells and their role in bone tissue engineering bone repair; Stem cell based gene therapy and benefits to human. Techniques in stem cell technology - fluorescence activated cell sorting (FACS), time lapse video, green fluorescent protein tagging.

UNIT V	APPLICATION AND ETHICAL ISSUES	9

Therapeutic applications-Parkinson's disease, Cancer stem cell – Neural stem cell for central nervous system repair – Spinal cord injury – use of ESC to treat heart disease – Burns and skin ulcers – Orthopaedic applications of stem cell - Insulin-producing Cells Derived from Stem cells: A Potential Treatment for Diabetes; Stem cell policy and ethics, stem cell research: Hype, hope and controversy.

	TOTAL PERIODS	45

COURSE OUTCOMES		
At the end of this course, the students will be able to		**BT MAPPED (Highest Level)**
CO1	differentiate different types of stem cells and to characterize them	Analyzing (K4)
CO2	gain knowledge on development potential of human embryonic and adult stem cell	Applying (K3)
CO3	develop techniques to program stem cells into specific cell types	Understanding (K2)
CO4	understand the role of stem cells in tissue engineering and regenerative medicine	Understanding (K2)
CO5	familiarize with stem cell technology and its applications for the betterment of society	Applying (K3)

TEXT BOOKS

1. Robert Paul Lanza, Essentials of stem cell biology, Academic Press, 2006
2. Ariff Bongso, Eng Hin Lee, "Stem cells", World Scientific Publication Co. Pvt. Ltd., 2005.

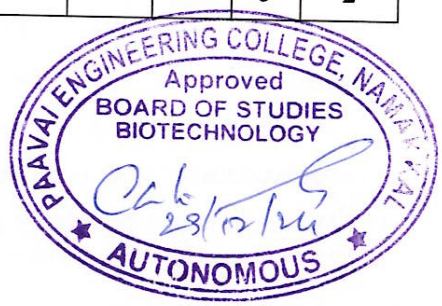
REFERENCES

1. Alberts et al, "Molecular Biology of the Cell", 2014.
2. Stephen Sullivan, Chad Cowan, "Human Embryonic Stem Cells", 2007.
3. Scott F. Gilbert, "Developmental Biology", 2020.
4. Ali Gholamrezanezhad, "Stem cells in clinic and Research", Intech, 2013.

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



BT20552	METABOLIC ENGINEERING	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	describe the metabolic design and pathway analysis.
2	outline the models of cellular reactions and measurements errors, rate.
3	point out the determined system and their metabolic fluxes by isotope labelling.
4	calculate the analysis of metabolic control and flux control coefficients.
5	examine the stoichiometric network and their consistency tests and experimental validation.

UNIT I BASICS OF METABOLIC DESIGN AND PATHWAY ANALYSIS **9**

Basic principles of metabolic design, thermodynamics of pathway, redox balancing, transport of substrates, enzyme candidates, substrate and product transport and choice of appropriate genetic strategies.

UNIT II MATERIAL BALANCES AND DATA CONSISTENCY **9**

Comprehensive models of cellular reactions; stoichiometry of cellular reactions, lumping of reaction rates, analysis of over determined systems using black box model- identification of gross measurement errors. Introduction to MATLAB®.

UNIT III METABOLIC FLUX ANALYSIS **9**

Theory of determined, over-determined systems, underdetermined systems- linear programming, sensitivity analysis, methods for the experimental determination of metabolic fluxes by isotope labeling.

UNIT IV METABOLIC CONTROL ANALYSIS **9**

Fundamentals of Metabolic Control Analysis, control coefficients and the summation theorems, Experimental determination of flux control coefficients and other coefficients. Theory of large deviations.

UNIT V ANALYSIS OF METABOLIC NETWORKS **9**

Stoichiometric Network Analysis. Elementary mode analysis, extreme pathways. Control of flux distribution at a single branch point, Grouping of reactions, optimization of flux amplifications, consistency tests and experimental validation.

TOTAL PERIODS **45**

COURSE OUTCOMES

At the end of this course, the students will be able to		**BT MAPPED** (Highest Level)
CO1	explain thermodynamics of pathway and redox balancing	Understanding (K2)
CO2	identify stoichiometry of cellular reactions and understanding MATLAB®.	Understanding (K2)
CO3	discover the basics of metabolic flux and control analysis	Analysing (K4)
CO4	estimate theoretical analysis of large deviation and experimental coefficients.	Analysing (K4)
CO5	evaluate stoichiometric analysis of metabolic networks and extreme pathways.	Analysing (K4)

TEXT BOOKS

1. Gregory N Stephanopoulos, Aristos A Aristidou, Jens Nielsen, "Metabolic Engineering: Principles and Methodologies", Academic Press, 2007.

2. Sang Yup Lee E Terry Papoutsakis Marcel Dekker, "Metabolic Engineering", inc 2009.

REFERENCES

1. Eberhard O Voit, "Computational Analysis of Biochemical Systems: A Practical Guide for Biochemists and Molecular Biologists", Cambridge University Press, 2000.
2. Verpoorte R, Alfermann AW, Johnson TS, (eds), "Applications of Plant Metabolic Engineering", Springer, The Netherlands, 2007.
3. Zoltan Szallasi, JorgStelling, Vipul Periwal, "Systems Modeling in Cellular Biology: From Concepts to Nuts and Bolts, MIT Press, Cambridge, 2006.
4. Nielsen J, Villadsen J, "Bioreaction Engineering Principles", 3rd Edition New York: Plenum Press, 2011.

CO/PO MAPPING :

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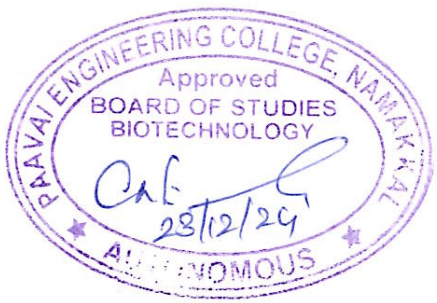
CO2	2	3	3	-	2	3	-	-	-	-	3	3	2	1
CO3	3	3	2	-	-	-	-	-	-	-	3	2	2	-
CO4	1	2	2	2	-	2	1	1	-	-	-	3	3	3
CO5	1	3	3	2	-	2	1	1	-	-	-	2	3	2



BT20553	SYSTEMS BIOLOGY	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	acquaint with the concepts of system biology.
2	make aware of the kinetic modelling and flux.
3	explain the flux balance analysis and signal transduction networks.
4	Interpret the Network motifs and their integration.
5	familiarize tools and databases for modelling.

UNIT I INTRODUCTION **9**

Introduction to Systems Biology, Systems level understanding of biological systems. Basic concepts in Systems modeling : Model Scope, Model Statements, System state, Variables, parameters and constants, Model behavior, classification and steady state. Merits of computational modeling.

UNIT II KINETIC MODELLING **9**

Kinetic modeling of biochemical reactions, describing dynamics with ODEs, rate equations, deriving a rate equation, incorporating regulation of enzyme activity by effectors, E-cell platform and erythrocyte modeling.

UNIT III FLUX BALANCE ANALYSIS **9**

Introduction to Flux balance analysis, Construction of stoichiometric matrices, Constraint based models. Network basics, examples of mathematical reconstruction of transcriptional networks and signal transduction networks.

UNIT IV NETWORK MOTIFS **9**

Network motifs, Feed forward loop network motif. Gene circuits, robustness of models, Chemotaxis model, Integration of data from multiple sources: Building genome scale models.

UNIT V TOOLS AND DATABASES FOR MODELING **9**

Tools and databases for modeling: Pathway databases KEGG, EMP, Metacyc, Enzyme kinetics database BRENDA, Gene expression databases, Biomodels database, Basics of Systems Biology Markup Language (SBML), SBML editors.

TOTAL PERIODS **45**

COURSE OUTCOMES

At the end of this course, the students will be able to		**BT MAPPED (Highest Level)**
CO1	understand System level concepts of biological systems	Understanding (K2)
CO2	develop simple kinetic modeling of biochemical reactions	Understanding (K2)
CO3	employ the flux balance models and network basics	Applying (K3)
CO4	characterise network motifs and building genome scale models	Applying (K3)
CO5	determine basics tools and databases for modeling	Applying (K3)

TEXT BOOKS

1. Edda Klipp, Wolfram Liebermeister, Christoph Wierling, "Systems Biology", Wiley-BlackWell Publications, 2009.
2. Uri Alon, "An introduction to Systems Biology: Design Principles of Biological Circuits", Chapman and Hall / CRC, 2007.

REFERENCES

1. Hiroaki Kitano, "Foundations of Systems Biology", MIT Press, 2001.
2. Lilia Albhergina, "Systems Biology: Definitions and perspectives", Springer Publications, 2008.
3. Edda Klipp, Ralf Herwig, Axel kowald, Christoph Wierling, Hans Lehrach, "Systems Biology in practice : concepts, implementation and application", Wiley – VCH, 2005.
4. AUTODOCK, autodock.scripps.edu

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

BA20252	TOTAL QUALITY MANAGEMENT	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	know the importance of quality management, customer perception and retention.
2	acquaint with the principles and philosophies of quality management.
3	understand the significance of statistical process control for quality management.
4	ascertain quality management tools and techniques.
5	familiarise with the norms governing quality systems and implementations.

UNIT I	INTRODUCTION TO QUALITY MANAGEMENT	9

Definitions, TQM framework, benefits, awareness and obstacles, quality- vision, mission and policy statements; customer focus – customer perception of quality, translating needs into requirements, customer retention, dimensions of product and service quality, cost of quality.

UNIT II	PRINCIPLES AND PHILOSOPHIES OF QUALITY MANAGEMENT	9

Overview of the contributions of Deming, Juran, crobsy, Masaaki Imai, Feigenbaum, Ishikawa, Taguchi techniques- introduction, loss function, parameter and tolerance design, signal to noise ratio; concepts of quality circle, Japanese 5S principles and 8D methodology.

UNIT III	STATISTICAL PROCESS CONTROL AND PROCESS CAPABILITY	9

Meaning and significance of statistical process control (SPC)- construction of control charts for variables and attributes; Process capability – meaning, significance and measurement – Six sigma concepts of process capability, Business process re-engineering (BPR) - principles, applications, reengineering process, benefits and limitations.

UNIT IV	TOOLS AND TECHNIQUES FOR QUALITY MANAGEMENT	9

Control Charts, Process capability, Concepts of six sigma, Quality Function Development (QFD), Taguchi quality loss function, TPM- Concepts, improvement needs and Performance measures.

UNIT V	QUALITY SYSTEMS ORGANIZING AND IMPLEMENTATION	9

Need for ISO 9000; ISO 9001-2008 Quality System – Elements, documentation, Quality Auditing; QS 900-ISO 14000-Concepts, requirements and benefits, TQM implementation in manufacturing and service sectors.

	TOTAL PERIODS	45

COURSE OUTCOMES

At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	frame effective quality policies	Understanding (K2)
CO2	apply the quality philosophies and practices in business.	Applying (K3)
CO3	implement the statistical process control and process capability to enhance quality.	Applying (K3)
CO4	examine the quality tools to enhance organizations quality performance.	Applying (K3)
CO5	value and practice quality systems.	Understanding (K2)

TEXT BOOKS

1. Paneerselvam R.Sivasankaran.P, Quality Management, PHI Learning, 2014.
2. Dale H.Besterfield, Carol Besterfield-Michna, Glen H. Besterfield, Mary Besterfield- Sacre, Hemant Urdhwareshe, Rashmi Urdhwareshe, Total Quality Management (TQM), Fifthe edition, Pearson Education, 2018.

REFERENCES

1. Shridhara Bhat K, Total Quality Management – Text and Cases, Himalaya Publishing House, First Edition 2010.
2. Poornima M.Charantimath, Total Quality Management, Pearson Education, Second Edition, 2011.
3. Douglas C.Montgomory, Introduction to Statistical Quality Control, Wiley Student Edition, 4th Edition, Wiley India Pvt Limited, 2008.
4. Indian Standard – Quality Management systems- Guidelines for performance improvement (Fifth Revision), Bureau of Indian Standards, New Delhi

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

23/12/24

BT20651	MOLECULAR THERAPEUTICS AND DIAGNOSTICS	3	0	0	3

COURSE OBJECTIVES	
To enable the students to	
1	explain the molecular diagnostics for infections.
2	detail the traditional disease and various methods and tools.
3	discuss the various disease and diagnostics and treatments.
4	classify therapies against for cancer.
5	examine the techniques in molecular and clinical diagnostic technologies.

UNIT I	INTRODUCTION TO MOLECULAR DIAGNOSTICS	9

History of diagnostics, Diseases- infectious, physiological and metabolic errors, genetic basis of diseases, inherited diseases. Infection – mode of transmission in infections, factors predisposing to microbial pathogenicity, types of infectious diseases- bacterial, viral, fungal, protozoans and other parasites; general approach to clinical specimens, Sample collection- method of collection, transport and processing of samples,

UNIT II	TRADITIONAL DISEASE DIAGNOSIS METHODS AND TOOLS	9

Diagnosis of infection caused by Streptococcus, Coliforms, Salmonella, Shigella, Vibrio, and Mycobacterium., Diagnosis of major fungal infections: Dermetophytoses, Candidiosis and Aspergillosis. · Diagnosis of DNA and RNA viruses- Pox viruses, Adenoviruses, Rhabdo Viruses, Hepatitis Viruses and · Retroviruses. · Diagnosis of Protozoan diseases: Amoebiosis, Malaria, Trypnosomiosis, Leishmaniasis.

UNIT III	DIAGNOSIS AND TREATMENT OF COMMON DISEASES	9

Atherosclerosis, ischemic heart disease and cerebrovascular disease; coagulation system and hypertension; metabolic syndrome and diabetes mellitus; asthma, allergy and inflammatory diseases of the lung; gastrointestinal system, including inflammatory bowel diseases.

UNIT IV	TARGETED THERAPY	9

Objective and types of targeted therapy, working mode of targeted therapy against cancer – by immunotherapy, by cell signaling interruption, by angiogenesis inhibitors, monoclonal antibody therapy, by apoptosis, hormone therapy for prostate cancer and hormone therapy for breast cancer; side effects of cancer treatment and drawbacks of targeted therapy. Targeted drug delivery – active and passive targeting, drug delivery vehicles

UNIT V	TECHNIQUES IN MOLECULAR AND CLINICAL DIAGNOSTICS	9

PCR-based methods for mutation detection, alternative methods for mutation detection and DNA sequencing for disease association, microarray approaches for gene expression analysis, methods for analysis of DNA methylation; clinical diagnostic technologies: flow cytometry, medical cytogenetics, fluorescence *in situ* hybridization, immunohistochemistry and laser capture microdissection (FFPE).

	TOTAL PERIODS	45

COURSE OUTCOMES		
At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	articulate sample collections and diagnostics.	Understanding (K2)
CO2	estimate the diagnostics for traditional diseases.	Understanding (K2)
CO3	list treatment of common diseases and diagnostics.	Understanding (K2)
CO4	interpret various targeted therapy and types.	Applying (K3)
CO5	identify the types of mutation and clinical diagnostics.	Applying (K3)

TEXT BOOKS

1. Harald Seitz Sarah Schumacher, "Molecular Diagnostics", Springer, 2013.
2. David E Bruns, Edward R, Ashwood, Carl A Burtis, "Fundamentals of Molecular Diagnostics", Elsevier Health Sciences, 2008.

REFERENCES

1. Lela Buckingham FA, "Molecular Diagnostics: Fundamentals, Methods and Clinical Applications", Davis Company, 2023.
2. George C Prendergast, "Molecular Cancer Therapeutics: Strategies for Drug Discovery and Development", Wiley and Sons, Inc, 2004.
3. David Whitehouse, Ralph Rapley, "Molecular and Cellular Therapeutics", Wiley and Sons, Ltd, 2012.
4. Nader Rifai , A. Rita Horvath , Carl T. Wittwer, "Principles and Applications of Molecular Diagnostics, Jason Park, 2018.

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

BT20652	MUSHROOM CULTIVATION AND BIOFERTILIZER PRODUCTION	3	0	0	3

COURSE OBJECTIVES	
To enable the students to	
1	understand the basic concepts of mushroom cultivation and its importance.
2	interpret the mushroom Cultivation and harvesting techniques.
3	instil the ability and skills required to become entrepreneur in mushroom cultivation.
4	explain various methods of composting techniques and their steps.
5	illustrate various types of biofertilizer and their applications.

UNIT I	MUSHROOM BIOLOGY MORPHOLOGY	9

Classification: edible and poisonous mushrooms. Life cycle of Basidiomycetes fungi Breeding and Genetic improvement of mushroom strains. Medicinal and Nutritional value of mushrooms.

UNIT II	MUSHROOM CULTIVATION TECHNIQUES	9

Cultivation conditions for tropical and temperate countries. Isolation, spawn production, growth media, spawn running and harvesting of mushrooms (*Volvariella* spp., *Pleurotus* spp., *Agaricus* spp., *Calocybe* spp., and *Lentinus* spp). Diseases and contamination; Post Harvest Technology: Freezing, drying, Freeze-drying and canning.

UNIT III	ECONOMICS OF MUSHROOM CULTIVATION	9

Economics of the production of oyster mushroom, milky mushroom and paddy straw mushroom cultivation: Infrastructure facilities, expenditure on fixed assets, plant and machinery, cost of the project, recurring expenditure, interest and depreciation of the expenditure, cost of production and profit. Entrepreneurship in mushroom cultivation

UNIT IV	COMPOSTING TECHNIQUES	9

History of composting – compost - composting processes - microbiology of composting fate of pathogens - ingredients in composting - various methods of composting: vermi- composting and home composting-steps in composting.

UNIT V	BIO-FERTILIZERS AND THEIR PRODUCTION	9

Introduction - Types: Microbes as biofertilizer, Green manure, importance of macronutrients; Biofertilizers vs Chemical fertilizers; Nitrogen fixers – types and examples; Phosphate solubilizers – role of bacteria and Mycorrhizae -Mass cultivation; Biofertilizers applications- Rhizobium, Azospirillum, Cyanobacteria, Mycorrhizae Quality control; Challenges and opportunities; Biofertilizer Entrepreneurship.

	TOTAL PERIODS	45

COURSE OUTCOMES		
At the end of this course, the students will be able to		**BT MAPPED** (Highest Level)
CO1	articulate the morphology, lifecycle of mushroom and its functional values.	Understanding (K2)
CO2	apply the cultivation techniques for mushroom production	Understanding (K2)
CO3	illustrate the marketing potential of the produced mushroom and composts.	Applying (K3)
CO4	classify various composting process and identify its multifunctioning.	Applying (K3)
CO5	interpret the importance of biofertilizer and their mass production.	Applying (K3)

TEXT BOOKS

1. Nita Bahl, "Hand Book on Mushroom Cultivation", 4th Edition, Vijay Primlani for Oxford and IBH Publishing Co, New Delhi, 2024.
2. Biswas S, Datta M, Nagachan, SV, "Mushrooms- A manual for cultivation", PHI Learning Private Limited, New Delhi, 2012.

REFERENCES

1. Chang TS, Hayes WA, The Biology and Cultivation of Edible Mushrooms. Academic Press, New York, 2004.
2. Tiwari SC, Pankaj Kapoor, Mushroom Cultivation, Mittal Publications, 2018.
3. Krishnamoorthy, Hand Book of Mushroom Cultivation. TNAU Publications, Coimbatore, TN, India, 2019.
4. Subba Rao NS, Biofertilizers in agriculture and forestry. India Book House Ltd. New Delhi, 2024.

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

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BT20653	MOLECULAR MODELING	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	understand the molecular behaviour of proteins, nucleic acids and small molecules in biological system.
2	explain the principles involved in molecular modelling.
3	apply modelling tools and docking programme.
4	analyse how drugs interact with macromolecules.
5	strategies used in designing novel drugs and prodrugs.

UNIT I	**INTRODUCTION TO CLASSICAL MECHANICS**	**9**

Newtons laws of motion – time intervals- algorithms

UNIT II	**INTRODUCTION TO STATISTICAL MECHANICS**	**9**

Boltzman's Equation – Ensembles – Distribution law for non-interacting molecules – Statistical mechanics of fluids.

UNIT III	**QUANTUM MECHANICS**	**9**

Photoelectric effect – De Broglies hypothesis – Uncertainity principle – Schrodingers time independent equation – particle in a one -dimensional box.

UNIT IV	**GROMOS, GROMACS, AMBER and DOCK**	**9**

Various forcefields for proteins and nucleic acids – Molecular mechanics – Molecular dynamics– Molecular dynamics simulations in water and organic solvents.

UNIT V	**GAUSSIAN**	**9**

Preparing input files – job types – model chemistries – basis sets – molecule specifications running Gaussian – examples.

TOTAL PERIODS	**45**

COURSE OUTCOMES

At the end of this course, the students will be able to		**BT MAPPED** (Highest Level)
CO1	understand the classical mechanics to study the behavior of molecules in biological system.	Understanding (K2)
CO2	simulate the biomolecules using statistical mechanics.	Understanding (K2)
CO3	assess and utilize various principles based on quantum mechanics.	Applying (K3)
CO4	evaluate the development of new biomolecules by modification	Applying (K3)
CO5	create new lead molecules in drug design	Anaysing (K3)

TEXT BOOKS
1. Leach Andrew R, "Molecular Modelling: Principles and Applications" 2nd Edition, Pearson, 2010.
2. Leach R. "Molecular Modelling: Principles and Applications" 2nd Edition, Longman Publications, 2010.
REFERENCES
1. McQuarrie D, "Statistical Mechanics", Narosa, University Science Books; 1st Edition 2000
2. McQuarrie D, "Quantum Mechanics"; D. McQuarrie, Narosa, 1999.
3. GROMOS Handbook, www.gromacs.org
4. Hans Pieter H, Folkers G, "Molecular Modelling", VCH, 1999.
CO/PO MAPPING:

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

BT20654	ENERGY CONSERVATION AND MANAGEMENT	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	analyze global and national energy consumption and impacts.
2	apply knowledge of power systems, motors, and lighting
3	valuate efficiency of boilers, furnaces, and steam systems.
4	identify energy-saving opportunities in pumps, fans, and compressors.
5	apply energy economics concepts like payback period and irr.

UNIT I INTRODUCTION **9**

Energy - Power – Past and Present scenario of World; National Energy consumption Data – Environmental aspects associated with energy utilization – Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers. Instruments for energy auditing.

UNIT II ELECTRICAL SYSTEMS **9**

Components of EB billing – HT and LT supply, Transformers, Cable Sizing, Concept of Capacitors, Power Factor Improvement, Harmonics, Electric Motors - Motor Efficiency Computation, Energy Efficient Motors, Illumination – Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of Encon in Illumination.

UNIT III THERMAL SYSTEMS **9**

Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters – Efficiency computation and EnCon measures. Steam: Distribution andUsage: Steam Traps, Condensate Recovery, Flash Steam, Utilization, Insulators and Refractories

UNIT IV ENERGY CONSERVATION IN MAJOR UTILITIES **9**

Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems – Cooling Towers – D.G. sets

UNIT V ECONOMICS **9**

Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value,
Life Cycle Costing –ESCO concept

TOTAL PERIODS **45**

COURSE OUTCOMES

At the end of this course, the students will be able to		**BT MAPPED** (Highest Level)
CO1	learn environmental and societal implications of energy consumption.	Understanding (K2)
CO2	design efficient electrical systems for power management and illumination	Applying (K3)
CO3	investigate thermal system efficiencies and implement conservation measures.	Applying (K3)
CO4	propose strategies for improving energy efficiency in industrial utilities.	Applying (K3)
CO5	calculate economic impacts of energy projects using financial metrics	Applying (K3)

TEXT BOOKS

1. Mehmet Kanoglu et al., "Energy Efficiency and Management for Engineers", McGraw Hill Education, 2020.
2. Wayne C Turner, Steve Doty, "Energy Management Handbook, Fairmont Press / CRC Press, 2020.

REFERENCES

1. Albert Thumann, Terry Niehus, "Handbook of Energy Audits", 9th Edition, CRC Press, 2017.
2. Gupta JP, "Boiler Efficiency Improvement", 3rd Edition, Khanna Publishers, 2015.
3. Barney L Capehart, Wayne C Turner, William J Kennedy, "Guide to Energy Management", 8th Edition, CRC Press, 2020.
4. Craig B Smith, Kelly E Parmenter, "Energy Management Principles", 2nd Edition, Elsevier, 2015.

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

BT20903	BASICS OF MICROBIAL TECHNOLOGY	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	gain knowledge on basics of microbes and its types
2	understand various sterilization techniques and diagnostic methods.
3	learn about microbes causing infections to humans.
4	explain the beneficial applications of microbes in various industries.
5	produce fermented products from microorganism.

UNIT I	BASICS OF MICROBES AND ITS TYPES	9

Introduction to microbes, existence of microbes, inventions of great scientist and history, types of microorganisms – Bacteria, Virus, Fungi.

UNIT II	MICROBIAL TECHNIQUES	9

Sterilization – types – physical and chemical sterilization, Decontamination, Preservation methods, fermentation, Cultivation and growth of microbes, Diagnostic methods.

UNIT III	PATHOGENIC MICROBES	9

Infectious Disease – Awareness, Causative agent, Prevention and control - Cholera, Dengu, Malaria, Diarrhea, Tuberculosis, Typhoid, Covid, HIV.

UNIT IV	BENEFICIAL MICROBES	9

Applications of microbes – Clinical microbiology, agricultural microbiology, Food Microbiology, Environmental Microbiology, Animal Microbiology, Marine Microbiology.

UNIT V	PRODUCTS FROM MICROBES	9

Fermented products – Fermented Beverages, Curd, Cheese, Mushroom, Agricultural products – Biopesticide, Biofertilizers, Vermi compost, Pharmaceutical products - Antibiotics, Vaccines

	TOTAL PERIODS	45

COURSE OUTCOMES

At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	explain the microbes and their types.	Understanding (K2)
CO2	identify methods to cultivation of microbes.	Understanding (K2)
CO3	detect the pathogens and control measures for safety.	Applying (K3)
CO4	group and characterize microbes based on their applications.	Applying (K3)
CO5	distinguish microbes in different industry for economy.	Applying (K3)

TEXT BOOKS

1. Joanne Willey, Linda Sherwood, Chris Woolverton, "Prescott's Microbiology", 11th Edition, McGraw-Hill Education, 2022.
2. Gerard J Tortora, Berdell R Funke, Christine L Case, "Microbiology: An Introduction", 13th Edition, Pearson, 2019.

REFERENCES

1. Michael T Madigan, Kelly S Bender, Daniel H Buckley, David A Stahl, "Brock Biology of Microorganisms", 15th Edition, Pearson, 2018.
2. Jeffrey C Pommerville, "Fundamentals of Microbiology", 11th Edition, Jones and Bartlett Learning, 2021.
3. Patrick R Murray, Ken S Rosenthal, Michael A Pfaller, "Medical Microbiology", 9th Edition, Elsevier, 2020.
4. Martin R Adams, Maurice O Moss, "Food Microbiology", 4th Edition, Royal Society of Chemistry, 2016.

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

BT20904	BIOTECHNOLOGY FOR WASTE MANAGEMENT	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	impart the fundamentals of biological treatment processes.
2	understand the types of waste biomass and value-added products from them.
3	comprehend the perspective of biofuels from wastes
4	illustrate various chemicals and enzyme production from wastes
5	acquire knowledge on bio composting processes.

UNIT I	BIOLOGICAL TREATMENT PROCESS	9

Fundamentals of biological process - Anaerobic process – Pretreatment methods in anaerobic process – Aerobic process, Anoxic process, Aerobic and anaerobic digestion of organic wastes - Factors affecting process efficiency - Solid state fermentation – Submerged fermentation – Batch and continuous fermentation

UNIT II	WASTE BIOMASS AND ITS VALUE ADDITION	9

Types of waste biomass – Solid waste management - Nature of biomass feedstock – Bio based economy/process – Value addition of waste biomass – Biotransformation of biomass – Biotransformation of marine processing wastes – Direct extraction of biochemicals from biomass – Plant biomass for industrial application

UNIT III	BIOCONVERSION OF WASTES TO ENERGY	9

Perspective of biofuels from wastes - Bioethanol production – Biohydrogen Production – dark and photo fermentative process - Biobutanol production – Biogas and Biomethane production - Single stage anaerobic digestion, Two stage anaerobic digestion - Biodiesel production - Enzymatic hydrolysis technologies

UNIT IV	CHEMICALS AND ENZYME PRODUCTION FROM WASTES	9

Production of lactic acid, succinic acid, citric acid – Biopolymer synthesis – Production of Amylases - Lignocellulolytic enzymes - Pectinolytic enzymes - Proteases – Lipases

UNIT V	BIOCOMPOSTING OF ORGANIC WASTES	9

Overview of composting process - Benefits of composting, Role of microorganisms in composting - Factors affecting the composting process - Waste Materials for Composting, Fundamentals of composting process - Composting technologies, Composting systems – Nonreactor Composting, Reactor composting - Compost Quality.

	TOTAL PERIODS	45

COURSE OUTCOMES

At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	learn the various methods biological treatment	Understanding (K2)
CO2	know the details of waste biomass and its value addition	Understanding (K2)
CO3	develop the bioconversion processes to convert wastes to energy	Applying (K3)
CO4	synthesize the chemicals and enzyme from wastes	Applying (K3)
CO5	apply the theoretical knowledge for the development of value-added products	Applying (K3)

TEXT BOOKS

1. Antoine PT, "Biofuels from Food Waste Applications of Saccharification Using Fungal Solid-State Fermentation", CRC press, 2017.
2. Joseph CA, "Anaerobic Waste-Wastewater Treatment and Biogas Plants-A Practical Handbook", CRC Press, 2019.

REFERENCES

1. Palmiro P, Oscar FD Urso, "Biotransformation of Agricultural Waste and By-Products - The Food, Feed, Fibre, Fuel (4F) Economy", Elsevier, 2016.
2. Kaur Brar S, Gurpreet Singh D, Carlos RS, (Eds), "Biotransformation of Waste Biomass into High Value Biochemicals", Springer, 2014.
3. Keikhosro K, Editor, "Lignocellulose-Based Bioproducts', Springer, 2015.
4. John P, "Waste Management Practices-Municipal, Hazardous, and Industrial", Second Edition, CRC Press, 2014.

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