PAAVAI ENGINEERING COLLEGE, NAMAKKAL – 637018
(AUTONOMOUS)
B.Tech. BIOTECHNOLOGY
REGULATIONS 2023
(CHOICE BASED CREDIT SYSTEM)
(Applicable to the students admitted during the academic year 2023 – 2024 onwards)
CURRICULUM
SEMESTER III

S. No.	Category	Course Code	Course Title	L	T	P	C
Theory							
1.	BS	MA23301	Transform Techniques and Partial differential equations	3	1	0	4
2.	PC	BT23301	Cell Biology	3	0	0	3
3.	PC	BT23302	Biochemistry	3	0	0	3
4.	PC	BT23303	Microbiology	3	0	0	3
5.	MC	MC23301	Environmental Sciences and Sustainability	2	0	0	0
Theory Cum Laboratory							
6.	ES	BT23304	Fluid Transport and Mechanical Operations	3	0	2	4
Practical							
7.	PC	BT23305	Biochemistry Laboratory	0	0	4	2
8.	PC	BT23306	Cell and Microbiology Laboratory	0	0	4	2
9.	EE	GE23301	Professional Development I	0	0	2	1
			Total	**17**	**1**	**12**	**22**

SEMESTER IV

S. No.	Category	Course Code	Course Title	L	T	P	C
Theory							
1.	BS	MA23403	Probability and Statistics	3	1	0	4
2.	PC	BT23401	Heat and Mass Transfer	3	0	0	3
3.	PC	BT23402	Biochemical Process Calculations	3	0	0	3
4.	PC	BT23403	Genetics and Molecular Biology	3	0	0	3
5.	MC	MC23402	Human Values and Gender Equality	2	0	0	0
Theory Cum Laboratory							
6.	PC	BT23404	Bio Analytical Techniques	3	0	2	4
Practical							
7.	PC	BT23405	Heat and Mass Transfer Laboratory	0	0	4	2
8.	PC	BT23406	Molecular Biology Laboratory	0	0	4	2
9.	EE	GE23401	Professional Development II	0	0	2	1
			Total	**17**	**1**	**12**	**22**

PAAVAI ENGINEERING COLLEGE, NAMAKKAL
Approved
BOARD OF STUDIES
BIOTECHNOLOGY
8/5/24
AUTONOMOUS

MA23301	TRANSFORM TECHNIQUES AND PARTIAL DIFFERENTIAL EQUATIONS	3	1	0	4

(Common to Aero, Agri, BME, Biotech, Civil, Chemical, EEE, Food, Pharma, Mech, MCT, R&A)

COURSE OBJECTIVES

To enable the students to

1.	develop the knowledge of periodic and non-periodic functions and their representations using fourier series.
2.	acquaint the student with Fourier transform techniques used in wide variety of situations.
3.	introduce the basic concepts of PDE for solving standard partial differential equations.
4.	acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
5.	develop Z transform techniques for discrete time systems.

UNIT I	FOURIER SERIES	12

Dirichlet's conditions; General Fourier series; Odd and even functions; Half range series; Statement of Complex form of Fourier Series; Parseval's identity; Harmonic Analysis.

UNIT II	FOURIER TRANSFORMS	12

Fourier integral theorem (without proof); Fourier transform pair; Sine and Cosine transform - Properties; Transforms of elementary functions; Convolution theorem; Parseval's identity.

UNIT III	PARTIAL DIFFERENTIAL EQUATIONS	12

Formation of partial differential equations; Lagrange's linear equation; Solutions of four standard types of first order partial differential equations; Linear partial differential equations of second order with constant coefficients.

UNIT IV	FOURIER SERIES SOLUTION TO PARTIAL DIFFERENTIAL EQUATIONS	12

Solutions of One-dimensional wave and heat equation; Steady state two-dimensional heat equation.

UNIT V	Z -TRANSFORMS AND DIFFERENCE EQUATIONS	12

Z-transforms - Elementary properties; Inverse Z-transform; Method of partial fraction ; Residue method; Convolution theorem; Solution of difference equations by Z-transform.

	TOTAL PERIODS	60

COURSE OUTCOMES		BT MAPPED (Highest Level)
At the end of this course, the students will be able to		
CO1	classify the properties of periodic and non-periodic vibrations with the help of Fourier series.	Applying (K3)
CO2	apply the Fourier transform to convert the function from frequency domain to time domain.	Applying (K3)

CO3	demonstrate partial differential equations that occur in many engineering applications.	Applying (K3)
CO4	apply Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.	Applying (K3)
CO5	apply knowledge of Z transform to analyse linear time invariant systems.	Applying (K3)

TEXT BOOKS

1. Veerarajan T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., New Delhi, Second reprint, 2012.
2. Grewal. B.S, "Higher Engineering Mathematics", 44th Edition, Khanna Publications, New Delhi, (2018).

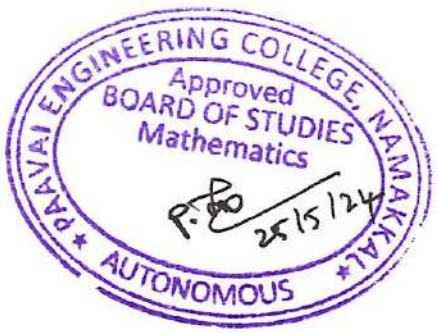
REFERENCES

1. Erwin Kreyszig , "Advanced Engineering Mathematics ", 10th Edition, Wiley Publications, New Delhi, India, 2016.
2. Ramana. B.V., "Higher Engineering Mathematics", Tata Mc-Graw Hill Publishing Company limited, New Delhi (2010).
3. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education (2007).
4. Wylie. R.C. and Barrett. L.C., "Advanced Engineering Mathematics", Tata Mc-Graw Hill Publishing Company limited, 6th Edition, New Delhi, 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

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



BT23301	CELL BIOLOGY	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	impart knowledge on the cell, cytoskeleton architecture and cell junctions.
2	inculcate the mechanism of cell proliferation, control and cancer.
3	understand the basis of molecular transport across the membranes.
4	comprehend various signaling pathways and their functions.
5	educate various techniques to study cells.

UNIT I	CELL STRUCTURE AND FUNCTION OF THE ORGANELLES	9

Prokaryotic, Eukaryotic cells, Sub-cellular organelles and functions. Principles of membrane organization membrane proteins, cytoskeletal proteins. Extra cellular matrix, cell-cell junctions.

UNIT II	CELL DIVISION, CANCER, APOPTOSIS AND IMMORTALIZATION OFCELLS	9

Cell cycle – Mitosis, Meiosis, Molecules controlling cell cycle, cancer, role of Ras and Raf in oncogenesis and apoptosis. Stem cells, Cell culture and immortalization of cells and its applications.

UNIT III	TRANSPORT ACROSS CELL MEMBRANE	9

Passive and Active Transport, Permeases, Ion channels, ATP pumps. Na+ / K+ /Ca+2Tpumps, uniport, symport antiporter system. Ligand gated / voltage gated channels, Agonists and Antagonists.

UNIT IV	SIGNAL TRANSDUCTION	9

Receptors – extracellular signaling, Cell surface / cytosolic receptors and examples, Different classes of receptors autocrine / paracrine / endocrine models, Secondary messengers' molecules.

UNIT V	TECHNIQUES USED TO STUDY CELLS	9

Cell fractionation and flow cytometry, Morphology and identification of cells using microscopic studies like SEM, TEM, Fluorescent and Confocal Microscopy. Cell viability – MTT assay.

	TOTAL PERIODS	45

COURSE OUTCOMES

At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	articulate various cells at different structural and functional level.	Understanding (K2)
CO2	explain the stages of cell proliferation and relate them in cancer development and apoptosis.	Understanding (K2)
CO3	illustrate the transport phenomena across the plasma membrane.	Applying (K3)
CO4	classify various signaling pathways and to identify its malfunctioning.	Applying (K3)
CO5	employ simple techniques to analyze cell and their morphology.	Applying (K3)

TEXT BOOKS

1. Lodish H, Berk A, Kaiser CA, Krieger M, Bretscher A, Ploegh H, Martin KC, Yaffe M, Amon A, "Molecular Cell Biology", 9th Edition, W H Freeman, 2021.

2. Cooper G, Adams K, "The Cell: A Molecular Approach", 9th Edition, Oxford University Press, 2022.

REFERENCES

1. Hardin J, Lodolce J, "Becker's World of the Cell", 10th Edition, Pearson, 2021.
2. Simon E, Dickey J, Jane, "Campbell Essential Biology", 6th Edition, Pearson, 2019.
3. Alberts B, Hopkin K, Johnson A, Morgan D, Roberts K, Walterp, Heald R, "Essential Cell Biology", 6th Edition, W. W. Norton & Company, 2023.
4. Pollard TD, Earnshaw WC, Lippincott-Schwartz J, Johnson G, "Cell Biology", 4th Edition, Elsevier, 2022.

CO/PO MAPPING:

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(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	1	1
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

BT23302	BIOCHEMISTRY	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	learn the fundamentals of biochemical processes and biomolecules.
2	understand the chemical basis which allows biological molecules to give rise to the process.
3	comprehend the structure of nucleic acid and their function.
4	educate various metabolic pathways of carbohydrates and their interconnection.
5	inculcate the metabolic pathways of lipids, amino acids and protein.

UNIT I	INTRODUCTION TO BIOMOLECULES - CARBOHYDRATES	9

Basic principles of organic chemistry, role of carbon, types of functional groups, chemical, nature of water, pH and biological buffers, bio molecules structure and properties of Carbohydrates (mono, di, oligo and polysaccharides) Proteoglycans, glucosaminoglycans. mutarotation, glycosidic bond, reactions of monosaccharides, reducing sugars. Starch, glycogen, cellulose and chitin. Proteoglycans, glycosaminoglycans. hyaluronic acid, chondroitin sulfate.

UNIT II	STRUCTURE AND PROPERTIES OF LIPIDS AND PROTEINS	9

Structure and properties of Important Biomolecules. Lipids: fatty acids, glycerol, saponification, iodination, hydrogenation, phospholipids, glycolipids, sphingolipids, cholesterol, steroids, prostaglandins. Protein: Amino Acids, Peptides, Proteins, measurement, structures, hierarchy of organization primary, secondary, tertiary and quaternary structures, glycoproteins, lipoproteins, Functions of Proteins. Protein targeting, Folding, Chaperone and targeting of organelle proteins, Protein degradation, Enzymes, introduction to biocatalysts.

UNIT III	STRUCTURE AND PROPERTIES OF NUCLEIC ACIDS	9

Primary structure of Nucleic acids: purines, pyrimidines, nucleoside, nucleotide, RNA, DNA-Watson-Crick structure of DNA, reactions, properties, measurement, nucleoprotein complexes.

UNIT IV	METABOLISM CONCEPTS AND CARBOHYDRATE METABOLISM	9

Metabolic pathways, primary and secondary metabolites. Interconnection of pathways and metabolic regulation. Glycolysis, TCA cycle, gluconeogenesis, pentose phosphate shunt and glyoxalate shunt.

UNIT V	INTERMEDIARY METABOLISM AND REGULATION	9

Fatty acid synthesis and oxidation, reactions of amino acids, deamination, transamination and decarboxylation, urea cycle, Bioenergetics - High energy compounds, electronegative potential of compounds, respiratory chain, ATP cycle, calculation of ATP yield during oxidation of glucose and fatty acids.

	TOTAL PERIODS	45

COURSE OUTCOMES

At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	infer a strong foundation in the structure of biomolecules and to describe its biochemical reactions.	Understanding (K2)
CO2	articulate the structure and functions of lipids and proteins and to understand the biological process.	Understanding (K2)
CO3	explain the structure and properties of nucleic acids in biological function.	Understanding (K2)

CO4	illustrate the metabolism of carbohydrates through various anabolic and catabolic pathways.	Applying (K3)
CO5	explore the intermediary metabolism and its regulation in biological functions.	Applying (K3)

TEXT BOOKS

1. Nelson DL, Lehninger AL, Cox MM, "Lehninger Principles of Biochemistry", 6th Edition, W.H.Freeman and Company, 2017.
2. Satyanarayana U, Chakrapani U, "Biochemistry", 5th Edition, Books & Ailled (P), 2020.

REFERENCES

1. Berg JM, Tymoczko JL, Stryer L, "Biochemistry", 6th Edition, W.H . Freeman & Company, 2017
2. Rodwell VW, Bender D, Botham KM, "Harper's Illustrated Biochemistry", 31st Edition, McGraw-Hill, 2018.
3. Voet D, Voet JG, Pratt CW, "Voet's principles of biochemistry", 5th Edition, John Wiley & Sons Inc., 2018.
4. Horton HR, Moran LA, Scrimgeour KG, Perry MD, Rawn JD, "Principles of Biochemistry", 5th Edition, Pearson New International, 2014.

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

BT23303	MICROBIOLOGY	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	describe the principles of microbiology to emphasize fundamentals of various microbes.
2	recognize structural organization, morphology and reproduction of microbes.
3	state the requirements for microbial growth and their lifecycle.
4	solve the problems in microbial infection and their control.
5	comprehend the role of microbes in various industries and environment.

UNIT I INTRODUCTION 9

Basics of microbial existence; history of microbiology, classification and nomenclature of microorganisms, microscopic examination of microorganisms, Principles and applications of Microscopy – Light, dark field, phase contrast, fluorescence and electron microscopes;principles of different staining techniques like Gram staining, acid-fast, capsular staining, flagellar staining.

UNIT II MICROBES- STRUCTURE AND MULTIPLICATION 9

Structural organization and multiplication of bacteria, viruses, algae and fungi, with specialmention of life history of actinomycetes, yeast, mycoplasma and bacteriophages.

UNIT III MICROBIAL NUTRITION, GROWTH AND METABOLISM 9

Nutritional requirements of bacteria; different media used for bacterial culture; growth curve and different methods to quantify bacterial growth; preservation techniques; aerobic and anaerobic bioenergetics and utilization of energy for biosynthesis of important molecules.

UNIT IV CONTROL OF MICROORGANISMS 9

Physical and chemical control of microorganisms; host-microbe interactions; anti-bacterial, anti-fungal and anti-viral agents; mode of action and resistance to antibiotics; clinically important microorganisms.

UNIT V INDUSTRIAL AND ENVIRONMENTAL MICROBIOLOGY 9

Primary metabolites; secondary metabolites and their applications; preservation of food; production of penicillin, alcohol, vitamin B-12; biogas; bioluminescence; bioremediation; leaching of ores by microorganisms; biofertilizers and biopesticides; microorganisms and pollution control; biosensors.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course, the students will be able to		**BT MAPPED** (Highest Level)
CO1	classify microorganisms and its methods of examination.	Understanding (K2)
CO2	outline the structural organization of microorganisms and understand the multiplication process.	Understanding (K2)
CO3	illustrate nutritional requirements of microorganisms and to know their growth and metabolism.	Understanding (K2)
CO4	apply the technology to control of microorganisms.	Applying (K3)
CO5	identify the use of metabolites and biotechniques for industrial and environmental applications.	Applying (K3)

TEXT BOOKS

1. Pelczar MJ, Chan ECS, Krein NR, "Microbiology", Tata McGraw Hill Edition, New Delhi, India, 2015.
2. Prescott LM, Hardy MP, Klein JP, "Microbiology", 8th Edition, McGraw Hill, New York, 2006.

REFERENCES

1. Black JG, Black LJ, "Microbiology: principles and explorations", 10th Edition, John Wiley & Sons, 2018
2. Ananthanarayan CK, Panikars J, "Textbook of Microbiology", 11th Edition, Orient Longman Private Limited, 2020.
3. Alberts B, Heald R, Johnson A, Morgan D, Raff M, Roberts K, Walter P, "Molecular Biology of the Cell", 7th International Student Edition, W.W. Norton & Company, 2022.
4. Talaro KP, Chess B, "Foundations in Microbiology", 10th Edition, McGraw-Hill Education, 2018.

CO/PO MAPPING :

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

MC23301	ENVIRONMENTAL SCIENCES AND SUSTAINABILITY	2	0	0	0

COURSE OBJECTIVES	
To enable the students to	
1	establish the knowledge of precious resources of the environment and their various impacts.
2	create awareness on ecosystem and biodiversity preserve.
3	learn scientific and technological solutions to current day pollution issues.
4	analyze climate changes, concept of carbon credit and the challenges of environmental management.
5	understand green materials, energy cycles and the role of sustainable urbanization.

UNIT I	ENVIRONMENT AND NATURAL RESOURCES	6

Definition, scope and importance of Environment. Forest resources: Use and over-exploitation, deforestation, - mining, dams and their effects on forests and tribal people. Water resources: Use and over- utilization of surface and ground water, dams-benefits and problems. Food resources: effects of modern agriculture, fertilizer-pesticide problems. Role of an individual in conservation of natural resources.

UNIT II	ECOSYSTEMS AND BIODIVERSITY	6

Concept of an ecosystem: Structure and function of an ecosystem - ecological succession - food chains and food webs. Ecosystems- Types of ecosystem: Introduction - forest ecosystem and lake ecosystems. Biodiversity: Introduction - definition (genetic - species - ecosystem). Diversity - Value of biodiversity - Hotspots of biodiversity - Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

UNIT III	ENVIRONMENTAL POLLUTION	6

Pollution: Définition - air pollution - water pollution - marine pollution - noise pollution. Solid waste management: Causes - effects - control measures of urban and industrial wastes. Role of an individual in prevention of pollution - Electronic waste -Sources-Causes and its effects- Pollution case studies- Field study of local polluted site – Industrial/Agricultural

UNIT IV	SUSTAINABILITY AND ENVIRONMENT	6

Sustainability - from unsustainability to sustainability-millennium development goals, and protocols. Sustainable development goals-targets, indicators and intervention areas. Climate change— acid rain - ozone layer depletion. Regional and local environmental issues and possible solutions-case studies. Concept of carbon credit, carbon footprint. Environmental management in industry-A case study.

UNIT V	SUSTAINABILITY PRACTICES	6

Zero waste and R concept, Circular economy, ISO 14000 Series, Environmental Impact Assessment - Sustainable energy: Non-conventional Sources, Green materials, Energy Cycles - carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio economical and technological change.

	TOTAL PERIODS	30

COURSE OUTCOMES		
At the end of this course, students will be able to		**BT Mapped (Highest Level)**
CO1	find the method of conservation of natural resources	Understanding (K2)
CO2	understand ecosystem and the conservation of biodiversity.	Understanding (K2)
CO3	aware of environmental pollution and interpret its effects.	Understanding (K2)
CO4	apply sustainable development for technological advancement and societal development.	Applying (K3)
CO5	measure the sustainability practices for green energy cycles.	Analyzing (K4)

TEXT BOOKS

1. Benny Joseph, "Environmental Science and Engineering", Tata McGraw Hill, 1st edition, 2017.
2. Gilbert M. Masters, Wendell P. Ela " Introduction to Environmental Engineering and Science", 3rd edition, Pearson, 2022.

REFERENCES

1. William P. Cunningham and Mary Ann Cunningham, "Environmental Science: A Global Concern", McGraw Hill, 16th edition, 2023.
2. C. S. Rao, Environmental Pollution and Control engineering, New Age International (P) ltd Publication, New Delhi, 4th edition, 2021.
3. Erach Bharucha, "Textbook of Environmental Studies", Universities Press Pvt. Ltd., edition, 2020.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 4th Edition, 2015.

CO-PO MAPPING :

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

BT23304	FLUID TRANSPORT AND MECHANICAL OPERATIONS	3	0	2	4

COURSE OBJECTIVES

To enable the students to

1	impart the knowledge on properties of fluids and its flow types.
2	understand the engineering of fluid dynamics for flow measurements.
3	inculcate dynamic characteristics of fluid flow through Bernoulli's equation.
4	comprehend the various types of pumps and their characteristics.
5	extend knowledge on size reduction equipment and its analysis techniques.

UNIT I	INTRODUCTION	9

Properties of fluids Newton's law of viscosity – Fluid behaviour under shear, Newtonian and non-Newtonian fluids, Types of flow – laminar, turbulent, steady, unsteady, non-uniform and uniform flows – compressible and incompressible fluids – dimensional analysis Rayleigh method and Buckingham ' s Pi theorem.

UNIT II	FLUID DYNAMICS	9

Continuity equation, Bernoulli's equation, boundary layer condition, form drag, skin drag, drag coefficient -flow through pipes – pressure drop under laminar and turbulent flow conditions – major and minor losses.

UNIT III	FLUID FLOW MEASURMENT	9

Orifice meter, Venturi meter, Pitot tube, Rotameter, weirs and notches, hot wire anemometer, displacement meter, current meter, magnetic flow meter, pressure measurement by manometers, U-tube, differential and inclined manometers.

UNIT IV	PUMPING EQUIPMENTS	9

Pumps – types, selection and specifications, positive displacement pumps, reciprocating pump, rotarypumps, centrifugal pumps - characteristics curve of pumps.

UNIT V	MECHANICAL OPERATIONS	9

Size reduction equipment – operations and their classification, Energy and power requirements, Laws of crushing, open and closed circuit operations - techniques of size analysis – different methods for storage of solids, conveyors and elevators.

	TOTAL PERIODS	45

LIST OF EXPERIMENTS

1. Determination of Calibration of Rotameter.
2. Determination of coefficient of discharge of a venturimeter.
3. Determination of coefficient of discharge of a Orifice meter.
4. Determination of friction factor for flow through pipes.
5. Determination of Bernoulli's equation.
6. Characteristics of centrifugal pumps.
7. Characteristics of reciprocating pump.
8. Sieve analysis.

9. Characteristics of batch Sedimentation.		
	TOTAL PERIODS	**75**

COURSE OUTCOMES		
At the end of this course, the students will be able to		**BT MAPPED (Highest Level)**
CO1	evaluate stress–strain relationship in fluids and analyse fluid flow problems.	Analyzing (K4)
CO2	illustrate Bernoulli principle and measure pressure drop in flow systems.	Applying (K3)
CO3	describe the function and performance of flow metering devices.	Understanding (K2)
CO4	interpret the design and working of pumping equipment.	Understanding (K2)
CO5	make use of the methods and mechanical operations of various equipment.	Applying (K3)

TEXT BOOKS

1. McCabe WL, Smith JC, Harriot P, "Unit Operations of Chemical Engineering", 7th Edition, McGraw Hill, 2014.
2. Geankoplis CJ, "Transport Processes and Unit Operations", 3rd Edition, Prentice Hall of India, 2002.

REFERENCES

1. White FM, "Fluid Mechanics", 9th Edition, Tata McGraw-Hill company, 2022.
2. Sinnott RK,Richardson JF,Coulson JM,"Chemical Engineering:An introduction to chemical engineering design.", Butterworth-Heinemann Ltd, 2013.
3. Bansal RK, "Fluid Mechanics and Hydraulic Machines", 5th edition, Laxmi Publications Pvt. Ltd, New Delhi, 2017.
4. Foust AS, Wenzel LA, Clump CW, Naus L, Anderson LB, "Principles of Unit Operations", John Wiley & Sons, 2nd edition, 2008.

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CO's	PO's												PSO's	
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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

BT23305	BIOCHEMISTRY LABORATORY	0	0	4	2

COURSE OBJECTIVES

To enable students to

1	learn and understand the fundamental approaches for experimenting biochemical problems.
2	able to extract living cell samples from plants and animals for genetic research.
3	carry out experimental research on bimolecular separation.
4	experiment with the biochemical techniques and its applications.

LIST OF EXPERIMENTS

1. General guidelines for working in Biochemistry laboratory (theory)
2. Units of volume, weight, density and concentration measurement and their range in biological measurements. Demonstration of proper use of volume and weight measurement devices
3. Preparation of solutions: 1) percentage solutions, 2) molar solutions, 3) normal solutions
4. Preparation of buffer-Bicarbonate and PBS
5. Qualitative tests for carbohydrates- distinguishing reducing from non-reducing sugars and keto from aldo sugars
6. Quantitative method for amino acid estimation using ninhydrin- distinguishing amino from imino acid
7. Estimation of Proteinby Biuret and Lowry's methods
8. Estimation of total carbohydrates by Anthrone method
9. Estimation of Cholesterol by Zak's Method
10. Enzymatic assay: phosphatase from potato
11. Precipitation of Casein from milk

TOTAL PERIODS 60

COURSE OUTCOMES

At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	acquire methods for biochemical analysis	Applying (K3)
CO2	carry out experiments in biomolecular separations	Applying (K3)
CO3	compare the principles behind the qualitative and quantitative estimation of biomolecules.	Analyzing (K4)
CO4	develop the applicability of biochemical methods to realistic solution	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	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

BT23306	CELL AND MICROBIOLOGY LABORATORY	0	0	4	2

COURSE OBJECTIVES

To enable students to

1	demonstrate various techniques to learn the morphology and propagation of cells and microbes.
2	learn the staining techniques for identification of diverse cell types and microorganisms.
3	describe the preparation of different media and their importances
4	experiment the culturing and isolation methods of microorganisms.

LIST OF EXPERIMENTS

1. Introduction, Laboratory Safety, Use of Equipment; Sterilization Techniques
2. Microscopy – Working and care of Microscope
3. Staining Techniques Simple, Differential- Gram's Staining, Giemsa, and Leishman Staining.
4. Staining for different stages of mitosis in *Allium Cepa* (Onion)
5. Culture Media-Types and Use; Preparation of Nutrient broth and agar
6. Quantification of microorganisms by serial dilution method.
7. Cultivation and enumeration of microorganisms using spread plate method.
8. Isolation of microorganisms by pour plate method.
9. Isolation of microorganisms by streak plate method and slants.
10. Cultivation and enumeration of microorganisms from a given sample (air/soil/water).
11. Antibiotic sensitivity test for microorganisms

TOTAL PERIODS 60

COURSE OUTCOMES

At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	assign the advanced technical information pertaining to laboratory bio-safety and preventive measures from pathogenic microorganism.	Applying (K3)
CO2	handle the various aseptic techniques and sterilization methods.	Applying (K3)
CO3	develop the skills to work on important techniques for the study of microorganisms in the laboratory.	Applying (K3)
CO4	figure out various techniques of culturing microorganisms and media preparation.	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

GE23301	PROFESSIONAL DEVELOPMENT I	0	0	2	1

COURSE OBJECTIVES

To enable the students to

1. enhance and evaluate the student's professional skills and introduce the function of corporate world.
2. enhance and develop the students behavioral, speaking and listening skills to face the interview.
3. solve advance level verbal aptitude tests to get placed in Tier I companies.
4. improve their reasoning skills to get placed in reputed companies.

UNIT I	SELF - UNDERSTANDING AND PERSONALITY ENHANCEMENT SKILLS	7

Introduction self-exploration; SWOT analysis - Types and barriers; Effective communication in workplace; Leadership skills; Decision making - Problem solving; Goal setting - Critical, strategic and lateral thinking; JAM level- I; Basic resume building level- I.

UNIT II	BEHAVIOURAL SKILLS, LISTENING AND SPEAKING SKILLS	7

Behavioural skills; Time management; Emotional intelligence; Analytical thinking- Listening; Listening and hearing; Self-introduction; Group discussion - Types and importance, evaluation criteria, do's and don'ts of GD; GD Level-1.

UNIT III	QUANTITATIVE APTITUDE	8

Number System; LCM and HCF; Simple interest and compound interest; Average; Pipes and cisterns; Area; Profit and loss.

UNIT IV	LOGICAL REASONING	8

Logical sequence; Analogy; Classification; Causes and effect; Making judgment; Directions.

	TOTAL PERIODS	30

COURSE OUTCOMES

At the end of this course, students will be able to		BT Mapped (Highest Level)
CO1	define and analyze soft skills to improve the leadership skills.	Analyzing (K4)
CO2	demonstrate the behavioral skills through various activities.	Applying (K3)
CO3	develop the problem solving skills through quantitative aptitude.	Applying (K3)
CO4	illustrate the logical reasoning Skills to solve real world problems.	Analyzing (K4)

TEXT BOOKS

1. Agarwal, R.S. "Objective General English", S.Chand & Co.2021.
2. Agarwal, R.S. "Quantitative Aptitude", S.Chand & Co.2021.

REFERENCES

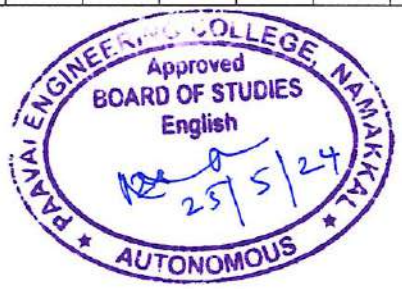
1. Abhijit Guha, "Quantitative Aptitude ", Tata-Mcgraw Hill, 2023.
2. Agarwal, R.S." a modern approach to Verbal & Non Verbal Reasoning", S.Chand & Co Ltd, New Delhi.2021.
3. Word Power Made Easy By Norman Lewis, Wr.Goyal Publications, 2021.

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	-	-	-	-	-	-	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



MA23403	PROBABILITY AND STATISTICS	3	1	0	4

(Common to Agri, Biotech, Cyber, CSE, CSE(IOT), CSE(AI&ML), AI&DS, IT, Food, Pharma)

COURSE OBJECTIVES

To enable the students to

1.	analyse the concept of random variables and probability distribution in designing processes.
2.	differentiate the discrete and continuous two dimensional random variables.
3.	determine the concepts of hypotheses testing, its need and applications.
4.	equip with statistical techniques for designing experiments, analyzing, interpreting and presenting research data.
5.	emphasize the aspects of control charts in quality control.

UNIT I	RANDOM VARIABLES	12

Discrete and continuous random variables – Moments, Moment generating functions; Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions; Functions of random variables.

UNIT II	TWO - DIMENSIONAL RANDOM VARIABLES	12

Joint distributions; Marginal and conditional distributions; Covariance, Correlation and Linear regression; Transformation of random variables; Applications of Central limit theorem (for independent and identically distributed random variables).

UNIT III	TESTING OF HYPOTHESIS	12

Sampling distributions - Estimation of parameters; Statistical hypothesis; Large sample test for single mean and difference of means; Small samples - Tests based on t, Chi-square and F distributions for mean, variance and proportion; Contingency table (test for independent), Goodness of fit.

UNIT IV	DESIGN OF EXPERIMENTS	12

Completely randomized design; Randomized block design; One way and two way classifications- Latin square design - 2^2 factorial design.

UNIT V	STATISTICAL QUALITY CONTROL	12

Control charts for measurements (X and R charts) - Control charts for attributes (P, C and NP charts), Tolerance limits, Acceptance sampling - U-test and Sign test.

	TOTAL PERIODS	60

COURSE OUTCOMES At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	assign suitable probability distributions in engineering problems.	Applying (K3)
CO2	apply the concept of discrete and continuous two dimensional random variables.	Applying (K3)
CO3	apply the concept of testing of hypothesis for small and large samples in real life problems	Applying (K3)
CO4	analyse the principles to be adopted for designing the experiments.	Analysing (K4)
CO5	examine statistical data using control chart in quality control	Applying (K3)

TEXT BOOKS

1. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4thEdition, 2007.
2. Johnson. R.A. and Gupta. C.B., Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 7thEdition, 2007.

REFERENCES

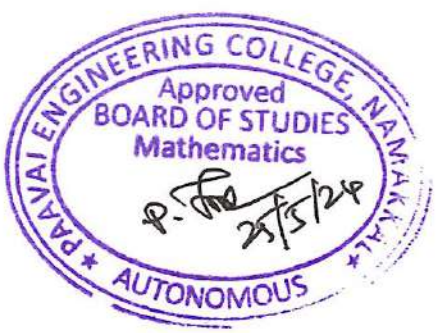
1. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8thEdition, 2012.
2. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education Asia, 8thEdition, 2007.
3. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 3rd Edition, Elsevier, 2004.
4. Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 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	3	3	3	-	-	-	-	-	-	-	3	3	3
CO2	3	2	3	3	-	-	-	-	-	-	-	3	3	3
CO3	3	3	3	2	-	-	-	-	-	-	-	2	2	3
CO4	3	3	2	2	-	-	-	-	-	-	-	2	3	3
CO5	3	3	2	3	-	-	-	-	-	-	-	2	2	3



BT23401	HEAT AND MASS TRANSFER	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	understand the principles of Fourier's law of heat conduction and its applications in bioprocesses.
2	classify the mechanisms and concepts of heat transfer through convection and radiation.
3	gain knowledge about different industrial heat transfer equipment.
4	apply the principles of mass transfer phenomena in diffusion and distillation of biological systems.
5	build the mass transfer phenomena in Liquid-Liquid and Solid-Fluid operations.

UNIT I HEAT TRANSFER - CONDUCTION 9

Basic heat transfer processes - conductors and insulators - conduction – Fourier's law of heat conduction – thermal conductivity and thermal resistance - linear heat flow – heat transfer through homogenous wall, composite walls, radial heat flow through cylinders and sphere – solving problems in heat transfer by conduction.

UNIT II HEAT TRANSFER – CONVECTION AND RADIATION 9

Heat transfer - convection – free and forced convection - factors affecting the heat transfer coefficient in free and forced convection heat transfer – overall heat transfer coefficient - solving problems in bioprocesses; Radiation heat transfer – concept of black and grey body - monochromatic Total emissive power– Kirchhoff's law – Planck's law - Stefan-Boltzmann's law.

UNIT III HEAT TRANSFER EQUIPMENTS 9

Heat exchangers – parallel, counter and cross flow- Logarithmic Mean Temperature Difference – overall coefficient of heat transfer in shell and tube heat exchanger for bioproducts.

UNIT IV MASS TRANSFER –DIFFUSION AND DISTILLATION 9

Mass transfer in bioprocesses – introduction – Fick's law for molecular diffusion - molecular diffusion in gases – equimolar counters diffusion in gases; diffusion coefficients for gases - molecular diffusion in liquids, solids, biological solutions and gels; Vapour liquid equilibria - Raoult's law- Principle of distillation - flash distillation, differential distillation, steam distillation, Mc.Cabe -Thiele method.

UNIT V MASS TRANSFER – LIQUID-LIQUID AND SOLID-FLUID OPERATIONS 9

L-L equilibria, Staged and continuous extraction, Solid-liquid equilibria, Leaching Principles; Adsorption equilibria – Batch and fixed bed adsorption; Drying-Mechanism-Drying curves; Time of Drying; Batch and continuous dryers.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course, the students will be able to		**BT MAPPED** (Highest Level)
CO1	enumerate the different heat transfer principles by conduction in biological systems.	Understanding (K1)
CO2	defend the various types of heat transfer through convection and radiation.	Understanding (K2)
CO3	calculate engineering problems involving modes of heat transfer and heat exchangers used in biotechnology industry.	Applying (K3)

CO4	apply the different mass transfer principles in biological systems.	Applying (K3)
CO5	operate the liquid- liquid, solid- liquid equilibria by mass transfer operations.	Applying (K3)

TEXT BOOKS

1. Geankoplis CJ. "Transport Processes and Separation Process Principles (Includes Unit Operations)". Pearson New International, 4th Edition, Pearson Education Limited, 2013.
2. Treybal RE. "Mass Transfer Operations", 3rd edition. Mcgraw Hill, 2017.

REFERENCES

1. Nag P, "Heat and Mass Transfer". McGraw Hill Education; 3rd edition, 2011.
2. Coulson JM. and etal., "Coulson & Richardson's Chemical Engineering", 6th Edition, Vol. I & II. Butterworth – Heinman (an imprint of Elsevier), 2004.
3. Incropera FP, Dewitt DP, Bergman TL, Lavine AS, "Principles of heat and mass transfer", Wiley India Edition, 2018
4. McCabe WL, Smith JC, Harriot P, "Unit Operations of Chemical Engineering", 7th Edition, McGraw Hill, 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

	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	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

BT23402	BIOCHEMICAL PROCESS CALCULATIONS	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	acquire the knowledge on dimensions and conversion systems.
2	understand the ideal and actual gas equations in process industries.
3	relate the material balance equations for biochemical processes calculations.
4	apply the energy balance equation for bioengineering systems.
5	endow the basics calculations pertaining to microbial growth kinetics.

UNIT I BASIC CHEMICAL CALCULATIONS 9

Dimension – Systems of units-FPS, MKS and SI systems; Conversion from one system to the other; composition of mixtures and solutions; mass fraction, mass %, mole fraction, mole %, mass ratios, molarity, molality, normality, ppm, composition by density.

UNIT II IDEAL AND ACTUAL GAS EQUATIONS 9

Ideal and actual gas equations; Vander Walls, compressibility factor equations, Application to pure gas & gas mixtures; partial pressures, partial volumes; Air-water vapour systems, Humidity, Molar Humidity, Relative Humidity, % Saturation, humid Volume; Humidity chart - wet, Dry bulb, Dew point temperatures, pH of solutions, Vapour pressure.

UNIT III MATERIAL BALANCES 9

Material balance concept – overall & component; material balance applications for evaporator, gas absorber without reaction, Distillation (Binary system), Liquid extraction, solid-liquid extraction, drying, crystallization, Humidification, Reverse Osmosis separation and Mixing, Material Balances in Recycle, Bypass Purge Streams.

UNIT IV ENERGY BALANCES 9

General energy balance equation for open systems, closed system sensible heat calculation, Heat required for phase change thermo chemistry, application of steam tables, Saturated and superheated steam application in bioprocess, Energy Balances in Recycle, Bypass Purge Streams.

UNIT V BIOCHEMICAL REACTIONS 9

Growth stoichiometry and elemental balances, Respiratory quotient, Degree of reduction, Electron balances, Biomass yield, Product stoichiometry, Theoretical Oxygen Demand, Unsteady and steady-state operations.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course, the students will be able to		**BT MAPPED** (Highest Level)
CO1	detail the concepts of dimensional consistency and effective application of units.	Understanding (K2)
CO2	examine the gas equations for various gas mixtures in process industries.	Understanding (K2)
CO3	infer the material balance equations for various biochemical processes calculations.	Understanding (K2)

CO4	illustrate general energy balance parameters and apply to open and closed systems.	Applying (K3)
CO5	apply the basics of microbial kinetics, metabolic stoichiometry and energetics in biochemical operations.	Applying (K3)

TEXT BOOKS

1. Gavhane KA. Introduction to Process Calculations Stoichiometry. Nirali Prakashan; 2012.
2. Venkataramani V, Anantharaman N, Begum KM. Process Calculations. PHI Learning Pvt. Ltd.; 2011.

REFERENCES

1. Bhatt BI, Thakore SB, "Stoichiometry", 5th edition Tata McGraw Hill, 2017.
2. McCabe WL, Smith JC, Harriot P, "Unit operations of chemical Engineering" 7th Edn McGraw Hill,2017.
3. Himmelblau DM, "Basic principles & Calculations in Chemical Engineering" 6th edn PHI 2013.
4. Narayanan KV, Lakshmikutty B, "Stoichiometry and Process Calculations", PHI Learning, 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	2	3	2	3	-	2	1	-	-	-	-	1	2	3
CO2	2	3	2	3	-	2	1	-	-	-	-	1	2	3
CO3	2	3	2	3	-	2	1	-	-	-	-	1	2	2
CO4	2	3	2	3	-	2	1	-	-	-	-	2	3	1
CO5	2	3	2	3	-	3	1	1	-	-	-	2	2`	1

BT23403	GENETICS AND MOLECULAR BIOLOGY	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	acquire basic fundamental knowledge in genetics and explore skills in molecular biology.
2	emphasize the molecular mechanism of DNA replication and repair.
3	understand the structure and function of RNA types in prokaryotes and eukaryotes.
4	discuss the concepts of genetic code and translation process in cells.
5	illustrate the regulation of gene expression and various types of mutations.

UNIT I	CLASSICAL GENETICS	9

Eukaryotic genetics - Mendelian genetics, Gene interaction, Complementation linkage, Recombination and chromosomal mapping, crossing over, classical experiments – Hershey and Chase, Avery McLeod and McCarty. Prokaryotic genetics - Bacterial conjugation, transduction and transformation. Chromosomal validation; Genetic disorders; Population genetics; Epigenetics.

UNIT II	STRUCTURE OF NUCLEIC ACIDS AND DNA REPLICATION	9

Molecular structure of genes and chromosomes, Conformation of DNA, Types of RNA, Replication in prokaryotes, D-loop and rolling circle mode of replication, replication of linear viral DNA. Organization of eukaryotic chromosome – cot value, replication of telomeres in eukaryotes.

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 ofRNA synthesis, Fidelity of RNA synthesis, Inhibitors of transcription, Differences in prokaryotic andeukaryotic 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.

UNIT V	REGULATION OF GENE EXPRESSION	9

Regulation of genes – replication, transcription & translation factors, Lac operon, ara operon and trp operon, phage life cycle, Mutation – transition, transversion, artificial & natural mutation, suppressor mutation and mutagenesis. Non coding and micro-RNA; RNA interference; DNA damage and repair.

	TOTAL PERIODS	45

COURSE OUTCOMES

At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	describe the basic concepts of genetics to explain chromosomal validation.	Understanding (K2)

CO2	elaborate the chemical characteristics of nucleic acids to understand the molecular process.	Understanding (K2)
CO3	illustrate the structure and functions of RNA to know the transcriptional process.	Applying (K3)
CO4	utilize the basic mechanisms of gene expression through translation process.	Applying (K3)
CO5	apply the concept of gene regulation and its significance in prokaryotes.	Applying (K3)

TEXT BOOKS

1. Malacinski GM, "Friefelders Essentials of Molecular Biology" 4th Edition, Narosa Publications, 2015.
2. Weaver RF, "Molecular Biology", 5th 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, and Cox MM, "Lehninger Principles of Biochemistry", 8thEdition, W.H. Freeman. USA. 2021.
4. Alberts B, Johnson A, Lewis J, Morgan D, Raff M, Roberts K, Walter P, "Molecular Biology of the cell", 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

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

MC23402	HUMAN VALUES AND GENDER EQUALITY	2	0	0	0

COURSE OBJECTIVES	
To enable the students to	
1	define different types of human values and their impact on individual behaviour and societal norms.
2	apply principles of personal development such as self-confidence, self-discipline, and resilience to navigate modern challenges effectively.
3	evaluate the role of values in shaping professional ethics, civic sense and global citizenship.
4	examine the socio-economic factors influencing gender inequality and explore avenues for empowerment and advocacy.
5	critically analyze prevalent issues and challenges faced by women, including gender-based violence, discrimination, and cultural biases, and propose measures for their eradication.

UNIT I	HUMAN VALUES	6

Value Education - Definition, Types of values; Human values - Acceptance, Consideration. Appreciation, Listening. Empathy, Sympathy, Honesty, Integrity, Wisdom, Decision making, Self- actualization, Character formation towards positive personality, Contentment; - Religious Values - Humility, Compassion, Gratitude. Peace, Justice, Freedom, Equality.

UNIT II	PERSONALITY DEVELOPMENT	6

Personal Development - Introspection, Self-confidence, Self-discipline; Flexibility -Peer pressure - Sensitization towards Gender Equality; Reliability; Unity; Modern Challenges of Adolescent Emotions and behavior - Comparison and Competition, Positive and Negative attitudes; Family values; Self- improvement - Physical exercises, Meditation ,Yoga.

UNIT III	VALUE EDUCATION TOWARDS NATIONAL AND GLOBAL DEVELOPMENT	6

Professional Values -. Integrity, Responsibility, Punctuality, Dedication - Perseverance - Competence; Civic sense and Responsibility; Global Values - Computer Ethics, Moral Leadership, Code of Conduct; Corporate Social Responsibility; Aesthetic values; National Integration and International understanding of Religious Values – Spirituality, thought process.

UNIT IV	GENDER EQUALITY	6

Gender Equality - Definition, Empowerment, Economic Equality; Condition of Women in India- Education, Healthcare, Political Representation, Gender-based Violence; Challenging Stereotypes: Parental and Caregiving Responsibilities; Legal and Policy Reform; Cultural Shifts; Global Perspective; Male Chauvinism; Sustainable Development..

UNIT V	WOMEN ISSUES AND CHALLENGES	6

Women Issues and Challenges - female feticide, violence against women; Domestic violence- dowry related abuse and deaths, Physical violence, Emotional abuse; Sexual assault; Honour killing; Eve-teasing- Stalking, e-stalking (cyber-crime).

		TOTAL PERIODS	30
COURSE OUTCOMES			
At the end of this course, the students will be able to		**BT MAPPED** (Highest Level)	
CO1	discuss the concept of human values and their significance in personal and societal development.	Understanding (K2)	
CO2	demonstrate introspective skills to enhance personal growth and self-awareness.	Applying (K3)	
CO3	recognize the importance of gender equality in promoting a just and equitable society.	Understanding (K2)	
CO4	cultivate a sense of social responsibility and ethical conduct towards achieving national and global development.	Analyzing (K4)	
CO5	analyse the challenges faced by women in various spheres and identify strategies for addressing them.	Analyzing (K4)	

TEXT BOOKS

1. A Foundation Course in Human Values and Professional Ethics: Presenting a Universal Approach to Value Education - Through Self-exploration. New Delhi, 2016.
2. Aurther, John. Personality Development. Lotus Press, 2018.

REFERENCES

1. Joshi, Dhananjay. Value Education in Global Perspective. Lotus Press, 2014.
2. Mahrotra, Mamta. Gender Inequality in India: Challenging Social Norms. Prabhat Books, 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	-	1	-	1	1	1	2	3	2	1	1	3	1	1
CO2	-	1	-	1	1	1	3	3	2	2	1	1	2	2
CO3	-	1	-	1	1	1	2	3	1	1	1	3	1	1
CO4	-	1	-	1	1	1	2	3	2	2	1	2	3	3
CO5	-	1	-	1	1	1	1	3	2	2	1	3	2	2

BT23404	BIO ANALYTICAL TECHNIQUES	3	0	2	4

COURSE OBJECTIVES

To enable the students to

1	understand the basic concepts of wave properties and radiation sources.
2	acquire knowledge of the chromatographic methods for the separation of biological products.
3	describe the working mechanism of electrophoresis and surface microscopy.
4	acquire fundamental knowledge about the light spectrum, absorption, fluorescence.
5	illustrate the basic workings and principles of absorption spectroscopy.

UNIT I INTRODUCTION TO SPECTROMETRY 9

Properties of electromagnetic radiation- wave properties – components of optical instruments – Sources of radiation – wavelength selectors – sample containers – filters – detectors – signal to noise ratio - sources of noise – Enhancement of signal to noise - types of optical instruments – GLP-Standard Operating Procedures - Documentation - record maintenance.

UNIT II SEPARATION METHODS 9

General description of chromatography – Band broadening and optimization of column performance- Liquid chromatography – Partition chromatography – Adsorption chromatography – Ion exchange chromatography - size exclusion chromatography- Affinity chromatography- principles of GC and applications –FPLC- HPLC-UPLC- Capillary electrophoresis – Applications.

UNIT III ELECTROPHORESIS AND SURFACE MICROSCOPY 9

Electrophoresis – Agarose gel, SDS-PAGE, denaturing gradient gel electrophoresis (DGGE), capillary electrophoresis, 2D, Optical densitometry, isoelectric focusing – principle, instrumentation and applications. Study of surfaces – Scanning probe microscopes – AFM and STM.

UNIT IV MOLECULAR SPECTROSCOPY 9

Molecular absorption spectrometry – Measurement of Transmittance and Absorbance – Beer's law – Instrumentation - Applications -Theory of fluorescence and Phosphorescence – Instrumentation – Applications – Theory of Infrared absorption spectrometry – IR instrumentation – Applications – Theory of Raman spectroscopy – Instrumentation – applications.

UNIT V MAGNETIC RESONANCE SPECTROSCOPY AND MASS SPECTROMETRY 9

Theory of NMR – environmental effects on NMR spectra – chemical shift- NMR-spectrometers – applications of 1H and 13C NMR- Molecular mass spectra – ion sources – Mass spectrometer-MALDI, LC-MS, GC-MS, MS-MS, MALDI-Mass imaging- Applications of molecular mass - Electron paramagnetic resonance- g values –instrumentation.

TOTAL PERIODS 45

LIST OF EXPERIMENTS

1. Precision and validity in an experiment using absorption spectroscopy.
2. Validating Lambert-Beer's law using $KMnO_4$
3. Finding the pKa of 4-nitrophenol using absorption spectroscopy.

4.	UV spectra of nucleic acids.
5.	Estimation of SO4-- by nephelometry.
6.	Limits of detection using aluminium alizarin complex.
7.	Paper Chromatography.
8.	Chromatography analysis using TLC.
	TOTAL PERIODS 75

COURSE OUTCOMES

At the end of this course, the students will be able to		**BT MAPPED** (Highest Level)
CO1	detail the functions of electrical and optical components in analytical instruments.	Understanding (K2)
CO2	enumerate the chromatographic techniques to separate, purify and quantify molecules.	Understanding (K2)
CO3	determine the analytes using microscopic and electrophoresis techniques.	Applying (K3)
CO4	Apply spectroscopic techniques to identify, estimate and characterize analytes.	Applying (K3)
CO5	interpret the data to predict unknown compounds using NMR and mass spectroscopy.	Analysing (K4)

TEXT BOOKS

1. Skoog DA, Holler FJ, Crouch SR. Textbook "principles of instrumental analysis". 6th Edition Cengage learning, 2019.
2. Willard HH, Merritt LL, Dean JA, Settle FA, "Instrumental Methods of Analysis", 7th Edition, CBS Publication, New Delhi Reprint, 2004.

REFERENCES

1. Fifield FW, "Principles and Practice of Analytical Chemistry", Blackwell, Scientific Publishers, 2016.
2. Sharma BK, "Instrumental Methods of Chemical Analysis: Analytical Chemistry", Krishna Prakashan Media (P) Ltd, 2014.
3. Haven MC, Tetrault GA, Schenken JR, editors, "Laboratory Instrumentation", 4th Edition, Wiley India Pvt Ltd, 2010.
4. Philopose PM, "Analytical Biotechnology", Domihant Publishers and distributors, New Delhi, 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	2	1	1	1	-	-	-	-	1	-	-	1	2	2
CO2	2	1	3	1	1	-	-	-	1	-	-	3	2	2
CO3	2	2	3	1	-	-	-	-	1	-	-	2	3	3
CO4	2	2	3	2	2	-	-	-	1	-	-	1	3	3
CO5	2	3	3	3	2	-	-	-	-	-	-	-	3	3

BT23405	HEAT AND MASS TRANSFER LABORATORY	0	0	4	2

COURSE OBJECTIVES

To enable the students to

1	study the basic phenomena of heat and mass transfer to develop methodologies for solving problems.
2	understand the information, performance and design of heat exchangers.
3	develop process for better heat efficiency.
4	explore a detailed experimental analysis.

LIST OF EXPERIMENTS

1. Natural convection.
2. Thermal Conductivity -Lagged Pipe.
3. Thermal Conductivity -metal rod.
4. Stefan Boltzmann constant for radiation heat.
5. Forced convection.
6. Double pipe heat exchanger -cocurrent flow.
7. Double pipe heat exchanger -counter current flow.
8. Separation of binary mixture using Steam distillation.
9. Drying characteristics of Rotary dryer.
10. Separation of binary mixture using Simple distillation.
11. Extraction of acetic acid by Liquid –liquid Extraction.

TOTAL PERIODS	60

COURSE OUTCOMES

At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	employ the basic laws of heat transfer for analyses of engineering systems.	Applying (K3)
CO2	determine Stefan Boltzmann constant and diffusivity coefficient for analyses of heat radiation.	Applying (K3)
CO3	explore the characteristics of dryers in engineering systems.	Applying (K3)
CO4	calculate the separation yield and purity of mixtures without loss.	Analysing (K4)

CO/PO MAPPING :

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

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BT23406	MOLECULAR BIOLOGY LABORATORY	0	0	4	2

COURSE OBJECTIVES

To enable students to

1	perform hands-on experience in basic molecular biology techniques.
2	discuss the DNA isolation techniques.
3	learn about the identification and characterization of genes and proteins.
4	impart knowledge on gene isolation, electrophoresis and applications of molecular biology.

LIST OF EXPERIMENTS

1. Good Laboratory Practices (GLP) in Molecular Lab.
2. Micropipette usage and calibration Methods.
3. Preparation of Reagents, stock solutions and calculations.
4. Isolation of genomic DNA from plant tissue.
5. Isolation of genomic DNA from animal tissue.
6. Isolation of Plasmid DNA from bacterial cell.
7. Total cellular RNA isolation and analysis.
8. Quantitative analysis of isolated genomic DNA using spectrophotometer.
9. Preparation of Agarose gel electrophoresis.
10. Extraction of proteins from tissue and confirmation with qualitative test.
11. Preparation of SDS-PAGE.

TOTAL PERIODS: 60

COURSE OUTCOMES

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

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	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	3	2	3	2

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GE23401	PROFESSIONAL DEVELOPMENT II	0	0	2	1

COURSE OBJECTIVES

To enable the students to

1. enhance their own behavioural skills to survive in corporate world.
2. evaluate their listening and speaking skills to face the interviews in a successful way.
3. solve advance level verbal aptitude tests to get placed in Tier I companies.
4. improve their reasoning skills to get placed in reputed companies.

UNIT I	WRITING SKILLS	7

Email writing; Fixing and cancelling appointments; Paper submission for seminars and conferences; Business communication; Stress management; Body language; Dress code; Self-introduction II; Update resume building II; JAM level -3.

UNIT II	PRESENTATION SKILLS	7

Presentation skills - Types and methods of delivering presentation, ways and methods to improve presentation skills; Mini presentation in smaller groups; Situational role play; Face to face interview; Group discussion level IL; JAM Level-4.

UNIT III	QUANTITATIVE APTITUDE - I	8

Simplification; Time, speed and distance; Trains; Boats and streams; Ratio and proportion; Partnership; Percentage.

UNIT IV	LOGICAL REASONING	8

Seating arrangement; Arithmetic reasoning; Character puzzle; Syllogisms; Matching definitions; Statements and arguments.

	TOTAL PERIODS	30

COURSE OUTCOMES

At the end of this course, students will be able to		BT Mapped (Highest Level)
CO1	interpret the personality development through various activities.	Understanding (K2)
CO2	examine speaking and listening skills to excel in their jobs.	Analyzing (K4)
CO3	develop the quantitative skills and analytical skills to face the interview.	Applying (K3)
CO4	extend the reasoning abilities by scoring exceeded percentage to get placed in reputed companies.	Understanding (K2)

TEXT BOOKS

1. Agarwal, R.S. "Objective General English", S.Chand & Co.2021.
2. Agarwal, R.S. "Quantitative Aptitude", S.Chand & Co.2021.

REFERENCES

1. Abhijit Guha, "Quantitative Aptitude ", Tata-Mcgraw Hill, 2023.
2. Agarwal, R.S." a modern approach to Verbal & Non Verbal Reasoning", S.Chand & Co Ltd, New Delhi.2021.
3. Word Power Made Easy By Norman Lewis, Wr.Goyal Publications, 2021.

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

	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