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**GANDHI INSTITUTE OF ENGINEERING AND TECHNOLOGY
UNIVERSITY, ODISHA, GUNUPUR**



BACHELOR'S DEGREE PROGRAMME

B.Tech

BIOTECHNOLOGY

Course Structure and Detailed Syllabus

For a student admitted in

2023-2027



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Curriculum, Syllabus, and Course Structure

For

Undergraduate Degree Programme

In

Engineering & Technology

Regulation 2023



BIOTECHNOLOGY



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Department of Biotechnology

Vision

The Department of Biotechnology is committed to achieving high standards in academic excellence through quality teaching with the latest technology and translational research in areas of agriculture, environment, and entrepreneurship.

Mission

M 1: To adopt innovative teaching methodologies and practical oriented curriculum to fulfil the professional aspirations of students

M 2: To empower and encourage the students for product-oriented research for the sustainable development of society.

M 3: To inculcate ethical and moral values among the students to become responsible citizens.



Program Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals, and an engineering specialization as specified in WK1 to WK4, respectively, to develop solutions to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems, reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society, and environment as required. (WK5)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge, including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5: Engineering Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering & IT tools, including prediction and modelling, recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture, and environment. (WK1, WK5, and WK7).

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences



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PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making, and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8).



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Program Educational Objectives (PEOs)

PEO-1: To provide teaching in applied biology with technological advancement and to ascertain competence in designing new experiments, tools, and techniques with social relevance in the field of Biotechnology and allied sciences.

PEO-2: To develop an urge for advanced learning and to explore new areas of research in biotechnology to serve society for sustainable development.

PEO-3: To encourage the students for lifelong learning, career enhancement and enable them to evolve as entrepreneurs with high ethical values. and molecular biology concepts to address practical biotechnology issues.

Program Specific Outcomes(PSOs)

PSO-1: Acquire knowledge on principles and practices of basic and modern biotechnology for application in research and industry.

PSO-2: Identify, analyze, and offer biotechnological solutions to real-world problems in agriculture, food, and the environment.

PSO-3: Engage in lifelong learning and explore entrepreneurial opportunities in the biotechnology sector, fostering innovation and societal development.



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I Semester [First Year] UG Engineering & Technology

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits
				L	T	P	
1	Basic Science Courses	23BBSBS110B1	Engineering Mathematics-I	3	1	0	4
2	Basic Science Courses	23BBSBS10003	Engineering Chemistry	3	0	0	3
3	Engineering Science Courses	23BBSES10002	Elements of Mechanical Engineering	3	1	0	4
4	Engineering Science Courses	23BBSES11003	Programming for Problem Solving	3	0	0	3
5	Engineering Science Courses	23BBSES10004	Dietetics and Nutrition	1	0	0	1
6	Humanities and Social Sciences including Management Courses	23BBSHS11001	Communicative English and Soft Skills	2	0	0	2
7	Basic Science Courses	23BBSBS10103	Engineering Chemistry Lab	0	0	2	1
8	Engineering Science Courses	23BBSES11103	Programming for Problem Solving Lab	0	0	2	1
9	Humanities and Social Sciences	23BBSHS11101	Communicative English and Soft Skills Lab	0	0	2	1
10	Engineering Science Courses	22BBSES10106	Engineering Workshop	0	0	4	2
11	Mandatory Courses	23BBMC11101	Induction Program	-	-	-	0
			Total Credits:	15	2	10	22



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II Semester [First Year] UG Engineering & Technology

Sl. No	Category	Course Code	Course Title	Hours per week			Credits
				L	T	P	
1	Basic Science Courses	23BBSBS120B1	Mathematics-II	3	1	0	4
2	Basic Science Courses	23BBSBS10002	Engineering Physics	3	0	0	3
3	Engineering Science Courses	23BBSES10001	Basic Electrical and Electronics Engineering	3	0	0	3
4	Engineering Science Courses	23BBSES12003	Data Structure & Algorithms	3	0	0	3
5	Humanities and Social Sciences including Management Courses	23BBSHS12001	Communicative English and Technical Communication	2	0	0	2
6	Humanities and Social Sciences including Management Courses	23BBSHS1102	Human Values and Professional	1	0	0	1
7	Engineering Science Courses	23BBSBS10102	Engineering Physics Lab	0	0	2	1
8	Engineering Science Courses	23BBSES10101	Basic Electrical and Electronics Engineering	0	0	2	1
9	Engineering Science Courses	23BBSES121003	Data Structure & Algorithms	0	0	2	1
10	Humanities and Social Sciences	23BBSHS12101	Communicative English and Technical Communication	0	0	2	1
11	Engineering Science Courses	23BBSES10105	Engineering Graphics and Design Lab	0	0	2	2
12	Mandatory Courses	23BBSMC12201	NCC/NSS/Yoga	-	-	-	0
			Total Credits:	15	1	10	22



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**III Semester [Second Year]
UG ENGINEERING IN BIOTECHNOLOGY**

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits
				L	T	P	
1	PC	23BBTPC23001	Biochemistry	3	0	0	3
2	PC	23BBTPC23002	Microbiology	3	0	0	3
3	PC	23BBTPC23003	Fundamentals of Biology and Biotechnology	3	0	0	3
4	ES	23BCSES23001	Object Oriented Programming using JAVA	3	0	0	3
5	BS	23MEES23001	Fluid Mechanics and Hydraulic Machine	3	1	0	4
6	HS	23BBSH23001	Intermediate Communication Skills and Critical thinking	1	0	0	1
7	PC	23BBTP23101	Biochemistry Lab	0	0	2	1
8	PC	23BBTPC23102	Microbiology Lab	0	0	2	1
9	ES	23BCSES23101	Object-Oriented Programming using JAVA Lab	0	0	2	1
10	HS	23BBSHS23101	Intermediate Communication Skills and Critical Thinking	0	0	2	1
11	ES	23BBTLP23001	Learning Project-1	0	0	2	1
12	ES	23BBTPW23001	Summer Internship-1	0	0	0	1
			Total Credits:	16	1	10	23



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**IV Semester [Second Year]
UG ENGINEERING IN BIOTECHNOLOGY**

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits
				L	T	P	
1	PC	23BBTPC24001	Molecular Biology	3	0	0	3
2	PC	23BBTPC24002	Biostatistics	3	0	0	3
3	PC	23BBTPC24003	Upstream Process Engineering	3	0	0	3
4	PC	23BBTPC24004	Bio-analytical Techniques	3	0	0	3
5	ES	23CSES24001	Data Base Management System	3	0	0	3
6	HS	23BBSHS24001	Advance communication skills and professional ethics	2	0	0	2
7	PC	23BBTPC24101	Molecular Biology Lab	0	0	2	1
8	PC	23BBTP24102	Biostatistics Lab	0	0	2	1
9	PC	23BBTPC24103	Upstream Process Engineering Lab	0	0	2	1
10	PST	23BBTLP24101	Learning Project-2	0	0	2	1
			Total Credits:	17	0	8	21



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**V Semester [Third Year]
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Sl. No.	Category	Course Code	Course Title	Hours per week			Credits
				L	T	P	
1	PC	23BBTPC35001	Genetic Engineering	3	0	0	3
2	PC	23BBTPC35002	Plant Biotechnology	3	0	0	3
3	PC	23BBTPC35003	Industrial Microbiology and Enzyme Technology	3	0	0	3
4	PE	23BBTPE35001	Bioreactor Design and Analysis	3	0	0	3
5	OE	23BBTOE35001	Biochemical Reaction Engineering	3	0	0	3
6	MGC	23OMGC35001	Organisational Behaviour /Engineering Economics and Costing	2	0	0	2
7	PC	23BBTPC35101	Genetic Engineering	0	0	2	1
8	PC	23BBTPC35102	Plant Biotechnology	0	0	2	1
9	PST	23BBTPW35001	Summer Internship-2	0	0	2	1
10	PST	23BBTLP35001	Minor Project-1	0	0	4	2
11	MC	23BMCM35001	Constitution of India	0	0	0	0
			Total Credits:	17	0	10	22



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VI Semester [Third Year] UG ENGINEERING IN BIOTECHNOLOGY

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits
				L	T	P	
1	PC	23BBTPC36001	Immunology and Immunotechnology	3	0	0	3
2	PC	23BBTPC36002	Bioinformatics	3	0	0	3
3	PC	23BBTPC36003	Environmental Biotechnology	3	0	0	3
4	PE	23BBTPE36001	Downstream Process Engineering	3	0	0	3
5	OE	23BBTOE001	Optimization Engineering	3	0	0	3
6	MGC	23BMGC001	Organisational Behaviour /Engineering Economics and Costing	2	0	0	2
7	PC	23BBTPC36101	Immunology and Immunotechnology	0	0	2	1
8	PC	23BBTPC36102	Bioinformatics	0	0	2	1
9	PST	23BBTLP36001	Minor Project-2	0	0	4	2
10	MC	23MCMC36001	Essence of Indian Knowledge Tradition	0	0	0	0
Total Credits:				17	0	8	21



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**VII Semester [Fourth Year]
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Sl.No.	Category	Course Code	Course Title	Hours per week			Credits
				L	T	P	
1	PC	23BBTPC47001	Animal Biotechnology	3	1	0	4
2	PC	23BBTPC47002	Medical and Pharmaceutical Biotechnology	3	0	0	3
3	PC	23BBTPC47003	Food Biotechnology	3	0	0	3
4	PE	23BBTPE47001	Nanobiotechnology	3	0	0	3
5	OE	23BBOE47001	Process Instrumentation	3	0	0	3
6	PST	23BBTPW47001	Summer Intership-3	0	0	2	1
7	PST	23BBTPLP47001	Major Project-1	0	0	6	3
			Total Credits:	15	1	8	20



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**VIII Semester [Fourth Year]
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Sl. No.	Category	Course Code	Course Title	Hours per week			Credits
				L	T	P	
1	PE	23BBTPE48001	Protein Engineering	3	0	0	3
2	PE	23BBTPE48002	IPR, Bioethics and Biosafety	3	0	0	3
3	OE	23BBTOE48001	Biomedical Instrumentation	3	0	0	3
4	PST	23BBTPW48001	Technical Seminar	0	0	2	1
5	PST	23BBTPW48002	Major Project-2	0	0	6	3
			Total Credits:	9	0	8	13



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SL. NO.	COURSE WORK - SUBJECTS AREA	CREDITS / SEMESTER								TOTAL CREDIT S
		I	II	III	IV	V	VI	VI I	VIII	
1	Humanities and Social Sciences	3	3	2	2	-	-	-	-	10
2	Management Courses	-	1	-	-	2	2	-	-	5
3	Basic Science Courses	4	7	4	-	-	-	-	-	15
4	Engineering Science Courses	15	11	4	3	-	-	-	-	33
5	Professional Core Courses			11	15	11	11	10		58
6	Professional Elective Courses	-	-	-	-	3	3	3	6	15
7	Open - Electives	-	-	-	-	3	3	3	3	12
8	Project work, Seminar and Internship	0	0	2	1	3	2	4	4	16
9	Mandatory Courses	-	0	-	-	-	-	-	-	0
	TOTAL	22	22	23	21	22	21	20	13	164



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I Semester Syllabus

Subject Code	Title of the subject	L	T	P	C									
23BBSBS110B1	Engineering Mathematics-I	3	1	0	4									
Course Educational Objectives														
CEO1	To find critical points, and use them to locate maxima and minima.													
CEO2	To provide the standard methods for solving differential equations.													
CEO3	To study Fourier series and to express a function in Fourier series.													
CEO4	To use matrices, determinants and techniques for solving systems of linear equations in the different areas of Linear Algebra.													
Course Outcomes: Towards the end of the course students will be able to :														
CO1	Memorizing some mathematical definition for solving. mathematical problems													
CO2	Understand and categorize. the basic concept of different problems													
CO3	Determine and articulate the different concept for solving the problems.													
CO4	Estimate the Eigen values and vectors of a matrix, and maxima minima for function of two variables .													
CO5	predict the even and odd functions and extreme points.													
CO6	Evaluate the engineering problems by using the concept of Partial differentiation and series and to understand its application.													
CO-PO & PSO Mapping														
COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	2												
CO2	1	3												
CO3	2	3												
CO4	2	3												
CO5	3	2												
CO6	3	3												



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UNIT I- LOGIC AND SET THEORY Introduction, Statement, Negation, Conjunction, Disjunction, Conditional, Converse, Bi-Conditional, Inverse, Contra positive, Truth Table, Tautology, Logical Equivalence and Implication. Methods of Proof, Sets, Subset and Power Set, Venn Diagrams and Cartesian Product of Sets. Relations and Functions. (12 Hours)

UNIT-II LINEAR ALGEBRA (10 Hours) Matrices, Types of matrices, Rank of matrix, Determinants of a matrices, Minors and Cofactors, Inverse of matrix, Transpose of Matrix and Properties, Solution of linear equations by Cramer's rule, symmetric and skew symmetric matrices, Orthogonal matrix.

UNIT -III NUMERICAL METHODS (14 Hours) Errors, solving of algebraic and transcendental equations by using Bisection method, fixed point iteration, and Newton-Raphson's method. Solution of system of Linear equations by Gauss elimination, Gauss Jordan, Gauss Seidal. Inverse of a matrix by Gauss Jordan method.

UNIT- IV INTERPOLATION (12 Hours) Errors, Finite Differences, Newton's forward and backward interpolation formula (without proof), Newton's divided difference interpolation, Lagrange's interpolation.

UNIT-V STATISTICS (12 Hours) Mean, Median, Mode, Correlation and Regression analysis, fitting of straight line by method of least squares method. Testing of hypothesis (small sample tests –t, F and chi-square test).



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Subject Code	Name of the Subject (1 st Sem.)	L	T	P	C										
23BBSHS11001	Communicative English and Soft Skills	2	0	0	2										
Course Educational Objectives															
CEO1	To promote communication skills and soft skills.														
CEO2	To enhance the employ ability and entrepreneurial skills														
Course Out comes: Towards the end of the course, the students will be able to:															
CO1	Understand the importance of effective communication for professional development														
CO2	Apply effective vocabulary and grammar in everyday communication														
CO3	Analyze various types of corporate communication.														
CO4	Formulate crucial soft skills for career development.														
CO5	Develop useful LSRW skills for professional growth.														
CO6	Describe communication process effectively														
CO-PO Mapping															
PROGRAMMEOUTCOMES															
COs	1	2	3	4	5	6	7	8	9	10	11	12			
CO1										3					
CO2											2				
CO3										3					
CO4									3						
CO5										3					
CO6										3					

UNIT-1 Importance of English for Communication in the 21st Century (8hours) 1.1 Role of English in enhancing employ ability and entrepreneurial skills. The Nature and Scope of Communication 1.2 Introduction to LSRW skills; appropriate use of skills in communicative contexts. 1.3The process of communication and factors that influence communication: sender, receiver, channel, code, topic, message, context, feedback, noise, filters and barriers (steps such as Ideation, Encoding, Transmission, Decoding, etc.); audience and purpose 1.4 Types of Communication: General and Professional Communication; Written communication and Spoken communication.

UNIT-2 English Vocabulary, Grammar & Usage (7hours) 2.1 Essential grammar (Tense, Active & Passive voice, Subject Verb Agreement) 2.2 Words often confused 2.3 Technical terms and one word substitutes 2.4 Sentence Structure and syntax 2.5 Common errors in English. 2.6 Difference between American, British



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and Indian English (Vocabulary based)

UNIT- 3 Introduction to Corporate Communication (8 hours) 3.1 Seven C's communication and Ten C's of Non-communication. 3.2 Corporate Communication– Types, Characteristics, Importance. 3.3 Direction of corporate communication 3.4 Communication challenges in today's work place: Advances in technology; Culturally diverse workforce; Team- based organizational Settings; Strategies to overcome these challenges 3.5 Use of ICT. 3.6 Challenges in today's workplace and how to overcome this.

UNIT-4 Basic Soft Skills Development. (7 hours) 4.1 Soft Skills, Importance, Characteristics, Hard Skills v/s Soft Skills. 4.2 Importance soft skill, lateral thinking, networking skill, emotional intelligence. 4.3 Cross Cultural and Inter Cultural communication.

UNIT- 5 Corporate Etiquettes. (6 hours) 5.1 Email etiquettes. 5.2 Business Meeting Etiquettes 5.3 Telephone Etiquettes

Reference Books: 1. Technical Communication-, Principle and Practice by Meenakshi Raman & Sangeeta Sharma, Oxford University Press, 2015. 2. Business Communication Today by Bovee, Courtland L., Thill, John V. Prentice Hall, 2018. 3. The Ace of Soft Skills: Attitude, Communication and Etiquette for Success by Gopaldaswamy Ramesh and Mahadevan Ramesh. Pearson, 2010. 4. Oxford Guide to English Grammar by John Eastwood. Oxford University Press, 2003. 5. 365 Ways to Change Your World by Norman Vincent Peale by Orient Paperbacks, 2019. 6. Soft Skills For Your Career by Kalyani Samantray Oxford University Press, 2016.



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Course Code	Course Title	L	T	P	C	QP
23BBSES11003	Programming for Problem Solving	3	0	0	3	
Pre -Requisite: computer basics.						
Course Educational Objective						
CEO1:To formulate algorithm, translate into program and then execute the programs for verifying its correctness.						
CEO2: To analyse a problem for knowing its efficiency and decompose it into functions using divide and conquer approach.						
Course Outcome: student can able to						
CO1	Memorize features of structure oriented programming and describe control statements, arrays, structures and pointers.					
CO2	Classify various types of statements and demonstrate programs on control structures, arrays, functions, pointers and structures.					
CO3	Solve problems using different programming logics and can able to discover better solutions.					
CO4	Analyse different programs by experimenting on them and estimating their efficiency.					
CO5	Evaluate complex programs by verifying their logics and justify their results.					
CO6	Develop applications and projects using various features of structure oriented programming.					

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1	3	2	1	1									
CO2	2	3	2	1									
CO3	2	2	3	3	1								
CO4	2	1	3	3	1				1				
CO5	0	0	2	2					1	1			
CO6	0	0	1	1					1	1			
	1.5	1.33	2	1.83	0.33				0.5	0.33			1.12

UNIT- I (9 Hours) Programming Basics: Introduction to Structured Programming Approach, Basic structure of C program, C compilers, Compilation and Execution Process, Error debugging. Character set, C Tokens, data types, modifiers, format specifiers, escape sequence characters, constants, variables, standard I/O statements, Operators classifications, Operator precedence and associativity, Implicit nd



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Explicit type casting, programs using sequential statements.

UNIT- II (9 Hours) Selection Control Statements: if, if..else, else if ladder, nested if, switch..case Loop Control Statements: while, do-while and for loop, break, continue, nested loop.

UNIT- III (9 Hours) 1-D Array: declaration, initialization, array operations, 2-D Array: declaration, Initialization, 2-D array operations Character arrays and Strings: String operations, Library Functions: strcmp(), strncmp(), strcat(), strncpy(), strcpy (), strlen(), toupper(), tolower (), isupper (), islower()).

UNIT- IV (9 Hours) User Defined Functions: Function categories, Parameter passing in functions, Passing arrays to functions, Recursive functions, storage classes Pointers: Declaration and initialization of pointers, Pointer arithmetic, Pointer to Array, Pointer to Function, call by value and call by address, Function returning pointer.

UNIT- V (9 Hours) Dynamic memory allocation with Array and Function. Declaration and initialization of structures, Union, type def, enum , accessing structure elements, nested structures, structures with array, structures with functions, structures with pointer, structures with DMA.

References: 1) Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, 2nd edition, Prentice Hall of India 2) Programming in C, by Reema Thareja, 2nd edition, OUP India 3) C Programming and Coding by swati saxena, BPB Publication



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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
23BBSES10002	ELEMENTS OF MECHANICAL ENGINEERING	3	1	0	4	
Pre - Requisite: Math and Physics						
Course Educational Objectives						
CEO1	To understand the Basics of Forces and Force Analysis.					
CEO2	To apply the established engineering methods to complex engineering problem.					
CEO3	To understand the fundamental Concepts of thermodynamics and to distinguish the components and working principle of heat engine and determine the COP of heat pump and refrigerator.					
CEO4	To impart basic knowledge on automation and basic codes in CNC machining, to study different properties of Fluids.					
Course outcomes: At the end of the course, the student will be able to:						
CO1	To analyze mechanical engineering systems using vectorial representation of forces and moments.					
CO2	To analyze and apply the concept of centroid and centre of gravity.					
CO3	To apply the concept of friction and ability to solve problem related to the same.					
CO4	To apply the basic concept of thermodynamics, its properties and to generate the ability to differentiate different forms of energy i.e. heat and work.					
CO5	To apply first law of thermodynamics to closed and flow systems. To realize the need of second law of thermodynamics in nature.					
CO6	To understand the fundamental concepts of viscosity, surface tension, pressure (absolute and gauge), CNC coding and FMS.					



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COs	PROGRAMME OUTCOMES										PSOs			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3												
CO2	3	3												
CO3	3	3												
CO4	3	2												
CO5	3	3												
CO6	2	1												
Avg.	2.8	2.5												

UNIT:1 [10 hours] STATICS OF PARTICLES Force System: Force, Parallelogram Law, Free body diagram, Determination of reactions, Lami's theorem, Principle of Transmissibility of forces. Moment of a force, Couple, Varignon's theorem, Resolution of a force into a force and a couple. Resultant of coplanar force system. Equilibrium of coplanar force system. Concept of Centre of Gravity: Basic definition of Centroid and centre of gravity, use of axis of symmetry, determination of centroid of simple figures (like triangle, rectangle, etc), Centroid of composite sections.

UNIT:2 [10 Hours] ANALYSIS OF TRUSSES AND FRICTION Plane Truss: Perfect and imperfect truss, Assumptions and Analysis of Plane Truss by Method of joints and Method of section. Friction: Laws of Friction - Angle of Friction-Angle of Repose, Numerical problems including ladder friction.

UNIT:3 [10 Hours] BASICS OF THERMODYNAMICS Fundamental Concepts and Definitions: Definition of Thermodynamics, System, surrounding and universe, Macroscopic & microscopic point of view. Property, State, Path, process, Cyclic process, Density, Specific volume, Pressure, temperature. Thermodynamic equilibrium, Quasi-static process, concept of ideal gas, Work and heat transfer, Zeroth law. First law of thermodynamics. Numericals based on simple formula.

UNIT:4 [8 Hours] Application of first law in non-flow and flow processes. Steady flow energy equation, limitation of first law. Thermal reservoir, Statements of second law, Heat engine, COP of heat pump and refrigerator. Carnot cycle. Basic concepts of power plant and IC engines. Numericals based on simple formula.

UNIT:5 [12 Hours] FUNDAMENTALS OF FLUIDS Fluids: Properties of Fluid like Pressure, Viscosity, Capillary Effect, Surface Tension, Pascal's Law, and Bernoulli's Equation for incompressible fluid flow. **ROBOTICS AND AUTOMATION** Basic concepts of Robotics, Automation and its Classification, Numerical Control of machine tools, Introduction to CNC machine, Basic codes used in CNC, Introduction to Flexible manufacturing system.



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REFERENCE BOOK:- 1. Engineering Mechanics by S. S. Bhavikatti, K. G. Rajashekarappa, New Age International 2. Basic Mechanical Engineering by Agrawal & Agrawal, Wiley 3. S.Timoshenko, and D.H.Young, "Engineering Mechanics", TMG Hill Book,5th edition 4. Thermodynamics An Engineering Approach by Cengel & Boles, McGraw Hill 5. Engineering Thermodynamics by P.K.Nag, McGraw Hill 6. A text book of Fluid mechanics and Hydraulic machines by R K Bansal, Laxmi Publications, 2010 7. Computer aided Design and Manufacturing by Mikell P. Groover,McGraw-Hill Inc, 2007



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Subject Code	First Year	L	T	P	C	QP
23BBSES10004	Dietetics and Nutrition	1	0	0	1	A
Course Educational Objective						
CEO1: Graduates can understand the importance of diet for good health						
CEO2: Graduates should know about balance diet, menu planning and critically evaluation of meal						
Course outcomes: At the end of the course, the student will be able to:						
CO1	Know about importance of health and balance diet					
CO2	Understand about composition of human diet and their function					
CO3	Have the knowledge on importance of macro and micro nutrients.					
CO4	Acquire knowledge on role of vitamins and minerals in food					
CO5	Know the digestive system of the human beings.					
CO6	Get an idea about menu planning and critically evaluation of meal					

CO-PO & PSO Mapping															
COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO	2	1	1	-	-	-	-	-	-	-	-	-	2	1	-
CO	1	2	1	-	-	-	-	-	-	-	-	-	1	1	-
CO	2	1	2	-	-	-	-	-	-	-	-	1	-	-	-
CO	1	1	1	-	-	-	-	-	-	-	-	-	1	-	-
CO	2	2	1	-	-	-	-	-	-	-	-	1	1	1	-
CO	2	1	2	-	-	-	-	-	-	-	-	1	1	2	-
Av	1.6	1.33	1.33	-	-	-	-	-	-	-	-	1.0	1.2	1.2	-

UNIT:1 10 Hours Basic Aspects: Definition of the terms Health, Nutrition and Nutrients. Importance of food (Physiological, Psychological and social function of food) in maintaining good health. Classification of nutrients, Balanced diet, food groups. Balanced Diet: Definition, Importance of balanced diet, RDA for various nutrients- age, gender, physiological state. Macronutrients: Carbohydrates-Definition, Classification (Mono, di and polysaccharides), Dietary Sources, Function- Excess. Lipids-Definition, Classification, Dietary Sources, Functions.



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UNIT:2 10 Hours Protein-Definition, Classification based upon amino acid composition, Dietary sources, Functions, Methods of improving quality of protein in food (special emphasis on soya protein and whey protein), Evaluation of protein quality: PER, BV, NPU and Chemical score. Energy: Definition of Energy and Units of its measurement (Kcal), Energy contribution from macronutrients (carbohydrates, proteins, and fat), Factors affecting energy requirements, Concept of BMR, SDA, Factors affecting BMR, Thermic effect of food, Dietary Sources of energy, Concept of energy balance and the health hazards associated with Underweight, Overweight

UNIT:3 8 Hours Water: Definition, Dietary Sources (visible, invisible), Function of water, Role of water maintaining health (water balance) Dietary Fibre: Definition, Dietary Sources, Classification, Physiological effects of deficiency. Micronutrients: Vitamins-Definition and classification (water and fat soluble vitamins), Food Sources, function and significance of Fat soluble vitamins (Vitamin A, D, E, K), Water soluble vitamins (Vitamin C, Thiamine, Riboflavin, Niacin, Cyanocobalamin and Folic acid)

UNIT:4 6 Hours Minerals: Definition and classification (major and minor), Food Sources, functions and significance of calcium, Iron, Sodium, Iodine and Fluorine. Digestion: Digestion and Absorption, Mechanical and Chemical breakdown of food. Menu Planning- Planning of nutritionally balanced meals based upon the three food group system, Factor affecting food planning, Critical evaluation of few meals served at the Institutes/Hotels based on the principle of meal planning, Calculation of proximate principles and energy of 3 Indian and 3 Conti lunch menus, Critical evaluation and suggested improvement

UNIT:5 6 Hours Food in day to day life: Principles of food preservation (Fruits- Squashes and jams, Vine & Vegetables by Pickling), Nutrition in physical fitness. Immunomodulator foods.

Ref. Books 1. Food Science and nutrition- Sunetra Roday 2. Food hygiene and sanitation -Sohna Roda 3. Nutrition and Dietetics by Shubhangini A. Joshi 4. BamjiMS (2019) Text book of Human Nutrition, 4 thEdn, Oxford & IBH Publishing Co Pvt. Ltd, ISBN 9788120417908. 5. Food Science- Porter and Hotchkin 6. Advanced Nutrition and Dietetics in Nutrition Support, Editor(s):Mary Hickson PhD RD, Sara Smith PhD RD, Kevin Whelan PhD RD FBDA



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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BBSES10106	Engineering Workshop	0	0	4	2
Pre - Requisite:					
Course Educational Objectives					
CEO1	To develop an appreciation for the importance of safety, ethics, and sustainability in engineering practice.				
CEO2	To develop practical skills and knowledge in the field of mechanical engineering, including the ability to use hand and machine tools, read technical drawings, and fabricate simple components.				
Course outcomes: At the end of the course, the student will be able to:					
CO1	Familiarity on various safety precautions in a workshop setting, including the ability to identify potential hazards and risks, and to develop appropriate safety measures to mitigate those risks.				
CO2	Understanding of the various hand and machine tools used in fitting and the ability to select the appropriate tool for a given task.				
CO3	Gain knowledge of the various components and working principles of a standard center lathe machine and developing skills in preparing a cylindrical job using a lathe machine, including facing, taper turning, step turning, and knurling operations.				
CO4	Acquire skills in preparing different types of joints, including lap joint, butt joint, corner joint, and T-joint, using electric arc welding and oxy-acetylene gas welding.				
CO5	Develop an understanding of the principles and techniques of calibration, including the ability to calibrate various instruments, such as LVDT, load cell, and thermocouple, using appropriate tools and techniques.				
CO6	Acquire skills in surface roughness testing, including the ability to determine the surface roughness of various components using appropriate instruments and techniques.				



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CO-PO & PSO Mapping														
COs	PROGRAMME OUTCOMES										PSOs			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2	2		2											
CO3	2		2											
CO4	2		2											
CO5	2		2											
CO6	2		1											
Avg.	2		1.5											

SYLLABUS

List of Experiment (Any eight) 1. To study various safety precaution in workshop. 2. To study different hand tools and machine tools used in fitting. 3. To study various components and working principle of Standard centre Lathe machine. 4. To prepare a cylindrical job by Lathe machine (Facing, Taper Turning, Step Turning, Knurling) 5. To study and know the working principle of Shaper and Milling machine. 6. To prepare Lap joint, Butt joint, Corner joint and T-Joint with the help of Electric arc welding. 7. To Prepare a Lap joint with the help of Oxy-Acetylene gas welding. 8. To calculate the angle of the given tapered component by using sine bar and slip gauges. 9. To determine the flatness of a given surface plate. 10. To determine the surface roughness test of various components. 11. Calibration of LVDT by using micrometer. 12. Calibration of load cell by using proving ring. 13. Calibration of thermocouple by using thermometer

Reference book : 1. Elements Of Workshop Technology Vol 1 and 2 , by S. K. Hajra Choudhury 2. Laboratory Manual



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Subject Code	Title of the subject	L	T	P	C									
23BBSBS10003	Engineering Chemistry	3	0	0	3									
Course Educational Objectives														
CEO1	To impart the knowledge of application of chemical sciences in the field of engineering													
CEO2	To elucidates principles of applied chemistry in industrial systems, water treatment and engineering materials													
CEO3	To enlighten the students with the applications of advanced materials.													
Course Outcomes: Upon successful completion of this course, students will be able to:														
CO1	Understand microscopic chemistry in terms of atomic and molecular orbitals.													
CO2	Implementation of water treatment techniques for domestic and industrial purposes													
CO3	Application of electrochemistry for the future study on battery/electrochemical devices related to energy storage.													
CO4	Evaluation of corrosion protective techniques to be applied on different materials.													
CO5	Design new materials, which are corrosion resistant and or bio-degradable.													
CO6	Creation and use of different materials as per the requirements of the society.													
CO-PO & PSO Mapping														
COs	PROGRAMME OUTCOMES													
	1	2	3	4	5	6	7	8	9	10	11	12		
CO1	2	2												
CO2	3	2	3				2						2	
CO3	2	3	1				1						2	
CO4	2	3	2				2						2	
CO5	2	2	3				1						2	
CO6	3	2	3				1						2	
AVG	2.3	2.3	2.4	-	-	-	1.4	-	-	-	-		2.0	



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UNIT:01 ATOMIC AND MOLECULAR STRUCTURE (10Hours) deBroglie's theory, Heisenberg's uncertainty principle- wave nature of electron, Schrodinger's wave equation (no derivation), Eigen values and Eigen functions, Significance of wave functions, Particle in one dimensional box, Pauli's exclusion principle – Hund's rule of maximum multiplicity, Aufbau principle. Molecular Orbital theory and Energy level diagram for Homo diatomic molecules of H₂, N₂, O₂ & F₂, and Hetero diatomic molecule CO & NO

UNIT:02 WATER CHEMISTRY (10Hours) Types of Hardness, Determination of Hardness by EDTA method, Treatment of water for Domestic use, Water softening processes Lime-soda process, Ion Exchange method, Boiler feed water, Scale and Sludge, Caustic embrittlement, Carbonate and phosphate conditioning, Colloidal conditioning, Calgon conditioning.

UNIT:03 ELECTROCHEMISTRY (10Hours) Electrodes and electrode potentials – construction of cell and EMF values, Relation between E.M.F and free energy, Electrochemical series, Galvanic series, Conductance, Faraday's Law of Electrolysis, Nernst Equation and applications. Ionic product of water, pH and pH– buffer solutions – use of pH values. Cells –Fuel cells.

UNIT:04 CORROSION (10Hours) Definition of corrosion, Types of corrosion: Dry corrosion and wet corrosion, Galvanic corrosion, Concentration cell corrosion, Factors influencing corrosion, Corrosion control: Cathodic protection (Sacrificial anodic protection and Impressed current cathodic protection), Protective coatings: Electroplating, Galvanization and Tinning.

UNIT:05 POLYMER CHEMISTRY (10Hours) Introduction, polymer, Classification of polymers, Plastics: Thermosetting and thermoplastic plastics, Preparation, Properties and uses of different plastics such as PVC, PE, PTFE, Bakelite, Nylon-6,6, Conducting Polymer (Polyaniline, and Polyacetylene), Bio-Degradable and Non-Bio Degradable Polymer.

Reference Books: 1. Engineering chemistry by Jain & Jain, Dhanpat Rai publishing company (p) Ltd. 2. A Text Book of Engineering Chemistry by S. S. Dara, S Chand Publishers. 3. A Text Book of Engineering Chemistry by Sashi Chawla, Dhanpat Rai Publishing house. 4. Text Book of Engineering Chemistry, 2nd edition, by R.Gopalan, D.Venkapaya & Sulochana Nagarajan, Vikas Publishing House Pvt. Ltd. 5. B. Tech Chemistry- I and II by P.K. Kar, S. Dash, B. Mishra kalyani publishers. 6. Physical Chemistry By P.W. Atkins 7. Engineering Chemistry (NPTEL Web Book) by B. L Tembe, Kamaluddin and M.S.Krishna 8. Essentials of Physical Chemistry, Bahl & Tuli, S. Chand Publishing 9. Applied Chemistry, Sunita Rattan, Kataria 10. Engineering Chemistry, Baskar, Wiley 11. Engineering Chemistry Fundamental and Applications, Shikha Agarwal (Second Edition) 2019, Cambridge University Press. 12. University chemistry by B.H.Mahan.



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Lab Code	Name of the lab	L	T	P	C	QP						
23BBSBS10103	Engineering Chemistry Laboratory	0	0	2	1							
Course Educational Objectives												
CEO	To train the students about the applications of chemical sciences in the field of engineering and technology											
Course Outcomes: Upon successful completion of this course, students should be able to:												
CO1	Understand the basic methods of chemical analysis and instrumentations involved											
CO2	Prepare standard chemicals											
CO3	Analyze various physical parameters such as pH, DO, etc of unknown sample.											
CO4	Apply the principle of chemistry for preparation of drugs.											
CO5	Evaluate different chemical parameters (Hardness and alkalinity)											
CO6	Design various materials for engineering applications											
CO-PO & PSO Mapping												
COs	PROGRAMME OUTCOMES											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	2		1									
CO2	2		2				1					
CO3	2		2				1					
CO4	3		1				1					
CO5	2		1				1					
CO6	2		1				1					
Avg.	2.1		1.3	-	-	-	1	-	-	-	-	
List of Experiments:												



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1. Determination of amount of OH^- and CO_3^{2-} present in supplied water sample.
2. Determination of total hardness of water.
3. Standardization of KMnO_4 using sodium oxalate.
4. Determination of ferrous ion in Mohr's salt by standardized KMnO_4 .
5. Determination of percentage of dissolved oxygen in given water sample.
6. Estimation of available chlorine in bleaching powder/ chloride content.
7. Determination of rate constant of acid catalyzed hydrolysis of ester.
8. Preparation of drug (aspirin/Paracetamol).
9. Adsorption of acetic acid by charcoal.
10. Acid value of oil.



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Course Code	Course Title	L	T	P	C	QP
23BBSES11103	Programming for Problem Solving Laboratory	0	0	2	1	
Pre -Requisite: Basics of Computer Science						
Course Educational Objective						
CEO1: To develop programs for problems on different applications of array, functions, pointers and structure.						
CEO2: To analyse different problems by comparing and implementing in programming.						
Course Outcome: student can able to						
CO1	Memorize features of structure oriented programming and describe control statements, arrays, structures and pointers.					
CO2	Classify various types of statements and demonstrate programs on control structures, arrays, functions, pointers and structures.					
CO3	Solve problems using different programming logics and can able to discover better solutions.					
CO4	Analyse different programs by experimenting on them and estimating their efficiency.					
CO5	Evaluate complex programs by verifying their logics and justify their results.					
CO6	Develop applications and projects using various features of structure oriented programming.					
Lab Experiment 1: Familiarization with programming environment						
1) Introduction to OS: Before starting experiments explain the facilities and operations of OS.						
2) Introduction to the C compiler, Compilation and Execution Process & writing simple programs.						
Lab Experiment 2: Simple computational problems using arithmetic expressions.						
1) Write a program to input radius of a circle and Find the area, perimeter of it.						
2) Write a program to input two numbers and swap them using an intermediate variable.						
3) Write a program to input two float values and find their sum						
4) Write a program to input 2 sides i.e: length and breadth of a rectangle. Find the area and perimeter of it.						



Lab Experiment 3: Simple computational problems using arithmetic expressions.

- 1) Write a program to accept Fahrenheit and calculate its equivalent Celsius.
- 2) Write a program to input three unequal numbers and find the greatest using conditional operator.
- 3) Write a program to find simple interest when principle amount, no. of terms and rate of interest given. [Given formula: $si = (p * t * r) / 100$]
- 4) Write a program to find the area of a triangle when the 3 sides of it given as input.
[Given formula: $s = (a + b + c) / 2$ and $area = \sqrt{s * (s - a) * (s - b) * (s - c)}$]

Lab Experiment 4: Simple computational problems using arithmetic expressions.

- 1) Write a program to input three unequal integers and find the largest number using conditional operator.
- 2) Apply Pythagorean theorem for finding the distance between two points i.e. side 'a' when the two sides namely 'b', 'c' are given as input. [Given formula is $a = \sqrt{b^2 + c^2}$]
- 3) John, Ram and Shah were fishing in a river bank. Input the no. of fishes caught by each person and display

who have caught more fishes (use conditional operator).

- 4) A boy is running in a circular playground having radius R given input. What will be the distance and displacement from one end to other end of ground? [Formula distance = $\pi * R$ and Displacement = $2 * R$]

Lab Experiment 5: Problems involving using if statement

- 1) In your garden two flower plants of rose and lily are growing. Input the growth of each plant in centimetres. Display the plant whose height is more. (use if..else)
- 2) In a software company a project team of 3 members namely Manvi, Shyam and William. Input their job experience in no. of years. The team lead must have more experience. Display who can be team lead. (use if..else)
- 3) Write a program to input 3 coefficients and find the real roots of quadratic equation.
- 4) Write a program input a digit within 0 to 6. Display week day example: 0 for Sunday, 1 for Monday etc (use else if ladder).

Lab Experiment 6: Problems involving using switch..case

- 1) Write a program to input a lower case alphabet and test whether it is vowel or consonant. (using else..if and switch both)
- 2) Write a program to input an arithmetic operator and two operands. Calculate and display the result as per the given operator using switch..case.
- 3) Write a program to find the greatest among three numbers. (using else..if and switch both)



Lab Experiment 7: Programming with while loop and do..while loop:

- 1) Write a program to input a number and test whether it is prime number or not using while statement.
- 2) Write a program to test a number is perfect or not using while statement.
(ex: The perfect number is 6, which is the sum of 1, 2, and 3. Other perfect numbers are 28, 496, and 8,128.)
- 3) Write a program to input a positive number and test whether it is palindrome or not using do..while statement.
- 4) Write a program to accept a positive integer and test it for Armstrong or not using do..while statement.

Lab Experiment 8: Programming with For loops and nested Loop:

- 1) The length of two rods are given as input in meters. The rods are to be cut into pieces of equal length. Find the maximum length of each piece. (use for loop)
- 2) Write a program to generate a series of Fibonacci numbers using for statement
- 3) Write a program to calculate the following sum using nested for statement: $\text{Sum} = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} + \frac{x^8}{8!} - \frac{x^{10}}{10!} + \dots + \frac{x^n}{n!}$
- 4) Write a program to generate the following pyramid using nested for statement:

```
1
1 2 1
1 2 3 2 1
1 2 3 4 3 2 1
```

Lab Experiment 9: Programming with 1D Array and 2D Array

- 1) Write a program to accept 10 integers in to an array and find largest and smallest integers present in them.
- 2) Write a program to input 10 numbers into an array. Find how many prime numbers exist in the array.
- 3) Write a program to input values into a square matrix of size 3X3. Display the transpose of the matrix.
- 4) Write a program to input elements into two matrices A[3][4], B[4][3]. Multiply A and B store result into matrix C [3][3]. Display the resultant matrix C.

Lab Experiment 10: Programming with Strings Handling Operations

- 1) Write a program to input a string and find the frequency of a given character in it.
- 2) Write a program to input two strings and compare them for equality without using library function.
- 3) Write a program to input a string and test it for palindrome or not using library functions.



Lab Experiment 11: Programming with User Defined Functions

- 1) Write a C program which contains three UDF's namely add(), subtract() and multiply(). Each function accepts two integers as their arguments and calculate and return the results.
- 2) Write a program to create an UDF and test a number is prime or not.
- 3) Write a program to create an UDF which accepts an array of 10 integers and find the largest element and smallest element present in the array.

Lab Experiment 12: Programming with Recursive Functions

- 1) Write a program to find the factorial of a number using recursive function.
- 2) Write a program to accept 10 elements into an integer array. Find the largest element present using recursive function.
- 3) Write a program to generate Fibonacci series using a recursive function.

Lab Experiment 13: Programming with Pointers

- 1) Write a program to swap two numbers using User Defined Function by applying call by address concept.
- 2) Write a program to perform matrix addition. Create an UDF which accepts the two matrices using two pointers and performs matrix addition.
- 3) Write a program to store N integer values using dynamic memory allocation. Then find the largest, smallest present in it using User Defined Function.
- 4) Write a program to store N integers using dynamic memory allocation. Find the average value of the integers using a user defined function.

Lab Experiment 14: Programming with Structures

- 1) Write a program create a structure PRODUCT having members Product no, Name and Price. Using a pointer Input 5 product details into a structure array and then display those products whose price is >1000 rupees.
- 2) Write a program to store 11 cricket players' details into an array of structure. The structure having member's
player name, team name and batting average. Displays the name of players whose batting average is >=30.



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3) Write a program to create a structure EMPLOYEE to store N employee details using DMA having members: employee no, name, salary. Create a function which displays only those employee names whose salary ≥ 50000 .

4) Write a program to create a structure for store library books using a structure having members book no, name, author, price. Store N books details using dynamic memory allocation. Create an UDF which accepts these books details using pointer and then display only those books whose cost ≥ 1000 .

Topic Beyond Syllabus

2) Write a program to input a set of numbers into a file called NUM.TXT. Display only the even numbers present in the file and also display their sum.

3) Write a program to store a paragraph into a file A.TXT using command line arguments and then create a copy of it with name B.TXT.

Teaching Methods: Chalk& Board/ PPT/Video Lecture

- A case study can be given to each student for each UNIT.
- A Mini Project can be given which the student has to complete during the semester break.

Text Books:

- 4) E. Balaguruswamy, Programming in ANSI C, 7th edition, Tata McGraw-Hill
- 5) Let us 'C' by Yashwant Kanethkar, 16th edition, BPB Publications
- 6) Byron Gottfried, Schaum's Outline of Programming with C, 3rd edition, McGraw-Hill

References:

- 4) Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, 2nd edition, Prentice Hall of India
- 5) Programming in C, by Reema Thareja, 2nd edition, OUP India
- 6) C Programming and Coding by swatisaxena, BPB Publications



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CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1	3	2	1	1									
CO2	2	3	2	1									
CO3	2	2	3	3	1								
CO4	2	1	3	3	1				1				
CO5	0	0	2	2					1	1			
CO6	0	0	1	1					1	1			
	1.5	1.33	2	1.83	0.33				0.5	0.33			1.12

[HIGH-3 MID-2 LOW -1]



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Lab Code	Name of the Lab (1 st Sem)	L	T	P	C										
23BBSHS11101	Communicative English and Soft Skills Laboratory	0	0	2	1										
Course Educational Objectives															
CEO1	To develop communication skills of the students.														
CEO2	To develop vocabulary and usages kills of students by practice.														
CEO3	To enable students to participate I group discussions through listening and speaking.														
CEO4	To enable students eliminate grammatical mistakes in speech and writing.														
Course Out comes :The students will be able to:															
CO1	Understandtheimportanceofeffectivecommunicationforprofessionaldevelopment.														
CO2	Apply effective vocabulary and grammar in everyday communication.														
CO3	Analyse various types of corporate communication.														
CO4	Formulate crucial soft skills for career development.														
CO5	Develop useful LSRW skills for professional growth.														
CO6	Develop confidence for effective presentation.														
CO-PO Mapping															
PROGRAMMEOUTCOMES															
COs	1	2	3	4	5	6	7	8	9	10	11	12			
CO1										3					
CO2											2				
CO3										3					
CO4									3						
CO5										3					
CO6										3					
SYLLABUS															



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Motivational videos

Activity- Listening to videos and filling the gaps in a worksheet(2 hours)

Famous Speeches

Activity- Describing, paraphrasing and summarizing famous speeches.(2

hours) Self Evaluation

Activity–Evaluating self through assessments using British Council App(2 hours)

Listening for Pronunciation

Activity- Listening to ted talks and focusing on segmental sounds and intonation by articulating it. (2 hours)

Oral Presentation

Activity - verbal presentation and speaking for 1 to 5 minutes.(2

hours) Just a Minute

Activity –Speaking on any given topic for a minute.(2

hours) Story Telling

Activity- Analysing and narrating a story.(2

hours) PPT Presenting

Activity- presentation and engaging topic with visual presentation.(2 hours)

News Article Reading

Activity - Regulating reading speed by loud reading and reading news article. (2

hours) Reading story

Activity - Story reading with proper intonation. (2

hours) Poem Recitation

Activity - Reading poems focusing on rhythm and specific reading skills. (2

hours) Prose Reading

Activity- Reading prose focusing on the punctuations and pronunciation. (2 hours)

Basic Writing Skill

Activity - Focusing on basic writing skills by sequencing of thoughts and ideas. (2

hours) Story Writing

Activity -. Writing a story using the given clues.(2 hours)

Precise Writing

Activity – Paraphrase a given passage(2 hours)

Article Writing

Activity- Writing newspaper article and magazines.(2 hours)



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Teaching Methods: Chalk & Board/ PPT/Video Lectures

Text/ Reference Books:

2. *Form and Finesse, Business Communication and Soft skills by Shruti Das, Published by Orient Black Swan, 2022.*
3. *Business and Corporate Soft skills developed by RaiTech. University (PDF available)*
4. *Spoken English (with CD). Sasikumar V nd PVD hamija. New Delhi:Tata McGraw-Hill Education Pvt. Ltd.(2ndEd.),2008.*



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II Semester Syllabus

Subject Code	Title of the subject	L	T	P	C
23BBSBS10002	Engineering Physics	3	0	0	3
Course Educational Objectives					
CEO1	Impart among the students an attitude of being inquisitive so that they are capable of independent and critical thinking.				
CEO2	Enable the students to analyze problems starting from first principles, evaluate and validate experimental results, and draw logical conclusions.				
CEO3	Prepare the students to pursue research careers, careers in academics, industries in Physical Science and allied fields.				
CEO4	To attain fundamental information about Quantum mechanics with applications.				

Cos	PROGRAMME OUTCOMES												
	1	2	3	4	5	6	7	8	9	10	11	12	
CO1	2	2											
CO2	2	2											
CO3	1	2											
CO4	1	2											
CO5	1	1											
CO6	1	2											
AVG.	1.33	1.83	1.58										



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UNIT:1 Oscillation and Waves (10 Hours) Introduction to Oscillatory motion, Simple harmonic oscillation, Damped harmonic oscillation and its characteristics, Waves and its characteristics, Wave equation, Superposition of Waves, coherent and incoherent superposition, Interference of light waves, Newton's Ring experiment, diameter of rings, determination of wavelength of unknown light and refractive index of liquid

UNIT:2 Electromagnetic Theory (10Hours) Review of grad, divergence and curl, Gauss divergence theorem and Stokes theorem (no derivations), fundamental laws of electrostatics, magnetostatics and electromagnetism, displacement current and conduction current, Maxwell's equations, Equation of continuity using Maxwell's Relations. Electromagnetic wave and its characteristics, electromagnetic wave equation for free space and in Charge free conducting medium, electromagnetic energy and Poynting vector, Poynting theorem.

UNIT: 3 Solid state Physics (08Hours) Crystal Structure: crystal direction and plane, Miller indices, Inter planar spacing, Reciprocal Lattice and its characteristics, Reciprocal Lattice of SC, FCC and BCC, Brillouin Zone, X-ray diffraction (Basic) & Bragg's law, Crystal defects.

UNIT: 4 Physics of Materials and Optoelectronics (12Hours) Super Conducting Materials: Origin, type-1 and type-2, Meissner's effect, critical magnetic field and current density, Applications. Magnetic Materials: Properties of Magnetic Materials types and applications. Di-electric Materials: Polar and non-polar dielectric, types of dielectric, piezoelectric, pyro-electric and ferroelectric, Applications. Nano Materials: (elementary ideas) Surface to volume ratio, graphene, carbon nano tubes and their applications. LASER, Lasing action and characteristics & application of laser beam, construction and working of He-Ne Laser, applications of Laser. Optical fiber, Acceptance angle, Numerical aperture, Step index and Graded index fibers, Attenuations in optical fibers, Block diagram of optical fiber communication Systems and applications.

UNIT: 5 Quantum Mechanics and Application (12Hours) Introduction to dual nature: Black body radiation, photoelectric effect, Compton effect (qualitative ideas only), de-Broglie's hypothesis, Heisenberg's uncertainty principle and its application to non-existence of electron inside the nucleus and ground state energy of one dimensional harmonic oscillator, Basic postulates of Quantum Mechanics, Wave function and its characteristics, probability density, normalization, eigen values, eigen functions and expectation values, Schrödinger's equation (time dependent and time independent). Application of Schrödinger equation to particle in a box and its Energy eigen values, Qualitative ideas on potential step and potential barrier with transmission probability.



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Subject Code	Title of the subject	L	T	P	C											
23BBSBS120B1	Engineering Mathematics-II	3	1	0	4											
Course Educational Objectives																
CEO1	To focus on coordinate system															
CEO2	To study vector function and scalar function in vectors.															
CEO3	To provide the standard methods for solving algebraic equations.															
CEO4	To study the probability and its properties.															
Course Outcomes: Towards the end of the course students will be able to :																
CO1	Understand the concept of straight-line and circle and application.															
CO2	Understand the concept of conditional probability and testing of hypothesis.															
CO3	Solve the algebraic equations by using different methods and also understand the concept of interpolation.															
CO4	Categorize different types of curves and their properties,															
CO5	Solve the equations by some numerical methods															
CO6	Evaluate the properties of curl ,divergence and gradient and its application.															
CO-PO & PSO Mapping																
COs	PROGRAMME OUTCOMES												PSOs			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
CO1	1	2														
CO2	2	3														
CO3	1	3														
CO4	2	3														
CO5	2	3														
CO6	2	3														
Avg	1.66	3.0					1.0					1.0				



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UNIT –I CO-ODINATE GEOMETRY (12 Hours) Straight Lines: Introduction, Slope of a line and angle between two lines. Various forms of equations of a line: parallel to axes, point-slope form, slope-intercept form, two point form, intercepts form and normal form. General equation of a line. Circles : circle, Equation of circle whose centre and radius is known, General equation of a circle, equation of tangent and normal Equation of circle passing through three given points, Equation of circle whose diameters is line joining two points.

UNIT-II DIFFERENTIAL CALCULUS (14 Hours) Limit and continuity Simple problems on limit, Simple problems on continuity, Differentiability, Derivatives using first principle, Derivatives of sum, difference, product and quotient of two functions, Differentiation of functions of functions (Simple problem based on it), Logarithmic differentiation (Simple problem based on it), Differentiation by substitution method.

UNIT- III INTEGRAL CALCULUS (12 Hours) Integration of simple functions, Integration by substitution method, Definite Integral (simple problems based on it), Integration by parts, Integration by partial fraction, Area under simple well-known curves (simple problems based on it).

UNIT-IV PROBABILITY (12 Hours) Events, Sample space, definition of probability, Axioms of probability, Addition theorem of probability with examples, Multiplication theorem of probability with illustrate examples. Conditional probability, Bayer’s theorem, simple problems.

UNIT – V VECTOR ANALYSIS (12 Hours) Vectors and Scalars, Types Of Vectors, Algebra Of Vectors, Position Vectors, Scalar Product , Vector Product, Unit Vectors, Scalar Triple Product And Vector Triple Product, Vector Functions, Derivatives, Gradient, Divergence, Curl And Their Simple Applications.

Reference Books: 1. Higher Engineering Mathematics by BS Grewal : Khanna Publishers, New Delhi. 2. Advanced Engineering Mathematics by E. Kreyszig, Tenth Edition, Willey 3. Numerical Method by S. S. Sastry 4. Higher Engineering Mathematics by B.V.Ramana, McGraw Hills Education 5. Advanced Engineer methods by N. P. Bali & Manish Goyal.



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Subject Code	Title of the subject	L	T	P	C
23BBSES10001	Basic Electrical and Electronics Engineering	3	0	0	3
Course Educational Objectives:					
CEO1:	Impart a basic knowledge of electrical quantities such as current, voltage, power, energy and frequency to understand the impact of technology in a global and societal context.				
CEO2:	To provide comprehensive idea about AC and DC circuit analysis, working principles and applications of basic machines in electrical engineering.				
CEO3:	To expose the students in the field of analog and digital electronics engineering and to acquire the fundamental knowledge in the field.				

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2											2		
CO2	3	2	2												
CO3	2	1	1												
CO4	2	1	1												
CO5	2	1	1												
CO6	1	1													
Avg.	2.16	1.33	1.16												



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Unit – I [12 hrs] DC Circuits & Network Theorems: Introduction to electrical terminology, Ohm's Law, Equivalent Resistance, Star-delta transformation, Source conversion, Ideal and practical sources; Kirchhoff's Law, Mesh and Nodal Analysis; Thevenin's theorem excited by independent sources. Single Phase AC Circuits: AC Fundamentals: RMS & Average value, Complex algebra, AC through pure R, L, C, series RL & RC circuits.

Unit - II [10 hrs] Three-Phase AC Circuits: Comparison between 1-ph & 3-ph AC circuit, phase sequence, Balanced Star & Delta connection, Relation between line and phase quantities. Elementary concept of DC & AC machines: Construction and working of DC Generator and motor, EMF equation, Types of DC machines, Applications, Single phase transformers: Construction, principle of working, e.m.f equation;

Unit – III [10 hrs] Semiconductor Diodes: Introduction; Ideal Diode; Semiconductor Materials; Energy Levels; Extrinsic Materials- n- and p-Type; Semiconductor Diode; Resistance Levels; Diode Equivalent Circuits; Zener Diode. Diode Applications: Half-Wave Rectification; Full-Wave Rectification, Clipper, Clamper

Unit – IV [10 hrs] Digital Electronics Fundamentals: Binary, Octal, Hexadecimal and Decimal Number System and their Conversion; 1's and 2's Complements; Logic gates: AND, OR, NOT, Universal Gates, Electronic Instrumentation: Introduction; Basic Principle; Digital Oscilloscope; Block.

Unit – V [8 hrs] Introduction to Sensors: - Temperature sensors, Light sensors, Force sensors, Displacement sensors, Motion sensors, Sound sensors, Piezoelectric Sensors Introduction to Power System & Domestic Wiring Generation of electricity (Hydro, Thermal and Nuclear power plant); General layout of electrical power system and functions of its elements, Meter board, Fuse, MCB, Earthing (pipe & plate earthing), House wiring, Electric shock & precautions.

1. **Reference Text Books:** 2. E. Hughes, "Electrical and Electronics Technology", Pearson, 2012. 3. B.L. Thereja, A.K. Thereja, „Electrical Technology“Volume-I, S. Chand. 4. Electronic Devices and Circuit Theory by Robert L Boylestad and Louis Nashelsky, 11th Edition, Prentice Hall. 5. Kothari DP and I.J Nagrath, "Basic Electrical and Electronics Engineering", Second Edition, McGraw Hill Education, 2020 6. S.K.Bhattacharya "Basic Electrical and Electronics Engineering", Pearson Education, Second Edition, 2017. 7. Digital Design by M. Morris Mano, 5 th Edition, Pearson Education. 8. B.L. Thereja, A.K. Thereja, „Electrical Technology“Volume-I, S. Chand. 9. S. Parker Smith: "Problems in Electrical Engineering" Asia Publications 10. Schaum's Outline of Basic Electrical Engineering. 11. Handbook of Modern Sensors: Physics, Designs, and Applications Paperback – 19 September 2014 by Jacob Fraden (Springer)



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Course Code	Course Title	L	T	P	Credits	QP
23BBSES12003	DATA STRUCTURES & ALGORITHMS	3	0	0	3	
Pre -Requisite: Basic knowledge of Algorithms						
Course Educational Objective						
CEO1: Develop algorithms for performing different operations on arrays, stack, Queue, linked list. Analyze the difference between them and understand different applications. Understand different searching and sorting methods and applications.						
CEO2: Understand and analyze Binary Search Tree, AVL Tree, Heap Tree and their applications. Understand the memory representation of graph, its traversal methods and applications. Analyze the Hashing techniques in compare with other sorting techniques.						
Course Outcome: student can able to						
CO1	Understand the basic concepts of data structures, remember the fundamental concepts.					
CO2	Understand the methods by comparing the different data structures concepts.					
CO3	Develop algorithms for implementing different operations on data structures.					
CO4	Analyses of the algorithms regarding different operations on data structures.					
CO5	Solve and evaluate complex problems by coding on linear and non-linear data structures.					
CO6	Design algorithms on advanced concepts of data structure by implementation in different application of data structure.					

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1	3	3	0	0	0				0	0			
CO2	2	3	2	1	0				0	0			
CO3	2	3	3	1	0				1	0			
CO4	2	3	3	1	1				1	0			
CO5	2	2	1	0	0				1	1			
CO6	1	1	0	0	0				0	0			
Avg	2.00	2.50	1.50	0.50	0.17				0.50	0.17			1.05



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UNIT- I (9 Hours) Basic concepts: Data abstraction, Data structures and types. Algorithm specification, 1D array: operations, 2D array: row major order and column major order, sparse matrix and storing into triplet matrix Stack: Basic concepts, operations and implementation of stack using arrays, Mathematical procedure for conversions of arithmetic expressions. Applications of stack: infix to postfix conversion and postfix evaluation.

UNIT- II (9 Hours) Queue: Linear queue, operations and implementation using arrays, circular queue and its operations, Basics concepts of Double ended Queue and priority queue Searching: Linear search and Binary search on elements in a linear array. Sorting: Bubble sort, Insertion sort, Selection sort, radix sort using linear array.

UNIT- III (9 Hours) Linked Lists: The concepts and operations: insertion of a node(at the beginning, at the end, at location), deletion of a node(from the beginning, from the end, from a specific location), searching for a node in single linked list, circular single linked list and Double linked list. Implementation of stack and queue using single linked list. Basic concept of Circular double linked list.

UNIT- IV (9 Hours) Trees: Introduction, Terminology, Binary Trees, Memory Representation of Binary Trees using arrays and linked lists, Binary Tree recursive traversal methods, Construction of binary tree using in-order & pre-order sequences, in-order & post-order sequence. Binary Search Trees: Algorithm for construction, searching and insertion operation, Introduction to Height Balanced trees, Balance factor, Balancing the BST by rotations during insertions of a node.

UNIT- V (9 Hours) Heaps: Introduction to binary heaps, definition of a Max-heap, Min-heap, creating Heap Tree using insertion. Graphs: Terminologies, Graph Memory representation - Adjacency matrix, Incidence Matrix, Linked Representation, path matrix, Warshall's Algorithm to find path matrix, Graph Traversals (BFS & DFS). Hashing: Hashing Functions: Division, Mid-square, Folding methods.

Reference Books: 1. "Fundamentals of data structure in C" Horowitz, Sahani & Freed, Computer Science Press. 2. "Data Structures and algorithms" by Narasimha Karumanchi, Career Monk Publications 3. "Data structures through C in depth" by S.K.Srivastava, BPB Publications



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Subject Code	Title of the subject (2 nd Sem)	L	T	P	C										
23BBSHS12001	Communicative English and Technical Communication	2	0	0	2										
Course Educational Objectives															
CEO1	To develop communication skills and soft skills of the students.														
CEO2	To enhance employability and entrepreneurial skills														
Course Out comes: <i>The students will be able to:</i>															
CO1	Understand the importance of technology in communication.														
CO2	Develop skills important for career making.														
CO3	Apply Technical approach to reading.														
CO4	Prepare professional documents for career needs (e.g. Job application letter, résumé) and Professional needs (e.g., Memo and E-mail writing)														
CO5	Develop creativity and imagination.														
CO6	Execute Self-learning through technology.														
CO-PO Mapping															
PROGRAMME OUTCOMES															
COs	1	2	3	4	5	6	7	8	9	10	11	12			
CO1										3					
CO2									2						
CO3									2						
CO4										3					
CO5									3						
CO6										3					
Avg									2.33	3.0	1.0				



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UNIT1 Introduction to Technical Communication (7 hours) 1.1 Introducing technical communication, Nature and Scope, Characteristics, Importance. 1.2 Self learning through technology, use of internet for technical learning. 1.3 Need of technical communication for career development. 1.4 Computer Assisted Language Learning (CALL) for developing English language.

UNIT-2 Skills for Career Making (8 hours) 2.1. Career Making: Setting Goals, SWOT Analysis 2.2 Preparing a Résumé: Elements of a Résumé; Types of Résumés: Chronological Résumé, Functional Résumé; Use of job portals 2.3 Group Discussion 2.4 Job Interview 2.5 Effective Oral Presentation 2.6 Handling a Meeting.

UNIT3 Technical Approach to Reading (7 hours) 3.1 Know your Reading speed; Advantages of speed reading 3.2 SQ4R Techniques of Reading 3.3 Techniques of Rapid Reading: Skimming, Scanning, Intensive and Extensive 3.4 Barriers to effective readings.

UNIT-4 Technical Writing (7 hours) 4.1 Writing a technical paper 4.2 Writing business letters – significance, purpose, structure and elements, layout; types of business letters, Job application/ cover letter 4.3 Email Etiquette 4.4 Business Reports and Technical proposals.

UNIT 5 Advanced Soft Skills development (7 hours) 5.1 What is conflict resolution; Importance, tips to improve conflict resolution. 5.2 What is Problem Solving Skills, Importance, tips to improve problem solving skills. 5.3 Difference between Conflict resolution and Problem Solving Skills.

Reference Books: 1. Basic Communication Skills for Technology by Andrea J. Rutherford, Pearson Education Asia, Patparganj, New Delhi, 2001. 2. Business Communication by Varinder Kumar and Bodh Raj. Kalyani Publishers, 2014. 3. A Textbook of English Phonetics for Indian Students by T. Balasubramanian, 2017. 4. Technical Communication, Principle and Practice by Meenakshi Raman & Sangeeta Sharma, Oxford University Press, 2015. 5. How to Read better and Faster by Norman Lewis. 4th Edition. Publisher: Crowell, 1978. 6. Soft Skills For Your Career by Kalyani Samantray OXFORD UNIVERSITY PRESS, 2016



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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
23BBSHS10002	Human Values and Professional Ethics (HVPE)B.Tech. First Semester (Non Credit Paper)	1	0	0	1	

1. *BASIC CONCEPTS*

Introduction, Terminology, Moral and Morality, Ethics, Values, Spirituality, Stakeholders, Government Edicts, Religious Edicts, Social Edicts, Constitutional Edicts, Universality, Contextual Aspects, Context, Changing Scenario, Personal Ethics, Professional Ethics, Ethical Dilemmas, Life Skills, Life Skills (WHO), Emotional Intelligence, Ability – based Model (Salovey - Mayer, Model), Emotional Competencies (Goleman’s Model), Thoughts on Ethics, Indian Thoughts, Global Thoughts on Ethics, Value Education, Current Scenario, Objectives of value Education, Importance of value Education, Acquiring Values, Dimensions of Ethics, Setting Goals in Life.

2. *PROFESSION AND PROFESSIONALISM*

Introduction, Profession, Professional, Professionalism, Criteria, Characteristics, Responsibilities, Competencies, Expectations, Support, Professional Associations, Roles of a Professional, Professional Risks, Professional Accountability, Professional Success, Ambition and Satisfaction, Ethics and Profession, Image of a Profession.

3. *ETHICAL THEORIES*

Introduction, Basic Ethical, Principles, Moral Development Theories, Piaget’s Theory, Elliot Turiel’s Domain Theory, Comparison of Moral Development Theories, Learning Moral Values, Classification of Ethical Theories, History, Classification, Some Basic Theories, Deontology, Utilitarianism, Virtue Theory, Rights Theory, Casuist Theory, Moral Absolutism, Moral Relativism, Ethical Egoism, Feminist Consequentialism, Comparison of Ethical Theories, Moral Issues, Variety of Moral Issues, Examples, Moral Dilemmas, Examples, Resolving Moral Dilemmas, Moral Autonomy, Religion and Ethics, Influence of Religion, Conflict with Ethics, Types of Enquiry, Descriptive or Factual Enquiry, Conceptual Enquiry, Normative Enquiry,



Uses of Ethical Theories.

4. ETHICS IN ENGINEERING PROFESSION

Introduction, Engineering Profession, Technology and Society, Engineering as Social, Experimentation, Similarities between Engineering and Other Scientific Experiments, Differences, Engineering Professionals, Training, Skill Set, Life Skills, Innovation and Creativity, Professional Organizations, Professional Categories, Engineering Failures, Issues in Engineering Ethics, Ethical Obligations of Engineering Professional, Concept of safe Exit, Roles of Engineers, Engineers as Managers, Other Roles Played by Engineers, Balanced Outlook on Law.

5. ENGINEER'S RESPONSIBILITY FOR SAFETY

Introduction, Safety and Risk, Concept of Safety, Assessment of Risk, Risk Assessment Technique, Safety in Engineering Products, Risk and Cost, Engineer's Responsibility for Safety, Product Safety, Mandatory Product Standards, (Australia), Designing for Safety, Product Costs, Probability of Safety and Risk, Risk- Benefit Analysis, Risk Cost and Management, Principles of Risk Management, Context Establishment, Identification, Severity and Probability of Risk, Strategies for Risk Management, Case Studies ,

Space Shuttle Challenger, Tamil Nadu Floods (2015), Bhopal Gas Tragedy, Other Tragedies, Classification of Disasters, Disaster Management Cycle, Disaster Management in India, Providing for Safe Exit, Major Ethical Issues.

6. RESPONSIBILITIES AND RIGHTS OF PROFESSIONALS

Introduction, Rights and Responsibility as Citizens, Responsibilities, Rights, Professional Responsibilities, Collegiality, Loyalty, Confidentiality, Respect for Authority, Accountability, Pride of Profession, Pride of Employer, Conflict of Interest, Gifts and Bribes, Collective Bargaining, Occupational Crimes, Professional

Rights, Rights of an Employee, Rights of a Professional, Whistle- blowing,



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Discrimination, Vishakha Guidelines and Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act 2013.

7. *GLOBAL ISSUES*

Introduction, Current Scenario, Technology Revolution, Globalization and MNCS, Impact of Automation, International Trade, World Summits, Disaster Management (in 2015), Issues, Business Ethics, Corporate Governance, Finance and Accounting, Corporate Social Responsibility, Definitions, Concept, ISO and CSR, Scenario, CSR Rules in India, Case Studies, Kellogg's, Infosys Foundation, Tata Group of Companies, Environment Ethics, Environment, Challenge of Environmental Ethics, Anthropocentrism, Sustainable Development, Ecosystem, Energy Concerns, Ozone Depletion, Pollution, Ethical Issues, Computer Ethics, Manufacturing and Marketing of Computers, Software, Cybercrimes, Data Stealing, Embezzlement, Hacking, Media Ethics, Roles of Media, Positive Aspects of Media, Negative Aspects of Media, Classification of Media, Support to Media, Accountability of Media, Regulation of Media, Factors in Media Ethics, Advertising Ethics, War Ethics, Weapons Development, Terrorism, Ethical Issues, Bioethics, Abortion, Euthanasia, Surrogacy, Cloning, Genetics, Research Ethics, Intellectual Property Rights, Why Intellectual Property Rights?, Purpose and Advantages on IPR, Domains of IPR, Professionals and Ethics.

8. *ETHICAL CODES*

Introduction, Need for Ethical Codes, Sample Codes, Institution of Electrical and Electronics Engineers, National Society for Professional Engineers (USA), Board of Ethical Review, American Society of Civil Engineers, American Society for Mechanical Engineers. Computer Society of India, Codes from Other Professions, Medical Council of India, Observations, Advertising Standards Council of India, Corporate Codes, Tata Group of Companies, Development of Codes, Implementation of Codes, Limitation of Codes.



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9. *ETHICS AUDIT*

Introduction, Need of Ethics Audit, Ethics Profile of Organizations, Consideration for Ethics Audit, Manufacturing Unit, Educational Institution, Ethics Standards and Benchmarking, Objectives of Ethics Audit, Setting Ethics Standards, Ethics Assurance, Audit Brief, Ethics Auditors, Procedure for ethics Audit, Ethics Audit Report, Examples, Drug Manufacturing Unit, Educational Institution, Ethics Indices, Ethisphere Institute, FTSE4Good Index, Dow Jones Sustainability Index, Good Corporation Standard, Starting an Ethics Audit Programme.

10. *HUMAN VALUES AND ATTITUDES*

Introduction, Terminology, Domains of Learning, Affective Domain Taxonomy, Human Values, Classification of Values, Values and Ethics, University of Values, Value System, Degeneration of Values, Importance of Values, Acquiring Values, Attitudes, Components of Attitude, Types of Attitude, Attitude Formation, Attitude Change, Importance of Correct Attitude, Values, Attitude, and Professionals.

11. *ETHICAL LIVING*

Introduction, Needs of Life, Maslow's Hierarchy of Needs, Mc Celland's Theory, some Thoughts on Life, Four Orders of Nature, Anthrosophical View, Indian Philosophical Thoughts, Harmony in Life, Harmony with the self, Harmony with the Family, Harmony with Society, Harmony with Nature, Ethical Living, Why Ethical Living, Setting Goals in Life, Areas, Achieving Goals, Ethical Living for Professionals, Appendix Practical Tasks, Index, About the Author.

RECOMMENDED BOOKS FOR REFERENCE:

1. R. Subramanian, "Professional Ethics", Oxford University Press, New Delhi, 2013
2. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, NewDelhi, 2013
3. Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics –Concepts and Cases", Thompson Learning, 2003.



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4. Daniel Albuquerque, "Business Ethics", Oxford University Press, New Delhi, 2013
5. Edmund G. Seebauer and Robert L. Barry, "Fundamentals of Ethics", Oxford University Press New Delhi, 2012



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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C									
23BBSES10105	Engineering Graphics & Design Lab	0	0	2	2									
Pre - Requisite:														
Course Educational Objectives														
CEO1	To enable students to acquire and use engineering drawing skills as a means of accurately and clearly communicating ideas, information and instructions													
CEO2	To enable students to acquire requisite knowledge, techniques and attitude required for advanced study of engineering drawing and basic of AUTOCAD.													
Course outcomes: At the end of the course, the student will be able to:														
CO1	Understand the basics of engineering drawing and method dimensioning in engineering systems.													
CO2	Prepare the orthographic projections of points and straight lines placed in various quadrants													
CO3	Demonstrate the ability of drawing orthographic projections of various planes & solids parallel, perpendicular and inclined to different planes.													
CO4	Sketch the isometric view of different planes and solids by showing all their features in 3D.													
CO5	Draw and interpret the sectioned views of solids													
CO6	Apply the software skills to prepare engineering drawings using AutoCAD													
CO-PO & PSO Mapping														
COs	PROGRAMME OUTCOMES											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3			1										
CO2	2		2	2										
CO3	2		2	2										
CO4	2		2	2										
CO5	2		2	2										
Avg	2.66		2.0	2.0							2.0			



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UNIT:1 Introduction: Drawing Instruments and their uses, BIS conventions, Types of line, Types of scale. Projections : Introduction, Types, Definitions - Planes of projection, reference line and conventions employed, Orthographic Projections of points in all the four quadrants, Projections of straight lines (located in First quadrant/first angle only), True and apparent lengths, projection of line inclined to one plane and both the planes.

UNIT:2 Orthographic Projections of Plane Surfaces (First Angle Projection Only): Introduction, Definitions–projections of plane surfaces–triangle, square, rectangle, pentagon, hexagon and circle, planes in different positions by change of position method, projection of inclined planes. Orthographic Projections of Solids (First Angle Projection Only) : Introduction, Definitions – Projections of right regular tetrahedron, hexahedron (cube), prisms, pyramids, cylinders and cones in different positions.

UNIT:3 Isometric Projections: Introduction, projection of plane-square, triangular, circle, method of point and four center method Isometric projection of solids: projection of prisms, pyramids method of drawing non-isometric lines, box method , offset method, projection some typical solids.

UNIT:4 Sections and Development of Lateral Surfaces of Solids: Introduction, Section planes, Sections, Section views, Sectional views, Apparent shapes and True shapes of Sections of right regular prisms, pyramids, cylinders and cones resting with base on HP.

UNIT:5 Introduction to AUTO CAD: Layout of the software, standard tool bar/menus and description of most commonly used toolbars, navigational tools. Co-ordinate system and reference planes. Definitions of HP, VP, RPP & LPP. Creation of 2D/3D environment. Selection of drawing size and scale. Commands and creation of Lines, Coordinate points, axes, poly-lines, square, rectangle, polygons, splines, circles, ellipse, text, move, copy, off-set, mirror, rotate, trim, extend, break, chamfer, fillet, curves, constraints.

REFERENCE BOOK:- 8. Engineering Drawing - N.D. Bhatt & V.M. Panchal, Charotar Publishing House, Gujarat. 9. Computer Aided Engineering Drawing - S. Trymbaka Murthy, 4th Ed, University Press Engineering Drawing by N.S. Parthasarathy and Vela Murali Oxford University Press. 10. Engineering Graphics - K.R. Gopalakrishna, Subash Publishers Bangalore. 11. Fundamentals of Engineering Drawing with an Introduction to Interactive Computer Graphics for Design and Production-Luzadder Warren J., Duff John M., Eastern Economy Edition, Prentice-Hall of India Pvt. Ltd., New Delhi. 12. Computer Aided Engineering drawing, Prof. M. H. Annaiah, New Age International Publisher, New Delh



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Lab Code	Name of the Lab	L	T	P	C	QP
23BBSBS10102	Engineering Physics Laboratory	0	0	2	1	
Course Educational Objectives						
CEO1	Providing fundamental information on basic instruments and their uses.					
CEO2	To familiarize different apparatus and applications through different experiments.					
Course Outcomes: Upon successful completion of this course, students should be able to:						
CO1	Understand the concepts of oscillation and waves through experimental observation.					
CO2	study and explain the experimental observation of interference and diffraction pattern					
CO3	interpret the fundamental characteristics of various materials and semiconductor materials through experiments					
CO4	Analyze the quantum concept of light by experimental observation.					

CO5	study thermal conductivity and dielectric constant of a given solid.											
CO6	Understand surface tension and viscosity properties of liquids.											
CO-PO & PSO Mapping												
COs	PROGRAMME OUTCOMES											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	2		1	1								
CO2	2		1	1								
CO3	2		1	1								
CO4	2		1	2								
CO5	2		1	2								
CO6	2		1	2								
AVG.	2		1	1.5								1.58



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List of Experiments:

1. Determination of the acceleration due to gravity by using Bar/Kater's pendulum.
2. Verification of the laws of transverse vibration by using sonometer.
3. Determination of Rigidity modulus of a wire by Static/Dynamic method.
4. Determination of wavelength of light by Newton's Rings apparatus.
5. Determination of no. of lines of a diffraction grating plate.
6. Determination of slit width of a double slit.
7. Determination of plank's constant using photo-voltaic cell.
8. Determination of band gap energy of PN junction (Ge/Si) diode.
9. Determination of the resistivity of a semiconductor with temperature by four- probe method.
10. Determination of dielectric constant of given solid by Lecher wire method.

Add on Experiments

11. Determination of coefficient of Thermal conductivity (**K**) of a metal (Cu) by using Searle's apparatus.
12. Study of B-H curve of ferromagnetic substance.
13. Study the Hall Effect.
14. Determination of surface tension of water using Capillary- rise method.
15. Determination of coefficient of viscosity using Stoke's method.



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Course Code	Course Title	L	T	P	Credits	QP
23BBSES12203	DATA STRUCTURES & ALGORITHMS LABORATORY	0	0	2	1	
Pre -Requisite: Basic knowledge of Algorithms						
Course Educational Objective						
CEO1:Develop programs for performing different operations on Arrays, Stack, Queue, Linked list. Analyze the difference between them and understand different applications.						
CEO2:Develop programs for understanding different searching and sorting methods and their applications.						
Course Outcome: student can able to						
CO1	Understand the basic concepts of data structures, remember the fundamental concepts.					
CO2	Understand the programming by comparing the types of data structures concepts.					
CO3	Develop the codes for implementing different operations on data structures.					
CO4	Analyses of the codes regarding different operations on data structures.					
CO5	Solve and evaluate complex problems by coding on linear and non-linear data structures.					
CO6	Design the codes on advanced concepts of data structure by implementation in different application of data structure.					
Experiment-1 (functions and arrays)						
Q1) Write a program to create an UDF for input 10 numbers into a 1D array. Create two functions MAX() and MIN(). MAX() is used to return the largest element and MIN() is used to return the smallest number in array.						
Q2) Write a C program to create methods for operations insertion and display on 1D array of elements using UDF.						
Q3) Write a C program to create methods for operations deletion, and display on 1D array of elements using UDF.						
Experiment 2: (concepts of matrix and sparse matrix)						
Q1) Write a C program to create function for performing matrix multiplication using UDF						
Q2) Write a C program to input elements into a square matrix and display the transpose of it using UDF.						
Q3) Write a program to input elements into a 4X4 matrix, check it for sparse or not. If sparse then store the non- zero elements into an alternate matrix and then display it using UDF.						



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Experiment 3:(Pointer, structure and DMA)

- Q1) Write a program to store N numbers using dynamic memory allocation and then find the largest element using UDF.
- Q2) Write a C program to create a structure called student to store your roll no, name, age. Create an array to input 5 students data and then create an UDF to display details where age \geq 20.
- Q3) Write a program to create a structure for products of a super market. Store product no, name and cost for N products using dynamic memory allocation. Display the products whose cost is in between 100 rupees to 1000 rupees.

Experiment 4: (stack and queue)

- Q1) Write a program using C to create a stack of numbers and perform using UDF:

	PROGRAMME OUTCOMES											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	1	2	3
CO1	3			2										
CO2	2		2	2										
CO3	2		2	2										
CO4	3		2	2							2			
CO5	2		2	2										
CO6	2		2	2							2			
Avg.	2.66		2.0	2.0							2.0			



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Subject Code	Name of the Subject (2 nd Sem.)	P	C									
23BBSHS12201	Communicative English and Technical Communication Laboratory	2	1									
Course Educational Objectives												
CEO1	To develop communication skills and soft skills of the students.											
CEO2	To enhance employ ability and entrepreneurial skills											
Course Out comes: <i>The students will be able to:</i>												
CO1	Understand the importance of technology in communication.											
CO2	Develop skills important for career making.											
CO3	Apply Technical approach to reading.											
CO4	Prepare professional documents for career needs (e.g. Job application letter, résumé) and Professional needs(e.g., Memo and E-mail writing)											
CO5	Develop creativity and imagination.											
CO6	Execute Self-learning through technology.											
CO-PO Mapping												
Cos	PROGRAMMEOUTCOMES											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1										3		
CO2									2			
CO3									2			
CO4										3		
CO5									3			
CO6										3		



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SYLLABUS

SYLLABUS	
Professional Writing	(2hours)
Activity-Techniques to write Circular/notice writing	
Resume Writing	(2hours)
Activity- Types and format for writing an effective resume	



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Lab Code	Name of the Lab	L	T	P	C											
23BBSES10101	Basic Electrical and Electronics Engineering Laboratory	0	0	2	1											
<i>Course Outcomes: Upon successful completion of this course, students should be able to:</i>																
CO1	Explain the concept of network theorems and apply them to laboratory Measurements using different measuring devices.															
CO2	Measure power and power factor in ac circuits using different lamps															
CO3	Understand and identify different parts of AC and DC machines.															
CO4	Verify the characteristics of diodes, transistors, digital electronic components Experimentally and able to use oscilloscope, signal generator to measure amplitude and frequency of different waveforms.															
CO5	Demonstrate the operating principle and VI characteristics of Semiconductor diode and transistor.															
CO6	Understand the concept of various logic gates															
CO-PO & PSO Mapping																
COs	PROGRAMME OUTCOMES												PSOs			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
CO1	3	1	1		2											
CO2	3	2	2		2											
CO3	2	1	2													
CO4	2	2	2		2											
CO5	2	2	2		2											
CO6	1	1	2													
Avg.	2.16	1.6	2		1.3											
SYLLABUS																



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List of experiments/demonstrations:

Electrical Part:

Experiments: (Any 4 Experiments) :

1. Study of different electrical equipment's (Voltmeter, Ammeter & Wattmeter)
2. Verification of Thevenin's Theorem.
3. To study the connection and working of fluorescent lamp and to learn about the improvement of power factor using capacitor.
4. Calculation of current, voltage and power in series R-L-C circuit excited by single-phase AC supply and calculation of power factor.
5. Connection and testing of a single-phase energy meter.

6. VI Characteristic of an incandescent lamp.
7. Study of various parts of DC & AC machines.

Electronics Part: (Any 4 Experiments):

1. Familiarization of electronic components and devices (testing of semiconductor diodes and transistors using digital multimeter)
2. Study and use of oscilloscope, signal generator to view waveforms and measure amplitude and frequency of a given waveform.
3. V-I characteristics of semiconductor diode and determining its DC and AC resistance.
4. Studies on half-wave and full-wave rectifier circuits without and with capacitor filter; recording of the waveforms and measurement of average and rms values of the rectifier output.
5. V-I characteristic of an n-p-n or p-n-p transistor, DC biasing the transistor in common-emitter configuration and determination of its operating point (i.e., various voltages and currents).
6. Study and Truth table verification of different logic gates.
Studies on Clipper and Clamper along with their corresponding waveforms



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**III Semester Syllabus [Second Year]
UG ENGINEERING IN BIOTECHNOLOGY**

Title of the subject																
Subject Code		Third Semester										L	T	P	C	QP
23BBTPC23001		Biochemistry										3	0	0	3	A
Course Educational Objective																
CEO1: To provide the knowledge on macromolecules present in the cell.																
CEO2: To have an idea about various metabolisms and their functions.																
Course outcomes: At the end of the course, the student will be able to:																
CO1	Obtain knowledge about the structure and functions of biomolecules such as Carbohydrates, Proteins, Amino acids and Lipids.															
CO2	Learn the basic structure of nucleic acids and principle of bioenergetics.															
CO3	Understand the hormones, vitamins, minerals and their functions.															
CO4	Understand the fundamentals of biochemical principles such as cellular metabolism and metabolic pathways.															
CO5	Know the regulations of biological/biochemical Processes of cell.															
CO6	Acquire the knowledge on concept of enzymes and its regulation.															
CO-PO & PSO Mapping																
COs	PROGRAMME OUTCOMES												PSOs			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
CO1	3	2	1	-	-	-	-	-	-	-	-	-	2	1	-	
CO2	1	2	1	1	-	-	-	-	-	-	-	-	1	1	-	
CO3	2	1	2	1	-	-	-	-	-	-	-	1	-	-	-	
CO4	2	1	1	1	-	-	-	-	-	-	-	-	1	-	-	
CO5	3	2	1	-	-	-	-	-	-	-	-	1	1	1	-	
CO6	2	1	2	1	-	-	-	-	-	-	-	1	1	2	1	
Avg.	2.16	1.5	1.33	0.66	-	-	-	-	-	-	-	-	0.5	1.0	0.83	0.16
UNIT:1 [10 Hours]																
Structure and Function of Carbohydrates: Monosaccharide, Oligosaccharides, Polysaccharides, Structure and Function of Lipids: Concept of fatty acids Fatty Acids, Lipids Classification, storage lipids, structural lipids (glycerol phospholipid and sphingolipids). Structure and Function of Proteins: Amino acids, Peptide bond, Hierarchy of protein architecture, Ramachandran Plot.																



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UNIT:2	[10 Hours]
Structure and Function of Nucleic Acids: Nucleosides, nucleotides, difference in RNA and DNA structure, Double Helix Model of DNA, Structure and function of Hormones, Minerals and Vitamins. Principle of Bioenergetics: Bioenergetics and Thermodynamics, Phosphoryl group transfer and energy currency-ATP; Biological Oxidation and reduction reactions.	
UNIT:3	[10Hours]
Metabolism-I: Introduction to metabolic processes; Metabolism of Carbohydrates: Glycolysis, TCA Cycle, ETS and Oxidative Phosphorylation, Gluconeogenesis, Glycogen metabolism, pentose-phosphate pathway. Metabolism of Lipids: Anabolism (Saturated), Catabolism (β -Oxidation).	
UNIT:4	[10 Hours]
Metabolism-II: Metabolism of proteins: Biosynthesis of amino acids (role of precursors); Metabolism of Nucleic Acids: Catabolism and anabolism of purine and pyrimidine nucleotides. Photosynthesis: Light reaction and dark reaction.	
UNIT:5	[10 Hours]
Enzymes: Properties of Enzyme, Classification of Enzymes, Mechanism of enzyme action, Kinetics of enzyme action (Michaelis- Menten kinetics and its significance), Activation energy, Enzyme Inhibition, Coenzymes.	
Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCs	
Ref. Books: 1. Principle of Bio-Chemistry – Lehinger, Nelson and Cox	
2. Biochemistry of Biochemistry by L. Stryer	
3. Fundamentals of Biochemistry by A.C Deb	
4. Fundamentals of Biochemistry – Voet&Voet	
5. Fundamental of Biochemistry, Jain and Jain	



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Subject Code	Course Title	L	T	P	C	
BBTPC3130	Biochemistry Lab	0	0	2	1	

Course Educational Objective

In this laboratory, students will have the opportunity to do the analysis of different biomolecules through lectrophoreticity and chromatographic techniques

Analysis of different Enzymatic activity and assay

Course outcomes: At the end of the course, the student will be able to:

CO1	Student can lectro the protein and carbohydrate by spectrophotometry
CO2	Student can be determined the quality and quantity of nucleic acid.
CO3	The undergraduate will separate the biomolecules by chromatography techniques
CO4	Students can extract and study the activity and assay of enzymes
CO5	Know the regulations of biological/biochemical Processes of cell.
CO6	Acquire the knowledge on concept of enzymes and its regulation

LIST OF EXPERIMENTS

1. Estimation of Protein using Biuret/Lowry's Method
2. Estimation of carbohydrates
3. Estimation of DNA using DPA method
4. Estimation of RNA using Orcinol Method
5. Estimation of Saponification value of fatty acids/Oil
6. Separation of Amino acids by Paper Chromatography
7. Separation of Sugars by Thin Layer Chromatography
8. Separation of Proteins by ectrophoretic method.
9. Extraction of enzymes from bacterial culture.
10. Assay of Enzyme activity: Amylase/Protease

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES											PSOs			
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	
CO1	3	2	1												
CO2	2	2	3								1				
CO3	2	3	2										1		
CO4	2	3	3								1				
CO5	2	3	3												
CO6	2	3	2									1			
Avg.	2.16	2.33	2.33								1.0	1.0	1.0		



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Title of the subject																
Subject Code	Third Semester											L	T	P	C	QP
23BBTPC23002	Microbiology											3	0	0	3	A
Course Educational Objective																
CEO1: To make the student learn about origin and evolution of microbes																
CEO2: To make the student understand regarding structure and function of different microbial groups																
Course outcomes: At the end of the course, the student will be able to:																
CO1	Gain the knowledge about classifications, culture and identification of important microorganisms.															
CO2	Understand the microbial growth, reproduction and process of nitrogen fixation.															
CO3	Obtain the knowledge about food microbiology, human pathogens and their life cycle.															
CO4	Learn about the importance and types of antibiotics.															
CO5	Acquire the knowledge on medical microbiology.															
CO6	Understand the microbiology of environment.															
CO-PO & PSO Mapping																
PROGRAMME OUTCOMES																
COs	PROGRAMME OUTCOMES												PSOs			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
CO1	3	-	2	1	-	-	-	-	-	-	-	2	1	1	-	
CO2	2	-	2	2	-	-	-	-	-	-	-	1	1	1	-	
CO3	1	2	-	1	1	-	-	-	-	-	-	-	1	1	-	
CO4	2	-	-	-	2	-	-	-	-	-	-	-	1	2	-	
CO5	3	2	1	2	2	-	-	-	-	-	-	-	1	3	1	
CO6	3	1	1	1	1	-	-	-	-	-	-	1	1	3	-	
Avg.	2.3	0.8	1	1.16	1	-	-	-	-	-	-	0.6	1	1.83	0.16	
UNIT:1 [10 Hours]																
Major contribution and events in microbiology, Microbial cell structures and importance (Bacteria, Fungi & Virus), Microbial classification and taxonomy: Domains of life, classification techniques for determining microbial taxonomy and phylogeny, Microbes in human welfare.																
UNIT:2 [10 Hours]																
Microscopy- Principles and applications, Culture media, Sterilization, Establishment of pure culture, Staining of bacteria, Host-Parasite relationship. Pattern of bacterial growth curve, influence of environmental factors on growth, Growth kinetics, Cyanobacteria and nitrogen fixation.																



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UNIT:3

[10 Hours]

Genetic recombination in bacteria (Transformation, Conjugation and Transduction), Transposons, Mutation in Microorganisms, Ames test for Mutagenesis, Use of recombinant DNA technology in Microbiology.

Microbiology of foods and food poisoning, Types of microbes associated with food spoilage, Food preservation methods.

UNIT-4

[10 Hours]

Basic concepts of diseases causing by microbes, Life cycle of some important pathogens like- Malaria, hepatitis, filaria, Antibiotics-classification & mode of action, Therapeutic index.

UNIT:5

[10 Hours]

Microbiology of fresh water and wastewater (sewage), Bacteriological analysis of water, Microbiology of Air, Microbiology of soil, Microbiology of extreme environments (Halobacteria, Methanogens, Thermofiles).

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCs

- Ref. Books: 1. A text book by Micro biology by R.C.Dubey and D.K. Maheshwari, .S.Chand
2. A text book by Micro biology by Naveen Kango, I.K.International Publishing House Pvt. ltd.
3. Prescott's Micro biology by Michael J.Pelczar, JR, E.C.S.Chan, Noel R.Krieg. Indian edition
4. Prescott's Micro biology by JoanneM.Willey, Linda M.Sherwood and Christopher J. Woolverton



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Title of the subject																
Subject Code		Third semester										L	T	P	C	QP
23BBTPC23003		Fundamentals of Biology & Biotechnology										3	0	0	3	A
Course Educational Objective																
CEO1: To introduce the basic knowledge of biology and its application																
CEO2: To understand the functions of cell , cell division and principle of inheritance in living system																
Course outcomes: At the end of the course, the student will be able to:																
CO1	Understand the chemistry of living cell and characteristic properties of both prokaryotic and eukaryotic cell.															
CO2	Know the organization of DNA in nucleus and importance of cell division.															
CO3	Understand different forms of DNA and DNA as genetic material.															
CO4	Learn about the scope and applications of biotechnology															
CO5	Learn about gene cloning and use of tools in genetic engineering.															
CO6	Understand the manipulation of genes and genet ransfer techniques															
CO-PO & PSO Mapping																
COs	PROGRAMME OUTCOMES												PSOs			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
CO1	1	1	-	2	-	-	-	-	-	-	-	-	2	1	1	
CO2	-	2	-	2	-	1	-	-	-	-	-	-	1	2	1	
CO3	-	1	-	2	2	-	-	-	-	-	-	-	1	1	1	
CO4	-	-	-	2	-	3	-	-	-	-	-	1	2	1	2	
CO5	-	-	1	3	2	2	-	-	-	-	-	-	1	-	1	
CO6	-	-	1	2	3	-	-	2	-	-	-	-	1	1	-	
Avg.	0.16	0.66	0.33	2.16	1.16	1.0	-	0.33	-	-	-	-	0.16	1.33	1.2	1.2
UNIT:1 [10 Hours]																
<p>The cell: Cell as a unit of structure and function; ultra structure and characteristics of prokaryotic and eukaryotic cells; Cell wall and plasma membrane: Chemistry, structure and function of cell wall. Overview of membrane structure and functions; Structural organization of cell organelles: Chloroplast, Mitochondria, Peroxisomes, Endoplasmic reticulum, Golgi apparatus, Lysosomes and Vacuoles.</p>																



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UNIT:2	[10 Hours]
Nucleus: structure, molecular organization of chromatin (nucleosome), Cytoskeleton ; Cell division: Cell Cycle, Mitosis and Meiosis; Mechanism of membrane transport and trafficking-protein sorting and targeting; intercellular communication and associated signaling pathways; Cancer cell biology (Causes, Cell characteristics).	
UNIT:3	[10 Hours]
DNA as the genetic material-Griffiths experiments, Avery, McLeod and McCarty's experiments. Hershey-Chase experiments. Structure of DNA- A, B and Z forms of DNA. Isolation, Purification and yield analysis of DNA.	
UNIT:4	[10 Hours]
Scope of Biotechnology: Milestones in Biotechnology, Molecular tools: Enzymes (Nucleases, Restriction endonucleases, Alkaline phosphatase, Polynucleotide kinase, DNA ligase, DNA polymerases, Reverse transcriptase, terminal deoxynucleotidyl transferase, Poly A polymerase).	
UNIT:5	[10 Hours]
Introduction to gene cloning: Cloning vectors, Plasmid vectors, Bacteriophage vector, Cosmid vector, Phagemid vector, artificial chromosomes and expression vectors; Cloning in prokaryotic cells. Teaching Methods: Chalk & Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCs	
Ref. Books : 1. Cell Biology, Genetics, Molecular Biology, Evolution & Ecology by P S Verma and VK Agrawal, S. Chand 2. Cell biology and Genetics by P K Gupta Rastogi Publication 3. Biotechnology by U Satyanarayana, Publisher : Books & Allied Ltd, India 4. A Textbook of Biotechnology, by R C Dubey, Publisher : S Chand 5. Molecular Biology of the Cell 4th Edition Bruce Alberts	



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Subject Code	Object Oriented Programming Through Java	L	T	P	C
23BCSES23001		3	0	0	3
Course Educational Objectives					
CEO 01	The model of object oriented programming: abstract data types, encapsulation, inheritance and polymorphism				
CEO 02	Fundamental features of an object oriented language like Java: object classes and interfaces, exceptions and libraries of object collections				
CEO 03	How to take the statement of a business problem and from this determine suitable logic for solving the problem; then be able to proceed to code that logic as a program written in Java.				
Course Outcomes: : Upon successful completion of this course, students should be able to:					
CO 01	Knowledge of the structure and model of the Java programming language.				
CO 02	Use the Java programming language for various programming technologies.				
CO 03	Develop software in the Java programming language.				
CO 04	Evaluate user requirements for software functionality required to decide whether the Java programming language can meet user requirements.				
CO 05	Propose the use of certain technologies by implementing them in the Java programming language to solve the given problem.				
CO 06	Choose an engineering approach to solving problems, starting from the acquired knowledge of programming.				



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CO-PO & PSO Mapping (Articulation Matrix):															
COs	PROGRAMME OUTCOMES												PSOs		
	01	02	03	04	05	06	07	08	09	10	11	12	01	02	03
01	3	1											1	2	1
02	3	2											1	1	
03	2	2	2										2	1	1
04	2	1	2										1	1	2
05	2	1	3										1	2	
06	1	3	3										1	1	3
Avg.	2.1	1.6	2.5										1.16	1.33	1.75
Syllabus															
UNIT I													13 Hours		
<p>An introduction to Object Oriented Programming, Features of Object Oriented Programming Introduction to Java. Difference between C/C++ and Java, Features of Java, First Java Program, Writing the java program, Compiling the program, JVM and its significance in executing a program, Architecture of JVM. Taking Input from keyboard, Command Line Arguments, Using Scanner Class, Using Buffered Reader class.</p> <p>Java Tokens, Datatypes, Operators, Control Structures, Conditional Statements, Iteration Statement/Loops, Jumping Statements, Java Arrays, 1-dimensional arrays, 2-dimensional arrays.</p>															
UNIT II													15 Hours		
<p>Introduction to Classes and Objects. Constructors, static Keyword, this Keyword, Array of Objects, Access Modifiers (Public, Private, Protected, Default). Inheritance, Types of Inheritance and Java-supported Inheritance, super, Polymorphism, Method Overloading, Constructor Overloading, Method Overriding, Dynamic Method Dispatching. Interfaces, Multiple Inheritance Using Interfaces, abstract classes.</p>															
UNIT III													12 Hours		
<p>String Handling in Java: String, StringBuffer, StringBuilder, StringTokenizer Wrapper classes, Auto boxing and unboxing. Java API Packages, User-Defined Packages, Accessing Packages. Error and Exception Handling, Types of exceptions Hierarchy of Exception classes, try, catch, finally, throw, throws, Commonly used Exceptions and their details, User defined exception classes.</p>															



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UNIT IV		12 Hours
<p>Multithreading, Thread in Java, Thread execution prevention methods. (yield(), join(), sleep()), Concept of Synchronization, Inter Thread Communication, Basics of Deadlock, Demon Thread.</p> <p>IO Streams (java.io package), Byte Stream and Character Stream, Files and Random Access Files, Serialization.</p> <p>Applet Introduction, Life Cycle of an Applet, GUI with an Applet.</p>		
UNIT V		12 Hours
<p>AWT : The AWT class hierarchy, user interface components- Labels, Button, Text Components, Check Box, Check Box Group, Choice, List Box, Panels - Scroll Pane, Menu, Scroll Bar.</p> <p>Working with Frame class, Colour, Fonts and layout managers.</p> <p>Event Handling: Events, Event sources, Event Listeners, Event Delegation Model (EDM), Handling Mouse and Keyboard Events, Adapter classes</p> <p>SWINGS: Introduction to Swings, Hierarchy of swing components. Containers, Top level containers -JFrame, JWindow, JDialog, JPanel, JButton, JToggleButton, JCheckBox, JRadioButton, JLabel, JtextField, JTextArea, JList, JComboBox, JScrollPane.</p>		
Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCs		
<p>Text Books:</p> <ol style="list-style-type: none">1. E Balaguruswamy, 6th Edition, Programming with Java, McGraw Hill Education2. R Nageswara Rao(2016), Core Java: An Integrated Approach, Dreamtech Press.3. Herbalt Schelidt(2017), Java: The Complete Reference, McGraw Hill Education.		
<p>Reference Book:</p> <ol style="list-style-type: none">1. SachinMalhotra/ SauravChoudhary, Second Edition, Programming in Java, Oxford Higher Education,2. RashmiKanta Das, Core Java For Beginners, Vikas Publication.		



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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C										
23BMEES23001	FLUID MECHANICS & HYDRAULICS MACHINES	3	1	0	4										
Pre -Requisite: Physics, Thermodynamics, Mechanics, Mathematics															
Course Educational Objectives															
CEO1	To know the concept of fluid and its properties, manometer, hydrostatic forces acting on different surfaces and also problem solving techniques.														
CEO2	To relate the basic laws of fluids, flow patterns, viscous flow through pipes and their corresponding problems.														
CEO3	To analyze the hydrodynamic forces acting on vanes and their performance evaluation														
CEO4	To evaluate of the importance, function and performance characteristics of hydro machinery														
Course outcomes: At the end of the course, the student will be able to:															
CO1	Explain various fluid properties and behavior of fluid in static and dynamic mode..														
CO2	Apply basic fundamental theorems governing fluid flows i.e., continuity, energy and momentum and flow through pipes.														
CO3	Exposed to the basic laws of fluids, flow patterns, viscous flow through ducts and their corresponding problems.														
CO4	Analyze fully developed laminar and turbulent pipe flows and also apply mathematical definitions and equations in fluid flow.														
CO5	Analyze theory of impact of jet and apply the same for hydraulic turbine.														
CO6	Evaluate performance of centrifugal pumps and other hydraulic machines.														
CO-PO & PSO Mapping															
COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1										2	1	-
CO2	2	2	3										1	1	1
CO3	2	3	2										-	1	-
CO4	2	3	3										1	-	1
CO5	2	3	3										2	1	-
CO6	2	3	2										1	2	1
Avg.	2.16	2.33	2.33										1.4	1.2	1.0
SYLLABUS															
UNIT:1															
(10 Hours)															
Scope of fluid mechanics and its development as a science, Physical property of Fluid: Density, specific gravity, specific weight, specific volume, surface tension and capillarity, viscosity, compressibility and bulk modulus, Fluid classification.															
Fluid statics: Pressure, Pascal's Law, Pressure variation for incompressible fluid, atmospheric pressure, absolute pressure, gauge pressure and vacuum pressure, manometer, and its classification.															



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Hydrostatic process on submerged surface, force on a horizontal submerged plane surface, force on a vertical submerged plane surface. Buoyancy and floatation, Archimedes' principle, stability of immersed and floating bodies, determination of metacentric height.	
UNIT:2 Hours) Fluid kinematics: Introduction, description of fluid flow, classification of fluid flow. Reynolds number, Acceleration of fluid particles, flow rate and continuity equation, differential equation of continuity, Mathematical definitions of irrotational and rotational motion. Circulation, potential function and stream function. Flow net	(10)
UNIT:3 Hours) Fluid dynamics: Introduction, Euler's equation along a streamline, energy equation, Bernoulli's equation and its application to siphon, venturimeter, orifice meter, pitot tube. Flow through pipes: Major and minor energy losses, hydraulic gradient and total energy lines, pipes in series and parallel, equivalent pipes, water hammer in pipes	(10)
UNIT: 4 Hours) Impact of Jet: Introduction, Force exerted by the jet on a stationary and movable plate (vertical, inclined, curved) Hydraulic turbines: Classification, Impulse and Reaction turbine; Tangential, Radial and axial turbine. Impulse turbine, Pelton wheel, bucket dimensions, number of buckets in pelton wheel, efficiency and performance curves. Reaction Turbines: Francis turbine and Kaplan turbine, velocity triangle and efficiencies, performance curve. Function of draft tube and casing cavitation.	(10)
UNIT:5 Hours) Centrifugal Pump: Constructional features, vane shape, velocity triangles, Efficiencies, Pump Characteristic, NPSH and Cavitation. Positive displacement pumps: Reciprocating Pump, Working principle, Discharge, work done and power requirement, Slip, Indicator diagram. Hydraulic Machines: Hydraulic press, hydraulic accumulator, hydraulic intensifier, hydraulic crane, hydraulic jack, hydraulic lift, hydraulic ram, fluid couplings, fluid torque converter and air lift pump	(10)
Teaching Methods: Chalk& Talk/ PPT/Video Lectures/Demonstration	



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REFERENCE BOOK:

1. M. White Frank, Fluid Mechanics
2. Cimbala John, CengelYunus, Fluid Mechanics
3. Chakraborty S, Introduction To Fluid Mechanics And Fluid Machines
4. Modi & Seth, Fluid Mechanics and Hydraulic Machines
5. M. White Frank, Fluid Mechanics



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Title of the subject												
Subject Code	Third Semester	L	T	P	C	QP						
23BBSHS23001	INTERMEDIATE COMMUNICATION SKILLS AND CRITICAL THINKING	1	0	0	1	-						
Course Educational Objective												
CEO1: To develop the communication skills and soft skills of the students.												
CEO2: To enhance employability and entrepreneurial skills.												
CEO3: To promote critical thinking.												
Course outcomes: Towards the end of the course, the students will be able to:												
CO1	Recognise the importance of LSRW skills.											
CO2	Develop effective listening skills.											
CO3	Demonstrate public speaking skills.											
CO4	Distinguish professional writing from general writing.											
CO5	Develop effective reading skills.											
CO6	Execute critical thinking.											
CO-PO & PO Mapping												
COs	PROGRAMME OUTCOMES											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1										3		
CO2											3	
CO3											3	
CO4											3	
CO5											3	
CO6												
									3			2
SYLLABUS												

UNIT:1 Comprehensive Listening Skills

(4 hours)

1.1 What and why

1.2 Techniques for improving listening skills

UNIT:2 Public Speaking Skills

(4 hours)

2.1 Public speaking; what and why

2.2 Overcoming stage fear



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2.3 Techniques for effective speaking skill (4 hours)

UNIT:3 Stages of Writing

3.1 Pre-Writing-selecting a topic

3.2 Writing- Free Writing, Drafting

3.3 Re-writing- Revision, editing, proof Reading.

UNIT:4 Effective Reading Skills (3 hours)

4.1 What is Reading Comprehension;

4.2 Tips for effective reading;

4.3 Techniques and types.

UNIT:5 Critical Thinking Skills (4 hours)

5.1 What and Why

5.2 Critical thinking vs. Lateral thinking

5.3 Ways to improve Critical Thinking

Teaching Methods: Chalk & Board/ PPT/Video Lectures

Reference Books

1 Basic Communication Skills for Technology by Andrea j.Rutherford, Pearson Educaton Asia, Patpargani, New Delhi,2001

2 How to Read better and faster by Norman Lewi. 4th edition publisher; crowell 1978.

3. The kabuliwala and other stories by Rabindranath Tagore, Maple Classics 2019.

4 The Gift of Magi by O Henry, Candlewick Press 2008.



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Title of the subject						
Subject Code	Third Semester	L	T	P	C	QP
23BBSHS23101	INTERMEDIATE COMMUNICATION SKILLS AND CRITICAL THINKING LAB	0	0	2	1	-
Course Educational Objective						
CEO1: To develop the communication skills and soft skills of the students.						
CEO2: To enhance employability and entrepreneurial skills.						
CEO3: To promote critical thinking.						
Course outcomes: Towards the end of the course, the students will be able to:						
CO1	Recognise the importance of LSRW skills.					
CO2	Develop effective listening skills.					
CO3	Demonstrate public speaking skills.					
CO4	Distinguish professional writing from general writing.					
CO5	Develop effective reading skills.					
CO6	Execute critical thinking.					

CO-PO & PO Mapping													
COs	PROGRAMME OUTCOMES												
	1	2	3	4	5	6	7	8	9	10	11	12	
CO1										3			
CO2											3		
CO3											3		
CO4											3		
CO5											3		
CO6													
									3				2
SYLLABUS													

<p>Comprehensive Listening Activity- Summarizing a Passage Comprehensive Listening (2 hours) Activity- Listening to a short video/ Ted Talk and giving a brief.</p>	(2 hours)
<p>Oral Presentation Activity- Presenting seminar paper in a team and presenting to the class</p>	(2 hours)



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Individual Oral Presentation	(2 hours)
Activity- Preparing a seminar paper individually and presenting.	
Persuasive Speaking	(2 hours)
Activity- Individual/ Group Debate.	
Situational Interviews	(2 hours)
Activity- Answering hypothetical question in a mock interview	
Video Resume	(2 hours)
Activity- Preparing a digital resume	
Professional e-mail	(2 hours)
Activity-Writing e-mail for professional purpose	
Minutes of the Meeting	(2 hours)
Activity- Preparing minutes of mock meetings.	
Memo Writing	(2 hours)
Writing Memos for internal organization	
Vocabulary Exercise	(2 hours)
Activity- Playing word games in small groups.	
Intermediate Reading Comprehension	(2 hours)
Activity-Reading an Intermediate level passage/ poems and answer questions.	
Preparing a Sales Pitch	(2 hours)
Activity- Prepare a presentation on any product (real/imaginary) of choice and present a sales pitch	
Critical Thinking Activity	(2 hours)
Activit- critically analysis of Kabuliwala by Rabindranath Tagore OR The Gift of Magi by O Henry	
Critical Thinking	(2 hours)
Activity 2- Critically Analyse Stopping by the Woods in a Snowy Evening by Robert Frost OR Ozymondias by P.B Shelly.	
Reference Books	
1. An Introduction to Professional English and Soft Skills by B. K. Das et al., Cambridge University Press, 2009.	
2. Communicative English for Engineers and Professionals by Nitin Bhatnagar and Mamta Bhatnagar Published by DK/Pearson, 2010	
3. Practical English Usage. Michael Swan, OUP, 1995	



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Course Code	Course Title	L	T	P	Credits	QP
23BCSES23101	Object Oriented Programming Through Java Lab	0	0	2	1	
Pre -Requisite: Basic knowledge of C language						
Course Outcome: student can able to						
CO1	Learn to use object orientation to solve problems and use java language to implement them					
CO2	To experiment with the syntax and semantics of java language and gain experience with java programming Course Outcomes:					
CO3	Ability to create user friendly interfaces					
CO4	Ability to write portable programs which work in all environments					
CO5	Ability to solve the problem using object oriented approach and design solutions which are robust					
CO6	Ability to design GUI using AWT/Swing					
Experiment-1(I/O in Java)						
Q 1. Write a Program that accepts two Strings as command line arguments and generate the output in the required format						
Q 2. Write a Java program to find if the given number is prime or not.						
Q 3. Write a program to print the sum of all the digits of a given number. Q 4. Write a Java program to find if the given number is palindrome or not						
Experiment 2: (Array)						
Q 1. Write a program to initialize an integer array and find the maximum and minimum value of the array.						
Q 2. Write a program to initialize an integer array with values and check if a given number is present in the array or not.						
Q 3. Write a program to find the largest 2 numbers and the smallest 2 numbers in the given array. Q 4. Write a program to remove the duplicate elements in an array and print the same.						



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Experiment 3:(Class, Object, Static method, Constructor)

Q 1 Create a class Box that uses a parameterized constructor to initialize the dimensions of a box. The dimensions of the Box are width, height, depth. The class should have a method that can return the volume of the box. Create an object of the Box class and test the functionalities.

Q 2. Create a new class called Calculator with the following methods:

1. A static method called powerInt(int num1,int num2) This method should return num1 to the power num2.
2. A static method called powerDouble(double num1,int num2). This method should return num1 to the power num2.
3. Invoke both the methods and test the functionalities. Hint: Use Math.pow(double,double) to calculate the power.

Q 3 Design a class that can be used by a health care professional to keep track of a patient's vital statistics. The following are the details.

Name of the class - Patient

Member Variables -

patientName(String),height(double),width(double)

Member Function - double computeBMI()

The above method should compute the BMI and return the result. The formula for computation of BMI is weight (in kg) ÷ height*height(in metres).

Create an object of the Patient class and check the results. Q 4 Create a class Author with the following information.

Member variables : name (String), email (String), and gender (char)

Parameterized Constructor: To initialize the variables

Create a class Book with the following information.

Member variables : name (String), author (of the class Author you have just created), price (double), and qtyInStock (int)

[Assumption: Each book will be written by exactly one

Author] Parameterized Constructor: To initialize the variables

Getters and Setters for all the member variables

In the main method, create a book object and print all details of the book (including the author details)



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Experiment 4: (Inheritance and polymorphism)

Q 1. Create a class named 'Animal' which includes methods like eat() and sleep(). Create a child class of Animal named 'Bird' and override the parent class methods. Add a new method named fly(). Create an instance of Animal class and invoke the eat and sleep methods using this object. Create an instance of Bird class and invoke the eat, sleep and fly methods using this object.

Q 2. Create a class called Person with a member variable name. Save it in a file called Person.java. Create a class called Employee that will inherit the Person class. The other data members of the Employee class are annual salary (double), the year the employee started to work, and the national insurance number which is a String. Save this in a file called Employee.java

Your class should have the necessary constructors and getter/setter methods. Write another class called TestEmployee, containing a main method to fully test your class definition.

Q 3. Create a school application with a class called Person. Create name and dateOfBirth as member variables. Create a class called Teacher that inherits from the Person class. The teacher will have additional properties like salary, and the subject that the teacher teaches.

Create a class called Student that inherits from Person class. This class will have a member variable called studentId.

Create a class called College Student that inherits from Student class. This class will have collegeName, the year in which the student is studying (first/second/third/fourth) etc.

Create objects of each of these classes, invoke and test the methods that are available in these classes. Q 4. Create a base class Fruit with name, taste and size as its attributes.

Create a method called eat() which describes the name of the fruit and its taste.

Inherit the same in 2 other classes Apple and Orange and override the eat() method to represent each fruit taste. Q 5. Write a program to create a class named shape. It should contain 2 methods, draw() and erase() that prints "Drawing Shape" and "Erasing Shape" respectively.

For this class, create three sub classes, Circle, Triangle and Square and each class should override the parent class functions - draw () and erase () .

The draw() method should print "Drawing Circle", "Drawing Triangle" and "Drawing Square" respectively. The erase() method should print "Erasing Circle", "Erasing Triangle" and "Erasing Square" respectively.

Create objects of Circle, Triangle and Square in the following way and observe the polymorphic nature of the class by calling draw() and erase() method using each object.

```
Shape c=new Circle();
```

```
Shape t=new Triangle();
```

```
Shape s=new Square();
```

Experiment 5: (String and StringBuffer)

Q 1. Write a Program to check whether a given String is Palindrome or not.

Q 2. Write a java program that will concatenate 2 strings and return the result. The result should be in lowercase. Q 3 Given a string, return a new string made of 'n' copies of the first 2 chars of the original string where 'n' is the length of the string.

Q 4. Write a java program that will return the first half of the string, if the length of the string is even. It should return null for odd length string.

Q 5. Write a java program that accepts a string and returns a new string without the first and last character of the input string.



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Experiment 6: (Abstract class and Interface)

Q 1. Create a class called GeneralBank that acts as base class for all banks. This class has getSavingsInterestRate and getFixedDepositInterestRate methods, which returns the savings account interest rate and fixed deposit account interest rate that the specific bank gives. Since GeneralBank cannot say what percentage which bank would give, make these methods abstract.

Create two subclasses of GeneralBank called ICICIBank and KotMBank. Override the inherited methods from the base class. The following are the interest rates of these banks.

ICICIBank - Savings 4% Fixed 8.5% and

KotMBank - Savings 6% Fixed 9%.

Create a main method to test the above classes and their methods. Try one by one and observe your findings

- ICICIBank i=new ICICIBank();
- KotMBank k=new KotMBank();
- GeneralBank g=new KotMBank();
- GeneralBank g=new ICICIBank();

Q 2. Create an abstract class Compartment to represent a rail coach. Provide an abstract function notice in this class.

```
public abstract String notice();
```

Derive FirstClass, Ladies, General, Luggage classes from the compartment class. Override the notice function in each of them to print notice message that is suitable to the specific type of compartment.

Create a class TestCompartment. Write main function to do the following:

Declare an array of Compartment of size 10.

Create a compartment of a type as decided by a randomly generated integer in the range 1 to 4.

Check the polymorphic behavior of the notice method. [i.e based on the random number generated, the first compartment can be Luggage, the second one could be Ladies and so on..

Experiment 7 : (Exception Handling)

Q 1. Get an input String from user and parse it to integer, if it is not a number it will throw number format exception Catch it and print "Entered input is not a valid format for an integer." or else print the square of that number. (Refer Sample Input and Output).

Q 2. Write a program that takes as input the size of the array and the elements in the array. The program then asks the user to enter a particular index and prints the element at that index.

This program may generate Array Index Out Of Bounds Exception. Use exception handling mechanisms to handle this exception. In the catch block, print the class name of the exception thrown.

Q 3. Write a program that takes as input the size of the array and the elements in the array. The program then asks the user to enter a particular index and prints the element at that index. Index starts from zero.

This program may generate Array Index Out Of Bounds Exception or NumberFormatException . Use exception handling mechanisms to handle this exception.

Q 4. Write a program to accept name and age of a person from the command prompt(passed as arguments when you execute the class) and ensure that the age entered is ≥ 18 and < 60 . Display proper error messages.



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Experiment-8 : (Wrapper class and file handling)

- Q 1. Write a program to receive an integer number as a command line argument, and print the binary, octal and hexadecimal equivalent of the given number.
- Q 2. Write a Java program that reads an integer number (between 1 and 255) from the user and prints the binary representation of the number. The answer should be printed as a String.
- Q 3. Create an employee class with properties of your choice. Create an object of this class and also create a clone of the same. After making the clone, change the properties of the original employee object and print the properties of both the original and clone object and note down your observation.
- Q 4. Write a program to count the number of times a character appears in a File.
- Q 5. Write a program to copy contents from one file to another and check the output.

Experiment 9: (AWT and Swing)

- Q 1. Write a java program to create a frame containing three buttons (Yes, No, Close). When button yes or no is pressed, the message "Button Yes/No is pressed" gets displayed in label control. On pressing CLOSE button frame window gets closed.
- Q 2. Write a Java program to create three radio buttons. When any of them is selected, an appropriate message is displayed.
- Q 3. Write a Java program to create a combo box which includes list of subjects. Display the selected subject in the text field using Swing.

- Q 4. Write a java program using swing to create a frame having three text fields. Accept number in first textfield and display previous number in second textfield and next number in the third textfield.
- Q 5. Write a program to display "All The Best" in 5 different colors on screen. (Using AWT/Swing)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1	3	2											
CO2	2	2	2										
CO3	2	3	3	1									
CO4	2	2	3	2	1				1				
CO5	2	3	2						1	1			
CO6	1	2											
	2.00	2.33	1.67	0.50	0.17				0.33	0.17			1.02



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Subject Code	Course Title	L	T	P	C
BBTPC3140	Microbiology Lab	0	0	2	1
Course Educational Objective					
In this laboratory, students will have the opportunity to learn the sterilization and staining techniques					
know about the preparation of culture media, bacteria culture methods.					

Course outcomes: At the end of the course, the student will be able to:	
CO1	understand the micrometry and different staining techniques
CO2	do the preparation of media and its various method of sterilization
CO3	Isolate the microbes from natural sources and study the growth and culture technique.
CO4	Learn the antibiotic assay of microbes and different kinds of microscopy
CO5	Acquire the knowledge on medical microbiology.
CO6	Understand the microbiology of environment.

LIST OF EXPERIMENTS

1. Micrometry: calibration of stage and ocular micrometer and measurement of dimension of microbial cells.
2. Staining of microbial sample (Gram's Staining, Endospore staining, Fungal staining)
3. Media preparation and sterilization (Slant, Stab and Broth culture)
4. Isolation of micro organisms from natural habitats (Air, Water, Soil & Milk)
5. Establishment of pure culture by streak plate and serial dilution method.
6. Study the bacterial growth curve using spectrophotometer and viability assessment.
7. Antibiotic assay and estimation of Zone of inhibition.
8. Chemical assay and MIC determination of antibiotics.
9. Biochemical assay of microorganisms (Starch Hydrolysis, Casein Hydrolysis and IMVIC test).
10. Microscopy: Study of Compound, Phase contrast and Fluorescence Microscopes..



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CO-PO & PSO Mapping															
COs	PROGRAMME OUTCOMES												PSOs		
	3	2	2	-	-	-	-	-	-	-	-	-	1	2	3
CO1	2	2	3	-	-	-	-	-	-	-	-	-			
CO2	2	3	1	-	-	-	-	-	-	-	-	-			
CO3	2	2	3	-	-	-	-	-	-	-	-	1			
CO4	3	2	2	-	-	-	-	-	-	-	-	-			
CO5															
CO6															
Avg.															



IV Semester Syllabus [Second Year] UG ENGINEERING IN BIOTECHNOLOGY

Subject Code		Title of the subject														
23BBTPC24001		Molecular Biology														
Fourth Semester		L	T	P	C	QP										
		3	0	0	3	A										
Course Educational Objective																
CEO1: To provide the general concept of genes and their variations.																
CEO2: To provide detailed knowledge about gene expression.																
Course outcomes: At the end of the course, the student will be able to:																
CO1	Understand the organization and complexity of genome.															
CO2	Explore the mechanism of DNA replication, DNA repair and DNA recombination.															
CO3	Know the molecular mechanism of transcription and processing of m-RNA.															
CO4	Understand the protein synthesis and gene regulations.															
CO5	Acquire the knowledge on silencing of genes															
CO6	Articulate applications of molecular biology in the modern world.															
CO-PO & PSO Mapping																
COs	PROGRAMME OUTCOMES												PSOs			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
CO1	3	2	1	-	-	-	-	-	-	-	-	1	2	1	-	
CO2	2	2	1	1	-	-	-	-	-	-	-	1	1	1	-	
CO3	2	2	2	1	-	-	-	-	-	-	-	1	-	-	-	
CO4	2	1	1	1	-	-	-	-	-	-	-	1	1	-	-	
CO5	2	2	1	-	-	-	-	-	-	-	-	1	1	1	-	
CO6	3	1	3	1	-	-	-	-	-	-	-	1	1	2	1	
Avg.	2.33	1.66	1.5	0.66	-	-	-	-	-	-	-	1.0	1.0	0.83	0.16	
UNIT:1 [12 Hours]																
Genome Organization: Prokaryotes and Eukaryotes, Nuclear genome and Organellar genome, DNA as the genetic material, Central dogma of molecular biology, Genome complexity, C-value Paradox, Cot curve analysis, Repetitive DNA, satellite DNA; Transposable element, Variants of gene- Split genes, cryptic genes, pseudo genes, Overlapping genes and selfish DNA.																
UNIT:2 [10 Hours]																
DNA Replication: Models of DNA replication, Enzymology of DNA replication, Process of DNA replication, DNA replication at the telomere, Replication of Mitochondrial and Chloroplast genome, DNA repair, Homologous recombination and Holliday junction.																



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UNIT:3	[10 Hours]
Transcription: Transcription machinery (prokaryotes and eukaryotes), Transcription factors, Transcription process, m-RNA processing (Pre and Post transcriptional processing), m-RNA stability and nuclear transport, m-RNA editing.	
UNIT:4	[8 Hours]
Translation: Genetic code, Translation machinery (t-RNA, Aminoacyl t-RNA synthetase, Ribosome), Translation process, Post translational modification of protein.	
UNIT:5	[10 Hours]
Regulation of Gene expression: Constitutive and Induced gene expression, Operon model (Lac-operon and Trp- operon), Gene silencing, DNA methylation, Introduction to recombinant DNA technology.	
Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCs	
Ref. Books:	
<ol style="list-style-type: none">1. Molecular Biology of Cell By Lodish and Baltimore2. Molecular Biology by Frefelder.3. Gene VII by Benjamin Lewin4. Molecular "Biology of Gene" – Watson5. Genome by T.A Brown	



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Fourth Semester														
Subject Code	Title of the subject	L	T	P	C	QP								
23BBTPC24101	Molecular Biology Lab	0	0	2	1	A								
Course Educational Objective														
CEO1: Develop fundamental laboratory skills in molecular biology by training students in nucleic acid isolation, electrophoresis, and other essential molecular techniques for engineering applications.														
CEO2: Enhance analytical and problem-solving abilities by applying molecular biology methods to investigate genetic material, interpret experimental results, and correlate them with theoretical concepts.														
CEO3: Promote scientific attitude and teamwork by emphasizing biosafety practices, accurate documentation, effective communication of laboratory findings														
Course outcomes: At the end of the course, the student will be able to:														
CO1	Isolate and quantify nucleic acids (DNA/RNA) from different biological samples using standard molecular techniques.													
CO2	Demonstrate proficiency in essential laboratory methods such as agarose gel electrophoresis, PCR amplification, and restriction digestion.													
CO3	Analyze and interpret molecular biology experimental data to draw valid scientific conclusions.													
CO4	Design and execute basic genetic engineering experiments, including cloning and transformation, with proper controls.													
CO5	Communicate laboratory findings effectively through well-structured lab records, reports, and oral presentations while working in teams.													
CO6	Evaluate experimental accuracy and reliability by following biosafety guidelines, quality control measures, and troubleshooting strategies													
CO-PO & PSO Mapping														
COs	PROGRAMME OUTCOMES											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	1												1
CO2	3	2										1	1	
CO3	2	2	2								1			1
CO4	2	1	2									1	1	1
CO5	2	1	3									1		
CO6	1	3	3								1		1	
Avg.	2.1	1.6	2.5								1.0	1.0	1.0	1.0



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Fourth Semester																
Subject Code		Title of the subject										L	T	P	C	QP
23BBTPC24002		Biostatistics										3	0	0	3	A
Course Educational Objective																
CEO1: To provide the basic knowledge on importance of biostatistics																
CEO2: Analyses of biological data with various bio statistical tools to draw relevant conclusion																
Course outcomes: At the end of the course, the student will be able to:																
CO1	Know the biological variables and their representation in various forms.															
CO2	Analyse the data with Bio statistical tools.															
CO3	Know the concept and theoretical probability.															
CO4	Have an idea about the theoretical distribution of data in natural condition															
CO5	Design of experiments and draw samples without any biasness															
CO6	Learn about the test of significance and their importance															
CO-PO & PSO Mapping																
PROGRAMME OUTCOMES																
COs	PROGRAMME OUTCOMES												PSOs			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
CO1	2	1	2	-	-	-	-	-	-	-	-	-	1	2	1	
CO2	2	2	-	-	-	-	-	-	-	-	-	1	1	1		
CO3	-	-	2	-	-	-	-	-	-	-	-	-	2	1	1	
CO4	1	2	2	-	-	-	-	-	-	-	-	-	1	1	2	
CO5	-	1											1	2		
CO6	2	2	1										1	1	3	
Avg.	1.75	1.6	1.75										1	1.16	1.33	1.75
UNIT:1 10 Hours																
Introduction and definition of Biostatistics; Role and application of Biostatistics, variables in biological systems, population and samples. Collection, tabulation, graphical and diagrammatic representation of data. Measures of central tendency: Mean, Median and Mode and their relationship and Importance.																



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UNIT:2	10 Hour
Measures of dispersion: Range, Quartile range, Mean deviation, Standard deviation, Uses of standard deviation, Concept of standard error, variance and coefficient of variation. Skewness: coefficients of skewness, moments and Kurtosis. Correlation analysis: definition, calculation of correlation coefficient, graphical Method-Scatter or dot diagram. Spearson's Rank correlation coefficient. Regression analysis: introduction, regression line and regression equations.	
UNIT:3	10 Hours
Probability: Introduction, important terms and concept of probability, various definition and theorems of probability. Theoretical distribution: Binomial distribution, characteristics of Binomial distribution, Poisson distribution and application, Normal distribution , properties of normal curve	
UNIT:4	08 Hours
Sampling and sample designs: Introduction, theoretical basis of sampling, methods of sampling, Non-probability and probability sampling methods, size of sample, merits and limitations of sample.	
UNIT:5	10 Hours
Tests of hypothesis: Introduction, procedure of testing hypothesis, two tailed and one-tailed tests of hypothesis. Tests of significance: Chi-square and goodness of fit, student's t test. Analysis of variance: Technique of analysis of variance (ANOVA), two-way classifications model.	
Teaching Methods: Chalk & Board/PPT/Video Lectures/ Lecture by Industry Expert/MOOCs	
Reference Books	
<ol style="list-style-type: none">1. Biostatistics by P.N.Arora and P.N.Malhan, Himalaya Publishing house .2. Introduction to biostatistics by P.K.Banerjee,S.Chand Publication3. Introduction to Biostatistics and Research methods by P.S.S Sundar Rao and J.Richard,PHI publication4. Biostatistics by Munju Pandey, Euro span Publisher.	



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Title of the subject																
Subject Code	Title of the subject	L	T	P	C	QP										
23BBTPC24003	Upstream Process Engineering	3	-	-	3	A										
Course Educational Objective																
CEO1: To provide the knowledge on fluid mechanics and their properties																
CEO2: To understand the basic law of heat transfer																
Course outcomes: At the end of the course, the student will be able to:																
CO1	Describe the operation, as well as constriction and exploitation characteristics of machines for mechanical operations.															
CO2	Solve simple radiation heat transfer problems															
CO3	Make use of empirical equations to solve forced and natural convection heat-transfer problems															
CO4	Design the distillation column															
CO5	Learn about law and equations of mass transfer															
CO6	Learn theory of mass transfers															
CO-PO & PSO Mapping																
COs	PROGRAMME OUTCOMES												PSOs			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
CO1	2	1	2	-	-	-	-	-	-	-	-	-	1	2	1	
CO2	2	2	-	-	-	-	-	-	-	-	-	1	1	2	1	
CO3	-	-	2	-	-	-	-	-	-	-	-	-	1	1	1	
CO4	1	2	2	-	-	-	-	-	-	-	-	-	2	1	2	
CO5	-	1											1	-	1	
CO6	2	2	1										1	1	-	
Avg.	1.75	1.6	1.75										1	1.16	1.4	1.2
UNIT:1 [10 Hours]																
Processing of particulates Properties and handling of particulate solids, size reduction equipments-working principles of crusher, grinder and pulveriser, screening and particle size distribution.																
UNIT:2 [10 Horus]																
Methods of analysis and description - fluid as a continuum, Classification of fluid. Fluid statics – basic equation - equilibrium of fluid element – Hydrostatic Pressure, Pressure measuring Devices. Flow in boundary layers. Its formation & growth in tubes & plates. Basic equations of fluid flow continuity, momentum & Bernoulli’s equation. Flow measuring devices; Venturi, Orifice, Pitot tube & Rotameter.																
UNIT:3 [12 Hours]																
heat transfer, basic laws of heat transfer, Conduction: The Fourier heat conduction equation, Steady-state one dimensional heat conduction through plane wall, cylindrical wall, spherical wall and composite structures. Heat transfer from extended surfaces, critical insulation of thickness. Introduction to convection: Natural and forced convection, Natural Convection: Grashoff number, natural convection from vertical and horizontal surfaces. Forced convection, The convective heat transfer coefficient, Types of heat exchangers, log-mean temperature difference, energy balances, overall heat transfer coefficients																



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UNIT:4

[14 Hours]

Introduction to Mass transfer operations, molecular diffusion in fluids, binary solutions, Fick's law, equation of continuity, steady state equimolar counter current diffusion, Stefan-Maxwell equation, diffusivity of gases and liquids, application of molecular diffusion, mass transfer coefficients, in laminar and turbulent flow.

UNIT-5

Interphase mass transfer, Film theory, Penetration theory, surface-renewal theories, analogy between mass, heat and momentum transfer. relative volatility, ideal solutions, azeotropes, enthalpy concentration diagrams, flash vaporization, partial condensation, differential distillation steam distillation, azeotropic and extractive distillation. Continuous distillation.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCs

Text Books 1:McCabe, Smith and Harriot, Unit Operations of Chemical Engineering
2:Foust et al, Principles of Unit Operations.

Ref. Books 1: Badger and Banchero. Introduction to Chemical Engineering.
2:Foust, Wenzel, Clump, Maus and Andersen, Principles of Unit Operations.



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Subject Code	Title of the subject	L	T	P	C	QP								
23BBTPC24103	Upstream Process Engineering Lab	0	0	2	1	A								
Course Educational Objective														
CEO1: To equip students with practical knowledge and hands-on skills in upstream bioprocess engineering														
CEO2: To develop the ability to design, operate, and analyze laboratory-scale bioreactors, fermenters, and upstream processing systems, emphasizing process control														
CEO3:														
Course outcomes: At the end of the course, the student will be able to:														
CO1	Demonstrate practical skills in aseptic techniques, media preparation, and microbial culture handling for upstream bioprocesses.													
CO2	Perform batch, fed-batch, and continuous cultivation experiments using laboratory-scale fermenters/bioreactors.													
CO3	Analyze growth kinetics, substrate utilization, and product formation to interpret bioprocess performance.													
CO4	Optimize process parameters (pH, temperature, aeration, agitation, inoculum density, etc.) for improved biomass and metabolite yield.													
CO5	Apply process monitoring techniques (dissolved oxygen, cell density, metabolite concentration) to evaluate upstream operations.													
CO6	Design and execute small-scale experimental protocols with safety, accuracy, and reproducibility.													
CO-PO & PSO Mapping														
	PROGRAMME OUTCOMES											PSOs		
COs	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2		1									1		
CO2		1												
CO3	2													1
CO4	3		1							1		1		
CO5		2			1									
CO6	2												2	
Avg.	2.25	1.5	1.0		1.0						1.0	1.0	2.0	1.0



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Title of the subject																
Subject Code	Fourth Semester											L	T	P	C	QP
23BBTPC24004	Bio-analytical Techniques											3	0	0	3	A
Title of the subject																
CEO1: To provide knowledge about bio instruments and their working principle.																
CEO2: To learn the use of instruments and their application in research.																
Course outcomes: At the end of the course, the student will be able to:																
CO1	Understand the working principle of spectroscopic techniques and their application for the characterization of various biomolecules.															
CO2	Gain fundamental knowledge in microscopic techniques and their applications in study of microscopic objects.															
CO3	Perform techniques involved in biochemistry and genetic engineering															
CO4	Learn and design different chromatographic techniques for separation of biological products.															
CO5	Demonstrate knowledge and practical skills of using instruments in molecular biology.															
CO6	Update current knowledge regarding biomedical engineering involving new methods and the instrumentation.															
CO-PO & PSO Mapping																
COs	PROGRAMME OUTCOMES												PSOs			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
CO1	1	-	-	2	3	-	-	-	-	-	-	-	2	1	1	
CO2	2	-	-	2	2	1	-	-	-	-	-	-	1	2	1	
CO3	-	2	-	2	2	-	-	-	-	-	-	-	1	1	1	
CO4	-	1	-	2	3	-	-	-	-	-	-	1	2	1	2	
CO5	-	-	2	-	3	2	-	-	-	-	-	-	1	-	1	
CO6	2	-	-	2	3	1	-	-	-	-	-	-	1	1	-	
Avg.	0.83	0.5	0.33	1.66	2.66	0.66	-	-	-	-	-	-	0.16	1.33	1.2	1.2
UNIT:1 [10 Hours]																
Spectroscopic Techniques: Spectroscopic methods to study physicochemical properties of biomolecules, Laws of absorption of light, Beer-Lambert's Law, UV-Vis spectroscopy, IR spectroscopy, FTIR, Fluorescence spectroscopy, Mass spectroscopy, NMR spectroscopy, ESR spectroscopy and X-ray crystallography.																
UNIT:2 [10 Hours]																
Microscopy: Magnification and resolution parameters of light, Principle of operation and Instrumentation of Light microscopy (Bright field, Phase-contrast, Fluorescence), Principles of electron microscopy, preparation of samples, TEM and SEM.																
Centrifugation: Basic principles of sedimentation (RCF), Types of centrifuge and centrifugation.																



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UNIT:3	[10 Hours]
Electrophoresis: General principle of electrophoresis, support media (agarose and polyacrylamide gels), Agarose gel electrophoresis electrophoresis of proteins by SDS-PAGE, native PAGE, gradient gels, isoelectric focusing gel, 2-D PAGE.	
Blotting Techniques: Southern, Northern and Western blot analysis; Polymerase Chain Reaction (PCR).	
UNIT:4	[10 Hours]
Chromatography: Principles of chromatography, distribution coefficient, retention time, Chromatographic methods for macromolecular separation- Paper, TLC and column chromatography, Partition chromatography, ion exchange chromatography, gel exclusion chromatography, affinity chromatography, normal phase and reversed phase chromatography, HPLC, Gas Chromatography.	
UNIT:5	[10 Hours]
Radioisotope Techniques: Radioactivity activity detection methods based on ionization (Geiger- Muller monitor), excitation (solid and liquid scintillation counting), autoradiography, safety aspects of handling radioactive material.	
Teaching Methods: Chalk & Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCs	
Ref. Books: 1. Principles and Techniques of Biochemistry and Molecular Biology, Wilson K. and Walker J., Cambridge University Press (2005) 6th ed. 2. Biochemical Method-A Concise guide for students and researchers, Pingoud A., UrbankeC., Hoggett J. and Jeltsch A. Wiley-VCH Publishers. 3. Biophysical Chemistry principles and techniques Author : Upadhyay , Upadhyay , Nath. Himalaya Publishing House. 4. Physical Biochemistry Principles and Applications By David Sheehan. Wiley publisher 5. Bioseparations: Science and Engineering, Harrison, R.G., Todd, P., Rudge'	



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Subject Code	Name of the Subject	L	T	P	C	QP
23BCSES24001	DATABASE MANAGEMENT SYSTEM	3	0	0	3	A

Course Educational Objectives

Pre -Requisite:

CEO 1	Gain a good understanding of the architecture and functioning of Database Management Systems as well as associated tools and techniques.
CEO 2	Understand and apply the principles of data modeling using Entity Relationship and develop a good database design.
CEO3	Understand the use of Structured Query Language (SQL) and its syntax
CEO4	Apply Normalization techniques to normalize a database.

Course Outcomes: Upon successful completion of this course, students should be able to:

CO1	Identify and Classify the concepts of Database Management system, Data models and architecture of database, ER to Relational mapping concepts.
CO2	Applying the constraints in database using different query languages like:- relational algebra and calculus, SQL and QBE for the implementing the Data definition and data manipulate languages in Database.
CO3	Compare the different normal forms to Apply normalization process to construct the consistent Database.
CO4	Design and Develop the Database by inspecting concurrency control and recovery strategies to make complete Database without confliction and anomalies in concurrent access environment.
CO5	Learn about timestamp
CO6	Learn about the Recovery techniques for database

CO-PO & PSO Mapping:															
Cos	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	1	1										1	2	2
CO2	3	2	1										1	1	1
CO3	2	1	1										2	1	1
CO4	2	1	2										1	2	1
CO5	1	2	1										-	1	2
CO6	1	1	1										2	-	1
Avg.	2.0	1.33	1.16										1.4	1.4	1.33

SYLLABUS

UNIT:1 **[12 Hours]**
 Introduction to database Systems, advantages of database system over traditional file system, Basic concepts & Definitions, Database users, Database Language, Database System Architecture, Schemas, Sub Schemas, & Instances, database constraints, 3-level database architecture, Data Abstraction, Data Independence, Mappings, Structure, Components & functions of DBMS, Data models.

UNIT:2 **[14 Hours]**
 Entity relationship model, Components of ER model, Mapping E-R model to Relational schema,



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Relational Algebra, Tuple & Domain Relational Calculus, Relational Query Languages: SQL and QBE. Database Design:-Database development life cycle (DDLC), Automated design tools, Functional dependency and Decomposition, Join strategies, Dependency Preservation & lossless Design, Normalization, Normal forms:1NF, 2NF,3NF, and BCNF, Multi-valued Dependencies, 4NF & 5NF. Query processing and optimization: Evaluation of Relational Algebra Expressions, Query optimization, Query cost estimation.

UNIT:3

[10 Hours]

Network and Object Oriented Data models, Storage Strategies: Detailed Storage Architecture, Storing Data, Magnetic Disk, RAID, Other Disks, Magnetic Tape, Storage Access, File & Record Organization, File Organizations & Indexes, Order Indices, B+ Tree Index Files, Hashing Data Dictionary.

UNIT:4

[12 Hours]

Transaction processing and concurrency control: Transaction concepts, properties of transaction, concurrency control, locking and Timestamp methods for concurrency control schemes.

UNIT:5

Database Recovery System, Types of Data Base failure & Types of Database Recovery, Recovery techniques, fundamental concepts on Object-Oriented Database, Object relational database, distributed database, Parallel Database, introduction to Data warehousing & Data Mining.

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Text Books:

1. Sudarshan, Korth: Database System Concepts, 6th edition, McGraw-Hill Education
2. Elmasari&Navathe: Fundamentals of Database System, Pearson Education.

Reference Books:

1. Elmasari&Navathe: Fundamentals of Database System, Pearson Education.
2. Ramakrishnan: Database Management Systems, McGraw-Hill Education.
3. Andrew S. Tanenbaum: Modern Operating Systems, 3rd Edition, Pearson Education.
4. Terry Dawson, Olaf Kirch: Linux Network Administrator's Guide, 3rd Edition O'Reilly



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Title of the subject															
Subject Code	4TH Semester										L	T	P	C	QP
23BBSHS24001	ADVANCED COMMUNICATION SKILLS AND PROFESSIONAL ETHICS										2	0	0	2	-
Course Educational Objective															
CEO1: To develop communication skills and soft skills of the students.															
CEO2: To enhance employ ability and entrepreneurial skills.															
CEO3: To inculcate professional ethics.															
Course outcomes: Towards the end of the course, the students will be able to:															
CO1	Develop ways to overcome barriers in professional communication														
CO2	Formulate advance speaking skills														
CO3	Organise professionals meetings and talks.														
CO4	Develop professional writing skills for career growth														
CO5	Understand the importance of ethics in professional life.														
CO6	Use technological aids for self-learning.														
CO-PO & PO Mapping															
COs	PROGRAMME OUTCOMES														
	1	2	3	4	5	6	7	8	9	10	11	12			
CO1											3				
CO2										3					
CO3									3						
CO4										3					
CO5								3				2			
CO6										3					
SYLLABUS															

UNIT:1 Advance Listening Skills	(4 hours)
1.1 Barriers to effective listening at work place	
1.2 Overcoming the barriers.	
UNIT:2 Advance Speaking Skills	(3 hours)



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2.1 Barriers to the public speaking

2.2 Overcoming the barriers

UNIT:3 Advance writing skills

(3 hours)

3.1 Barriers to professional writing

3.2 Overcoming the barriers

UNIT:4 Professional Ethics

(4 hours)

4.1 What is professional ethics importance

4.2 Plagiarism Definition, Types, How to avoid

4.3 Citation what, why

UNIT:5 Technological Aids for Effective Communication

(4 hour)

5.1 What and Why

5.2 Spell check, Grammarly, Quill-bot, Ithenticate, Turnitin

Teaching Methods: chalk and board PPT/Video Lectures

ReferenceBooks:

1. Practical English Usage. Michael Swan, OUP, 1995

2. Communication skills by Sanjay Kumar and Pushp Lata, Oxford University Press; Second Edition, 2015.

3. Advanced Communication English by Dr. O.V. Nachmuthu, The Cambridge Publishers; First Edition, 2011.



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Subject Code	Course Title	L	T	P	C	QP
23BBTPC24102	Biostatistics Lab	0	0	2	1	A

Course Educational Objective

In this laboratory, students will study the analysis of data biotechnological experiments with various biostatistical tools to draw conclusion

Student can understand how to generate data and application of biostatistics in biological experiment.

Course outcomes: At the end of the course, the student will be able to:

CO1	Understand the importance and application of biostatistics in biotechnological experiments
CO2	learn how to collect, organize, and manage biological data using statistical software and tools
CO3	Create and interpret various types of graphs and charts to visualize data effectively, enhancing understanding of biological trends and patterns.
CO4	Apply fundamental statistical methods such as descriptive statistics, probability distributions, and hypothesis testing to analyze biological data.
CO5	Know advanced statistical analyses, including regression, ANOVA, and chi-square tests
CO6	Analyze and interpret results of statistical analyses to solve biological and health-related problems, and draw meaningful conclusions.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	2	3	-	-	-	-	-	-	-	-	-			
CO2	2	3	2	-	-	-	-	-	-	-	-	-			
CO3	2	2	1		-	-	-	-	-	-	-	2			
CO4	3	1	2	-	-	-	-	-	-	-	-	-			
CO5	1	2	2												
CO6	2	1	1												
Avg.															

LIST OF EXPERIMENTS

1. Tabulation of data: Construction of the bar graph
2. Tabulation of data: Construct and interpret graphical displays such as histograms, ogive etc.
3. Measures of central tendency of a distribution
4. Measures of dispersion: range and mean deviation
5. Measures of dispersion: Standard deviation and Coefficient of variance
6. Hypothesis testing; Students t-test and paired 't' test interpreting confidence level.
7. Hypothesis testing; Chi-square test and interpreting confidence level.
8. Analysis of correlation of variables and correlation coefficient
9. Analysis of variance (ANOVA)



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V Semester Syllabus [Third Year] UG ENGINEERING IN BIOTECHNOLOGY

Fifth Semester																	
Subject Code	Title of the subject												L	T	P	C	QP
23BBTPC35001	Genetic Engineering and r-DNA Technology												3	0	0	3	-
Course Educational Objective																	
CEO1: To introduce the basic of Genetic Engineering and its application																	
CEO2: To understand the functions gene transfer to organisms																	
Course outcomes: At the end of the course, the student will be able to:																	
CO1	Obtain knowledge in digestion of DNA, vector system for cloning and expression.																
CO2	Understand the cloning strategies and library construction																
CO3	Knowledge on different techniques used in genome analysis.																
CO4	Understand the mechanism of silencing of gene																
CO5	Acquire knowledge in molecular markers, genome mapping.																
CO6	Apply genetic engineering principles for biotechnological and biomedical applications.																
CO-PO & PSO Mapping																	
COs	PROGRAMME OUTCOMES												PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3		
CO1	1	-	-	2	1	-	-	-	-	-	-	-	2	1	3		
CO2	-	1	2	2	3	-	-	1	-	-	-	-	2	2	2		
CO3	-	-	3	2	1	-	-	-	-	-	-	-	1	3	1		
CO4	2	-	-	1	-	-	2	-	-	-	-	2	3	1	1		
CO5	3	2	2	1	2	-	-	-	-	-	-	-	1	1	2		
CO6	1	2	1	1	2	-	-	-	-	-	-	-	1	1	1		
Avg.	1.75	1.25	2.0	1.6	1.8	-	2.0	1.0	-	-	-	2.0	1.66	1.5	1.66		
UNIT:1	[12 Hours]																
Basic principle of DNA isolation and purification; Restriction endonuclease, Ligase and other modifying enzymes; DNA& RNA Markers, Linker, Adapter and MCS; Gene cloning vectors-Plasmid, bacteriophage, cosmid, BAC, YAC; Expression vectors: basic concept, bacteria and yeast based expression vector.																	
UNIT:2	[10 Hours]																
Basic concept of gene cloning; Gene library- genomic and c-DNA, contig library; Polymerase Chain reaction, Cloning of interacting gene: two hybrid and three hybrid assay; Cloning of differentially expressed gene; DNA micro arrays and Chips - principle and Manufacturing process.																	
UNIT:3	[10 Hours]																
DNA finger printing and DNA foot printing; DNA Sequencing; Site-directed mutagenesis; Expression of heterologous gene; In vitro transcription and translation; Gene knock out strategies; RNA interference: Antisense RNA, si RNA and mi RNA; Ribozyme Technology.																	



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UNIT:4	[10 Hours]
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Molecular markers- Types (RFLP, RAPD, AFLP, SCAR, SSR, SNP, EST), Principle and methodology; Application of molecular markers: in diagnostics, gene tagging, gene mapping, Physical mapping of the genome.

UNIT:5	[08 Hours]
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Genome analysis using 16S rRNA typing/ sequencing, Genome. Projects: Human, Rice; Gene therapy and its applications; DNA vaccines and rDNA products; Genetic engineering regulations and safety guidelines.

Teaching Methods: Chalk & Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCs

Reference: Books 1. Principles of Mol. Biology - OS Prim Rose

2. Genetic Engineering by B D Singh, Rastogi Publication
3. Molecular Biotechnology by Glick and Pasternik
4. Molecular Biology. By Turner.
5. Molecular "Biology of Gene" – Watson



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Title of the subject														
Subject Code		L	T	P	C	QP								
23BBTPC35101	Genetic Engineering and r-DNA Technology Lab	0	0	2	1	-								
Course Educational Objective														
CEO1: To provide students with hands-on experience in essential genetic engineering techniques, including recombinant DNA technology, gene cloning, and molecular analysis														
CEO2: To develop the ability to design and perform experiments, analyze molecular data, and interpret results accurately														
CEO3: To prepare students to apply laboratory techniques responsibly in research and industry, with awareness of biosafety														
Course outcomes: At the end of the course, the student will be able to:														
CO1	Demonstrate proficiency in basic laboratory techniques used in genetic engineering, including DNA isolation, plasmid preparation, and gel electrophoresis.													
CO2	Perform recombinant DNA experiments such as gene cloning, restriction digestion, ligation, and transformation of host cells.													
CO3	Analyze and interpret experimental results using molecular biology tools and techniques, including PCR, DNA fingerprinting, and electrophoretic profiling.													
CO4	Apply theoretical knowledge to troubleshoot laboratory experiments and optimize protocols for successful molecular biology experiments.													
CO5	Develop the ability to design simple genetic engineering experiments and propose novel approaches for biotechnological applications.													
CO6	Demonstrate understanding of biosafety, ethical considerations, and regulatory compliance in genetic engineering and recombinant DNA technology.													
CO-PO & PSO Mapping														
COs	PROGRAMME OUTCOMES											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	1													
CO2		2								1				1
CO3	2	3			2								1	
CO4		2	1											
CO5	3				1					1	2			
CO6	1												1	1
Avg.	1.75	2.25	1.0		1.5						1.0	2.0	1.0	1.0



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Title of the subject						
Subject Code	Fifth Semester	L	T	P	C	QP
23BBTPC35002	PLANT BIOTECHNOLOGY	3	0	0	3	-
Course Educational Objective						

Course Educational Objective	
CEO1: To provide the practical oriented theory on plant tissue culture	
CEO2: To have knowledge on gene transfer to plants	
Course outcomes: At the end of the course, the student will be able to	
CO1	Acquire knowledge in various types of plant tissue culture techniques and various components of plant tissue culture media
CO2	Understand the importance of micro propagation and somatic hybridization.
CO3	Learn the technology of plant transformation including vector and vector less gene transfer methods.
CO4	Know the importance of germplasm and their conservation techniques
CO5	Have idea on importance of genetically modified crops
CO6	Acquire knowledge in biosynthesis of plant primary and secondary metabolites and their importance

COs	CO-PO & PSO mapping												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	1	1										1	2	2
CO2	1	3	1		1								1	1	1
CO3	1	2	2										2	1	1
CO4	-	2	1	1									1	2	1
CO5	2	1	1								1		-	1	2
CO6	2	-	1	1									2	-	1
Avg	1.6	2.0	1.16	1.0	1.0						1.0		1.4	1.4	1.33

UNIT:1

10 Hours

Plant tissue culture: historical perspective, concept of totipotency and plasticity of plant cell; Tissue culture media- Composition preparation, composition and plant growth regulators; sterilization techniques. Initiation and establishment of culture: Explants preparation, Callus culture, Single cell culture, Suspension culture.

UNIT:2

10 Hours

Plant Regeneration: Microspore and Anther culture, Embryo culture and embryo rescue Micro propagation: Organogenesis, Somatic embryogenesis, Artificial seed; Protoplast technology: Isolation and culture of protoplast, Somatic hybridization - methods and applications; Cybrids, Screening and selection of somatic hybrids.



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UNIT:3

10 Hours

Germplasm conservation and cryopreservation. Chloroplast transformation. Molecular pharming - concept of plants as biofactories, production of industrial enzymes and pharmaceutically important compounds. Biotransformation.

UNIT:4

10 Hours

Concept of genetic transformation: Vector based (*Agrobacterium*, Virus) and Direct transformation (Gene gun, Electroporation, Microinjection, etc.); Screenable and selectable markers; development of herbicide resistance, insect resistance, disease resistance, terminator seed technology; Products of genetic transformation: Case studies for golden rice, Bt cotton and *FlavrSavr* tomato.

UNIT:5

12 Hours

Primary and secondary metabolites in plant, types of secondary metabolites, Alkaloids and its importance. Production of secondary metabolites through tissue culture, bioreactor based production and factors affecting the production of secondary metabolite. Specialized strategies for the production of secondary metabolites.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCs

Reference Books

1. Introduction to Plant Biotechnology by H S Chawal, Science Publisher Inc.
 2. Plant Biotechnology by Adrian Slater, Oxford press
 3. Introduction to Plant Biotechnology by M.K.Razdan, Science Publisher Inc.
- Plant Biotechnology by Agnes Ricroch ,S.Chopra, S.J.Fleisher, Springer



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Title of the subject		L	T	P	C	QP										
Subject Code																
23BBTPC35003	Industrial Microbiology and Enzyme Technology	3	0	0	3	A										
Course Educational Objective																
CEO1: To study about fermentation process and to study the culturing of micro organisms and maintenance of cultures.																
CEO2: To study about the preparation of alcohol using yeast cells and sugars by fermentation process.																
Course outcomes: At the end of the course, the student will be able to:																
CO1	Obtain knowledge in microbial growth, design of fermenter and types of fermentation technology.															
CO2	Able to demonstrate a knowledge and understanding of different types of commercially important products by using fermentation technology.															
CO3	Acquire the knowledge about formulation and selection of media and application of molecular products with its biosafety.															
CO4	Obtain knowledge in strain development and improvement of possible process modifications for improved control over microorganisms for microbial product synthesis.															
CO5	Obtain knowledge regarding stability of enzymes through different techniques, its application with the idea of fermentation economics.															
CO6	Gaining knowledge regarding the mechanism of enzyme action.															
CO-PO & PSO Mapping																
	PROGRAMME OUTCOMES												PSOs			
COs	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
CO1	3	2	2	1	1	-	-	-	-	-	-	-	3	1	-	
CO2	2	1	2	3	3	-	-	-	-	-	-	-	2	3	2	
CO3	1	2	3	2	2	-	-	-	-	-	-	-	2	2	-	
CO4	2	1	1	3	2	-	2	-	-	-	-	2	3	3	-	
CO5	1	2	3	1	2	-	-	-	-	-	1	-	1	1	-	
CO6	1	1	1	2	1	-	-	-	-	-	-	-	1	1	-	
Avg.	1.6	1.5	2	2	1.8	-	-	-	-	-	0.16	0.3	2.0	1.83	0.33	
UNIT:1							[10 Hours]									
Microbial Processes and fermentation technology: Design and components of basic fermentor, Types of fermentation processes-Solid-state, Semi solid-state and liquid-state fermentations; batch, fed-batch and continuous fermentations, Different separation techniques and application of fermentation in waste treatment.																
UNIT:2							[10 Hours]									
A brief outline of microbial processes for the production of some commercially important Organic acids (e.g. citric acid); Amino acid (Glutamic acid); and Alcohol (ethanol) Antibiotics(penicillin),enzymes(Proteases),polysaccharides(cellulose); lipids(Triglycerides) recombinant protein (Insulin), production of vaccines (Hepatitis-B).																



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UNIT:3	[10Hours]
Commercial media and strain development: Media selection and development for industrial production, Isolation, selection, characterization of microorganisms, Molecular products from microbes, Recombinant microbial strain of bio-safety for agricultural and industrial engineering	
UNIT-4	[10Hours]
stock culture, development of inoculum, strain improvement: induced mutation, over producing decontrolled mutants, genetically engineered strain, Economics of a fermentation process, Microbiology technology for environmental nourishment.	
UNIT:5	[10 Hours]
Stability of enzyme: Enzyme immobilization, Enzyme stabilization by selection and genetic engineering, Biotechnological applications of enzymes in industry, analytical purpose and medical therapy, Group transfer redox, Elimination, isomerization and rearrangement, C-C bond cleavage.	
Teaching Methods: Chalk & Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCs	
Text Books 1. Principle of Fermentation Technology, P.F. Stanbury, A. Whitaker and S.J. Hall, Elsevier 2. Industrial Microbiology, Prescott and Dunn,	
Ref. Books 1. Biochemical Engineering and Biotechnology Handbook, Atkinson, B and Maritona, F., The Nature Press, Macmillan Publ. Ltd. 2. Biochemical Engineering Fundamentals, Bailey & Ollis. MGH.	



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Title of the subject		L	T	P	C	QP									
Subject Code															
23BBTPE35001	Bioreactor Design and Analysis	3	0	0	3	A									
Pre -Requisite:															
Course Educational Objective															
CEO1:To understand the importance of bioprocess engineering and the role of bioprocess engineer and the importance of regulatory constraints.															
CEO2:To understand the instrumentation and control of bioreactors their scale up aspects etc.															
Course outcomes: At the end of the course, the student will be able to															
CO1	learn the principle and operation of different types of bioreactors.														
CO2	understand the conditions for both ideal and non-ideal bioreactors.														
CO3	know about mass transfer in biochemical processes carried out in different bioreactors.														
CO4	acquire basic concept in bioreactor design and modelling and simulation of fermentation process.														
CO5	Learn about the factors that regulating the bioreactors.														
CO6	Knowledge on the instrumentation and maintaining its regulations														
CO-PO & PSO Mapping															
COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	-	1	1	1	-	-	-	-	-	-	-	2	1	1
CO2	-	1	2	1	2	-	-	-	-	-	-	-	1	2	2
CO3	1	-	2	2	3	-	-	-	1	-	-	-	1	1	2
CO4	-	-	2	3	-	-	-	-	-	-	-	-	2	1	1
CO5	2	1	1	1	1	-	-	-	-	-	-	-			
CO6	2	1	-	1	1	2	-	-	-	-	-	-			
Avg.	1.75	1.0	1.6	1.5	1.6	2.0	-	-	1.0	-	-	-	1.5	1.25	1.5
UNIT:1							[10 Hours]								
Principles and concepts: Recapitulation of the principles of Kinetics for chemical and Bio-chemical Reactions. Fundamentals of homogeneous reactions for batch / semi-batch, plug flow reactor (PFR), continuous stirred tank reactors (CSTR), fluidized bed reactor, bubble column, air lift fermenter etc, stirred tank/mixed reactors, adiabatic and programmed reactors. Unconventional bioreactors: Hollow fiber reactor, membrane reactor, perfusion reactor for animal and plant cell culture															
UNIT:2							[10 Hours]								
Bioreactor Analysis: Analysis of ideal bioreactors: Fed-Batch reactors, Enzyme catalyzed reactions in CSTRs, CSTR reactors with Recycle and wall growth, Ideal Plug-Flow Tubular reactor. Analysis of Non-Ideal Reactor. Concept of ideal and non-ideal reactor; residence time distribution; models of non-ideal reactors – plug flow reactor for microbial processes.															



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UNIT:3	[10 Hours]
Mass transfer in biochemical processes; Multiphase bioreactors – packed bed with immobilized enzymes or microbial cells; three – phase fluidized bed trickling bed reactor; Design and analysis of the above reactor systems; Gas liquid reactors, Reactor stability.	
UNIT:4	[10 Hours]
Bioreactor Design: Design considerations: oxygen transfer, heat transfer, rheology, mixing. Scale up and scale down concepts. Bioprocess control and computer coupled bioreactors; Growth and product formation by recombinant cells.	
UNIT:5	[10 Hours]
Mechanical fittings in a bioreactor: vessel, agitation system materials, piping and valves for biotechnology. Instrumentation and control of bioprocesses: Bioreactor sensor, online sensors for cell properties, off-line analytical methods; Biosensors. Bioreactor design calculation.	
Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCs	
Text Books	
1. Bailey and Ollis, "Biochemical Engineering Fundamentals", McGraw Hill (2nd Ed.). 1986. Press.	
2. Scragg.A.H "Bioreactors in Biotechnology"- A Practical approach	
Ref. Books	
1. Bailey & Ollis, Biochemical Engg. Fundamentals, MGH.,1990	
3. Levenspiel, O., Chemical Reaction Engineering, Wiley Eastern Ltd.	
4. Lydersen, D'Elia, Nelson, Bioprocess engineering: Systems and equipment.	



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Subject code	Title of the subject	L	T	P	C	QP									
23BBTOE35001	Bio-chemical Reaction Engineering	3	0	0	3										
Course Educational Objective															
CEO1: To enhance skills in the areas of biochemical processes, to provide the fundamental background of biological systems, bio															
CEO2: To provide the fundamental background of biological systems, bio-chemical engineering, environmental engineering, advanced bioprocess engineering, biologically mediated processes and waste treatment.															
Pre-Requisites (If any)-Chemical Engg Process calculation, Mathematics, Chemical Engg. Reaction Engg															
Course Outcome: Upon successful completion of this course, students should be able to:															
CO1	Knowledge about material balance and energy balance in process industry. Describe the bioprocess monitoring/control.														
CO2	Knowledge of fundamentals of chemical reaction engineering..														
CO3	Design of ideal batch and continuous reactor														
CO4	Design of ideal reactors for single and complex reactions and non-isothermal reactors Illustrate operation and choice of bioreactor.														
CO5	Know about the models of biochemical reactions														
CO6	Know about the different types of fermentators														
CO-PO & PSO Mapping															
	PROGRAMME OUTCOMES												PSOs		
COs	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	3	2	2	1	-	-	-	-	-	-	-	1	2	1
CO2	2	2	1	2	3	-	-	-	-	-	-	-	3	1	2
CO3	2	1	2	3	2	-	-	-	1	-	-	-	2	1	1
CO4	2	2	1	1	3	-	-	-	-	-	-	-	3	2	1
CO5	1	1	2	3	1	-	-	-	-	-	-	-	1		
CO6	-	1	1	1	2	2	-	-	-	-	-	-	1		
Avg.	1.6	1.6	1.5	2	2	2.0	-	-	1.0	-	-	-	1.83	1.5	1.25
Unit:1							[10 Hours]								
Material Balance & Energy Balances: Mathematical requisites – use of log-log and semi-log graph paper, triangular diagram, graphical differentiation and graphical integration, material balance without chemical reaction, material balance with chemical reaction, energy balance; enthalpy changes, heat of reaction and its temperature dependence, heats of solution and mixing, adiabatic flame temperature, use of psychometric charts.															
Unit:2							[10 Hours]								
Kinetics of homogeneous reactions: classification of reactions, reaction rate, speed of reaction, rate equation, concentration-dependent term of rate equation, rate constant, order and molecularity, representation of elementary and nonelementary reactions, kinetic models															



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for nonelementary reactions, temperature-dependent term of a rate equation, activation energy and temperature dependency.
Unit:3 [10 Hours] Kinetic analysis of batch reactor data: Integral and differential methods for analyzing kinetic data, interpretation of constant volume batch reactor, data for zero, first, second and third order reactions, half-life period, irreversible reaction in parallel and series, auto catalytic reaction. Kinetic interpretation of batch reactor data for single reactions: interpretation of variable volume batch reaction data for zero, first and second order reactions,
Unit:4 [10 Hours] Ideal batch reactor, steady state CSTR and plug flow reactors and their use for kinetic interpretation. Design for single reaction: size comparison of single reactors, plug flow reaction in series and/or parallel, equal and different size of mixed reactor in series, finding the best system for given conversion, recycle reactor, Design of multiple reactions in batch, CSTR and PFR.
Unit:5 [10 Hours] Biochemical reaction systems: Cell and enzyme fermentation, Monod's model of growth kinetics. Kinetics of Enzyme catalyzed reactions for free and immobilized enzymes. – derivation of Michaelis-Menten equation, Briggs-haldane relationship, the determination and significance of kinetic constants, Lineweaver-burk and Eadie-Hofstee plot, principles of enzyme inhibition – Competitive, noncompetitive and uncompetitive Michaelish-Menten kinetics, inhibition by foreign substances, kinetics of competitive and noncompetitive inhibitions, microbial fermentation, batch fermentor and mixed flow fermentor, kinetic expressions of fermentation.
Teaching Mentod (s):Chalk& Board/PPT/Video Lecture
Text Books 1:Chemical process Principles (Part I & II), Houge, Watson & Ragatz, Asian Student Edition Asia Publishing House 2.Basic Principles and Calculations in Chemical Engineering, Himmelbalu, Prentice Hall (l) 6th Ed.
Ref. Books 1: Levenspiel, O., Chemical Reaction Engineering, Wiley Eastern Ltd. 2:Smith& Vanes, Thermodynamics for Chemical Engineers, MGH.



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Title of the subject																
Subject Code												L	T	P	C	QP
23OMGC35001	Organizational Behavior											2	0	0	2	A
Course Educational Objective																
CEO1: To provide knowledge in organizational behavior.																
CEO2: To provide knowledge on leadership quality and managerial skill.																
Course outcomes: At the end of the course, the student will be able to																
CO1	Understand the importance of organization and its sustenance.															
CO2	Have knowledge on theories of motivation and perception.															
CO3	Know the culture of organization.															
CO4	Understand the importance of organizational change.															
CO5	Analysis the Organizational Change															
CO6	Learn about the technique analysis															
CO-PO & PSO Mapping																
COs	PROGRAMME OUTCOMES												PSOs			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
CO1	3	1											1	2	1	
CO2	3	2	2										1	1	2	
CO3	2	2	2										3	1	2	
CO4	2	1	2										1	1	1	
CO5	2	1	1										2	1	1	
CO6	1	1	1										1	2	1	
Avg.	2.4	2.4											1.5	1.33	1.33	
UNIT:1 [12 Hours]																
Fundamental of OB: Definition, scope and importance of OB, relationship between OB and the individual, evolution of OB, Theoretical framework (cognitive), behaviouristic and social cognitive, limitations of OB.																
Attitude: importance of attitude in an organization, right attitude, components of attitude, relationship between behaviour and attitude, developing emotional intelligence at the workplace, job attitude, barriers to change attitude.																
Personality and values: definition and importance of personality for performance, the Myers- Briggs types indicator and the big five personality model, significant personality traits suitable to the workplace (personality and job – fit theory), personality tests and their practical applications.																
Perception: meaning and concept of perception, factor Influencing perception, selective perception, attribution theory, perceptual process, social perception (stereotyping and halo effect).																
Motivation: Definition & concept of motive & motivation, the content theories of motivation (Maslow’s need hierarchy & Herzberg’s two factor model theory), the process (Vroom’s expectancy theory & Porter (Lawler model)), contemporary theories—equity theory of work motivation.																



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UNIT:2	[12 Hours]
Foundation of Group Behaviour: The meaning of Group & Group Behavior & Group Dynamic, Types of Groups, The Five –Stage model of group development.	
Managing Teams: Why work teams, work teams in organization, developing work teams, team effectiveness & team building.	
Leadership : concept of leadership, trait approach contingency leadership approach, contentary, meaning and significance of contentary leadership, concept of transformations leadership, contentary theories of leadership, success stories of today’s Global and Indian leaders.	
UNIT:3	[12 Hours]
Organizational Culture: Meaning & Definition of Organizational Culture, creating & sustaining Organizational Culture, types of Organizational Culture (strong vs. weak culture, soft vs. hard culture & formal vs. informal culture), creating positive Organizational Culture, concept of workplace spirituality.	
UNIT:4	[12 Hours]
Organizational Change: Meaning, Definition & nature of Organizational change, type of Organizational change, Forces that acts as stimulants to change. Implementing Organizational change: how to overcome the resistance to change, approaches to managing Organizational change, Kurt Lewin’s- three step model, seven stage model of change & Koter’s Eight-step plan for implementing change, leading the change process.	
UNIT:5	
Facilitating change, dealing with individual & group resistance, intervention strategies for facilitating Organizational change, method of implementing Organizational change, developing a learning organization.	
Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCs	
Text Books 1. Understanding Organizational Behaviour, Parek, Oxford 2. Organizational Behaviour, K. Awathappa,HPH.	
Ref. Books 1. nroduction to Organizational Behaviour, Moorhead, Griffin, Cengage. 2. Organizational Behaviour, Hitt, Miller, Colella, Wiley 3. Organizational Behaviour, Robbins, Judge, Sanghi, Pearson	



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Subject Code	Course Title	L	T	P	C	QP
23BBTPC35102	Plant Biotechnology Lab	0	0	2	1	

Course Educational Objective

To impart practical skills in plant tissue culture, genetic transformation, and molecular techniques, enabling students to apply biotechnological tools for crop improvement and research in plant sciences.

Course outcomes: By the end of the course, students will be able to:

CO1	Demonstrate aseptic techniques for plant tissue culture
CO2	know about the establishment of callus culture.
CO3	Perform micropropagation using explants and culture media
CO4	learn about <i>Agrobacterium</i> mediated gene transfer technique
CO5	Apply molecular techniques such as DNA extraction and PCR.
CO6	acquire the skill for protoplast isolation and somatic hybridization.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
CO1	3	2	1													2
CO2	3			2				2								
CO3	3	1	1										1			
CO4		2										2				2
CO5	1	3		1												
CO5	2	3	2									2		1		
Avg.																

List of Experiments

1. Surface sterilization and preparation of explants
2. Preparation of plant tissue culture media
3. Establishment of callus culture from carrot root



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4. Micropropagation through shoot tip culture
5. Root induction and hardening of regenerated plantlets
6. Somatic embryogenesis from explants
7. Isolation and quantification of genomic DNA from plant tissues
8. *Agrobacterium* mediated transformation (Demonstration)
9. Synthetic seed production and encapsulation techniques
10. Isolation of protoplasts and viability test



VI Semester Syllabus [Third Year] UG ENGINEERING IN BIOTECHNOLOGY

Title of the subject																	
Subject Code													L	T	P	C	QP
23BBTPC36001	Immunology & Immunotechnology												3	0	0	3	A
Course Educational Objective																	
CEO1: To study about the process of immunity and organs and cells of lymphoid system.																	
CEO2: To study about complement system, major histocompatibility Hybridoma technology and various Immune responses.																	
Course outcomes: At the end of the course, the student will be able to:																	
CO1	Understand the mechanisms by which our body elicits immune response.																
CO2	Able to demonstrate humoral and cellular immune mechanism																
CO3	Evaluate the usefulness of immunological techniques in different disease diagnosis.																
CO4	Interpret the immune response with respect to hypersensitive , organ transplantations and Auto-immunity.																
CO5	Acquired knowledge on the immune response to explain the mechanisms involved in immune system alterations and to comprehend the function of vaccines and immunotherapy.																
CO6	Apply the acquired knowledge on the immune response to explain defense mechanisms against infectious agents and tumors.																
CO-PO & PSO Mapping																	
COs	PROGRAMME OUTCOMES												PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3		
CO1	3	-	2	1	-	-	-	-	-	-	-	2	1	1	-		
CO2	2	-	2	2	-	-	-	-	-	-	-	1	1	1	-		
CO3	1	2	-	1	1	-	-	-	-	-	-	-	1	1	-		
CO4	2	-	-	-	2	-	-	-	-	-	-	-	1	2	-		
CO5	3	2	1	2	2	-	-	-	-	-	-	-	1	3	1		
CO6	3	1	1	1	1	-	-	-	-	-	-	1	1	3	-		
Avg.	2.3	0.8	1	1.16	1	-	-	-	-	-	-	0.6	1	1.83	0.16		



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UNIT:1 [10 Hours] Basic concepts of immunology: Immunity, types of immunity, humoral and cell mediated immunity, Cells of immune system and Haematopoiesis, Lymphoid organs, Primary and secondary lymphoidorgans, antigen-properties of antigen, antigenity, immunogenicity, immunoglobulin and antibodies.
UNIT:2 [10 Hours] Major Histocompatibility Complex: Structur and functions of MHC, Antigen processing and presentation, Antibody: synthesis and secretion, Molecular basis of antibody diversity, Polyclonal, Monoclonal antibody and Hybridoma technology, Complement system.
UNIT:3 [10 Hours] Antigens: Nature and biology of antigens, super antigens; Cytokines: properties, biological function and therapeutic uses; Antigen-antibody reaction: Precipitation, agglutination and complement mediated immune reactions; Advanced immunological techniques: RIA, ELISA, ELISPOT assay; Immunoelectrophoresis.
UNIT:4 [10 Hours] Immunesponse and tolerance: Regulation of immune response, immune tolerance, Hypersensitivity, autoimmunity, Transplantation immunology, Immuno- deficiency and immuno- proliferate diseases. Dysfunctions of immune system and their modulation, Approaches for correcting immune dysfunction.
UNIT:5 [10 Hours] Immuno biotechnology: Vaccines, Active and passive immunization viral, bacterial peptides, edible vaccine and therapeutic vaccine; genetically engineered production of lymphokines, second generation antibodies, Immunity to infection: bacteria, viral, fungal and parasitic infections (with examples from each group).
Teaching Methods: Chalk & Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCs
Ref. Books: 1. Immunology: Kuby, J. 3rd Ed. (1997) Freeman W. H., oxford. 2. Immunotechnology by A Khan, Pearson Publication. 3. Immunology: Lydyard, P.M., Whelan, A., Fanger, M.W., 1st Ed., Viva Books. 4. Essential Immunology: Roitt, I.M., 9th Ed.(1997) Blackwell Scientific, Oxford, UK.



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Subject Code	Title of the subject	L	T	P	C	QP
23BBTPC36101	Immunology & Immunotechnology Lab	0	0	2	1	A

Course Educational Objective

CEO1: To provide students with a practical understanding of basic immunological principles, including the structure and function of the immune system

CEO2: To equip students with hands-on experience in immunotechnology techniques such as ELISA, immunodiffusion, immunoelectrophoresis, and cell-mediated immunity assays

CEO3 To enable students to analyze and interpret experimental results, understand the role of immunotechnology in diagnostics, therapeutics, and biomedical research

Course outcomes: At the end of the course, the student will be able to:

CO1	Demonstrate understanding of the fundamental principles of immunology, including innate and adaptive immunity, and antigen-antibody interactions.
CO2	Perform standard immunological laboratory techniques such as ELISA, immunodiffusion, and immunoelectrophoresis with accuracy and precision.
CO3	Analyze and interpret experimental results to evaluate immune responses and identify the presence of specific antigens or antibodies.
CO4	Apply immunotechnology methods in real-world scenarios and biotechnological research.
CO5	Maintain laboratory safety, proper documentation, and ethical practices while conducting immunological experiments
CO6	Develop problem-solving, critical thinking, and collaborative skills through design, execution, and discussion of immunology-based experiments.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	1		2											
CO2		2									1			1
CO3	2	3			2								1	
CO4		2	2											
CO5	3				3						1	2		
CO6	1												1	1
Avg.	1.75	2.25	2.0		1.5						1.0	2.0	1.0	1.0



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Title of the subject																
Subject Code												L	T	P	C	QP
23BBTPC36002	Bioinformatics											3	0	0	3	A
Course Educational Objective																
CEO1: Providing fundamental knowledge of different computational tools to find sequential analysis using various software.																
CEO2: To familiar with different Bio-informatics algorithms for prediction of structure of protein and DNA..																
CEO3: Providing knowledge on use of different biological database.																
CEO4: Creating the computational programming for data analysis.																
Course outcomes: At the end of the course, the student will be able to																
CO1	Understand and analyze the concept of use of various biological databases.															
CO2	Analysis of various algorithms for structural study of DNA & protein.															
CO3	Design different molecular modeling using software.															
CO4	Develop of different computational program for drug design.															
CO5	Acquire the knowledge motion of atom in amino acid and nucleoid sequence															
CO6	Acquire the applications of molecular biology in the modern world.															
CO-PO & PSO Mapping																
COs	PROGRAMME OUTCOMES												PSOs			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
CO1	2	1	1	-	-	-	-	-	-	-	-	-	2	1		
CO2	2	2	1	1	-	-	-	-	-	-	-	-	1	1		
CO3	3	1	1	1	-	-	-	-	-	-	-	-	-	-	-	
CO4	3	2	1	1	-	-	-	-	-	-	-	-	1	-	-	
CO5	2	1	1	-	-	-	-	-	-	-	-	-	1	1	-	
CO6	2	2	2	1	-	-	-	-	-	-	-	-	1	2	1	
Avg	2.33	1.66	1.5	0.66	-	-	-	-	-	-	-	-	1.0	1.0	0.16	
UNIT:1 15 Hours																
Sequence data banks- Introduction to sequence data banks- protein sequence data bank. NBFIR-PIR, SWISSPORT, Signal peptide data bank, Nucleic acid sequence data bank –Gen bank, EMBL nucleotide sequence data bank, structural data banks- protein Data bank (PDB), The Cambridge Structural Database (CSD): Genome data bank – Metabolic pathway data: Microbial and Cellular Data Banks.																
UNIT:2 12 Hours																
systems of microbes, Hybridoma data Bank Structure, Virus Information System, Cell line Information system; other important Data Banks in the area of Biotechnology/life sciences/biodiversity.																
Sequence Analysis :Analysis Tools for Sequence Data Banks: Pair wise alignment- Dot matrix ,Needleman- Wunch algorithm, Smith –Waterman algorithm , BLAST, FASTA																



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algorithms to analyse sequence data: , Flexible sequence similarity search with FASTA3 programme , Algorithm of Multiple sequence alignment , Phylogenetic analysis	
UNIT:3	13 Hours
Secondary Structure Predictions prediction algorithms, Chao-Fasman algorithm, GOR , Hidden-Markov model, Neural Networking. PAM and BLOSUM matrix Tertiary Structure predictions: Rasmol ,Pymol Cn3D.Swiss PDB Viewer	
UNIT:4	10 Hours
Protein classifications, Fold libraries, Protein structure prediction; Fold recognition (threading), Protein structure predictions: Comparative Modeling (Homology, Advanced topics: Protein folding, Protein-ligand interactions,	
UNIT:5	
Molecular Modeling & Dynamics, Structural DNA variation ,Motif discovery and gene prediction ,Pattern matching ,Non –Redundant data set , Drug Designing ,Data Mining	
Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCs	
Text Books 1. Bryan Bergeron, Bioinformatics computing, Prentice Hall Inc. 2. Baxevanis AS and Ouellette BF, Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, Wiley International Science.	
Ref. Books 1. Tao Jiang, Ying Xu, Michael Q. Zhang, Current Topics in Computational Molecular Biology, MIT press. 2. Thomas Lengauer, Bioinformatics from genome to drug .WILEY-VCH press. 3. Mount DW, Bioinformatics: Sequence and Genome Analysis, Spring Harbor Press.	



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Subject Code	Title of the subject	L	T	P	C	QP								
23BBTPC36102	Bioinformatics Lab	0	0	2	1	A								
Course Educational Objective														
CEO1: Enable students to acquire practical skills in handling biological data using bioinformatics tools and databases														
CEO2: Equip students with the ability to apply computational methods and algorithms to solve real-world biological problems														
CEO3: Promote understanding of the integration between biology, computer science, and statistics														
Course outcomes: At the end of the course, the student will be able to														
CO1	Demonstrate the ability to retrieve and analyze biological sequence data from public databases such as NCBI, UniProt, and PDB.													
CO2	Apply sequence alignment tools (BLAST, ClustalW) to compare DNA, RNA, and protein sequences													
CO3	Perform phylogenetic analysis and interpret evolutionary relationships among organisms using computational tools.													
CO4	Utilize bioinformatics software to predict protein structure, motifs, and domains, and analyze their functional significance.													
CO5	Develop simple scripts or use computational pipelines to process and analyze large-scale biological datasets.													
CO6	Integrate computational and biological knowledge to critically evaluate and solve real-world problems in genomics, proteomics, and molecular biology.													
CO-PO & PSO Mapping														
PROGRAMME OUTCOMES														
COs	1	2	3	4	5	6	7	8	9	10	11	PSOs		
CO1												1	2	3
CO2														
CO3														
CO4														
CO														
CO														
Avg														



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Title of the subject																
Subject Code												L	T	P	C	QP
23BBTPC36003	Environment Biotechnology											3	0	0	3	A
Pre -Requisite:																
Course Educational Objective																
CEO1: To introduce the environmental biotechnology and its importance																
CEO2: To have knowledge on biodegradation processes																
Course outcomes: At the end of the course, the student will be able to																
CO1	Acquire the basic knowledge in environmental pollution and source of pollution.															
CO2	Learn about biological treatment of waste water by using different microbes.															
CO3	Understand the types of xenobiotic compounds, their adverse effect on environment and their remediation by using microbes and plants.															
CO4	Gain the idea about bio-oxidation, bioleaching and bioconversion of waste into value added products.															
CO5	Acquire knowledge about the concept of clean technology.															
CO6	Understand the use of basic microbiological techniques for product development and environmental sustainability.															
CO-PO & PSO Mapping																
		PROGRAMME OUTCOMES											PSOs			
COs	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
CO1	2	2	3	1	1	1	3	-	-	-	-	-	2	3		
CO2	1	2	3	1	2	2	3	-	-	-	-	-	3	3	3	
CO3	1	2	3	2	2	1	3	-	-	-	-	-	3	3	1	
CO4	1	1	3	1	2	2	2	-	-	-	-	-	3	3		
CO5	1	2	2	2	2	2	2						3	1		
CO6	1	2	2	2	1	2	2						3	1	1	
Avg.	1.16	1.83	2.66	1.5	1.66	1.66	2.5						2.83	2.33	0.83	
UNIT:1 [[10 Hours]]																
Introduction to environmental biotechnology, Environmental monitoring bioreporter, biomarker. Bioprospecting and biosensor technology; Introduction to environmental pollutants: Water, Soil and Air: their sources and effects. Removal of Specific Pollutants: Sources of Heavy Metal Pollution, Microbial Systems for Heavy Metal accumulation, Biosorption & detoxification mechanisms.																
UNIT:2 [10 Hours]																
Microbiology and biochemistry of wastewater treatment: Biological Treatment of anaerobic and aerobic; methanogenesis, methanogenic, acetogenic, and fermentative bacteria- technical process and conditions; Use of Genetically Engineered Organisms as emerging biotechnological processes in waste - water treatment; Applications include treatment of																



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municipal and industrial wastewaters.

UNIT:3

[10 Hours]

Biodeterioration –Principles, prevention and control, Biodegradation of xenobiotic compounds (Hydrocarbons, Detergents, Dyes and pesticides)Bioremediation and types, Phytoremediation: Use of plants for removal of organic and metallic pollutants,Common prejudices against Enzymes. Advantages & Disadvantages of Biocatalysts, Isolated enzymes versus whole cell systems. Biocatalyticapplication,

UNIT:4

[10 Hours]

Biooxidation–Direct and Indirect Mechanisms, Bioleaching and recovery of metals, Microbes in petroleum extraction; Biotechnology of fossil fuels:Desulfurization of coal, oil shales, Bioconversion of agricultural and other highly organic waste materials into gainfully utilizable products

UNIT:5[10 Hours]

Clean technologies: Composting Technology and Organic farming, biofertilizers, biopesticides, microbial polymer production and bio plastic technology. Microbial enhanced oil recovery (MEOR). Biofuels: Bio gas technology, biohydrogen, bioethahnol production. Ethicalissues in environmental biotechnology and regulatory framework.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCs

Reference Books:

1. Text book of Environmental Biotechnology by P.K.Mohapatra, I.K.International
2. of Environmental Biotechnology concept and application by Hans Joachim, Jordening, J.winter, Wiley- Vch
3. Advanced Environmental Biotechnology by S.K. Agarwal, A P H Publishing corporation
4. Environmental Biotechnology by D.K.Markandey and. Rajvaidya A P H Publishing Corporation



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Subject Code	Title of the subject	L	T	P	C	QP									
23BBTPE36001	Downstream processing Engineering	3	-	-	3										
Course Educational Objective															
CEO1: Learn the fundamentals of downstream processing															
CEO2: Understand the principle, working and application of major unit operations in Bioprocessing of industrially important products.															
Course outcomes: At the end of the course, the student will be able to															
CO1	understand the principles of major downstream operations used in a bioprocess industry such as filtration, centrifugation, extraction and chromatography.														
CO2	design and optimize the cost effective bioseparation techniques.														
CO3	understand techniques such as precipitation, coagulation and flocculation in downstream processing.														
CO4	learn product recovery and product polishing methods.														
CO5	Learn techniques of product purification.														
CO6	Learn about product purification and analysis about pure product cost.														
CO-PO & PSO Mapping															
	PROGRAMME OUTCOMES												PSOs		
COs	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	1	1	1	1	-	-	-	-	-	-	-	2	1	1
CO2	1	1	2	3	2	-	-	-	-	-	-	-	1	2	2
CO3	2	2	2	2	3	-	-	-	1	-	-	-	1	1	2
CO4	1	2	2	3	-	2	-	-	-	-	-	1	2	1	1
CO5	1	1	1												
CO6	1	1	1												
Avg.	1.33	1.33	1.5	2.25	2.0	2.0			1.0			1.0	1.5	1.25	1.5
UNIT:1							12 Hours								
Introduction; An overview of bioseparation. Role and importance of Bioseparation process in biotechnological processes. Problems and requirements of bioproduct purification. Cost-cutting strategies Characteristics of biological mixtures – Process of Classification of Bioproducts.															
UNIT:2							14 Hours								
Separation of cells and other insoluble from fermented broth. Foam separation, Precipitation, Filtration and microfiltration, centrifugation (batch, continuous, basket). Chromatography in bio separation.															
UNIT:3							10 Hours								
Cell disruption: Physical methods (osmotic shock, grinding with abrasives, solid shear, liquid shear), Chemical methods (alkali, detergents), Enzymatic methods, RO.															



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UNIT:4	14 Hours
Separation of soluble bio-products: Liquid-liquid extraction, Distillation, Absorption, Adsorption precipitation. Other bioseparation techniques like Dialysis, electro-dialysis, Liquid Electrophoresis. Products polishing : Crystallization and drying.	
UNIT:5	
Ultra-filtration: Semipermeable membranes, membrane geometry and ultrafiltration module configuration. Bioproducts -Biological activity Analysis of purity-Process economics-Capital and operating cost analysis.	
Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCs	
Text Books 1. Roger G. Harrison, Paul W. Todd, Scott R. Rudge, and Demetri Petrides, Bioseparations Science and Engineering, Oxford University Press, USA (October 31, 2002)	
2. Heinemann, Product Recovery in Bioprocess Technology, Butterworth Publication.	
Ref. Books 1. Wankat P.C, “ Rate controlled separations ”, Elsevier, 1990	
2. Asenjo J.M., “ Separation processes in Biotechnology ” Marcel Dekker Inc. 1993.	
3. Belter PA and Cussler E, “ Bioseparations ”, Wiley 1985	



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Title of the subject															
Subject Code											L	T	P	C	QP
23BBTOE001	Optimization in Engineering										3	0	0	3	A
Course Educational Objective															
CEO1: To provide basics of optimization in engineering.															
CEO2: To introduce linear and non linear programming															
Course outcomes: At the end of the course, the student will be able to															
CO1	make use of the concepts of operations research modelling approaches														
CO2	Formulate and solve engineering and managerial situations as LPP.														
CO3	Formulate and solve engineering and managerial situations as Transportation and Assignment problems.														
CO4	Determine average queue length and waiting times of queuing models.														
CO5	Concepts of non-linear programming														
CO6	Learn about genetic algorithm.														
CO-PO & PSO Mapping															
COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	1	1	1									1	2	2
CO2	1	3	1	1	1								1	1	1
CO3	1	2	2	1									2	1	1
CO4	1	2	1	1									2	2	1
	2	1	1									1	-	1	2
	2	1	1	1									2	-	1
Avg.	1.5	1.66	1.16	1.0	1.0							1.0	1.4	1.4	1.33
UNIT:1 [10 Hours]															
Introduction: Historical overview of operations research, fundamentals of OR Modeling Approach. Linear Programming: Basic assumptions, formulation, graphical method, simplex method, duality theory, primal-dual relationships, sensitivity analysis.															
UNIT:2 [12 Hours]															
Transportation and Assignment Problems: Specific features of transportation problem, streamlined simplex method for solving transportation problems, special features of assignment problems, Hungarian method for solving assignment problems. Integer programming: Special features, binary integer programming models, branch-and-bound technique, cutting-plane method..															
UNIT:3 [12 Hours]															
Dynamic Programming: Characteristics, principle of optimality, solution procedure, deterministic problems. Concepts relating to queuing systems, basic elements of queuing															



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model, role of Poison & exponential distribution, concepts of birth and death process.

UNIT:4

[14 Hours]

Non-linear programming: Introduction to non-linear programming. Unconstraint optimization: Fibonacci and Golden Section Search method. Constrained optimization with equality constraint:

UNIT:5

Lagrange multiplier, Projected gradient method Constrained optimization with inequality constraint: Kuhn-Tucker condition, Quadratic programming Introduction to Genetic Algorithm.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCs

Text Books

1. Taha H.A., Operations Research 9th Edition, Prentice Hall of India, New Delhi, 2010.
2. Kanti Swarup., Man Mohan., and Gupta, P.K., Introduction to Operations Research 7th Edition, Sultan chand& Sons, New Delhi, 2005

Ref. Books

3. P.K.Gupta, D.S.Hira, "Operations Research", S.Chand and Company Ltd
4. Hillier, F.S., and Lieberman G.J., Introduction to Operations Research, 7th Edition, TMH, 2009.
5. Kalyanmoy Deb, "Optimization for Engineering Design", PHI Learning Pvt Ltd



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Title of the subject						
Subject Code		L	T	P	C	QP
23BMGC001	Engineering Economics & Costing	2	0	0	2	A

Course Educational Objective	
CEO1: to understand the significance of the economic aspects of engineering and to become proficient in the evaluation of engineering proposals in terms of worth and cost	
CEO2: to help students to grasp various economics concepts and theories towards making economic decision.	
Course outcomes: At the end of the course, the student will be able to:	
CO1	Understanding the fundamentals of economic theory in general- concept of demand & supply, theories of production-Laws of returns
CO2	Overview of cost and revenue concepts: Understood the nature and behavior of cost, cost sheet, Break-even analysis- linear approach and understanding of depreciation with its measurement.
CO3	Acquainted with evaluation of engineering proposals (Private and public) by learning the concept of Time-value of Money, Determination of economic life of an asset, Replacement of existing asset with a new asset etc.
CO4	Familiar with Indian financial system and banking structure, idea about concept of national income –its measurement and inflation.
CO5	Ultimately learners of the subject get the benefits of understanding the diverse situation happening in the economy and able to make rational decision in the field of engineering.
CO6	Will have idea about cost benefit analysis

CO-PO & PSO Mapping																
COs	PROGRAMME OUTCOMES												PSOs			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
CO1	1	1	1	1									1	2	2	
CO2	1	3	1	1							2		1	1	1	
CO3	2	2	2	1							2		2	1	1	
CO4	1	2	1	1							2		2	2	1	
CO5	1	1	1										-	1	2	
CO6	1	1	1	1									2	-	1	
Avg.	1.16	1.66	1.16	1.0							2.0		1.6	1.4	1.33	



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UNIT:1	[12 Hours]
Engineering Economics –Meaning,Nature, Scope, Basic problems of an economy, Micro economics and Macro Economics.Demand and Supply Analysis -Meaning of demand, Demand function, Law of Demand and its exceptions, Determinants of demand, Elasticity of demand &its measurement (Simple numerical problems to be solved) Meaning of supply, Law of supply and its exception, Determinants of supply, Elasticity of supply, Determination of market equilibrium (Simple numerical problems to be solved).Theory of Production -Production function, Laws of returns: Law of variable proportion, Law of returns to scale.	
UNIT:2	[12 Hours]
Cost and revenue concepts, Elements of costs, Preparation of cost sheet, Segregation of costs into Fixed and variable costs. Basic understanding of different market structures, Price and output Determination under perfect competition (Simple numerical problems to be solved), Break Even Analysis - Linear approach (Simple numerical problems to be solved). Depreciation- Causes of depreciation, Methods of calculating depreciation (Straight line method, Declining balance method)	
UNIT: 3	[12 Hours]
Time value of money -Interest Analysis - Simple and compound, nominal and effective rate of interest, Cash flow diagrams, Principles of economic equivalence.Evaluation of engineering projects.	
UNIT:4	[12 Hours]
Overview of Indian financial system. Commercial bank, Functions of commercial bank, Central bank, Functions of Central Bank. Inflation- Meaning of inflation, types, causes, measures to control inflation. National Income - Definition, Concepts of national income, Method of measuring national income.	
UNIT:5	
Present worth method, Future worth method, Annual worth method, Internal rate of return method, Cost benefit analysis for public projects. Replacement Analysis- Determination of economic life of an asset, Replacement of existing asset with a new asset.	
Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCs	
Text Books 1. Riggs, Bedworth and Randhwa, “Engineering Economics”, McGraw Hill Education India	
Principles of Economics, Deviga Vengedasalam; Karunagaran Madhavan , Oxford University Press.	
Ref. Books 1. Engineering Economy by William G.Sullivan, ElinM.Wicks, C. PatricKoelling, Pearson R.PaneerSeelvan, “ Engineering Economics”, PHI	
Ahuja,H.L., “Principles of Micro Economics” , S.Chand& Company Ltd	



VII Semester Syllabus [Fourth Year] UG ENGINEERING IN BIOTECHNOLOGY

Title of the subject																																																																																																																																																																														
Subject Code												L	T	P	C	QP																																																																																																																																																														
23BBTPC47001	Animal Biotechnology											3	1	0	4	A																																																																																																																																																														
Course Educational Objective																																																																																																																																																																														
CEO1: To provide a basic knowledge on animal cell culture.																																																																																																																																																																														
CEO2: To provide the knowledge on application of cell culture for pharmaceutical purposes.																																																																																																																																																																														
Course outcomes: At the end of the course, the student will be able to																																																																																																																																																																														
CO1	Understand the basics of animal cell culture and culture conditions.																																																																																																																																																																													
CO2	To learn the basic concept in each area of Animal Biotechnology																																																																																																																																																																													
CO3	Acquire knowledge in optimization of media, scaling up animal cell culture, characterization and maintenance of cell lines.																																																																																																																																																																													
CO4	To learn the future prospect of the Animal Biotechnology.																																																																																																																																																																													
CO5	Students will understand the stem cell culture and its applications in tissue engineering and animal cloning.																																																																																																																																																																													
CO6	Students will learn molecular biology techniques like PCR, hybridization and RFLP.																																																																																																																																																																													
<table border="1"> <thead> <tr> <th colspan="16">CO-PO & PSO Mapping</th> </tr> <tr> <th rowspan="2">COs</th> <th colspan="12">PROGRAMME OUTCOMES</th> <th colspan="3">PSOs</th> </tr> <tr> <th>1</th> <th>2</th> <th>3</th> <th>4</th> <th>5</th> <th>6</th> <th>7</th> <th>8</th> <th>9</th> <th>10</th> <th>11</th> <th>12</th> <th>1</th> <th>2</th> <th>3</th> </tr> </thead> <tbody> <tr> <td>CO1</td> <td>2</td> <td>-</td> <td>1</td> <td>1</td> <td>-</td> <td>2</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>2</td> <td>1</td> <td>3</td> </tr> <tr> <td>CO2</td> <td>3</td> <td>1</td> <td>2</td> <td>2</td> <td>1</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>1</td> <td>2</td> <td>1</td> </tr> <tr> <td>CO3</td> <td>-</td> <td>2</td> <td>2</td> <td>3</td> <td>2</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>2</td> <td>1</td> <td>1</td> <td>2</td> </tr> <tr> <td>CO4</td> <td>-</td> <td>-</td> <td>-</td> <td>1</td> <td>2</td> <td>-</td> <td>2</td> <td>1</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>2</td> <td>1</td> <td>1</td> </tr> <tr> <td>CO5</td> <td>1</td> <td>1</td> <td>1</td> <td>-</td> <td>1</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>1</td> <td>2</td> <td>1</td> </tr> <tr> <td>CO6</td> <td>1</td> <td>2</td> <td>1</td> <td>-</td> <td>1</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>2</td> <td>3</td> <td>2</td> </tr> <tr> <td>Avg.</td> <td>1.75</td> <td>1.5</td> <td>1.4</td> <td>1.75</td> <td>1.75</td> <td>2.0</td> <td>1.0</td> <td>1.0</td> <td>-</td> <td>-</td> <td>-</td> <td>2.0</td> <td>1.5</td> <td>1.75</td> <td>1.75</td> </tr> </tbody> </table>																CO-PO & PSO Mapping																COs	PROGRAMME OUTCOMES												PSOs			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	CO1	2	-	1	1	-	2	-	-	-	-	-	-	2	1	3	CO2	3	1	2	2	1	-	-	-	-	-	-	-	1	2	1	CO3	-	2	2	3	2	-	-	-	-	-	-	2	1	1	2	CO4	-	-	-	1	2	-	2	1	-	-	-	-	2	1	1	CO5	1	1	1	-	1	-	-	-	-	-	-	-	1	2	1	CO6	1	2	1	-	1	-	-	-	-	-	-	-	2	3	2	Avg.	1.75	1.5	1.4	1.75	1.75	2.0	1.0	1.0	-	-	-	2.0	1.5	1.75	1.75
CO-PO & PSO Mapping																																																																																																																																																																														
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CO2	3	1	2	2	1	-	-	-	-	-	-	-	1	2	1																																																																																																																																																															
CO3	-	2	2	3	2	-	-	-	-	-	-	2	1	1	2																																																																																																																																																															
CO4	-	-	-	1	2	-	2	1	-	-	-	-	2	1	1																																																																																																																																																															
CO5	1	1	1	-	1	-	-	-	-	-	-	-	1	2	1																																																																																																																																																															
CO6	1	2	1	-	1	-	-	-	-	-	-	-	2	3	2																																																																																																																																																															
Avg.	1.75	1.5	1.4	1.75	1.75	2.0	1.0	1.0	-	-	-	2.0	1.5	1.75	1.75																																																																																																																																																															
UNIT:1 (10 Hours) Animal Biotechnology Equipments and materials for animal cell, culture technology, Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium, Development of primary culture. Development of cell line by enzymatic disaggregation, Biology and characterization of the cultured cells, measuring parameters of growth																																																																																																																																																																														
UNIT:2 (10 Hours) Different type of cell culture media, growth supplements, serum free media, balanced salt solution, other cell culture reagents, culture of different tissues and its application. Behavior of cells in culture, division, their growth pattern, metabolism of estimation of cell number.																																																																																																																																																																														



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UNIT:3	(10 Hours)
Measurement of viability and cytotoxicity; Scaling up the cell culture to large scale/industrial level production, Development of cell lines, characterization and maintenance of cell lines, cryopreservation, common cell culture contaminants. Culture of cells for production of various biologicals.	
UNIT:4	(10 Hours)
Application of animal cell culture, Embryonic stem cell and their application, Stem Cell culture, Transfection of animal cells with its applications, Hybridoma technology, Organ culture technology, Future tissue engineering, Animal cloning.	
UNIT:5(10 Hours)	
Bacterial and viral diseases in animals; monoclonal antibodies and their use in diagnosis; molecular diagnostic techniques like PCR, insitu hybridization; northern and southern blotting; RFLP.	
Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCs	
Ref. Books	
<ol style="list-style-type: none">1. Animal cell culture by R.I. Freshney2. Animal Biotechnology by P.Ramadas3. In vitro cultivation of Animal cells by Dr.C.K.Leach, Butterworth and Heinemann Ltd.1994.4. Hand book of Animal Husbandry by Gopalakrishnan .5. A Text Book of Biotechnology R C Dubey, S Chand publication6. Animal Cell Culture by John R.W. Masters; Oxford University Press7. Introduction to Cell and Tissue Culture by Jennie P. Mather and Penelope E. Roberts; Plenum Press, New York and London8. Molecular Biotechnology: Primrose.9. Animal Cell Biotechnology: R.E. Spier and J.B. Griffiths (1988), Academic press.	



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Subject Code	Title of the subject	L	T	P	C	QP
23BBTPC47002	Medical and Pharmaceutical Biotechnology	3	0	0	3	A

Course Educational Objectives

CEO1: To provide knowledge on pharmaceutical techniques and new generation antibiotics.

CEO2: To deliver practical knowledge on different diagnosis techniques

Course outcomes: At the end of the course, the student will be able to

CO1 understand the production of genetically developed pharmaceutical products

CO2 comprehend genetically disease and diagnosis

CO3 learn about the role of proteomics in drug development

CO4 Know about the diagnostic kits and its importance

CO5 Learn on use of molecules for detection of diseases

CO6 Separate protein and identify its characteristic

COs	CO-PO & PSO mapping												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	2	2										2	1	3
CO2	2	2	1										1	2	1
CO3	1	-	1										1	1	2
CO4	-	1	1								1		2	1	1
CO5	1	-	-										1	2	1
CO6	1	2	2										2	3	2
Avg	1.0	1.75	1.4									1.0	1.5	1.75	1.75

UNIT:1 [10 Hours]

Production of pharmaceuticals by genetically engineered techniques: hormones (insulin and growth hormones), interferons. Microbial transformation for production of important pharmaceuticals: types of reactions, Biotransformation of Steroids, Biotransformation of Antibiotics, Generation of antibiotics- Penicillin and Cephalosporin.

UNIT:2 [10 Hours]

Protein engineering: methods and application of protein engineering, Drug design: Methods of drug design, Drug targeting passive and active of drug targeting, advantages and disadvantages. Use of enzymes in clinical diagnosis: important enzymes in disease diagnosis, Enzymes in diseases Prevention and treatment.



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UNIT:3	[10 Hours]
Use of biosensors for rapid clinical analysis: Parts of a biosensor, application of biosensor in medical sciences, Diagnostic kit development: importance of diagnostic kit for detection of disease. <i>In vitro</i> testing for microanalysis,	
UNIT:4	[10 Hours]
Genetic diseases and DNA based diagnoses: types of genetic diseases, DNA based diagnoses: direct and indirect detection of diseases, Gene Therapy: types of gene therapy and success, DNA vaccine, ELISA	
UNIT: 5	[10 Hours]
Toxicogenomics: concept, types and application of toxicogenomics. Proteomics in Drug Development: Drug development process, applications of proteomics in the drug industry. Diagnosis of disease by Proteomics. Separation and identification techniques for protein analysis, Pharmaceutical products and their control: Therapeutically categories such as laxatives, analgesics, non-steroid contraceptives, antibodies and biologicals hormones.	
Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCs	
Reference Books	
1. Stanbury.P.F, Whitaker.A and Hall.S.J, "Principles of Fermentation Technology", 2nd Edition, Aditya Books (P) Ltd, 1995.	
2. Molecular Diagnosis of Infectious Diseases (Methods in Molecular Medicine) by Jochen Decker, U. Reischl	
3. Gary Walsh, "Pharmaceutical Biotechnology-Concepts and Applications," Wiley, 2007	
4. Epenetos.A.A.(ed), Monoclonal antibodies: applications in clinical oncology, Chapman and Hall Medical, London	
5. Text book of industrial pharmacy by S R Hiremath, Orient Black Swan publication.	
6. Leon and Lachman et al- Theory and Practice of Industrial pharmacy.	



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Title of the subject																
Subject Code												L	T	P	C	QP
23BBTPC47003	Food Biotechnology											3	0	0	3	A
Pre -Requisite:																
Course Educational Objective																
CEO1:To provide knowledge on food production technology																
CEO2: To have idea on food preservative technologies																
Course outcomes: At the end of the course, the student will be able to																
CO1	understand the composition of major food products ,analysis of food quality and food production technology.															
CO2	understand the role of beneficial enzymes in food processing and preservation.															
CO3	To quantitate and identify the spoilage microorganisms present in food, technology used to control or destroy micro organism commonly found in food.															
CO4	understand the role of beneficial microorganisms in food processing.															
CO5	To learn the concepts of technology in food preservation.															
CO6	To follow the regulations and ethical issues of food safety by using good manufacturing practices in industry															
CO-PO & PSO Mapping																
PROGRAMME OUTCOMES																
COs													PSOs			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
CO1	1	-	-	2	1	1	-	-	-	-	-	-	2	1	3	
CO2	-	2	1	-	2	2	-	-	-	-	-	-	1	2	1	
CO3	-	-	-	1	3	2	-	-	-	-	-	1	1	1	2	
CO4	-	1	-	2	-	1	2	-	-	-	-	-	2	1	1	
CO5	1	-	-	1	-	-	-	-	-	-	-	-	1	2	1	
CO6	1	-	-	1	-	-	-	-	-	-	-	-	2	3	2	
Avg.	1.0	1.5	1.0	1.4	2.0	1.5	2.0	-	-	-	-	-	1.5	1.75	1.75	
UNIT:1 10 Hours																
Food quality and Production technology Analysis of food, major ingredients present in different product, Food additives colour, flavour, vitamins, Single cell protein, mushroom, Fermentative production of food, Pickling and alcoholic beverages, Genetically manipulated crop based food, oriental foods, probiotics/ prebiotics in food products.																
UNIT:2 10 Hours																
Technology for improved process: Enzyme in bakery, fermented cereal products, Enzymes in fat/oil industries, Protease in cheese making, enzymes in beverage production, Utilization of food waste for production of value added products, enzymes in sugar syrup, genetically modified food.																



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UNIT:3	10 Hours
Food spoilage and control Spoilage of food, Rapid methods for identification of microorganism in food, Chemical safety of food products, Detection of heavy metal, fungal toxins, pesticide and herbicide contamination,	
UNIT:4	10Hours
Microbiology of fruits & vegetable and products like jam, jelly, sauce, juice; Microbiology of cereal and cereal products like bread, biscuits, confectionary. Microbiology of milk & milk products like cheese, butter, ice-cream, milk powder; Microbiology of meat, fish, poultry & egg and their products.	
UNIT:5	10 Hours
Food preservatives and additives, Post-harvest technology for food preservation– canning, dehydration, ultrafiltration, sterilization, irradiation, Pasteurization, Low temperature, Legal status of irradiated food and preservatives, Concept of HACCP, Hazop, codex alimentarius, ISO series.	
Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCs	
Ref. Books	
1. Food Biotechnology by V K. Joshi and R.S. Singh, I K International Publishing House.	
2. Food Biotechnology by Rita Singh , Global vision publishing house	
3.Fundamental of food biotechnology by Byong H. Lee, Wiley-BCH.	
4. Food biotechnology by S.C. Bhatia, WPI Publishing	
5.Fundamentals of Food Biotechnology by Lee	



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Title of the subject																
Subject Code	Seventh Semester											L	T	P	C	QP
23BBTPE47001	Nanobiotechnology											3	0	0	3	A
Pre -Requisite:																
Course Educational Objective																
CEO1: To provide the knowledge on importance on nano biotechnology and its application.																
CEO2: To have an idea about the application of nano biotechnology in industry and allied sciences at the end of course, student will be able.																
Course Outcome																
CO1	Learn the concept of "nanotechnology" and its interdisciplinary aspects.															
CO2	Students will learn various approaches to synthesize Nanomaterials and their advantages and limitations.															
CO3	Learn the various techniques used for the characterization of nanomaterials.															
CO4	Understand the importance of engineered nanomaterials for biomedical, therapeutic and environmental applications.															
CO5	Get the knowledge on the functions of biologically existing various bio-nanomotors and bio-nanomachines.															
CO6	Evaluate the potential toxic effects of nanotechnology on living organisms and the environment.															
CO-PO & PSO Mapping																
	PROGRAMME OUTCOMES												PSOs			
COs	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
CO1	2	-	-	-	1	-	2	-	-	-	-	-	2	1	3	
CO2	1	-	1	2	1	2	-	-	-	-	-	-	1	2	1	
CO3	3	2	2	1	1	-	-	-	-	-	-	1	1	1	2	
CO4	1	-	2	2	3	2	-	-	-	-	-	-	2	1	1	
CO5	2	1	3	2	1	2	-	-	-	-	-	-	1	2	1	
CO6	1	2	2	1	1	1	-	-	-	-	-	-	2	3	2	
Avg.	1.66	1.66	2.0	1.6	1.33	1.75	2.0	-	-	-	-	1.0	1.5	1.75	1.75	
UNIT:1 [10 Hours]																
Basic Concepts of Nanoscience: Importance of "Nano" dimension, size matters: bulk vs nanomaterials, nanotechnology exists in nature, brief history of nanotechnology, applications of nanotechnology, challenges and future prospects, Properties of nanomaterials (electrical, thermal, mechanical, optical, chemical), classification of nanostructured materials, surface effects of nanomaterials																
UNIT:2 [12 Hours]																
Synthesis of Nanomaterials: Bottom-up and bottom-down approaches: milling, arc discharge, laser ablation, spray pyrolysis, chemical vapor deposition, physical vapor deposition, wet chemical synthesis of nanoparticles, self-assembled monolayer, biogenic synthesis of nanoparticles: microbial and plant mediated, surface functionalization of nanomaterials.																
UNIT:3 [10 Hours]																
Characterization of nanostructures: UV-Vis Spectroscopy, FTIR; Electron microscopy: Scanning electron microscopy, EDX, Transmission electron microscopy, Atomic force microscopy,																



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DLS, TGA.

UNIT:4

[12 Hours]

Nanomaterials for Biological Applications: Current status of nanobiotechnology, biological applications of functionalized nanomaterials, Biological nanomachines: ribosomes, photosynthesis systems, Bionanomotors, Nano-antimicrobials, Immobilized nanoparticles for water disinfection and biopesticides delivery applications.

UNIT:5

[12 Hours]

Biomedical Applications and Nanotoxicity: Biopolymers, Polymeric biomaterials, lipid nanoparticles for drug delivery applications, magnetic nanoparticles based hyperthermia treatment of cancer, DNA nanotechnology, Nano-biosensors: fabrication, functionalization, applications, Cytotoxic and genotoxic effects of nanomaterials, toxic effects on environment, impact of nanotechnology on society and industry.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCs

Ref. Books

1. Gabor L. Hornyak., H.F. Tibbals, Joydeep Dutta, John J. Moore, Introduction to Nanoscience and Nanotechnology, CRC Press, 2008.
2. "Nanostructures and Nanomaterials: Synthesis, Properties and Applications", G. Cao, Imperial College Press (2004)
3. Nanobiotechnology; Concepts, Applications and Perspectives", C. M. Niemeyer, C. A. Mirkin, Wiley-VCH (2004)
4. Stuart M. Lindsay, Introduction to Nanoscience, Oxford University Press, 2009.
5. Poole C., and Owens F., Introduction to Nanotechnology, John Wiley, New Jersey, 2003.



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Title of the Course															
Subject Code	PROCESS INSTRUMENTATION										L	T	P	C	QP
23BBOE47001											3	0	0	3	
Pre -Requisite: Instruments and spectroscopy.															
Course Educational Objective															
CEO1: Troubleshoot electronics and instrumentation systems using current equipment and systems.															
CEO2: Analyze and solve problems in electronics and instrumentation systems dealing with meters and instruments.															
CEO3: To Conduct, analyze, and interpret experimental results to improve process.															
Course Outcome															
At the end of this course students will be able to demonstrate the ability to															
CO1	State and summarize the different flow, level, temperature and pressure measuring devices used in instrumentation.														
CO2	Describe the process of measuring different environmental factors.														
CO3	Test the outcomes of measurement and minimize the possible error by various techniques.														
CO4	Design the various meters with their specification, working and applications.														
CO5	Understand about the Absorption techniques														
CO6	Learn about different methods to measure temperature														
CO-PO & PSO Mapping															
		PROGRAMME OUTCOMES											PSOs		
Cos	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	1	1										2	3	
CO2	3	2	2										3	3	3
CO3	2	2	2										3	3	1
CO4	2	1	2										3	3	
CO5	1	1	1										3	1	
CO6	1	1	1										3	1	1
Avg.	2.4	2.4	1.5										2.83	2.33	0.83
UNIT I [8 Hours]															
BASIC CONCEPTS AND QUALITIES OF MEASUREMENT: Introduction; Measurement and its Aim; The Functional Elements of an Instrument; Performance Characteristics; Statistical Analysis.															
UNIT II [15 Hours]															
LEVEL MEASUREMENT: Methods of Liquid Level Measurement, Direct Methods – Hook-type Level Indicator, Sight Glass, Float-type Level Indicator; Displacer Level Detectors; Indirect Methods – Hydrostatic Pressure Type, and Electrical Methods.															
FLOW MEASUREMENT: Methods of Flow Measurement; Inferential Flow Measurement; Quantity Flow meters; Mass Flowmeters; Calibration of Flowmeters; Selection of															



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Flowmeters.

UNIT III

[15 Hours]

PRESSURE MEASUREMENT: Pressure; Methods of Pressure Measurement; Manometers; Elastic Pressure Transducers; Measurement of Vacuum; Force-Balance Pressure Gauges; Electrical Pressure Transducers; Pressure Switches; Calibration of Pressure Measuring Instruments; Maintenance and Repair of Pressure Measuring Instruments; Troubleshooting.

UNIT IV

[8 Hours]

METHODS OF COMPOSITION ANALYSIS: Spectroscopic Analysis; Absorption Spectroscopy; Emission Spectroscopy; Mass Spectroscopy.

UNIT:V

[10 Hours]

TEMPERATURE MEASUREMENT: Temperature; Temperature Scales; Methods of Temperature Measurement; Expansion Thermometers; Filled-System Thermometers; Electrical Temperature Instruments; Pyrometers.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCs

Text Books:

1. Industrial Instrumentation and Control, 3rd ed. by S K Singh, McGraw-Hill.
2. Industrial Instrumentation by D P Eckman, CBS.

Reference Books:

1. Principles of Measurement Systems, 3rd ed. by J P Bentley, PHI.
2. Instrumentation: Devices and Systems, 2nd ed. by C Rangan, G Sarma, and V S V Mani, McGraw-Hill.



VIII Semester Syllabus [Fourth Year] UG ENGINEERING IN BIOTECHNOLOGY

Subject Code		Title of the subject											L	T	P	C	QP
23BBTPE48001		Protein Engineering											3	0	0	3	A
Course Educational Objective																	
CEO1: To provide importance and application of protein engineering.																	
CEO2: To have an idea about industrial important enzymes.																	
Course outcomes: At the end of the course, the student will be able to																	
CO1	Gain the knowledge about different forces acting on protein structure interactions and protein engineering applications.																
CO2	Know thermodynamic and chemical principle of proteins																
CO3	Have the knowledge in the features, design principles of protein.																
CO4	Understand the computational approaches of protein engineering.																
CO5	Gain the knowledge on techniques of stabilization protein																
CO6	Understand the biophysical techniques used in protein characterization.																
CO-PO & PSO Mapping																	
COs	PROGRAMME OUTCOMES												PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3		
CO1	1	-	2	1	2	-	-	-	-	-	-	-	2	1	3		
CO2	2	1	2	2	-	-	-	-	-	-	-	-	1	2	1		
CO3	-	2	1	3	2	-	-	-	-	-	-	-	1	1	2		
CO4	-	-	2	1	3	-	-	-	-	-	-	1	2	1	1		
CO5	2	1	1	2	-	-	-	-	-	-	-	-	1	2	1		
CO6	1	2	2	1	1	-	-	-	-	-	-	-	2	3	2		
Avg.	1.5	1.5	1.75	1.75	1.25	-	-	-	-	-	-	-	1.0	1.5	1.75	1.75	
UNIT:1 (12 Hours)																	
Overview of protein structure and its hierarchical architecture; Protein engineering – definition, applications; Forces stabilizing proteins – Van der waals, electrostatic, hydrogen bonding and weakly polar interactions, hydrophobic effects. Structural features of protein, Ramachandran map, Protein-protein, Protein-DNA, protein-ligand interactions. Protein structure-function relationship.																	
UNIT:2 (10 Hours)																	
Stability of Protein Structure: Laws of thermodynamics, heat, energy and work, chemical equilibrium flexibility, reversible folding and unfolding, pH titration, chemical denaturation, thermal denaturation, solvent perturbation and chemical modification.																	
UNIT:3 (11 Hours)																	
Features or characteristics of proteins that can be engineered- affinity and specificity;																	



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Experimental methods of protein engineering: Rational designing, Directed evolution like site directed mutagenesis, Module shuffling, Guided protein recombination, etc.; Computational Approaches to protein engineering.

UNIT:4

(10 Hours)

Mechanism of stabilization of proteins from psychrophiles and thermophiles vis-à-vis those from mesophiles; Protein and enzyme engineering case studies for its stability, specificity and affinity- Protease, Lipase and Lysozyme. Role of solvent.

UNIT:5

(10 Hours)

Characterization of proteins: NMR spectroscopy, crystallography, spectroscopic (UV-Vis, CD, IR, Florescence), calorimetric methods, Viscometry, Molecular sieve chromatography, Electrophoresis, EPR in protein structure and function analysis with example.

Teaching Methods: Chalk & Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCs

Text Books 1. Edited by T E Creighton, Protein function. A practical approach, 2nd Edition, Oxford university press.

2. Cleland and Craik, Protein Engineering, Principles and Practice, Vol 7, Springer Netherlands.

3. Mueller and Arndt., Protein engineering protocols, 1st Edition, Humana Press.

4. L. Alberghina, Protein Engineering for industrial biotechnology, Harwood Academic Publisher



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Title of the subject															
Subject Code											L	T	P	C	QP
23BBTPE48002	IPR, Bioethics and Bio safety										3	0	0	3	A
Pre -Requisite:															
Course Educational Objective															
CEO1: To provide the knowledge on importance on IPR in Biotechnology.															
CEO2: To introduce biosafety regulations and its application in biotechnology															
Course outcomes: At the end of the course, the student will be able to															
CO1	Distinguish and explain various forms of IPRs and responsibilities of holder of Patent, Copyright, Trademark, Industrial Design etc														
CO2	Identify criteria's to fit one's own intellectual work in particular form of IPRs.														
CO3	Identify procedure to protect different forms of IPRs national and international level.														
CO4	Understand the professional responsibilities to maintain biosafety.														
CO5	Students will understand the social and ethical issues related to plant, animal and modern biotechnology.														
CO6	Develop skill of making search using modern tools and techniques.														
CO-PO & PSO Mapping															
COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
CO1	2	-	-	1	2	3	-	-	-		-	-	2	1	
CO2	-	-	2	-	-	3	2	-	-	-	-	-	1	2	
CO3	-	-	1	-	-	3	2	-	1	-	-	-	1	1	
CO4	-	-	-	2	-	-	2	3	1	-	-	2	2	1	
CO5	-	-	-	-	-	1	2	3	-	-	2	-	1	2	
CO6	-	1	-	2	3	-	-	-	-	-	-	1	2	3	
Avg.	2.0	1.0	1.5	1.66	2.5	2.5	2.0	3.0	1.0		2.0	1.5	1.5	1.75	



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UNIT:1	[10 Hours]
Concept of property, rights, duties and their correlation; Intellectual property rights and its types- Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of new GMOs; Process patent vs product patent; IP as a factor in R&D; IPs of relevance to Biotechnology and few Case Studies.	
UNIT:2	[10 Hours]
Basic requirement of a patentable invention- novelty, inventive step, Prior art and State of art; Patent databases; Searching International Databases; Analysis and report formation; Indian Patent Act 1970 and Recent Amendments; Filing of a patent application; Precautions before patenting- disclosure/non-disclosure. WIPO Treaties;	
UNIT:3	[10 Hours]
International framework for the protection of IP; Introduction to History of GATT, WTO, WIPO and TRIPS; Budapest Treaty; PCT and Implications; Role of a Country Patent Office; Procedure for filing a patent, International patenting-requirement, Patent infringement- meaning, scope, litigation, remedies; Case studies and examples-Rice, Neem etc.	
UNIT:4	[10 Hours]
Introduction to Biosafety regulations; Primary Containment for Biohazards and Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals; Biosafety guidelines - Government of India. Definition of GMOs & LMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs.	
UNIT:5	[10 Hours]
Overview of National Regulations and relevant International Agreements including Cartagena Protocol. Concept of Bioethics, Public concerns on Human genome research and transgenics- Genetic testing and screening, Ethics in clinical trials and GCP, ELSI & Human genome projects; Ethics in human cloning- a case study.	
Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCs	
Text Books 1. Stanley SA, Bioethics, Wisdom educational services 2. Sateesh MK, Bioethics and Biosafety, IK International Pvt. Ltd. 3. Text Book on Intellectual Property Rights, N K Acharya, Asia Law House	



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Title of the Course																
Subject Code	BIOMEDICAL										L	T	P	C	QP	
23BEETOE48001	INSTRUMENTATION										3	0	0	3	A	
Pre -Requisite: Biomedical equipments, tissues, cells and electrodes.																
Course Educational Objective																
CEO1: With widespread use and requirements of medical instruments, this course gives knowledge of the principle of operation and design of biomedical instruments.																
CEO2: It attempts to render a broad and modern account of biomedical instruments.																
CEO3: It gives the introductory idea about human physiology system which is very important with respect to design consideration.																
Course Outcome																
At the end of the course, students will be able to:																
CO1	Define and recognize several signals which are drawn out from the human body.															
CO2	Describe divergent physical inabilities in living body by biomedical electrodes.															
CO3	Examine & interpret the simulated and experimental data.															
CO4	Summarize the various recorders and blood flowmeters															
CO5	Un															
CO6	Learn about the medical recording instruments															
CO – PO & PSO mapping of Biomedical Instrumentation																
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	
CO1	3	1	-		-	-	-	-	-	-	-	-	2	1	3	
CO2	2	3	-		-	-	-	-	-	-	-	-	1	2	1	
CO3	3	-	-	3	-	-	-	-	-	-	-	-	1	1	2	
CO4	2	3	-		-	-	-	-	-	-	-	-	2	1	1	
CO5	1	1											1	2	1	
CO6	1	1											2	3	2	
Average	2.5	1.75	-	.75	-	-	-	-	-	-	-	-	1.5	1.75	1.75	
UNIT: I [12 Hours]																
FUNDAMENTALS OF MEDICAL INSTRUMENTATION: Sources of Biomedical Signals; Basic Medical Instrumentation System; Performance Requirements of Medical Instrumentation Systems; Intelligent Medical Instrumentation Systems - Use of Microprocessors in Medical Instruments, PC Based Medical Instruments; General Constraints in Design of Medical Instrumentation Systems; Regulation of Medical Devices.																



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BIOELECTRIC SIGNALS AND ELECTRODES: Origin of Bioelectric Signals; Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Recording Electrodes - Electrode-Tissue Interface, Polarization, Skin Contact Impedance, Motion Artefacts; Silver-Silver Chloride Electrodes; Electrodes for ECG, EEG, EMG; Microelectrodes.

UNIT: II [16 Hours]

PHYSIOLOGICAL TRANSDUCERS: Introduction; Classification of Transducers; Performance Characteristics of Transducers; Displacement, Position and Motion Transducers; Pressure Transducers; Transducers for Body Temperature Measurement; Photoelectric Transducers; Biosensors; Smart Sensors.

RECORDING SYSTEMS: Basic Recording System; General Considerations for Signal Conditioners; Preamplifiers - Differential Amplifier, Isolation Amplifier; Sources of Noise in Low Level Measurements - Electrostatic and Electromagnetic Coupling to AC Signals, Proper Grounding (Common Impedance Coupling); Biomedical Signal Analysis Techniques; Signal Processing Techniques; Writing Systems: Direct Writing Recorders, The Ink Jet Recorder, Potentiometric Recorder, Digital Recorders.

UNIT: III [10 Hours]

PATIENT MONITORING SYSTEMS: System Concepts; Measurement of Heart Rate; Blood Pressure Measurement; Measurement of Respiration Rate.

BLOOD FLOWMETERS: Electromagnetic Blood Flowmeters; Ultrasonic Blood Flowmeters; NMR Blood Flowmeter; Laser-Doppler Blood Flowmeter.

UNIT: IV [6 Hours]

PATIENT SAFETY: Electric Shock Hazards; Leakage Currents; Safety Codes for Electro medical Equipment.

UNIT: V [8 Hours]

BIOMEDICAL RECORDERS: Electrocardiograph (ECG); Phonocardiograph (PCG); Electroencephalograph (EEG); Electromyograph (EMG).

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCs

Text Books:

Hand Book of Biomedical Instrumentation, 2nd Edition by R S Khandpur, Tata McGraw Hill 2003 (Chapters 1, 2, 3, 4, 5, 6, 11, 18)

Biomedical Instrumentation and Measurements, 2nd Edition by Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, PHI Pvt. Ltd.

Reference Books:

Introduction to Biomedical Equipment Technology, 4th Edition by Joseph J. Carr, John M. Brown, Pearson Education 2007.