RAJALAKSHMI ENGINEERING COLLEGE
DEPARTMENT OF BIOTECHNOLOGY
CURRICULUM AND SYLLABUS REGULATIONS – 2023
B.TECH –BIOTECHNOLOGY
CHOICE BASED CREDIT SYSTEM

RAJALAKSHMI ENGINEERING COLLEGE

(An Autonomous Institution Affiliated to Anna University Chennai)

DEPARTMENT OF BIOTECHNOLOGY

CURRICULUM AND SYLLABUS REGULATIONS – 2023

B. TECH –BIOTECHNOLOGY

CHOICE BASED CREDIT SYSTEM

VISION OF THE INSTITUTION

To be an institution of excellence in Engineering, Technology and Management Education & Research.

To provide competent and ethical professionals with a concern for society.

MISSION OF THE INSTITUTION

To impart quality technical education imbibed with proficiency and humane values

To provide right ambience and opportunities for the students to develop into creative, talented and globally competent professionals

To promote research and development in technology and management for the benefit of the society

VISION OF THE DEPARTMENT

To be a department of academic excellence focused on education, research and development and to conquer the frontiers of biotechnology, benefitting the society.

MISSION OF THE DEPARTMENT

- To impart quality technical education

- To continuously enhance and enrich the teaching / learning process

- To provide an ambience for overall development of the students to be more creative, innovative and globally competent ethical professionals

- To promote research and develop technologies and products for the sustenance and wellbeing of the society

PROGRAM EDUCATIONAL OBJECTIVES
This program enables Biotechnology graduates

I. To apply knowledge across the disciplines and in emerging areas of biotechnology for higher studies, research, employability and product development

II. To develop communication skills, sense of responsibility to protect the environment and ethical conduct towards their profession and commitment to serve the society

III. To possess academic excellence, managerial skills, leadership qualities and understand the need for lifelong learning for a successful professional career

PROGRAM OUTCOMES

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems

2. **Problem Analysis:** Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

3. **Design and Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal and environmental considerations.

4. **Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering

and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable development.

8. **Ethics:** Apply the ethical principles and commit to professional ethics and responsibilities and norms of engineering practices.

9. **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively in complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions.

11. **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and a leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long Learning:** Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES

1. To apply the knowledge and solve problems through clinical research and improve health related issues of the society
2. To design, develop processes and bioproducts for health care
3. Apply basic skills in Engineering to promote interdisciplinary research in Biotechnology

CURRICULUM

SEMESTER – I

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	Total Hours	Total Credits	Category
THEORY & PRACTICALS								
1	HS23111	Technical Communication I	2	0	0	2	2	HS
2	MA23112	Algebra and Calculus	3	1	0	4	4	BS
3	CY23132	Chemistry for Technologists	3	0	2	5	4	BS
4	GE23111	Engineering Graphics	2	0	4	6	4	ES
5	GE23121	Engineering Practices- (Civil and Mechanical)	0	0	2	2	1	ES
6	BT23131	Microbiology	2	0	4	6	4	PC
7	MC23112	Audit Course I (Environmental Science and Engineering)	3	0	0	3	0	MC
8	GE23117	தமிழர்மரபு /Heritage of Tamils	1	0	0	1	1	HS
		TOTAL	**16**	**3**	**8**	**27**	**20**	

SEMESTER – II

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	Total Hours	Total Credits	Category
THEORY& PRACTICALS								
1	HS23221	Technical Communication II	0	0	2	2	1	HS
	HS23222	English for Professional Competence						
2	MA23212	Differential Equations and Complex Variables	3	1	0	4	4	BS
3	PH23231	Physics for Bioscience	3	0	2	5	4	BS
4	GE23231	Programming using Python	1	0	4	5	3	ES
	GE23212	Basic Civil and Mechanical Engineering	3	0	0	3	3	ES
5	BT23211	Biochemistry	3	0	0	3	3	PC
6	MC23111	Audit Course II (Indian Constitution and Freedom Movement)	3	0	0	3	0	MC
7	GE23217	தமிழரும் தொழில்நுட்பமும் /Tamils and Technology	1	0	0	1	1	HS
8	BT23221	Biochemistry Laboratory	0	0	4	4	2	PC
		TOTAL	**17**	**1**	**12**	**30**	**21**	

SEMESTER –III

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	Total Hours	Total Credits	Category
THEORY & PRACTICALS								
1	MA23311	Transforms and Applied Partial Differential Equations	3	1	0	4	4	BS
2	BT23311	Enzyme Technology and Biotransformations	3	0	0	3	3	PC
3	BT23312	Stoichiometry and Fluid Mechanics	3	1	0	4	3	ES
4	BT23313	Molecular Genetics	3	0	0	3	3	PC
5	BT23314	Cell Biology	3	0	0	3	3	PC
6	BT23321	Basic Food and Enzyme Technology Laboratory	0	0	2	2	1	ES
7	BT23331	Analytical Techniques in Biotechnology	2	0	2	4	3	ES
		TOTAL	**17**	**2**	**4**	**23**	**20**	

SEMESTER –IV

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	Total Hours	Total Credits	Category
THEORY								
1	MA23431	Probability, Statistics and Reliability	3	0	2	5	4	BS
2	BT23411	Food Biotechnology	3	0	0	3	3	ES
3	BT23412	Genetic Engineering	3	0	0	3	3	PC
4	BT23413	Thermodynamics and Heat transfer	3	1	0	4	3	ES
5	BT23414	Basic Industrial Biotechnology	3	0	0	3	3	PC
PRACTICALS								
6	CS23422	Python Programming for Machine Learning	0	0	4	4	2	ES
7	BT23421	Chemical Engineering Laboratory for Biotechnologists	0	0	4	4	2	ES
8	BT23422	Molecular Biology and Genetic Engineering Laboratory	0	0	4	4	2	PC
9	GE23421	Soft skills - I	0	0	2	2	1	EEC
		TOTAL	**15**	**2**	**14**	**32**	**23**	

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	Total Hours	Total Credits	Category
THEORY								
1	BT23511	Bioprocess Principles	3	0	0	3	3	PC
2	BT23512	Bioinformatics	3	0	0	3	3	PC
3	BT23513	Separation Process Principles	3	1	0	4	3	ES
4		Professional Elective I	3	0	0	3	3	PE
5		Professional Elective II	3	0	0	3	3	PE
6		Professional Elective III	3	0	0	3	3	PE
PRACTICALS								
7	BT23521	Bioprocess Laboratory- I	0	0	4	4	2	PC
8	BT23522	Bioinformatics Laboratory	0	0	4	4	2	PC
9	GE23521	Soft Skills-II	0	0	2	2	1	EEC
		TOTAL	**18**	**1**	**8**	**27**	**23**	

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	Total Hours	Total Credits	Category
THEORY								
1	BT23611	Bioprocess Technology	3	0	0	3	3	PC
2	BT23612	Chemical Reaction Engineering	3	0	0	3	3	ES
3		Professional Elective IV	3	0	0	3	3	PE
4		Professional Elective V					3	PE
5		Professional Elective VI					3	PE
6		Open Elective I	3	0	0	3	3	OE
PRACTICALS								
7	BT23621	Bioprocess Laboratory II	0	0	4	4	2	PC
8	BT23622	Innovation and Design Thinking for Biotechnologists	0	0	4	4	2	EEC
9	BT23623	Numerical Programming for Biotechnologists	0	0	2	2	1	PC
10	GE23622	Problem Solving Techniques	0	0	2	2	1	EEC
		TOTAL	**15**	**0**	**20**	**35**	**24**	

SEMESTER – VII

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	Total Hours	Total Credits	Category
THEORY								
1	BT23711	Downstream Processing	3	0	0	3	3	PC
2	BT23712	Immunology	3	0	0	3	3	PC
3	BT23713	Protein Engineering	3	0	0	3	3	PC
4	BT23714	Comprehensive Course for Biotechnologists	2	0	0	2	2	PC
5		Open Elective II	3	0	0	3	3	OE
PRACTICALS								
6	BT23721	Downstream Processing Laboratory	0	0	4	4	2	PC
7	BT23722	Immunology lab	0	0	4	4	2	PC
8	BT23723	Artificial Intelligence and Machine Learning for Biotechnologist	0	0	4	4	2	PC
9	BT23724	Industry Training (2 weeks Training during vacation)	0	0	0	0	1	EEC
10	CR23P62	Microfluidics Laboratory	0	0	2	2	1	ES
		TOTAL	**17**	**0**	**14**	**28**	**22**	

SEMESTER – VIII

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	Total Hours	Total Credits	Category
PRACTICALS								
1	BT23821	Project Work	0	0	24	24	12	EEC
		TOTAL			**24**	**24**	**12**	

TOTAL CREDITS: 165

PROFESSIONAL ELECTIVE VERTICAL LIST

VERTICAL I	VERTICAL II	VERTICAL III	VERTICAL IV	VERTICAL V	VERTICAL VI
Bioprocess & biochemical Technology	**Biosciences**	**Medical Biotechnology**	**Animal Biotechnology**	**Computational Biotechnology**	**Agro and Marine Biotechnology**
BT23A11 Bioprocess control and Instrumentation	BT23B21 Bioentrepreneur-ship and Patent Design	BT23C31 Human Genetics	BT23D41 Fundamentals of Animal Biotechnology	BT23E51 Programming for Bioinformatics Applications	BT23F61 Fundamentals of Plant Biotechnology
BT23A12 Bioprocess Economics and plant Design	BT23B22 Fundamentals of Nano Biotechnology	BT23C32 Cancer Biology	BT23D42 Molecular Pathogenesis	BT23E52 Computer Aided Drug Design	BT23F62 Therapeutic Applications of Phytochemicals
BT23A13 Bioreactor consideration for recombinant products	BT23B23 Biomaterial Engineering	BT23C33 Biopharmaceutical Technology	BT23D43 Animal Cell Culture technology	BT23E53 Molecular Modelling	BT23F63 Marine Biotechnology
BT23A14 Advances in Bioenergy and Biofuels	BT23B24 Genome Editing	BT23C34 Clinical Biochemistry	BT23D44 Advanced Immunotechnology	BT23E54 Fundamentals of Algorithms for Bioinformatics	BT23F64 Biofertilizer Production and Mushroom Cultivation
BT23A15 Biosensors	BT23B25 Glycobiology	BT23C35 Free radicals in Health and Diseases	BT23D45 Biosafety Management and Bioethics	BT23E55 Metabolomics and Metabolic engineering	BT23F65 Plant Tissue Culture and Transformation Techniques
BT23A16 Environmental Biotechnology	BT23B26 Neurobiology and Cognitive Sciences	BT23C36 Medical Microbiology	BT23D46 Stem Cell and Regenerative Medicine	BT23E56 Data Mining and Machine Learning Techniques for Bioinformatics	BT23F66 Total Quality Management

S.NO.	SUBJECT AREA	CREDITS PER SEMESTER								CREDITS TOTAL
		I	II	III	IV	V	VI	VII	VIII	
1.	HS	3	2							**5**
2.	BS	8	8	4	4					**24**
3.	ES	5	6	7	10	3	3	1		**35**
4.	PC	4	5	9	8	10	6	17		**59**
5.	PE					9	9			**18**
6.	OE						3	3		**6**
7.	EEC				1	1	3	1	12	**18**
8	MC	*	*							
	Total	20	21	20	23	23	24	22	12	**165**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
HS 23111	**TECHNICAL COMMUNICATION I**	Theory	2	0	0	2
	Common to all branches of B.E/B. Tech programmes – First Semester					

Objectives:
• To facilitate students, develop their comprehension skills
• To enable students to improve their receptive skills
• To equip learners with better vocabulary and enhance their writing skills
• To aid students speak effectively in all kinds of communicative contexts.
• To improve the learners' basic proficiency in workplace communication

UNIT-I	**DEVELOPING COMPREHENSION SKILLS**	6
Listening: Introduction to Informational listening – Listening to Podcasts, News **Reading**: Intentional Reading - Short Narratives and Passages. **Speaking:** Introducing Oneself, Narrating a Story / Incident. **Writing:** Sequential Writing – connecting ideas using transitional words (Jumbled Sentences), Process Description **Grammar:** Verbs – Main & Auxiliary: Simple Tenses – Form, Function and Meaning. **Vocabulary**: Word formation – Prefix, Suffix, Compound Words.		
UNIT-II	**LISTENING AND EXTENDED READING**	6
Listening: Deep Listening – Listening to Talk Shows and Debates **Reading**: In-depth Reading - Scanning Passages **Speaking**: Describing Current Issues, Happenings, etc., **Writing**: Note Making, Note Taking – Paragraph Writing **Grammar**: Continuous Tenses, Prepositions, Articles **Vocabulary**: One Word Substitutes, Phrasal Verbs.		
UNIT-III	**FORMAL WRITING AND VERBAL ABILITY**	6
Listening: Listening to Lectures and Taking Notes **Reading:** Interpretation of Tables, Charts and Graphs **Speaking:** SWOT Analysis on Oneself **Writing:** Formal Letter Writing and Email Writing **Grammar:** Perfect Tenses, Phrases and Clauses, Discourse Markers **Vocabulary:** Verbal Analogy / Cloze Exercise		
UNIT-IV	**ENHANCING SPEAKING ABILITY**	6
Listening: Listening to eminent voices of one's interest (Martin Luther King, APJ Abdul Kalam, etc.) **Reading:** Timed Reading, Filling KWL Chart. **Speaking:** Just a Minute, Impromptu **Writing:** Check-list, Instructions. **Grammar:** 'Wh' Questions / 'Yes' or 'No' Questions, Imperatives **Vocabulary:** Synonyms, Antonyms, Different forms of the same words.		
UNIT-V	**LANGUAGE FOR WORKPLACE**	6

Listening: Extensive Listening (Audio books, rendering of poems, etc.)
Reading: Extensive reading (Jigsaw Reading, Short Stories, Novels)
Speaking: Short Presentations on Technical Topics
Writing: Recommendations, Essay Writing
Grammar: Impersonal Passive, Reported Speech, Concord
Vocabulary: Informal Vocabulary and Formal Substitutes

Total Contact Hours: 30

Course Outcomes: On completion of the course students will be able to
- Apply their comprehension skills and interpret different contents effortlessly
- Read and comprehend various texts and audio-visual contents
- Infer data from graphs and charts and communicate it efficiently in varied contexts
- Participate effectively in diverse speaking situations
- To present, discuss and coordinate with their peers in workplace using their language skills

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SUGGESTED ACTIVITIES
- Ice breaker
- Just A Minute
- Ship wreck
- Hot seat
- Vocabulary building
- Chinese whispers
- Case study

SUGGESTED EVALUATION METHODS
- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Continuous Assessment Tests

Text Book(s):
1. Effective Technical Communication by M. Ashraf Rizvi (Author) 2nd Edition Paperback 2017
2. Sylvan Barnet and Hugo Bedau, 'Critical Thinking Reading and Writing', Bedford/St. Martin's: Fifth Edition (June 28, 2004)
3. Meenakshi Upadhyay, Arun Sharma – Verbal Ability and Reading Comprehension.
4. Teaching Speaking: A Holistic Approach, Book by Anne Burns and Christine ChuenMeng Goh, Cambridge University Press

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Reference Books(s) / Web links:
1. Basic Vocabulary in Use: 60 Units of Vocabulary Practice in North American English with Answers 2nd Edition by Michael McCarthy (Author), Felicity O'Dell (Author), John D. Bunting (Contributor)
2. Reading Development and Difficulties By Kate Cain
3. The 7 Habits of Highly Effective People by Stephen Covey, Simon and Schuster, UK
4. Everybody Writes: Your Go-To Guide to Creating Ridiculously Good Content Hardcover by Ann Handley (Author)

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
HS23111. 1	-	-	-	1	-	-	-	-	-	3	-	-	-	-	-
HS23111. 2	-	-	-	1	-	-	-	-	-	3	-	-	-	-	-
HS23111. 3	-	1	-	1	-	-	-	-	-	3	-	-	-	-	-
HS23111. 4	-	-	-	2	-	-	-	-	1	3	-	-	-	-	-
HS23111. 5	-	-	-	1	-	-	-	-	1	3	-	-	-	-	-
Average	-	1	-	1.2	-	-	-	-	1	3	-	-	-	-	-

Course Code	Course Title	Category	L	T	P	C
MA23112	**ALGEBRA AND CALCULUS**	BS	3	1	0	4
Common to I sem. B.E. - AERO, AUTO, MECH, MCT, R&A, CIVIL and B.Tech. - BT, FT & CHEM						

Objectives:
- To introduce the matrix techniques and to illustrate the nature of the matrix.
- To address data and synthesis of the information to provide valid conclusions.
- To explain techniques of calculus which are applied in the solutions of engineering problems
- To analyse special types of integrals by analytical methods and numerical techniques.
- To practice the techniques of Integration in finding area and volumes.

UNIT-I	**MATRICES**	12

Matrices - Eigenvalues and eigenvectors - Diagonalization of matrices using orthogonal transformation - Cayley-Hamilton Theorem (without proof) -Quadratic forms- Reduction to canonical form using orthogonal transformation- Numerical computation of Eigen value using Power method

UNIT-II	**FUNCTIONS OF SEVERAL VARIABLES**	12

Partial differentiation–Total derivative–Change of variables–Jacobians–Partial differentiation of implicit functions– Taylor's series for functions of two variables–Maxima and minima of functions of two variables–Lagrange's method of undetermined multipliers.

UNIT-III	**INTEGRAL CALCULUS**	12

Integral Calculus: Definite Integrals as a limit of sums - Applications of integration to area, volume - Improper integrals: Beta and Gamma integrals - Numerical computation of integrals: Trapezoidal rule - Gaussian Two point quadrature

UNIT-IV	**MULTIPLE INTEGRALS**	12

Double integrals – Change of order of integration – Area enclosed by plane curves–Triple integrals–Volume of solids– Numerical computation of double integrals: Trapezoidal rule.

UNIT-V	**REGRESSION**	12

Scatter diagram - Karl Pearson coefficient of correlation for raw data –Spearman rank correlation coefficient - Lines of regression - Regression equation X on Y and Y on X- Curve fitting by Principle of least squares - Fitting a straight-line $y = ax+b$ and a parabola $y = ax^2 + bx + c$.

Total Contact Hours:60

Course Outcomes:
On completion of the course students will be able to
- Demonstrate the matrix techniques in solving the related problems in engineering and technology.
- Analyse and interpret data, and synthesize information to provide valid conclusions.
- Interpret the problems in Engineering and Technology using the principles of mathematical calculus.
- Apply the analytical methods and numerical techniques to solve the related engineering problems.
- Evaluate multiple integrals to conduct investigations of complex problems.

SUGGESTED ACTIVITIES
- Problem solving sessions
- Activity Based Learning
- Implementation of small module

SUGGESTED EVALUATION METHODS
- Problem solving in Tutorial sessions
- Assignment problems
- Quizzes and class test
- Discussion in classroom

Text Book(s):	
1.	Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2.	Gupta S.C. and Kapoor V.K."Fundamentals of Mathematical Statistics", Sultan and Sons 10th Edition,2000.
3.	T Veerarajan, Engineering Mathematics –I, Mc Graw Hill Education, 2018.
4.	I.R. Miller, J.E. Freund and R. Johnson, "Probability and Statistics for Engineers ",4th Edition, Pearson, 2018.

| 5. | A. Goon, M. Gupta and B.Dasgupta , "Fundamentals of Statistics ",Vol. I & Vol. II, World Press, 2019. |

Reference Books(s) / Web links:	
1.	Ramana. B.V., "Higher Engineering Mathematics ", McGraw Hill Education Pvt. Ltd, New Delhi, 2018.
2.	T Veerarajan, Fundamentals of Mathematical Statistics , yesdee publications, 2017.
3.	Erwin Kreyszig ," Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016
4.	Bali, N.P. and Manish Goyal, A Text Book of Engineering Mathematics, Lakshmi Publications Pvt. Ltd., New Delhi, 2006.
5.	N. Draper & H. Smith,"Applied Regression Analysis" III edition, Wiley, 1998.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MA23112.1	3	2	1	-	-	-	-	-	-	-	1	-	-	-	-
MA23112.2	3	2	-	1	-	-	-	-	-	-	1	1	1	-	-
MA23112.3	2	2	-	-	-	-	-	-	-	-	1	1	-	-	-
MA23112.4	3	3	1	-	-	-	-	-	-	-	1	1	1	1	-
MA23112.5	2	2	-	-	-	-	-	-	-	-	-	-	1	1	-
Average	2.6	2.2	1	1	-	-	-	-	-	-	1	1	1	1	-

Subject Code	Subject Name	Category	L	T	P	C
CY23132	**CHEMISTRY FOR TECHNOLOGISTS**	**BS**	**3**	**0**	**2**	**4**
	Common to B.TECH. - CHEMICAL ENGG., FT & BT					

Course Objectives:
● To acquire knowledge on surface chemistry for industrial and domestic uses.
● To impart the knowledge on principles of electrochemistry for engineering applications.
● To provide an insight into the latest nanotechnology to pursue further research.
● To appreciate the need for and importance of polymer materials and heterocyclic compounds.
● To enhance the knowledge in line with the modern techniques for material analysis.

UNIT-I	**SURFACE CHEMISTRY**	**9**

Introduction – Adsorption- difference between adsorption and absorption - types of adsorptions - Factors influencing adsorption - Adsorption from solutions- Types of adsorption isotherms - Freundlich adsorption isotherm - Langmuir adsorption isotherm - Industrial applications of adsorption – Adsorption Chromatography - Role of adsorption in Catalysis - Enzyme catalysis-Michael's Menten equation.

UNIT-II	**ELECTROCHEMISTRY**	**9**

Terminology involved in electrochemistry – Types of Cells - Galvanic and concentration cells- Derivation of Nernst equation - Applications of Electrochemical series - Types of Electrodes - Hydrogen, Calomel, ion-selective electrode - Determination of pH using glass electrode - Determination of electrode potentials - Conductometric titrations - Potentiometric Titration-Redox titration.

UNIT-III	**NANO CHEMISTRY**	**9**

Basic Definitions - Distinction between nanoparticles and bulk materials - size-dependent properties - Mechanical, Chemical, Optical, Electrical and Magnetic properties – Nanoparticles - nanoclusters, nanorods, nanotubes and nanowires - Synthesis of nanoparticles - Precipitation method - Hydrothermal synthesis - Solvothermal synthesis - Sonochemical synthesis - Chemical vapor deposition – Electrodeposition - biogenic synthesis - Applications of nanomaterials.

UNIT-IV	**POLYMERS AND HETEROCYCLES**	**9**

Polymers – Introduction - Polymerization - Types of Polymerizations - Condensation, Addition, Coordination, Copolymerization - Mechanism of Polymerization - Free Radical Mechanism - Biopolymers - PLA and PHB - Synthesis properties and applications.

Heterocyclic compounds - Synthesis and electrophilic and nucleophilic substitution reactions of pyrrole - furan -

	thiophene- pyridine- quinoline - isoquinoline.	
UNIT-V	**ANALYTICAL TECHNIQUES**	**9**

Electromagnetic spectrum - absorption of radiation - electronic, vibrational and rotational transitions - Thermal methods of analysis - TGA, DTA – Principle, instrumentation and applications - Spectro Analytical methods - Colorimetry, IR, UV-visible spectroscopy - Principles instrumentation and applications.

Total Contact Hours:45

Description of the Experiments	Total Contact Hours:30
1.	Construction and determination of EMF of simple electrochemical cells and concentration cells
2.	Estimation of acids by pH metry
3.	Determination of corrosion rate on mild steel by weight loss method
4.	Estimation of mixture of acids by conductometry
5.	Estimation of extent of corrosion of iron pieces by potentiometry
6.	Estimation of copper / ferrous ions by spectrophotometry
7.	Estimation of DO by using sensors
8.	Estimation of concentration of sulphate/ Chloride ions in the given sample solution.
9.	Determination of molecular weight of a polymer by viscometry method
10.	Synthesis of nanomaterials by simple precipitation method
11.	Verification of adsorption isotherms (acetic acid on charcoal)
12.	Determination of phase change temperature of a solid.

Course Outcomes: At the end of the course the student will be able to:
● Explore the applications of Surface Chemistry in domestic and industrial uses.
● Employ the basic principles of Electrochemistry in our daily life appliances.
● Synthesize Nano materials for modern engineering applications.
● Recognize the need of advanced polymer and heterocyclic compounds in industrial applications.
● Identify the structure of unknown/new compounds with the help of spectroscopy.

SUGGESTED ACTIVITIES
● Electroplating process can be done by a group of students.
● Determination of alkali content in the soap.
● Biogenic synthesis of nanomaterials

SUGGESTED EVALUATION METHODS
● Continuous assessment tests
● Assignments
● Model lab examination
● End semester examination

Text Book(s):
1. P. C. Jain and Monika Jain, "Engineering Chemistry", DhanpatRai Publishing Company (P) Ltd,New Delhi, 2015
2. O.G.Palanna, "Engineering Chemistry", McGraw Hill Education (India) Pvt, Ltd, New Delhi, 2017
3. Shikha Agarwal "Engineering Chemistry-Fundamentals and applications", Cambridge University Press, New Delhi, 2015

Reference Books(s)
● A Text Book of Engg. Chemistry, Shashi Chawla, Dhanpat Rai & Co. (P) Ltd.
● B.K. Sharma, "Industrial chemistry", Krishna Prakashan Media (P) Ltd, Meerut, 2016.
● Polymer Science, V R Gowariker, N V Viswanathan, Jayadev, Sreedhar, Newage Int. Publishers, 4th Edition, 2021.
● PradeepT, "A Text Book of Nanoscience and Nanotechnology", Tata McGraw Hill, New Delhi, 2012
● An Introduction to nanomaterials and nanoscience (PB 2020) : Asim K DAS, Mahua Das, CBS publishers and distributors Pvt. Ltd.
● Laboratory Manual Engg. Chemistry, Anupma Rajput, Dhanpat Rai & Co

Lab equipment required:

S. No	Name of the Equipment	Quantity Required
1.	pH meter	10
2.	Ion selective electrodes for various ions in solution	10
3	Spectrophotometer	4
4	Magnetic stirrer with hot plate	10
5	Shaker	5

SUGGESTED EVALUATION METHODS
- Experiment based viva
- Quizzes

Weblinks:

1. NPTEL course Elementary Electrochemistry course url
   https://onlinecourses.nptel.ac.in/noc23_cy19/preview
2. For downloading text/reference books the weblink is given below can be used
   http://libgen.rs/
3. https://nptel.ac.in/courses/104/103/104103019
4. https://ndl.iitkgp.ac.in/

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CY23132.1	2	1	1	-	-	-	1	1	-	-	-	-	-	2	-
CY23132.2	2	2	1	-	-	-	-	-	-	-	-	1	-	1	2
CY23132.3	3	2	2	-	-	-	-	-	-	-	-	-	1	1	1
CY23132.4	2	2	1	-	-	-	1	1	-	-	-	-	2	1	-
CY23132.5	2	1	1	-	-	-	-	-	-	-	-	-	-	1	1
Average	2.2	1.6	1.2	-	-	-	1	1	-	-	-	1	1.5	1.2	1.3

Subject Code	Subject Name	Category	L	T	P	C
GE23111	ENGINEERING GRAPHICS	ES	2	0	4	4

Objectives:	
	To understand the importance of the drawing in engineering applications
	To develop graphic skills for communication of concepts, ideas and design of engineering products
	To expose them to existing national standards related to technical drawings.
	To improve their visualization skills so that they can apply this skill in developing new products.
	To improve their technical communication skill in the form of communicative drawings

CONCEPTS AND CONVENTIONS (Not for Examination)	**1**

Importance of graphics in engineering applications–Use of drafting instruments– BIS conventions and specifications–Size, layout and folding of drawing sheets– Lettering and dimensioning. Basic Geometrical constructions.

UNIT-I	**PLANE CURVES AND PROJECTION OF POINTS**	**5+12**

Curves used in engineering practices: Conics–Construction of ellipse, parabola and hyperbola by eccentricity method – Cycloidal Curves–Construction of cycloid, epicycloid and hypocycloid – Construction of involutes of square and circle–Drawing of tangents and normal to the above curves.Principles of Projection and Projection of points.

UNIT-II	**PROJECTION OF LINES AND PLANE SURFACES**	**6+12**

Projection of straight lines (First angle projection) inclined to both the principal planes – Determination of true lengths and true inclinations by rotating line method. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT-III	**PROJECTION OF SOLIDS AND PROJECTION OF SECTIONED SOLIDS**	**6+12**

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to oneof the principal planes by rotating object method.Sectioning of solids in simple vertical position when the cutting

plane is inclined to HP and perpendicular to VP – obtaining true shape of the section.Practicing three-dimensional modeling of simple objects by CAD software (Not for examination)

UNIT-IV	DEVELOPMENT OF SURFACE AND ISOMETRIC PROJECTIONS	6+12

Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.Principles of isometric projection–isometric scale–Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders and cones. Model making of isometric projection of combination of solids as assignment (Not for End semester)

UNIT-V	FREE HAND SKETCHING AND PERSPECTIVE PROJECTIONS	6+12

Free Hand sketching: Freehand sketching of multiple views from pictorial views of objects - Freehand sketching of pictorial views of object from multiple views. Perspective projection of simple solids-Prisms, pyramids, cylinder and cone by visual ray method.

	Total Contact Hours:	(L=30; P=60) 90 Periods	:	90

Course Outcomes: The students will be able to

●	To construct different plane curves and to comprehend the theory of projection
●	To draw the basic views related to projection of lines and planes
●	To draw the projection of simple solids and to draw the projection of development of surfacesof Sectioned solids in simple vertical position
●	To draw the orthographic projection from pictorial objects and Isometric projections of simple solids
●	To visualize Perspective view of simple solids

Text Book(s):	
1	Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50thEdition, 2010.
2	Natarajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai,2017.

Reference Book(s):	
1	Varghese P I., "Engineering Graphics", McGraw Hill Education (I) Pvt.Ltd., 2013.
2	V.B Sikka "Civil Engineering Drawing", S.K Kataria & Sons, New Delhi.
3	Venugopal K. and PrabhuRaja V., "Engineering Graphics", New Age International(P) Limited, 2008.
4	Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores,Bangalore, 2017.
5	Basant Agarwal and Agarwal C.M., "Engineering Drawing", McGraw Hill PublishingCompany Limited, New Delhi, 2018

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
GE23111.1	3	2	2	1	-	1	-	2	2	2	-	2	-	-	-
GE23111.2	3	2	2	1	-	1	-	2	2	2	-	2	-	-	-
GE23111.3	3	2	2	1	-	1	-	2	2	2	-	2	-	-	-
GE23111.4	3	2	2	1	-	1	-	2	2	2	-	2	-	-	-
GE23111.5	3	2	2	1	-	1	-	2	2	2	-	2	-	-	-

Subject Code	Subject Name (Laboratory Course)	Category	L	T	P	C
GE23121	ENGINEERING PRACTICES – Civil& Mechanical	ES	0	0	2	1

Objectives:	
●	To provide exposure to the students with hands on experience on various basic engineering practices in Civil and Mechanical Engineering

List of Experiments
CIVIL ENGINEERING PRACTICE
1.	Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, and elbows in household fittings.
2.	Preparation of basic plumbing line sketches for wash basins, water heaters, etc.
3.	Hands-on-exercise: Basic pipe connections – Pipe connections with different joining components.

	Carpentry Works:	
4.	Study of joints in roofs, doors, windows and furniture.	
5.	Hands-on-exercise: Woodwork, joints by sawing, planning and chiselling.	
MECHANICAL ENGINEERING PRACTICE		
6.	Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.	
7	Gas welding practice.	
Basic Machining:		
8	Simple Turning and Taper turning	
9	Drilling Practice	
Sheet Metal Work:		
10	Forming & Bending:	
11	Model making – Trays and funnels	
12	Different type of joints.	
Machine Assembly Practice:		
13	Study of centrifugal pump	
14	Study of air conditioner	
	Total Contact Hours :	30

Course Outcomes:

- Able to perform plumbing activities for residential and industrial buildings considering safety aspects while gaining clear understanding on pipeline location and functions of joints like valves, taps, couplings, unions, reducers, elbows, etc.
- Able to perform wood working carpentry activities like sawing, planning, cutting, etc. while having clear understanding of the joints in roofs, doors, windows and furniture.
- Able to produce joints like L joint, T joint, Lap joint, Butt joint, etc. through arc welding process while acquiring in depth knowledge in the principle of operation of welding and other accessories
- Able to perform operations like Turning, Step turning, Taper turning, etc. in lathe and Drilling operation in drilling machine
- Able to perform sheet metal operations like Forming, Bending, etc. and fabricating models like Trays, funnels, etc.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
GE23121.1	1	1	1	-	-	2	1	-	2	-	-	2	-	2	1
GE23121.2	1	1	1	-	-	2	1	-	2	-	-	2	-	2	1
GE23121.3	1	1	1	-	-	2	1	-	2	-	-	2	-	2	1
GE23121.4	1	1	1	-	-	2	1	-	2	-	-	2	-	2	1
GE23121.5	1	1	1	-	-	2	1	-	2	-	-	2	-	2	1

Subject Code	MICROBIOLOGY	Category	L	T	P	C
BT23131		**PC**	**2**	**0**	**4**	**4**

Objectives:

- To inculcate knowledge on fundamentals of microorganisms and microscopy
- To learn the structural organization, morphology and reproduction of microbes
- To acquire knowledge on basic principles of microbial culture, growth and its metabolism
- To understand the principles of sterilization technique and chemotherapeutic agents
- To gain knowledge on various applications of microbes in biotechnology

UNIT-I	INTRODUCTION TO MICROBIOLOGY	6

History of Microbiology- Spontaneous generation conflict - Contributions of Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Edward Jenner and Winogradsky. Microbial Taxonomy- Classification and Nomenclature of microorganisms- Whittaker's Five Kingdom concept. Microscopy: Bright field, Dark field, Phase contrast, Fluorescent Microscopy and Electron microscope.

UNIT-II	STRUCTURE OF BACTERIA AND VIRUS	6

Structural organization and multiplication of Bacteria. Stains and Staining techniques: Simple staining, Differential staining (Gram's & Acid fast), Special staining (Capsule & Endospore). Virus- Structure, Classification & Multiplication (Lytic and Lysogenic cycle).

UNIT-III	STRUCTURE AND REPRODUCTION OF FUNGI AND ALGAE	6

Fungi - General structure and its reproduction (Aspergillus & Penicillium). Algae - General structure and its economic importance. Actinomycetes - Features & its biotechnological importance.

UNIT-IV	MICROBIAL NUTRITION, GROWTH AND METABOLISM	6

Nutritional requirement and classification of microorganisms based on physiological factors, Culture media (defined, complex, selective, differential, and enriched). Growth: Definition, Growth curve. Quantification of microbial growth: (Direct and Indirect methods).

UNIT-V	CONTROL OF MICROORGANISMS	6

Sterilization (Physical and Chemical) – Definition, Types, Mode of action, Sterility control and its applications. Antimicrobial chemotherapy – Antibiotics (Antibacterial, antifungal and antiviral agents) and its mode of action – Antibiotic Resistance - Antibiotic Sensitivity tests

	Total Contact Hours	:	30

Course Outcomes: The students will be able to

●	Gain the knowledge on the principles of microscopes
●	Understand and differentiate the microorganisms based on its morphology
●	Apply the knowledge in identification of fungi, algae & actinomycetes
●	Formulate and design the culture media for the growth of microorganisms
●	Analyze and apply the appropriate sterilization technique to control the microorganisms

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Text Book(s):

1	Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. (2002) Microbiology. 7th Edition, Tata McGraw-Hill, New Delhi.
2	Schlegel, H.G.—GeneralMicrobiology‖, 7th Edition, CambridgeUniversity Press,1993.
3	Ananthanarayan, CK Jayaram Panikars. Text book of Microbiology, 2005, Orient Blackswan Publishers.

Reference Books(s) / Web links:

1	Joanne W., Kathleen S and Dorothy W., Prescott's Microbiology, 12th Edition, Mc Graw Hill, New York, 2023
2	Black, Text book of microbiology, Freeman Publishers, 2016
3	Talaron K, Talaron A, Casita, Pelczar and Reid. Foundations in Microbiology, W.C. Brown Publishers, 1993.

Objectives:

●	To Train students in the proper use and maintenance of the Microbiology laboratory with emphasis on observation microbes by staining techniques
●	To demonstrate appropriate methods to estimate the number of microorganisms in a sample
●	To demonstrate an understanding of environmental effects on bacterial growth
●	To familiarize the student on biochemical tests to identify microbes.
●	Provide students with a hands-on familiarity with basic research procedure and associated critical and investigative thinking skills utilizing identification of unknown microorganism from specimens.

List of Experiments	
1	Laboratory Safety
2	Introduction to sterilization techniques
3	Microscopy: Working and its principles
4	Culture media: Media preparation- Broth, Agar (deep, slant and plate)
5	Culture techniques: Isolation- Streak plate, Pour plate, spread plate, Slant and Stab
6	Quantification of microbes from soil, water, and milk (Pour plate & Spread plate technique)
7	Staining: a. Simple Staining b. Gram's staining
8	Motility test: - Hanging drop method
9	Growth Curve of bacteria
10	Antibiotic Sensitivity test
	Total Contact Hours : 60

Course Outcomes:

●	The student will be able to identify Microorganism through microscope
●	The student will be able to prepare a suitable media and cultivate the microbes by different techniques.
●	The student can able to isolate and identify microbial strain by staining and biochemical tests
●	The students can able to find out antibiotic susceptibility and resistance prototype of pathogens.
●	The student will be able to check the role of physiological factors on Microbial growth and multiplication.

References

Cappuccino, J.G. and N. Sherman ―Microbiology: A Laboratory Manual‖, 4th Edition, Addison-Wesley, 1999.

Collee, J.G.etal., ―Mackie &McCartney Practical Medical Microbiology‖4th Edition, Churchill Livingstone, 1996.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT23131.1	2	1	2	3	3	2	2	2	3	3	2	2	3	2	2
BT23131.2	2	2	2	3	3	2	3	2	3	3	2	3	3	3	2
BT23131.3	1	2	2	3	3	2	3	2	3	3	2	3	2	3	2
BT23131.4	2	2	1	3	2	2	3	2	3	3	2	3	3	2	2
BT23131.5	2	2	3	3	3	3	3	3	3	3	3	3	2	3	2
Average	1.8	1.8	2.0	3.0	2.8	2.2	2.8	2.2	3.0	3.0	2.2	2.8	2.6	2.8	2.0

WEB SOURCE REFERENCES:

1	http://journals.asm.org/ American Association of Microbiology
	http://www.who.int/en/ World Health Organization
	http://www.microbes.info/news/ Microbiology News
	http://www.nlm.nih.gov/ Library of medicine
	http://www.fda.gov/Food/FoodSafety/FoodborneIllness/FoodborneIllnessFoodbornePathogensNatural Toxins/BadBugBook/default.htm
2	http://www.microbiologybytes.com/video/Gram.html
3	http://www.mansfield.ohio-state.edu/~sabedon/biol2025.htm
4	http://nt.ars-grin.gov/sbmlweb/fungi/index.cfm

Subject Code	Subject Name	Category	L	T	P	C
MC23112	ENVIRONMENTAL SCIENCE AND ENGINEERING	MC	3	0	0	0
Non Credit Course - Common to B.E. /B.Tech all branches except CSBS					

Objectives:

●	To develop the understanding of environmental and associated issues
●	To develop an attitude of concern for the environment
●	To promote enthusiasm in participating environmental protection initiatives
●	To nurture skills to solve environmental degradation issues
●	To develop the knowledge about the environmental laws

UNIT-I	AIR AND NOISE POLLUTION	9

Definition –sources of air pollution –chemical and photochemical reactions in the atmosphere - formation of smog, PAN, acid rain, ozone depletion, particulate pollutants-Air quality standards-Air quality indices - control of particulate air pollutants-gravitational settling chambers, cyclone separators, wet collectors, fabric filters (Bag-house filter), electrostatic precipitators (ESP)-catalytic converters.

Noise pollution –sources - health effects - standards- measurement and control methods.

UNIT-II	WATER POLLUTION AND ITS MANAGEMENT	9

Definition-causes-effects of water pollution-point and nonpoint sources of wastewater-marine pollution - thermal pollution - Control of water pollution by physical, chemical and biological methods – wastewater treatment-primary, secondary and tertiary treatment-sources and characteristics of industrial effluents- zero liquid discharge.

UNIT-III	SOLID WASTE AND HAZARDOUS WASTE MANAGEMENT	9

Solid waste – types- municipal solid waste management: sources, characteristics, collection, and transportation- sanitary landfill, recycling, composting, incineration, energy recovery options from waste - Hazardous waste – types, characteristics, and health impact - hazardous waste management: neutralization, oxidation reduction, precipitation, solidification, stabilization,incineration and final disposal. E-waste-definition-sources-effects on human health and environment- E-waste management- steps involved - Role of E-waste management within the initiatives of the Govt. of India- Swachh Bharat Mission.

UNIT-IV	SUSTAINABLE DEVELOPMENT	9

Sustainable development- concept-dimensions-sustainable development goals - value education- gender equality – food security - poverty – hunger - famine - Twelve principles of green chemistry - Green technology - definition, importance - Cleaner development mechanism - carbon credits, carbon trading, carbon sequestration, eco labeling-International conventions and protocols-Disaster management.

UNIT-V	ENVIRONMENTAL MANAGEMENT AND LEGISLATION	9

Environmental Management systems - ISO 14000 series- Environmental audit-Environmental Impact Assessment- life cycle assessment- human health risk assessment - Environmental Laws and Policy-Objectives - Polluter pays principle, Precautionary principle - The Environment (Protection) Act 1986 - Role of Information technologyin environment and human health.

Total Contact Hours:45

Course Outcomes:
On completion of the course, the students will be able to
- Associate air and noise quality standards with environment and human health.
- Illustrate the significance of water and devise control measures for water pollution.
- Analyze solid wastes and hazardous wastes.
- Outline the goals of sustainable development in an integrated perspective.
- Comprehend the significance of environmental laws.

SUGGESTED EVALUATION METHODS
- Continuous assessment tests
- Assignments
- Case studies, class room presentations (or) site visit

Text Book(s):
- Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016
- Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publisher, 2018.
- Johri R., E-waste: implications, regulations, and management in India and current global best practices, TERI Press, New Delhi

Reference Books(s) / Web links:
- R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38. Edition 2010.
- Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
- Fowler B, Electronic Waste – 1 st Edition (Toxicology and Public Health Issues), 2017 Elsevier
- NPTEL course url https://onlinecourses.nptel.ac.in/noc19_ge22/
  NPTEL https://news.mit.edu/2013/ewaste-mit
- For downloading text/reference books the weblink is given below can be used
  http://libgen.rs/

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
MC23112.1	1	2	3	1	-	2	2	2	1	1	1	2	1	-	-
MC23112.2	1	2	3	1	-	2	2	2	1	1	1	2	1	-	-
MC23112.3	-	-	3	1	-	2	3	2	1	-	1	2	1	-	-
MC23112.4	-	1	2	1	1	3	3	2	1	1	1	2	-	-	-
MC23112.5	-	1	2	-	-	2	2	2	1	2	2	2	-	-	-
Average	0.4	1.2	2.6	0.8	0.2	2.2	2.4	2	1	1	1.2	2	0.6	-	-

GE23117   தமிழர் மரபு   **L T P C**

                                                                 1 0 0 1

அலகு I   மொழி மற்றும் இலக்கியம்:   3

இந்திய மொழிக் குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி - தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமய சார்பற்ற தன்மை - சங்க இலக்கியத்தில் பகிர்தல் அறம் - திருக்குறளில் மேலாண்மைக் கருத்துக்கள் - தமிழிக் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் - சிற்றிலக்கியங்கள் - தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு II   மரபு - பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை - சிற்பக்
**   கலை:   3**

நடுகல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் - தேர் செய்யும் கலை - சுடுமண் சிற்பங்கள் - நாட்டுப்புறத் தெய்வங்கள் - குமரிமுனையில் திருவள்ளுவர் சிலை - இசைக் கருவிகள் - மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் - தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு III   நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்:   3

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஓயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு IV   தமிழர்களின் திணைக் கோட்பாடுகள்:   3

தமிழகத்தின் தாவரங்களும், விலங்குகளும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு - சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் - சங்ககால நகரங்களும் துறை முகங்களும் - சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு V   இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத்
**   தமிழர்களின் பங்களிப்பு:   3**

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் - சுயமரியாதை இயக்கம் - இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு - கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

                                                        TOTAL : 15 PERIODS

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
HS 23221	TECHNICAL COMMUNICATION II	Theory	0	0	2	1
	Common to all branches of B.E/B. Tech programmes –Second Semester					

Course Objectives:
• To facilitate students to improve their vocabulary for a better communication
• To enable learners to understand and reproduce language
• To aid students to write technical reports in a convincing manner
• To expose students to different sentence structures
• To equip learners to present their ideas in an efficient manner

UNIT-I	VOCABULARY FOR BETTER COMMUNICATION	6
Listening: Telephonic Conversations and TV News		
Reading: Newspapers and Magazines		
Speaking: Conversational Practice: Speaking in a given situation, asking permission and requesting etc.,		
Writing: Job Application Letter and Resume		
Grammar: Reference words: pronouns and determiners		
Vocabulary: Guessing meanings of words in different contexts.		
UNIT-II	**FUNCTIONAL LANGUAGE ASPECTS**	6
Listening: Motivational listening – listening to real life challenges		
Reading: Articles and Technical reports		
Speaking: Using Polite Expressions, Indirect Questions		
Writing: Paraphrasing a Text, Poem		
Grammar: Purpose Statements, Cause and Effect Expressions		
Vocabulary: Neologisms.		
UNIT-III	**TECHNICAL REPORTWRITING**	6
Listening: Empathetic Listening – Giving Solutions to Problems		
Reading: Inferential Reading		
Speaking: Dialogues – Interviewing Celebrities / Leaders / Sportspersons, etc.,		
Writing: Report Writing		
Grammar: Functional Usage of Expressions – used to, gone / been, etc.,		
Vocabulary: Words Often Confused		
UNIT-IV	**STRUCTURAL GRAMMAR**	6
Listening: Comprehension (IELTS practice tests)		
Reading: Intensive Reading for specific information		
Speaking: Pick and Talk		
Writing: Proposals		
Grammar: Sentence Structures – Simple, Compound, Complex Sentences		
Vocabulary: Replacing dull words with vivid ones		
UNIT-V	**PRESENTATION SKILLS**	6
Listening: Discriminative listening – sarcasm, irony, pun, etc.,		
Reading: Practice of chunking – breaking up reading materials		
Speaking: Mini presentation on some topic		
Writing: Minutes of the meeting		
Grammar: Correction of Errors		
Vocabulary: Advanced vocabulary – fixing appropriate words in the given context.		
	Total Contact Hours: 30	

Course Outcomes:
On completion of the course students will be able to
• Communicate effectively using appropriate vocabulary
• Use the acquired language skills to comprehend various types of language contents
• Evaluate different texts and write effective technical content
• Use appropriate sentence structures to convey their thoughts in varied contexts
• Present their concepts and ideas in an effective manner

SUGGESTED ACTIVITIES
● Story Lines ● One truth and two lies ● Hang Man ● Pictionary ● Word Scramble ● Case study

SUGGESTED EVALUATION METHODS
● Assignment topics ● Quizzes ● Class Presentation/Discussion ● Continuous Assessment Tests

Text Book(s):
5. Raymond Murphy, "Intermediate English Grammar," Second Edition, Cambridge University Press, 2018
6. Meenakshi Raman & Sangeeta Sharma, "Technical Communication" Third Edition, Oxford University Press, 2015
7. Teaching Speaking: A Holistic Approach, Book by Anne Burns and Christine ChuenMeng Goh, Cambridge University Press

Reference Books(s) / Web links:
Michael McCarthy (Author), Felicity O'Dell (Author), John D. Bunting (Contributor), "Basic Vocabulary in Use: 60 Units of Vocabulary Practice in North American English with Answers" 2nd Edition
Dale Carnegie, "The Art of Public Speaking," Insight Press
Jack C. Richards & Theodore S. Rodgers, "Approaches and Methods in Language Teaching, Second Edition Cambridge University Press

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
HS23221. 1	-	-	-	1	-	-	-	-	-	2	-	-	-	-	-
HS23221. 2	-	-	-	1	-	-	-	-	-	3	-	-	-	-	-
HS23221. 3	-	2	-	1	-	-	-	-	-	3	-	-	-	-	-
HS23221. 4	-	-	-	1	-	-	-	-	2	3	-	-	-	-	-
HS23221. 5	-	-	-	1	-	-	-	-	2	2	-	-	-	-	-
Average	-	2	-	1	0	0	0	0	2	2.6	-	-	-	-	-

Subject Code	Subject Name	Category	L	T	P	C
HS 23222	**ENGLISH FOR PROFESSIONAL COMPETENCE** Common to all branches of B.E/B. Tech programmes	**HS**	**0**	**0**	**2**	**1**

Objectives:
• To facilitate the learners in acquiring listening and reading competence
• To enable the learners to communicate effectively through written and oral medium
• To assist the learners in preparing for competitive examinations
• To train the students in acquiring corporate skills
• To inculcate professional standards among the students and make them realize their responsibility in addressing the challenges

UNIT-I	**RECEPTIVE SKILLS**	6

Listening – Comprehensive Listening – Watching the news – Listening to a peer giving presentation, etc. – Critical Listening – Watching a televised debate, listening to poems – **Reading** – Extensive Reading – Short stories and One-act Plays – Intensive Reading – Articles or Editorials in Magazines, Blog posts on topics like science and technology, arts, etc.

UNIT-II	**PRODUCTIVE SKILLS**	6

Speaking – Demonstrative Speaking – Process description through visual aids – Persuasive Speaking – Convincing the listener with the speaker's view – **Writing** – Descriptive Writing - Describing a place, person, process – Subjective Writing – Autobiography, Writing based on personal opinions and interpretations

UNIT-III	**ENGLISH FOR COMPETITIVE EXAMS**	6

An introduction to International English Language Testing System (IELTS) – Test of English as a Foreign Language (TOEFL) – Graduate Record Examination (GRE) – Civil Service, Indian Economic Service Examination, Indian Statistical Service Examination, Combined Defence Services Examination, Staff Selection- (Language Related) – Aptitude tests.

UNIT-IV	**CORPORATE SKILLS**	6

Critical Thinking and Problem Solving – Case Study, Brainstorming, Q & A Discussion – **Team work and Collaboration** – Activities like Office Debates, Perfect Square, Blind Retriever, etc. – **Professionalism and Strong Work Ethics** – Integrity, Resilience, Accountability, Adaptability, Growth Mind set

UNIT-V	**PROJECT WORK**	6

Case Study based on the challenges faced by the employers and the employees – Devise Plan, Provide Solution

	Total Contact Hours	30

Course Outcomes:
On completion of the course, students will be able to
• Interpret and respond appropriately in the listening and reading contexts.
• Express themselves effectively in spoken and written communication
• Apply their acquired language skills in writing the competitive examinations
• Exhibit their professional skills in their work place
• Identify the challenges in the work place and suggest strategies solutions

SUGGESTED ACTIVITIES
• Online Quizzes on Vocabulary
• Online Quizzes on grammar
• Communication Gap Exercises
• Presentations
• Word Building Games
• Case study

SUGGESTED EVALUATION METHODS
- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Continuous Assessment Tests

	Reference Books
1	How to Read Better & Faster, Norman Lewis, Goyal Publishers
2	Teaching Speaking: A Holistic Approach, Book by Anne Burns and Christine Chuen Meng Goh, Cambridge University Press
3	The Official Cambridge Guide To IELTS by Pauline Cullen, Cambridge University Press
4	The 7 Habits of Highly Effective People by Stephen Covey, Simon and Schuster, UK

Reference Books(s) / Web links:
1. Board of Editors. Sure Outcomes. A Communication Skills Course for Undergraduate Engineers and Technologists. Orient Black Swan Limited, Hyderabad, 2013.
2. Hartley, Mary. "The Power of Listening," JaicoPublishing House; First Edition (2015).
3. Chambers, Harry. "Effective Communication Skills for Scientific and Technical Professionals," Persues Publishing, Cambridge, Massachusetts, 2000.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
HS23222. 1	-	1	-	-	-	-	-	-	-	3	-	-	-	-	-
HS23222. 2	-	1	-	-	-	-	-	-	-	3	-	-	-	-	-
HS23222. 3	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
HS23222. 4	-	-	-	-	-	-	2	2	-	3	-	-	-	-	-
HS23222. 5	-	-	1	-	-	-	2	-	-	3	-	-	-	-	-
Average	0	1	1	0	0	0	2	2	0	3	0	0	-	-	-

Subject Code	Course Title	Category	L	T	P	C
MA23212	**DIFFERENTIAL EQUATIONS AND COMPLEX VARIABLES**	**BS**	**3**	**1**	**0**	**4**
Common to II Sem. B.E. –AERO, AUTO, BME, CIVIL, EEE, ECE, MECH, MCT, R&A and B. Tech. - BT, FT & CHEM						

Objectives:
- To provide students with an introduction to the theory of ordinary differential equations through applications, methods of solution, and numerical approximations.
- To introduce students to how to solve linear Partial Differential with different methods.
- To enable the students to study the Laplace Transforms, properties of Laplace Transform, inverse Laplace Transform and some applications to solve the differential equations and integral equations.
- To explain the concept of a vector integration in a plane and in space.
- To describe basic properties of complex variables and to have the ability to compute complex integrals.

UNIT-I	ORDINARY DIFFERENTIAL EQUATIONS	12

Second and higher order Linear differential equations with constant coefficients - Method of variation of parameters – Legendre's linear equations – Numerical solution of ODE - Single Step methods: Taylor's series

method, Euler's method.

UNIT-II	PARTIAL DIFFERENTIAL EQUATIONS	12

Formation of partial differential equations - Classification of PDE – Solutions of standard types of first order partial differential equations - Lagrange's linear equation –Linear homogeneous partial differential equations of second and higher order with constant coefficients.

UNIT-III	LAPLACE TRANSFORM	12

Laplace transform –Basic properties – Transforms of derivatives and integrals of functions - Transforms of unit step function and impulse functions, periodic functions. Inverse Laplace transform – Problems using Convolution theorem – Solution of linear ODE of second order with constant coefficients using Laplace transformation techniques

UNIT-IV	VECTOR CALCULUS	12

Gradient, divergence and curl – Directional derivative – Irrotational and Solenoidal vector fields – Vector integration – Green's theorem in a plane, Gauss divergence theorem and Stokes' theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelopipeds.

UNIT-V	COMPLEX VARIABLES	12

Analytic functions — Construction of analytic function - Bilinear transformation –Singularities – Cauchy's integral theorem (without proof) - Residues – Residue theorem (without proof) - Simple problems - Contour integral over $|z|=1$.

	Total Contact Hours: 60

Course Outcomes: On completion of the course students will be able to
● Apply the methods as a potent tool in the solution of a variety of problems in the natural sciences and technology.
● Develop specific methodologies, techniques and resources in Partial differential equations to conduct research and produce innovative results in the area of specialisation.
● Use Laplace transform and inverse transform techniques to solve the complex problems in engineering and technology.
● Apply the concepts in multivariable analysis, including space curves; directional derivative; gradient; multiple integrals; line and surface integrals; vector fields; divergence, curl; the theorems of Green and Stokes, and the divergence theorem in different fields of engineering.
● Demonstrate the concept of Analytic functions, conformal mapping and complex integration in solving Engineering problems.

SUGGESTED ACTIVITIES
● Problem solving sessions
● Activity Based Learning

SUGGESTED EVALUATION METHODS
● Problem solving in Tutorial sessions
● Assignment problems
● Quizzes and class test
● Discussion in classroom

Text Book(s):	
1.	Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2.	Veerarajan. T, Engineering Mathematics –II, Mc Graw Hill Education, 2018.
3.	Erwin Kreyszig," Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016.
4.	Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, 4th Edition, New Delhi, 2011.
5.	Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, 5 th Edition, New Delhi, 2017.

	Reference Books(s) / Web links:
5.	Ramana. B.V., "Higher Engineering Mathematics ", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
6.	T Veerarajan, Transforms and Partial Differential Equations, Third Edition, 2018.
7.	Bali, N.P. and Manish Goyal, A Text Book of Engineering Mathematics, Lakshmi Publications Pvt. Ltd., New Delhi, 4th Edition 2006.
8.	Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, 7th Edition, New Delhi, 2012.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MA23212.1	3	2	1	-	-	-	-	-	-	-	-	1	1	1	1
MA23212.2	3	2	1	-	-	-	-	-	-	-	-	1	1	1	1
MA23212.3	3	2	1	-	-	-	-	-	-	-	-	-	1	-	-
MA23212.4	2	2	1	-	-	-	-	-	-	-	-	-	1	-	-
MA23212.5	3	2	1	-	-	-	-	-	-	-	-	1	1	-	1
Average	2.8	2	1	-	-	-	-	-	-	-	-	1	1	1	1

Subject Code	PHYSICS FOR BIOSCIENCE	Category	L	T	P	C
PH23231	**Common to - B.E. – Biomedical Engineering and B.Tech – Bio Technology & Food Technology**	BS	3	0	2	4

Course Objectives:	
•	To enhance the fundamental knowledge of oscillations, Ultrasonic wave properties and its applications.
•	To strengthen the basic information of semiconducting materials, characteristic and its applications.
•	To study the behaviour of superconducting materials and optical fibres for medical applications.
•	To understand the properties of nuclear radiation and elementary particles.
•	To study the advanced analytical techniques.

UNIT-I	WAVES AND ULTRASONICS	9

Oscillatory motion – forced and damped oscillations: differential equation and its solution – plane progressive waves – wave equation – Fundamentals of sound– generation of ultrasound – magnetostriction and piezo-electric method – properties - acoustical grating- velocity of Ultrasonics- Non-destructive Testing – pulse echo system through transmission and reflection modes - A,B and C – scan displays.

UNIT-II	PHYSICS OF SEMICONDUCTORS	9

Fundamentals of semiconductors– Intrinsic semiconductor– carrier concentration in an intrinsic semiconductor – variation of Fermi level with temperature – band gap determination-Extrinsic semiconductor- carrier concentration of N-type and P-type –variation of Fermi level with temperature and impurity concentration –Hall effect – Determination of Hall coefficient – Formation of PN junction -LED and Solar cells.

UNIT-III	MATERIALS FOR MEDICAL APPLICATIONS	9

Introduction to Superconductivity - Properties of Superconductors - BCS theory (qualitative) – Type-I and Type II Superconductors - Applications-Cryotron-Josephson devices- SQUID-MRI scan and Magnetic Levitation. Magnetism in materials - magnetic field and magnetic induction –permeability - susceptibility–types of magnetic materials – Dia, Para, Ferro, anti-ferro and ferrites-hysteresis. Fiber optics –Total internal reflection, Numerical aperture and acceptance angle - types of fibers -Temperature and displacement sensors- endoscopy.

UNIT-IV	NUCLEAR AND PARTICLE PHYSICS	9

Radioactivity - characteristics of radioactive material – isotopes - probing by isotopes, reactions involved in the preparation of radioisotopes, the Szilard-Chalmer's reaction – radiochemical principles in the use of tracers - nuclear medicines – Interaction of charged particles with matter –Specific ionization, Linear energy transfer,

range, Bremsstrahlung, Annihilation. Gamma-Ray Spectrometry- Liquid Scintillation Counters-Characteristics of Counting Systems-Gamma Well Counters.		
UNIT-V	**ADVANCED ANALYTICAL TECHNIQUES**	9
Theory, Instrumentation and Applications of: Thermogravimetric Analysis - Differential Thermal Analysis - Differential Scanning Calorimetry. Surface analysis – Electron microscope-magnification-resolving power-Scanning electron microscope, atomic force microscope - Transmission electron microscope, –Principle, instrumentation and applications		

	Contact Hours	**:**	**45**

List of Experiments		
1	Determination of Velocity of ultrasound and compressibility of given liquid – Ultrasonic interferometer.	
2	Determination of wavelength of diode laser and angular divergence.	
3	Determination of Band gap of given semiconducting material.	
4	Determination of Hall coefficient of the given semiconducting material.	
5	Determination of solar cell characteristics.	
6	Determine the energy loss of material by using B-H curve set up.	
7	Determination of free space permeability using Helmholtz coil.	
8	Determination of Numerical aperture and angle of acceptance of the optical fiber cable.	
9	Spectrometer – Wavelength of Hg spectrum by diffraction grating.	
10	Spectrometer – Determine refractive index of a prism.	

	Contact Hours	**:**	**30**
	Total Contact Hours	**:**	**75**

Course Outcomes:
On completion of the course, the students will be able to
• Apply the knowledge of oscillating particles and generation of waves in real time applications.
• Comprehend the principles of semiconductors and their device fabrication.
• Make use the properties of superconductors and optical fibre in engineering and technology.
• Apply the characteristics of nuclear and elementary particles to develop innovative instruments.
• Utilize the concepts of advanced analytical techniques.

Suggested Activities	
•	Problem solving sessions
Suggested Evaluation Methods	
•	Quizzes
•	Class Presentation / Discussion

Text Book(s):	
1	Kasap, S.O. "Principles of Electronic Materials and Devices", McGraw-Hill Education, 2017.
2	Umesh K Mishra &Jasprit Singh, "Semiconductor Device Physics and Design", Springer, 2014.
3	Wahab, M.A. "Solid State Physics: Structure and Properties of Materials". Narosa Publishing House, 2009.
4	B.H Brown, R.H.Smallwood, D.C Barber . P.V Lawford Medical physics and Biomedical Engineering, CRC Press 1998.

Reference Books(s) / Web links:	
1	S. O. Pillai, Solid state Physics (Multi colour Edition), New Age International Publisher, 2018.
2	Arthur Besier and S. Rai Choudhury, Concepts of Modern Physics (SIE), 7th Edition, 2017.
3	B.L.Theraja, Modern Physics, 16th edition, S.Chand, 2018.
4	J.B.Rajam, Atomic Physics, 7th edition, S.Chand, 2010.

| 5 | Charles Kittel, Introduction to Solid State Physics, 8th Edition, Willey India Pvt.Ltd, 2012. |
| 6 | Garcia, N. & Damask, A. "Physics for Computer Science Students". Springer-Verlag, 2012. |

List of Equipment Available
(Common to B.E. BME and B.Tech. - Bio –Tech. and Food Tech.)

S. No	Name of the equipment	Quantity Required	Quantity Available	Deficiency
1	Young's modulus by Uniform bending method Travelling Microscope	6	13	-
2	Young's modulus by non-Uniform bending method Travelling Microscope	6	13	-
3	Rigidity Modulus - Torsional Pendulum Setup	6	19	-
4	Band gap of a semiconductor Setup	6	19	-
5	Determination of Plank's constant - Rheostat, Multimeter, LED	6	10	-
6	B-H curve Setup and CRO	6	7	-
7	Determination of permeability of free space - Helmholtz coil setup	5	5	-
8	Refractive index of Prism – Spectrometer	6	12	-
9	LCR circuit kit	6	7	-
10	Wavelength of Laser and Characteristics -Laser source and grating	6	12	-

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
PH23231. 1	3	2	1	-	-	-	-	-	-	-	-	-	1	1	-
PH23231.2	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
PH23231. 3	3	1	2	-	-	-	-	-	-	-	-	-	1	1	-
PH23231.4	3	1	1	-	-	-	-	-	-	-	-	-	-	-	-
PH23231.5	3	2	2	-	1	-	-	-	-	-	-	-	1	-	-
Average	3	1.6	1.4	-	0.2	-	-	-	-	-	-	-	0.6	0.4	-

Subject Code	Subject Name (Laboratory Course)	Category	L	T	P	C
GE23231	**PROGRAMMING USING PYTHON** Common to all branches of B. E. / B.Tech program (Except–CSE, CSBS, CSD, IT, AI/ML, CYBER SECURITY, AI/DS)	ES	1	0	4	3

Course Objectives:
• To understand computers, programming languages and their generations and essential skills for a logical thinking for problem solving.
• To write, test, and debug simple Python programs with conditionals, and loops and functions
• To develop Python programs with defining functions and calling them
• To understand and write python programs with compound data-lists, tuples, dictionaries
• To search, sort, read and write data from /to files in Python.

List of experiments	
1.	Study of algorithms, flowcharts and pseudocodes.
2.	Introduction to Python Programming and Python IDLE/Anaconda distribution.
3.	Experiments based on Variables, Data types and Operators in Python.
4.	Coding Standards and Formatting Output.
5.	Algorithmic Approach: Selection control structures.
6.	Algorithmic Approach: Iteration control structures.
7.	Experiments based on Strings and its operations.
8.	Experiments based on Lists and its operations.
9.	Experiments based on Tuples and its operations.
10.	Experiments based on Sets and its operations.
11.	Experiments based on Dictionary and its operations.
12.	Functions: Built-in functions.
13.	Functions: User-defined functions.
14.	Functions: Recursive functions.
15.	Searching techniques: Linear and Binary.
16.	Sorting techniques: Bubble and Merge Sort.
17.	Experiments based on files and its operations.

		Contact Hours	**:**	**75**

Course Outcomes:
On completion of the course, students will be able to:
• Understand the working principle of a computer and identify the purpose of a computer programming language and ability to identify an appropriate approach to solve the problem.
• Write, test, and debug simple Python programs with conditionals and loops.
• Develop Python programs step - wise by defining functions and calling them.
• Use Python lists, tuples, dictionaries for representing compound data.
• Apply searching, sorting on data and efficiently handle data using flat files.

Text Books:	
1.	Allen B. Downey, Think Python: How to Think Like a Computer Scientist, Second edition, UpdatedforPython3, Shroff/ O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)
2.	Guido Van Rossum and Fred L. Drake Jr, An Introduction to Python-Revised and updated for Python3.2, Network Theory Ltd., 2011.

Reference Books:	
1.	JohnVGuttag, Introduction to Computation and Programming Using Python, Revised and expanded Edition, MIT Press, 2013.
2.	Robert Sedgewick, Kevin Wayne, Robert Dondero, Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd, 2016.
3.	Timothy A.Budd, Exploring Python, Mc-Graw Hill Education (India) Private Ltd., 2015.
4.	Kenneth A. Lambert, Fundamentals of Python: First Programs, Cengage Learning, 2012.
5.	Charles Dierbach, Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
6.	Paul Gries, Jennifer Campbell and Jason Montojo, Practical Programming: An Introduction to Computer Science using Python3, Second edition, Pragmatic Programmers, LLC, 2013.

Platform needed: Python3 interpreter for Windows/Linux

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
GE23231.1	2	2	2	2	1	-	-	-	1	1	1	1	3	3	-
GE23231.2	2	1	1	1	1	-	-	-	-	-	1	1	3	2	-
GE23231.3	1	1	2	1	2	-	-	-	-	-	1	1	2	3	2
GE23231.4	2	2	3	2	2	-	-	-	-	-	2	1	2	2	2
GE23231.5	2	2	3	2	3	-	-	-	-	-	2	1	2	2	2
Average	1.8	1.6	2.2	1.6	1.8	0.0	0.0	0.0	0.2	0.2	1.4	1	2.4	2.4	2

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
GE 23212	**BASIC CIVIL AND MECHANICAL ENGINEERING**	**ES**	**3**	**0**	**0**	**3**

Objectives:
• To impart basic knowledge on Civil Engineering and to familiarize the measurements used in Civil Engineering.
• To provide the exposure on the fundamental elements of civil engineering structures and different types of foundation.
• To familiarize the materials used in Civil Engineering and to impart basic knowledge on Mechanical Engineering
• To understand the working principle of power plant units, IC engines.
• To understand the working principle of Refrigeration & AC system.

UNIT-I	**SCOPE OF CIVIL ENGINEERING AND SURVEYING**	**9**

Overview of Civil Engineering - Civil Engineering contributions to the welfare of Society –Specialized sub disciplines in Civil Engineering – Structural, Construction, Geotechnical, Environmental, Transportation and Water Resources Engineering.

Surveying: Objective – classification – principles – measurements of distances: Chain surveying– measurements of angles: Compass surveying – leveling: Reduction of levels–Height of instrument method & Rise and fall method – contouring – determination of areas– examples and basic problems.

Content beyond syllabus (Not for Examination): Discussion related to civil engineering constructions of Ancient Monuments

UNIT-II	**BUILDING COMPONENTS AND STRUCTURES**	**9**

Foundations: Essential Requirements and function of good foundation – Types of Foundations – Shallow foundations andDeep foundations.

Superstructure: Brick masonry – stone masonry – beams – columns – lintels – roofing – flooring –plastering – Types ofBridges and Dams – Rain water harvesting - introduction to high way and rail way

Content beyond syllabus (Not for Examination): Making of model for Building Components

UNIT-III	**CONSTRUCTION MATERIALS AND SCOPE OF MECHANICAL ENGINEERING**	**9**

Construction Materials: Properties, characterization and types of Bricks – stones– sand – cement – concrete – steel– modern materials. Overview of Mechanical Engineering- Interdisciplinary concepts in Civil and Mechanical Engineering - Mechanical Engineering contributions to the welfare of Society –Specialized sub disciplines in Mechanical Engineering - Manufacturing, Automotives, Energy Engineering- Mechanical Properties. **Content beyond syllabus (Not for Examination):** Case studies

UNIT-IV	ENERGY AND AUTOMOTIVES ENGINEERING	9

Energy engineering: Introduction-Classification: Conventional and Non-conventional -Layout and working principle of Thermal, Hydro, Nuclear, Solar and Wind Power Plants–working principle of Boilers: Cochran boiler, Babcock and Wilcox boiler, Turbines, Reciprocating Pumps (single acting and double acting) and Centrifugal Pumps. Automotives: IC Engine – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – EmissionStandards and regulations – Introduction to Alternate fuels for IC Engines and Electric Vehicle.

UNIT-V	REFRIGERATION AND AIR-CONDITIONING SYSTEMS	9

Terminology of Refrigeration and Air Conditioning– Characteristics and requirements of good refrigerant – Principle of vapour compression and absorption system–Layout of typical domestic refrigerator–Window and Split type room Air conditioner.

Content beyond syllabus (Not for Examination): Discussion related to types of refrigerants

	Total Contact Hours	**:**	**45**

Course Outcomes: Upon completion of the course students should be able to:	
•	Able to explain the specialized sub disciplines of civil engineering. And they can Measure distances and area by surveying.
•	Able to explain building components, structures and various types of foundations.
•	Able to explain the usage of construction materials and they can explain the specialized sub disciplines of mechanical Engineering.
•	Able to explain the working principles of internal combustion engines and power plant cycle.
•	Able to explain the components of refrigeration and Air conditioning cycle.

Text Books:	
1	Shanmugam G and Palanichamy M S, "Basic Civil and Mechanical Engineering", Tata McGraw Hill Publishing Co., New Delhi, 2018
2	Rameshbabu V, "Basic Civil and Mechanical Engineering", VRB publishers Pvt. Ltd., 2018.

Reference Books(s) / Web links:	
1	Palanikumar, K. Basic Mechanical Engineering, ARS Publications, 2010.
2	RamamruthamS., "Basic Civil Engineering", Dhanpat Rai Publishing Co.(P) Ltd.2013.
3	Sadhu Singh.,"Basic Mechanical Engineering", S.Chand Publication 2009
4	Shantha Kumar S R J., "Basic Mechanical Engineering", Hi-tech Publications, Mayiladuthurai,2000.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
GE 23202.1	3	1	2	-	1	1	-	-	-	-	1	2	-	-	-
GE 23202.2	3	-	2	-	1	-	-	-	-	-	2	2	-	-	-
GE 23202.3	3	-	2	-	1	1	1	-	-	-	2	2	-	-	-
GE 23202.4	3	-	2	-	1	-	1	-	-	-	1	2	-	-	-
GE 23202.5	3	-	2	-	1	-	-	-	-	-	1	2	-	-	-
Average	3	-	2	-	1	0.4	0.4	-	-	-	0.46	2	-	-	-

Subject Code	BIOCHEMISTRY	Category	L	T	P	C
BT23211		PC	3	0	0	3

Course objectives:
This course will enable the students to understand

- The chemical basis of life which involves the importance of water, biological buffers
- The structure, properties of carbohydrates and lipids.
- The structure, properties of proteins and nucleic acids.
- Intermediary metabolic reactions and their regulation.
- Energy production from biomolecules

UNIT I	INTRODUCTION TO BIOMOLECULES	9

Basic principles of organic chemistry - role of carbon - types of functional groups - overview of biomolecules and biochemical reactions - chemical nature of water - pH-Henderson & Hasselbalch equation and biological buffers.

UNIT II	CARBOHYDRATES AND LIPIDS	9

Carbohydrates: (mono, di – oligo & polysaccharides) - mutarotation, glycosidic bond - epimers, anomers and asymmetric nature of carbon - reactions of monosaccharides and reducing sugars.
Lipids: Classification- structure and properties- fatty acids – glycerol – saponification – iodination – hydrogenation – phospholipids – glycolipids – sphingolipids – cholesterol – steroids

UNIT-III	STRUCTURE AND PROPERTIES OF PROTEINS AND NUCLEIC ACIDS	9

Proteins: Structure and properties of amino acids - hierarchy of structural organization of proteins- primary, secondary, tertiary and quaternary structures of proteins.
Nucleic acids: Introduction to nucleic acids - purines pyrimidines, nucleoside and nucleotide - primary structure of DNA - chemical and structural qualities of 3',5'- phosphodiester bond - secondary structure of DNA - Watson & Crick model - physicochemical properties of DNA - Chargaff's rule – RNA – types and structure - difference between DNA and RNA.

UNIT-IV	INTERMEDIARY METABOLISM AND ITS REGULATION	9

Introduction to enzymes and metabolism -glycolysis - gluconeogenesis - pentose phosphate shunt -β oxidation of fatty acid- TCA cycle - reactions of amino acids - deamination, transamination and decarboxylation - urea cycle - interconnection of pathways and their regulation.

UNIT-V	BIOENERGETICS	9

Structure of mitochondria - general concept of oxidation and reduction - electronegative potential - high energy compounds - ATP/ADP cycle - electron transport chain - oxidative phosphorylation - uncouplers– inhibitors - bioenergetics of glucose and palmitic acid oxidation.

	Total Contact Hours	:	45

Course outcomes: Upon completion of the course, the students will be able to

- Understand the chemical basis of life which involves the importance of water and biological buffers.
- Comprehend the structure and functions of carbohydrates and lipids.
- Recognize the structure and functions of proteins and nucleic acids.
- Gain more knowledge about the different metabolic pathways.
- Compute the bioenergetics of various oxidative pathways and understand the importance of ATP.

Text books:

- Hames D, Hooper N., BIOS Instant notes - Biochemistry. 4[th]edition, Garland Science, Taylor and Francis group, New York and London, 2011.
- Emine Ercikan Abali, Susan D. Cline, David S. Franklin and Susan M. Viselli. Lippincott's Illustrated Reviews, Biochemistry, Eighth Edition, Lippincott Williams & Wilkins 2021.
- Peter Kennelly, Kathleen Botham, Owen McGuiness, Anthony Weil and Rodwell V.W. Harpers Biochemistry. Appleton and Lange, Stanford, Conneticut, 32nd Edition, McGraw Hill Education,

	February 2022.

Reference books:

- Nelson D.L. and Cox M.M. Lehninger Principles of Biochemistry, 8[th]edition, WH Freeman & Co, 2021.
- Burtis & Ashwood W.B. Tietz Textbook of Clinical chemistry, Volume 564, Saunders Company, 1999.
- Jeremy Berg, Gregory Gatto Jr, Justin Hines, John L. Tymoczko, Lubert Stryer. Biochemistry, 10th Edition McMillan Publishers, 2023.
- Donald Voet & Judith G. Voet. Biochemistry, 4th Edition, John Wiley and Sons, Inc., 2010.
- Rama Rao, A.V.S.S., A Textbook of Biochemistry, 11th Edition, 2009.
- A.C Deb. Fundamentals of Biochemistry, 10th Edition, 2023.

Web links:

- https://nptel.ac.in/courses/102105034
- https://nptel.ac.in/courses/102106087

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT23211.1	3	3	3	3	1	3	3	1	1	3	1	3	3	3	3
BT23211.2	3	3	3	3	1	3	3	1	2	3	2	3	3	3	3
BT23211.3	3	3	3	3	3	3	3	1	2	3	2	3	3	3	3
BT23211.4	3	3	3	3	2	3	3	3	1	3	1	3	3	3	3
BT23211.5	3	3	3	3	3	1	1	1	3	1	3	3	3	3	3
Average	3	3	3	3	2	2.6	2.6	1.4	1.5	2.6	1.5	3	3	3	3

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
MC23111	**Indian Constitution and Freedom Movement**	Theory	3	0	0	0
Non Credit Course - Common to all branches of B.E/B. Tech programmes – First / Second/third Semester						

Objectives:

- To apprehend the sacrifices made by the freedom fighters.
- To inculcate the values enshrined in the Indian constitution.
- To instill a sense of responsibility as the citizens of India.
- To familiarise about the functions of the various levels of Government.
- To be informed about Constitutional and Non- Constitutional bodies.

UNIT-I	INDIAN FREEDOM MOVEMENT	9
British Colonialism in India-Colonial administration till 1857- Revolt of 1857- Early Resistance to British Rule- Rise of Nationalism in India-**Indian Freedom Struggle under Mahatma Gandhi-**Non- Cooperation Movement- Civil Disobedience Movement- Quit India Movement-British Official response to National movement- Independence of India Act 1947-Freedom and Partition.		
UNIT-II	**CONSTITUTION OF INDIA**	9
Historical Background – Indian Constitution: Constitution' meaning of the term, Sources and constitutional history, Constituent Assembly of India – Philosophical foundations of the Indian Constitution – Preamble – Fundamental Rights – Directive Principles of State Policy – Fundamental Duties – Citizenship – Constitutional Remedies for citizens.		
UNIT-III	**STRUCTURE AND FUNCTIONS OF CENTRAL GOVERNMENT**	9
Union Government – Structure of the Union Government and Functions – President – Vice President – Prime Minister – Cabinet – Parliament – Supreme Court of India – Judicial Review.		

UNIT-IV	STRUCTURE AND FUNCTION OF STATE GOVERNMENT AND LOCAL BODY	9

State Government – Structure and Functions – Governor – Chief Minister – Cabinet – State Legislature – Judicial System in States – High Courts and other Subordinate Courts- Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Pachayati Raj: Introduction, Elected officials and their roles, Village level: Role of Elected and Appointed officials.

UNIT-V	CONSTITUTIONAL FUNCTIONS AND BODIES	9

Indian Federal System – Centre – State Relations – President's Rule – Constitutional Functionaries – Assessment of working of the Parliamentary System in India- CAG, Election Commission, UPSC, GST Council and other Constitutional bodies-. NITI Aayog, Lokpal, National Development Council and other Non –Constitutional bodies.

Total Contact Hours: 45

Course Outcomes: Upon completion of the course, students will be able to:

- Appreciate the sacrifices made by freedom fighters during freedom movement.
- Be responsible citizens and abide by the rules of the Indian constitution.
- Be aware of the functions of the Indian government.
- Be knowledgeable about the functions of the state Government and the Local bodies.
- Apply the knowledge on constitutional functions and role of constitutional bodies and non-constitutional bodies.

SUGGESTED ACTIVITIES
- Famous speeches from around the world relating to independence
- Case study
- Quiz on Portfolio and Cabinet
- Discussions on International Associations like the UN, BRICS, QUAD
- Presentation on issues around the world

SUGGESTED EVALUATION METHODS
- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Continuous assessments (CAT)

Text Book(s):
- M. Laxmikanth , "Indian Polity:, McGraw-Hill, New Delhi.
- Durga Das Basu, "Introduction to the Constitution of India ", Lexis Nexis, New Delhi. 21sted 2013.
- P K Agarwal and K N Chaturvedi, PrabhatPrakashan, New Delhi, 1sted , 2017.

Reference Books(s) / Web links:
- Sharma, Brij Kishore, "Introduction to the Constitution of India, Prentice Hall of India, New Delhi.
- U.R.Gahai, "Indian Political System ", New Academic Publishing House, Jalaendhar
- Bipan Chandra, India's Struggle for Independence, Penguin Books, 2016.
- Maciver and Page, "Society: An Introduction Analysis ", Mac Milan India Ltd., New Delhi.2nded, 2014.
- Bipan Chandra, History of Modern India, Orient Black Swan, 2009.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MC23111.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MC23111.2	-	-	-	-	-	-	-	-		-	-	-	-	-	-
MC23111.3	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-
MC23111.4	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
MC23111.5	-	-	-	-	-	1	-	1	1	-	-	-	-	-	-
Average	-	-	-	-	-	1	-	1	1	-	-	-	-	-	-

GE23217 தமிழரும் தொழில்நுட்பமும் L T P C

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அலகு I நெசவு மற்றும் பானைத் தொழில்நுட்பம்: 3

சங்க காலத்தில் நெசவுத் தொழில் - பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் - பண்டங்களில் கீறல் குறியீடுகள்.

அலகு II வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்: 3

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப்பொருட்களில் வடிவமைப்பு - சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் - சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் - நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டிநாடு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ - சாரோசெனிக் கட்டிடக் கலை.

அலகு III உற்பத்தித் தொழில் நுட்பம்: 3

கப்பல் கட்டும் கலை - உலோகவியல் - இரும்புத் தொழிற்சாலை - இரும்பை உருக்குதல், எஃகு - வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள், கண்ணாடி மணிகள் - சுடுமண் மணிகள் - சங்கு மணிகள் - எலும்புத்துண்டுகள் - தொல்லியல் சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு IV வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்: 3

அணை, ஏரி, குளங்கள், மதகு - சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கல்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு - மீன்வளம் - முத்து மற்றும் முத்துக்குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்.

அலகு V அறிவியல் தமிழ் மற்றும் கணித்தமிழ் : 3

அறிவியல் தமிழின் வளர்ச்சி - கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் இணையக் கல்விக்கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம்.

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை - ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr. K. K. Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils – The Classical Period (Dr. S. Singaravelu)(Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr. S. V. Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies).
9. Keeladi – 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

BT23211	**BIOCHEMISTRY LABORATORY**	Category	L	T	P	C
		PC	0	0	4	2

Course objectives:
• To learn and understand the principles behind the qualitative and quantitative estimation of biomolecules

List of Experiments	
1	Preparation of buffers of biological importance
2	Qualitative tests for carbohydrates – distinguishing reducing from non-reducing sugars and keto from aldo sugars.
3	Glucose estimation by DNS method
4	Extraction of lipids and analysis by TLC
5	Estimation of rancidity, iodine number and acetyl number of lipids
6	Quantitative estimation of aminoacids using Ninhydrin-distinguishing amino from imino group.
7	Protein estimation by Bradford method.
8	Protein estimation by Folin Lowry method.
9	Estimation of Creatinine in given sample and its significance.
10	Estimation of DNA
	Contact Hours : 60

Course outcomes: Upon completion of the course, the students will be able to
• Acquire the skill to prepare biologically important buffers
• Perform qualitative analyses for the identification of biomolecules
• Estimate various biomolecules

●	Acquire expertise in operation of analytical instruments
●	Perform diagnostic tests in biochemical laboratories

Text books:

●	J.Jayaraman, Laboratory Manual in Biochemistry, 2nd Edition, New Age International Private Limited, January 2011.
●	S. K. Sawhney, Randhir Singh Eds, Introductory Practical Biochemistry, 5th or later edition, Narosa Publishing House, New Delhi, 2014.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT23211.1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
BT23211.2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
BT23211.3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
BT23211.4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
BT23211.5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Average	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Subject Code	Course Title	Category	L	T	P	C
MA23311	**TRANSFORMS AND APPLIED PARTIAL DIFFERENTIAL EQUATIONS**	BS	3	1	0	4
	Common to III sem. B.E. - AERO, MCT, R&A and B.Tech. – BT, FT and CHEM					

Objectives:

- To express Fourier series to study the behaviour of periodic functions and their applications in system communications, digital signal processing and field theory.
- To show continuous function arising in wave and heat propagation, signals and systems using Fourier Transforms.
- To obtain solution of one dimensional wave equation with finite difference techniques.
- To solve one and two dimensional heat flow equations using finite difference methods and numerical techniques.
- To make use of Z-transform to illustrate discrete function arising in wave and heat propagation, signals and systems.

UNIT-I	FOURIER SERIES	12
Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series –Parseval's identity – Harmonic analysis.	

UNIT-II	FOURIER TRANSFORMS	12
	Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity - Application to boundary value problems.	

UNIT-III	WAVE EQUATION	12
	Solution of one-dimensional wave equation - Finite difference techniques for the solution for PDE- One Dimensional Wave Equation by Explicit method	

UNIT-IV	HEAT EQUATION	12
	One dimensional equation of heat conduction – Steady state solution of two-dimensional equation of heat conduction (excluding insulated edges)- Numerical computation: One dimensional heat flow equation by	

implicit and explicit methods

UNIT-V	Z-TRANSFORMS	12

Z- transforms - Elementary properties – Inverse Z - transform (using residues) - Formation of difference equations – Solution of difference equations using Z- transform.

Total Contact Hours: 60

Course Outcomes:

On completion of the course, students will be able to

●	Demonstrate Fourier series to study the behaviour of periodic functions and their applications in engineering problems such as system communications, digital signal processing and field theory.
●	Apply the shifting theorems, Fourier integral theorems, Inverse Fourier sine and cosine transforms appropriate problems in engineering and technology.
●	Evaluate solution of one-dimensional wave equation arising in various field of engineering using finite difference techniques.
●	Apply the numerical techniques of differentiation to solution of heat flow equations arising in various branches of engineering.
●	Use Z-transform to illustrate discrete function arising in wave and heat propagation, signals and systems.

SUGGESTED ACTIVITIES
- Problem solving sessions
- Activity Based Learning
- Online MATLAB session can be implemented

SUGGESTED EVALUATION METHODS
- Problem solving in Tutorial sessions
- Assignment problems
- Quizzes and class test
- Discussion in classroom

Text Books:	
1	Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India, 2015.
2	Veerarajan. T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt.Ltd.,New Delhi, Second reprint, 2012.
3	Grewal B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, Delhi, 2014.
4	Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
5	P. Kandasamy, K. Gunavathy, Thilagavathy., "Engineering Mathematics Transforms and Partial Differential Equations", S.Chand & Company, 2002.

Reference Books / Web links:	
1	N. Subramaniam, K. S. Ramaswami., "Transforms and Partial Differential Equations", Pearson Education, 2018.
2	Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2007.
3	Ray Wylie C and Barrett.L.C, "Advanced Engineering Mathematics" Tata McGraw Hill Education Pvt Ltd, Sixth Edition, New Delhi, 2012.
4	Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), 7th Edition, New Delhi, 2009.
5	Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, 7 th Edition, New Delhi, 2012. https://drspmaths.files.wordpress.com/2020/01/advanced-engineering-mathematics-peter-v.-o-neil.pdf

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MA23311.1	3	3	3	2	1	-	-	-	-	-	-	1	2	1	2
MA23311.2	3	3	3	2	1	-	-	-	-	-	-	1	2	1	2
MA23311.3	3	3	3	3	2	-	-	-	-	-	-	2	1	2	2
MA23311.4	3	3	2	3	2	-	-	-	-	-	-	2	1	-	1
MA23311.5	2	3	2	-	-	-	-	-	-	-	-	-	1	1	-
Average	2.8	3	2.6	2.5	1.5	-	-	-	-	-	-	1.5	1.4	1.3	2

BT23311	ENZYME TECHNOLOGY AND BIOTRANSFORMATIONS	Category	L	T	P	C
		PC	3	0	0	3

Objectives: To enable the students to
● Learn enzyme reactions
● Investigate kinetics of enzymatic reactions
● Understand enzyme extraction, production and purification process.
● Study various methods of enzyme immobilisation and applications of immobilised enzymes
● Basic knowledge concerning biotransformation reactions with the usage of enzymes.

UNIT-I	INTRODUCTION TO ENZYMES	9
Classification of enzymes – Mechanisms of enzyme action – Concept of active site and energetics of enzyme substrate complex formation – Coenzymes and cofactors - Factors affecting enzyme activity – Specificity of enzyme action – Principles of catalysis – Collision theory and transition state theory – Role of entropy in catalysis.		
UNIT-II	**KINETICS OF ENZYME ACTION**	9
Kinetics of single substrate reactions; estimation of Michaelis-Menten parameters – Multi- substrate reactions Mechanisms and kinetics – Turnover number – Types of inhibition and models for substrate and product – Allosteric regulation of enzyme – Monod Changeux Wyman model.		
UNIT-III	**ENZYME IMMOBILIZATION AND BIOSENSORS**	9
Physical and chemical techniques for enzyme immobilization – Adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding and suitable examples – Advantages and disadvantages – Design of enzyme electrodes (calorimetric, potentiometric, amperometric, optical, piezoelectric, immunosensors) - Application of biosensors in industry, healthcare and environment.		
UNIT-IV	**PURIFICATION CHARACTERIZATION AND APPLICATION OF ENZYMES**	12
Isolation and purification of crude enzyme extracts from plant, animal and microbial sources – Methods of characterization of enzymes – Development of enzymatic assays. Application of enzymes in food, leather and pharmaceutical industry, Industrial applications of hyperthermophilic and psychrophilic enzymes.		
UNIT-V	**BIOTRANSFORMATION REACTIONS**	6
Enzymes role in reduction reactions – Aldehydes, Ketones, Baeyer-Villiger Oxidation, Enzymes in organic synthesis – esters, amide, peptide – Modified and Artificial Enzymes – Catalytic antibodies.		
	Contact Hours :	**45**

Course Outcomes:
On completion of the course, the students will be able to
● Understand enzyme classification and enzyme reactions.
● Understand kinetics of enzyme catalysed reactions.
● Comprehend the immobilization process and its application in various industries
● Carry out enzyme isolation, purification and characterization.
● Design biotransformation reactions and production of novel enzymes.

Suggested Activities
● Problem solving sessions
● Industrial Visit
● Case studies

Suggested Evaluation Methods
● Quizzes
● Seminar Presentation / Discussion

Text Book(s):	
1	Trevor Palmer , Enzymes II Horwood Publishing Ltd
2	Faber K , Biotransformations in Organic Chemistry, IV edition, Springer

Reference Books(s) / Web links:	
1	Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Dekker, Inc.
2	James M. Lee, Biochemical Engineering, PHI, USA.
3	James. E. Bailey & David F. Ollis, Biochemical Engineering Fundamentals, McGraw Hill.
4	Wiseman, Enzyme Biotechnology, Ellis Horwood Pub.

PO /PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT23311.1	2	1	2	3	1	3	-	-	-	-	-	3	2	1	3
BT23311.2	3	3	2	3	2	-	-	-	-	-	-	3	3	3	3
BT23311.3	3	3	3	3	3	3	2	-	2	-	-	3	3	3	3
BT23311.4	3	3	3	3	3	3	3	-	2	-	2	3	3	3	3
BT23311.5	3	3	3	3	3	3	3	-	2	-	-	3	3	3	3
Average	2.8	2.6	2.6`	3	2.4	2.4	1.6	0	1.2	0	0.4	3	2.8	2.6	3

BT23312	STOICHIOMETRY AND FLUID MECHANICS	Category	L	T	P	C
		ES	3	1	0	3

Course Objectives:
• To learn the fundamentals of units and conversion
• To understand the concepts in material balance for different unit operations
• To gain knowledge about the concepts of energy balance equations
• To understand the basics of fluid flow
• To work with fluidized bed and pumps

UNIT-I	INTRODUCTION	9
Dimensions – system of units - conversion factors - Compositions of mixtures and solutions - gas laws		
UNIT-II	CONCEPTS IN MATERIAL BALANCES	9
Material balance concept – overall & component – material balance applications in industries - evaporator, absorber, Distillation, Extraction, crystallization, drying, mixing, Chemical Reaction-Limiting, excess component, Fractional conversion and yield, Combustion Reactions.		
UNIT-III	CONCEPTS IN ENERGY BALANCES	9
Energy balance equation for open systems, closed system, sensible and latent heat calculations - Application of energy balance in Bioprocesses		
UNIT-IV	FLUID PROPERTIES & FLUID MECHANICS	9
Fluids – types - Fluid statics and its application – Boundary layer - Fluid Dynamics – equation of continuity – Bernoulli's equation – Flow of incompressible fluids in pipes - Fluid flow measurement - Orifice, venturi and Rotameter.		
UNIT-V	FLOW OF FLUID THROUGH PACKINGS	9
Drag, Flow through packed bed, Fluidization – Types – Applications, Pipes, Fittings and Valves, Pumps – Centrifugal pump and Reciprocating pump.		
	Total Contact Hours :	45

Course Outcomes: Upon the completion of the course, the students will be able to
• Learn the fundamentals of the units and conversions
• Solve the material balance problems for different unit operations
• Solve energy balance equations for different systems
• Solve the problems related to fluid flow
• Select various valves and pumps for its application in industries

Text Book(s):
• Bhatt, B.I. and S.M.Vora–Stoichiometry (SI Units) ‖, 3rd Edition, Tata McGraw Hill, 1996.
• McCabe,W.L.,J.C.Smith and P.Harriot—UnitOperationsofChemicalEngineering‖,6th Edition,McGraw Hill, 2001

Reference Books(s) / Web links:
• Himmelblau, D.M. –Basic principles and calculations in Chemical Engineering ‖, 6th Edition, PHI, 2006.
• Smith J.M., Van Ness H.C., and Abbot M.M. –Introduction to Chemical Engineering Thermodynamics‖, VI th Edition. Tata McGraw-Hill, 2003.
• Sandler S.I.–Chemical and Engineering Thermodynamics‖, John Wiley, 1989.
• Perry's Chemical Engineers' Handbook, 9th Edition, Kindle Edition by Don W. Green, Marylee Z. Southard, Imprint: McGraw-Hill Education.
• http://www.learnchem.net/tutorials/stoich.shtml

●	http://nptel.ac.in/courses/113104010
●	Y.V.C.Rao , Chemical Engineering Thermodynamics' , University Press (India) Ltd., Hyderabad 1997

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT23312.1	3	3	1	-	-	-	-	-	1	-	3	3	-	-	3
BT23312.2	3	3	3	3	2	-	-	-	1	-	2	3	-	-	3
BT23312.3	3	3	3	3	2	-	-	-	1	-	2	3	-	-	3
BT23312.4	3	3	2	2	-	-	-	-	-	-	2	3	-	--	3
BT23312.5	3	3	2	-	-	-	-	-	-	-	2	3	-	-	3
Average	3	3	2.2	1.6	0.8	-	-	-	1	-	2.2	3	-	-	3

BT23313	MOLECULAR GENETICS	Category	L	T	P	C
		PC	3	0	0	3

Objectives:	
●	Familiarize students with cell and molecular components and their characteristics of both Prokaryotes and Eukaryotes.
●	To elucidate the mechanisms of replication
●	To provide in depth knowledge in transcription process
●	To explain about the decoding process
●	To provide in-depth knowledge in the area of gene expression and their regulation.

UNIT-I	NUCLEIC ACIDS AND THEIR PROPERTIES	9
Introduction to nucleic acids: Nucleic acids as genetic material, Structure and physicochemical properties of DNA and RNA, differences in DNA and RNA. Primary structure of DNA and RNA, Forms of DNA(A-DNA,B-DNA and Z-DNA),Chargaffs rule, Hogsteen base pairing, Denaturation and renaturation ,hyperchromic effect, Organization of genes in prokaryotic and eukaryotic chromosomes	
UNIT-II	DNA REPLICATION AND REPAIR	9
Overview of Central dogma. Organization of prokaryotic and eukaryotic chromosomes. Classic Experiments: DNA as the genetic material, DNA replication: Meselson & Stahl experiment, bi–directional DNA replication, Okazaki fragments, Proteomics of DNA replication, Fidelity of DNA replication, Inhibitors of DNA replication, phage replication, Telomere replication in eukaryotes. D-loop and rolling circle mode of replication. Mutation, various types of repair mechanisms.	
UNIT-III	TRANSCRIPTION	9
Transcription, characteristics of promoter and enhancer sequences. Inhibitors of transcription, ribozymes, post transcriptional modification, splicing, reverse transcription, transcriptomics.	
UNIT-IV	TRANSLATION	9
Introduction to Genetic code: Elucidation of genetic code, Codon degeneracy, Wobble hypothesis and its importance, Prokaryotic and eukaryotic ribosomes. Steps in translation: Initiation, Elongation and termination of protein synthesis. Inhibitors of protein synthesis. Post-translational modifications and its importance. Protein localization	
UNIT-V	REGULATION OF GENE EXPRESSION	9
Prokaryotic gene regulation –lac and trp operon, Eukaryotic Gene Regulation, gene transfer, Regulatable promoter transduction, transformation, Epigenetics	
	Total Contact Hours	:	45

Course Outcomes: Students should be able to	
●	Describe the basic structure and biochemistry of nuclear components
●	Demonstrate the replication mechanism
●	Explain how synthesis of RNA occurs in the cell
●	Describe the mechanism of protein synthesis and localization
●	Understand gene expression.

	Text Book(s):
1	Friefelder, David. ―Molecular Biology.NarosaPublications, 1999
2	Weaver, Robert F. ―Molecular Biology IInd Edition,Tata McGraw-Hill, 2003.
3	Karp, Gerald―Cell and Molecular Biology: Concepts and Experiments, IVthEdition, JohnWiley, 2005.
4	Friefelder, David and George M. Malacinski ―Essentials of Molecular Biology‖ IInd Edition, Panima Publishing, 1993.

	Reference Books(s) / Web links:
1	Tropp, BurtonE. ―Molecular Biology: Genesto Proteins‖. IIIrd Edition.Jones and Bartlett, 2008.
2	Glick, B.R. and J.J. Pasternak. ―Molecular Biotechnology : Principles and Applications of Recombinant DNA‖ 4th Edition. ASM,201

Suggested activities
Animated video
Lecture –PPT
Lecture –BB

Suggested assessment
Quizzes
Assignment/case study

Weblink
https://www.bing.com/search?q=molecular+biology&cvid=9fcf3cb89a4049f1a77a14ea9c45b483&aqs=edge.0.0l4j46j0l
4.5671j0j9&FORM=ANAB01&PC=U531

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT23313.1	3	3	2	3	-	-	-	3	-	3	-	1	1	2	3
BT23313.2	3	3	3	3	3	-	-	3	-	3	2	3	2	3	3
BT23313.3	3	3	3	3	3	-	1	3	-	3	2	3	2	3	3
BT23313.4	3	3	3	3	3	-	-	3	-	3	2	3	2	3	3
BT23313.5	3	3	3	3	-	2	-	3	3	3	-	3	2	2	3
Average	3	3	2.8	3	1.8	0.4	0.2	3.0	0.6	3	1.2	2.6	1.8	2.6	3

BT23314	CELL BIOLOGY	Category	L	T	P	C
		PC	3	0	0	3

	Objectives:
•	To understand the structure and functions of cells and their organisation into tissues.
•	To acquire knowledge in the area of transport of ions and the mechanism of transmission of nerve impulses.
•	To analyse the various modes of communication between cells.
•	To study the types of cell division and its role in carcinogenesis.
•	To understand the techniques applied in cell research.

UNIT-I	CELL STRUCTURE AND FUNCTION OF THE ORGANELLES	9

Evolution of cells, Eukaryotic cells, Sub-cellular organelles and functions, Membranes-Structure and Function, Cytoskeletal proteins- Actin, IF, Microtubules -Significance of RBC Cytoskeleton, Extracellular matrix- Composition and function, Cell Junctions -Anchoring Junctions, Tight Junctions, Gap Junctions

UNIT-II	TRANSPORT ACROSS BIOLOGICAL MEMBRANES	9

Active, passive transport (simple diffusion, facilitated diffusion, glucose transport, anion exchanger), ATP powered pumps –

Na+/K+ pumps, Ca++ pumps – significance, structure and mechanism of transport, secondary active transport, uniport, symport, antiport, exocytosis and endocytosis. Resting potential, action potential, conduction of nerve impulses, neurotransmitters. Ligand gated (acetyl choline) / voltage gated ion channels (Na+, K+, Ca++).		
UNIT-III	**SIGNAL TRANSDUCTION**	9
Biosignals, Steps involved in signalling, Modes of Signalling- autocrine, paracrine and endocrine, Types of receptor- Intracellular and Membrane bound - role of second messengers in cell signalling, cyclic AMP- Epinephrine Signalling, cyclic GMP – Visual signal transduction and NO signalling, IP3, DAG, Ca++– Phosphoinositol lipid pathway, Ras/MAPK pathway –EGF.		
UNIT-IV	**CELL DIVISION, APOPTOSIS AND CANCER**	9
Mitosis, Meiosis, Cell cycle and its regulation, molecules controlling cell cycle – cyclins CDKs, CDKIs, check points, cell survival and apoptosis pathways - In relation to cancer.		
UNIT-V	**TECHNIQUES USED TO STUDY CELLS**	9
Cell fractionation and flow cytometry-FACS, sub cellular fractionation - Differential velocity centrifugation and Equilibrium density centrifugation, Characterization of cells in culture using: Cell viability assays–MTT Assay,Tryphan Blue exclusion, Leishman staining, H &E staining, Immunohistochemistry, Cell migration- Scratch assay, Membrane fluidity -FRAP		
	Contact Hours :	**45**

Course Outcomes:
On completion of the course, the students will be able to
●   Apply knowledge in the area of cellular organisation.
●   Analyse the modes of transport and relate the same to function of nervous muscular systems.
●   Examine the methods of communication within the cells.
●   Correlate the basic concepts of cell division and their role in carcinogenesis.
●   Design simple methods to analyse cell and its activity

Suggested Activities
●   Laboratory session (Unit 5), Interactive animation (Unit 2,3), Interactive videos (Unit 1,4), Discussion on major endocrine systems, Discussion on relevant case studies

Suggested Evaluation Methods
●   Quizzes
●   Class Presentation / Discussion
●   Assignments
●   Continuous Assessment Tests

Text Book(s):	
1	Lodish, Harvey etal., ―Molecular Cell Biology‖, Vth Edition, W.H.Freeman, 2ss005.
2	Cooper, G.M. and R.E. Hansman ―The Cell : A Molecular Approach‖, IVth Edition, ASM Press, 2007.
3	Jeff Hardin and James P Lodolce – Becker's World of the Cell, Xth Edition, Pearson Education, 2022
4	Lewis J Kleinsmith – Principles of Cancer Biology, Ist Edition, Pearson Education, 2014

Reference Books(s) / Web links:	
1	Lehninger A.L., Nelson D.L. and Cox M.M. Principles of Biochemistry,6thedition, CBS publishers and distributors, 2012.
2	LubertStryer W.H. Biochemistry, 5thRevised edition Freeman and company, New York, 2002.
3	https://www.nature.com/scitable/ebooks/cell-biology-for-seminars-14760004/contents/
4	https://openbooks.lib.msu.edu/neuroscience/chapter/the-membrane-at-rest/
5	https://www.physiologyweb.com/lecture_notes/resting_membrane_potential/resting_membrane_potential_in_real_cells_multiple_ions_contribute_to_the_membrane_potential.html
6	https://www.labxchange.org/library/items/lb:LabXchange:4400b96e:lx_simulation:1

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT23314.1	1	-	-	3	-	-	2	2	3	3	1	3	3	2	3
BT23314.2	2	3	3	3	3	2	2	2	3	3	2	3	3	3	3
BT23314.3	2	2	2	3	3	2	2	2	3	3	3	2	2	2	2
BT23314.4	2	3	2	3	3	2	2	2	3	3	2	3	3	3	2
BT23314.5	3	3	2	2	3	3	2	3	3	3	2	3	3	3	2
Average	2	2.2	1.8	2.8	2.4	1.8	2.0	2.2	3.0	3.0	2.0	2.8	2.8	2.6	2.4

BT23321	BASIC FOOD AND ENZYME TECHNOLOGY LABORATORY	Category	L	T	P	C
		ES	0	0	2	1

Objectives:
● To apply the basic concepts of food to analyse the food products
● To identify the presence of food adulterants
● To analyze food samples for its physical parameters
● To demonstrate enzyme isolation experiments
● To perform assay of enzymes

List of Experiments	
1	Estimation of Vitamin C
2	Identification of monosodium glutamate content of various food preparations
3	Determination of Brix value of different food items
4	Identification of food adulterants
5	Anti-browning effect- Assay of polyphenol oxidase (Catecholase)
6	Isoelectric precipitation of protein from casein milk
7	Estimation of moisture and fiber content in food sample
8	Assay of acid phosphatase from potato.
9	Determination of amylase using Petri-plate method
10	Assay of urease from horsegram
11	Assay of catalase
	Contact Hours : 60

Course Outcomes:
Upon completion student will be able to
● Analyze and assess the composition of food products
● Develop tools to detect the presence of harmful food adulterants
● Evaluate physical parameters of food samples
● Isolate enzymes from plant sources
● Carry out assay of enzymes

Suggested Activities
● Demonstrating use of enzymes in food processing

Suggested Evaluation Methods
● Quizzes
● Viva

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Text Book(s):	
1	Govindharajan, Sattanathan & Padmapriya, Swaminathan & B, Balamuralikrishnan. (2020). Practical Manual of Biochemistry. 10.22573/spg. 020. BK/S/028.
2	Tiwari, PhD, Anand. (2015). Practical Biochemistry: A Student Companion.
3	Joy PP, Surya S, Aswathy C. Laboratory Manual of Biochemistry. Kerala Agricultural University, 2015.
4	T.P. Coultate – Food – The Chemistry of Its Components, 2nd Edn. Royal Society, London, 1992.
5	B. Sivasanker – Food Processing And Preservation, Prentice-Hall Of India Pvt. Ltd. New Delhi 2002

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT23321.1	3	3	1	2	1	1	2	1	1	2	1	3	3	2	1
BT23321.2	3	3	3	3	2	2	2	2	2	2	2	3	3	3	3
BT23321.3	3	3	3	3	2	2	2	2	2	2	2	3	3	3	3
BT23321.4	3	3	3	3	3	2	3	2	3	2	3	3	3	3	3
BT23321.5	3	3	3	3	3	2	3	2	3	2	3	3	3	3	3
Average	3	3	2.6	2.8	2.2	1.8	2.4	1.8	2.2	2	2.2	3	3	2.8	2.6

BT23331	ANALYTICAL TECHNIQUES IN BIOTECHNOLOGY	Category	L	T	P	C
		ES	2	0	2	3

Objectives:	
•	To gain knowledge on the principles of spectrometry and optical instruments.
•	To learn the theoretical and practical aspects of molecular spectroscopy.
•	To identify the suitable structure elucidation and interaction techniques.
•	To know different separation methods used in Biotechnology.
•	To understand various advanced analytical techniques.

UNIT-I	INTRODUCTION TO SPECTROMETRY	6

Properties of Electromagnetic Radiation – Wave Properties – Components of Optical Instruments – Sources of Radiation – Wavelength Selectors – Sample Containers – Radiation Transducers – Signal Process and Read Outs –Signal to Noise Ratio – Sources of Noise – Enhancement of Signal to Noise Ratio– Types of Optical Instruments

UNIT-II	SPECTROSCOPIC TECHNIQUES - I	6

Beer's Law – UV-Visible Light Spectroscopy – Instrumentation – Applications – Light Scattering –Turbidometric and Nephalometric Analysis – Fluorescence Spectroscopy – Instrumentation – Applications – Fourier Transform Infrared Spectroscopy – Instrumentation – Applications – Raman Spectroscopy – Instrumentation – Applications

UNIT-III	SPECTROSCOPIC TECHNIQUES - II	6

Nuclear Magnetic Resonance – Theory – Instrumentation – Applications –Electron Paramagnetic Resonance – Instrumentation – X-Ray Diffraction –Theory – Instrumentation – Applications –Mass Spectrometer –Ion Sources – Applications – Atomic Absorption Spectroscopy –Theory – Instrumentation – Applications.

UNIT-IV	SEPARATION TECHNIQUES	6

General principles of chromatography – Chromatographic Performance Parameters – Ideal Separation – Band Broadening and Optimization – HPLC – Gas Chromatography – Principles of Electrophoresis – Gel Electrophoresis – Capillary Electrophoresis.

UNIT-V	ADVANCED ANALYTICAL TECHNIQUES	6

Theory, Instrumentation and Applications of: Thermogravimetric Analysis - Differential Thermal Analysis - Differential Scanning Calorimetry – Atomic Force Microscopy – Scanning Tunneling Microscope –Brunauer Emmett Teller Analysis – Vibrating Sample Magnetometer Analysis.	
Total Contact Hours :	**30**

EXPERIMENTS
1. Precision and validity in an experiment using absorption spectroscopy and Validating Lambert-Beer's law using $KMnO4/K_2Cr_2O_7$
2. Finding the molar absorbtivity and stoichiometry of the Fe (1, 10 phenanthroline) using absorption spectrometry.
3. Estimation of AL^{+++} by flourimetry.
4. Job's plot for finding stoichiometry of iron salicylate complex.
5. UV spectra of nucleic acids.
6. UV – spectra of proteins.
7. Limits of detection of colorimeter using aluminum alizarin complex/Absorption spectrum
8. Analysis of riboflavin by flourimetry method
9. Separation of sugars by thin layer chromatography
10. Separation of plant pigments by column chromatography

Suggestive activity
1. Demo on HPLC
2. Demo on Thermogravimetric Analysis
3. Demo on Atomic Absorption Spectroscopy

Course Outcomes: At the end of the course the students will be able to	
•	Demonstrate the principle of spectrometry and the optical instruments
•	Assess the theoretical and practical aspects of molecular spectroscopy.
•	Detect appropriate techniques for structure elucidation and interactions.
•	Comprehend various separation techniques in biotechnology.
•	Apply different techniques to analyse the properties of the samples

Text Book(s):	
1	Wilson, K and Walker, J - Principles and Techniques of Biochemistry and Molecular Biology, VIIth Edition,Cambridge University Press, 2010.
2	Skoog, D.A. F. James Holler, and Stanky, R.Crouch —Principles of Instrumental Analysis, VIth Edition,ThomsonBrooks/Cole,2007.
3	Willard, Hobart, etal., —Instrumental Methods of Analysis. VIIth Edition, CBS,1986.
4	Braun, Robert D. —Introduction to Instrumental Analysis. Pharma Book Syndicate,1987.

Reference Books(s) / Web links:	
1	Sharma, B.K. —Instrumental Methods of Chemical Analysis: Analytical Chemistry‖ Goel Publishing House,1972.
2	Haven,MaryC.,etal.,—LaboratoryInstrumentation‖.IV[th]Edition,JohnWiley,1995.
3	https://lecturenotes.in/materials/14302-note-of-instrumental-methods-of-analysis-by-rishab-sahoo
4	https://youtu.be/LLPMxBB9hRw
5	https://youtu.be/2oPUyIbPxLo (Knowbee)

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT23331.1	3	3	3	3	3	-	1	3	-	-	3	3	3	3	3
BT23331.2	3	3	3	3	3	-	1	1	1	1	3	3	3	3	3
BT23331.3	3	3	3	3	3	3	1	1	1	1	3	3	3	3	3
BT23331.4	3	3	3	3	3	3	-	1	1	1	3	3	3	3	3
BT23331.5	3	3	3	3	3	3	1	1	1	1	3	3	3	3	3
Average	3	3	3	3	3	3	1	1.4	1	1	3	3	3	3	3

MA23431	PROBABILITY, STATISTICS AND RELIABILITY	Category	L	T	P	C
	Common to IV sem. B.Tech. - BT, FT and CHEM	BS	3	0	2	4

Course Objectives:
● To introduce the basic concepts of probability, one dimensional random variable.
● To solve the problems those are faced in testing of a hypothesis with reference to the errors in decision making.
● To analyse the different mathematical models with the help of statistical deigns and appropriate data and made valuable conclusions by proper evaluation.
● To explain the concepts of quality control in industry and to apply various tools to examine the quality of a process and product.
● To analyse statistical experiments leading to reliability modelling and to identify reliability testing components for assessment of reliability in engineering design.

UNIT-I	PROBABILITY	9
One dimensional Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Uniform and Normal distributions, Two dimensional Discrete and continuous random variables – Conditional and Marginal densities.		
UNIT-II	STATISTICAL TESTING	9
Maximal Likelihood estimation – Parameters of Binomial and Poisson distribution - Tests of significance – Z test: Single mean, difference of means- Chi square - F test.		
UNIT-III	ANOVA	9
Design of Experiments - Completely randomized design – Randomized block design –Latin square design.		
UNIT-IV	STATISTICAL QUALITY CONTROL	9
Control charts for measurements ($\bar{X}$and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling		
UNIT-V	RELIABLITY	9
Reliability Concepts: Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve - Failure Data Analysis: Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions - Reliability Hazard Models: Constant Failure Rate, Linearly increasing, Time Dependent Failure Rate, Weibull Model- Distribution functions and reliability analysis.		
	Total Contact Hours: 45	

S.No.	LIST OF EXPERIMENTS (USING R SOFTWARE)	Total Contact Hours: 30
1	Basic Functions in R and plotting	
2	Mathematical functions in R – Integration	
3	Control flow – Loops in R	
4	Probability Distributions using R- PDF, CDF for Binomial, Poisson, Exponential, Uniform and Normal Distributions.	
5	Testing of Hypothesis – Z testing	
6	Testing of Hypothesis – F and chi square testing	
7	ANOVA – one way and two way	
8	Statistical quality control – p, np , c, $\bar{X}$charts	
9	Reliability – MTTF, MTBF	
10	Reading , Writing data in R and working with inbuilt data sets in R	

Course Outcomes: on completion of the course, the students will be able to
● Have the critical thinking in the theory of probability and its applications in real life problems.
● Apply the different testing tools like t-test, F-test, chi-square test to analyse the relevant real life problems.
● Analyse the different mathematical models with the help of statistical deigns and appropriate data and made valuable conclusions by proper evaluation.
● Use various tools to examine the quality of a process and product in engineering and technology.
● Illustrate the basic concepts and techniques of modern reliability engineering tools.

SUGGESTED ACTIVITIES
- Problem solving sessions
- Smart Class room sessions

SUGGESTED EVALUATION METHODS
- Problem solving in Tutorial sessions
- Assignment problems
- Quizzes and class test
- Discussion in classroom

Text Book(s):

●	Veerarajan T, 'Probability, Statistics and Random Processes with Queueing Theory and Queueing Networks'.
●	McGraw Hill, 2016. 2 Johnson R.A. and Gupta. C.B., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 7th Edition, 2007.
●	Srinath. L.S., "Reliability Engineering", Affiliated East west press, 1991.
●	Kandasamy P., Thilagavathi and K. Gunavathi., "Statistics and Numerical Methods", S. Chand & Company Ltd. (2010).

Reference Books(s) / Web links:

●	Jhon wiley& Sons .Erwin Kreyszig., "Advanced Engineering Mathematics", Pearson Education, Asia, 7th Edition, 2007.
●	Ramana. B.V., "Higher Engineering Mathematics ", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
●	Gupta. R.C, "Statistical Quality control", Khanna Publishers, 1997
●	Douglas.C. Montgomery, "Introduction to Statistical quality control", 7th edition, John Wiley 2012.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MA23431.1	2	2	-	-	-	-	-	-	-	-	-	-	1	-	-
MA23431.2	2	2	1	1	-	-	-	-	-	-	-	1	1	-	-
MA23431.3	2	2	-	2	-	-	-	-	-	-	-	1	-	-	-
MA23431.4	2	2	2	2	-	-	-	-	-	-	-	1	-	-	-
MA23431.5	2	2	2	1	-	-	-	-	-	-	-	1	-	-	-
Average	2	2	1.6	1.5	-	-	-	-	-	-	-	1	1	-	-

BT23411	FOOD BIOTECHNOLOGY	Category	L	T	P	C
		ES	3	0	0	3

Course Objectives: To enable the students:
● To impart knowledge on various foods and their nutritional values
● Learn the constituents and additives present in the food
● Gain knowledge about the microorganisms, which spoil food and cause food-borne diseases
● Familiarise different techniques used for the preservation of foods
● To know about the Food Safety and standards act

UNIT-I	**PRINCIPLES AND BASICS OF FOOD CHEMISTRY**	9
Role and functions of macro and micronutrients in human nutrition, food additives with respect to their technological functions, Enzymes as food processing aids, Food allergens and allergenicity, overview of nutraceuticals and food contamination.		
UNIT-II	**FOOD SCIENCE AND NUTRITION**	9
Food adulteration and their effects on human health. and Food testing, and rapid detection methods, Supplementation, Fortification/Bio-fortification, Poor Diet and consequencest- Stunting, wasting & anemia and Lifestyle diseases- Coronary heart disease, diabetes & obesity.		
UNIT-III	**FOOD MICROBIOLOGY & GENERAL PRINCIPLES OF FOOD PROCESSING AND PRESERVATION.**	9
Sources of microorganisms in the food, microbial food spoilage and Food-borne diseases, Principles and methods of food preservation- Heat processing, pasteurization, canning, Preservation by low temperature-refrigeration, frozen storage, freeze-drying, Irradiation method of foods preservation, modified atmosphere storage and hurdle technology.		
UNIT-IV	**FOOD HYGIENE /QUALITY MANAGEMENT**	9
General principles of food safety management systems including traceability and food recall- sanitation, Food Surveillance and Quality control of food-HACCP and Good production and processing practices (GHP, GMP, GAP, BAP, GLP).		
UNIT-V	**INDIAN AND INTERNATIONAL FOOD LAWS**	9
Food Safety and Standards Act of India, 2006(FSSAI), Rules and Regulations of FSSAI, Overview of other national bodies- APEDA, BIS, MPEDA, International Food Control Systems- CODEX Alimentarius Commission and WTO agreements (SPS/TBT).		
	Total Contact Hours: 45	

Course Outcomes: on completion of the course, the students will be able to
● Apply knowledge gained in food chemistry, microbiology and processing/preservation of food products.
● Familiar with nutrients and it's functional properties of foods
● Design food products that meet the various food regulations and laws.
● Knowledge about the importance of food additives and their function and will develop strategies that will promote food safety and prevent food borne illness.
● Identify spoilage and deterioration of food and apply the methods to control the food spoilage and deterioration.

SUGGESTED ACTIVITIES
●   Activity based sessions
●   Smart Class room sessions

SUGGESTED EVALUATION METHODS
- Case studies
- Assignment problems
- Quizzes and class test
- Discussion in classroom

Text Book(s):	
●	T.P.Coultate-Food-The Chemistry of its Components, 2nd edition. Royal society, London, 1992.
●	B.Sivasanker-Food processing and preservation, Prentice-Hall of IndiaPvt.Ltd.New Delhi, 2002.
●	George JB. Basic Food Microbiology, CBS Publishers & Distributors, 1987.

Reference Books:	
●	W.C.Frazier and D.C.Westhoff-Food Microbiology, 4th Ed.,McGraw-Hill book Co.,New York.
●	J.M.Jay-Modern Food Microbiology, CBS Pub.New Delhi, 1987.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT23411.1	3	3	3	3	3	2	3	2	2	2	2	2	2	3	2
BT23411.2	3	3	3	3	3	2	3	2	2	2	2	2	2	3	2
BT23411.3	3	3	3	3	3	2	3	2	2	2	2	2	2	3	2
BT23411.4	3	3	3	3	3	2	3	2	2	2	2	2	2	3	2
BT23411.5	3	3	3	3	3	2	3	2	2	2	2	2	2	3	2
Average	3	3	3	3	3	2	3	2	2	2	2	2	2	3	2

BT23412	GENETIC ENGINEERING	Category	L	T	P	C
		PC	3	0	0	3

Objectives:
- To discuss the gene cloning methods, the tools and techniques involved in gene cloning and genome analysis.
- To explain the advanced gene isolation techniques
- To explain the applications of PCR
- To familiarize the students to carry out research in the determination of the gene and it's function
- To provide in-depth knowledge about functional genomics

UNIT-I	BASICS OF RECOMBINANT DNA TECHNOLOGY	9

DNA Manipulative enzymes, DNA Modifying Enzymes, Linkers and Adaptors. Characteristics of cloning and expression vectors based on plasmid and bacteriophage, Vectors for Yeast, Insect and Mammalian systems, Introduction of recombinant DNA into host cells and selection methods

UNIT-II	DNA LIBRARIES	9

Construction of genomic and cDNA libraries, Screening methods for recombinant clones from DNA libraries using nucleic acid hybridization and Immunological and PCR Method. BACs and YACs, Chromosome walking, Restriction Modifying System.

UNIT-III	DNA SEQUENCING AND AMPLIFICATION OF DNA	9

Maxam Gilbert's and Sanger Coulson's and automated methods of DNA sequencing, pyrosequencing method. Principle of PCR, Types of PCR-Inverse PCR, Nested PCR, AFLP-PCR, Asymmetric PCR, Assembly PCR, Touch down PCR, Colony PCR, Real-time PCR – SYBR green assay and Taqman assay; Site directed mutagenesis.

UNIT-IV	MAPPING AND SEQUENCING OF GENOME	9

Genome sequencing methods- Conventional and shotgun genome sequencing methods, Next generation sequencing technologies. Genetic maps and Physical maps, Restriction Enzyme Finger Printing, Hybridization mapping, Radiation Hybrid Maps, Optical mapping. ORF finding and functional annotation.

UNIT-V	FUNCTIONAL GENOMICS	9

Introduction to functional genomics, Applications of Genetic Engineering - Microarrays, Serial Analysis of Gene expression (SAGE), Northern Blotting, Subtractive hybridization, MALDI-TOF, Yeast Two hybrid System.

Total Contact Hours: 45

Course Outcomes: The students will be able to
- Be aware of how to clone commercially important genes
- Produce the commercially important recombinant proteins
- Gain knowledge about genome sequencing methods
- Gain knowledge about how to characterize a gene
- Learn about DNA amplification and diagnosis of disease

Text Book(s):
- Primrose SB and R. Twyman ―Principles Of Gene Manipulation &Geneomic Blackwell Science Publications, 2006.
- Principles of Genome Analysis and Genomics by S.B.Primrose and R.M.Twyman, Third Edition (Blackwell Publishing), 2003.
- Gene cloning and DNA analysis by T.A Brown ,Sixth edition
- Primrose SB and R. Twyman ―Principles Of Gene Manipulation &Geneomic Blackwell Science Publications, 2006.

Reference Books(s) / Web links:
- Ansubel FM, Brent R, Kingston RE, Moore DD, ―Current Protocols In Molecular Biology ―Greene Publishing Associates, NY,1988.
- Berger Sl, KimmerAR, ―Methods In Enzymology ‖, Vol 152, Academic Press,1987.
- Genomes 3 by T.A.Brown, Third Edition (Garland Science Publishing)
- Ansubel FM, Brent R, Kingston RE, Moore DD, ― Current Protocols In Molecular Biology ―Greene Publishing Associates, NY,1988.

Suggested Activities
- Animated video
- Lecture –PPT
- Lecture –BB
- Quizzes
- Assignment/case study

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT23412.1	3	3	3	3	-	3	3	3	3	-	2	3	3	3	3
BT23412.2	3	3	3	3	-	3	3	3	3	-	2	3	3	3	2
BT23412.3	3	3	3	2		3	3	3	3	-	2	3	3	3	3
BT23412.4	3	3	3	3	-	3	3	3	3	-	2	3	3	3	2
BT23412.5	3	3	3	2	-	3	3	3	3	-	2	3	3	3	2
Average	3	3	3	2.6	-	3	3	3	3	-	2	3	3	3	2.8

BT23413	THERMODYNAMICS AND HEAT TRANSFER	Category	L	T	P	C
		ES	3	1	0	3

Objectives:
• To endow the students with the thermodynamic relations and concept of partial molar properties
• To solve VLE calculations for binary system
• To study the mechanism of heat transfer by conduction
• To inculcate the heat flow mechanism by convection
• To design heat exchange equipment

UNIT-I	INTRODUCTION TO THERMODYNAMICS	9
Thermodynamic properties and relations, Maxwell's equations and applications; fugacity and activity, Partial molar properties - determination of partial molar properties; Chemical potential, Fugacity in solutions, activity coefficients, Gibbs Duhem equations.		
UNIT-II	PHASE EQUILIBRIA	9
Criteria for phase equilibrium and stability, Phase diagrams for binary solutions, Azeotropes, Activity coefficient equations, Bubble point and dew point equilibria; liquid- liquid equilibrium diagrams.		
UNIT-III	CONDUCTION	9
Steady state conduction; combined resistances; unsteady state conduction - lumped heat capacity; extended surfaces; combined conduction and convection		
UNIT-IV	CONVECTION	9
Dimensional analysis; forced and natural convection; convection in flow over surfaces through pipes; boiling and condensation.		
UNIT-V	HEATEXCHANGERS	9
Heat exchanger- overall heat transfer coefficients; design of heat exchangers; Effectiveness - NTU concept; Evaporators-single effect- mass and enthalpy balances.		
	Total Contact Hours: 45	

Course Outcomes: Upon the completion of the course, the students will be able to
• Apply the concepts of partial molar properties in solutions
• Determine the VLE composition for binary systems
• Resolve problems for heat flow by conduction for various geometries
• Elucidate the convective heat transfer problems
• Design heat exchanger equipment for bioprocess

Text books
• Narayanan K.V.–A Text Book of Chemical Engineering Thermodynamics, Prentice Hall India, 2003
• Binay K.Dutta, Heat transfer: Principles and applications, PHI learning Pvt. Ltd., New Delhi, 1st edition, 2006
• Y.V.C.Rao , Chemical Engineering Thermodynamics' , University Press (India) Ltd., Hyderabad 1997

Reference books
• Geankoplis C.J. Transport Processes And Unit Operations. Prentice HallIndia.2002.
• Perry's Chemical Engineers' Handbook, 9th Edition, Kindle Edition by Don W. Green , Marylee Z. Southard, Imprint: McGraw-Hill Education.
• http://nptel.ac.in/courses/112108149
• http://onlinecourses.nptel.ac.in/noc20_ch12/preview

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT23413.1	3	3	3	3	1	1	1	-	1	-	2	3	-	-	3
BT23413.2	3	3	3	3	1	1	1	-	1	-	2	3	-	-	3
BT23413.3	3	3	3	3	-	1	1	-	-	-	2	3	-	-	3
BT23413.4	3	3	3	3	-	1	1	-	-	-	2	3	-	-	3
BT23413.5	3	3	3	3	-	1	1	-	-	-	2	3	-	-	3
Average	3	3	3	3	0.4	1.0	1.0	-	0.4	-	2	3	-	-	3

BT23414	BASIC INDUSTRIAL BIOTECHNOLOGY	Category	L	T	P	C
		PC	3	0	0	3

Objectives:
• To impart knowledge on industrial fermentation technology
• To understand the fundamentals of upstream and downstream process in fermentation
• To design fermentation process for the production of various primary metabolites
• To learn new technology for the production of secondary metabolites
• To develop skills for bulk production of commercially and therapeutically important bioproducts

UNIT-I	INTRODUCTION TO INDUSTRIAL FERMENTATION TECHNOLOGY	8

History and scope of Fermentation technology, Fermentor design, Types of Fermentors. Types of fermentation process- Batch, Continuous and Fed Batch, Submerged fermentation, Solid state fermentation. Fermented Products- Plants, Animals and Microorganisms.

UNIT-II	UPSTREAM AND DOWNSTREAM PROCESS	9

Basic concepts of Upstream- Screening- Primary and Secondary, Strain Improvement, Preparation of inoculum, Media formulation and Sterilization- Equipment, Media, Air. Downstream process in fermentation- Intracellular & Extracellular, Process flow sheet.

UNIT-III	PRODUCTION OF PRIMARY METABOLITES	8

Production of commercially important primary metabolites like organic acids (Citric acid and acetic acid), amino acids (Glutamic acid and Lysine), Enzymes (Amylase and Protease), Solvents (Acetone-Butanol, Ethyl alcohol)

UNIT-IV	PRODUCTION OF SECONDARY METABOLITES	8

Production of commercially important secondary metabolites: Antibiotics (Penicillin, Streptomycin & Tetracycline), Vitamins (B12, B2 & C) and Biotransformation- Steroids.

UNIT-V	PRODUCTION OF OTHER MODERN BIOTECHNOLOGY PRODUCTS	12

Food products (Cheese & Mushroom culture), Alcoholic beverages (Beer & Wine), Biopesticides, Biofertilizers, Biopreservatives (Nisin), Biopolymers (Xanthan gum & PHB), Recombinant therapeutic & diagnostic proteins (Insulin & Monoclonal antibodies).

	Contact Hours	:	45

Course Outcomes:
Upon completion of the course, students will be able to
• Gain knowledge on fundamentals of fermentation technology
• Apply appropriate techniques of upstream and downstream process for the bio product production
• Formulate and design the production process of primary metabolites
• Analyze and apply the knowledge of fermentation techniques for the production and recovery of secondary metabolites
• Design and develop the process for the production of modern biotechnology products

Suggested Activities
• Problem solving sessions

Suggested Evaluation Methods	
●	Quizzes
●	Class Presentation / Discussion

Text Book(s):	
1	Patel, AH- Industrial Microbiology. 2nd edition, Trinity press Lakshmi publication (P) Ltd., 2017.
2	Satyanarayana, U. ―Biotechnology‖ Books & Allied (P) Ltd., 2005.
3	Kumar, H.D. ―A Textbook on Biotechnology‖ IInd Edition. Affiliated East West Press Pvt. Ltd., 1998.
4	Balasubramanian, D. et. al., ―Concepts in Biotechnology‖ Universities Press Pvt.Ltd., 2004.
5	Ratledge, Colin and Bjorn Kristiansen ―Basic Biotechnology‖ IInd Edition Cambridge University Press, 2001
6	Dubey, R.C. ―A Textbook of Biotechnology‖ S.Chand & Co. Ltd., 2006.

Reference Books(s) / Web links:	
1	Casida, L.E. ―Industrial Microbiology‖, New Age International (P) Ltd, 1968.
2	Presscott, S.C. and Cecil G. Dunn, ―Industrial Microbiology‖, Agrobios (India), 2005.
3	Cruger,Wulf and Anneliese Crueger, ―Biotechnology: A Textbook of Industrial Microbiology‖, IInd Edition,Panima Publishing, 2000.
4	Moo-Young, Murrey, ―Comprehensive Biotechnology‖, 4 Vols. Pergamon Press, (An Imprint of Elsevier) 2004.
5	Stanbury, P.F., A. Whitaker and S.J. Hall ―Principles of Fermentation Technology‖, IInd Edition, Butterworth Heinemann (an imprint of Elsevier), 1995.
6	C.F.A Bryce and EL.Mansi, Fermentation microbiology & Biotechnology, 1999.
7	K.G.Ramawat & Shaily Goyal, Comprehensive Biotechnology, 2009, S.Chand publications.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT23414.1	3	-	-	-	-	-	-	-	-	-	-	2	3	-	-
BT23414.2	-	3	-	-	2	-	-	-	-	-	-	3	-	3	-
BT23414.3	-	3	3	3	3	-	-	-	2	-	-	3	-	3	-
BT23414.4	-	3	3	3	3	-	2	-	-	-	-	3	-	3	-
BT23414.5	-	-	3	3	3	-	3	-	-	-	-	3	3	3	3
Average	3	3	3	3	2.2	-	2.5	-	2	-	-	2.8	3	3	3

CS23422	PYTHON PROGRAMMING FOR MACHINE LEARNING	Category	L	T	P	C
		ES	0	0	4	2

Course Objectives:
This course is aimed at enabling the students to:
● To understand the relationship of the data collected for decision making.
● To know the concept of principal components, factor analysis and cluster analysis for profiling and interpreting the data collected.
● Lay the foundation of machine learning and its practical applications and prepare students for real-time problem-solving in data science.
● Develop self-learning algorithms using training data to classify or predict the outcome of future datasets.
● Distinguish overtraining and techniques to avoid it such as cross-validation.

List of Experiments
1. NumPy Basics: Arrays and Vectorized Computation
2. Getting Started with pandas

3.	Data Loading, Storage, and File Formats
4.	Data Cleaning and Preparation
5.	Data Wrangling: Join, Combine, and Reshape
6.	Plotting and Visualization
7.	Data Aggregation and Group Operations
8.	Time Series
9.	Supervised Learning
10.	Unsupervised Learning and Pre-processing
11.	Representing Data and Engineering Features
12.	Model Evaluation and Improvement

	Contact Hours	**:**	**60**

Course Outcomes:

On completion of the course, students will be able to:

- Develop a sound understanding of current, modern computational statistical approaches and their application to a variety of datasets.
- Analyze and perform an evaluation of learning algorithms and model selection.
- Compare the strengths and weaknesses of many popular machine learning approaches.
- Appreciate the underlying mathematical relationships within and across machine learning algorithms and the paradigms of supervised and unsupervised learning.
- Design and implement various machine learning algorithms in a range of real-world applications.

Text Books:

1. Wes McKinney, Python for Data Analysis - Data wrangling with pandas, Numpy, and ipython, Second Edition, O'Reilly Media Inc, 2017.
2. Andreas C. Müller and Sarah Guido, Introduction to Machine Learning with Python - A Guide for Data Scientists, First Edition, O'Reilly Media Inc, 2016.

Reference Books:

1. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd Edition, O'Reilly Media Inc, 2019.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS23422.1	2	2	2	2	1	-	-	-	1	1	1	1	3	3	-
CS23422.2	2	1	1	1	1	-	-	-	-	-	1	1	3	2	-
CS23422.3	1	1	2	1	2	-	-	-	-	-	1	1	2	3	2
CS23422.4	2	2	3	2	2	-	-	-	-	-	2	1	2	2	2
CS23422.5	2	2	3	2	3	-	-	-	-	-	2	1	2	2	2
Average	1.8	1.6	2.2	1.6	1.8	0.0	0.0	0.0	0.2	0.2	1.4	1	2.4	2.4	2

BT23421	**CHEMICAL ENGINEERING LABORATORY FOR BIOTECHNOLOGIST**	**Category**	**L**	**T**	**P**	**C**
		ES	**0**	**0**	**4**	**2**

Course Objectives: This course is aimed at enabling the students
• To conduct experiments using flow measuring devices
• To perform characteristic studies on centrifugal pumps

•	To carryout experiments on separation processes
•	To perform mass transfer studies on diffusion of binary mixtures
•	To study the effect of operating variables of heat exchanger

List of Experiments	
1	Flow measurement a) Orifice meter b) Venturimeter c) Rotameter
2	Pressure drop- flow in pipes
3	Characteristics of centrifugal pump
4	Packed bed
5	Fluidized bed
6	Filtration- leaf filter
7	Shell and tube heat exchanger
8	Simple and steam distillation
9	HETP in packed distillation
10	Liquid-liquid extraction
11	Adsorption isotherms
12	Diffusion
13	Leaching
14	Drying
	Total Contact Hours : 45

Course Outcomes: Upon the completion of the course, the students will be able to	
•	Operate different flow meters
•	Work on pumps
•	Carry out experiments on unit operations like distillation, extraction and adsorption
•	Estimate the rate of mass transfer in diffusion
•	Solve the problems on heat exchangers

Text Book(s):	
1	McCabe W.L., Smith J.C. Unit Operations In Chemical Engineering.5th Edition. McGraw Hill. 1993.
2	BinayK.Dutta, Heat transfer: Principles and applications, PHI learning Pvt. Ltd., New Delhi, 1st edition, 2006

Reference Books(s) / Web links:	
1	Geankoplis C.J. Transport Processes And Unit Operations. Prentice HallIndia.2002.
2	Perry's Chemical Engineers' Handbook, 9th Edition, Kindle Edition by Don W. Green , Marylee Z. Southard, Imprint: McGraw-Hill Education.
3	https://doi.org/10.1017/CBO9780511608346

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PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT23421.1	3	3	3	3	-	-	-	-	1	-	2	3	-	-	3
BT23421.2	3	3	3	3	-	-	-	-	1	-	2	3	-	-	3
BT23421.3	3	3	3	3	-	-	-	-	1	-	2	3	-	-	3
BT23421.4	3	3	3	3	-	-	-	-	1	-	2	3	-	-	3
BT23421.5	3	3	3	3	-	-	-	-	1	-	2	3	-	-	3
Average	3	3	3	3	-	-	-	-	1	-	2	3	-	-	3

BT23422	MOLECULAR BIOLOGY AND GENETIC ENGINEERING LABORATORY	Category	L	T	P	C
		PC	0	0	4	2

Objectives:
- To provide hands on practical training in the isolation of genomic DNA from different sources.
- To discuss the principles behind the recombinant DNA technology.
- To explain the concept of transformation.
- To provide in depth knowledge in protein characterization techniques.
- To develop the skills of the students by providing hands on practical training in Molecular biology

	List of Experiments
1	Agarose gel electrophoresis
2	Isolation of genomic DNA from bacteria.
3	Isolation of genomic DNA from plant.
4	Isolation of plasmid DNA from bacteria.
5	Check the purity of DNA by using UV spectrophotometer.
6	PCR
7	Elution of DNA from agarose gel.
8	Restriction enzyme digestion.
9	Ligation
10	Competent cells preparation, transformation and blue white screening method
11	SDS PAGE
12	Western blotting
13	Effect of inducer concentration in gene expression
14	Effect of inducer time in gene expression
	Total Contact Hours : 60

Course Outcomes: Upon completion of this course the students will be able to
- Produce transgenic animals and plants
- Analyze nucleic acid molecules quantitatively
- Clone and express a gene and produce therapeutically valuable proteins.
- Modify the enzyme activity and improve its half- life by using site directed mutagenesis.
- Perform protein expression and characterization

	Reference Books(s) :
1	Sambrook, Josephand David W. Russell ―The Condensed Protocols: From Molecular Cloning: A Laboratory Manual‖ Cold Spring Harbor,2006
2	Old RW, Primrose SB, ―Principles Of Gene Manipulation, An Introduction To Genetic Engineering ―, Blackwell Science Publications,1993.
3	AnsubelFM, Brent R, Kingston RE, Moore DD, ―Current Protocols In Molecular Biology ―,Greene Publishing Associates, NY,1988.
4	Berger Sl, Kimmer AR, ―Methods In Enzymology‖, Vol 152, Academic Press,1987.

Web links:
● Plasmid DNA (pDNA) Manufacturing Process: Downstream Purification (sigmaaldrich.com)
● Isopropyl b- D -thiogalactopyranoside ReadyMade IPTG solution for Blue-white screening 367-93-1 (sigmaaldrich.com)

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT23422.1	3	3	3	3	3	3	3	3	3	3	2	3	3	3	2
BT23422.2	3	3	3	3	3	3	3	3	3	3	2	3	3	3	2
BT23422.3	3	3	3	3	3	3	3	3	3	3	2	3	3	2	2
BT23422.4	3	3	3	3	3	3	3	3	3	3	2	3	3	3	2
BT23422.5	3	3	3	3	3	3	3	3	3	3	2	3	3	2	2
Average	3	3	3	3	3	3	3	3	3	3	2	3	3	2.6	2