ARUNAI ENGINEERING COLLEGE
(AUTONOMOUS)
TIRUVANNAMALAI
REGULATIONS 2024

CHOICE BASED CREDIT SYSTEM

B.TECH BIOTECHNOLOGY

CURRICULUM AND SYLLABI FOR I TO VIII SEMESTERS
SEMESTER I

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	IP24101	Induction Programme	HS	0	0	0		0
THEORY								
2.	HS24101	Professional English-I	HSMC	3	0	0	3	3
3.	MA24101	Matricesand Calculus	BSC	3	1	0	4	4
4.	PH24101	Engineering Physics	BSC	3	0	0	3	3
5.	CY24101	Engineering Chemistry	BSC	3	0	0	3	3
6.	GE24101	Problem Solving and Python Programming	ESC	3	0	0	3	3
7.	GE24102	Heritage of Tamils/ தமிழர் மரபு	HSMC	1	0	0	1	1
PRACTICALS								
7.	GE24111	Problem Solving and Python Programming Laboratory	ESC	0	0	4	4	2
8.	BS24111	Physics and Chemistry Laboratory	BSC	0	0	4	4	2
9.	GE24112	English Laboratory($)	EEC	0	0	2	2	1
			TOTAL	16	1	10	27	22

($) Skill Based Course

The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

HoD/BOS Chairman

Principal

SEMESTER II

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	HS24201	Professional English - II	HSMC	2	0	0	2	2
2.	MA24201	Statistics and Numerical Methods	BSC	3	1	0	4	4
3.	PH24205	Materials Science for Biotechnologists	PCC	3	0	0	3	3
4.	BE24204	Basic Electrical, Electronics and Instrumentation Engineering	ESC	3	0	0	3	3
5.	GE24201	Engineering Graphics	ESC	2	0	4	6	4
6.	BT24201	Bioorganic Chemistry	PCC	3	0	0	3.	3
7.	GE24202	Tamils and Technology /தமிழரும் தொழில்நுட்பமும்	HSMC	1	0	0	1	1
8.		NCC Credit Course Level 1(#)		2	0	0	2	2
PRACTICALS								
7.	GE24211	Engineering Practices Laboratory	ESC	0	0	4	4	2
8.	BT24211	Bioorganic Chemistry Laboratory	PCC	0	0	4	4	2
9.	GE24212	Communication Laboratory / Foreign Language($)	EEC	0	0	4	4	2
			TOTAL	14	1	16	31	23

NCC Credit Course level 1 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.
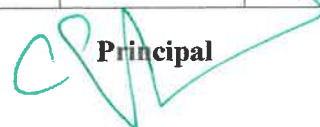
SEMESTER III

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA24304	Transforms and Linear Programming Problems	BSC	3	1	0	4	4
2.	BT24301	Biochemistry	PCC	3	0	0	3	3
3.	BT24302	Microbiology	PCC	3	0	0	3	3
4.	BT24303	Cell Biology	PCC	3	0	0	3	3
5.	BT24304	Industrial Bioprocesses	PCC	3	0	0	3	3
6.	BT24305	Biochemical Process Calculations	PCC	3	0	0	3	3

HoD/BOS Chairman

Principal

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	TOTAL CONTACT PERIODS	CREDITS
7.	BT24311	Biochemistry Laboratory	PCC	0	0	3	3	1.5
8.	BT24312	Cell and Microbiology Laboratory	PCC	0	0	3	3	1.5
9.	GE24903	Professional Development	EEC	0	0	2	2	1
			TOTAL	18	1	8	27	23

SEMESTER IV

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA24401	Probability and Statistics	BSC	3	1	0	4	4
2.	BT24401	Enzyme Technology	PCC	3	0	0	3	3
3.	BT24402	Molecular Biology	PCC	3	0	0	3	3
4.	BT24403	Analytical Techniques in Biotechnology	PCC	3	0	0	3	3
5.	BT24404	Basics of Fluid Mechanics and Thermodynamics	PCC	3	1	0	4	4
6.	GE24901	Environmental Sciences and Sustainability	BSC	3	0	0	3	3
PRACTICALS								
7.	BT24411	Biochemical Engineering Laboratory	PCC	0	0	3	3	1.5
8.	BT24412	Analytical Instrumentation Laboratory	PCC	0	0	3	3	1.5
9.	BT24513	Internship* (2Weeks)	EEC	0	0	0	0	0
			TOTAL	18	2	6	26	23

*Two weeks industrial training/internship carries one credit. Industrial training/internship during IV Semester Summer Vacation will be evaluated in V semester.
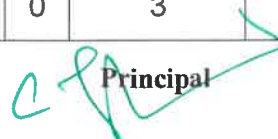
SEMESTER V

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	BT24501	Genetic Engineering	PCC	3	1	0	4	4
2.	BT24502	Mass and Heat Transfer Operations in Bioprocesses	PCC	3	0	0	3	3
3.	BT24503	Immunology	PCC	3	0	0	3	3
4.		Professional Elective I	PEC	3	0	0	3	3

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S.NO	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	TOTAL CONTACT PERIODS	CREDITS
5.		Professional Elective II	PEC	3	0	0	3	3
6.		Open Elective I	OEC	3	0	0	3	3
PRACTICALS								
7.	BT24511	Molecular Biology and Genetic Engineering laboratory	PCC	0	0	4	4	2
8.	BT24512	Immunology Laboratory	PCC	0	0	3	3	1.5
9.	BT24613	Internship	EEC	-	-	-	-	1
			TOTAL	**18**	**1**	**7**	**26**	**23.5**

*Two weeks industrial training/internship carries one credit. Industrial training/internship during IV Semester Summer Vacation will be evaluated in V semester.
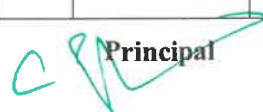
SEMESTER VI

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	BT24601	Bioinformatics	PCC	3	1	0	4	4
2.	BT24602	Bioprocess Engineering	PCC	3	0	0	3	3
3.	GE24902	Human values and Ethics	HSMC	2	0	0	2	2
4.		Professional Elective III	PEC	3	0	0	3	3
5.		Professional Elective IV	PEC	3	0	0	3	3
6.		Open Elective II	OEC	3	0	0	3	3
7.		Mandatory Course-I	MC	3	0	0	3	0
PRACTICALS								
7.	BT24611	Bioprocess Laboratory	PCC	0	0	3	3	1.5
8.	BT24612	Bioinformatics Laboratory	PCC	0	0	3	3	1.5
9.	BT24613	Internship* (2 Weeks)	EEC	-	-	-	-	-
			TOTAL	**20**	**1**	**6**	**27**	**21**

*Two weeks industrial training/internship carries one credit. Industrial training/internship during VI Semester Summer Vacation will be evaluated in VIII semester.

SEMESTER VII

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	BT24701	Downstream Processing	PCC	3	0	0	3	3

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S.NO	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	TOTAL CONTACT PERIODS	CREDITS
2.		Management Elective	HSMC	3	0	0	3	3
3.		Professional Elective V	PEC	3	0	0	3	3
4.		Professional Elective VI	PEC	3	0	0	3	3
5.		Open Elective III	OEC	3	0	0	3	3
6.		Mandatory Course-II	MC	3	0	0	3	0
PRACTICALS								
7.	BT24711	Downstream Laboratory	PCC	0	0	3	3	1.5
8.	BT24712	Environment and Bioenergy Laboratory	PCC	0	0	4	4	2
9.	BT24713	Internship*	EEC	-	-	-	-	1
			TOTAL	**18**	**0**	**10**	**28**	**19.5**

*Two weeks industrial training/internship carries one credit. Industrial training/internship during VI Semester Summer Vacation will be evaluated in VIII semester.

SEMESTER VIII

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	BT24811	Project Work	EEC	0	0	20	20	10
2.		VAC	EEC	-	-	-	-	-
			TOTAL	**0**	**0**	**20**	**20**	**10**

TOTAL CREDITS: 165

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		Name of the Programme: B.TECH BIOTECHNOLOGY								
S.No	Subject Area	Credits per semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	HSMC	4	3	-	-	-	2	3	-	12
2	BSC	12	4	4	7	-	-	-	-	27
3	ESC	5	9	-	-	-	-	-	-	14
4	EEC	1	2	1	-	1	-	1	10	16
5	PCC	-	5	18	16	13.5	10	6.5	-	69
6	PEC	-	-	-	-	6	6	6	-	18
7	OEC	-	-	-	-	3	3	3	-	9
8	MC	-	-	-	-	-	0	0	-	0
	Total	22	23	23	23	23.5	21	19.5	10	165

Vertical I Bioprocess Technology	Vertical II Bioproducts	Vertical III Medical Biotechnology	Vertical IV Quality and Regulatory Affairs	Vertical V Biosciences	Vertical VI Computational Biotechnology
Fermentation Technology	Biofuel and Renewable Energy	Pharmaceutical Biotechnology	Biotechnological products and its validation	Biomaterials	Programming for Bioinformatics Applications
Bioreactors	Food Biotechnology	Molecular Therapeutics and Diagnostics	Intellectual property rights and Entrepreneurship in Biotechnology	Biosensors	Bioinformatics and Data Analysis
Environmental Biotechnology	Agro Bioproducts	Cancer Biology	Good Manufacturing Practices (GMP) and Quality Control (QC)	Bio-Nanotechnology	Systems Biology
Food Processing Technology	Biofertilizers and Biopesticides	Stem Cell Technology	Bioethics and Biosafety	Modern Bio analytical Techniques	Molecular Modelling
Environmental Biotechnology	Enzymes and Bio-supplements	Regenerative Medicine and Tissue Engineering	Regulatory Affairs in Biologics	Fundamentals of Animal Biotechnology	Computer Aided Drug Design
Bioprocess Control and Instrumentation	Biopharmaceuticals and Biosimilars	Pharmacogenomics	Clinical Trials Management	Fundamentals of Plant Biotechnology	Data Mining And Machine Learning Techniques For Bioinformatics

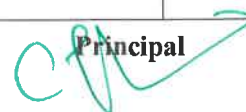HoD/BOS Chairman   Principal

PROFESSIONAL ELECTIVE COURSES

VERTICAL I BIOPROCESS TECHNOLOGY

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	BT24901	Fermentation Technology	PEC	3	0	0	3	3
2.	BT24902	Bioreactors	PEC	3	0	0	3	3
3.	BT24903	Environmental Biotechnology	PEC	3	0	0	3	3
4.	BT24904	Food Processing Technology	PEC	3	0	0	3	3
5.	BT24905	Environmental Biotechnology	PEC	3	0	0	3	3
6.	BT24906	Bioprocess Control and Instrumentation	PEC	3	0	0	3	3

VERTICAL II BIOPRODUCTS

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	BT24907	Biofuel and Renewable Energy	PEC	3	0	0	3	3
2.	BT24908	Food Biotechnology	PEC	3	0	0	3	3
3.	BT24909	Agro Bioproducts	PEC	3	0	0	3	3
4.	BT24910	Biofertilizers and Biopesticides	PEC	3	0	0	3	3
5.	BT24911	Enzymes and Bio-supplements	PEC	3	0	0	3	3
6.	BT24912	Biopharmaceuticals and Biosimilars	PEC	3	0	0	3	3

VERTICAL III MEDICAL BIOTECHNOLOGY

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	BT24913	Pharmaceutical Biotechnology	PEC	3	0	0	3	3
2.	BT24914	Molecular Therapeutics and Diagnostics	PEC	3	0	0	3	3
3.	BT24915	Cancer Biology	PEC	3	0	0	3	3
4.	BT24916	Stem Cell Technology	PEC	3	0	0	3	3
5.	BT24917	Regenerative Medicine and Tissue Engineering	PEC	3	0	0	3	3
6.	BT24918	Pharmacogenomics	PEC	3	0	0	3	3

VERTICAL IV QUALITY AND REGULATORY AFFAIRS

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	BT24919	Biotechnological products and its validation	PEC	3	0	0	3	3

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S.NO	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	TOTAL CONTACT PERIODS	CREDITS
2.	BT24920	Intellectual property rights and Entrepreneurship in Biotechnology	PEC	3	0	0	3	3
3.	BT24921	Good Manufacturing Practices (GMP) and Quality Control (QC)	PEC	3	0	0	3	3
4.	BT24922	Bioethics and Biosafety	PEC	3	0	0	3	3
5.	BT24923	Regulatory Affairs in Biologics	PEC	3	0	0	3	3
6.	BT24924	Clinical Trials Management	PEC	3	0	0	3	3

VERTICAL V BIOSCIENCES

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	BT24925	Biomaterials	PEC	3	0	0	3	3
2.	BT24926	Biosensors	PEC	3	0	0	3	3
3.	BT24927	Bio-Nanotechnology	PEC	3	0	0	3	3
4.	BT24928	Modern Bio analytical Techniques	PEC	3	0	0	3	3
5.	BT24929	Fundamentals of Animal Biotechnology	PEC	3	0	0	3	3
6.	BT24930	Fundamentals of Plant Biotechnology	PEC	3	0	0	3	3

VERTICAL VI COMPUTATIONAL BIOTECHNOLOGY

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	BT24931	Programming for Bioinformatics Applications	PEC	3	0	0	3	3
2.	BT24932	Bioinformatics and Data Analysis	PEC	3	0	0	3	3
3.	BT24932	Systems Biology	PEC	3	0	0	3	3
4.	BT24934	Molecular Modelling	PEC	3	0	0	3	3
5.	BT24935	Computer Aided Drug Design	PEC	3	0	0	3	3
6.	BT24936	Data Mining And Machine Learning Techniques For Bioinformatics	PEC	3	0	0	3	3

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OPEN ELECTIVE COURSES

OPEN ELECTIVE I - EMERGING TECHNOLOGIES

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	TOTAL CONTACT PERIODS	CREDITS
1.	OCS2401	Artificial Intelligence and Machine Learning fundamentals	OEC	2	0	2	4	3
2.	OCS2402	Data science fundamentals	OEC	2	0	2	4	3
3.	OCS2403	Augmented Reality/ Virtual Reality	OEC	2	0	2	4	3
4.	OCS2404	IOT and its applications	OEC	2	0	2	4	3
5.	OCS2405	Deep Learning Techniques	OEC	2	0	2	4	3
6.	OEC2401	Introduction to ASIC design	OEC	2	0	2	4	3
7.	OCS2401	Artificial Intelligence and Machine Learning fundamentals	OEC	2	0	2	4	3

OPEN ELECTIVE II – INDUSTRIAL PROCESSES

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	TOTAL CONTACT PERIODS	CREDITS
1.	OME2401	Applied design thinking	OEC	3	0	0	3	3
2.	OME2402	Introduction to industrial automation systems	OEC	3	0	0	3	3
3.	OME2403	Industrial Management	OEC	3	0	0	3	3
4.	OME2404	Quality Engineering	OEC	3	0	0	3	3
5.	OME2405	Sustainable Manufacturing	OEC	3	0	0	3	3
6.	OME2406	Industrial design and rapid prototyping techniques	OEC	3	0	0	3	3
7.	OEE2401	Industrial IOT and industry 4.0	OEC	3	0	0	3	3
8.	OEC2402	Robotics and Industrial Automation	OEC	3	0	0	3	3

OPEN ELECTIVE III – OTHER DOMAINS

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	TOTAL CONTACT PERIODS	CREDITS
1.	OAG2401	Urban agriculture	OEC	3	0	0	3	3
2.	OAG2402	Agriculture Entrepreneurship Development	OEC	3	0	0	3	3

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3.	OBT2401	Basics of Biomolecules	OEC	3	0	0	3	3
4.	OBT2402	Basics of Microbial Technology	OEC	3	0	0	3	3
5.	OBT2403	Biotechnology for Waste Management	OEC	3	0	0	3	3
6.	OBT2404	Food Processing Technology	OEC	3	0	0	3	3
7.	OEC2403	VLSI Design	OEC	3	0	0	3	3
8.	OEC2404	Remote Sensing Concepts	OEC	3	0	0	3	3
9.	OEC2405	Drone technologies	OEC	3	0	0	3	3
10.	OEE2402	Baiscs of Electric Vehicle Technology	OEC	3	0	0	3	3
11.	OEE2403	Introduction To Control Systems	OEC	3	0	0	3	3
12.	OEE2404	Integrated energy planning for sustainable development	OEC	3	0	0	3	3
13.	OHS2401	Nano technology	OEC	3	0	0	3	3
14.	OHS2402	Operations research	OEC	3	0	0	3	3
15.	OME2407	Additive Manufacturing	OEC	3	0	0	3	3

MANDATORY COURSES

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MX24101	Introduction to women and gender studies	MC	3	0	0	3	0
2.	MX24102	Elements of literature	MC	3	0	0	3	0
3.	MX24103	Disaster risk reduction and management	MC	3	0	0	3	0
4.	MX24104	History of science and technology in India	MC	3	0	0	3	0
5.	MX24105	State, nation building and politics in India	MC	3	0	0	3	0
6.	MX24106	Political and economic thought for a humane society	MC	3	0	0	3	0
7.	MX24107	Understanding Society & Culture through Literature	MC	3	0	0	3	0

The title **MANDATORY COURSE I (SOCIETY)** spans the header of the second table.

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S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
8.	MX24108	Work Ethics & Social Responsibility	MC	3	0	0	3	0
9.	MX24109	Technology & Society	MC	3	0	0	3	0
10.	MX24110	Social Innovation & Entrepreneurship	MC	3	0	0	3	0
11.	MX24111	Education & Social Change	MC	3	0	0	3	0

MANDATORY COURSE II (HEALTH AND WELL BEING)

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MX24201	Industrial Safety	MC	3	0	0	3	0
2.	MX24202	Well Being with Traditional Practices - Yoga, Ayurveda and siddha	MC	3	0	0	3	0
3.	MX24203	Application of Psychology in Everyday Life	MC	3	0	0	3	0
4.	MX24204	Stress Management & Well Being	MC	3	0	0	3	0
5.	MX24205	Health & WellBeing in Education	MC	3	0	0	3	0
6.	MX24206	Physical fitness & Mental Resilience	MC	3	0	0	3	0
7.	MX24207	Food, Nutrition and Health	MC	3	0	0	3	0
8.	MX24208	Life style diseases	MC	3	0	0	3	0

MANAGEMENT ELECTIVE

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	GE24M01	Principles of management	HSMC	3	0	0	3	3
2.	GE24M02	Total quality management	HSMC	3	0	0	3	3
3.	GE24M03	Engineering economics and financial accounting	HSMC	3	0	0	3	3
4.	GE24M04	Human resource management	HSMC	3	0	0	3	3
5.	GE24M05	Knowledge management	HSMC	3	0	0	3	3
6.	GE24M06	Industrial management	HSMC	3	0	0	3	3
7.	GE24M07	Foundations of entrepreneurship	HSMC	3	0	0	3	3

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Subject Code	Subject Name	Category	L	T	P	C
IP24101	**INDUCTION PROGRAMME**	**HS**	**0**	**0**	**0**	**0**

The Induction Programme is a compulsory two-week orientation introduced by AICTE for all first-year engineering students. Its primary aim is to facilitate a smooth transition into college life by fostering academic readiness, personal development, social responsibility, and a holistic outlook.

Purpose and Vision

The programme is designed to:

- Help students acclimate to their new academic environment.
- Build a sense of connection and camaraderie among peers.
- Inculcate human values and nurture character.
- Encourage engagement in physical and creative pursuits.
- Minimize unhealthy competition and promote a culture of excellence.
- Instill a wider awareness of societal and national responsibilities.

Key Components of the Programme

1. Physical Activity

Daily sessions involving yoga, sports, games, and gardening help develop fitness, discipline, and mental well-being.

2. Creative Arts

Students choose and practice a form of visual or performing art—such as music, painting, or dance—enhancing creativity and aesthetic sensitivity.

3. Universal Human Values (UHV)

As the cornerstone of the programme, UHV sessions focus on self-awareness, empathy, interpersonal relationships, and ethical decision-making.

Delivered in small interactive groups led by faculty mentors, these discussions promote reflection and experiential learning over rote instruction.

4. Literary Activities

Reading, writing, debating, and dramatics nurture communication skills and intellectual expression.

5. Proficiency Modules

These sessions address basic skill gaps, especially in English language and computer literacy, equipping students for academic success.

6. Lectures by Eminent Personalities

Motivational talks by distinguished individuals from diverse fields offer inspiration and broaden students' perspectives.

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7. Visits to Local Areas

Field visits to city landmarks or social institutions like hospitals and orphanages develop civic consciousness and social empathy.

8. Departmental Familiarization & Innovation Exposure

Students are introduced to their chosen department, its societal relevance, laboratories, and infrastructure, offering a glimpse into their academic and professional journey.

9. Department-Specific Activities

Hands-on activities related to the student's branch—such as simple coding tasks, circuit building, or mini design projects—are conducted to spark curiosity and practical interest in their field, promoting a "maker" mindset.

Additional Highlights

- **No Examinations or Assessments:** The programme is entirely activity-based.
- **Faculty Mentorship:** Each student is guided by a faculty mentor, ideally the same advisor who will support them throughout their undergraduate studies.
- **Holistic Development:** Emphasizes growth across physical, emotional, ethical, social, and intellectual domains.

Ultimately, the Induction Programme lays the foundation for a purposeful academic journey, shaping students into competent, conscientious, and socially responsible engineers.

Note:

The Induction Programme is entirely activity-based. As such, **no tests or formal assessments** will be conducted during its duration.

References:
AICTE – *Guide to Induction Programme*

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Subject Code	Subject Name	Category	L	T	P	C
HS24101	PROFESSIONAL ENGLISH-I	HSMC	3	0	0	3

Course Objectives:

- To improve the communicative competence of learners
- To learn to use basic grammatic structures in suitable contexts
- To acquire lexical competence and use them appropriately in a sentence and understand their meaning in a text
- To help learners use language effectively in professional contexts
- To develop learners' ability to read and write complex texts, summaries, articles, blogs, definitions, essays and user manuals.

UNIT – I	INTRODUCTION TO EFFECTIVE COMMUNICATION	1

What is effective communication? (Explain using activities) Why is communication critical for excellence during study, research and work? What are the seven C's of effective communication? What are key language skills? What is effective listening? What does it involve? What is effective speaking? What does it mean to be an excellent reader? What should you be able to do? What is effective writing? How does one develop language and communication skills? What does the course focus on? How are communication and language skills going to be enhanced during this course? What do you as a learner need to do to enhance your English language and communication skills to get the best out of this course?

UNIT – I	INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION	8

Reading - Reading brochures (technical context), telephone messages / social media messages relevant to technical contexts and emails. Writing - Writing emails / letters introducing oneself. Grammar - Present Tense (simple and progressive); Question types: Wh/ Yes or No/ and Tags. Vocabulary - Synonyms; One word substitution; Abbreviations & Acronyms (as used in technical contexts).

UNIT – II	NARRATION AND SUMMATION	9

Reading - Reading biographies, travelogues, newspaper reports, Excerpts from literature, and travel & technical blogs. Writing - Guided writing-- Paragraph writing Short Report on an event (field trip etc.) Grammar –Past tense (simple); Subject-Verb Agreement; and Prepositions. Vocabulary - Word forms (prefixes& suffixes); Synonyms and Antonyms. Phrasal verbs.

UNIT – III	DESCRIPTION OF A PROCESS / PRODUCT	9

Reading – Reading advertisements, gadget reviews; user manuals. Writing - Writing definitions; instructions; and Product /Process description. Grammar - Imperatives; Adjectives; Degrees of comparison; Present & Past Perfect Tenses. Vocabulary - Compound Nouns, Homonyms; and Homophones, discourse markers (connectives & sequence words).

UNIT – IV	CLASSIFICATION AND RECOMMENDATIONS	9

Reading – Newspaper articles; Journal reports –and Non-Verbal Communication (tables, pie charts etc.). Writing – Note-making / Note-taking (*Study skills to be taught, not tested); Writing recommendations; Transferring information from non-verbal (chart ; graph etc, to verbal mode). Grammar – Articles; Pronouns - Possessive & Relative pronouns. Vocabulary - Collocations; Fixed / Semi fixed expressions.

UNIT – V	EXPRESSION	9

Reading – Reading editorials; and Opinion Blogs; Writing – Essay Writing (Descriptive or narrative). Grammar – Future Tenses, Punctuation; Negation (Statements & Questions); and

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Simple, Compound & Complex Sentences. Vocabulary - Cause & Effect Expressions – Content vs Function words.	
	Total Contact Hours: 45

Course Outcomes:	Upon completion of the course students should be able to:
CO1	At the end of the course, learners will be able
CO2	To use appropriate words in a professional context
CO3	To gain understanding of basic grammatical structures and use them in right context.
CO4	To read and interpret information presented in tables, charts and other graphic forms
CO5	To write definitions, descriptions, narrations and essays on various topics

Textbooks:	
1.	English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English, Anna University, (2020 edition)
2.	English for Science & Technology Cambridge University Press, 2021. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University. 24

Reference books/other materials/web resources:	
1.	Technical Communication – Principles And Practices By Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2016, New Delhi.
2.	A Course Book On Technical English By Lakshminarayanan, Scitech Publications (India) Pvt. Ltd.
3.	English For Technical Communication (With CD) By Aysha Viswamohan, Mcgraw Hill Education, ISBN : 0070264244.
4.	Effective Communication Skill, Kulbhusan Kumar, RS Salaria, Khanna Publishing House.
5.	Learning to Communicate – Dr. V. Chellammal, Allied Publishing House, New Delhi,2003.

CO	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	3	3	1	3	-	3	-	-	-
CO2	1	1	1	1	1	3	3	1	3	-	3	-	-	-
CO3	2	3	2	3	2	3	3	2	3	3	3	-	-	-
CO4	2	3	2	3	2	3	3	2	3	3	3	-	-	-
CO5	2	3	3	3	-	3	3	2	3	-	3	-	-	-
Average:	1.6	2.2	1.8	2.2	1.5	3	3	1.6	3	3	3	-	-	-

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Subject Code	Subject Name	Category	L	T	P	C
MA24101	MATRICES AND CALCULUS	BSC	3	1	0	4

Course Objectives:

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To familiarize the students with differential calculus.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To make the students understand various techniques of integration.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications

UNIT – I	MATRICES	9+3

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley - Hamilton theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms – Applications: Stretching of an elastic membrane.

UNIT – II	DIFFERENTIAL CALCULUS	9+3

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules (sum, product, quotient, chain rules) - Implicit differentiation - Logarithmic differentiation - Applications: Maxima and Minima of functions of one variable.

UNIT – III	FUNCTIONS OF SEVERAL VARIABLES	9+3

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

UNIT – IV	DESCRIPTION OF A PROCESS / PRODUCT	9+3

Definite and Indefinite integrals - Substitution rule - Techniques of Integration: Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals - Applications: Hydrostatic force and pressure, moments and centres of mass.

UNIT – V	MULTIPLE INTEGRALS	9+3

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals – Applications: Moments and centres of mass, moment of inertia.

	Total Contact Hours :60

Course Outcomes:	Upon completion of the course students should be able to:
CO1	Use the matrix algebra methods for solving practical problems.
CO2	Apply differential calculus tools in solving various application problems.
CO3	Able to use differential calculus ideas on several variable functions.
CO4	Apply different methods of integration in solving practical problems.
CO5	Apply multiple integral ideas in solving areas, volumes and other practical problems.

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Textbooks:	
1.	Kreyszig.E, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
2.	Grewal.B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2018.
3.	James Stewart, " Calculus: Early Transcendentals ", Cengage Learning, 8th Edition, New Delhi, 2015. [For Units II & IV - Sections 1.1, 2.2, 2.3, 2.5, 2.7 (Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1 (Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.1 - 7.4 and 7.8].

Reference books/other materials/webresources:	
1.	Anton. H, Bivens. I and Davis. S, " Calculus ", Wiley, 10th Edition, 2016
2.	Bali. N., Goyal. M. and Watkins. C., " Advanced Engineering Mathematics ", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
3.	Jain . R.K. and Iyengar. S.R.K., " Advanced Engineering Mathematics ", Narosa Publications, New Delhi, 5th Edition, 2016.
4.	Narayanan. S. and Manicavachagom Pillai. T. K., " Calculus " Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2009.
5.	Ramana. B.V., " Higher Engineering Mathematics ", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
6.	Srimantha Pal and Bhunia. S.C, " Engineering Mathematics " Oxford University Press, 2015.
7.	Thomas. G. B., Hass. J, and Weir. M.D, " Thomas Calculus ", 14th Edition, Pearson India, 2018.

CO	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	1	1	0	0	0	2	0	2	3	-	-	-
CO2	3	3	1	1	0	0	0	2	0	2	3	-	-	-
CO3	3	3	1	1	0	0	0	2	0	2	3	-	-	-
CO4	3	3	1	1	0	0	0	2	0	2	3	-	-	-
CO5	3	3	1	1	0	0	0	2	0	2	3	-	-	-
Average:	3	3	1	1	0	0	0	2	0	2	3	-	-	-

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Subject Code	Subject Name	Category	L	T	P	C
PH24101	ENGINEERING PHYSICS	BSC	3	0	0	3

Course Objectives:
• To make the students effectively to achieve an understanding of mechanics.
• To enable the students to gain knowledge of electromagnetic waves and its applications.
• To introduce the basics of oscillations, optics and lasers.
• Equipping the students to be successfully understand the importance of quantum physics.
• To motivate the students towards the applications of quantum mechanics.

UNIT – I	MECHANICS	9

Multi-particle dynamics: Center of mass (CM) – CM of continuous bodies – motion of the CM – kinetic energy of system of particles. Rotation of rigid bodies: Rotational kinematics – rotational kinetic energy and moment of inertia - theorems of M .I –moment of inertia of continuous bodies – M.I of a diatomic molecule - torque – rotational dynamics of rigid bodies – conservation of angular momentum – rotational energy state of a rigid diatomic molecule - gyroscope - torsional pendulum – double pendulum –Introduction to nonlinear oscillations.

UNIT – II	ELECTROMAGNETIC WAVES	9

The Maxwell's equations - wave equation; Plane electromagnetic waves in vacuum, Conditions on the wave field - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - polarization - Producing electromagnetic waves - Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure - Cell-phone reception. Reflection and transmission of electromagnetic waves from a non-conducting medium-vacuum interface for normal incidence.

UNIT – III	OSCILLATIONS, OPTICS AND LASERS	9

Simple harmonic motion - resonance –analogy between electrical and mechanical oscillating systems - waves on a string - standing waves - traveling waves - Energy transfer of a wave - sound waves - Doppler effect. Reflection and refraction of light waves - total internal reflection - interference –Michelson interferometer –Theory of air wedge and experiment. Theory of laser - characteristics - Spontaneous and stimulated emission - Einstein's coefficients - population inversion - Nd-YAG laser, CO2 laser, semiconductor laser –Basic applications of lasers in industry.

UNIT – IV	BASIC QUANTUM MECHANICS	9

Photons and light waves - Electrons and matter waves –Compton effect - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization –Free particle - particle in a infinite potential well: 1D,2D and 3D Boxes-Normalization, probabilities and the correspondence principle.

UNIT – V	APPLIED QUANTUM MECHANICS	9

The harmonic oscillator(qualitative)- Barrier penetration and quantum tunneling(qualitative)-Tunneling microscope - Resonant diode - Finite potential wells (qualitative)- Bloch's theorem for particles in a periodic potential –Basics of Kronig-Penney model and origin of energy bands.

	Total Contact Hours :45

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Course Outcomes:	Upon completion of the course students should be able to:
CO1	Understand the importance of mechanics.
CO2	Express their knowledge in electromagnetic waves.
CO3	Demonstrate a strong foundational knowledge in oscillations, optics and lasers.
CO4	Understand the importance of quantum physics.
CO5	Comprehend and apply quantum mechanical principles towards the formation of energy bands.

Textbooks:	
1.	D.Kleppner and R.Kolenkow. An Introduction to Mechanics. McGraw Hill Education (Indian Edition), 2017.
2.	E.M.Purcell and D.J.Morin, Electricity and Magnetism, Cambridge Univ. Press, 2013.
3.	Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, Concepts of Modern Physics, McGraw- Hill (Indian Edition), 2017.

Reference books/other materials/web resources:	
1.	R.Wolfson. Essential University Physics. Volume 1 & 2. Pearson Education (Indian Edition), 2009.
2.	Paul A. Tipler, Physic – Volume 1 & 2, CBS, (Indian Edition), 2004.
3.	K.Thyagarajan and A.Ghatak. Lasers: Fundamentals and Applications, Laxmi Publications, (Indian Edition), 2019.
4.	D.Halliday, R.Resnick and J.Walker. Principles of Physics, Wiley (Indian Edition), 2015.
5.	N.Garcia, A.Damask and S.Schwarz. Physics for Computer Science Students. Springer-Verlag, 2012.

CO	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	1	-	-	-	-	-	-	-	-
CO2	3	3	2	1	2	1	-	-	-	-	-	-	-	-
CO3	3	3	2	2	2	1	-	-	-	-	1	-	-	-
CO4	3	3	1	1	2	1	-	-	-	-	-	-	-	-
CO5	3	3	1	1	2	1	-	-	-	-	-	-	-	-
Average:	3	3	1.6	1.2	1.8	1	-	-	-	-	1	-	-	-

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Subject Code	Subject Name	Category	L	T	P	C
CY24101	ENGINEERING CHEMISTRY	BSC	3	0	0	3

Course Objectives:

- To inculcate sound understanding of water quality parameters and water treatment techniques.
- To impart knowledge on the basic principles and preparatory methods of nanomaterials.
- To introduce the basic concepts and applications of phase rule and composites.
- To facilitate the understanding of different types of fuels, their preparation, properties and combustion characteristics.
- To familiarize the students with the operating principles, working processes and applications of energy conversion and storage devices.

UNIT – I	WATER AND ITS TREATMENT	9

Water: Sources and impurities, Water quality parameters: Definition and significance of-color, odour, turbidity, pH, hardness, alkalinity, TDS, COD and BOD, flouride and arsenic. Municipal water treatment: primary treatment and disinfection (UV, Ozonation, break-point chlorination). Desalination of brackish water: Reverse Osmosis. Boiler troubles: Scale and sludge, Boiler corrosion, Caustic embrittlement, Priming &foaming. Treatment of boiler feed water: Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) and External treatment – Ion exchange demineralization and zeolite process.

UNIT – II	NANOCHEMISTRY	9

Basics: Distinction between molecules, nanomaterials and bulk materials; Size-dependent properties (optical, electrical, mechanical and magnetic); Types of nanomaterials: Definition, properties and uses of – nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. Applications of nanomaterials in medicine, agriculture, energy, electronics and catalysis.

UNIT – III	PHASE RULE AND COMPOSITES	9

Phase rule: Introduction, definition of terms with examples. One component system - water system; Reduced phase rule; Construction of a simple eutectic phase diagram - Thermal analysis; Two component system: lead-silver system - Pattinson process.
Composites: Introduction: Definition & Need for composites; Constitution: Matrix materials (Polymer matrix, metal matrix and ceramic matrix) and Reinforcement (fiber, particulates, flakes and whiskers). Properties and applications of: Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. Hybrid composites - definition and examples.

UNIT – IV	FUELS AND COMBUSTION	9

Fuels: Introduction: Classification of fuels; Coal and coke: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). Petroleum and Diesel: Manufacture of synthetic petrol (Bergius process), Knocking - octane number, diesel oil - cetane number; Power alcohol and biodiesel.
Combustion of fuels: Introduction: Calorific value - higher and lower calorific values, Theoretical calculation of calorific value; Ignition temperature: spontaneous ignition temperature, Explosive range; Flue gas analysis - ORSAT Method. CO_2 emission and carbon foot print.

UNIT – V	ENERGY SOURCES AND STORAGE DEVICES	9

Stability of nucleus: mass defect (problems), binding energy; Nuclear energy: light water nuclear power plant, breeder reactor. Solar energy conversion: Principle, working and applications of solar cells; Recent developments in solar cell materials. Wind energy; Geothermal energy; Batteries: Types of batteries, Primary battery - dry cell, Secondary battery - lead acid battery and lithium-ion-

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battery; Electric vehicles; working principles; Fuel cells: H2-O2 fuel cell, microbial fuel cell; Supercapacitors: Storage principle, types and examples.

	Total Contact Hours: 45
Course Outcomes:	Upon completion of the course students should be able to:
CO1	To infer the quality of water from quality parameter data and propose suitable treatment methodologies to treat water.
CO2	To identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.
CO3	To apply the knowledge of phase rule and composites for material selection requirements.
CO4	To recommend suitable fuels for engineering processes and applications.
CO5	To recognize different forms of energy resources and apply them for suitable applications in energy sectors.

Textbooks:	
1.	P. C. Jain and Monica Jain, "Engineering Chemistry", 17th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2018.
2.	Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008.
3.	S.S. Dara, "A Text book of Engineering Chemistry", S. Chand Publishing, 12th Edition, 2018.

Reference books/other materials/web resources:	
1.	B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, "Text book of nanoscience and nanotechnology", Universities Press-IIM Series in Metallurgy and Materials Science, 2018.
2.	O.G. Palanna, "Engineering Chemistry" McGraw Hill Education (India) Private Limited, 2nd Edition, 2017.
3.	Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
4.	ShikhaAgarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, Second Edition, 2019.
5.	O.V. Roussak and H.D. Gesser, Applied Chemistry-A Text Book for Engineers and Technologists, Springer Science Business Media, New York, 2nd Edition, 2013

CO	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	1	-	1	-	-	-	-	1	-	-	-
CO2	2	-	-	1	-	2	-	-	-	-	-	-	-	-
CO3	3	1	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	1	1	-	-	1	-	-	-	-	-	-	-	-
CO5	3	1	2	1	-	2	-	-	-	-	2	-	-	-
Average:	2.8	1.3	1.6	1	-	1.5	-	-	-	1.5	-	-	-	-

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Subject Code	Subject Name	Category	L	T	P	C
GE24101	PROBLEM SOLVING AND PYTHON PROGRAMMING	ESC	3	0	0	3

Course Objectives:
• To understand the basics of algorithmic problem solving.
• To learn to solve problems using Python conditionals and loops.
• To define Python functions and use function calls to solve problems.
• To use Python data structures - lists, tuples, dictionaries to represent complex data.
• To do input/output with files in Python.

UNIT – I	COMPUTATIONAL THINKING AND PROBLEM SOLVING	9
	Fundamentals of Computing – Identification of Computational Problems -Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.	
UNIT – II	DATA TYPES, EXPRESSIONS, STATEMENTS	9
	Python interpreter and interactive mode, debugging; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.	
UNIT – III	CONTROL FLOW, FUNCTIONS, STRINGS	9
	Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.	
UNIT – IV	LISTS, TUPLES, DICTIONARIES	9
	Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.	
UNIT – V	FILES, MODULES, PACKAGES	9
	Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file, Voter's age validation, Marks range validation (0-100).	
		Total Contact Hours: 45

Course Outcomes:	Upon completion of the course students should be able to:
CO1	Develop algorithmic solutions to simple computational problems.
CO2	Develop and execute simple Python programs.
CO3	Write simple Python programs using conditionals and looping for solving problems.
CO4	Decompose a Python program into functions.
CO5	Represent compound data using Python lists, tuples, dictionaries etc.

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Textbooks:	
1.	Allen B. Downey, "Think Python : How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016.
2.	Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and programming", 1st Edition, BCS Learning & Development Limited, 2017.

Reference books/other materials/web resources:	
1.	Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021.
2.	G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.
3.	John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", Third Edition, MIT Press , 2021
4.	Eric Matthes, "Python Crash Course, A Hands - on Project Based Introduction to Programming", 2nd Edition, No Starch Press, 2019.
5.	https://www.python.org/
6.	Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc-Graw Hill, 2018

CO	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	3	3	-
CO2	3	3	3	3	2	-	-	-	-	2	2	3	-	-
CO3	3	3	3	3	2	-	-	-	-	2	-	3	-	-
CO4	2	2	-	2	2	-	-	-	-	1	-	3	-	-
CO5	1	2	-	-	1	-	-	-	-	1	-	2	-	-
Average:	2	3	3	3	2	-	-	-	-	2	2	3	3	-

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Subject Code	Subject Name	Category	L	T	P	C
GE24102	Heritage of Tamils/தமிழர் மரபு	HSMC	1	0	0	1

அலகு 1	மொழி மற்றும் இலக்கியம்	3
	இந்திய மொழிக்குடும்பங்கள் - திராவிடமொழிகள் – தமிழ் ஒரு செம்மொழி -தமிழ் செவ்விலக்கியங்கள் – சங்க இலக்கியத்தின் சமயச்சார்பற்றதன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம் திருக்குறளில் மேலாண்மைக் கருத்துக்கள் தமிழ்க்காப்பியங்கள், 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 – சிற்பக்கலை	3
	நடுகல் முதல் நவீன சிற்பங்கள் வரை ஐம்பொன்சிலைகள்- பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப்பொருட்கள், பொம்மைகள் தேர்செய்யும் கலை சுடுமண்சிற்பங்கள் நாட்டுப்புறத் தெய்வங்கள் -குமரிமுனையில் திருவள்ளுவர் சிலை இசைக்கருவிகள் - மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.	

அலகு III	நாட்டுப்புறக்கலைகள்மற்றும்வீரவிளையாட்டுகள்	3
	தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான்கூத்து, ஒயிலாட்டம். தோல்பாவைக்கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.	

அலகு IV	தமிழர்களின் திணைக் கோட்பாடுகள்	3
	தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக்கோட்பாடுகள் தமிழர்கள் போற்றிய அறக்கோட்பாடு – சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் – சங்க கால நகரங்களும் துறைமுகங்களும் – சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல் கடந்த நாடுகளில் சோழர்களின் வெற்றி	

அலகு V	இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு	3
	இந்திய விடுதலைப் போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப்பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு புத்தகங்களின் அச்சு வரலாறு. கல்வெட்டுகள், கையெழுத்துப்படிகள்–தமிழ்ப் புத்தகங்களின் அச்சுவரலாறு	

	Total Contact Hours :15
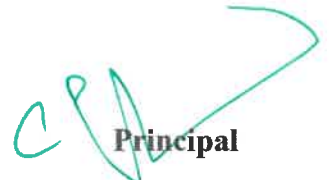
Text-Cum-Reference Books	
1.	தமிழகவரலாறுமக்களும்பண்பாடும்கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடுபாடநூல்மற்றும்கல்வியியல்பணிகள்கழகம்).
2.	கணினித்தமிழ் - முனைவர்இல. சுந்தரம். (விகடன்பிரசுரம்).

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3.	கீழடி - வைகைநதிக்கரையில்சங்ககாலநகரநாகரிகம் (தொல்லியல்துறைவெளியீடு)
4.	பொருநை - ஆற்றங்கரைநாகரிகம். (தொல்லியல்துறைவெளியீடு)
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 C ivilization 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.

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Subject Code	Subject Name	Category	L	T	P	C
GE24102	HERITAGE OF TAMILS	HSMC	1	0	0	1

UNIT – I	LANGUAGE AND LITERATURE	3
Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.	
UNIT – II	HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE	3
	Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.	
UNIT – III	FOLK AND MARTIAL ARTS	3
	Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.	
UNIT – IV	THINAI CONCEPT OF TAMILS	3
	Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.	
UNIT – V	CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE	3
	Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.	
		Total Contact Hours :15

Text-Cum-Reference Books	
1.	தமிழகவரலாறுமக்களும்பண்பாடும்கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடுபாடநூல்மற்றும்கல்வியியல்பணிகள்கழகம்).
2.	கணினித்தமிழ் - முனைவர்இல. சுந்தரம். (விகடன்பிரசுரம்).
3.	கீழடி - வைகைநதிக்கரையில்சங்ககாலநகரநாகரிகம் (தொல்லியல்துறைவெளியீடு)
4.	பொருநை - ஆற்றங்கரைநாகரிகம். (தொல்லியல்துறைவெளியீடு)
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.)

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9.	Keeladi - 'Sangam City C ivilization 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.

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Subject Code	Subject Name	Category	L	T	P	C
GE24111	PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY	ESC	0	0	4	2

Course Objectives:

- To understand the problem solving approaches.
- To learn the basic programming constructs in Python.
- To practice various computing strategies for Python-based solutions to real world problems.
- To use Python data structures - lists, tuples, dictionaries.
- To do input/output with files in Python.

EXPERIMENTS:
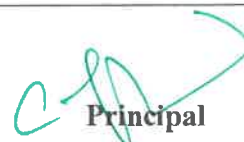
Note: The examples suggested in each experiment are only indicative. The lab instructor is expected to design other problems on similar lines. The Examination shall not be restricted to the sample experiments listed here.

1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.)
2. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
3. Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern)
4. Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building –operations of list & tuples)
5. Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.- operations of Sets & Dictionaries)
6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)
7. Implementing programs using Strings. (reverse, palindrome, character count, replacing characters)
8. Implementing programs using written modules and Python Standard Libraries (pandas, numpy. Matplotlib, scipy)
9. Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word)
10. Implementing real-time/technical applications using Exception handling. (divide by zero error, voter's age validity, student mark range validation)
11. Exploring Pygame tool.
12. Developing a game activity using Pygame like bouncing ball, car race etc.

	Total Contact Hours: 45

Course Outcomes:	Upon completion of the course students should be able to:
CO1	Develop algorithmic solutions to simple computational problems
CO2	Develop and execute simple Python programs.
CO3	Implement programs in Python using conditionals and loops for solving problems.
CO4	Deploy functions to decompose a Python program.
CO5	Process compound data using Python data structures.

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Textbooks:	
1.	Allen B. Downey, "Think Python : How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016.
2.	Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017.

Reference books/other materials/web resources:	
1.	Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021.
2.	G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.
3.	John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", Third Edition, MIT Press , 2021
4.	Eric Matthes, "Python Crash Course, A Hands - on Project Based Introduction to Programming", 2nd Edition, No Starch Press, 2019.
5.	https://www.python.org/
6.	Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc-Graw Hill, 2018.

CO	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	-	-	-	-	3	2	3	3	-
CO2	3	3	3	3	3	-	-	-	-	3	2	3	-	-
CO3	3	3	3	3	2	-	-	-	-	2	-	3	-	-
CO4	3	2	-	2	2	-	-	-	-	1	-	3	-	-
CO5	1	2	-	-	1	-	-	-	-	1	-	2	-	-
Average:	2	3	3	3	2	-	-	-	-	2	2	3	3	-

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Subject Code	Subject Name	Category	L	T	P	C
BS24111	**PHYSICS AND CHEMISTRY LABORATORY**	BSC	0	0	4	2

PHYSICS LABORATORY: (Any Seven Experiments)
Course Objectives:
• To learn the proper use of various kinds of physics laboratory equipment.
• To learn how data can be collected, presented and interpreted in a clear and concise manner.
• To learn problem solving skills related to physics principles and interpretation of experimental data.
• To determine error in experimental measurements and techniques used to minimize such error.
• To make the student as an active participant in each part of all lab exercises.

LIST OF EXPERIMENTS
1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of regular and irregular objects.
2. Simple harmonic oscillations of cantilever.
3. Non-uniform bending - Determination of Young's modulus
4. Uniform bending – Determination of Young's modulus
5. Laser- Determination of the wave length of the laser using grating
6. Air wedge - Determination of thickness of a thin sheet/wire
7. a) Optical fibre -Determination of Numerical Aperture and acceptance angle
b) Compact disc- Determination of width of the groove using laser.
8. Acoustic grating- Determination of velocity of ultrasonic waves in liquids.
9. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids
10. Post office box -Determination of Band gap of a semiconductor.
11. Photoelectric effect
12. Michelson Interferometer.
13. Melde's string experiment
14. Experiment with lattice dynamics kit.

	Total Contact Hours :30
Course Outcomes:	Upon completion of the course students should be able to:
CO1	Understand the functioning of various physics laboratory equipment.
CO2	Use graphical models to analyze laboratory data.
CO3	Use mathematical models as a medium for quantitative reasoning and describing physical reality.
CO4	Access, process and analyze scientific information.
CO5	Solve problems individually and collaboratively.

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CO	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	3	1	1	-	-	-	-	-	-	-	-	-
CO2	3	3	2	1	1	-	-	-	-	-	-	-	-	-
CO3	3	2	3	1	1	-	-	-	-	-	-	-	-	-
CO4	3	3	2	1	1	-	-	-	-	-	-	-	-	-
CO5	3	2	3	1	1	3	-	-	-	-	-	-	-	-
Average:	3	2.4	2.6	1	1	3	-	-	-	-	-	-	-	-

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CHEMISTRY LABORATORY: (Any seven experiments)
Course Objectives:
• To inculcate experimental skills to test basic understanding of water quality parameters, such as, acidity, alkalinity, hardness, DO, chloride and copper.
• To induce the students to familiarize with electroanalytical techniques such as, pH metry, potentiometry and conductometry in the determination of impurities in aqueous solutions.
• To demonstrate the analysis of metals and alloys.
• To demonstrate the synthesis of nanoparticles

LIST OF EXPERIMENTS
1. Preparation of Na_2CO_3 as a primary standard and estimation of acidity of a water sample using the primary standard 2. Determination of types and amount of alkalinity in water sample. - Split the first experiment into two 3. Determination of total, temporary & permanent hardness of water by EDTA method. 4. Determination of DO content of water sample by Winkler's method. 5. Determination of chloride content of water sample by Argentometric method. 6. Estimation of copper content of the given solution by Iodometry. 7. Estimation of TDS of a water sample by gravimetry. 8. Determination of strength of given hydrochloric acid using pH meter. 9. Determination of strength of acids in a mixture of acids using conductivity meter. 10. Conductometric titration of barium chloride against sodium sulphate (precipitation titration) 11. Estimation of iron content of the given solution using potentiometer. 12. Estimation of sodium /potassium present in water using flame photometer. 13. Preparation of nanoparticles (TiO2/ZnO/CuO) by Sol-Gel method. 14. Estimation of Nickel in steel 15. Proximate analysis of Coal

	Total Contact Hours :30

Course Outcomes:	Upon completion of the course students should be able to:
CO1	To analyse the quality of water samples with respect to their acidity, alkalinity, hardness and DO.
CO2	To determine the amount of metal ions through volumetric and spectroscopic techniques
CO3	To analyse and determine the composition of alloys.
CO4	To learn simple method of synthesis of nanoparticles
CO5	To quantitatively analyze the impurities in solution by electroanalytical techniques

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Textbooks:

1.	J. Mendham, R. C. Denney, J.D. Barnes, M. Thomas and B. Sivasankar, Vogel's Textbook of Quantitative Chemical Analysis (2009).

CO	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	-	1	-	-	2	-	-	-	-	2	-	-	-
CO2	3	1	2	-	-	1	-	-	-	-	1	-	-	-
CO3	3	2	1	1	-	-	-	-	-	-	-	-	-	-
CO4	2	1	2	-	-	2	-	-	-	-	-	-	-	-
CO5	2	1	2	-	1	2	-	-	-	-	1	-	-	-
Average:	2.6	1.3	1.6	1	1	1.4	-	-	-	-	1.3	-	-	-

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Subject Code	Subject Name	Category	L	T	P	C
GE24112	English Laboratory	EEC	0	0	2	1

Course Objectives:

- To improve the communicative competence of learners
- To help learners use language effectively in academic /work contexts
- To develop various listening strategies to comprehend various types of audio materials like lectures, discussions, videos etc.
- To build on students' English language skills by engaging them in listening, speaking and grammar learning activities that are relevant to authentic contexts.
- To use language efficiently in expressing their opinions via various media.

UNIT – I	INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION	6

Listening for general information-specific details- conversation: Introduction to classmates - Audio / video (formal & informal); Telephone conversation; Listening to voicemail & messages; Listening and filling a form. Speaking - making telephone calls-Self Introduction; Introducing a friend; - politeness strategies- making polite requests, making polite offers, replying to polite requests and offers- understanding basic instructions(filling out a bank application for example).

UNIT – II	NARRATION AND SUMMATION	6

Listening - Listening to podcasts, anecdotes / stories / event narration; documentaries and interviews with celebrities. Speaking - Narrating personal experiences / events-Talking about current and temporary situations & permanent and regular situations* - describing experiences and feelings-engaging in small talk- describing requirements and abilities.

UNIT – III	DESCRIPTION OF A PROCESS / PRODUCT	6

Listening - Listen to product and process descriptions; a classroom lecture; and advertisements about products. Speaking – Picture description- describing locations in workplaces- Giving instruction to use the product- explaining uses and purposes- Presenting a product- describing shapes and sizes and weights- talking about quantities(large & small)-talking about precautions.

UNIT – IV	CLASSIFICATION AND RECOMMENDATIONS	6

Listening – Listening to TED Talks; Listening to lectures - and educational videos. Speaking – Small Talk; discussing and making plans-talking about tasks-talking about progress- talking about positions and directions of movement-talking about travel preparations- talking about transportation-

UNIT – V	CLASSIFICATION AND RECOMMENDATIONS	6

Listening – Listening to debates/ discussions; different viewpoints on an issue; and panel discussions. Speaking –making predictions- talking about a given topic-giving opinions- understanding a website-describing processes

	Total Contact Hours :30

Course Outcomes:	Upon completion of the course students should be able to:
CO1	To listen to and comprehend general as well as complex academic texts information
CO2	To listen to and understand different points of view in a discussion
CO3	To speak fluently and accurately in formal and informal communicative contexts
CO4	To describe products and processes and explain their uses and purposes clearly and accurately
CO5	To express their opinions effectively in both formal and informal discussions

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CO	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3	1	3	3	3	3	3	3	-	-	-
CO2	3	3	3	3	1	3	3	3	3	3	3	-	-	-
CO3	3	3	3	3	1	3	3	3	3	3	3	-	-	-
CO4	3	3	3	3	1	3	3	3	3	3	3	3	-	-
CO5	3	3	3	3	1	3	3	3	3	3	3	3	-	-
Average:	3	3	3	3	1	3	3	3	3	3	3	3	-	-

HoD/BOS Chairman

Principal

Subject Code	Subject Name	Category	L	T	P	C
HS24201	PROFESSIONAL ENGLISH - II	HSMC	2	0	0	2

Course Objectives:

- To engage learners in meaningful language activities to improve their reading and writing skills
- To learn various reading strategies and apply in comprehending documents in professional context.
- To help learners understand the purpose, audience, contexts of different types of writing
- To develop analytical thinking skills for problem solving in communicative contexts
- To demonstrate an understanding of job applications and interviews for internship and placements

UNIT – I	MAKING COMPARISONS	6

Reading - Reading advertisements, user manuals, brochures; Writing – Professional emails, Email etiquette - Compare and Contrast Essay; Grammar – Mixed Tenses, Prepositional phrases

UNIT – II	EXPRESSING CAUSAL RELATIONS IN SPEAKING AND WRITING	6

Reading - Reading longer technical texts– Cause and Effect Essays, and Letters / emails of complaint, Writing - Writing responses to complaints. Grammar - Active Passive Voice transformations, Infinitive and Gerunds

UNIT – III	PROBLEM SOLVING	6

Reading - Case Studies, excerpts from literary texts, news reports etc. Writing – Letter to the Editor, Checklists, Problem solution essay / Argumentative Essay. Grammar – Error correction; If conditional sentences

UNIT – IV	REPORTING OF EVENTS AND RESEARCH	6

Reading –Newspaper articles; Writing – Recommendations, Transcoding, Accident Report, Survey Report Grammar – Reported Speech, Modals Vocabulary – Conjunctions- use of prepositions

UNIT – V	THE ABILITY TO PUT IDEAS OR INFORMATION COGENTLY	6

Reading – Company profiles, Statement of Purpose, (SOP), an excerpt of interview with professionals; Writing – Job / Internship application – Cover letter & Resume; Grammar – Numerical adjectives, Relative Clauses.

	Total Contact Hours :30

Course Outcomes:	Upon completion of the course students should be able to:
CO1	To compare and contrast products and ideas in technical texts.
CO2	To identify and report cause and effects in events, industrial processes through technical texts
CO3	To analyse problems in order to arrive at feasible solutions and communicate them in the written format.
CO4	To present their ideas and opinions in a planned and logical manner
CO5	To draft effective resumes in the context of job search.

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Textbooks:	
1.	English for Engineers & Technologists (2020 edition) Orient Blackswan Private Ltd. Department of English, Anna University.
2.	English for Science & Technology Cambridge University Press 2021.
3.	Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University

Reference books/other materials/webresources:	
1.	Raman. Meenakshi, Sharma. Sangeeta (2019). Professional English. Oxford university press. New Delhi.
2.	Improve Your Writing ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001, NewDelhi.
3.	Learning to Communicate – Dr. V. Chellammal. Allied Publishers, New Delhi, 2003
4.	Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.
5.	Developing Communication Skills by Krishna Mohan, Meera Bannerji- Macmillan India Ltd. 1990, Delhi.

CO	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	2	3	3	3	-	-	-
CO2	3	3	3	3	3	3	3	2	3	3	3	-	-	-
CO3	3	3	3	3	3	3	3	2	3	3	3	-	-	-
CO4	3	3	3	3	2	3	3	2	3	3	3	-	-	-
CO5	-	-	-	-	-	-	-	3	3	3	3	-	-	-
Average:	3	3	3	3	2.75	3	3	2.2	3	3	3	-	-	-

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Subject Code	Subject Name	Category	L	T	P	C
MA24201	**STATISTICS AND NUMERICAL METHODS**	**BSC**	**3**	**1**	**0**	**4**

Course Objectives:

- This course aims at providing the necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

UNIT – I	TESTING OF HYPOTHESIS	9+3
Sampling distributions - Tests for single mean, proportion and difference of means (Large and small samples) – Tests for single variance and equality of variances – Chi square test for goodness of fit – Independence of attributes.	
UNIT – II	DESIGN OF EXPERIMENTS	9+3
One way and two way classifications - Completely randomized design – Randomized block design – Latin square design - 22 factorial design.	
UNIT – III	SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS	9+3
Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method- Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices.	
UNIT – IV	INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION	9+3
Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivates using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules.	
UNIT – V	NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS	9+3
Single step methods: Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first order differential equations - Multi step methods: Milne's and Adams - Bash forth predictor corrector methods for solving first order differential equations.	
		**Total Contact Hours :60**

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Course Outcomes:	Upon completion of the course students should be able to:
CO1	Apply the concept of testing of hypothesis for small and large samples in real life problems.
CO2	Apply the basic concepts of classifications of design of experiments in the field of agriculture.
CO3	Appreciate the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.
CO4	Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
CO5	Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.

Textbooks:	
1.	Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.
2.	Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.

Reference books/other materials/web resources:	
1.	Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
2.	Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
3.	Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 7th Edition, 2007.
4.	Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 7th Edition, 2007.
5.	Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outlines on Probability and Statistics ", Tata McGraw Hill Edition, 4th Edition, 2012.
6.	Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", 9th Edition, Pearson Education, Asia, 2010.

CO	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	1	1	1	0	0	2	0	2	3	-	-	-
CO2	3	3	1	1	1	0	0	2	0	2	3	-	-	-
CO3	3	3	1	1	1	0	0	2	0	2	3	-	-	-
CO4	3	3	1	1	1	0	0	2	0	2	3	-	-	-
CO5	3	3	1	1	1	0	0	2	0	2	3	-	-	-
Average:	3	3	1	1	1	0	0	2	0	2	3	-	-	-

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Subject Code	Subject Name	Category	L	T	P	C
PH24205	MATERIALS SCIENCE FORBIOTECHNOLOGISTS	PCC	3	0	0	3

Course Objectives:

- To make the students effectively to understand the basics of crystallography and crystal
- imperfections
- To enable the students to get knowledge on various strengthening methods of materials, and
- also various mechanical properties and their measurement.
- To impart knowledge on the basics of phase diagrams and their applications.
- To learn about iron-carbon system, and about various ferrous and non-ferrous alloys.
- To introduce different types of biomaterials and their applications.

UNIT – I	CRYSTALLOGRAPHY	9

Crystallographic directions and planes – metallic crystal structures: BCC, FCC and HCP – linear and planar densities – crystal imperfections- edge and screw dislocations, Burgers vector and elastic strain energy- surface imperfections – grain and twin boundaries – Polymorphism – phase changes – nucleation and growth – homogeneous and heterogeneous nucleation.

UNIT – II	MECHANICAL PROPERTIES	9

Tensile test - plastic deformation by slip – slip systems – mechanisms of strengthening in metals: strain hardening, grain size reduction, solid solution strengthening, precipitation hardening – Creep: creep curves,stress and temperature effects, mechanisms of creep, creep-resistant materials – Fracture: ductile and brittle fractures - the Griffith criterion –fracture toughness - Fatigue failure:the S-N curve – factors that affect fatigue life – Hardness: Rockwell and Brinell hardness tests, Knoop and Vickers microhardness tests.

UNIT – III	PHASE DIAGRAMS	9

Basic concepts - Gibbs phase rule –Unary phase diagram (iron) - Binary phase diagrams: isomorphous systems (Cu-Ni) –determination of phase composition and phase amounts – tieline and lever rule - binary eutectic diagram with no solid solution and limited solid solution (Pb-Sn) – eutectoid and peritectic reactions - other invariant reactions – microstructural development during the slow cooling: eutectic, hypereutectic and hypoeutectic compositions.

UNIT – IV	FERROUS AND NONFERROUS ALLOYS	9

The $Fe-Fe_3C$ phase diagram: phases, invariant reactions,development of microstructure in eutectoid, hypoeutectoid and hypereutectoid alloys–influence of other alloying elements in the FeC system - phase transformations –isothermal transformation diagram for eutectoid iron-carbon alloy – microstructures: pearlite, bainite, spheroidite and martensite – steels, stainless steels and cast irons – copper alloys – aluminum alloys – titanium alloys.

UNIT – V	MATERIALS FOR BIOLOGICAL APPLICATIONS	9

Biocompatibility – host response – materials response – Metallic implants: Titanium and its alloys, stainless steel – Cobalt-Chromium alloys – Tantalum – Nitinol – magnesium based biodegradable alloys. Bioceramics: Alumina, Zirconia, hydroxyapatite, tricalcium phosphate, bioactive glasses, pyrolytic carbon, graphite, graphene. Polymeric implant materials: Polyethylene, polypropylene, polyacrylates – soft and hard tissue replacement materials.

	Total Contact Hours :45

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Course Outcomes:	Upon completion of the course students should be able to:
CO1	Understand the basics of crystallography and its importance in materials properties
CO2	Understand the significance of dislocations, strengthening mechanisms,and tensile, creep,hardness and fracture behavior of materials
CO3	Gain knowledge on binary phase diagrams, and also will be able to determine the phase composition and phase amount.
CO4	Understand about the Fe-C system and various microstructures in it, and also about various ferrous and non-ferrous alloys.
CO5	Get adequate understanding on metallic, ceramic and polymeric biomaterials and their applications.

Textbooks:	
1.	R.Balasubramaniam, Callister's Materials Science and Engineering.Wiley (Indian Edition),2014.
2.	V.Raghavan. Materials Science and Engineering: A First Course, Prentice Hall India
3.	Learning Private Limited, 2015.

Reference books/other materials/webresources:	
1.	J.F.Shackelford. Introduction to Materials Science for Engineers. Pearson, 2015.
2.	Wendelin Wright and Donald Askeland, Essentials of Materials Science and Engineering,
3.	CL Engineering, 2013.
4.	J.C. Anderson, K.D. Leaver, P. Leevers and R.D. Rawlings, Materials Science for
5.	Engineers, CRC Press, 2003.

CO	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	1	-	-	-	-	-	-	-	-
CO2	3	2	1	1	2	1	-	-	-	-	-	-	-	-
CO3	3	2	1	2	2	1	-	-	-	-	-	-	-	-
CO4	3	2	2	1	2	2	-	-	-	-	1	-	-	-
CO5	3	2	2	1	2	1	-	-	-	-	-	-	-	-
Average:	3	2	1.4	1.4	1.8	1.2					1			

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Subject Code	Subject Name	Category	L	T	P	C
BE24204	BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION ENGINEERING	ESC	3	0	0	3

Course Objectives:

- To introduce the basics of electric circuits and analysis
- To impart knowledge in domestic wiring
- To impart knowledge in the basics of working principles and application of electrical machines
- To introduce analog devices and their characteristics
- To introduce the functional elements and working of sensors and transducers

UNIT – I	ELECTRICAL CIRCUITS	9

DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm's Law - Kirchhoff's Laws – Simple problems- Nodal Analysis, Mesh analysis with Independent sources only (Steady state)

Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor – Steady state analysis of RLC circuits (Simple problems only), Three phase supply – star and delta connection – power in three-phase systems

UNIT – II	MAGNETIC CIRCUITS AND ELECTRICAL INSTALLATIONS	9

Magnetic circuits-definitions-MMF, flux, reluctance, magnetic field intensity, flux density, fringing, self and mutual inductances-simple problems.

Domestic wiring , types of wires and cables, earthing ,protective devices- switch fuse unit- Miniature circuit breaker-moulded case circuit breaker- earth leakage circuit breaker, safety precautions and First Aid

UNIT – III	ELECTRICAL MACHINES	9

Construction and Working principle- DC Separately and Self excited Generators, EMF equation, Types and Applications. Working Principle of DC motors, Torque Equation, Types and Applications. Construction, Working principle and Applications of Transformer, Three phase Alternator, Synchronous motor and Three Phase Induction Motor.

UNIT – IV	ANALOG ELECTRONICS	9

Resistor, Inductor and Capacitor in Electronic Circuits- Semiconductor Materials: Silicon &Germanium – PN Junction Diodes, Zener Diode –Characteristics Applications – Bipolar Junction Transistor-Biasing, JFET, SCR, MOSFET,IGBT – Types, I-V Characteristics and Applications, Rectifier and Inverters, harmonics

UNIT – V	SENSORS AND TRANSDUCERS	9

Sensors, solenoids, pneumatic controls with electrical actuator, mechatronics, types of valves and its applications, electro-pneumatic systems, proximity sensors, limit switches, piezoelectric, hall effect, photo sensors,Strain gauge, LVDT, differential pressure transducer,optical and digital transducers, Smart sensors, Thermal Imagers.

	Total Contact Hours :45

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Course Outcomes:	Upon completion of the course students should be able to:
CO1	Compute the electric circuit parameters for simple problems
CO2	Explain the concepts of domestics wiring and protective devices
CO3	Explain the working principle and applications of electrical machines
CO4	Analyze the characteristics of analog electronic devices
CO5	Explain the types and operating principles of sensors and transducers

Textbooks:	
1.	D P Kothari and I.J Nagarath, "Basic Electrical and Electronics Engineering", McGraw Hill Education (India) Private Limited, Second Edition, 2020
2.	A.K. Sawhney, Puneet Sawhney 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, 2015.
3.	S.K. Bhattacharya, Basic Electrical Engineering, Pearson Education, 2019
4.	James A Svoboda, Richard C. Dorf, Dorf's Introduction to Electric Circuits,Wiley,2018

Reference books/other materials/webresources:	
1.	John Bird, "Electrical Circuit theory and technology", Routledge; 2017.
2.	Thomas L. Floyd, 'Electronic Devices', 10th Edition, Pearson Education, 2018.
3.	Albert Malvino, David Bates, 'Electronic Principles, McGraw Hill Education; 7th edition, 2017
4.	Muhammad H.Rashid, "Spice for Circuits and electronics", 4th Edition.,Cengage India, 2019.
5.	H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 2010

CO	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	1	-	-	-	1	-	-	-	-	-	-	-
CO2	2	1	1	-	-	-	1	-	-	-	-	-	-	-
CO3	2	1	1	-	-	-	1	-	-	-	-	-	-	-
CO4	2	1	1	-	-	-	1	-	-	-	-	-	-	-
CO5	2	1	1	-	-	-	1	-	-	-	-	-	-	-
Average:	2	1	1	-	-	-	1	-	-	-	-	-	-	-

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Subject Code	Subject Name	Category	L	T	P	C
GE24201	ENGINEERING GRAPHICS	ESC	2	0	4	4

Course Objectives: The main learning objective of this course is to prepare the students for:

- Drawing engineering curves.
- Drawing freehand sketch of simple objects.
- Drawing orthographic projection of solids and section of solids.
- Drawing development of solids
- Drawing isometric and perspective projections of simple solids.

	CONCEPTS AND CONVENTIONS (Not for Examination)	
	Importance of graphics in engineering applications — Use of drafting instruments — BIS conventions and specifications — Size, layout and folding of drawing sheets — Lettering and dimensioning.	
UNIT – I	**PLANE CURVES**	6+12
Basic Geometrical constructions, Curves used in engineering practices: Conics — Construction of ellipse, parabola and hyperbola by eccentricity method — Construction of cycloid — construction of involutes of square and circle — Drawing of tangents and normal to the above curves.	
UNIT – II	**PROJECTION OF POINTS, LINES AND PLANE SURFACE**	6+12
Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.	
UNIT – III	**PROJECTION OF SOLIDS AND FREEHAND SKETCHING**	6+12
Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes and parallel to the other by rotating object method. Visualization concepts and Free Hand sketching: Visualization principles — Representation of Three Dimensional objects — Layout of views- Freehand sketching of multiple views from pictorial views of objects. Practicing three dimensional modeling of simple objects by CAD Software(Not for examination)	
UNIT – IV	**PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES**	6+12
Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other — obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids — Prisms, pyramids cylinders and cones. Practicing three dimensionalmodeling of simple objects by CAD Software(Not for examination)	
UNIT – V	**ISOMETRIC AND PERSPECTIVE PROJECTIONS**	6+12
Principles of isometric projection — isometric scale —Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method. Practicing three dimensional modeling of isometric projection of simple objects by CAD Software(Not for examination)	

TOTAL: (L=30+P=60) 90 PERIODS

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Course Outcomes:	Upon completion of the course students should be able to:
CO1	Use BIS conventions and specifications for engineering drawing.
CO2	Construct the conic curves, involutes and cycloid.
CO3	Solve practical problems involving projection of lines.
CO4	Draw the orthographic, isometric and perspective projections of simple solids.
CO5	Draw the development of simple solids.

Textbooks:

1.	Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 53rd Edition, 2019.
2.	Natrajan K.V., "A Text Book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2018.
3.	Parthasarathy, N. S. and Vela Murali, "Engineering Drawing", Oxford University Press, 2015

Reference books/other materials/webresources:

1.	Basant Agarwal and Agarwal C.M., "Engineering Drawing", McGraw Hill, 2nd Edit ion, 2019.
2.	Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Publications, Bangalore, 27th Edition, 2017.
3.	Luzzader, Warren.J. and Duff,John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
4.	Parthasarathy N. S. and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.
5.	Shah M.B., and Rana B.C., "Engineering Drawing", Pearson Education India, 2nd Edition, 2009.
6.	Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2008.

Publication of Bureau of Indian Standards:

1.	IS 10711 — 2001: Technical products Documentation — Size and lay out of drawing sheets.
2.	IS 9609 (Parts 0 & 1) — 2001: Technical products Documentation — Lettering.
3.	IS 10714 (Part 20) — 2001 & SP 46 — 2003: Lines for technical drawings
4.	IS 11669 — 1986 & SP 46 —2003: Dimensioning of Technical Drawings.
5.	IS 15021 (Parts 1 to 4) — 2001: Technical drawings — Projection Methods.

CO	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	2	-	2	-	-	-	3	-	2	2	2	-
CO2	3	1	2	-	2	-	-	-	3	-	2	2	2	-
CO3	3	1	2	-	2	-	-	-	3	-	2	2	2	-
CO4	3	1	2	-	2	-	-	-	3	-	2	2	2	-
CO5	3	1	2	-	2	-	-	-	3	-	2	2	2	-
Average:	3	1	2	-	2	-	-	-	3	-	2	2	2	-

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Subject Code	Subject Name	Category	L	T	P	C
BT24201	BIO ORGANIC CHEMISTRY	PCC	3	0	0	3

Course Objectives:

- About the elements of atom, charges and their bonding rule.
- Various kinetic properties and types of reaction mechanisms.
- The various properties of catalysis and their action
- Bio-organic reactions involved in biosynthesis

UNIT – I	BONDING AND STEREO CHEMISTRY	9

Atoms Electrons and orbitals - Covalent Bonds - Octet rule - Polar covalent Bonds - Electronegativity-formalcharge-ResonanceAcidsandBases-ArrheniusandBronstedLowry Theories-AcidBaseequilibria-SP3hybridization–Conformation analysis - ethane, butane and cyclohexane - Cis- trans isomerism. Stereochemical activity around the tetrahedral carbon–optical activity -Conformation of the peptide bond

UNIT – II	MECHANISMS OF SUBSTITUTION AND ADDITION REACTIONS	9

SN1 and SN2 reactions on tetrahedral carbon- nucleophiles- mechanism steric effects–nucleophilicadditiononAcetalsandketals-Aldehydeandketonegroups–reactionsofcarbonyl group with amines- acid catalyzed ester hydrolysis–Saponification of an ester- hydrolysis of amides. Ester enolates – Claisen condensation – Michael condensation

UNIT – III	KINETIC SAND MECHANISM	9

Kineticmethod–Ratelawandmechanism–Transitionstates-Intermediates–Trappingof intermediates – Microscopic reversibility – Kinetic and thermodynamic reversibility – Isotopes for detecting intermediates. Primary and secondary isotopes – the Arrhenius equation Eyring equation -$\Delta G, \Delta S, \Delta H$, Thermodynamics of coupled reactions.

UNIT – IV	CATALYSIS	9

Reactivity–Coenzymes–Protontransfer–metalions–Intramolecularreactions–Covalent catalysis – Catalysis by organized aggregates and phases. Inclusion complexation

UNIT – V	BIOORGANICREACTIONS	9

TimingofBondformationandfission–Acylgrouptransfer–C-Cbondformationandfission–Catalysis of proton transfer reactions – Transfer of hydride ion – Alkyl group. Transfer – Terpene biosynthesis–Merrifield state peptide synthesis–Sanger method for peptide and DNA sequencing

	Total Contact Hours :45

Course Outcomes:	Upon completion of the course students should be able to:
CO1	Bonding and stereochemistry
CO2	Mechanisms of substitution and addition reactions
CO3	Thermodynamics, kinetics and mechanism
CO4	Catalysis
CO5	Bioorganic reactions and mechanisms

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Textbooks:

1.	Carey, Francis A. "Organic Chemistry". VIIth Edition, Tata McGraw Hill, 2009.
2.	Page, M. I. and Andrew Williams "Organic and Bio-organic Mechanisms". Pearson, 2010.

Reference books/other materials/webresources:

1.	Dugas, Hermann "Bioorganic Chemistry: A Chemical Approach to Enzyme Action" 3rd Edition, Springer, 2003

CO	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	2	2	2	2	2	2	2	2	2
CO2	3	3	2	3	2	2	2	2	2	2	2	3	3	2
CO3	2	3	2	3	3	2	2	2	2	2	2	3	2	3
CO4	2	3	3	3	3	2	2	2	2	3	3	3	2	3
CO5	2	3	2	3	3	2	-	2	-	2	2	3	3	3
Average:	2.4	2.8	2.4	2.8	2.6	2	2	2	2	2.2	2.2	2.8	2.4	2.6

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Subject Code	Subject Name	Category	L	T	P	C
GE24202	தமிழரும் தொழில்நுட்பமும்	HSMC	1	0	0	1

அலகு 1	நெசவு மற்றும் பானைத் தொழில்நுட்பம்	3

சங்க காலத்தில் நெசவுத் தொழில் – பானைத் தொழில்நுட்பம் – கருப்பு சிவப்பு பாண்டங்கள்

அலகு II	வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்	3

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் 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 - செட்டிநாட்டு 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 கால்நடைகளுக்காக 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 -கணித் தமிழ் வளர்ச்சி – தமிழ் நூல்களை மின்பதிப்பு செய்தல் – தமிழ் மென்பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக்கழகம் தமிழ்மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்

	Total Contact Hours :15

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	Text-Cum-Reference Books
1.	தமிழகவரலாறுமக்களும்பண்பாடும்கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடுபாடநூல்மற்றும்கல்வியியல்பணிகள்கழகம்).
2.	கணினித்தமிழ் - முனைவர்இல. சுந்தரம். (விகடன்பிரசுரம்).
3.	கீழடி வைகைநதிக்கரையில்சங்ககாலநகரநாகரிகம்(தொல்லியல்துறை வெளியீடு)
4.	பொருநை - ஆற்றங்கரைநாகரிகம். (தொல்லியல்துறைவெளியீடு)
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 C ivilization 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.

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Subject Code	Subject Name	Category	L	T	P	C
GE24202	TAMILS AND TECHNOLOGY	HSMC	1	0	0	1

UNIT – I	WEAVING AND CERAMIC TECHNOLOGY	3
Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.	
UNIT – II	DESIGN AND CONSTRUCTION TECHNOLOGY	3
Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.	
UNIT – III	MANUFACTURING TECHNOLOGY	3
Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold- Coins as source of history - Minting of Coins – Beads making-industries Stone beads - Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.	
UNIT – IV	AGRICULTURE AND IRRIGATION TECHNOLOGY	3
Dam, Tank, ponds, Sluice, Significance of KumizhiThoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.	
UNIT – V	SCIENTIFIC TAMIL & TAMIL COMPUTING	3
Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.	
		Total Contact Hours :15

	Text-Cum-Reference Books
1.	தமிழகவரலாறுமக்களும்பண்பாடும்கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடுபாடநூல்மற்றும்கல்வியியல்பணிகள்கழகம்).
2.	கணினித்தமிழ் - முனைவர்இல. சுந்தரம். (விகடன்பிரசுரம்).
3.	கீழடி வைகைநதிக்கரையில்சங்ககாலநகரநாகரிகம்(தொல்லியல்துறைவெ ளியீடு)
4.	பொருநை - ஆற்றங்கரைநாகரிகம். (தொல்லியல்துறைவெளியீடு)
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.)

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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.

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Subject Code	Subject Name	Category	L	T	P	C
	(NAVAL WING) NCC Credit Course Level - I	NCC	2	0	0	2

NCC GENERAL		**6**
NCC 1	Aims, Objectives & Organization of NCC	1
NCC 2	Incentives	2
NCC 3	Duties of NCC Cadet	1
NCC 4	NCC Camps: Types & Conduct	2
NATIONAL INTEGRATION AND AWARENESS		**4**
NI 1	National Integration: Importance & Necessity	1
NI 2	Factors Affecting National Integration	1
NI 3	Unity in Diversity & Role of NCC in Nation Building	1
PERSONALITY DEVELOPMENT		**7**
PD 1	Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving	2
PD 2	Communication Skills	3
PD 3	Group Discussion: Stress & Emotions	2
LEADERSHIP		**5**
L 1	Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour 'Code	3
L 2	Case Studies: Shivaji, Jhasi Ki Rani	2
SOCIAL SERVICE AND COMMUNITY DEVELOPMENT		**8**
SS 1	Basics, Rural Development Programmes, NGOs, Contribution of Youth	3
SS 4	Protection of Children and Women Safety	1
SS 5	Road / Rail Travel Safety	1
SS 6	New Initiatives	2
SS 7	Cyber and Mobile Security Awareness	1
	Total Contact Hours : 30	

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Subject Code	Subject Name	Category	L	T	P	C
	(ARMY WING) NCC Credit Course Level - I	NCC	2	0	0	2

NCC GENERAL		**6**
NCC 1	Aims, Objectives & Organization of NCC	1
NCC 2	Incentives	2
NCC 3	Duties of NCC Cadet	1
NCC 4	NCC Camps: Types & Conduct	2
NATIONAL INTEGRATION AND AWARENESS		**4**
NI 1	National Integration: Importance & Necessity	1
NI 2	Factors Affecting National Integration	1
NI 3	Unity in Diversity & Role of NCC in Nation Building	1
PERSONALITY DEVELOPMENT		**7**
PD 1	Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving	2
PD 2	Communication Skills	3
PD 3	Group Discussion: Stress & Emotions	2
LEADERSHIP		**5**
L 1	Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour 'Code	3
L 2	Case Studies: Shivaji, Jhasi Ki Rani	2
SOCIAL SERVICE AND COMMUNITY DEVELOPMENT		**8**
SS 1	Basics, Rural Development Programmes, NGOs, Contribution of Youth	3
SS 4	Protection of Children and Women Safety	1
SS 5	Road / Rail Travel Safety	1
SS 6	New Initiatives	2
SS 7	Cyber and Mobile Security Awareness	1
	Total Contact Hours : 30	

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Principal

Subject Code	Subject Name	Category	L	T	P	C
	(AIR FORCE WING) NCC Credit Course Level - I	NCC	2	0	0	2

NCC GENERAL		6
NCC 1	Aims, Objectives & Organization of NCC	1
NCC 2	Incentives	2
NCC 3	Duties of NCC Cadet	1
NCC 4	NCC Camps: Types & Conduct	2
NATIONAL INTEGRATION AND AWARENESS		**4**
NI 1	National Integration: Importance & Necessity	1
NI 2	Factors Affecting National Integration	1
NI 3	Unity in Diversity & Role of NCC in Nation Building	1
PERSONALITY DEVELOPMENT		**7**
PD 1	Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving	2
PD 2	Communication Skills	3
PD 3	Group Discussion: Stress & Emotions	2
LEADERSHIP		**5**
L 1	Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour 'Code	3
L 2	Case Studies: Shivaji, Jhasi Ki Rani	2
SOCIAL SERVICE AND COMMUNITY DEVELOPMENT		**8**
SS 1	Basics, Rural Development Programmes, NGOs, Contribution of Youth	3
SS 4	Protection of Children and Women Safety	1
SS 5	Road / Rail Travel Safety	1
SS 6	New Initiatives	2
SS 7	Cyber and Mobile Security Awareness	1
	Total Contact Hours : 30	

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Subject Code	Subject Name	Category	L	T	P	C
GE24211	**ENGINEERING PRACTICES LABORATORY**	ESC	0	0	4	2

Course Objectives:

- Drawing pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planing; making joints in wood materials used in common household wood work.
- Wiring various electrical joints in common household electrical wire work.
- Welding various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping in parts; Assembling simple mechanical assembly of common household equipments; Making a tray out of metal sheet using sheet metal work.
- Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB.

GROUP – A (CIVIL & ELECTRICAL)		
PART I	**CIVIL ENGINEERING PRACTICES**	**15**

PLUMBING WORK:
a) Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.
b) Preparing plumbing line sketches.
c) Laying pipe connection to the suction side of a pump
d) Laying pipe connection to the delivery side of a pump.
e) Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

WOOD WORK:
a) Sawing,
b) Planing and
c) Making joints like T-Joint, Mortise joint and Tenon joint and Dovetail joint.

Wood Work Study:
a) Studying joints in door panels and wooden furniture
b) Studying common industrial trusses using models.

PART II	**ELECTRICAL ENGINEERING PRACTICES**	**15**

a) Introduction to switches, fuses, indicators and lamps - Basic switch board wiring with lamp, fan and three pin socket
b) Staircase wiring
c) Fluorescent Lamp wiring with introduction to CFL and LED types.
d) Energy meter wiring and related calculations/ calibration
e) Study of Iron Box wiring and assembly
f) Study of Fan Regulator (Resistor type and Electronic type using Diac/Triac/quadrac)
g) Study of emergency lamp wiring/Water heater
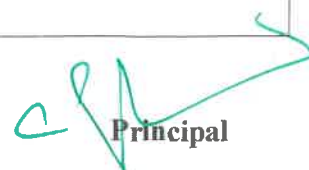
GROUP – B (MECHANICAL AND ELECTRONICS)		
PART III	**MECHANICAL ENGINEERING PRACTICES**	**15**

WELDING WORK:
a) Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
b) Practicing gas welding.

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BASIC MACHINING WORK:
a) (simple)Turning.
b) (simple)Drilling.
c) (simple)Tapping.

ASSEMBLY WORK:
a) Assembling a centrifugal pump.
b) Assembling a household mixer.
c) Assembling an airconditioner.

SHEET METAL WORK:
a) Making of a square tray

FOUNDRY WORK:
a) Demonstrating basic foundry operations.

PART IV	ELECTRONIC ENGINEERING PRACTICES	15

SOLDERING WORK:
a) Soldering simple electronic circuits and checking continuity.
ELECTRONIC ASSEMBLY AND TESTING WORK:
a) Assembling and testing electronic components on a small PCB.
ELECTRONIC EQUIPMENT STUDY:
a) Study an elements of smart phone..
b) Assembly and dismantle of LED TV.
c) Assembly and dismantle of computer/ laptop

	Total Contact Hours :60

Course Outcomes:	Upon completion of this course, the students will be able to:
CO1	Draw pipe line plan; lay and connect various pipe fittings used in common household plumbing work; Saw; plan; make joints in wood materials used in common household wood work.
CO2	Wire various electrical joints in common household electrical wire work.
CO3	Weld various joints in steel plates using arc welding work; Machine various simple processes like turning, drilling, tapping in parts; Assemble simple mechanical assembly of common household equipments; Make a tray out of metal sheet using sheet metal work.
CO4	Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.

CO	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	1	1	-	-	-	-	2	2	1	1
CO2	3	2	-	-	1	1	-	-	-	-	2	2	1	1
CO3	3	2	-	-	1	1	-	-	-	-	2	2	1	1
Average:	3	2	-	-	1	1	-	-	-	-	2	2	1	1

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Subject Code	Subject Name	Category	L	T	P	C
BT24211	BIO ORGANIC CHEMISTRY LABORATORY	ESC	0	0	4	2

Course Objectives:

Make the students understand the mechanism of synthesis of different chemical moieties

Familiarise the students with the isolation of biomolecules from natural sources

LIST OF EXPERIMENTS

1. Synthesisofaspirin
2. Hydrolysisofsucrose
3. Preparationofpyruvicacidfromtartaric acid
4. Preparationofoleicacidfromtartaricacid
5. PreparationofalphaD-glucopyranosepentaacetate
6. Preparationof1,2,5,6dicyclohexylnoinealphadglucofuranose
7. Isolationoflycopenefromtomatopaste
8. Preparationof L-proline
9. PreparationofL-cysteinefrom hair
10. PreparationofS-ethylhydroxylbutonatefrommethylacetoacetateusingyeast
11. ResolutionofS-ethylhydroxylbutonateusing3,5dinitrobenzoate.
12. Preparationof5,10,15,20-tetrakisphenylporphyrin.

	Total Contact Hours :60
Course Outcomes:	Upon completion of this course, the students will be able to:
CO1	Comprehend the mechanism of reactions
CO2	Be able to synthesize various Bioorganic compounds
CO3	Be able to work independently for the experimentation.

Textbooks:	
1.	Organic Chemistry, Francis A.Carey, VII Edition, Tata MCGraw Hill, Fourth reprint 2009.
2.	Organic and Bio-organic Mechanisms, M.I. Page and Andrew Williams. Pearson, First Impression, 2010.

Reference books/other materials/webresources:	
1.	Organic Chemistry, Francis A.Carey, VII Edition, Tata MC Graw Hill, Fourth reprint2009.
2.	Organic and Bio-organic Mechanisms, M.I.Pageand Andrew Williams. Pearson, First Impression, 2010.

CO	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	1	2	3	1	2	3	1	2	2	2	3	3
CO2	2	2	3	3	3	3	3	2	2	3	1	3	2	1
CO3	3	2	3	1	3	2	2	1	2	2	2	3	2	2
Average:	2	3	1	2	-	-	1.5	2	-	-	-	-	-	-

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Subject Code	Subject Name	Category	L	T	P	C
GE24212	COMMUNICATION LABORATORY / FOREIGN LANGUAGE	EEC	0	0	4	2

Course Objectives:

- To identify varied group discussion skills and apply them to take part in effective discussions in a professional context.
- To analyse concepts and problems and make effective presentations explaining them clearly and precisely.
- To be able to communicate effectively through formal and informal writing.
- To be able to use appropriate language structures to write emails, reports and essays
- To give instructions and recommendations that are clear and relevant to the context

UNIT – I	**12**
Speaking-Role Play Exercises Based on Workplace Contexts, - talking about competition- discussing progress toward goals-talking about experiences- talking about events in life- discussing past events-Writing: writing emails (formal& semi-formal).	
UNIT – II	**12**
Speaking: discussing news stories-talking about frequency-talking about travel problems- discussing travel procedures- talking about travel problems- making arrangements-describing arrangements-discussing plans and decisions- discussing purposes and reasons- understanding common technology terms-Writing: - writing different types of emails.	
UNIT – III	**12**
Speaking: discussing predictions-describing the climate-discussing forecasts and scenarios- talking about purchasing-discussing advantages and disadvantages- making comparisons- discussing likes and dislikes- discussing feelings about experiences-discussing imaginary scenarios Writing: short essays and reports-formal/semi-formal letters.	
UNIT – IV	**12**
Speaking: discussing the natural environment-describing systems-describing position and movement- explaining rules - (example - discussing rental arrangements)- understanding technical instructions-Writing: writing instructions-writing a short article.	
UNIT – V	**12**
Speaking: describing things relatively-describing clothing-discussing safety issues (making recommendations) talking about electrical devices-describing controlling actions- Writing: job application (Cover letter + Curriculum vitae)-writing recommendations.	

Total Contact Hours :60

Course Outcomes:	At the end of the course, learners will be able
CO1	Speak effectively in group discussions held in a formal/semi formal contexts
CO2	Discuss, analyse and present concepts and problems from various perspectives to arrive at suitable solutions
CO3	Write emails, letters and effective job applications.
CO4	Write critical reports to convey data and information with clarity and precision
CO5	Give appropriate instructions and recommendations for safe execution of tasks

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CO	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	3	3	3	1	3	3	3	3	3	3	-	-	-
CO2	2	3	3	3	1	3	3	3	3	3	3	-	-	-
CO3	2	2	3	3	1	3	3	3	3	3	3	-	-	-
CO4	3	3	3	3	3	3	3	3	3	3	3	-	-	-
CO5	3	3	3	3	3	3	3	3	3	3	3	-	-	-
Average:	2.4	2.8	3	3	1.8	3	3	3	3	3	3	-	-	-

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Subject Code:	Subject Name	Category	L	T	P	C
MA24304	TRANSFORMS AND LINEAR PROGRAMMING PROBLEMS	BSC	3	1	0	4

Course Objectives:

❖ To acquaint the student with Fourier transform techniques used in wide variety of situations

❖ To acquaint the student with Laplace Transform techniques used in various situations.

❖ To acquaint the student with Z-transformtechniques used in discrete-time signal processing, control systems.

❖ To apply quantitative techniques in modelling.

❖ To solving business related problems.

UNIT – I	FOURIER TRANSFORMS	9+3

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem–Parseval's identity.

UNIT – II	LAPLACE TRANSFORMS	9+3

Introduction to Laplace transforms – Sufficient conditions for existence - Properties of the Laplace transform - Transforms of derivatives and derivatives of transforms - Shifting theorems - Change of scale property – Periodic function - Convolution theorem - Inverse Laplace transforms – Solution of first and second order ordinary differential equations.

UNIT – III	Z - TRANSFORMS	9+3

Z-transforms - Elementary properties– Inverse Z - transform using partial fraction, convolution theorem –Formation of Difference equations, Solution of difference equations using Z – transform.

UNIT – IV	LINEAR PROGRAMMING PROBLEMS	9+3

Linear Programmingformulation, Solution by Graphical method - Simplex methods –Big-M method.

UNIT – V	TRANSPORTATION AND ASSIGNMENT PROBLEMS	9+3

Transportation Models – Balanced and unbalanced Problems – Initial Basic feasible solution by N-W Corner Rule, Least cost and Vogel's approximation methods. Check for optimality. Solution by MODI. Assignment Problems– Balanced and Unbalanced Problems-Hungarian Method.

	Total Contact Hours : 60

Course Outcomes:	Upon completion of the course students should be able to:
CO1	Use the effective mathematical tools for the solutions of Fourier transform techniques .
CO2	Use the effective mathematical tools for the solutions of Laplace transform techniques .
CO3	Use the effective mathematical tools for solutions of PDE by using Z transform techniques for discrete time systems.
CO4	Understand the Linear programming in product mix decisions.
CO5	Apply the Transportation and assignment in logistics and job allocation scenarios

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Textbooks:	
1.	Johnson. R.A., Miller. I.RandFreund . J.E, " Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia,9th Edition, 2016.
2.	JohnE.Freund,"MathematicalStatistics",PrenticeHall,5thEdition,1992.
3.	Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4th Edition, 2007
4.	Grewal.B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2018
5	N. D. Vohra, Business Statistics, Tata McGraw Hill, 2017.

Reference books/other materials/webresources:	
1.	Gupta. S.C. and Kapoor. V. K., "Fundamentals of Mathematical Statistics", Sultan Chand &Sons, New Delhi, 12th Edition, 2020
2.	Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
3.	Walpole.R.E.,Myers.R.H.,Myers.S.L.andYe.K.,"Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 9thEdition, 2010.
4.	Kreyszig.E, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.

PO& PSO / CO	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	-	-	-	-	-	1	-	-	-
CO2	3	3	2	2	1	-	-	-	-	-	1	-	-	-
CO3	3	3	2	2	1	-	-	-	-	-	1	-	-	-
CO4	3	3	3	2	2	-	-	-	1	-	1	-	-	-
CO5	3	3	3	2	2	-	-	-	1	-	1	-	-	-
Average:	3	3	2.4	2	1.4	-	-	-	1	-	1	-	-	-

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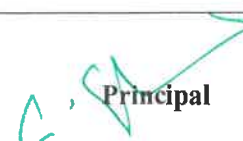
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Subject Code	Subject Name	Category	L	T	P	C
BT24301	BIOCHEMISTRY	PCC	3	0	0	3

Course Objectives:
- Enable students learn the fundamentals of Biochemical processes and Biomolecules.
- Understand the chemical basis which allows biological molecules to give rise to the process.

UNIT – I	INTRODUCTION TO BIOMOLECULES – CARBOHYDRATES	9

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

UNIT – II	STRUCTURE AND PROPERTIES OF OTHER BIOMOLECULES	9

Structure and properties of Important Biomolecules.
Lipids: fatty acids- glycerol-saponification-iodination-hydrogenation-phospholipids-glycolipids- sphingolipids-cholesterol-steroids-prostaglandins.
Protein: Amino Acids- Peptides- Proteins- measurement- structures- hierarchy of organization primary- secondary-tertiary and quaternary structures- glycoproteins- lipoproteins. Determine of primary structure.
Nucleic acids: purines- pyrimidines- nucleoside- nucleotide-RNA- DNA-Watson-Crick structure of DNA reactions-properties- measurement- nucleoprotein complexes

UNIT – III	METABOLISM CONCEPTS AND CARBOHYDRATE METABOLISM	9

Functions of Proteins- Enzymes- introduction to biocatalysts-metabolic pathways- primary and secondary metabolites- Interconnection of pathways and metabolic regulation- Glycolysis-TCA cycle- gluconeogenesis- pentose phosphate shunt &glyoxalate shunt.

UNIT – IV	INTERMEDIARY METABOLISM AND REGULATION	9

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

UNIT – V	PROTEIN TRANSPORT AND DEGRADATION	9

Protein targeting- signal sequence- secretion- Folding- Chaperone and targeting of organelle proteins- Protein degradation- receptor-mediated endocytosis- turnover.

	Total Contact Hours : 45

Course Outcomes:	Upon completion of the course students should be able to:
CO1	Ensure students have a strong foundation in the structure and reactions of biomolecules.
CO2	Introduce them to metabolic pathways of the major biomolecules and relevance to clinical conditions.
CO3	Correlate biochemical processes with biotechnology application.
CO4	Understand in detail about structures, types and classifications of amino acid.
CO5	Illustrate the metabolism of carbohydrates through various anabolic and catabolic pathways. Relate the structure of DNA with its function in replication and gene expression

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Textbooks:	
1.	Lehninger Principles of Biochemistry 6th Edition by David L. Nelson, Michael M. Cox W.H.Freeman and Company 2017
2.	Satyanarayana, U. and U. Chakerapani, "Biochemistry" 3rd Rev. Edition, Books & Allied (P) Ltd., 2006.
3.	Rastogi, S.C. "Biochemistry" 2nd Edition, Tata McGraw-Hill, 2003.
4.	Conn, E.E., etal., "Outlines of Biochemistry" 5th Edition, John Wiley & Sons, 1987.
5.	Outlines of Biochemistry, 5th Edition: By E E Conn, P K Stumpf, G Bruening and R Y Doi. pp 693. John Wiley and Sons, New York. 1987.

Reference books/other materials/webresources:	
1.	Berg, Jeremy M. et al. "Biochemsitry", 6th Edition, W.H. Freeman & Co., 2006.
2.	Murray, R.K., etal "Harper's Illustrated Biochemistry", 31st Edition, McGraw-Hill, 2018.
3.	Voet, D. and Voet, J.G., "Biochemistry", 4th Edition, John Wiley & Sons Inc.,2010.

PO & PSO / CO	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	2	3	2	2	2	3	3	3	3
CO2	2	2	3	2	2	2	2	2	-	3	2	2	2	2
CO3	3	3	3	2	3	-	2	1	-	2	1	3	3	2
CO4	2	3	3	3	2	-	3	-	1	2	1	3	3	2
CO5	2	3	3	2	3	2	3	2	2	1	2	2	2	3
Average:	2.4	2.8	2.8	2.2	2.4	2.0	2.6	1.8	1.7	2.0	1.8	2.6	2.6	2.4

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Subject Code	Subject Name	Category	L	T	P	C
BT24302	**MICROBIOLOGY**	PCC	3	0	0	3

Course Objectives:

- To introduce students the principles of Microbiology to emphasize structure and biochemical aspects of various microbes.
- To impart knowledge to the students to solve the problems in microbial infection and their control.

UNIT – I	**INTRODUCTION**	9

Basics of microbial existence- history of microbiology- classification and nomenclature of microorganisms- microscopic examination of microorganisms- light and electron microscopy- principles of different staining techniques like gram staining- acid fast- capsular staining- flagellar staining.

UNIT – II	**MICROBES- STRUCTURE AND MULTIPLICATION**	9

Structural organization and multiplication of bacteria- viruses- algae and fungi with special mention of life history of actinomycetes- yeast- mycoplasma and bacteriophages.

UNIT – III	**MICROBIAL NUTRITION, GROWTH AND METABOLISM**	9

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

UNIT – IV	**CONTROL OF MICROORGANISMS**	9

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

UNIT – V	**INDUSTRIAL AND ENVIRONMENTAL MICROBIOLOGY**	9

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

	Total Contact Hours : 45

Course Outcomes:	Upon completion of the course students should be able to:
CO1	Microorganisms and examination of microorganisms
CO2	Structural organization of microorganisms
CO3	Nutritional requirements of microorganisms, their growth and metabolism
CO4	Control of microorganisms
CO5	Metabolites, bioremediation, biofertilizers, biopesticides and biosensors

Textbooks:	
1.	Pelczar MJ, Chan ECS and Krein NR, Microbiology, Tata McGraw Hill Edition, New Delhi, India,2009
2.	Prescott L.M., Harley J.P., Klein DA, Microbiology, 3rd Edition, Wm. C. Brown Publishers, 1996.

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Reference books/other materials/webresources:

1.	Black, Text book of microbiology. Freeman Publishers,2016
2.	Talaron K, Talaron A, Casita, Pelczar and Reid. Foundations in Microbiology, W.C. Brown Publishers, 1993.
3.	Ananthanarayan, CK Jayaram Panikars. Text book of Microbiology, 2005, Orient Blackswan Publishers.

PO & PSO / CO	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3.0	2.0	3.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
CO2	3.0	3.0	2.0	3.0	2.0	2.0	3.0	2.0	2.0	3.0	2.0	3.0	3.0	2.0
CO3	2.0	3.0	2.0	3.0	3.0	2.0	3.0	2.0	2.0	3.0	2.0	3.0	2.0	3.0
CO4	2.0	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	2.0	3.0	3.0	2.0	3.0
CO5	2.0	3.0	2.0	3.0	3.0	2.0	2.0	-	2.0	-	2.0	3.0	3.0	3.0
Average:	2.4	2.8	2.4	2.8	2.6	2.0	2.4	2.0	2.0	2.5	2.2	2.8	2.4	2.6

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Subject Code	Subject Name	Category	L	T	P	C
BT24303	CELL BIOLOGY	PCC	3	0	0	3

Course 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 and function, Extracellular matrix- Composition and function, Cell Junctions -Anchoring Junctions, Tight Junctions, Gap Junctions.

UNIT – II	CELL DIVISION, CANCER, APOPTOSIS AND IMMORTALIZATION OF CELLS	9

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

UNIT – III	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	TRANSPORT ACROSS CELL MEMBRANE	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 – V	TECHNIQUES USED TO STUDY CELLS	9

Cell fractionation and flow cytometry, Morphology and identification of cells using microscopic studies like SEM, TEM and Confocal Microscopy. Cell viability assays– MTTAssay, Tryphan Blue exclusion, Leishman staining, H &E staining, Immunohistochemistry.

	Total Contact Hours : 45

Course Outcomes:	Upon completion of the course students should be able to:
CO1	Apply knowledge in the area of cellular organisation.
CO2	Analyse the modes of transport and relate the same to function of nervous muscular systems.
CO3	Examine the methods of communication within the cells.
CO4	Correlate the basic concepts of cell division and their role in carcinogenesis.
CO5	Design simple methods to analyse cell and its activity

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Textbooks:	
1.	Lodish, Harvey etal., "Molecular Cell Biology", 7th Edition, W.H.Freeman, 2013.
2.	Cooper, G.M. and R.E. Hansman "The Cell: A Molecular Approach", 8th Edition, Oxford University Press, 2018.
3.	Alberts, Bruce etal., "Molecular Biology of the Cell", 6th Edition, W.W. Norton,2014
4.	Sadava, D.E. "Cell Biology: Organelle Structure and Function", Panima Publishing, 2004.
5.	Rastogi, S.C. "Cell Biology" 2nd Edition, New Age International, 2017

Reference books/other materials/webresources:	
1.	Becker, W.M. etal., "The World of the Cell", 9th Edition, Pearson Education, 2003.
2.	Campbell, N.A., J.B. Recee and E.J. Simon "Essential Biology", VIIrd Edition, Pearson International, 2007.
3.	Alberts, Bruce etal., "Essential Cell Biology", 4th Edition, W.W. Norton, 2013

PO & PSO / CO	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3.0	-	-	3.0	3.0	2.0	2.0	-	3.0	-	-	3.0	3.0	3.0
CO2	3.0	2.0	3.0	2.0	3.0	-	1.0	1.0	3.0	-	2.0	3.0	-	-
CO3	2.0	3.0	3.0	2.0	1.0	-	2.0	-	2.0	-	1.0	2.0	3.0	-
CO4	2.0	1.0	3.0	2.0	3.0	1.0	-	1.0	-	-	-	3.0	2.0	-
CO5	3.0	3.0	2.0	1.0	-	-	-	2.0	2.0	-	2.0	3.0	2.0	2.0
Average:	2.6	2.3	2.8	2.0	2.5	1.5	1.7	1.3	2.5		1.7	2.8	2.5	2.5

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Subject Code	Subject Name	Category	L	T	P	C
BT24304	Industrial Bioprocesses	PCC	3	0	0	3

Course Objectives:

- To make the students aware of the overall industrial bioprocess so as to help them to manipulate the process to the requirement of the industrial needs.
- The course prepares the students for the bulk production of bioproducts and commercially important modern bioproducts,

UNIT – I	INTRODUCTION TO INDUSTRIAL BIOPROCESS	9

Overview of fermentation industry- general requirements of fermentation process- Basic concepts of upstream and downstream processing in Bioprocess- Process of flow sheeting – block diagrams.

UNIT – II	MEDIA PREPARATION AND STERILIZATION KINETICS	9

Criteria for good medium- medium requirements for fermentation processes- medium formulation of optimal growth and product formation- medium optimization methods. Thermal death kinetics of microorganisms- batch and continuous heat sterilization of liquid media- filter sterilization of liquid media.

UNIT – III	STOICHIOMETRY OF CELL GROWTH AND PRODUCT FORMATION	9

Stoichiometry of cell growth and product formation- elemental balances- degree of reduction of substrate and biomass- available electron balances-yield coefficients of biomass and product formation- maintenance coefficients. Thermodynamic efficiency of growth.

UNIT – IV	OVERVIEW OF BIOPRODUCTS	9

Primary Metabolites- Production of commercially important primary metabolites like organic acids, amino acids and alcohols. Secondary Metabolites- Production processes for various classes of secondary metabolites- Antibiotics, Vitamins and Steroids. Modern biotechnology products- Biofuel, Bio pesticides, Bio fertilizers, Biopolymers

UNIT – V	OVERVIEW OF FERMENTATION EQUIPMENT'S	9

Fermentor- Basic configuration of fermentor (CSTR) and ancillaries- main parameters to be monitored and controlled in fermentation processes. Types of fermentor- Packed bed reactor, airlift reactor, introduction to fluidized bed reactor and bubble column reactor.

	Total Contact Hours : 45

Course Outcomes:	Upon completion of the course students should be able to:
CO1	To explain the steps involved in the production of bio products and methods
CO2	To improve modern biotechnology.
CO3	To apply basic biotechnological principles, methods and models to solve biotechnological tasks.
CO4	To design and deliver useful modern biotechnology products to the Society.
CO5	Apply biotechnological concept and principles in bioprocess.

Textbooks:	
1.	Stanbury, P.F., A. Whitaker and S.J. Hall "Principles of Fermentation Technology", IInd Edition, Butterworth – Heinemann (an imprint of Elsevier), 1995.
2.	Michael L. Shuler, Fikret Kargi, Matthew De Lisa , Bioprocess Engineering , Prentice Hall, 3rd Edition, 2017

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Reference books/other materials/webresources:	
1.	Pauline M. Doran, Bioprocess Engineering Principles, Elsevier, 2nd Edition,2012
2.	Bailey, James E. and David F. Ollis, " Biochemical Engineering Fundamentals", 2ndEdition. McGraw Hill , 1986
3.	W. Blanch, Douglas S. Clark, Biochemical Engineering, CRC Press; 2nd Edition 1997

PO & PSO / CO	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3.0	3.0	3.0	2.0	2.0	1.0	2.0	-	2.0	1.0	3.0	3.0	2.0	3.0
CO2	3.0	3.0	3.0	2.0	2.0	3.0	3.0	-	-	-	2.0	3.0	3.0	3.0
CO3	3.0	3.0	3.0	2.0	2.0	-	-	-	-	-	2.0	3.0	1.0	3.0
CO4	3.0	3.0	3.0	2.0	2.0	3.0	3.0	2.0	2.0	2.0	-	3.0	1.0	3.0
CO5	3.0	3.0	3.0	2.0	2.0	3.0	3.0	1.0	2.0	2.0	-	3.0	-	3.0
Average:	3.0	3.0	3.0	2.0	2.0	2.5	2.8	1.5	2.0	1.7	2.3	3.0	1.8	3.0

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Subject Code	Subject Name	Category	L	T	P	C
BT24305	BIOCHEMICAL PROCESS CALCULATIONS	PCC	3	0	0	3

Course Objectives:

- To enable the students to learn about basic concepts of units, conversions and apply it in the estimation of composition of solid, liquids and gases.
- To equipthe students to acquire knowledge about basic concepts of humidification operations.
- To facilitate the students to acquire knowledge about basic concepts of material and energy balance

UNIT – I	BASIC CHEMICAL CALCULATIONS & PSYCHROMETRY	9

Dimension – Systems of units esp. engineering FPS, Engineering MKS & SI systems – Conversion from one system to the other – composition of solid, liquid & gases – mass fraction, mass %, mole fraction, mole %, mass ratios, molarity, molality, normality, ppm, composition by density.

UNIT – II	PSYCHROMETRY	9

Air-water vapour systems, Humidity, Molal Humidity, Relative Humidity, % Saturation, humid Volume& humid heat, adiabatic saturation temperature – Humidity chart – wet bulb, dry bulb, dew point temperatures, pH of solutions, Vapour pressure.

UNIT – III	MATERIAL BALANCE WITHOUT CHEMICAL REACTIONS	9

Material balance concept – overall & component – material balance applications for evaporation, distillation (Binary system), extraction, leaching, drying, crystallization.Recycle and Bypass illustration.

UNIT – IV	ENERGY BALANCE	9

General energy balance equation for open systems- closed system sensible heat calculation- Heat required for phase change- thermo chemistry, application of steam tables, Saturated and superheated steam application in bioprocess

UNIT – V	MATERIAL BALANCE WITH CHEMICAL REACTIONS	9

Orsat analysis, Chemical Reaction-Limiting reactant, excess reactant, Excess air calculations, Fractional conversion, Percent conversion, Fractional yield in multiple reactions. Simple problems, Combustion Reactions.

	Total Contact Hours : 45

Course Outcomes:	Upon completion of the course students should be able to:
CO1	To know in detail about units, dimensions and conversions, composition of mixtures and solutions.
CO2	To acquire knowledge about and know in depth on the concepts of humidification operation and its applications.
CO3	To understand the material balance and its application to different unit operations.
CO4	To attain and apply the concepts involved in energy balance in the calculation of heat loss or heat consumption.
CO5	To acquire and apply material balance to the process involving chemical reaction

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Textbooks:

1.	Bhatt B.I & SB Thakore, Stoichiometry, 5th Ed., Tata McGraw Hill 2017
2.	Narayanan K.V & Lakshmi Kutty B, "Stoichiometry & Process calculations", 2nd Ed., PHI, 2017.
3.	Pauline M Doran, Bioprocess Engineering Principles, 2nd Ed., Academia Press Inc., 1995.

Reference books/other materials/webresources:

1.	Himmel Blau D.M "Basic principles & Calculations in Chemical Engineering" 8th Ed., PHI 2014.
2.	Geankoplis C.J. "Transport process & Separation process Principles 4th edition-PHI 2006.
3.	S. Pushpavanam, Introduction to Chemical Engineering, PHI Learning (P). Ltd.,2012.

PO & PSO / CO	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3.0	-	1.0	-	2.0	1.0	-	2.0	1.0	1.0	-	2.0	1.0	-
CO2	3.0	3.0	2.0	3.0	2.0	2.0	2.0	2.0	1.0	-	1.0	3.0	2.0	3.0
CO3	2.0	1.0	3.0	2.0	2.0	2.0	2.0	3.0	2.0	2.0	2.0	3.0	3.0	3.0
CO4	3.0	3.0	3.0	3.0	3.0	2.0	3.0	3.0	2.0	2.0	2.0	3.0	3.0	3.0
CO5	3.0	2.0	2.0	2.0	2.0	2.0	3.0	2.0	2.0	2.0	1.0	2.0	2.0	1.0
Average:	2.8	2.3	2.2	2.5	2.2	1.8	2.5	2.4	1.6	1.8	1.5	2.6	2.2	2.5

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Subject Code	Subject Name	Category	L	T	P	C
BT24311	BIOCHEMISTRY LABORATORY	PCC	0	0	3	1.5

Course Objectives:
- Learn fundamental approaches for experimentally investigating biochemical problems.
- Able to extract living cell samples from plants and animals for genetic research

EXPERIMENTS

1. General guidelines for working in biochemistry lab (theory)
2. Units of volume, weight, density and concentration measurements and their range in biological measurements. Demonstration of proper use of volume and weight measurement devices.
3. Accuracy, precision, sensitivity and specificity (theory)
4. Preparation of buffer –titration of a weak acid and a weak base.
5. Qualitative tests for carbohydrates – distinguishing reducing from non-reducing sugars and keto from aldo sugars.
6. Quantitative method for amino acid estimation using ninhydrin – distinguishing amino from imino acid.
7. Protein estimation by Biuret and Lowry's methods.
8. Protein estimation by Bradford and spectroscopic methods.
9. Extraction of lipids and analysis by TLC.
10. Estimation of nucleic acids by absorbance at 260 nm and hyperchromic effect (demo).
11. Enzymatic assay: phosphatase from potato.
12. Enzymatic assay: estimation of glucose by GOD-POD method after hydrolysis of starch with acid   and specificity of the enzymatic method.

TOTAL: 45 PERIODS

Course Outcomes:	Upon completion of the course students should be able to:
CO1	Analyze current biochemical and molecular techniques to plan and carry out experiments.
CO2	Perform good biochemical laboratory practices.
CO3	Adapt methods for biochemical analysis.
CO4	Carry out experiments in biomolecular separations.
CO5	Learn and understand the principles behind the qualitative and quantitative estimation of biomolecules.

Textbooks:	
1.	Practical Biochemistry by R.C. Gupta and S. Bhargavan.
2.	Introduction of Practical Biochemistry by David T. Phummer. (II Edition)

Reference books/other materials/webresources:	
1.	Harpers Biochemistry Ed. R.K. Murray , D.K. Granner, P.A. Mayes and V.W.Rodwell, Appleton and Lange ,Stanford ,Conneticut.
2.	Textbook of Biochemistry with clinical correlations. Ed. Thomas M. Devlin. Wiley Liss Publishers

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PO & PSO / CO	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	1	2	3	1	3	2	3	1	2	3	3	3
CO2	2	2	3	3	3	3	2	3	2	2	3	2	2	1
CO3	3	2	3	1	3	2	2	2	1	2	2	3	2	2
CO4	1	3	3	2	2	3	2	1	2	2	1	2	1	3
CO5	2	1	3	2	1	1	3	2	1	2	2	1	2	2
Average:	2	2	2.6	2	2.4	2	2.4	2	1.8	1.8	2	2.2	2	2.2

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Subject Code	Subject Name	Category	L	T	P	C
BT24312	**CELL AND MICROBIOLOGY LABORATORY**	PCC	0	0	3	1.5

Course Objectives:

- To demonstrate various techniques to learn the morphology, identification and propagation of cells and microbes.
- To learn the staining techniques and culturing of microorganism.

EXPERIMENTS
1. Introduction, Laboratory Safety, Use of Equipment; Sterilization Techniques
2. Microscopy – Working and care of Microscope, phase contrast and fluorescent microscopy
3. Culture Media-Types and Use; Preparation of Nutrient broth and agar
4. Culture Techniques, Isolation and Preservation of Cultures- Broth: flask, test tubes; Solid:Pour plates, streak plates, slants, stabs
5. Identification of given plant, animal, bacterial cells and yeast/mould
6. Staining Techniques Simple, Differential- Gram's Staining, spore /capsule staining, Giemsa, and Leishman Staining
7. Quantification of Microbes: Sampling and Serial Dilution; Bacterial count in Soil – TVC
8. Effect of Disinfectants- Phenol Coefficient, Antibiotic Sensitivity Assay
9. Osmosis and Tonicity and Tryphan Blue Assay
10. Growth Curve in Bacteria and Yeast
11. Staining for different stages of mitosis in AlliumCepa (Onion)
12. Effect of pH, Temperature, UV radiation on Growth Bacteria

TOTAL: 45 PERIODS

Course Outcomes:	Upon completion of the course students should be able to:
CO1	Understand the advanced technical information pertaining to laboratory bio-safety and preventive measures from pathogenic microorganism.
CO2	Know the various aseptic techniques and sterilization methods.
CO3	Develop the minimum skills to work on several important techniques for the study of microorganisms in the laboratory.
CO4	Learn the various techniques of culturing of microorganisms and media preparation.
CO5	Study the growth of microorganisms by varying the growth conditions.

Textbooks:	
1.	Cappuccino, J.G. and N. Sherman "Microbiology: A Laboratory Manual", 4th Edition, Addison-Wesley, 1999.
2.	Collee, J.G. etal., "Mackie & McCartney Practical Medical Microbiology" 4th Edition, ChurchillLivingstone, 1996Rickwood, D. and J.R. Harris "Cell Biology: Essential Techniques", Johnwiley, 1996.

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Reference books/other materials/webresources:
1.	Davis, J.M. "Basic Cell Culture: A Practical Approach", IRL, 1994.

PO & PSO / CO	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	3	1	3	2	3	1	1	3	3	2	3	3	3
CO2	1	3	2	3	1	1	2	2	2	3	3	3	3	3
CO3	2	3	3	3	3	2	1	1	3	3	3	3	3	3
CO4	3	3	3	3	3	3	2	2	3	3	3	3	3	3
CO5	3	3	3	3	3	2	3	3	3	3	3	3	3	3
Average:	2.2	3	2.4	3	2.4	2.2	1.8	1.8	2.8	3	2.8	3	3	3

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Subject Code	Subject Name	Category	L	T	P	C
GE24903	PROFESSIONAL DEVELOPMENT	PCC	0	0	2	1

Course Objectives:

- To be proficient in using MS WORD to create quality technical documents, by using standard templates, widely acceptable styles and formats, variety of features to enhance the presentability and overall utility value of content.
- To be proficient in using MS EXCEL for all data manipulation tasks including the common statistical, logical, mathematical etc., operations, conversion, analytics, search and explore, visualize,interlink, and utilizing many more critical features offered
- To be able to create and share quality presentations by using the features of MS PowerPoint, including: organization of content, presentability, aesthetics, using media elements and enhance the overall quality of presentations.

MS WORD: 10 Hours

- Create and format a document
- Working with tables
- Working with Bullets and Lists
- Working with styles, shapes, smart art, charts
- Inserting objects, charts and importing objects from other office tools
- Creating and Using document templates
- Inserting equations, symbols and special characters
- Working with Table of contents and References, citations
- Insert and review comments
- Create bookmarks, hyperlinks, endnotes footnote
- Viewing document in different modes
- Working with document protection and security
- Inspect document for accessibility

MS EXCEL: 10 Hours

- Create worksheets, insert and format data
- Work with different types of data: text, currency, date, numeric etc.
- Split, validate, consolidate, Convert data
- Sort and filter data
- Perform calculations and use functions: (Statistical, Logical, Mathematical, date, Time etc.,)
- Work with Lookup and reference formulae
- Create and Work with different types of charts
- Use pivot tables to summarize and analyse data
- Perform data analysis using own formulae and functions
- Combine data from multiple worksheets using own formulae and built-in functions to generate results
- Export data and sheets to other file formats
- Working with macros
- Protecting data and Securing the workbook

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MS POWERPOINT: 10 Hours
• Select slide templates, layout and themes
• Formatting slide content and using bullets and numbering
• Insert and format images, smart art, tables, charts
• Using Slide master, notes and handout master
• Working with animation and transitions
• Organize and Group slides
• Import or create and use media objects: audio, video, animation
• Perform slideshow recording and Record narration and create presentable videos
TOTAL: 30 PERIODS

Course Outcomes:	Upon completion of the course students should be able to:
CO1	Use MS Word to create quality documents, by structuring and organizing content for their day to day technical and academic requirements
CO2	Use MS EXCEL to perform data operations and analytics, record, retrieve data as per requirements and visualize data for ease of understanding
CO3	Use MS PowerPoint to create high quality academic presentations by including common tables, charts, graphs, interlinking other elements, and using media objects

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Subject Code:	Subject Name	Category	L	T	P	C
MA24401	PROBABILITY AND STATISTICS	BSC	3	1	0	4

Course objectives:
❖ To introduce the basic concepts of probability and random variables.
❖ To introduce the basic concepts of Special distribution.
❖ To introduce the basic concepts of two dimensional random variables.
❖ To acquaint the knowledge of non-parametric test.
❖ To introduce the basic concepts of classifications of design of experiments.Which plays very important roles in the field of agriculture and statistical quality control.

UNIT – I	PROBABILITY AND RANDOM VARIABLES	9+3
Axioms of probability - Conditional Probability - Baye's Theorem – One dimensional Discrete and Continuous Random variables - Moments – Moment generating functions		
UNIT – II	SPECIAL DISTRIBUTIONS	9+3
Discrete distributions : Binomial, Poisson, Geometric – Continuous distributions: Uniform, Exponential and Normal distribution.		
UNIT – III	TWO DIMENSIONAL RANDOM VARIABLES	9+3
Two dimensional random variables: Joint distribution - Marginal and Conditional distributions -Covariance – Correlation co-efficient – Regression lines.		
UNIT – IV	NON PARAMETRIC TESTS	9+3
Introduction - The sign test - The Signal - Rank test - Rank sum tests - The U-test - The H-test - Tests based on Runs - Test of randomness - The Kolmogorov Tests.		
UNIT – V	STATISTICAL QUALITY CONTROL	9+3
Control charts for measurements(X and R charts) - Control charts for attributes (p,c,np charts) - Tolerance Limits - Acceptance Sampling.		
	Total Contact Hours : 60	

Course Outcomes:	Upon completion of the course students should be able to:
CO1	Understand the basic concepts of Probability and Random variables and applyin Engineering applications.
CO2	Understand he fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon.
CO3	Apply the concept of Two dimensional random variable in Engineering disciplines
CO4	Use the concept of non-parametric testing for Non-Normal population.
CO5	Apply the basic concepts of classifications of design of experiments in the field of agriculture and statistical quality control

Textbooks:	
1.	Johnson. R.A., Miller. I.RandFreund . J.E, " Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia,9th Edition, 2016.
2.	Milton. J. S. and Arnold.J.C., "Introduction to Probability and Statistics", Tata Mc GrawHill, 4th Edition, 2007.
3	John E.Freund,"MathematicalStatistics", Prentice Hall,5th Edition, 1992.

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	Reference books/other materials/webresources:
1.	Gupta. S.C. and Kapoor. V. K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 12th Edition, 2020.
2.	Devore. J.L., "Probability and Statistics for Engineering and the Sciences",Cengage Learning, New Delhi, 8th Edition, 2014.
3.	Ross. S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 5th Edition, Elsevier, 2014.
4.	Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 4th Edition, 2012.
5.	Walpole.R.E., Myers.R.H.,Myers S.L.andYe.K.,"Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 9thEdition, 2010.

PO& PSO / CO	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	2	-	2	-	-	-
CO2	3	3	-	-	-	-	-	-	2	-	2	-	-	-
CO3	3	3	-	-	-	-	-	-	2	-	2	-	-	-
CO4	3	3	3	2	-	-	-	-	2	-	2	-	-	-
CO5	3	3	2	2	-	-	-	-	2	-	2	-	-	-
Average:	3	3	2.5	2	-	-	-	-	2	-	2	-	-	-

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Subject Code	Subject Name	Category	L	T	P	C
BT24401	ENZYME TECHNOLOGY	PCC	3	0	0	3

Course Objectives:
• To enable the students
• To learn enzyme reactions and its characteristics along with the production and purification process
• To attain a basic knowledge concerning biotransformation reactions with the usage of enzymes

UNIT I	INTRODUCTION TO ENZYMES	9
Classification of enzymes-Properties of Enzyme- Mechanisms of enzyme action- concept of active site and energetics of enzyme substrate complex formation-specificity of enzyme action- principles of catalysis – collision theory, transition state theory- role of entropy in catalysis.		
UNIT II	KINETICS OF ENZYME ACTION	9
Kinetics of single substrate reactions; estimation of Michelis – Menten parameters, multisubstrate reactions - mechanisms and kinetics; turnover number; types of inhibition & models –substrate, product. Allosteric regulation of enzymes- Monod Changeux Wyman model- pH and temperature effect on enzymes & deactivation kinetics.		
UNIT – III	ENZYME IMMOBILIZATION AND BIOSENSORS	9
Physical and chemical techniques for enzyme immobilization – adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding etc., advantages and disadvantages, design of enzyme electrodes and their application as biosensors in industry, healthcare and environment.		
UNIT – IV	PURIFICATION AND CHARACTERIZATION OF ENZYMES FROM NATURAL SOURCES	9
Production and purification of crude enzyme extracts from plant- animal and microbial sources- methods of characterization of enzymes- Electrophoresis-2D PAGE- development of enzymatic assays		
UNIT – V	BIOTRANSFORMATION APPLICATIONS OF ENZYMES	9
Biotransformation of drugs- Hydrolytic- Ester bond, Amide, Epoxides, Nitriles, Reduction reactions – aldehydes, Ketones, C=C, Oxidation reactions – Alkanes, Aromatic, Baeyer-Villiger, Enzymes in organic synthesis – esters, amide, peptide -Modified and Artificial Enzymes- Catalytic antibodies		
	Total Contact Hours : 45	

Course Outcomes:	Upon completion of the course students should be able to:
CO1	On enzyme and enzyme reactions will be the key step in to proceed towards various concepts in biotechnology.
CO2	Theoretical and practical aspects of kinetics will provide the importance and utility of enzyme kinetics towards research.
CO3	Process of immobilization has been increased steadily in food, pharmaceutical and chemical industries and thus this study will provide simple and easy method of implementation.
CO4	Ideas on Processing, Production and Purification of enzymes at an industrial scale will be helpful to work technologically.
CO5	Study biotransformation of drugs

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Textbooks:

1.	Trevor Palmer , 5th edition Enzymes Horwood Publishing Ltd, 2001
2.	Faber K ,Biotransformations in Organic Chemistry, 2nd Edition , Springer

Reference books/other materials/webresources:

1.	Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, 2nd Edition, CRC Press, 1997
2.	James M. Lee, Biochemical Engineering, PHI, USA.
3.	James. E. Bailey & David F. Ollis, Biochemical Engineering Fundamentals, 2nd Edition, McGraw Hill Education; 2017.
4.	Wiseman, Enzyme Biotechnology, Ellis Horwood Pub. Volume 4, 1980

PO & PSO / CO	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2.0	-	-	2.0	-	-	3.0	2.0	-	-	2.0	3.0	-	-
CO2	2.0	-	3.0	-	3.0	-	2.0	3.0	-	-	3.0	2.0	2.0	-
CO3	2.0	-	3.0	-	3.0	-	2.0	2.0	-	-	2.0	3.0	2.0	2.0
CO4	2.0	-	3.0	-	2.0	-	2.0		-	-	2.0	2.0	-	-
CO5	2.0	-	3.0	-	3.0	-	3.0	2.0	-	-	2.0	2.0	2.0	-
Average:	2.0		3.0	2.0	2.8		2.4	2.3			2.2	2.4	2.0	2.0

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Subject Code	Subject Name	Category	L	T	P	C
BT24402	**MOLECULAR BIOLOGY**	PCC	3	0	0	3

Course Objectives:

- Familiarize students with the cell and molecular biology of both Prokaryotes and Eukaryotes.
- This will be needed for any project work in modern biotechnology.
- By doing this course students will acquire basic fundamental knowledge and explore skills in molecular biology and become aware of the complexity and harmony of the cells.
- This course will emphasize the molecular mechanism of DNA replication, repair, transcription, protein synthesis and gene regulation in various organisms.

UNIT I	CHEMISTRY OF NUCLEIC ACIDS	9

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

UNIT II	DNA REPLICATION & REPAIR	9

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

UNIT III	TRANSCRIPTION	9

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

UNIT IV	TRANSLATION	9

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

UNIT V	REGULATION OF GENE EXPRESSION	9

Organization of genes in prokaryotic and eukaryotic chromosoms, Hierarchical levels of gene regulation, Prokaryotic gene regulation –lac and trp operon, Regulation of gene expression with reference to λ phage life cycle.

	Total Contact Hours : 45

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Course Outcomes:	Upon completion of the course students should be able to:
CO1	Describe the basic structure and biochemistry of nucleic acids and proteins and discriminate between them;
CO2	Identify the principles of DNA replication, transcription and translation and explain how they relate to each other.
CO3	Discuss clearly about gene organization and mechanisms of control the gene expression.
CO4	Gain insights into the most significant molecular and cell-based methods to expand his/her understanding of biology.
CO5	Articulate applications of molecular biology in the modern world

Textbooks:	
1.	Friefelder, David. "Molecular Biology."Narosa Publications, 1999
2.	Weaver, Robert F. "Molecular Biology" IInd Edition, Tata McGraw-Hill, 2003.
3.	Karp, Gerald "Cell and Molecular Biology: Concepts and Experiments" IVth Edition, John Wiley, 2005.
4.	Friefelder, David and George M. Malacinski "Essentials of Molecular Biology" IInd Edition, Panima Publishing, 1993.

Reference books/other materials/webresources:	
1.	Tropp, Burton E. "Molecular Biology: Genes to 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, 2010.

PO & PSO / CO	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2.0	1.0	2.0	1.0					2.0		2.0	3.0		2.0
CO2	3.0		2.0	2.0	2.0				2.0		2.0	2.0	2.0	1.0
CO3	2.0		1.0	1.0					2.0		1.0	3.0	1.0	2.0
CO4	2.0	2.0	2.0	2.0	2.0		2.0		3.0		2.0	2.0	2.0	3.0
CO5	1.0	2.0	2.0		2.0	1.0			3.0	1.0	3.0	3.0	1.0	2.0
Average:	2.0	1.7	1.8	1.5	2.0	1.0	2.0		2.4	1.0	2.0	2.6	1.5	2.0

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Subject Code	Subject Name	Category	L	T	P	C
BT24403	Analytical Techniques in Biotechnology	PCC	3	0	0	3

Course Objectives:

- To have a fundamental knowledge about the Light spectrum, Absoprtion, Fluorescence, NMR, Mass spectroscopy
- To acquire knowledge on the different chromotographic methods for separation of biological products.

UNIT I	INTRODUCTION TO SPECTROMETRY	9

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 - types of optical instruments – Principle of Fourier Transform optical Measurements.

UNIT II	MOLECULAR SPECTROSCOPY	9

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

UNI III	MAGNETIC RESONANCE SPECTROSCOPY AND MASS SPECTROMETRY	9

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

UNIT IV	SEPARATION METHODS	9

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

UNIT V	ELECTRO ANALYSIS AND SURFACE MICROSCOPY	9

Electrochemical cells- Electrode potential cell potentials – potentiometry- reference electrode – ion selective and molecular selective electrodes – Instrument for potentiometric studies – Voltametry – Cyclic and pulse voltametry- Applications of voltametry . Study of surfaces – Scanning probe microscopes – AFM and STM.

	Total Contact Hours : 45

Course Outcomes:	Upon completion of the course students should be able to:
CO1	Study Spectrometry
CO2	Study Theory of fluorescence and Phosphorescence
CO3	Evaluate chemical shift
CO4	Analyse the molecules by chromatography
CO5	Measure potential of liquid

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Textbooks:	
1.	Skoog, D.A. F. James Holler, and Stanky, R.Crouch "Instrumental Methods of Analysis".CengageLearning , 2007
2.	Willard, Hobart, etal., "Instrumental Methods of Analysis". VIIth Edition, CBS, 1986.
3.	Fifield F.W., . Principles and Practice of Analytical Chemistry. Blackwell, Scientific Publishers,2016

Reference books/other materials/webresources:	
1.	Sharma, B.K. "Instrumental Methods of Chemical Analysis: Analytical Chemistry", Krishna Prakashan Media (P) Ltd, 2014
2.	Haven, Mary C., etal., "Laboratory Instrumentation ". 4th Edition, Wiley India Pvt Ltd, 2010
3.	Philopose P.M.Analytical Biotechnology. Domihant Publishers & distributors, New Delhi, 2016

PO & PSO / CO	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3.0	-	1.0	-	2.0	1.0	-	2.0	1.0	1.0	-	2.0	1.0	-
CO2	3.0	3.0	2.0	3.0	2.0	2.0	2.0	2.0	1.0	-	1.0	3.0	2.0	3.0
CO3	2.0	1.0	3.0	2.0	2.0	2.0	2.0	3.0	2.0	2.0	2.0	3.0	3.0	3.0
CO4	3.0	3.0	3.0	3.0	3.0	2.0	3.0	3.0	2.0	2.0	2.0	3.0	3.0	3.0
CO5	3.0	2.0	2.0	2.0	2.0	2.0	3.0	2.0	2.0	2.0	1.0	2.0	2.0	1.0
Average:	2.8	2.3	2.2	2.5	2.2	1.8	2.5	2.4	1.6	1.8	1.5	2.6	2.2	2.5

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Subject Code	Subject Name	Category	L	T	P	C
BT24404	**BASICS OF FLUID MECHANICS AND THERMODYNAMICS**	PCC	3	1	0	4

Course Objectives:

- To introduce the students the mechanics of fluids through a thorough understanding of the properties of the fluids, behaviour of fluids under static conditions. The dynamics of fluids is introduced through the control volume approach which gives an integrated understanding of the transport of mass, momentum and energy.
- To expose to the applications of the conservation laws to a) flow measurements b) flow through pipes (both laminar and turbulent) and c) forces on vanes.
- To understand the microbial growth and product formation and its kinetics.
- To explore the thermodynamic concepts in bio chemical engineering.

UNIT I	**FLUID PROPERTIES & FLUID MECHANICS**	9

Fluid definition- compressible, in compressible fluids – coefficient of isothermal compressibility, Density, specific gravity, specific weight, surface tension, vapour pressure, viscosity. Newtonian and Non-newtonian fluids. Fluid statics – Barometric equation – application for incompressible and compressible fluids. Pressure changes in atmospheric air – Gauge and absolute pressure – pressure measurement with Bourdon gauge & manometers. Centre of pressure concept. Fluid Dynamics – equation of continuity – Bernoulli's equation – press loss in straight pipes – in fittings – expansion and contraction losses (applied to Newtonian Fluids only) Fluid flow measurement, Orifice, venture & Rotameter for Newtonian fluids

UNIT II	**FLOW OF FLUID THROUGH PACKINGS**	9

Fluidization, Fluid transport Industrial application of fluid flow through packing-characterics of packed bed-Bed surface area-void fraction-Laminar flow through packed bed and turbulent flow-pressure drop experienced by the fluid-equations and application problems. Fluidization phenomena-Industrial application - minimum fluidization velocities. Industrial pipes and fittings- Fluid moving machinery-pumps centrifugal, Reciprocating-gear, Peristaltic pumps, Introduction togas moving machinery-Fans, blowers, compressors.

UNIT III	**CONDUCTION HEAT TRANSFER**	9

Heat transfer phenomena-thermodynamics & heat transfer. Heat conduction – Fourier's equation –steady state conduction in plexor and radial systems – Resistance concept – series and resistance in conduction –and parallel resistance in conduction – unsteady state conduction – lumped capacity model – extended surfaces (Feris) –combined conduction & convection.– 2 dimensional conduction.

UNIT IV	**THERMODYNAMIC LAW AND PROPERTIES OF FLUIDS**	9

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

UNIT V	**THERMODYNAMIC DESCRIPTION OF MICROBIAL GROWTH AND PRODUCT FORMATION**	9

Thermodynamics of microbial growth stoichiometry thermodynamics of maintenance, Calculation of the Operational Stoichiometry of a growth process at Different growth rates, Including Heat using the Herbert –Pirt Relation for Electron Donor, thermodynamics and stoichiometry of Product Formation

	Total Contact Hours : 45

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Course Outcomes:	Upon completion of the course students should be able to:
CO1	Study fluid Properties
CO2	Study fluid transport
CO3	Asses fourier's equation
CO4	Know Volumetric properties of fluids
CO5	derive Pirt Relation for Electron Donor

Textbooks:	
1.	Smith J.M., Van Ness H.C., and Abbot M.M. "Introduction to Chemical Engineering Thermodynamics", VIth Edition. Tata McGraw-Hill, 2003.
2.	Narayanan K.V. "A Text Book of Chemical Engineering Thermodynamics", PHI, 2003.
3.	Christiana D. Smolke, " The Metabolic Pathway Engineering Handbook Fundamentals", CRC Press Taylor & Francis Group, 2010.
4.	R.K. Bansal A Textbook of Fluid Mechanics, Laxmi Publications; Second edition, 2020
5.	Heat & Mass Transfer by P. K. Nag, Tata McGraw Hill – IIIrd Edition 2003

Reference books/other materials/webresources:	
1.	Sandler S.I. "Chemical and Engineering Thermodynamics", John Wiley,1989.
2.	K.A.Gavhane, Fluid flow Operations,Nirali publishers,1st Edition,2018
3.	R.K.Rajput A text Book of Heat & Mass Transfer SI Units , S.Chand publisher,2018
4.	Geankoplis. C.J "Transport Process & separation Process Principles" IVth Edition Prentice Hall of India 2013.

PO & PSO / CO	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3.0	-	-	3.0	3.0	2.0	2.0	-	3.0	-	-	3.0	3.0	3.0
CO2	3.0	2.0	3.0	2.0	3.0	-	1.0	1.0	3.0	-	2.0	3.0	-	-
CO3	2.0	3.0	3.0	2.0	1.0	-	2.0	-	2.0	-	1.0	2.0	3.0	-
CO4	2.0	1.0	3.0	2.0	3.0	1.0	-	1.0	-	-	-	3.0	2.0	-
CO5	3.0	3.0	2.0	1.0	-	-	-	2.0	2.0	-	2.0	3.0	2.0	2.0
Average:	2.6	2.3	2.8	2.0	2.5	1.5	1.7	1.3	2.5		1.7	2.8	2.5	2.5
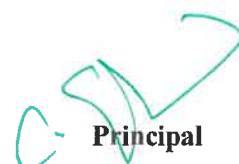
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Subject Code	Subject Name	Category	L	T	P	C
GE24901	Environmental Sciences and Sustainability	BSC	3	0	0	3

Course Objectives:

- To study the interrelationship between living organism and environment.
- To finding and implementing scientific, technological, economic and political solutions to environmental problems.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To study the dynamic processes and understand the features of the earth's interior and surface.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

UNIT I	ENVIRONMENT AND BIODIVERSITY	9

Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– ecological succession. Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ.

UNIT II	ENVIRONMENTAL POLLUTION	9

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions.Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts.

UNIT III	NATURAL RESOURCES	9

Forest resources: Use and over-exploitation, deforestation, case studies. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. New Renewable Energy Sources: Hydrogen energy, Solar energy, wind energy, Tidal energy, Ocean thermal energy and Geothermal energy. Role of an individual in conservation of natural resources.

UNIT IV	SUSTAINABILITY PRACTICES	9

Zero waste and R concept, Circular economy, Material Life cycle assessment, Environmental Impact Assessment, ISO 14000 Series, Green buildings. Water conservation, rain water harvesting. Issues and possible solutions – climate change, global warming.Concept of Carbon Credit and Carbon Footprint.Development and GDP.Environmental management in industry-A, case study.

UNIT V	SOCIAL ISSUES AND POPULATION	9

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health – Case studies. Urban problems related to energy.

	Total Contact Hours : 45

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Course Outcomes:	Upon completion of the course students should be able to:
CO1	To recognize and understand the functions of environment, ecosystems and biodiversity andtheir conservation.
CO2	To identify the causes, effects of environmental pollution and natural disasters and contributeto the preventive measures in the society.
CO3	To apply knowledge on the conservation of natural resources by keeping the sustainable development as a main goal.
CO4	To identify the importance of Development as a standard of living otherwise that leads to serious environmental disasters
CO5	To demonstrate the knowledge about human population and its drastic change which will eventually lead to unsustainable development.

Textbooks:	
1.	AnubhaKaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers ,2018.
2.	Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.
3.	Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
4.	Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
5.	Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
6.	Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998

Reference books/other materials/webresources:	
1.	R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media.38 .edition 2010.
2.	Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3.	Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.
4.	Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, Third Edition, 2015.
5.	ErachBharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.

PO & PSO / CO	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	2	3	-	-	-	-	-	-	-
CO2	3	2	-	-	-	3	3	-	-	-	-	-	-	-
CO3	3	-	1	-	-	2	2	-	-	-	-	-	-	-
CO4	3	2	1	1	-	2	2	-	-	-	-	-	-	-
CO5	3	2	1	-	-	2	2	-	-	-	-	-	-	-
Average:	2.8	1.8	1	1	-	2.2	2.4	-	-	-	-	-	-	-

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Subject Code	Subject Name	Category	L	T	P	C
BT24411	**BIOCHEMICAL ENGINEERING LABORATORY**	PCC	0	0	3	1.5

Course Objectives:

- To provide basic understanding of chemical engineering principles and operations
- Course will enable the students to apply the principles in other chemical engineering and biotechnology subjects offered in higher semesters

EXPERIMENTS
1. Flow measurement - Orifice meter
2. Flow measurement - Venturimeter,
3. Flow measurement - Rotameter
4. Pressure drop in flow through pipes
5. Pressure drop in flow through packed column
6. Pressure drop in flow through fluidized beds
7. Characteristics of centrifuge pump
8. Filtration through plate and frame filter press
9. Filtration in leaf filter
10. Heat transfer characteristics in heat exchanger
11. Simple and steam distillation

TOTAL: 30 PERIODS

Course Outcomes:	Upon completion of the course students should be able to:
CO1	Acquire knowledge on the basic concepts of chemical engineering.
CO2	Develop the skill of material balance and energy balance in unit operations and unit process.
CO3	Analyse the chemical engineering principles and their applications in chemical, mechanical and biological perspectives.
CO4	Realize the design and working principles of fluid moving machinery and transport phenomena in biological systems.
CO5	Select and apply appropriate techniques used for biological products.

PO & PSO / CO	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2.0	-	-	2.0	-	-	3.0	2.0	-	-	2.0	3.0	-	-
CO2	2.0	-	3.0	-	3.0	-	2.0	3.0	-	-	3.0	2.0	2.0	-
CO3	2.0	-	3.0	-	3.0	-	2.0	2.0	-	-	2.0	3.0	2.0	2.0
CO4	2.0	-	3.0	-	2.0	-	2.0		-	-	2.0	2.0	-	-
CO5	2.0	-	3.0	-	3.0	-	3.0	2.0	-	-	2.0	2.0	2.0	-
Average:	2.0		3.0	2.0	2.8		2.4	2.3			2.2	2.4	2.0	2.0

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Subject Code	Subject Name	Category	L	T	P	C
BT24412	ANALYTICAL INSTRUMENTATION LABORATORY	PCC	0	0	3	1.5

Course Objectives:
- To have a practical hands on experience on Absorption Spectroscopic methods
- To acquire experience in the purification by performing chromatography
- To validate and analysis using spectrometric and microscopic techniques

EXPERIMENTS
1. Precision and validity in an experiment using absorption spectroscopy.
2. Validating Lambert-Beer's law using $KMnO_4$
3. Finding the molar absorptivity and stoichiometry of the Fe (1,10phenanthroline)3 using absorption spectrometry.
4. Finding the pKa of 4-nitrophenol using absorption spectroscopy.
5. UV spectra of nucleic acids.
6. Chemical actinometry using potassium ferrioxolate.
7. Estimation of SO_4^{--} by nephelometry.
8. Estimation of Al^{3+} by Flourimetry.
9. Limits of detection using aluminium alizarin complex.
10. Chromatography analysis using TLC.
11. Chromatography analysis using column chromatography.

TOTAL: 45 PERIODS

Course Outcomes:	Upon completion of the course students should be able to:
CO1	The students would visualize and interpret the theory of spectroscopic methods by practice
CO2	The students would validate and interpret the theory of absorptivity by practice
CO3	The students would find pKa of solution
CO4	The students would spectra of sample by UV analysis
CO5	The students would interpret TLC by practice

Textbooks:	
1.	Authors Names, "Title of the Book", Publisher Name, Year of Publication.
2.	Parthasarathy, N. S. and Vela Murali, "Engineering Drawing", Oxford University Press, 2015.
3.	James. G., "Advanced Modern Engineering Mathematics", 4thEdition, Pearson Education, New Delhi, 2016

Reference books/other materials/webresources:	
1.	Skoog, D.A. etal. "Principles of Instrumental Analysis", Vth Edition, Thomson / Brooks Cole,1998.
2.	Braun, R.D. "Introduction to Instrumental Analysis", Pharma Book Syndicate, 1987.
3.	Willard, H.H. etal. "Instrumental Methods of Analysis", VIth Edition, CBS, 1986.
4.	Ewing,G.W. "Instrumental Methods of Chemical Analysis", Vth Edition, McGraw-Hill, 1985.

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PO & PSO / CO	CO-PO Mapping											CO-PSO Mapping		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2.0	-	-	2.0	-	-	3.0	2.0	-	-	2.0	3.0	-	-
CO2	2.0	-	3.0	-	3.0	-	2.0	3.0	-	-	3.0	2.0	2.0	-
CO3	2.0	-	3.0	-	3.0	-	2.0	2.0	-	-	2.0	3.0	2.0	2.0
CO4	2.0	-	3.0	-	2.0	-	2.0		-	-	2.0	2.0	-	-
CO5	2.0	-	3.0	-	3.0	-	3.0	2.0	-	-	2.0	2.0	2.0	-
Average:	2.0		3.0	2.0	2.8		2.4	2.3			2.2	2.4	2.0	2.0

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Subject Code	Subject Name	Category	L	T	P	C
BT24513	Internship* (2Weeks)	EEC	0	0	0	0

Course Objectives:

- Get connected with industry/ laboratory/research institute
- Get practical knowledge on production process in the industry and develop skills to solve related problems
- Develop skills to carry out research in the research institutes/laboratories

The students individually undergo training in reputed firms/ research institutes / laboratories for the specified duration. After the completion of training, a detailed report should be submitted within ten days from the commencement of next semester. The students will be evaluated as per the Regulations.

Course Outcomes:	Upon completion of the course students should be able to:
CO1	Plant layout, machinery, organizational structure and production processes in the firm or research facilities in the laboratory/research institute
CO2	Analysis of industrial / research problems and their solutions
CO3	Documenting of material specifications, machine and process parameters, testing parameters and results
CO4	Preparing of Technical report and presentation
CO5	Machinery, organizational structure and production processes in the firm research institute

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