



Jansons Institute of Technology

(Autonomous)

Regulations 2024

Choice Based Credit System

B.E. Electronics and Communication Engineering

Curriculum and Syllabi for Semesters I to VIII (Batch 2024-2028)

Programme Educational Objectives (PEOs)

Graduates of the Programme will

PE01	Graduates will be practicing professionals in the related fields of electronics and communication engineering.
PE02	Graduates will pursue higher education, be involved in research, or become entrepreneurs.
PE03	Graduates will be ethically and socially responsible and contribute to society and the country.

Program Outcomes (POs)

PO01	Engineering knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
PO02	Problem analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
PO03	Design/development of solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
PO04	Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).
PE05	Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
PO06	The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).
PO07	Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
PO08	Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
PO09	Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
PO10	Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
PO11	Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)



Program Specific Outcomes (PSOs)

On successful completion of the degree programme, the graduates shall exhibit,

PS01	Design, develop and analyze electronic systems through application of relevant electronics, mathematics and engineering principles
PS02	Design, develop and analyze communication systems through application of fundamentals from communication principles, signal processing, and RF System Design & Electromagnetics
PS03	Adapt to emerging electronics and communication technologies and develop innovative solutions for existing and newer problems

Summary

Subject Area	I	II	III	IV	V	VI	VII	VIII	Credits
Humanities and Social Science including Management Courses (HS)	4	3				3	3		13
Basic Science Courses (BS)	12	7	4	3					26
Engineering Sciences Course (ES)	6	5	4			4			19
Professional Core Courses (PC)		5	15	22	19	4			65
Professional Elective Courses (PE)					3	9	3		15
Open Elective Courses (OE)							6		6
Project Work, seminar and internship in industry (EE)	2	3	1	1	1	1	5	7	21
Total	24	23	24	26	23	21	17	7	165
Mandatory Course					✓	✓			



Mandatory Induction Programme

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
1	U24IP0101	Induction Programme						--

Semester - I

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
Theory Courses								
1	U24HS1101	Professional English - I	HS	3	0	0	3	3
2	U24MA2101	Matrices and Calculus	BS	3	1	0	4	4
3	U24PH2101	Engineering Physics	BS	3	0	0	3	3
4	U24CY2101	Engineering Chemistry	BS	3	0	0	3	3
5	U24GE1101	தமிழர்மரபு /Heritage of Tamils	HS	1	0	0	1	1
Theory Cum Laboratory Courses								
6	U24GE3003	Engineering Graphics	ES	2	0	4	6	4
Practical Courses								
7	U24GE3004	Engineering Practices Laboratory	ES	0	0	4	4	2
8	U24GE2101	Physics and Chemistry Laboratory	BS	0	0	4	4	2
9	U24GE7101	English Laboratory	EE	0	0	2	2	1
10	U24GE7102	Design Thinking and Innovation	EE	0	0	2	2	1
Total				15	1	16	32	24



Semester – II

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
Theory Courses								
1	U24HS1201	Professional English - II	HS	2	0	0	2	2
2	U24MA2203	Transforms and Ordinary Differential Equations	BS	3	1	0	4	4
3	U24PH2203	Semiconductor Physics, Electrical Machines and Instrumentation	BS	3	0	0	3	3
4	U24EC4201	Circuit Analysis	PC	3	1	0	4	4
5	U24GE3001	Problem Solving and Python Programming	ES	3	0	0	3	3
6	U24GE1201	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	HS	1	0	0	1	1
Practical Courses								
7	U24GE3002	Problem Solving and Python Programming Laboratory	ES	0	0	4	4	2
8	U24EC4202	Circuit Analysis laboratory	PC	0	0	2	2	1
9	U24GE7201	Communication Laboratory	EE	0	0	4	4	2
10	U24GE7202	Fundamentals of Entrepreneurship and Startup	EE	0	0	2	2	1
11	U24GE7203 / U24GE7204	Foreign Language ^	HS	0	0	2	2	1 [#]
Total				15	2	12	29	23

[^]Japanese/Duetsch

[#]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

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
Theory Courses								
1	U24MA2302	Random Processes and Linear Algebra	BS	3	1	0	4	4
2	U24EC4301	Control Systems	PC	3	0	0	3	3
Theory Cum Laboratory Courses								
3	U24EC4302	Electronic Devices	PC	3	0	2	5	4
4	U24EC4303	Signals and Systems	PC	3	0	2	5	4
5	U24CS3305	C Programming and Data Structures	ES	3	0	2	5	4
6	U24EC4304	Digital Electronics	PC	3	0	2	5	4
Practical Courses								
7	U24GE7302	Product development / Process design	EE	0	0	2	2	1
	U24GE1101	தமிழர்மரபு /Heritage of Tamils**	HS	1	0	0	1	1
Total				18	1	10	29	24

** only for lateral entry students



Semester – IV

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
Theory Courses								
1	U24EC4401	Electromagnetic Fields	PC	3	0	0	3	3
2	U24EC4402	Computer Architecture and Microprocessor System	PC	3	0	0	3	3
3	U24CY2401	Environmental Sciences, Climate change and Sustainability	BS	3	0	0	3	3
Theory Cum Laboratory Courses								
4	U24EC4403	Electronic Circuits	PC	3	0	2	5	4
5	U24EC4404	Digital Signal Processing	PC	3	0	2	5	4
6	U24EC4405	Communication Systems	PC	3	0	2	5	4
7	U24EC4406	Servicing Technology for Consumer Electronics	PC	2	0	4	4	4
Practical Courses								
8	U24GE7301	Professional Development	EE	0	0	2	2	1
	U24GE1201	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology**	HS	1	0	0	1	1
Total				20	0	12	30	26

** only for lateral entry students



Semester – V

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
Theory Courses								
1	U24EC4501	Transmission Lines and RF Systems	PC	3	0	0	3	3
2	U24EC4502	VLSI and Chip Design	PC	3	0	0	3	3
3	U24EC4503	Networks and Security	PC	3	0	0	3	3
4		Professional Elective I	PE	3	0	0	3	3
5		Mandatory Course – I*	MC	3	0	0	3	0
Theory Cum Laboratory Courses								
6	U24EC4504	Linear Integrated Circuits	PC	3	0	2	5	4
7	U24EC4505	Embedded Systems and IoT Design	PC	3	0	2	5	4
Practical Courses								
8	U24EC4506	VLSI Design Laboratory	PC	0	0	4	4	2
9	U24EC7501	Internship	EE	0	0	0	0	1
Total				21	0	8	29	23



Semester – VI

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
Theory Courses								
1	U24GE1601	Professional Ethics	HS	3	0	0	3	3
2		Professional Elective II	PE	3	0	0	3	3
3		Professional Elective III	PE	3	0	0	3	3
4		Professional Elective IV	PE	3	0	0	3	3
5		Mandatory Course – II*	MC	3	0	0	3	0
Theory Cum Laboratory Courses								
6	U24EC4601	Wireless Communication	PC	3	0	2	5	4
7	U24CS4502	Artificial Intelligence and Machine Learning	ES	3	0	2	5	4
Practical Courses								
8	U24EC4602	Prototype Studio	EE	0	0	2	2	1
Total				21	0	6	27	21



Semester – VII

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
Theory Courses								
1		Professional Elective V	PE	3	0	0	3	3
2		Elective – Management*	HS	3	0	0	3	3
3		Open Elective – I*	OE	3	0	0	3	3
4		Open Elective – II*	OE	3	0	0	3	3
Practical Courses								
5	U24EC7701	Project Work - Phase I	EE	0	0	0	6	3
6	U24EC7702	Summer Internship	EE	0	0	0	0	2
Total				12	0	0	18	17



Semester – VIII

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
Practical Courses								
1	U24EC7801	Project Work - Phase II /Internship/Apprenticeship	EE	0	0	14	14	7
Total				0	0	14	14	7



Mandatory Courses

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
1	U24GE8501	Introduction to Women Gender Studies	MC	3	0	0	3	0
2	U24HS8501	Elements of Literature	MC	3	0	0	3	0
3	U24HS8502	Film Appreciation	MC	3	0	0	3	0
4	U24CY8501	Disaster Risk Reduction and Management	MC	3	0	0	3	0
5	U24GE8502	Well-Being with Traditional Practices - Yoga, Ayurveda and Siddha	MC	3	0	0	3	0
6	U24GE8503	History of Science and Technology in India	MC	3	0	0	3	0
7	U24GE8504	Political and Economic Thought for a Humane Society	MC	3	0	0	3	0
8	U24GE8505	State, Nation Building and Politics in India	MC	3	0	0	3	0
9	U24GE8506	Industrial Safety	MC	3	0	0	3	0
10	U24MA8501	Exploring Vedic Mathematics	MC	3	0	0	3	0
11	U24MA8502	Fundamentals of Astrology	MC	3	0	0	3	0



Professional Elective Courses – Verticals

I	II	III	IV	V	VI
Semiconductor Chip Design and Testing	Signal Processing	RF Technologies	Bio Medical Technologies	Sensor Technologies and IoT	High Speed Networks
Low Power IC Design	Advanced Digital Signal Processing	RF Transceivers	Medical Imaging Systems	IoT Processors	Software Defined Radio
ASIC Design	Image Processing	Antenna Design	Human Assist Devices	MEMS and NEMS	Wireless Broadband Networks
VLSI Testing and Design For Testability	VLSI Signal Processing	MICs and RF System Design	Therapeutic Equipment	IoT Based System Design	4G/5G Communication Networks
Verification of IC Design	Speech Processing	RFID System Design and Testing	Body Area Networks	Drone Service Technology	Satellite Communication
Mixed Signal IC Design Testing	Natural Language Processing	EMI/EMC Pre Compliance Testing	Wearable Devices	Fundamentals of Nano Electronics	6G Technology
Design of Analog IC	Computer Vision	Signal Integrity	Brain Computer Interface and Applications	Wireless Sensor Network Design	Optical Communication Networks

*Professional Elective courses may be opted from the verticals based on the completion of the prerequisites



Vertical – I: Semiconductor Chip Design and Testing

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
1	U24EC5A01	Low Power IC Design	PE	2	0	2	4	3
2	U24EC5A02	ASIC Design	PE	3	0	0	3	3
3	U24EC5A03	VLSI Testing and Design For Testability	PE	2	0	2	4	3
4	U24EC5A04	Verification of IC Design	PE	2	0	2	4	3
5	U24EC5A05	Mixed Signal IC Design Testing	PE	3	0	0	3	3
6	U24EC5A06	Design of Analog IC	PE	2	0	2	4	3

Vertical – II: Signal Processing

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
1	U24EC5B01	Advanced Digital Signal Processing	PE	2	0	2	4	3
2	U24EC5B02	Image Processing	PE	3	0	0	3	3
3	U24EC5B03	VLSI Signal Processing	PE	3	0	0	3	3
4	U24AD5F04	Speech Processing	PE	2	0	2	4	3
5	U24AD5G04	Natural Language Processing	PE	2	0	2	4	3
6	U24CS5A04	Computer Vision	PE	2	0	2	4	3



Vertical – III: RF Technologies

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
1	U24EC5C01	RF Transceivers	PE	2	0	2	4	3
2	U24EC5C02	Antenna Design	PE	2	0	2	4	3
3	U24EC5C03	MICs and RF System Design	PE	2	0	2	4	3
4	U24EC5C04	RFID System Design and Testing	PE	2	0	2	4	3
5	U24EC5C05	EMI/EMC Pre Compliance Testing	PE	2	0	2	4	3
6	U24EC5C06	Signal Integrity	PE	2	0	2	4	3

Vertical – IV: Bio Medical Technologies

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
1	U24EC5D01	Medical Imaging Systems	PE	3	0	0	3	3
2	U24EC5D02	Human Assist Devices	PE	3	0	0	3	3
3	U24EC5D03	Therapeutic Equipment	PE	3	0	0	3	3
4	U24EC5D04	Body Area Networks	PE	3	0	0	3	3
5	U24EC5D05	Wearable Devices	PE	3	0	0	3	3
6	U24EC5D06	Brain Computer Interface and Applications	PE	3	0	0	3	3



Vertical – V: Sensor Technologies & IoT

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
1	U24EC5E01	IoT Processors	PE	2	0	2	4	3
2	U24EC5E02	MEMS and NEMS	PE	2	0	2	4	3
3	U24EC5E03	IoT Based System Design	PE	3	0	0	3	3
4	U24EC5E04	Drone Service Technology	PE	2	0	2	4	3
5	U24EC5E05	Fundamentals of Nano Electronics	PE	2	0	2	4	3
6	U24EC5E06	Wireless Sensor Network Design	PE	3	0	0	3	3

Vertical –VI: High Speed Networks

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
1	U24EC5F01	Software Defined Radio	PE	3	0	0	3	3
2	U24EC5F02	Wireless Broadband Networks	PE	3	0	0	3	3
3	U24EC5F03	4G/5G Communication Networks	PE	2	0	2	4	3
4	U24EC5F04	Satellite Communication	PE	3	0	0	3	3
5	U24EC5F05	6G Technology	PE	2	0	2	4	3
6	U24EC5F06	Optical Communication & Networks	PE	3	0	0	3	3



Open Electives

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
1	U24GE6601	Intellectual Property Rights	OE	3	0	0	3	3
2	U24CY6605	Food, Nutrition and Health	OE	3	0	0	3	3
3	U24CY6602	Renewable Energy Systems	OE	3	0	0	3	3
4	U24ME6605	Industrial Engineering	OE	3	0	0	3	3
5	U24CY6601	Universal Human Values	OE	3	0	0	3	3
6	U24MA6604	Resource Management Techniques	OE	3	0	0	3	3
7	U24ME6601	Entrepreneurship Development	OE	3	0	0	3	3
8	U24GE6604	Community Engagement and Social Responsibility	OE	3	0	0	3	3
9	U24CS6601	Digital Marketing Essentials	OE	3	0	0	3	3
10	U24GE6606	Project Report Writing	OE	3	0	0	3	3
11	U24ME6607	Mechatronics	OE	3	0	0	3	3
12	U24AD6604	AI Techniques in Engineering Applications	OE	3	0	0	3	3
13	U24AD6605	Cloud and Fog Computing	OE	3	0	0	3	3
14	U24PH6603	Fundamentals of Quantum Computing	OE	3	0	0	3	3
15	U24CE6601	Applied Design Thinking	OE	3	0	0	3	3
16	U24AD6603	Augmented Reality/Virtual Reality Technology	OE	3	0	0	3	3



Verticals for Minor Degree (In addition to all the verticals of other programmes)

I	II	III	IV	V
Fintech and Blockchain	Entrepreneurship	Public Administration	Business Data Analytics	Environment and Sustainability
Financial Management	Foundations of Entrepreneurship	Principles of Public Administration	Statistics for Management	Sustainable infrastructure Development
Fundamentals of Investment	Team Building & Leadership Management for Business	Constitution of India	Datamining for Business Intelligence	Sustainable Agriculture and Environmental Management
Banking, Financial Services and Insurance	Creativity & Innovation in Entrepreneurship	Public Personnel Administration	Human Resource Analytics	Sustainable Bio Materials
Introduction to Block chain and its Applications	Principles of Marketing Management For Business	Administrative Theories	Marketing and Social Media Web Analytics	Materials for Energy Sustainability
Fintech Personal Finance and Payments	Human Resource Management for Entrepreneurs	Indian Administrative System	Operation and Supply Chain Analytics	Green Technology
Fintech	Financing New Business Ventures	Public Policy Administration	Financial Analytics	Environmental Quality Monitoring and Analysis



Vertical – I: Fintech and Blockchain

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
1	U24CB5V01	Financial Management	PE	3	0	0	3	3
2	U24CB5V02	Fundamentals of Investment	PE	3	0	0	3	3
3	U24CB5V03	Banking, Financial Services and Insurance	PE	3	0	0	3	3
4	U24CB5V04	Introduction to Blockchain and its Applications	PE	3	0	0	3	3
5	U24CB5V05	Fintech Personal Finance and Payments	PE	3	0	0	3	3
6	U24CB5V06	Fintech	PE	3	0	0	3	3

Vertical – II: Entrepreneurship

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
1	U24CB5W01	Foundations of Entrepreneurship	PE	3	0	0	3	3
2	U24CB5W02	Team Building & Leadership Management for Business	PE	3	0	0	3	3
3	U24CB5W03	Creativity & Innovation in Entrepreneurship	PE	3	0	0	3	3
4	U24CB5W04	Principles of Marketing Management For Business	PE	3	0	0	3	3
5	U24CB5W05	Human Resource Management for Entrepreneurs	PE	3	0	0	3	3
6	U24CB5W06	Financing New Business Ventures	PE	3	0	0	3	3



Vertical – III: Public Administration

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
1	U24GE5X01	Principles of Public Administration	PE	3	0	0	3	3
2	U24GE5X02	Constitution of India	PE	3	0	0	3	3
3	U24GE5X03	Public Personnel Administration	PE	3	0	0	3	3
4	U24GE5X04	Administrative Theories	PE	3	0	0	3	3
5	U24GE5X05	Indian Administrative System	PE	3	0	0	3	3
6	U24GE5X06	Public Policy Administration	PE	3	0	0	3	3

Vertical – IV: Business Data Analytics

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
1	U24CB5Y01	Statistics for Management	PE	3	0	0	3	3
2	U24CB5Y02	Data mining for Business Intelligence	PE	3	0	0	3	3
3	U24CB5Y03	Human Resource Analytics	PE	3	0	0	3	3
4	U24CB5Y04	Marketing and Social Media Web Analytics	PE	3	0	0	3	3
5	U24CB5Y05	Operation and Supply Chain Analytics	PE	3	0	0	3	3
6	U24CB5Y06	Financial Analytics	PE	3	0	0	3	3



Vertical– V: Environment and Sustainability

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
1	U24GE5Z01	Sustainable infrastructure Development	PE	3	0	0	3	3
2	U24GE5Z02	Sustainable Agriculture and Environmental Management	PE	3	0	0	3	3
3	U24GE5Z03	Sustainable Bio Materials	PE	3	0	0	3	3
4	U24GE5Z04	Materials for Energy Sustainability	PE	3	0	0	3	3
5	U24GE5Z05	Green Technology	PE	3	0	0	3	3
6	U24GE5Z06	Environmental Quality Monitoring and Analysis	PE	3	0	0	3	3

Management Elective Courses

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
1	U24ME5H03	Principles of Management	HS	3	0	0	3	3
2	U24ME5F06	Total Quality Management	HS	3	0	0	3	3
3	U24ME5G03	Engineering Economics and Financial Accounting	HS	3	0	0	3	3
4	U24HS1601	Knowledge Management	HS	3	0	0	3	3
5	U24ME5H04	Industrial Management	HS	3	0	0	3	3

Foreign languages

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
1	U24GE7203	Deutsch - I	HS	0	0	2	2	1 [#]
2	U24GE7204	Japanese - I	HS	0	0	2	2	1 [#]



1. Student Induction Programme - Purpose & Concept

This is a 3-week long induction programme for the UG students entering the institution, right at the start. Purpose of the Student Induction Programme is to help new students adjust and feel comfortable in the new environment, inculcate in them the ethos and culture of the institution, help them build bonds with other students and faculty members, and expose them to a sense of larger purpose and self-exploration.

The term induction is a well-planned event to educate the new entrants about the environment in a particular institution, and connect them with the people in it. The Student Induction Programme engages with the new students as soon as they come into the institution; regular classes start only after that.

The time during the Induction Programme is also used to rectify some critical lacunas, for example, English background, for those students who have deficiency in it. These are included under Proficiency Modules. Its purpose is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature.

2. Daily Activity

The following are the activities under the induction programme in which the student would be fully engaged throughout the day for the entire duration of the programme.

2.1 Physical Activity

This would involve a daily routine of physical activity with games and sports. There would be games in the evening or at other suitable times according to the local climate. These would help develop team work besides health.

2.2 Creative Arts

Every student would choose one skill related to the arts whether visual arts or performing arts like painting, music, dance, pottery, sculpture etc. The student would pursue it every day for the duration of the programme. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, flow into engineering design later.

2.3 Mentoring and Universal Human Values

Mentoring and connecting the students with faculty members is the most important part of student induction. Mentoring takes place in the context and setting of Universal Human Values. It gets the student to explore oneself and experience the joy of learning, prepares one to stand up to peer pressure and make decisions with courage, be aware of relationships and be sensitive to others, understand the role of money in life and experience the feeling of prosperity.

Students are educated in Universal human Values in 3 modules. First module comprises Basic Aspirations and Self-Management and the second module includes Harmony in the Family and Health. The last module preaches Harmony in the Society and Nature. It is best taught through group discussions and real-life activities rather than lecturing. Discussions would be conducted in small groups of about 20 students with a faculty mentor each.

2.4 Introduction to Sustainable Development Goals (SDG)

Students are encouraged to gain knowledge in accepting the need for Sustainable Development Goals. The students are enlightened on the SDGs which give a comprehensive framework of goals and targets with which students understand the complexity of the actions we must take to achieve development that is sustainable across social, environmental, economic aspects and over time.

3. Other Activity

Below activities are not there on a daily basis, but are conducted for 3-4 days.

3.1 Familiarization with College, Department/Branch



The incoming students will be told about the credit and grading system, and about the examinations. They would be informed about how study in college differs from study in school. They shall be taken on a tour of the college and shown important points such as the library, canteen, laboratories, workshops and other facilities.

They would be shown their respective department, and told what it means to get into the branch or department. Students would be described about what role the technology related to their department plays in society and after graduation what role the student would play in society as an engineer in that branch. A lecture by an alumnus of the department would be carried out which would be very helpful in this regard. The above activity would be done right in the first two days, and then over the afternoons thereafter, as appropriate.

3.2 Department Specific Activities

Activities such as games, quizzes, social interactions, small experiments, design thinking etc., that are relevant to the particular branch of Engineering are introduced to kindle interest in building things in that particular field. For example, CSE, CSBS and AI&DS students would be given activities that kindle computational thinking and ECE students would be introduced to build simple circuits as an extension of their knowledge in science and so on.

3.3 Literary Activity

Literary activity would encompass reading a book, writing a summary, debating, enacting a play etc.

3.4 Proficiency Modules

The induction programme period is used to overcome some critical lacunas that students might have, for example, English, computer familiarity etc. These activities are run like crash courses, so that when normal courses start after the induction programme, the student would have overcome the lacunas substantially. The problems arising due to lack of English skills, wherein students start lagging behind or failing in several subjects, for no fault of theirs, would, hopefully, become a thing of the past.

3.5 Lectures & Workshops by Eminent People

Lectures by eminent people would be organized, once a week. It would give the students, exposure to people who are eminent, in industry or engineering, in social service, or in public life. Alumni would be invited as well. Motivational lectures about life, meditation, etc. would be organized.

3.6 Visits in Local Area

A couple of visits to the local landmarks including will be organized which would familiarize the students with the area together with bonding with each other, like in a picnic. Visits would also be organized to a hospital, orphanage or a village. These would expose them to people in suffering or to different lifestyles. This might also sensitize them to engineering needs in these areas.

3.7 Extra-Curricular Activities in College

The new students shall be introduced to the extra-curricular activities at the college/university. They would be shown the facilities and informed about activities related to different clubs etc. Selected senior students will be involved in leading these activities by giving presentations, under faculty supervision.

3.8 Feedback and Report on the Programme

Students would be asked to give their mid-programme feedback. They should write their opinions about the programme at the end of the first week or so. The feedback would be used to make any mid-course correction, if any. At the end of the programme, each group (of 20 students) would be asked to prepare a single report on their experiences of the programme. On the second last day, each group should present their report in front of other groups. Immediately after their presentation, they should submit their written report. This will also serve as a closure to the programme. Finally, online anonymous feedback would be collected at the end of the programme.



U24HS1101	PROFESSIONAL ENGLISH I	L	T	P	C
		3	0	0	3
Course Objectives:	To improve the basic grammar, lexical, communicative competence of learners and develop learners' ability to use language in professional context.				
Unit - I	INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION				9
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 Nonverbal Communication (tables, pie charts etc). Writing – Note-making / Note-taking (*Study skills to be taught, not tested); Writing recommendations; Transferring information from nonverbal (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 Simple, Compound & Complex Sentences. Vocabulary - Cause & Effect Expressions – Content vs Function words.					
Total Periods:					45

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Relate appropriate words in a technical context.	K2
CO2	Interpret the fundamentals of basic grammatical structures.	K2
CO3	Infer the denotative and connotative meanings in professional context.	K2
CO4	Explain the information presented in tables, charts and other graphical representations.	K2
CO5	Outline editorials, narrations, and essays on various topics	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	-	-	-	-	-	-	-	2	3	-	3	-	-	-
CO2	-	-	-	-	-	-	-	2	3	-	3	-	-	-
CO3	-	-	-	-	-	-	-	2	3	-	3	-	-	-
CO4	-	-	-	-	-	-	-	2	3	-	3	-	-	-
CO5	-	-	-	-	-	-	-	2	3	-	3	-	-	-
CO	-	-	-	-	-	-	-	2	3	-	3	-	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

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.

Reference Books

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.



U24MA2101	MATRICES AND CALCULUS		L	T	P	C
			3	1	0	4
Course Objectives:		Integrate matrix algebra, calculus, and multivariable functions to address engineering challenges adeptly. Emphasize practical applications of integration techniques and multiple integrals. Equip students with indispensable mathematical proficiencies vital for engineering analysis.				
Unit - I	MATRICES					9+3
Types of matrices – System of equations – Characteristic equation – Eigenvalues and Eigenvectors of real matrices – 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	INTEGRAL CALCULUS					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 centre 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 integrals – Applications: Moments and centre of mass, moment of inertia						
Total Periods:					60	

Course Outcomes

On completion of the course, the student can

CO	Statements	K-Level
CO1	Apply the matrix algebra methods for solving real time problems.	K3
CO2	Utilize the differential calculus tools to solve engineering problems.	K3
CO3	Apply the differential calculus ideas in functions of several variables.	K3
CO4	Choose the different methods of integration for solving engineering problems.	K3
CO5	Make use of the multiple integrals in solving real-world issues such as areas and volumes.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO	3	2	-	-	-	-	-	-	-	-	1	-	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

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.

Reference Books

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.



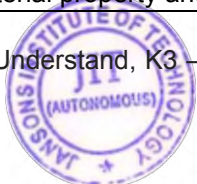
U24PH2101		ENGINEERING PHYSICS			L	T	P	C
					3	0	0	3
Course Objectives:		To enhance and apply the fundamental knowledge of Properties of matter, laser, optical fibre, thermal physics, Quantum physics, Optics and Ultrasonics and its applications relevant to various streams of Engineering and Technology.						
Unit - I		PROPERTIES OF MATTER					7	
Interatomic Forces & Intermolecular Forces - Solid - Elasticity – Stress & strain diagram and its uses - types of stress & strain - Hooke's Law - Young's modulus, Bulk modulus, modulus of rigidity, Poisson's Ratio, Relation between the Three Moduli of Elasticity– factors affecting elastic modulus and tensile strength – torsional stress and deformations – twisting couple – torsion pendulum: theory and experiment – bending of beams – bending moment – cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment – I-shaped girders.								
Unit - II		LASER AND FIBRE OPTICS					9	
Theory of laser - characteristics – Spontaneous and stimulated emission - Einstein 's A and B coefficients - derivation – resonant cavity, optical amplification (qualitative) – population inversion - CO2 laser, Nd-YAG laser, semiconductor laser – Basic applications of lasers in industry - 3D profiling, laser drilling and laser welding.Principle, numerical aperture and acceptance angle – types of optical fibres (material, refractive index, mode) – losses associated with optical fibres –Fibre optic communication system (Block diagram) - fibre optic sensors: pressure and displacement- Endoscope								
Unit - III		THERMAL PHYSICS					9	
Transfer of heat energy (conduction, convection and radiation) – thermal expansion of solids and liquids – expansion joints – bimetallic strips – thermal conduction, convection and radiation – heat conductions in solids – thermal conductivity – Forbe's method: thermal conductivity of good conductor and Lee's disc method: thermal conductivity of bad conductor : theory and experiment – conduction through compound media (series and parallel) – thermal insulation – applications: heat exchangers (qualitative) - refrigerators, ovens and solar water heaters.								
Unit – IV		QUANTUM PHYSICS					11	
Wave particle duality – electron diffraction – Heisenberg's uncertainty principle - wave function and its operators, physical significance of wave function – Schrödinger's wave equation – time independent and time dependent equations – particle in a infinite potential well: 1D, 2D and 3D Boxes – Normalization, probabilities, Expectation values, Eigen values and Eigen functions - tunnelling (qualitative) – Scanning Tunnelling Microscope (STM) - Finite potential wells (qualitative)- Bloch's theorem for particles in a periodic potential –Basics of Kronig -Penney model and origin of energy bands.								
Unit - V		OPTICS AND ULTRASONICS					9	
Optics: Reflection and refraction of light waves - total internal reflection - interference – MichelsonInterferometer: construction and working to determine thickness of the thin transparent material - Theory of air wedge and experiment: determination of the thickness of thin wire. Ultrasonics: Production of ultrasonics by Magnetostriction and Piezoelectric method – Acoustic grating: Wavelength of ultrasonic waves – Non-destructive testing – Pulse echo system through transmission and reflection modes – Medical applications – Sonogram.								
Total Periods:							45	

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the basics of properties of matter and its applications.	K2
CO2	Apply the knowledge of laser and fibre optics principle in various fields.	K3
CO3	Illustrate the concepts of thermal properties of materials and their applications in expansion joints and heat exchangers.	K2
CO4	Explain the importance of quantum theory and its applications in tunnelling microscopes.	K2
CO5	Apply the concepts of optics in material property and ultrasonics in medical field.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO– PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	1	-	-	-	-	-	-	-	-	1	1	-	-
CO2	3	2	1	-	-	-	-	-	-	-	1	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	1	1	-	-
CO4	3	1	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	2	1	-	-	1	-	-	-	-	1	-	-	-
CO	3	2	1	-	-	1	-	-	-	-	1	1	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Bhattacharya, D.K. & Poonam, T. —Engineering Physics. Oxford University Press, 2015
2	Gaur, R.K. & Gupta, S.L. —Engineering Physics. Dhanpat Rai Publishers, 2012
3	Pandey, B.K. & Chaturvedi, S. —Engineering Physics. Cengage Learning India, 2012
4	Arumugam M. Engineering Physics. Anuradha publishers, 2010
5	Palanisamy P.K. Engineering Physics. SCITECH Publications, 2011.
6	D.Kleppner and R.Kolenkow. An Introduction to Mechanics. McGraw Hill Education, 2017.
7	Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, Concepts of Modern Physics, McGraw-Hill, 2017.

Reference Books

1	Halliday, D., Resnick, R. & Walker, J. —Principles of Physics. Wiley, 2015.
2	Serway, R.A. & Jewett, J.W. —Physics for Scientists and Engineers. Cengage Learning, 2010.
3	Tipler, P.A. & Mosca, G. —Physics for Scientists and Engineers with Modern Physics.
4	W.H.Freeman, 2007. 4. Mani P. Engineering Physics I. Dhanam Publications, 2011.
5	Marikani A. Engineering Physics - PHI Learning Pvt., India, 2009.
6	K.Thyagarajan and A.Ghatak. Lasers: Fundamentals and Applications, Laxmi Publications, (Indian Edition), 2019.



U24CY2101		ENGINEERING CHEMISTRY		L	T	P	C
				3	0	0	3
Course Objectives:		To understand water quality parameters in water treatment and corrosion prevention methods, outline the phases and significance of alloys, summarize fuels and combustion properties, explore the uses of energy storage devices, and impart knowledge in nanomaterial preparation methods.					
Unit - I	WATER TECHNOLOGY					9	
Sources and impurities, Water quality parameters: Definition and significance of color, odour, turbidity, pH, hardness, alkalinity, TDS, COD and BOD, fluoride and arsenic. Municipal water treatment: primary treatment and disinfection (UV, Ozonation, break-point chlorination). 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. Desalination of brackish water: Reverse Osmosis (RO)- Applications of RO in domestic and industrial purposes.							
Unit - II	CORROSION AND ITS CONTROL					9	
Corrosion: Introduction - Mechanism of Corrosion - Chemical corrosion, Electrochemical corrosion - Differential Aeration corrosion - Pilling Bedworth rule - Factors influencing corrosion. Corrosion control- Cathodic Protection - Sacrificial Anodic Protection method - Impressed Current Cathodic Protection - Use of Inhibitors. Protective coatings - Metallic coatings - Anodic and Cathodic coatings - Methods of application of Metal coatings. Organic coatings - Paints, Varnishes, Emulsion paints, Special paints - Luminescent paint, Heat - resistant paint, Fire - retardant paint, Water repellent paint, Antifouling paint.							
Unit - III	ALLOYS AND PHASE RULE					9	
Alloys: Introduction- Definition- properties of alloys- significance of alloying, functions and effect of alloying elements- Nichrome and stainless steel (18/8) – Heat treatment of steel. Phase rule: Introduction, definition of terms with examples, One component system -water system - Reduced phase rule - Thermal analysis and Cooling curves - Two Component System - Lead-Silver system – Pattinson's process.							
Unit – IV	FUELS, COMBUSTION AND ENERGY STORAGE DEVICES					9	
Fuels and Combustion: Classification of fuels-Calorific value, units of heat, Gross and Net calorific values, problems on Calorific values. Coal- ranking of coal-Properties of coal- Carbonization-Manufacture of Metallurgical coke -Otto Hoffmann's by-product oven method. Petroleum-Refining of crude oil, Manufacture of Synthetic petrol (Bergius process), Knocking-Octane number and Cetane number. Energy storage devices: Types of batteries - Primary battery - dry cell, Secondary battery - Lead acid battery and Lithium-ion battery; Electric vehicles - working principle; Fuel cells: H ₂ -O ₂ fuel cell, Microbial Fuel Cell (MFC).							
Unit - V	NANOCHEMISTRY					9	
Distinction between molecules, nanomaterials and bulk materials; Size-dependent properties (optical, electrical, mechanical and magnetic); Types of nanomaterials: Definition, properties and uses of – Nanoparticle, Nanoclusters, Nanorods, Nanowire and Nanotube. Preparation of nanomaterials: Sol-gel, Solvothermal, Laser ablation, Chemical Vapour Deposition (CVD), Electrochemical deposition and Electro spinning. Applications of nanomaterials in medicine, agriculture, energy, electronics and catalysis.							
Total Periods:						45	

Course Outcomes

On completion of the course, the student can

Cos	Statements	K-Level
CO1	Apply suitable methodologies for water treatment using water quality parameters.	K3
CO2	Outline the different types of corrosion processes and preventive methods.	K2
CO3	Explain the relationship between phases and the selection of alloy materials.	K2
CO4	Interpret the knowledge of fuels in combustion technology and various energy storage devices.	K2
CO5	Infer the basic concepts of nanotechnology and the synthesis of nanomaterials.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	-	-	-	2	-	-	-	-	2	-	-	-
CO2	3	2	-	-	-	2	-	-	-	-	2	-	-	-
CO3	3	2	-	-	-	2	-	-	-	-	1	-	-	-
CO4	3	2	-	-	-	2	-	-	-	-	2	-	-	-
CO5	3	2	-	-	-	2	-	-	-	-	1	-	-	-
CO	3	2	-	-	-	2	-	-	-	-	2	-	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

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 Textbook of Engineering Chemistry", S. Chand Publishing, 12th Edition, 2018.
4	O.G. Palanna, "Engineering Chemistry" McGraw Hill Education (India) Private Limited, 2nd Edition, 2017.

Reference Books

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	T. Pradeep, "Nano: The Essentials: Understanding Nanoscience and Nanotechnology", (2008) Tata McGraw-Hill Publishing Company Limited, New Delhi.
3	B.R.Puri, L.R.Sharma, M.S.Pathania, "Principles of Physical Chemistry", Vishal Publishing Company, 2008.
4	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.



U24GE1101		தமிழர்மரபு		L	T	P	C
				1	0	0	1
Course Objectives:	இந்தபாடத்திட்டத்தில், மாணவர்களுக்கு தமிழர்களின் செழுமையான கலாச்சாரம் மற்றும் பாரம்பரியம் பற்றிய நுண்ணறிவை வழங்கவும், தமிழகத்தில் நடைமுறையில் உள்ள கட்டிடக்கலை அற்புதங்களை உருவாக்குவதற்கான பொறியியல் நுட்பங்கள் குறித்த விரிவான தகவல்களை மாணவர்களுக்கு வழங்கவும் மற்றும் மாணவர்களை தமிழர் மரபின் வேர்களுடன் இணைக்கவும், பாராட்டவும், பாதுகாக்கவும் உதவுகிறது						
Unit - I	மொழி மற்றும் இலக்கியம்					3	
இந்திய மொழிக்குடும்பங்கள் - திராவிடமொழிகள் - தமிழ் ஒரு செம்மொழி - தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச்சார்பற்றதன்மை - சங்க இலக்கியத்தில் பகிர்தல் அறம் - திருக்குறளில் மேலாண்மைக் கருத்துக்கள் - தமிழகாப்பியங்கள், தமிழகத்தில் சமண பௌத்தசமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் - சிற்றிலக்கியங்கள் - தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.							
Unit - II	மரபு - பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை - சிற்பக்கலை					3	
நடுகல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள்- பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் - தேர்செய்யும்கலை - சுடுமண்சிற்பங்கள் - நாட்டுப்புறத்தெய்வங்கள் - குமரிமுனையில்திருவள்ளுவர்சிலை - இசைக்கருவிகள் - மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் - தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.							
Unit - III	நாட்டுப்புறக் கலைகள் மற்றும் வீரவிளையாட்டுக்கள்					3	
தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான்கூத்து, ஓயிலாட்டம், தோல்பாவைக்கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுக்கள்.							
Unit - IV	தமிழர்களின்திணைக்கோட்பாடுகள்					3	
தமிழகத்தின் தாவரங்களும், விலங்குகளும் - தொல்காப்பியம் மற்றும் சங்கஇலக்கியத்தில் அகம்மற்றும் புறக்கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு - சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் - சங்ககால நகரங்களும் துறைமுகங்களும் - சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - கடல் கடந்த நாடுகளில் சோழர்களின் வெற்றி.							
Unit - V	இந்திய தேசிய இயக்கம் மற்றும் இந்தியபண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு					3	
இந்திய விடுதலைப் போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் - சுயமரியாதை இயக்கம் - இந்திய மருத்துவத்தில் சித்தமருத்துவத்தின் பங்கு - கல்வெட்டுக்கள், கையெழுத்துப்படிிகள் - தமிழ்ப் புத்தகங்களின் அச்ச வரலாறு.							
Total Periods:						15	



Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	தமிழ்இலக்கியத்தில்உள்ளமனிதவிழுமியங்களையும்உரிமைகளையும்புரிந்துகொள்ளலாம்.	K2
CO2	தமிழகமக்கள்கடைப்பிடிக்கும்கலைமற்றும்கலாச்சாரத்தைஅறிந்துகொள்ளலாம்.	K2
CO3	தமிழ்நாட்டுமக்கள்பயிற்சிசெய்யும்பல்வேறுவிளையாட்டுகளையும்நடனங்களையும்புரிந்துகொள்ளலாம்.	K2
CO4	சங்கஇலக்கியம்மற்றும்அரசர்களின்வீரம்பற்றியகருத்துக்களைஅறிந்துகொள்ளலாம்.	K2
CO5	சுதந்திரப்போராட்டவீரர்களின்வாழ்க்கைவரலாற்றை, வேதமுலிகைகள்மற்றும்வாழ்க்கையின்வளர்ச்சிகளைஅறிந்துகொள்ளலாம்.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	-	-	-	-	-	-	1	-	-	-	2	-	-	-
CO2	-	-	-	-	-	-	1	-	-	-	2	-	-	-
CO3	-	-	-	-	-	-	1	-	-	-	2	-	-	-
CO4	-	-	-	-	-	-	1	-	-	-	2	-	-	-
CO5	-	-	-	-	-	-	1	-	-	-	2	-	-	-
CO	-	-	-	-	-	-	1	-	-	-	2	-	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	தமிழக வரலாறு – மக்களும் பண்பாடும் – கே. கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2	கணினித் தமிழ் – முனைவர். இல. சுந்தரம். (விகடன்பிரசுரம்).
3	கீழடி – வைகை நதிக்கரையில் சங்ககால நகரநாகரிகம் (தொல்லியல் துறைவெளியீடு).
4	பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல்துறை வெளியீடு)
5	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)



Reference Books

1	Social Life of the Tamils - The Classical Period (Dr. S. Singaravelu) (Published by: International Institute of Tamil Studies.
2	Historical Heritage of the Tamils (Dr. S. V. Subramanian, Dr. K. D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
3	The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by: International Institute of Tamil Studies.)
4	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, and Educational Services Corporation, Tamil Nadu)
5	Studies in the History of India with Special Reference to Tamil Nadu (Dr. K. K. Pillay) (Published by: The Author)
6	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu).
7	Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by: RMRL) – Reference Book.



U24GE1101	HERITAGE OF TAMILS	L	T	P	C
		1	0	0	1
Course Objectives:	This course enables the students to provide an insight to the students into the rich culture and heritage of the state, to provide the students detailed information on the engineering techniques to construct architectural marvels practiced in Tamil Nadu and also to make the students connect with their roots, appreciate, and preserve it.				
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, Leatherpuppetry, 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 Periods:					15

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Understand the human values and rights in Tamil literature.	K2
CO2	Classify the art and culture being practiced by people of Tamil Nadu.	K2
CO3	Outline the various games and dance practices by people of Tamil Nadu.	K2
CO4	Explain the concepts of Sangam Literature and the bravery of Kings	K2
CO5	Summarise the life history of freedom fighters, Vedic herbs and developments in life	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	-	-	-	-	-	-	1	-	-	-	2	-	-	-
CO2	-	-	-	-	-	-	1	-	-	-	2	-	-	-
CO3	-	-	-	-	-	-	1	-	-	-	2	-	-	-
CO4	-	-	-	-	-	-	1	-	-	-	2	-	-	-
CO5	-	-	-	-	-	-	1	-	-	-	2	-	-	-
CO	-	-	-	-	-	-	1	-	-	-	2	-	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)



Text Books

1	தமிழக வரலாறு – மக்களும் பண்பாடும் – கே. கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2	கணினித்தமிழ் – முனைவர். இல. சுந்தரம். (விகடன் பிரசுரம்).
3	கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல்துறை வெளியீடு)
4	பொருதை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
4	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)

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3	The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by: International Institute of Tamil Studies.)
4	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, and Educational Services Corporation, Tamil Nadu)
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7	Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by: RMRL) – Reference Book.



U24GE3003		ENGINEERING GRAPHICS		L	T	P	C
				2	2	0	4
Course Objectives:		The main learning objective of this course is to prepare the students to acquaint the knowledge on Drawing Standards, projections of points, straight lines, plane surfaces, orthographic projection of solids, section of solids, development of lateral surfaces, isometric and perspective projections of simple solids, engineering curves and freehand sketch of simple objects.					
CONCEPTS AND CONVENTIONS							
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		PROJECTION OF POINTS, LINES AND PLANE SURFACE				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 - II		PROJECTION OF SOLIDS				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. Practicing three-dimensional modeling of simple objects by CAD Software.							
Unit - III		PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES				12	
Sectioning of solids like prisms, pyramids, cylinder and cone 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-dimensional modeling of simple objects by CAD Software.							
Unit – IV		ISOMETRIC AND PERSPECTIVE PROJECTIONS				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.							
Unit - V		PLANE CURVES AND FREEHAND SKETCHING				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. 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.							
Total Periods:						60	

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Interpret orthographic projections of points, lines and plane surfaces.	K2
CO2	Illustrate the projection of solids placed in first quadrant	K2
CO3	Show the projections of sectioned solids and development of surfaces.	K2
CO4	Show the projections of isometric and perspective sections of simple solids.	K2
CO5	Interpret conic curves, involutes, cycloids and perform freehand sketching	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	-	-	-	-	-	-	-	-	1	2	-	-
CO2	3	2	-	-	-	-	-	-	-	-	1	2	-	-
CO3	3	2	-	-	-	-	-	-	-	-	1	2	-	-
CO4	3	2	-	-	-	-	-	-	-	-	1	2	-	-
CO5	3	2	-	-	-	-	-	-	-	-	1	2	-	-
CO	3	2	-	-	-	-	-	-	-	-	1	2	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Natrajan K.V., "A Text Book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2018.
2	Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2018.

Reference Books

1	Bhrott N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 53 Edition, 2019.
2	Basant Agarwal and Agarwal C.M., "Engineering Drawing", McGraw Hill, 2 nd Edition, 2019.
3	Gopalakrishna K.R., "Engineering Drawing" (Vol. I & II combined), Subhas Publications, Bangalore, 27 th Edition, 2017.
4	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.
5	Parthasarathy N. S. and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.
6	Shah M.B., and Rana B.C., "Engineering Drawing", Pearson Education India, 5 th Edition, 2015.

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.



U24GE3004		ENGINEERING PRACTICES LABORATORY			L	T	P	C
					0	0	4	2
Course Objectives:		To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.						
Exp. No		Title						
GROUP – A (CIVIL & MECHANICAL)								
I - CIVIL ENGINEERING PRACTICE								
1		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.						
2		WOOD WORK: a) Sawing, b) Planning 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						
II - MECHANICAL ENGINEERING PRACTICE								
1		WELDING WORK: a) Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding b) Practicing gas welding and Basics						
2		MACHINING WORK: a) Turning Operation b) Drilling Operation c) Tapping Operation						
3		ASSEMBLY WORK: a) Assembling a centrifugal pump b) Assembling a household mixer c) Assembling an air conditioner						
4		SHEET METAL WORK: a) Making of a square tray b) Making of a funnel						
5		FOUNDRY WORK: a) Demonstrating basic foundry operations.						
					Total Periods :		30	
GROUP B (ELECTRICAL & ELECTRONICS)								
III - ELECTRICAL ENGINEERING PRACTICE								
1		a) Residential house wiring using switches, fuse, indicator, lamp and energy meter. b) Fluorescent lamp wiring. c) Stair case wiring d) Measurement of energy using single phase energy meter. e) Measurement of resistance to earth of electrical equipment. f) Study of Iron Box wiring and assembly						
IV - ELECTRONICS ENGINEERING PRACTICE								
1		a) Study of Electronic components and equipments – Resistor colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CRO. b) Study of logic gates AND, OR, EX-OR and NOT. c) Generation of Clock Signal. d) Soldering simple electronic circuits and checking continuity. e) Study the elements of smart phone.						
					Total Periods:		30	

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO1	Demonstrate various carpentry joints and plumbing connections.	K2
CO2	Identify welding tools, equipment and perform welding joints.	K2
CO3	Demonstrate simple machining process and sheet metal work.	K2
CO4	Demonstrate basic home electrical works, appliances and measure the electrical quantities.	K2
CO5	Infer the electronic components, logic gates, soldering and test simple electronic circuits.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	1	-	-	-	-	-	2	-	-	2	1	-	-
CO2	2	1	-	-	-	-	-	2	-	-	2	1	-	-
CO3	2	1	-	-	-	-	-	2	-	-	2	1	-	-
CO4	2	1	-	-	-	-	-	2	-	-	2	1	-	-
CO5	2	1	-	-	-	-	-	2	-	-	2	1	-	-
CO	2	1	-	-	-	-	-	2	-	-	2	1	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)



U24GE2101	PHYSICS AND CHEMISTRY LABORATORY	L	T	P	C
		0	0	4	2
Course Objectives:	To make students understand and apply the basic concepts of properties of matter, light, sound, thermal properties, semiconductor physics and fibre optics by carrying out experiments. To inculcate experimental skills to test the water and to familiarize with the electro analytical techniques applied for quantitative analysis.				

PHYSICS LABORATORY

Exp. No	Title (Any seven experiments)	
1	Torsional pendulum - Determination of rigidity modulus of wire.	
2	Non-uniform bending - Determination of Young's modulus of the beam.	
3	Uniform bending – Determination of Young's modulus of the beam.	
4	Laser- Determination of the wavelength of the laser using grating.	
5	Air wedge - Determination of thickness of a thin sheet/wire.	
6	Optical fibre -Determination of Numerical Aperture and acceptance angle.	
7	Ultrasonic Interferometer - Determination of velocity of ultrasonic waves in liquids.	
8	Determination of thermal conductivity of a bad conductor – Lee's Disc method.	
9	Determination of wavelength of mercury spectrum – spectrometer grating.	
10	Determination of band gap of a semiconductor.	
Total Periods:		30

CHEMISTRY LABORATORY

Exp. No	Title(Any seven experiments)	
1	Determination of Total, Temporary & Permanent Hardness of Water by EDTA method.	
2	Determination of Chloride Content of water sample by Argentometric method.	
3	Determination of types and amount of Alkalinity in water sample.	
4	Preparation of Na ₂ CO ₃ as a primary standard and Estimation of Acidity of a water sample using the primary standard solution.	
5	Determination of Dissolved Oxygen (DO) content of water sample by Winkler's method.	
6	Determination of strength and amount of the given Hydrochloric Acid by pH metric applications.	
7	Determination of strength and amount of acids in a Mixture of Acids using Conductivity meter.	
8	Conductometric titration of Barium Chloride against Sodium Sulphate (Precipitation Titration).	
9	Estimation of Ferrous ion present in Ferrous Ammonium Sulphate (FAS) solution using Potentiometer.	
10	Estimation of Iron content of the water sample using Spectrophotometer.	
Total Periods:		30

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO1	Gain hands-on experience to analyse the Rigidity modulus and Young's modulus of materials and to determine laser wavelength, thickness of thin films, and optical fiber characteristics by applying the optical principles.	K4
CO2	Demonstrate the velocity of ultrasonic waves in a liquid medium and evaluate the compressibility of the liquid using an ultrasonic interferometer based on the understanding of ultrasonic principles.	K3
CO3	Analyze the thermal conductivity of Glass, ebonite, cardboard using Lee's Disc method, estimate the wavelength of mercury spectral lines using a spectrometer and the band gap of a semiconductor using Post-Office box.	K4
CO4	Apply the knowledge of water quality parameters in water treatment through volumetric analysis.	
CO5	Interpret the amount of metal ions present in the solutions through Instrumental analysis.	
CO6	Infer the quantity of substances present in the solution by Electro Analytical Techniques.	

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	1	1	1	-	1	-	3	-	-	3			3
CO2	-	-	-	-	-	1	-	3	-	-	3			-
CO3	2	1	1	1	-	1	-	3	-	-	3			2
CO4														
CO5														
CO6														
CO														

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Physics Laboratory Manual / Record, Department of Physics.
2	Bhattacharya D K and Poonam Tandon, "Engineering Physics", 2nd Edition, Oxford University Press, Chennai, 2017
3	Marikani A, "Engineering Physics", 3rd edition, PHI publishers, Chennai, 2021.
4	Dr V.Veeraiyan, Dr L .Devaraj Stephan, "Chemistry Lab Manual "2021.
5	Engineering Chemistry Laboratory Manual / Record, Department of Chemistry.

Reference Books

1	Shatendra Sharma and Jyotsna Sharma, "Engineering Physics", 2nd Edition, Pearson India Education Services Private Limited, Chennai, 2018
2	Avadhanulu M N, Kshirsagar P G, Arun Murthy TVS, "A Text book of Engineering Physics", 2nd Edition, S Chand Publishing, New delhi, 2018.
3	Thyagaran K, Ajoy Ghatak, "Lasers - Fundamentals and Applications", 2nd Edition, Laxmi Publications Pvt Limited, New Delhi, 2019.
4	J. Mendham, R. C. Denney, J.D. Barnes, M. Thomas and B. Sivasankar, "Vogel's Textbook of Quantitative Chemical Analysis" (2009).
5	Daniel C. Harris, "Quantitative Chemical Analysis" 2015.



U24GE7101	ENGLISH LABORATORY	L	T	P	C
		0	0	2	1
Course Objectives:	To build on students' English language skills by engaging them in listening, speaking and grammar learning activities that are relevant to authentic contexts.				
Exp. No	Title				
1	Telephone communication				
2	Self-Introduction				
3	Summarising a documentary				
4	Mini Presentation				
5	Product Description				
6	Picture Comprehension				
7	Ted Talks Report				
8	Travelogue				
9	Debates and Discussions				
10	Just a Minute				
Total Periods:				30	

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO1	Relate the fundamentals of communication.	K2
CO2	Explain different points of view in a discussion on various topics	K2
CO3	Illustrate products and processes based on their purpose	K2
CO4	Explain fluently and accurately in formal and informal communicative contexts	K2
CO5	Interpret their opinions effectively in both formal and informal discussions	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	-	-	-	-	-	-	-	3	3	-	3	-	-	-
CO2	-	-	-	-	-	-	-	3	3	-	3	-	-	-
CO3	-	-	-	-	-	-	-	3	3	-	3	-	-	-
CO4	-	-	-	-	-	-	-	3	3	-	3	-	-	-
CO5	-	-	-	-	-	-	-	3	3	-	3	-	-	-
CO	-	-	-	-	-	-	-	3	3	-	3	-	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)



U24GE7102	DESIGN THINKING FOR INNOVATION			L	T	P	C
				0	0	2	1
Course Objectives:		To understand innovation, stages involved in design thinking and use the different idea generation techniques in Design Thinking.					
Unit - I	HISTORY OF MODERN DESIGN					4	
Introduction to Engineering design, History of Modern design: Early innovations- industrialization, Global Innovation Index-Design Thinking and Innovation.							
Unit - II	DESIGN THINKING APPROACHES					6	
Design thinking as a systematic approach to innovation, Three lenses of Design thinking, design challenges, product development-Case studies							
Unit - III	STAGES OF DESIGN THINKING					6	
Introduction – Empathize- Define- Ideate- Prototype- Test- Examples, constraints in design- Case studies							
Unit – IV	IDEA GENERATION TECHNIQUES					6	
Introduction -Creative Thinking-Idea Generation Techniques- brain storming, visual thinking, Mind Mapping- SCAMPER, Story boarding, Questioning Assumptions, Reverse Thinking- Case studies							
Unit - V	DESIGN THINKING AND INNOVATION					8	
Innovation, User Values and Behaviours-experimental mindset strategies for creativity, teams for innovation, design alternatives, decision making for new design.Concept Poster: Organize all information about an innovation concept to identify critical questions for prototyping. Project: Apply tools to your innovation problem or the provided scenario							
Total Periods:						30	

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO1	Explain early innovations in modern design history	K2
CO2	Classify design thinking approaches and applications	K2
CO3	Illustrate stages and constraints of design thinking	K2
CO4	Interpret various idea generation techniques and applications	K2
CO5	Demonstrate innovation concepts and creative strategies with suitable techniques	K2



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	-	-	-	1	3	-	-	2	-	-	-	-	-
CO2	2	1	-	-	1	3	-	-	2	-	2	-	-	-
CO3	2	1	-	-	1	3	-	-	2	-	2	-	-	-
CO4	2	1	-	-	1	3	-	-	2	-	2	-	-	-
CO5	2	1	-	-	1	3	-	-	2	-	2	-	-	-
CO	2	1	-	-	1	3	-	-	2	-	2	-	-	-

Correlation levels 1, 2 and 3 are defined below:

1. Slight

2. Moderate

3. Substantial(High)

Text Books

1	John.R.Karsnitz, Stephen O'Brien and John P. Hutchinson, "Engineering Design", Cengage learning (International edition) Second Edition, 2013
2	Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage", Harvard Business Press, 2009.
3	Hasso Plattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand – Improve – Apply", Springer, 2011
4	Idris Mootee, "Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School", John Wiley & Sons 2013

Reference Books

1	"Design Thinking - A Primer" By Prof. Ashwin Mahalingam, Prof. Bala Ramadurai, IIT Madras
2	Design Thinking: A User-Centred Approach To Innovation. (2023). Dr. Harjinthar Singh, Dr. Khairul Anuar Abdul Wahid: Marc & Zed PUBLISHING.
3	"Design Thinking - A Primer" By Prof. Ashwin Mahalingam, Prof. Bala Ramadurai, IIT Madras. Swayan NPTEL course
4	Yousef Haik and Tamer M. Shatin, "Engineering Design Process", Cengage Learning, Second Edition, 2011.
5	Handbook of Design Thinking: Tips & Tools for how to design thinking by Christian MuellerRoterberg, Kindle Direct Publishing



U24HS1201		PROFESSIONAL ENGLISH II			L	T	P	C
					2	0	0	2
Course Objectives:		To improve the basic grammar with reading, writing and analytical thinking skills in comprehending documents through professional context which demonstrate an understanding of job application, 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		BUSINESS COMMUNICATION					6	
Technical Synonyms and Antonyms, 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		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 Periods:							30	

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Compare the ideas in technical context.	K2
CO2	Interpret the cause and effects in events, industrial processes through writing and speaking skills.	K2
CO3	Relate problems for feasible solutions and communicate it in professional format.	K2
CO4	Explain logical ideas and opinions in technical context.	K2
CO5	Outline professional resume for internships and jobs in an effective manner.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	-	-	-	-	-	-	-	2	3	-	3	-	-	-
CO2	-	-	-	-	-	-	-	2	3	-	3	-	-	-
CO3	-	-	-	-	-	-	-	2	3	-	3	-	-	-
CO4	-	-	-	-	-	-	-	2	3	-	3	-	-	-
CO5	-	-	-	-	-	-	-	3	3	-	3	-	-	-
CO	-	-	-	-	-	-	-	2	3	-	3	-	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

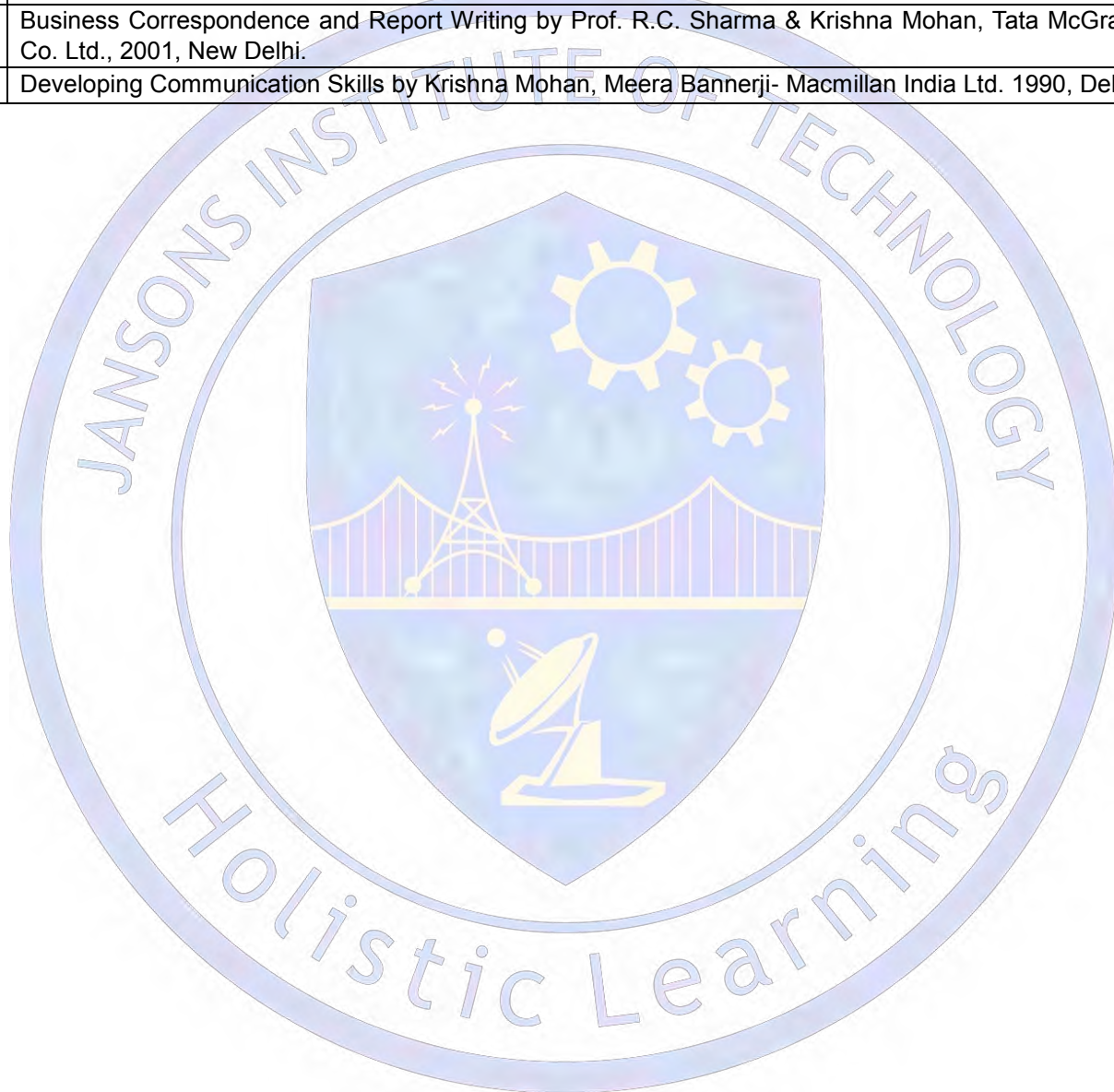


Text Books

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

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, New Delhi.
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.



U24MA2202		TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS				L	T	P	C
						3	1	0	4
Course Objectives:		Introduce essential PDE concepts and Fourier series analysis for engineering, exploring heat flow solutions and diverse scenarios, while also incorporating Z transform for discrete time systems.							
Unit - I		PARTIAL DIFFERENTIAL EQUATIONS						9+3	
		Formation of partial differential equations – Classification of linear and nonlinear partial differential equations - Solutions of standard types of first order partial differential equations - First order partial differential equations reducible to standard types- Lagrange's linear equation - Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.							
Unit - II		FOURIER SERIES						9+3	
		Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series and cosine series – Root mean square value – Parseval's identity – Complex form of the Fourier series – Harmonic analysis.							
Unit - III		APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS						9+3	
		Classification of PDE – Method of separation of variables - Fourier series solutions of one-dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two-dimensional equation of heat conduction (Cartesian coordinates only).							
Unit – IV		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 - V		Z - TRANSFORMS AND DIFFERENCE EQUATIONS						9+3	
		Z-transforms - Elementary properties – Convergence of Z-transforms - – Initial and final value theorems - Inverse Z-transform using partial fraction and convolution theorem - Formation of difference equations – Solution of difference equations using Z - transforms.							
		Total Periods:						60	

Course Outcomes

On completion of the course, the student can

CO	Statements	K-Level
CO1	Identify the various methods to solve the given partial differential equations.	K3
CO2	Construct the functions as a Fourier series.	K3
CO3	Apply the Fourier series techniques to solve the one-dimensional, two-dimensional heat flow problems and one-dimensional wave equations.	K3
CO4	Solve the physical engineering challenges by using Fourier transforms techniques.	K3
CO5	Make use of the Z- transform techniques to solve the ordinary difference equations.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO	3	2	-	-	-	-	-	-	-	-	1	-	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Grewal B.S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, New Delhi, 2018.
2	Kreyszig E, "Advanced Engineering Mathematics", 10th Edition, John Wiley, New Delhi, India, 2018.

Reference Books

1	Andrews. L.C and Shivamoggi. B, "Integral Transforms for Engineers", SPIE Press, 1999.
2	Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 10th Edition, Laxmi Publications Pvt. Ltd, 2021.
3	James. G., "Advanced Modern Engineering Mathematics", 4th Edition, Pearson Education, New Delhi, 2016.
4	Narayanan. S., Manicavachagom Pillay.T.K and Ramanaiah.G, "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.
5	Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2018.
6	Wylie. R.C. and Barrett. L.C., "Advanced Engineering Mathematics", Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.



U24PH2203	SEMICONDUCTOR PHYSICS, ELECTRICAL MACHINES AND INSTRUMENTATION	L	T	P	C
		3	0	0	3
Course Objectives:	To make the students understand and apply the electrical properties, principles of quantum mechanics, semiconductor properties on engineering materials. To study the construction and working of Transformers, DC machine and AC machines and measuring instruments.				
Unit - I	ELECTRICAL PROPERTIES OF MATERIALS	7			
Classical free electron theory - Expression for electrical conductivity – Thermal conductivity expression - Quantum free electron theory: Fermi- Dirac statistics – Density of energy states – Electronic periodic potential – Energy bands in solid: Concept of Conduction band, valence band and Forbidden band. - Tight binding approximation - Electron effective mass – concept of hole.					
Unit - II	FUNDAMENTAL PROPERTIES OF SEMICONDUCTORS	10			
Intrinsic Semiconductors – direct and indirect band gap semiconductors – Carrier concentration in intrinsic semiconductors – extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors – Variation of carrier concentration with temperature - Hall effect and devices - Introduction to P-N junction Diode and V-I characteristics, Zener diode and its characteristics, Schottky barrier diode- Varactor diode –Tunnel diode - UJT- LDR.					
Unit - III	TRANSFORMER	11			
Introduction – Faraday law of electromagnetic induction, Statically Induced EMF, self and Mutual inductances, basics of LCR circuit, Coefficient of coupling – Construction, principal, and operation of transformers - Ideal and Practical Transformer – Phasor diagram— Per Unit System – Equivalent circuit- Testing- Efficiency and Voltage Regulation – Three Phase Transformers – Applications- Auto Transformers, Advantages – Harmonics – Concept of harmonic Oscillator.					
Unit – IV	ELECTRICAL MACHINES	11			
Definition of MMF, Flux, Reluctance, Flux density, Comparison between electric and magnetic circuits, Lenz's law, dynamically induced EMF, Force on a current carrying element in a magnetic field, Fleming's right- and left-hand rules - Construction and Working principle of DC Machines - DC Separately and Self-excited Generators, EMF equation, Types and Applications. Working Principle of DC motors, Torque Equation, Types and Applications, three phase Alternator, Synchronous motor and Three Phase Induction Motor, Introduction to Special Machines, PMDC motor, SRM Motor and Stepper Motor.					
Unit - V	MEASUREMENTS AND INSTRUMENTATION	6			
Functional elements of an instrument, Standards and calibration, Operating Principle, types – Moving Coil and Moving Iron meters, Measurement of three phase power, Energy Meter, Instrument Transformers - CT and PT, DSO - Block diagram - Data acquisition- Introduction to sensors.					
Total Periods:					45

Course Outcomes

On completion of the course, the student can

CO	Statements	K-Level
CO1	Explain the electrical and thermal properties of materials	K2
CO2	Summarize the operating principles of semiconductor devices	K2
CO3	Apply the working principles of electrical transformers	K3
CO4	Apply the working principles of AC and DC motors.	K3
CO5	Explain the different types of measuring instruments.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO– PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	2	-	-
CO3	3	2	-	-	-	-	-	-	-	-	1	2	-	-
CO4	3	2	-	-	-	-	-	-	-	-	1	2	1	1
CO5	3	2	-	-	-	-	-	-	-	-	-	2	1	1
CO	3	2	-	-	-	-	-	-	-	-	1	2	1	1

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	S.O. Kasap. Principles of Electronic Materials and Devices, McGraw Hill Education (Indian Edition), 2020.
2	Kothari DP and I.J Nagrath, "Basic Electrical and Electronics Engineering", Second Edition, McGraw Hill Education, 2020.
3	A.K. Sawhney, Puneet Sawhney 'A Course in Electrical and Electronic Measurements & Instrumentation', Dhanpat Rai and Co, New Delhi, 2015.

Reference Books

1	Laszlo Solymar, Walsh, Donald, Syms and Richard R.A., Electrical Properties of Materials, Oxford Univ. Press (Indian Edition) 2015.
2	Jaspri Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Education (Indian Edition), 2019.
3	Charles Kittel, Introduction to Solid State Physics, Wiley India Edition, 2019.
4	Mark Fox, Optical Properties of Solids, Oxford Univ. Press, 2001.
5	N. Gershenfeld, The Physics of Information Technology. Cambridge University Press, 2011.



U24EC4201		CIRCUIT ANALYSIS		L	T	P	C
				3	1	0	4
Course Objectives:		To familiarize the basic laws and theorems of DC and AC circuits, interpret the transient and steady state response for various excitations and familiarize the resonance phenomena.					
Unit - I		DC CIRCUIT ANALYSIS					12
Basic Components of electric Circuits, Charge, current, Voltage and Power, Voltage and Current Sources, Ohms Law, Kirchoff's Current Law, Kirchoff's voltage law, Series and Parallel connections of Resistors, Inductors and capacitors, voltage and current division, Nodal analysis, Mesh analysis.							
Unit - II		NETWORK THEOREM AND DUALITY					12
Useful Circuit Analysis techniques - Linearity and superposition, Thevenin and Norton Equivalent Circuits, reciprocity, Millman, Maximum Power Transfer. Delta-Wye Conversion. Duals, Dual circuits. Analysis using dependent current sources and voltage sources.							
Unit - III		SINUSOIDAL STEADY STATE ANALYSIS					12
Sinusoidal Steady – State analysis , Characteristics of Sinusoids, The Complex Forcing Function, The Phasor, Phasor relationship for R, L, and C, impedance and Admittance, Nodal and Mesh Analysis, Phasor Diagrams, AC Circuit Power Analysis, Instantaneous Power, Average Power, apparent Power and Power Factor, Complex Power.							
Unit – IV		TRANSIENTS IN RLC CIRCUITS					12
Basic RL and RC Circuits, The Source- Free RL Circuit, The Source-Free RC Circuit, The Unit-Step Function, Driven RL Circuits, Driven RC Circuits, RLC Circuits, Frequency Response.							
Unit - V		RESONANCE AND COUPLED CIRCUITS					12
Parallel Resonance, Series Resonance, Quality Factor, Magnetically Coupled Circuits, Mutual Inductance, the Linear Transformer, the Ideal Transformer.							
Total Periods:							60

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Infer the basic concepts of circuit analysis such as Kirchoff's laws, mesh current and node voltage method on DC and AC circuits.	K2
CO2	Interpret network theorems on AC and DC circuits.	K2
CO3	Infer the steady state response of R, L and C circuits.	K2
CO4	Explain the transient response of RC, RL and RLC circuits	K2
CO5	Illustrate the frequency response of parallel and series resonance circuits and coupled circuits.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	-	-	-	-	-	-	-	-	-	2	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	2	-	-
CO3	3	3	-	-	-	-	-	-	-	-	-	1	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	1	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	1	-	-
CO	3	2	-	-	-	-	-	-	-	-	-	1	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Hayt Jack Kemmerly, Steven Durbin, "Engineering Circuit Analysis", Mc Graw Hill education, 9th Edition, 2018.
2	Charles K. Alexander & Mathew N.O.Sadiku, "Fundamentals of Electric Circuits", Mc GrawHill, 2nd Edition, 2003.
3	Joseph Edminister and Mahmood Nahvi, —Electric Circuits, Schaum's Outline Series, Tata McGraw Hill Publishing Company, New Delhi, Fifth Edition Reprint 2016.

Reference Books

1	Robert.L. Boylestead, "Introductory Circuit Analysis", Pearson Education India, 12 th Edition, 2014.
2	David Bell, "Fundamentals of Electric Circuits", Oxford University press, 7 th Edition, 2009.
3	John O Mallay, Schaum's Outlines "Basic Circuit Analysis", The Mc Graw Hill companies, 2 nd Edition, 2011.
4	Allan H.Robbins, Wilhelm C.Miller, "Circuit Analysis Theory and Practice", Cengage Learning, Fifth Edition, 1 st Indian Reprint 2013.



U24GE3001		PROBLEM SOLVING AND PYTHON PROGRAMMING		L	T	P	C
				3	0	0	3
Course Objectives:		To understand the basics of algorithmic problem solving and solve problems using python conditionals, loops and functions. To gain knowledge about the concepts of data structures - lists, tuples, dictionaries to represent complex data and input/output with files in python.					
Unit - I	COMPUTATIONAL THINKING AND PROBLEM SOLVING					8	
Introduction - Translators - Compilation and Interpretation - Language Processors - Computer Software –Types of Software – Application Software Packages - Software Development Steps - Fundamentals of Computing – Identification of Computational Problems – Algorithms - Building Blocks of Algorithms - Notation - Algorithmic Problem Solving - Strategies for Developing Algorithms.							
Unit - II	DATA TYPES, EXPRESSIONS, STATEMENTS					8	
Introduction to Python – History & Versions - Importance of Python – Applications - Comparison of Python with C and Java - Installing Python in Windows & Ubuntu - Structure of a Python Program - Standard libraries in Python - Executing Python programs - Python Interpreter and Interactive Mode - Types of Errors – Keywords - Values and Types - Variable Names and Keywords - Type Conversion - Operators and Operands - Precedence of Operators - Expressions – Statements.							
Unit - III	CONTROL FLOW, FUNCTIONS, STRINGS					8	
Conditionals Statements – Boolean Values and Operators – Conditional: if – Alternative: if-else - Chained Conditional: if-else-if - Iteration Statements – state – while – for – break – continue -pass - Fruitful Functions; Return Values, Parameters, Local and Global Scope, Function Call, Function Composition, Recursion; Strings: String Slices, Immutability, String Functions and Methods, String Module - Programs using Decision Making, Loops, Functions and Strings.							
Unit – IV	LISTS, TUPLES, DICTIONARIES					8	
Lists: List Operations - List Slices - List Methods and Functions - List Loop, Mutability – Aliasing - Cloning Lists - List Parameters; Tuples: Tuples Operations - Methods and Functions - Tuple Assignment - Tuple as Return Value; Dictionaries: Operations - Methods and Functions - Programs using Lists, Tuples and Dictionaries.							
Unit - V	FILES, MODULES, PACKAGES					13	
Files and Exception: File Types – Text Files – Binary Files - Reading and Writing files - Format Operator - Command Line Arguments - Errors and Exceptions - Handling Exceptions, Modules: Modules and Files – Namespaces - Importing Modules - Importing Module Attributes - Module Built-in Functions – Packages - Other Features of Modules, Introduction to Basic Standard Libraries - Installation of pip - Demonstrate Modules, Python Packages: Built-in functions of packages matplotlib, numpy, pandas - Explore Packages, Databases Connectivity using Python - Connecting to a Database, Creating Tables, INSERT, UPDATE, DELETE and READ Operations, Transaction Control, Disconnecting from a Database, Exception Handling in Databases, Python Frameworks: Overview of Django & Flask framework with an example.							
Total Periods:						45	



Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Outline the algorithmic solutions to solve the simple computational problems.	K2
CO2	Infer and execute simple python programs.	K2
CO3	Explain the simple python program using functions, conditionals and looping.	K2
CO4	Interpret the compound data using python lists, tuples and dictionaries.	K2
CO5	Extend the usage of read and write data from/to files in python programs.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
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	1	-	-
CO	2	1	1	-	-	-	-	-	-	-	1	1	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021.
2	John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", Third Edition, MIT Press, 2021.
3	David Amos, Dan Bader, Joanna Jablonski, Fletcher Heisler, "Python Basics: A Practical Introduction to Python3", 4th Edition, 2020.
4	Udayan Das, Aubrey Lawson, Chris Mayfield, Narges Norouzi, "Introduction to Python Programming", OpenStax, Rice University, Texas, 2024.

Reference Books

1	Arockia Mary P, Problem Solving and Python Programming, Shanlax Publications, 2021.
2	G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.
3	Dr. Krishna Kumar Mohbey, Dr. Brijesh Bakariya, "An Introduction to Python Programming: A Practical Approach", BPB Publications, 2021.



U24GE1201	TAMILS AND TECHNOLOGY		L	T	P	C
			1	0	0	1
Course Objectives:	This course enables the students to understand the art of making things and developments in the lifestyle of people, understand the various methods of constructing buildings, understand the techniques being used in Architecture by Tamils and also understand and apply the concepts of Tamil with modern technology.					
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 Periods:						15

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Understand the gradual improvement in the life history of Tamils.	K2
CO2	Interpret the concepts of the design & construction technology in Sangam age.	K2
CO3	Explain the manufacturing technology in the Sangam age.	K2
CO4	Summarise the ancient skills to find out the measurements of oceans.	K2
CO5	Outline the concepts of Tamil with modern technology.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	-	-	-	-	-	-	1	-	-	-	2	-	-	-
CO2	-	-	-	-	-	-	1	-	-	-	2	-	-	-
CO3	-	-	-	-	-	-	1	-	-	-	2	-	-	-
CO4	-	-	-	-	-	-	1	-	-	-	2	-	-	-
CO5	-	-	-	-	-	-	1	-	-	-	2	-	-	-
CO	-	-	-	-	-	-	1	-	-	-	2	-	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)



Text Books

1	தமிழகவரலாறு – மக்களும்பண்பாடும் – கே. கே. பிள்ளை (வெளியீடு: தமிழ்நாடுபாடநூல்மற்றும்கல்வியியல்பணிகள்கழகம்).
2	கணினித்தமிழ் – முனைவர். இல. சுந்தரம். (விகடன்பிரசுரம்).
3	கீழடி – வைகைநதிக்கரையில்சங்ககாலநகரநாகரிகம் (தொல்லியல்துறை வெளியீடு)
4	பொருதை – ஆற்றங்கரை நாகரிகம். (தொல்லியல்துறைவெளியீடு)
4	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)

Reference Books

1	Social Life of the Tamils - The Classical Period (Dr. S. Singaravelu) (Published by: International Institute of Tamil Studies).
2	Historical Heritage of the Tamils (Dr. S. V. Subramanian, Dr. K. D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
3	The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by: International Institute of Tamil Studies.)
4	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, and Educational Services Corporation, Tamil Nadu)
5	Studies in the History of India with Special Reference to Tamil Nadu (Dr. K. K. Pillay) (Published by: The Author)
6	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu).
7	Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by: RMRL) – Reference Book.



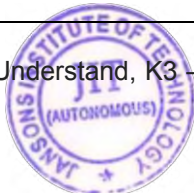
U24GE1201		தமிழரும்தொழில்நுட்பமும்			
		L	T	P	C
		1	0	0	1
Course Objectives:	இந்தபாடத்திட்டத்தில், மக்களின் வாழ்க்கை முறையில் பொருட்களை உருவாக்கும் கலை மற்றும் மேம்பாடுகளை புரிந்து கொள்ளவும், கட்டிடங்கள் கட்டும் பல்வேறு முறைகளை புரிந்துகொள்ளவும், தமிழர்கள் கட்டிடக்கலையில் பயன்படுத்தப்படும் நுட்பங்களை புரிந்துகொள்ளவும், நவீனதொழில் நுட்பத்துடன் தமிழின் கருத்துக்களை புரிந்துகொள்ளவும் பயன்படுத்தவும் உதவுகிறது.				
Unit - I	நெசவுமற்றும்பானைத்தொழில்நுட்பம்				3
சங்க காலத்தில் நெசவுத் தொழில் - பானைத் தொழில் நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் - பாண்டங்களில் கீறல் குறியீடுகள்.					
Unit - II	வடிவமைப்புமற்றும்கட்டிடத்தொழில்நுட்பம்				3
சங்ககாலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்ககாலத்தில் வீட்டுப் பொருட்களில்வடிவமைப்பு - சங்ககாலத்தில் கட்டுமான பொருட்களும், நடு கல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் -சோழர்காலத்து பெருங்கோவில்கள் மற்றும் பிற வழிபாட்டுத்தலங்கள் - நாயக்கர்காலக் கோயில்கள் - மாதிரிகட்டமைப்புகள்பற்றிஅறிதல், மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலைநாயக்கர் மஹால் - செட்டிநாட்டு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ - சாரோ செனிக் கட்டிடக்கலை.					
Unit - III	உற்பத்தித்தொழில்நுட்பம்				3
கப்பல் கட்டும் கலை - உலோகவியல் - இரும்புத் தொழிற்சாலை - இரும்பை உருக்குதல், எஃகு - வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்கநாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள், கண்ணாடி மணிகள் - சுடு மண்மணிகள் - சங்கு மணிகள் - எலும்புத்துண்டுகள் - தொல்லியல் சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.					
Unit - IV	வேளாண்மைமற்றும்நீர்ப்பாசனத்தொழில்நுட்பம்				3
அணை, ஏரி, குளங் கள் , மதகு - சோழர் காலக் குழுவித் தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு - மீன் வளம் - முத்து மற்றும் முத்துக்குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்.					
Unit - V	அறிவியல் தமிழ் மற்றும் கணித் தமிழ்				3
அறிவியல் தமிழின் வளர்ச்சி - கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின் பதிப்பு செய் தல் - தமிழ் மென் பொருட்கள் உருவாக்கம் - தமிழ் இணையக் கல் விக்கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம் .					
Total Periods:					15

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	தமிழர்களின் வாழ்க்கை வரலாற்றில் படிப்படியான முன்னேற்றத்தை அறிந்து கொள்ளலாம்.	K2
CO2	கடந்த காலத்தின் தாக்கத்தை நிகழ்காலத்துடன் சேர்த்து வீடுகள் மற்றும் கட்டிடங்களை கட்டலாம்.	K2
CO3	தொழில்நுட்பத்தின் உதவியுடன் குறிப்பிடத்தக்க விஷயங்களை உருவாக்க கற்றுக்கொள்ளலாம்.	K2
CO4	கடல்களின் அளவீடுகளைக் கண்டறிய பண்டைய திறன்களைப் பயன்படுத்தலாம்.	K2
CO5	தமிழின் கருத்துக்களை நவீன தொழில்நுட்பத்துடன் பயன்படுத்தலாம்.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	-	-	-	-	-	-	1	-	-	-	2	-	-	-
CO2	-	-	-	-	-	-	1	-	-	-	2	-	-	-
CO3	-	-	-	-	-	-	1	-	-	-	2	-	-	-
CO4	-	-	-	-	-	-	1	-	-	-	2	-	-	-
CO5	-	-	-	-	-	-	1	-	-	-	2	-	-	-
CO	-	-	-	-	-	-	1	-	-	-	2	-	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	தமிழக வரலாறு – மக்களும் பண்பாடும் – கே. கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2	கணிணித் தமிழ் – முனைவர். இல. சுந்தரம். (விகடன் பிரசுரம்).
3	கீழடி – வைகைநதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு).
4	பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)

Reference Books

1	Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
2	Historical Heritage of the Tamils (Dr. S. V. Subramanian, Dr.K.D.Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
3	The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
4	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)
5	Studies in the History of India with Special Reference to Tamil Nadu (Dr. K. K. Pillay) (Published by: The Author)
6	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu).
7	Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by: RMRL) – Reference Book.



U24GE3002	PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2
Course Objectives:	To understand the problem-solving approaches, basic programming constructs and practice various computing strategies for python-based solutions to real world problems. To familiarize the concepts of data structures - lists, tuples, dictionaries and input/output with files in Python.				
Exp. No	Title				
1	Install and configure Python IDE				
2	Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same.				
3	Python programming using simple statements and expressions				
4	Scientific problems using Conditionals and Iterative loops.				
5	Implementing real-time/technical applications using Lists, Tuples.				
6	Implementing real-time/technical applications using Sets, Dictionaries.				
7	Implementing programs using Functions.				
8	Implementing programs using Strings.				
9	Implementing programs using written modules				
10	Implementing programs using packages				
11	Implementing programs using database connectivity				
12	Implementing real-time/technical applications using File handling.				
13	Implementing real-time/technical applications using Exception handling.				
14	Exploring Pygame tool.				
15	Developing a game activity using Pygame like bouncing ball, car race etc.				
Total Periods:					60

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO1	Explain and debug simple Python programs.	K2
CO2	Infer the programs in Python using conditionals and loops for solving problems.	K2
CO3	Interpret the python program stepwise by defining functions and calling them.	K2
CO4	Outline the python lists, tuples, sets and dictionaries for representing compound data.	K2
CO5	Illustrate about python files and packages for developing software applications.	K2

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	1	1	-	-	-	-	1	-	-	1	1	-	-
CO2	2	1	1	-	-	-	-	1	-	-	1	1	-	-
CO3	2	2	1	-	-	-	-	1	-	-	1	1	-	-
CO4	2	1	1	-	-	-	-	1	-	-	1	1	-	-
CO5	2	2	1	1	1	-	-	1	-	-	1	1	-	-
CO	2	1	1	1	1	-	-	1	-	-	1	1	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)



Text Books

1	Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1 st Edition, 2021.
2	John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", Third Edition, MIT Press, 2021
3	David Amos, Dan Bader, Joanna Jablonski, Fletcher Heisler, "Python Basics: A Practical Introduction to Python 3", 4 th Edition, 2020.
4	Udayan Das, Aubrey Lawson, Chris Mayfield, Narges Norouzi, "Introduction to Python Programming", OpenStax, Rice University, Texas, 2024.

Reference Books

1	Arockia Mary P, Problem Solving and Python Programming, Shanlax Publications, 2021.
2	G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1 st Edition, Notion Press, 2021.
3	Dr. Krishna Kumar Mohbey, Dr. Brijesh Bakariya, "An Introduction to Python Programming: A Practical Approach", BPB Publications, 2021
4	https://www.python.org/
5	https://realpython.com/python-modules-packages/
6	https://learnpython.com/blog/python-modules-packages-libraries-frameworks/
7	https://www.upgrad.com/tutorials/software-engineering/python-tutorial/module-and-package-in-python/



U24EC4202	CIRCUIT ANALYSIS LABORATORY	L	T	P	C
		0	0	2	1
Course Objectives:	To gain hands-on experience in circuit Theorems. RLC circuit resonance, transient behaviour of RL, RC and RLC circuits.				
Exp. No	Title				
1	Verifications of KVL & KCL.				
2	Verifications of Thevenin & Norton theorem.				
3	Verification of Superposition Theorem & Maximum power transfer Theorem.				
4	Measurement of Inductive and Capacitive Reactance				
5	Determination of Resonance Frequency of Series & Parallel RLC Circuits				
6	Transient analysis of RL and RC circuits.				
Total Periods:					30

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO1	Explain KVL & KCL.	K2
CO2	Illustrate network theorems.	K2
CO3	Demonstrate Inductive and capacitive reactance with respect to frequency.	K2
CO4	Infer the performance of series and parallel RLC circuits.	K2
CO5	Interpret RL and RC circuits under transient conditions.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	-	-	-	-	-	2	-	-	-	1	-	-
CO2	3	2	-	-	-	-	-	2	-	-	-	1	-	-
CO3	3	2	-	-	-	-	-	2	-	-	-	1	-	-
CO4	3	2	-	-	-	-	-	2	-	-	-	1	-	-
CO5	3	2	-	-	-	-	-	2	-	-	-	1	-	-
CO	3	2	-	-	-	-	-	2	-	-	-	1	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Hayt Jack Kemmerly, Steven Durbin, "Engineering Circuit Analysis", McGraw Hill education, 9 th Edition, 2018.
2	Charles K. Alexander & Mathew N.O.Sadiku, "Fundamentals of Electric Circuits", McGraw- Hill, 2 nd Edition, 2003.
3	Joseph Edminister and Mahmood Nahvi, "Electric Circuits, Schaum's Outline Series", Tata McGraw Hill Publishing Company, New Delhi, Fifth Edition Reprint 2016.

Reference Books

1	David Bell, "Fundamentals of Electric Circuits", Oxford University press, 7 th Edition, 2009.
2	John O Mallay, Schaum's Outlines "Basic Circuit Analysis", The Mc Graw Hill companies, 2 nd Edition, 2011.
3	A.Bruce Carlson, "Circuits: Engineering Concepts and Analysis of Linear Electric Circuits, Cengage Learning, India Edition 2nd Indian Reprint 2009.
4	Allan H.Robbins, Wilhelm C.Miller, "Circuit Analysis Theory and Practice", Cengage Learning, Fifth Edition, 1 st Indian Reprint 2013.



U24GE7201		COMMUNICATION LABORATORY				L	T	P	C
						0	0	4	2
Course Objectives:		To encourage group discussion, effective presentation skills to analyse concepts that are relevant to the context and able to communicate effectively through formal and informal writing.							
Exp. No	Title								
1	Speaking Skill.								
2	Role Play.								
3	Email Writing.								
4	Group Discussion.								
5	Dialogue writing.								
6	Paragraph Writing.								
7	Formal / Semi – Formal letters								
8	Writing Instructions								
9	Short Article Writing								
10	Writing Recommendations								
Total Periods:						60			

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO1	Relate speaking skills effectively in formal and semi formal context.	K2
CO2	Infer concepts with problems from various perspectives for suitable solutions.	K2
CO3	Interpret the writing skills with technical format.	K2
CO4	Explain the content with the correct format to convey information with clarity.	K2
CO5	Relate recommendations for effective execution of tasks.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	-	-	-	-	-	-	-	3	3	-	3	-	-	-
CO2	-	-	-	-	-	-	-	3	3	-	3	-	-	-
CO3	-	-	-	-	-	-	-	3	3	-	3	-	-	-
CO4	-	-	-	-	-	-	-	3	3	-	3	-	-	-
CO5	-	-	-	-	-	-	-	3	3	-	3	-	-	-
CO	-	-	-	-	-	-	-	3	3	-	3	-	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)



U24GE7202		FUNDAMENTALS OF ENTREPRENEURSHIP AND STARTUP			L	T	P	C
					0	0	2	1
Course Objectives:		To familiarize Entrepreneurship and Startups, understand and formulate the Problem Canva, Business model Canva and relate the incubation support with respect to startups.						
Unit - I	FUNDAMENTALS OF ENTREPRENEURSHIP							4
Meaning and importance of Entrepreneurship- Types of entrepreneurial skills – Entrepreneurship in different sectors- Role of entrepreneurship development programmes (EDP).								
Unit - II	FUNDAMENTALS OF STARTUP							6
Introduction- Features of Startup- Understanding problems and Customer Persona- Problem statement Canva- Empathy map and Value Proposition- Prototyping- Presentation on Problem canva.								
Unit - III	BUSINESS PLAN AND PITCHING							6
Market Analysis- Business Model Canva- Go to Market Strategy- Cost Analysis and Revenue streams- Presentation on Business model Canva.								
Unit – IV	INCUBATION SUPPORT TO STARTUPS							6
Commercialisation- Meaning and Definition of Incubation support-Functions of pre incubation and Incubation centres- Registration process.								
Unit - V	CASE STUDIES ON STARTUP							8
How to Pitch a startup- Pitch deck – Case studies of Successful startups in India- Failure analysis of Startups Pitch deck presentation.								
Total Periods:								30

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the types of entrepreneurial skills	K2
CO2	Summarize the problem statement Canva for the identified problem	K2
CO3	Extend a business plan with market analysis and financial projection	K2
CO4	Explain commercialisation and incubation support for startups	K2
CO5	Demonstrate a pitch deck for startup with insights from the case studies	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	1	-	-	-	-	-	-	-	-	-	2	-	-	-
CO2	1	-	-	-	-	1	-	2	2	-	2	-	-	-
CO3	-	-	-	-	-	1	-	2	2	1	2	-	-	-
CO4	1	-	-	-	-	1	2	-	-	-	2	-	-	-
CO5	-	-	-	-	-	1	2	2	3	-	2	-	-	-
CO	1	-	-	-	-	1	2	2	2	1	2	-	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	"Entrepreneurship: Theory, Process, and Practice" Authors: Donald F. Kuratko, Richard M. Hodgetts, and Justin G. Longenecker, Publisher: Cengage Learning Year of Publication: 2021.
2	"Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers".
3	Alexander Osterwalder and Yves Pigneur Publisher: Wiley Year of Publication: 2010.
4	Rashmi Bansal, Connect the Dots, Westland and Tranquebar Press, 2012.



Reference Books

1	"Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses" by Eric Ries, Publisher: Currency, Year of Publication: 2011.
2	"The Art of the Start 2.0: The Time-Tested, Battle-Hardened Guide for Anyone Starting Anything" Author: Guy Kawasaki, Publisher: Portfolio, Year of Publication: 2015.



U24MA2302	RANDOM PROCESSES AND LINEAR ALGEBRA		L	T	P	C
			3	1	0	4
Course Objectives:	This course covers vector spaces, linear transformations, and inner product spaces with a focus on engineering applications. It also introduces probability concepts, including random variables and distributions, relevant to random signals and linear systems. Students will apply these principles to tackle real-world engineering challenges.					
Unit - I	PROBABILITY AND RANDOM VARIABLES					9+3
Axioms of probability - Conditional probability - Baye's theorem - Applications of Bayes' Theorem - Discrete and continuous random variables - Probability mass function, Probability density function, Cumulative distribution function - Moments - Raw moments and Central moments - Momeni generating functions - Properties of moment generating functions - Discrete distributions: Binomial, Poisson and Geometric distributions - Continuous Distributions: Uniform. Exponential and Normal distributions - Applications of discrete and continuous distributions.						
Unit -11	TWO - DIMENSIONAL RANDOM VARIABLES					9 +3
Joint distributions - Joint probability mass function for discrete random variables - Joint probability density function for continuous random variables - Joint cumulative distribution function - Marginal distribution for discrete random variables - Marginal distribution for Continuous random variables - Conditional distribution for discrete random variables - Conditional distribution for continuous random variables - Independence of random variables in joint distribution - Definition of covariance between two random variables - Properties of covariance - Covariance and independence - Correlation coefficient (Pearson's Correlation) - Properties of correlation - Spearman's rank correlation - linear regression - Central limit theorem (for independent and identically distributed random variables).						
Unit - III	RANDOM PROCESSES					9+3
Classification - Stationary process - Definitions of autocorrelation and autocovariance in stationary processes - Types of stationary processes: Strict Sense Stationary process, Wide Sense Stationary process - Applications of stationary processes in signal processing - Markov process - Types of Markov processes: Discrete-time Markov process - Continuous-time Markov process - Definition of Poisson process - Properties of Poisson process - Poisson distribution of the number of events in an Interval - Exponential Inter-arrival times - Definition of discrete parameter Markov chain - Transition probability matrix - Classification of states: Transient states, Recurrent states and Absorbing states - Chapman Kolmogorov equations (Statement only) - Limiting distributions.						
Unit-IV	VECTOR SPACES					9+3
Vector spaces: Axioms of vector spaces - Definition of vector spaces - Subspaces: Definition, Condition for a subspace - Row space, Column space and Null space of matrices - Linear combinations - Linear independence and linear dependence - Spanning sets and basis of subspaces - Linear transformation - Kernel and ranges - Bases and dimensions - Dimension theorem - Matrix representation of a linear transformations - Constructing the matrix representation of a linear transformation with respect to given bases - linear system of equations.						
Unit -V	INNER PRODUCT SPACES					9+3
Inner product: Definition of inner product, Properties of inner product - Norms (Euclidean norm only): Definition of a norm. Properties of norms - - Norms induced by inner products - Schwartz inequality - Properties - Orthogonality in inner product spaces - Orthogonal and orthonormal vectors - Properties of orthogonal and orthonormal vectors - Definition of orthogonal projection - Projection onto a subspace - - Gram Schmidt orthogonalization process - Adjoint of linear operations - Least squares approximation: Least squares solution, least squares error vector.						
Total Periods: J 60						



Course Outcomes

On completion of the course, the student can

Cos	Statements	K - Level
CO01	Apply the fundamental concepts of probability with knowledge of standard distributions that can describe certain real-life phenomenon.	K3
CO02	Relate the basic concepts of two dimensional random variables with one dimensional random variable and apply them to model engineering problems.	K3
CO03	Able to use the concept of random processes in engineering disciplines.	K3
CO04	Utilize the fundamental concepts of vector spaces in real life problems	K3
CO05	Make use of inner product spaces and linear transformation to find least square solution of engineering problems.	K3

Knowledge Level: K1 - Remember, K2 - Understand, K3 -Apply, K4 - Analyze, K5 - Evaluate, K6 - Create

CO-PO-PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO01	3	2	1	-	-	-	-	-	-	-	-	-	-	-
CO02	3	2	1	-	-	-	-	-	-	-	-	-	-	-
CO03	3	2	1	-	-	-	-	-	-	-	-	-	-	-
CO04	3	2	1	-	-	-	-	-	-	-	-	-	-	-
CO05	3	2	1	-	-	-	-	-	-	-	-	-	-	-
Co	3	2	1	-	-	-	-	-	-	-	-	-	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial(High)



Text Books

1	Gross, D., Shortle, J.F, Thompson, J.M and Harris. C.M., "Fundamentals of Queueing Theory", Wiley Student 4th Edition, 2014.
2	Ibe, O.C., "Fundamentals of Applied Probability and Random Processes", Elsevier.1st Indian Reprint, 2007.
3	Friedberg. A.H., Insel. A.J. and Spence. L., "Linear Algebra", Prentice Hall of India, New Delhi, 4th Edition, 2004.
4	Howard Anton and Chris Rorres, "Elementary Linear Algebra: Applications Version", Wiley, 11 th Edition, 2013.

Reference Books

1	Hsu, "Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes", Tata McGraw Hill Edition. New Delhi, 2004.
2	Peyton Z., Peebles, J.R., "Probability, Random Variables and Random Principles", Tata McGraw-Hill Publications, 4 th Edition, 2008.
3	Trivedi, K.S., "Probability and Statistics with Reliability, Queueing and Computer Science Applications", 2nd Edition, John Wiley and Sons, 2002.
4	Yates, R.D. and Goodman. D. J., "Probability and Stochastic Processes", 2nd Edition, Wiley India Pvt. Ltd., Bangalore, 2012.
5	Kolman. B. Hill. D.R., "Introductory Linear Algebra", Pearson Education, New Delhi, First Reprint, 2009.
6	Kumaresan. S., "Linear Algebra -A Geometric Approach", Prentice - Hall of India, New Delhi, Reprint, 2010.
7	Strang. G., "Linear Algebra and its applications", Thomson (Brooks/Cole), New Delhi, 2005.



U24EC4301	CONTROL SYSTEMS	L	T	P	C
		3	0	0	3
Course Objectives:	To introduce the components in control systems and learn their representation, analyse the time response, frequency response and stability of the system using various methods and understand the state space approach for control systems.				
Unit – I	SYSTEMS COMPONENTS AND THEIR REPRESENTATION	9			
Basic components of control system—Open loop and closed loop systems- examples- Types of feedback- Mathematical modelling of Electrical and Mechanical systems- Equivalence between the elements of different types of systems- Transfer function of linear systems, Block diagram representation, Block diagram reduction techniques, Signal flow graph using Mason's gain formula.					
Unit – II	TIME DOMAIN RESPONSE	9			
Transient response-Steady state response-Time domain specifications- Types of test inputs- Order and type of a system- Poles & Zeros- Response of I order and II order systems-Steady state errors – P, PI, PD and PID controllers.					
Unit - III	FREQUENCY DOMAIN RESPONSE	9			
Frequency response-Performance specification in frequency domain-Gain margin and phase margin- Bode Plot - Polar Plot- Stability analysis in frequency domain-Design of compensators using Bode plots-Cascade lead compensation-Cascade lag compensation-Cascade lag-lead compensation					
Unit – IV	CONCEPTS OF STABILITY ANALYSIS	9			
Concept of stability-Bounded - Input Bounded - Output stability-Routh stability criterion-Relative stability-Root locus concept-Guidelines for sketching root locus-Nyquist stability criterion.					
Unit – V	CONTROL SYSTEM ANALYSIS USING STATE VARIABLE METHODS	9			
State variable representation-Conversion of state variable models to transfer functions-Conversion of transfer functions to state variable models-Solution of state equations-State Transition matrix- Controllability and Observability- Artificial intelligence for closed loop control systems					
Total Periods:					45

Course Outcomes

On completion of the course, the student can

Cos	Statements	K-Level
CO1	Develop the transfer function for different physical systems using mathematical modelling, block diagram and signal flow graph	K3
CO2	Analyse the time response using time domain specifications and steady state error	K4
CO3	Solve the frequency response characteristics of control systems using bode plot and polar plot	K3
CO4	Examine the stability of a system using Routh table and root locus	K4
CO5	Illustrate the state space model of a physical system and the concepts of controllability and observability	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO–PO–PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	3	2	1	-	1	-	-	-	-	1	3	-	-
CO2	3	3	2	1	1	-	-	-	-	-	1	3	-	-
CO3	3	3	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	3	2	1	1	-	-	-	-	-	-	3	-	-
CO5	3	3	-	-	-	1	-	-	-	-	1	3	-	-
CO	3	3	2	1	1	1	-	-	-	-	1	3	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)



Text Books

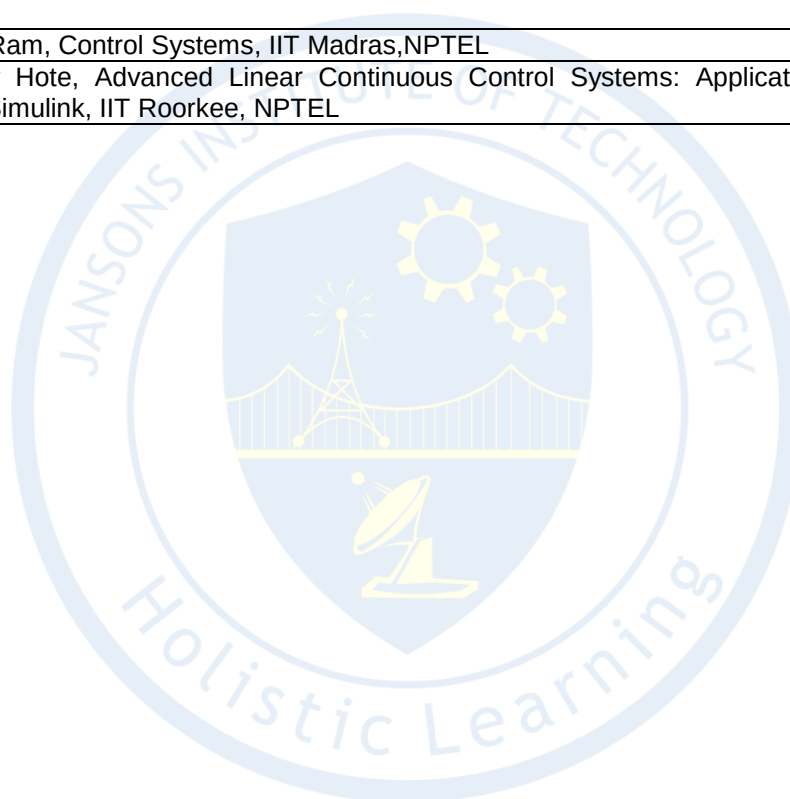
1	J.Nagrath and M.Gopal, —Control System EngineeringII, New Age International Publishers, 7th Edition, 2021, ISBN 978-8195175581
2	Ambikapathy A., Control Systems, Khanna Book Publications, 2019.ISBN 978-93-80016-94-8
3	B.N.Sarkar, —Advanced Control Systems:,PHI Learning Pvt Ltd. 2013, ISBN 978-81-203-4710-6

Reference Books

1	Norman S. Nise, — Control System EngineeringII, Wiley, 7th Edition, 2018, ISBN 978-81-26571-83-3.
2	K.Ogata, —Modern Control EngineeringII, PHI, 5th Edition, 2015. ISBN 978-9332550162.
3	S.K.Bhattacharya, —Control System EngineeringII, Pearson, 3rd Edition, 2013. ISBN 978-81-31718-20-9
4	Golnaraghi, Farid, and Benjamin C. Kuo, —Automatic Control SystemsII, Prentice Hall of India, 109th Edition,2017,.ISBN 978-12-59643-83-5.

Online Content

1	Prof. C.S.Shankar Ram, Control Systems, IIT Madras,NPTEL
2	Prof. Yogesh Vijay Hote, Advanced Linear Continuous Control Systems: Applications with MATLAB Programming and Simulink, IIT Roorkee, NPTEL



U24EC4302	ELECTRONIC DEVICES	L	T	P	C
		3	0	2	4
Course Objectives:	To provide a fundamental understanding of electronic devices, including semiconductor diodes, transistors, and power devices, along with their applications in circuits.				
Unit – I	SEMICONDUCTOR DIODES AND APPLICATIONS	08 + 06			
PN junction diode – Energy band diagram – Forward and reverse bias characteristics – Current equation – Breakdown mechanisms: Zener and avalanche breakdown – Zener diode voltage regulation – Rectifiers (Half-wave, Full-wave, Bridge) – Clippers, Clampers, and Voltage multipliers – Special-purpose diodes: Schottky diode, Tunnel diode, Varactor diode, Photodiode, LED.					
Practical Exercises: 1. VI Characteristics of PN Junction Diode 2. Zener Diode as Voltage Regulator					
Unit – II	BIPOLAR JUNCTION TRANSISTORS	10 + 06			
BJT structure and working principle – Current flow mechanism – Transistor configurations: CB, CE, and CC – Input and output characteristics – Early effect – Biasing techniques: Fixed bias, Voltage divider bias, Emitter bias – Load lines – Stability factor – BJT switching applications.					
Practical Exercises: 1.BJT as a Switch 2.BJT Characteristics in Common Emitter Configuration					
Unit - III	FIELD-EFFECT TRANSISTORS	10 +04			
JFET: Construction, operation, and characteristics – MOSFET (Enhancement and Depletion modes) – MOSFET biasing – Small-signal model – CS, CG, and CD amplifiers – Comparison of BJTs and MOSFETs – CMOS technology and applications.					
Practical Exercises: 1.MOSFET Characteristics					
Unit – IV	OPTOELECTRONIC AND POWER DEVICES	11 +08			
Photodiodes, Phototransistors, Solar cells, Laser diodes – Optical sensors and display applications – Power semiconductor devices: SCR, TRIAC, DIAC – UJT as a triggering device – Power MOSFETs – IGBTs – Applications in power electronics and industrial control.					
Practical Exercises: 1.Photodiode and LED Characteristics 2.SCR Characteristics					
Unit – V	SEMICONDUCTOR FABRICATION TECHNOLOGY	06 +06			
Growth of single-crystal silicon – Oxidation, Diffusion, Ion implantation – Lithography and Etching – Metallization – Planar fabrication process – IC packaging and testing – MEMS and Nanoelectronics introduction.					
Practical Exercises: 1.Photolithography Process Analysis					
Total Periods:					75

Course Outcomes

On completion of the course, the student can

Cos	Statements	K-Level
CO1	Recall the working principles of semiconductor diodes and validate their applications in rectifiers and voltage regulators through circuit implementation.	K2
CO2	Interpret the characteristics of BJTs in different configurations for amplification and switching applications.	K2
CO3	Examine the circuits using JFETs and MOSFETs and evaluate their performance for	K2

Cos	Statements	K-Level
	amplification and switching applications.	
CO4	Apply the characteristics of optoelectronic and power semiconductor devices and validate their applications in industrial and communication systems.	K3
CO5	Illustrate the semiconductor fabrication process flow and IC packaging techniques using appropriate design tools.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO– PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	1	1	-	-	1	-	-	-	-	1	2	-	-
CO2	3	2	1	1	-	1	-	-	-	-	1	3	2	1
CO3	3	2	1	1	-	1	-	-	-	-	1	3	2	1
CO4	3	3	3	2	2	2	-	-	-	-	2	3	3	2
CO5	3	2	1	1	1	1	-	-	-	-	1	2	2	1
CO	3	2	1	1	2	1	-	-	-	-	1	3	2	1

Correlation levels 1, 2 and 3 are as defined below:

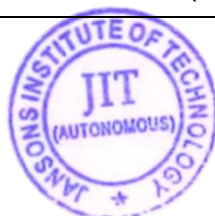
1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Salivahanan, S., Kumar, N.S., & Vallavaraj, A. (2020). <i>Electronic Devices and Circuits</i> (4th Edition). McGraw Hill Education.
2	Gopakumar, K. (2022). <i>Electronic Devices and Circuits</i> (2nd Edition). PHI Learning Pvt. Ltd.
3	Mehta, V.K., & Mehta, R. (2021). <i>Principles of Electronics</i> (4th Edition). S. Chand Publishing.
4	Bhargava, N.N., Kulshreshtha, D.C., & Gupta, S.C. (2020). <i>Basic Electronics and Linear Circuits</i> (2nd Edition). Tata McGraw Hill.
5	Gupta, J.B. (2023). <i>Electronic Devices and Analog ICs</i> (Revised Edition). S.K. Kataria & Sons

Reference Books

1	Neamen, D.A. (2022). <i>Microelectronics: Circuit Analysis and Design</i> (6th Edition). McGraw Hill.
2	Rashid, M.H. (2023). <i>Microelectronic Circuits: Analysis and Design</i> (3rd Edition). Cengage Learning.
3	Boylestad, R.L., & Nashelsky, L. (2023). <i>Electronic Devices and Circuit Theory</i> (12th Edition). Pearson Education.
4	Floyd, T.L. (2021). <i>Electronic Devices</i> (11th Edition). Pearson Education.
5	Sedra, A.S., & Smith, K.C. (2020). <i>Microelectronic Circuits</i> (8th Edition). Oxford University Press.



Web-links

1. <https://www.electronics-tutorials.ws/>
2. https://www.tutorialspoint.com/basic_electronics/index.htm
3. <https://www.allaboutcircuits.com/video-tutorials/>



U24EC4303	SIGNALS AND SYSTEMS				L	T	P	C
					3	1	0	4
Course Objectives:		To understand the basic properties of signal & systems, know the methods of characterization of LTI systems in time domain, analyze continuous time signals and system in the Fourier and Laplace domain and analyze discrete time signals and system in the Fourier and Z transform domain						
Unit – I	CLASSIFICATION OF SIGNALS AND SYSTEMS							9+6
Standard signals- Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids Classification of signals – Continuous time (CT) and Discrete Time (DT) signals, Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals – Classification of systems- CT systems and DT systems- – Linear & Nonlinear, Time-variant& Time-invariant, Causal & Non-causal, Stable & Unstable.								
PRACTICAL EXERCISES:								
Use any mathematical simulation software.								
1. Generate square wave, triangular, exponential, sinusoidal, step, impulse and ramp functions.								
2. Verify time shifting, time scaling, reflection operations on square wave, triangular, exponential, sinusoidal, step, impulse and ramp functions.								
Unit – II	ANALYSIS OF CONTINUOUS TIME SIGNALS							9+6
Fourier series for periodic signals – Trigonometric Fourier Series, Exponential Fourier Series – Properties of Fourier Series – Fourier Transform – Properties – Laplace Transforms and Properties – Inverse Laplace Transform.								
PRACTICAL EXERCISES:								
1. Calculate the Trigonometric and Exponential Fourier series coefficients of a rectangular periodic signal and plot the discrete spectrum of the signal and reconstruct the signal by combining the Fourier series coefficients with appropriate weightages and plot the signal.								
2. Verify the properties of Laplace transform.								
Unit - III	LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS							9+6
Impulse response - convolution integrals- Differential Equation- Fourier and Laplace transforms in Analysis of CT systems - Systems connected in series / parallel.								
PRACTICAL EXERCISES:								
1. Calculate Fourier transform of a given continuous signal. Plot its amplitude and phase spectrum.								
2. Calculate Laplace transform of a given continuous signal and plot it.								
Unit – IV	ANALYSIS OF DISCRETE TIME SIGNALS							9+6
Baseband signal Sampling – Reconstruction of signals from its samples – Effect of under sampling – Aliasing – Fourier Transform of discrete time signals (DTFT) – Properties of DTFT – Z Transform & Properties – Inverse Z Transform.								
PRACTICAL EXERCISES:								
1. Verify Cross correlation and Auto correlation of two sequences.								
2. Verify sampling theorem with perfect and under sampling rates and draw the spectrum.								
Unit - V	LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS							9+6
Impulse response – Difference equations – Convolution sum – DTFT and Z Transform Analysis of Recursive & Non-Recursive systems – DT systems connected in series and parallel.								
PRACTICAL EXERCISES:								
1. Compute the linear convolution of two discrete time sequences. Plot all the sequences.								
2. Examine the frequency response of LTI system by difference equation.								
Total Periods:								30+30

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Examine various signals and system properties.	K4
CO2	Analyze the characteristics of continuous-time signals in both the time and frequency domains.	K4
CO3	Inspect the characteristics of continuous LTI systems in the time and frequency domains.	K4
CO4	Analyze the characteristics of discrete-time signals in both the time and frequency domains.	K4
CO5	Inspect the characteristics of discrete LTI systems in the time and frequency domains.	K4

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO–PO–PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	3	2	2	2	-	-	-	2	2	1	3	2	1
CO2	3	2	2	2	2	-	-	-	2	2	1	3	2	-
CO3	3	3	2	2	2	-	-	-	2	2	1	3	2	1
CO4	3	2	2	2	2	-	-	-	2	2	1	3	2	-
CO5	3	3	2	2	2	-	-	-	2	2	1	3	2-	1
CO	3	3	2	2	2	-	-	-	2	2	1	3	2	1

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Oppenheim, Willsky and Hamid, "Signals and Systems", 2nd Edition, Pearson Education, New Delhi, 2015.(Units I - V)
2	Simon Haykin, Barry Van Veen, "Signals and Systems", 2nd Edition, Wiley, 2002

Reference Books

1	B. P. Lathi, "Principles of Linear Systems and Signals", 2nd Edition, Oxford, 2009.
2	M. J. Roberts, "Signals and Systems Analysis using Transform methods and MATLAB", McGraw- Hill Education, 2018.
3	John Alan Stuller, "An Introduction to Signals and Systems", Thomson, 2007.



U24CS3305		C PROGRAMMING AND DATA STRUCTURES		L	T	P	C
				3	0	2	4
Course Objectives:		To introduce the basics of the C programming language, explore its advanced features, and understand Abstract Data Types (ADTs) and linear data structures. Gain insights into non-linear data structures and hashing techniques, and become familiar with sorting and searching algorithms.					
Unit - I	C PROGRAMMING FUNDAMENTALS (8+1 SKILL)						9+6
Data Types – Variables – Operations – Expressions and Statements – Conditional Statements – Functions – Recursive Functions – Arrays – Single and Multi-Dimensional Arrays.							
PRACTICAL EXERCISES:							
1. Practice of C programming using statements, expressions, decision making and iterative statements							
2. Practice of C programming using Functions and Arrays							
Unit - II	C PROGRAMMING - ADVANCED FEATURES (8+1 SKILL)						9+5
Structures – Union – Enumerated Data Types – Pointers: Pointers to Variables, Pointers to Arrays and Pointers to Functions – File Handling – Preprocessor Directives.							
PRACTICAL EXERCISES:							
1. Implement C programs using Pointers and Structures							
Unit - III	LINEAR DATA STRUCTURES (8+1 SKILL)						9+7
Abstract Data Types (ADTs) – List ADT – Array Based Implementation – Linked Lists – Singly Linked List – Doubly Linked List – Circular Linked List – Stack ADT – Array Implementation of Stack – Linked list Implementation of Stack – Stack Applications – Queue ADT – Array Implementation of Queue – Linked list Implementation of Queue.							
PRACTICAL EXERCISES:							
1. Array implementation of List ADT							
2. Array implementation of Stack and Queue ADTs							
3. Linked list implementation of List, Stack and Queue ADTs							
Unit – IV	NON-LINEAR DATA STRUCTURES (8+1 SKILL)						9+5
Trees – Binary Trees – Tree Traversals – Expression Trees – Binary Search Tree – Hashing - Hash Functions – Separate Chaining – Open Addressing – Linear Probing– Double Hashing – Rehashing.							
PRACTICAL EXERCISES:							
1. Implementation of Binary Trees and operations of Binary Trees							
Unit - V	SORTING AND SEARCHING TECHNIQUES (8+1 SKILL)						9+7
Insertion Sort – Quick Sort – Heap Sort – Merge Sort –Linear Search – Binary Search.							
PRACTICAL EXERCISES:							
1. Implementation of searching techniques							
2. Implementation of sorting algorithms: Insertion Sort, Quick Sort, Merge Sort							
Total Periods:							45+30

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Develop fundamental C programming skills, including data types, functions, recursion, and arrays, and experiment with decision-making, iterative statements, and function implementations.	K3
CO2	Utilize advanced C features like structures, pointers, file handling, and preprocessor directives, and make use of practical implementation of pointers, structures, and file handling.	K3
CO3	Apply linear data structures such as lists, stacks, and queues, and construct their array-based and linked list implementations through hands-on exercises.	K3
CO4	Build non-linear data structures like trees and hashing for optimized data processing, and experiment with binary tree implementation and operations.	K3
CO5	Identify efficient sorting and searching algorithms to improve program performance, and plan practical exercises to implement and analyze these techniques.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	3	2	-	-	-	-	-	-	-	3	3	-	-
CO2	3	3	2	-	-	-	-	-	-	-	3	-	-	-
CO3	3	3	2	-	-	-	-	-	-	-	3	2	-	-
CO4	3	3	2	-	-	-	-	-	-	-	3	-	-	-
CO5	3	3	2	-	-	-	-	-	-	-	3	2	-	-
CO	3	3	2	-	-	-	-	-	-	-	3	2	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Second Edition, Pearson Education, 1997.
2	Reema Thareja, "Programming in C", Second Edition, Oxford University Press, 2016.

Reference Books

1	Brian W. Kernighan, Rob Pike, "The Practice of Programming", Pearson Education, 1999.
2	Paul J. Deitel, Harvey Deitel, "C How to Program", Seventh Edition, Pearson Education, 2013.
3	Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, 1983.
4	Ellis Horowitz, Sartaj Sahni, Susan Anderson, "Fundamentals of Data Structures", Galgotia, 2008.



U24EC4304	DIGITAL ELECTRONICS				L	T	P	C
					3	0	2	4
Course Objectives:		To present the fundamentals of digital circuits and simplification methods, To practice the design of various combinational digital circuits using logic gates, To bring out the analysis and design procedures for synchronous and asynchronous Sequential circuits, To learn integrated circuit families, To introduce semiconductor memories and related technology.						
Unit - I	BASIC CONCEPTS						9+4	
Review of number systems-Decimal,Binary,Octal,Hexadecimal,1's and 2's complements, Codes-Binary, BCD, Excess 3, Gray, Review of Boolean algebra- theorems, sum of product and product of sum simplification, min term and max term, Simplification of Boolean expressions-Karnaugh map,Tabulation methods.								
PRACTICAL EXERCISES:								
1. Verification of Boolean Theorems								
2. Verification of Gates								
Unit - II	COMBINATIONAL LOGIC CIRCUITS						9+12	
Problem formulation and design of combinational circuits - Code-Converters, Half and Full Adders, Binary Parallel Adder – Carry look ahead Adder, BCD Adder, Magnitude Comparator, Decoder, Encoder, Priority Encoder, Mux/Demux.								
PRACTICAL EXERCISES:								
1. Design of adders and subtractors.								
2. Design of code converters.								
3. Design of Multiplexers & Demultiplexers.								
4. Design of Encoder and Decoder								
Unit - III	SYNCHRONOUS SEQUENTIAL CIRCUITS						9+8	
Latches, Flip flops – SR, JK, T, D, Master/Slave FF, Triggering of FF, Analysis and design of clocked sequential circuits – Design - Moore/Mealy models, state minimization, state assignment,lock - out condition circuit implementation - Counters, Ripple Counters, Ring Counters, Shift registers, Universal Shift Register.								
PRACTICAL EXERCISES:								
1. Design and implementation of counters using flip-flops.								
2. Design and implementation of shift registers.								
Unit – IV	ASYNCHRONOUS SEQUENTIAL CIRCUITS						9+2	
Stable and Unstable states, output specifications, cycles and races, state reduction, race free assignments, Hazards, Essential Hazards, Fundamental and Pulse mode sequential circuits, Design of Hazard free circuits.								
PRACTICAL EXERCISES:								
1. Design and implementation of Asynchronous Up/Down counter.								
2. Design and implementation of Ripple Counter.								
Unit - V	LOGIC FAMILIES AND PROGRAMMABLE LOGIC DEVICES						9+4	
Logic families- Propagation Delay, Fan - In and Fan - Out - Noise Margin - RTL ,TTL, CMOS - Comparison of Logic families - Implementation of combinational logic/sequential logic design using standard ICs, PROM, PLA and PAL, basic memory- ROM,PROM,EPRM,EEPROM EAPROM. Design of Combinational circuits using VHDL.								
PRACTICAL EXERCISES:								
1. Design an Adder using VHDL.								
2. Design a 4-bit Multiplier using VHDL.								
Total Periods:							75	

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Identify Boolean algebra theorems and their significance in logic simplification.	K3
CO2	Build basic arithmetic circuits such as adders, subtractors, and code converters and Choose appropriate multiplexers, demultiplexers, encoders, and decoders for specific digital design applications.	K3
CO3	Experiment with different types of flip-flops and latches to understand their behaviour and applications.	K3
CO4	Identify stable and unstable states in asynchronous sequential circuits and Analyze hazards and essential hazards in digital circuits.	K3
CO5	Model different types of memory, including static ROM, PROM, EPROM, EEPROM, and EAPROM, for storage applications.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO–PO–PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	2	2	-	2	-	-	-	-	3	3	3	2
CO2	-	-	-	-	-	-	-	-	-	-	2	2	2	2
CO3	-	3	3	2	-	2	-	-	-	-	2	3	3	2
CO4	-	-	-	-	-	-	-	-	-	-	3	2	2	1
CO5	-	3	3	3	-	-	-	-	-	-	2	3	3	2
CO	3	2.6	2.6	2.3	-	2	-	-	-	-	2	3	3	2

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	M. Morris Mano and Michael D. Ciletti, 'Digital Design', Pearson, 6th Edition, 2018.(Unit - I - V), 978-9353062019
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Reference Books

1	Charles H. Roth, Jr, 'Fundamentals of Logic Design', Jaico Books, 7th Edition, 2024, 978-9360535650.
2	William I. Fletcher, "An Engineering Approach to Digital Design", Prentice- Hall of India,2015, 978-9332555228.
3	John. F. Wakerly, "Digital Design Principles and Practices", Pearson Education, 4 th Edition,2008, 978-9332508125.



U24GE7302	PRODUCT DEVELOPMENT / PROCESS DESIGN		L	T	P	C
			0	0	2	1
Course Objectives:	To equip students with hands-on experience in prototyping, understanding the entrepreneurial ecosystem, and leveraging resources for startup success.					
1	ENTREPRENEURIAL ECOSYSTEM					10
Understanding the Entrepreneurial Ecosystem - Components: Angels, Venture Capitalists, Maker Spaces, Incubators, Accelerators, Investors. Financing models - equity, debt, crowdfunding, etc, Support from the government and corporates. Navigating Ecosystem Support: Searching & Identifying the Right Ecosystem Partner - Leveraging the Ecosystem - Building the right stakeholder network						
ACTIVITY						
- Arrangement of Guest Speaker Sessions by successful entrepreneurs and entrepreneurial ecosystem leaders (incubation managers; angels; etc), - Visit one or two entrepreneurial ecosystem players (Travel and visit a research park or incubator or makerspace or interact with startup founders).						
2	PROTOTYPING					20
Prototyping - Importance in entrepreneurial process - Types of Prototypes - Different methods - Tools & Techniques. Hands-on sessions on prototyping tools (3D printing, electronics, software), Develop a prototype based on identified opportunities; Receive feedback and iterate on the prototypes.						
ACTIVITY						
Students should for a team of maximum 4 members and make a Final Presentation of the prototype they have innovated.						
Total Periods:						30

Course Outcomes

On completion of the course, the student can

COS	Statements	K-Level
CO1	Explain the significance of prototyping in the entrepreneurial process and identify different types, methods, and tools.	K2
CO2	Apply various prototyping techniques, including 3D printing, electronics, and software, to develop a functional prototype	K4
CO3	Analyze the components of the entrepreneurial ecosystem and evaluate different financing models.	K4
CO4	Engage with ecosystem partners such as incubators, investors, and accelerators to navigate startup support mechanisms.	K3
CO5	Develop a stakeholder network by interacting with successful entrepreneurs and reflect on real-world entrepreneurial experiences.	K3

Knowledge Level: K1 - Remember, K2 - Understand, K3 -Apply, K4 -Analyze, K5 - Evaluate, K6 – Create



CO - PO - PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	3	3	2	2	3		3			3	2	2	2
CO2	3	3	3	2	2	3		3			3	2	2	2
CO3	3	3	3	2	2	3		3			3	2	2	2
CO4	3	3	3	2	2	3		3			3	2	2	2
CO5	3	3	3	2	2	3		3			3	2	2	2
CO	3	3	3	2	2	3		3			3	2	2	2

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	S.S. Khanka - Entrepreneurial Development, S. Chand Publishing, 2021.
2	P.C. Jain - Handbook for New Entrepreneurs, Oxford University Press, 2017.
3	Poornima M. Charantimath - Entrepreneurship Development and Small Business Enterprises, Pearson India, 2022.

Reference Books

1	Ramachandran K. - <i>Entrepreneurship: Theory and Practice</i> , McGraw Hill, 2021.
2	Reddy K. Sudarsanam - <i>Essentials of Entrepreneurship Development</i> , Himalaya Publishing House, 2017.
3	Kelley, Tom & Littman, Jonathan - <i>The Art of Innovation: Lessons in Creativity from IDEO. America's Leading Design Firm</i> , Crown Business, 2001.
4	Ries, Eric - The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses , Crown Business, 2011.



U24EC4401	ELECTROMAGNETIC FIELDS	L	T	p	C
		3	0	0	3
Course Objectives:	To provide foundational knowledge of static electric and magnetic fields, introducing interactions through Maxwell's equations. Extend this understanding to electromagnetic wave propagation.				
Unit - I	INTRODUCTION	9			
Review of vector algebra -Introduction to rectangular, cylindrical and spherical coordinate systems-Line, surface and volume integrals-Gradient of a scalar field-Divergence of a vector field-Divergence theorem-Curl of a vector field-Stoke's theorem-Null identities-Helmholtz's theorem-Verify theorems for different path. surface and volume.					
Unit - II	ELECTROSTATICS	9			
Coulomb's law and Electric field intensity-Electric flux density-Gauss's law and applications-Electric potential, Relationship between potential and electric field-Conductors in static electric field-Dielectrics in static electric field, dielectric constant and strength-Current density and point form of ohm's law, Equation of continuity and relaxation lime-Boundary conditions-Capacitance, Parallel, cylindrical and spherical capacitors-Electrostatic energy-Poisson's and Laplace's equations.					
Unit -III	MAGNETOSTATICS	9			
Biot-Savart law in vector form, Magnetic field intensity due to a finite and infinite wire carrying a current, Magnetic field intensity on the axis of a circular loop-Ampere's circuital law and applications-Magnetic flux density and idea of relative permeability-Vector magnetic potential-Lorentz force equation, Magnetic forces and torques-Boundary conditions-Inductance and inductors-Magnetic energy.					
Unit- IV	TIME-VARYING FIELDS AND MAXWELL's EQUATIONS	9			
Faraday's law-Displacement current and Maxwell-Ampere law, Maxwell's equations, Maxwell's four equations in integral form, differential form and phasor form- Electromagnetic power flow and Poynting vector, Instantaneous, average and complex poynting vector-Poynting theorem.					
Unit -V	PLANE ELECTROMAGNETIC WAVES	9			
Wave equations for conducting and non-conducting medium-Phasor form of wave equations -Uniform plane waves -Plane waves in lossless media, lossy dielectrics and good conductors, skin effect-Normal incidence at a plane conducting boundary, Normal incidence at a plane dielectric boundary.					
Total Periods:					45

Course Outcomes

On completion of the course, the student can

COS	Statements	K-Level
CO1	Relate the fundamentals of vector, coordinate system to electromagnetic concepts	K2
CO2	Interpret electric fields in materials and solve basic estimation problems	K2
CO3	Illustrate magneto static fields in materials and solve basic estimation problems	K2
CO4	Explain the significance of Maxwell's equations for time varying field	K2
CO4	Apply Maxwell's equations to analyze wave propagation in different mediums	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO - PO- PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	-	-	-	-	-	-	-	-	1	1	-	
CO2	3	2	-	-	-	-	-	-	-	-	1	1	-	
CO3	3	2	-	-	-	-	-	-	-	-	1	1	-	
CO4	3	2	-	-	-	-	-	-	-	-	1	-	1	
CO5	3	2	2	-	-	-	-	-	-	-	1	-	1	
CO	3	2	2	-	-	-	-	-	-	-	1	1	1	

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	D.K. Cheng, Field and wave electromagnetics, 2nd ed., Pearson (India), 2014, ISBN: 978-9332535022
2	M.N.O.Sadiku and S.V. Kulkarni. Principles of electromagnetics, 6th ed., Oxford(Asian Edition), 2015, ISBN: 978-0199461851

Reference Books

1	Edward C. Jordan & Keith G. Balmain, Electromagnetic waves and Radiating Systems, Second Edition, Prentice-Hall Electrical Engineering Series, 2012. ISBN: 978-8120300545
2	W.H. Hayt and J.A. Buck, Engineering electromagnetics, 9th ed., McGraw-Hill (India), 2020. ISBN: 978-9353169725
3	B.M. Notaros, Electromagnetics, Pearson: New Jersey, 2011. ISBN: 978-0132433846.



U24EC4402	COMPUTER ARCHITECTURE AND MICROPROCESSOR SYSTEM	L	T	p	C
		3	0	0	3
Course Objectives:	To introduce the fundamentals of computer architecture, processor execution, memory hierarchy, I/O interfacing, and control unit design. It also explores 8086 microprocessor and 8051 microcontroller programming and interfacing, with an introduction to advanced controllers like PIC and ARM.				
Unit - I	COMPUTER FUNDAMENTALS	9			
Functional Units of a Digital Computer: Von Neumann Architecture - Operation and Operands of Computer Hardware Instruction - Instruction Set Architecture (ISA): Memory Location, Address and Operation - Instruction and Instruction Sequencing - Addressing Modes, Encoding of Machine Instruction - Interaction between Assembly and High Level Language.					
Unit - II	PROCESSOR ARCHITECTURE AND CONTROL	9			
Instruction Execution - Building a Data Path - Designing a Control Unit - Hardwired Control, Microprogrammed Control- Pipelining - Data Hazard - Control Hazards.					
Unit - III	MEMORY AND I/O	9			
Memory Concepts and Hierarchy - Memory Management - Cache Memories: Mapping and Replacement Techniques - Virtual Memory - OMA - I/O - Accessing I/O: Parallel and Serial Interface- Interrupt I/O - Interconnection Standards: USB, SATA					
Unit-IV	THE 8086 MICROPROCESSOR AND SYSTEM INTERFACING	9			
Introduction to 8086 - Microprocessor architecture, registers, and memory segmentation. Addressing Modes and Instruction Set - Various addressing modes, instruction formats, and assembler directives. Assembly Language Programming - Writing and executing simple programs. System Bus and Signals - 8086 signals, basic system configurations, and system bus timing. Interrupts and Interrupt Service Routines (ISR). Stack, Procedures, and Macros. Memory Interfacing - Parallel Communication Interface (8255 PPI). Case Study: Traffic Light Control.					
Unit - V	MICROCONTROLLER ARCHITECTURE AND INTERFACING	9			
Overview of 8051 Microcontroller - Special Function Registers (SFRs) - I/O Pins, Ports, and Circuits - Addressing Modes and Instruction Set - Assembly Language Programming - Timers and Serial Communication - Interrupt Handling in 8051 - Interfacing LCD and Keyboard - ADC, DAC, and Sensor Interfacing - Stepper Motor and Waveform Generation - Introduction to Advanced Microcontrollers: PIC and ARM.					
Total Periods:					45

Course Outcomes

On completion of the course, the student can

Cos	Statements	K-Level
CO1	Apply fundamental concepts of computer architecture, including functional units, Von Neumann architecture, instruction set architecture (ISA), and addressing modes.	K3
CO2	Construct processor architecture and control, covering instruction execution, data path design, control unit implementation, and pipelining with data and control hazards.	K3
CO3	Identify memory hierarchy and I/O mechanisms, including cache memory, virtual memory, OMA, parallel and serial interfaces, and interconnection standards.	K3



CO4	Make use of the 8086 microprocessor by exploring its architecture, instruction set. assembly language programming, system bus timing, interrupts. and memory interfacing.	K3
CO5	Extend knowledge of microcontroller architecture by exploring 8051 instruction set, programming, serial communication, interrupts and interfacing techniques	K3

Knowledge Level: K1 - Remember, K2 - Understand. K3 -Apply, K4 -Analyze, K5 - Evaluate, K6 - Create **CO - PO - PSO Articulation Matrix**

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	3	3	-	-	-	-	-	-	-	1	3	-	-
CO2	3	2	2	2	-	-	-	-	-	-	1	3	2	1
CO3	3	3	3	2	-	-	-	-	-	-	1	3	2	1
CO4	3	2	2	2	-	-	-	-	-	-	1	3	2	-
CO5	3	3	3	2	-	-	-	-	-	-	1	3	2	1
CO	3	3	3	2	0	0	0	0	0	0	1	3	2	1

Text Books

1	David A. Patterson, John L. Hennessy, "Computer Organization and Design, The Hardware/Software Interface", Sixth Edition, Morgan Kaufmann/Elsevier, 2020. (UNIT 1,11,111)
2	Yu-Cheng Liu, Glenn A.Gibson, -Microcomputer Systems: The 8086 / 8088 Family - Architecture, Programming and DesignII, Second Edition, Prentice Hall of India, 2007. (UNIT IV)
3	Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, -The 8051 Microcontroller and Embedded Systems: Using Assembly and CII, Second Edition, Pearson education, 2011. (UNIT V)

Reference Books

1	Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian, "Computer Organization and Embedded Systems", Sixth Edition. Tata McGraw-Hill, 2012.
2	William Stallings, "Computer Organization and Architecture - Designing for Performance", Tenth Edition, Pearson Education, 2016.
3	A.K.Ray,K.M.Bhurchandi, "Advanced Microprocessors and Peripherals" 3rd edition, Tata McGrawHill.2012



U24CY2401	ENVIRONMENTAL SCIENCES, CLIMATE CHANGE AND SUSTAINABILITY		L	T	P	C
			3	0	0	3
Course Objectives:	To understand the environmental issues, impacts of climate change, promoting sustainable practices, social responsibility, and conservation of natural resources.					
Unit - I	ENVIRONMENT, ECOSYSTEM AND BIODIVERSITY				9	
Great ancient civilizations and the environment, Industrial revolution and its impact on the environment. Definition, Scope and importance of Environmental Education; Ecosystem: components, energy flow; Ecosystem services classification and their significance, Economic value of ecosystem services. Biodiversity: Biodiversity as a natural resource; Levels of biodiversity; Biodiversity in India and the world; values of biodiversity; hot-spots of biodiversity; Threats to biodiversity and ecosystems; conservation of biodiversity: In-situ and ex-situ; the role of traditional knowledge, community-based conservation. International Union for Conservation of Nation (IUCN) red list criteria and categories.						
Unit - II	ENVIRONMENTAL ISSUES, POLLUTION AND HEALTH				9	
Environmental issues and scales: Concepts of micro-, meso-, synoptic and planetary scales; Temporal and spatial extents of local, regional, and global phenomena. Definition of pollution; Point and non-point sources of pollution; Types, sources, environmental impacts and control methods of Air, Water, Soil, Noise and Radioactive Pollution; adverse impacts of various pollution on human health.Solid waste management: causes, effects, control measures and management of municipal solid wastes; E-waste Management; role of an individual in prevention of pollution; Occupational Health and Safety Management system (OHASMS) and its case studies.						
Unit - III	CLIMATE CHANGE: IMPACTS, ADAPTATION AND MITIGATION				9	
Understanding climate change: Anthropogenic climate change from greenhouse gas emissions: past, present and future; Projections of global climate change with special reference to temperature, rainfall, climate variability and extreme events; Impacts, vulnerability and adaptation to climate change: Sea level rise, Ecosystems, animal species, agriculture, and Health. Climate change mitigation and adaptation strategies. Major International Environmental Agreements: Convention on Biological Diversity (CBD); Vienna Convention for the Protection of the Ozone Layer; Montreal Protocol on Substances that Deplete the Ozone Layer and the Kigali Amendment, United Nations Framework Convention on Climate Change (UNFCCC); Kyoto Protocol; Paris Agreement; Conference of the Parties (COP). United Nations Environment Programme (UNEP) and Governance policy.						
Unit – IV	ENVIRONMENTAL MANAGEMENT AND SUSTAINABLE PRACTICES				9	
Development, Effects of unplanned development - case studies. Economic growth - Gross Domestic Product (GDP), Sustainability: concept, needs and challenges; economic, social and aspects of sustainability; from unsustainability to sustainability; Sustainable Development: Goals, targets, Nation missions and environmental policy, indicators and intervention areas. Concept of Carbon Credit; Carbon Footprint; ISO14001; Environmental management in industry with case studies. Practices: Eco labelling; Circular economy; Material Life cycle assessment; Environmental Impact Assessment; Sustainable habitat: Green buildings, Green materials, Energy efficiency. Sustainable transports; Sustainable urbanization; Need of the Hour: Sustainable Industry, Innovation, and resilient Infrastructure. Significance of holistic value-based education for true sustainability.						
Unit - V	NATURAL RESOURCES AND ENVIRONMENTAL ACTS				9	
Definition of resource; Classification of natural resources: biotic and abiotic, renewable and non-renewable; Significance and challenges of biotic resources: forests, grasslands, wetlands, wildlife and aquatic (fresh water and marine). Significance, over exploitation and conservation: Water resources, Soil and mineral resources. Principle and applications of (a) Solar energy, (b) Wind energy (c) Hydrogen energy (d) Tidal energy (e) Geothermal energy and (f) Biomass energy. Significance of major Indian Environmental Legislation: Constitutional provisions- Article 48A, Article 51A (g) and other derived environmental rights; The Wild Life (Protection) Act, 1972; The Water (Prevention and Control of Pollution) Act, 1974; The Forest (Conservation) Act, 1980; The Air (Prevention and Control of Pollution) Act, 1981; The Environment (Protection) Act, 1986; Wetlands (Conservation and Management Rules) 2017.						
Total Periods:						45



Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO1	Explain the functions of environment, ecosystems, biodiversity and the impact of human activities on their conservation.	K2
CO2	Outline the causes, effects of environmental pollution and contribution to the preventive measures in the society.	K2
CO3	Understand the climate change, its impacts, and mitigation measures.	K2
CO4	Interpret the significance of sustainable development in reducing environmental degradation, fostering economic prosperity, and propose innovative solutions for a more sustainable future.	K2
CO5	Summarize the importance of natural resources and various environmental acts.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 - Apply

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	-	-	-	-	2	3	-	-	-	2	-	-	-
CO2	2	1	-	-	-	2	3	-	-	-	2	-	-	-
CO3	2	1	-	-	-	2	3	-	-	-	2	-	-	-
CO4	2	1	-	-	-	2	3	2	-	-	2	-	-	-
CO5	2	-	-	-	-	2	3	2	-	-	2	-	-	-
CO	2	1	-	-	-	2	3	2	-	-	2	-	-	-

Text Books

1	Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers, 2018.
2	S S Dara and D D Mishra, "A Textbook of Environmental Chemistry and Pollution Control", Ninth revised and enlarged edition, 2011, S Chand publishing New Delhi.
3	Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
4	Singh, J.S., Singh, S.P. and Gupta, S.R. (2017). Ecology, Environmental Science and Conservation. S. Chand Publishing, New Delhi.
5	R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38 .edition 2010.
6	Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.
7	Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.



Reference Books

1	Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
2	Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, Third Edition, 2015.
3	Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
4	Theodore, M. K. and Theodore, Louis (2021) Introduction to Environmental Management, 2nd Edition. CRC Press.
5	Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
6	Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.
7	Richard A. Marcantonio, Marc Lame (2022). Environmental Management: Concepts and Practical Skills. Cambridge University Press.



U24EC4403	ELECTRONIC CIRCUITS	L	T	P	C
		3	0	2	4
Course Objectives:	To provide a fundamental understanding of electronic devices, including semiconductor diodes, transistors, and power devices, along with their applications in circuits.				
Unit - I	TRANSISTOR BIASING AND BASIC AMPLIFIERS	09 +08			
Review of Basic principles and Biasing techniques for BJT and MOSFET (Voltage divider, self-bias), DC and AC load line concepts, Operating point stability and bias compensation, Single-stage amplifier configurations: CE, CB, CC (BJT) and CS, CG, CD (MOSFET), Case Study: Biasing and thermal stability in modern low-power analog circuits. PRACTICAL EXERCISES: 1. Observe the DC operating point of a BJT Voltage Divider Bias Circuit using simulation tool 2. Construct a Common-Emitter (CE) BJT Amplifier and measure voltage gain					
Unit - II	MULTISTAGE AND FREQUENCY RESPONSE ANALYSIS	09+04			
Multistage amplifier design: RC coupled, direct coupled, and transformer coupled amplifiers, Gain and bandwidth calculation for cascaded stages, High-frequency response of amplifiers: Gain-bandwidth trade-offs, Case Study: Frequency response optimization in audio amplifier design. PRACTICAL EXERCISES: 3. Analyze the Frequency Response of a Two-Stage RC Coupled Amplifier using simulation tool.					
Unit - III	DIFFERENTIAL, FEEDBACK, AND POWER AMPLIFIERS	09+04			
Differential amplifier configurations and common-mode rejection ratio (CMRR), Types of negative feedback amplifiers: Voltage-series, voltage-shunt, current-series, current-shunt, Power amplifiers: Class A, Class B, Class AB, and Class C, Efficiency and thermal considerations in power amplifiers, Case Study: Power amplifiers in audio and RF applications. PRACTICAL EXERCISES: 4. Measure the CMRR of a Differential Amplifier using simulation tool					
Unit – IV	OSCILLATORS AND SIGNAL GENERATION	09+08			
Principles of oscillation and Barkhausen criterion, RC oscillators: Wien bridge, Phase shift, LC oscillators: Hartley, Colpitts, Clapp, Crystal oscillators and frequency stability considerations. PRACTICAL EXERCISES: 5. Test a Wien Bridge Oscillator circuit in simulation tool and observe sine wave output 6. Assemble a Hartley Oscillator on a breadboard and measure oscillation frequency					
Unit - V	WAVEFORM SHAPING AND MULTIVIBRATORS	09+06			
Clippers and clampers: Practical design considerations, Schmitt trigger: Hysteresis and noise immunity, Multivibrators using transistors: Astable, monostable, and bistable, Function generators and voltage-controlled oscillators (VCO). PRACTICAL EXERCISES: 7. Design and analyze a Schmitt Trigger circuit in simulation tool and observe hysteresis 8. Construct an Astable Multivibrator using a BJT and observe waveform output					
Total Periods:					75



Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Apply biasing techniques and evaluate the stability of single-stage BJT and MOSFET amplifiers.	K3
CO2	Examine the frequency response of single-stage and multistage amplifiers to determine gain-bandwidth trade-offs.	K4
CO3	Construct differential, feedback, and power amplifiers and evaluate their efficiency and gain.	K4
CO4	Apply oscillator circuit design principles to generate sinusoidal and non-sinusoidal waveforms.	K3
CO5	Analyze waveform shaping circuits and multivibrators for signal processing applications.	K4

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO– PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	3	2	2	1	-	-	-	1	-	-	2	-	-
CO2	3	3	3	2	2	-	-	-	1	-	-	3	2	-
CO3	3	3	3	2	2	-	-	-	1	-	-	3	3	2
CO4	3	3	2	3	2	-	-	-	1	-	-	3	3	-
CO5	3	2	2	2	2	-	-	-	1	-	-	3	3	2
CO	3	2.8	2.4	2.2	1.8	-	-	-	1	-	-	2.8	2.75	2

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)



Text Books

1	Salivahanan, S., Kumar, N.S., & Vallavaraj, A. (2020). <i>Electronic Devices and Circuits (4th Edition)</i> . McGraw Hill Education.
2	Sudhakar, A., & Shyammohan, S.P. (2019). <i>Circuits and Networks: Analysis and Synthesis (5th Edition)</i> . McGraw Hill Education.
3	Bhargava, N.N., Kulshreshtha, D.C., & Gupta, S.C. (2013). <i>Basic Electronics and Linear Circuits (2nd Edition)</i> . McGraw Hill Education.
4	Rajput, R.K. (2017). <i>Electronic Devices and Circuits (6th Edition)</i> . S. Chand Publishing.
5	Gupta, J.B. (2023). <i>Electronic Devices and Analog ICs (Revised Edition)</i> . S.K. Kataria & Sons

Reference Books

1	Neamen, D.A. (2022). <i>Microelectronics: Circuit Analysis and Design (6th Edition)</i> . McGraw Hill.
2	Rashid, M.H. (2023). <i>Microelectronic Circuits: Analysis and Design (3rd Edition)</i> . Cengage Learning.
3	Boylestad, R.L., & Nashelsky, L. (2023). <i>Electronic Devices and Circuit Theory (12th Edition)</i> . Pearson Education.
4	Floyd, T.L. (2021). <i>Electronic Devices (11th Edition)</i> . Pearson Education.
5	Sedra, A.S., & Smith, K.C. (2020). <i>Microelectronic Circuits (8th Edition)</i> . Oxford University Press.

Web-links

4. <https://www.electronics-tutorials.ws/>
5. https://www.tutorialspoint.com/basic_electronics/index.htm
6. <https://www.allaboutcircuits.com/video-tutorials/>



U24EC4404		DIGITAL SIGNAL PROCESSING			L	T	P	C
					3	0	2	4
Course Objectives:		To learn Fourier transform, design of digital filters, finite word length effects, fundamental concepts of Multirate signal processing and adaptive filtering with their applications through its implementation.						
Unit - I		DISCRETE FOURIER TRANSFORM					9+6	
Sampling Theorem, concept of frequency in discrete-time signals, summary of analysis & synthesis equations for FT & DTFT, frequency domain sampling, Discrete Fourier transform (DFT) - deriving DFT from DTFT, properties of DFT - periodicity, symmetry, circular convolution. Linear filtering using DFT. Filtering long data sequences - overlap save and overlap add method. Fast computation of DFT - Radix-2 Decimation-in-time (DIT) Fast Fourier transform (FFT), Decimation-in-frequency (DIF) Fast Fourier transform (FFT). Linear filtering using FFT.								
Practical Activity: Use any mathematical simulation software (MATLAB / SCILAB / PYTHON) 1. Experiment with DFT for the Frequency Analysis of a discrete sequence 2. Apply overlap add and overlap save method to filter the long duration discrete sequences.								
Unit - II		INFINITE IMPULSE RESPONSE FILTERS					9+6	
Characteristics of practical frequency selective filters. characteristics of commonly used analog filters - Butterworth filters, Chebyshev filters. Design of IIR filters from analog filters (LPF, HPF, BPF, BRF) - Approximation of derivatives, Impulse invariance method, Bilinear transformation. Frequency transformation in the analog domain. Structure of IIR filter - direct form I, direct form II, Cascade, parallel realizations.								
Practical Activity: Use any mathematical simulation software (MATLAB / SCILAB / PYTHON) 1. Design of Butterworth and Chebyshev IIR filters (LPF/HPF/BPF/BSF) and demonstrate the filtering operations 2. Design of Chebyshev IIR filters (LPF/HPF/BPF/BSF) and demonstrate the filtering operations								
Unit - III		FINITE IMPULSE RESPONSE FILTERS					9+6	
Design of FIR filters - symmetric and Anti-symmetric FIR filters - design of linear phase FIR filters using Fourier series method - FIR filter design using windows (Rectangular, Hamming, Hanning and Blackman window), Frequency sampling method. FIR filter structures - linear phase structure, direct form realizations								
Practical Activity: Use any mathematical simulation software (MATLAB / SCILAB / PYTHON) 1. Design of FIR filters (LPF/HPF/BPF/BSF) and demonstrates the filtering operation using windowing technique. 2. Design of FIR filters (LPF/HPF/BPF/BSF) and demonstrates the filtering operation using frequency sampling technique.								
Unit – IV		FINITE WORD LENGTH EFFECTS					9+6	
Fixed point and floating point number representation - ADC - quantization - truncation and rounding - quantization noise - input / output quantization - coefficient quantization error - product quantization error - overflow error - limit cycle oscillations due to product quantization and summation - scaling to prevent overflow.								
Practical Activity: Use any mathematical simulation software (MATLAB / SCILAB / PYTHON) 1. Apply the fixed-point and floating-point representations and observe their differences in quantization effects. 2. Apply the coefficient quantization on a digital filter's design and find its effect on frequency response.								
Unit - V		ADVANCE DSP TECHNIQUES AND ARCHITECTURE OF DSP PROCESSORS					9+6	
Multirate signal processing: Decimation, Interpolation, Sampling rate conversion by a rational factor – Adaptive Filters: Introduction, Applications of adaptive filtering to channel equalization and echo cancellation-DSP Architecture: Introduction, Fixed and Floating point architecture principles, pipelining and Multiplier-accumulator (MAC) hardware.								
Practical Activity: Use any mathematical simulation software (MATLAB / SCILAB / PYTHON) 1. Design of adaptive channel equalizer Using DSP Processor 1. Design and demonstration of FIR Filter for Low pass, High pass, Band pass and Band stop filtering								
Total Periods:							45+30	



Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Develop DFT and FFT techniques to analyse and process discrete-time signals.	K4
CO2	Implement IIR filter design methods	K3
CO3	Design and implement FIR filters	K3
CO4	Develop and Implement the Finite Word Length effects in digital filters.	K3
CO5	Develop and verify the multirate signal processing and adaptive filtering techniques with real-time DSP.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	3	1	1	1	-	-	-	-	-	1	2	1	1
CO2	3	3	1	1	1	-	-	-	-	-	1	2	1	1
CO3	3	3	-	-	-	-	-	-	-	-	1	2	1	1
CO4	3	3	1	1	1	-	-	-	-	-	1	2	1	1
CO5	3	3	1	1	1	-	-	-	-	-	1	2	1	1
CO	3	3	1	1	1	-	-	-	-	-	1	2	1	1

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	John G. Proakis and Dimitris G. Manolakis, Digital Signal Processing – Principles, Algorithms and Applications, Fifth Edition, Pearson Education/Prentice Hall, 2021. ISBN: 978-0137348244
2	A. V. Oppenheim, R.W. Schaffer and J.R. Buck, —Discrete-Time Signal Processing, Third Edition, Pearson, 2014. ISBN: 978-9332535039

Reference Books

1	Emmanuel C. Ifeachor & Barrie W. Jervis, “Digital Signal Processing”, Second Edition, Pearson Education/Prentice Hall, 2006.
2	Sanjit K. Mitra, “Digital Signal Processing – A Computer Based Approach”, 4th Edition, Tata Mc Graw Hill, 2013 ISBN: 978-1259098581 .
3	Andreas Antoniou, “Digital Signal Processing”, Tata Mc Graw Hill, 2006.



U24EC4405	COMMUNICATION SYSTEMS		L	T	P	C
			3	0	2	4
Course Objectives:	To introduce Analog and Digital Modulation and demodulation Schemes, study various digital techniques and introduce the importance of sampling & quantization it enhance the class room teaching using smart connectivity instruments.					
Unit - I	AMPLITUDE MODULATION					9+8
Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations. Angle Modulation, Representation of FM and PM signals-SSB Generation - Filter and Phase Shift Methods, VSB Generation - Filter Method, Hilbert Transform, Pre-envelope & complex envelope AM techniques, Superheterodyne Receiver. Practical Exercises: 1. AM- Modulator and Demodulator 2. FM - Modulator and Demodulator						
Unit - II	SAMPLING					9+8
Pre-emphasis and De-emphasis, Threshold effect in angle modulation-Low pass sampling - Aliasing- Signal Reconstruction-Quantization - Uniform & non-uniform quantization -PAM, PPM, PWM, PCM -TDM, FDM Practical Exercises: 1. Pre-Emphasis and De-Emphasis. 2. Signal sampling.						
Unit - III	DIGITAL TECHNIQUES					9+8
Pulse modulation Differential pulse code modulation. Delta modulation, Noise considerations in PCM.Digital Multiplexers, Channel coding theorem - Linear Block codes - Hamming codes - Cyclic codes - Convolutional codes - Viterbi Decoder. Practical Exercises: 1. Delta Modulation and Demodulation 2. Pulse Code Modulation and Demodulation.						
Unit- IV	DIGITAL MODULATION SCHEME					9+4
Geometric Representation of signals - Generation, detection, IQ representation, PSD & BER of Coherent BPSK, BFSK, & QPSK - QAM - Structure of Non-coherent Receivers Synchronization and Carrier Recovery for Digital modulation, Spectrum Analysis-Principle of DPSK. Practical Exercises: 1. Digital Modulation'						
Unit -V	DEMODULATION TECHNIQUES					9+2
Elements of Detection Theory, Optimum detection of signals in noise, Coherent communication with waveforms- Probability of Error evaluations. Baseband Pulse Transmission- Inter symbol Interference, Optimum demodulation of digital signals over band-limited channels. Practical Exercises: 1. Pulse Position Modulation						
Total Periods:						75



Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Apply the design of communication systems and various modulation techniques	K3
CO2	Identify the types of coding methods in modulation techniques and the principles of sampling and quantization techniques	K3
CO3	Construct the various techniques to understand the digital techniques	K3
CO4	Experiment with the digital modulation techniques.	K3
CO5	Apply the demodulation techniques and rectify the errors.	K3

Knowledge Level: K1 - Remember, K2 - Understand, K3 -Apply, K4 -Analyze, K5 - Evaluate, K6 – Create

CO - PO - PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	2	2	2	-	-	-	-	-	-	2	-	-
CO2	3	3	2	2	2	-	-	-	-	-	-	2	-	-
CO3	3	3	2	2	2	-	-	-	-	-	-	1	-	-
CO4	3	2	2	2	2	-	-	-	-	-	2	1	-	-
CO5	3	2	2	2	2	-	-	-	-	-	2	1	-	-
CO	3	2	2	2	2	-	-	-	-	-	2	1	-	-

Text Books

1	David A. Patterson, John L. Hennessy, "Computer Organization and Design, The Hardware/Software Interface", Sixth Edition, Morgan Kaufmann/Elsevier, 2020.ISBN-13 978-0128201091
2	M. Morris Mano, Michael D. Ciletti, "Digital Design : With an Introduction to the Verilog HDL, VHDL and System Verilog", Sixth Edition, Pearson Education, 2018.ISBN-13:978-9353062019

Reference Books

1	William Stallings, "Computer Organization and Architecture - Designing for Performance", Tenth Edition, Pearson Education, 2016.ISBN-13:978-013410613
2	M. Morris Mano, "Digital Logic and Computer Design", Pearson Education, 2016,ISBN-13:978-9332542525
3	Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian, "Computer Organization and Embedded Systems", Sixth Edition, Tata McGraw-Hill, 2012.ISBN-13:978-9355323729



24EC4406	SERVICING TECHNOLOGY FOR CONSUMER ELECTRONICS	L	T	p	C
		3	0	2	4
Course Objectives:	This course aims to equip learners with the knowledge and skills required for servicing electrical and electronic home appliances, covering fault diagnosis, repair procedures, customer interaction, and workplace safety.				
Unit - I	INTRODUCTION				8+4
Overview of Home Appliance Service Industry, Roles and Responsibilities of a Service Technician, Essential Skills and Qualifications. Workplace Safety and Ethical Practices, Industry Trends and Professional Growth in Home Appliance Servicing.					
Practical Exercises:					
1. Conduct Market Research and Competitive Analysis in Home Appliance Service					
2. Accident Investigation and Reporting					
Unit - II	CUSTOMER INTERACTION AND SERVICE EXCELLENCE				8+2
Importance of Customer Engagement in Service, Communication Skills for Technicians, Service Process and Customer Interaction, Handling Customer Complaints and Difficult Situations, Ensuring Customer Satisfaction and Follow-up.					
Practical Exercises:					
1. Generate report on Handling Customer Complaints and Difficult Situations					
Unit - III	TROUBLESHOOTING TECHNIQUES FOR ELECTRICAL APPLIANCES				10+12
General Troubleshooting Steps, Electrical Fault Diagnosis, Preventive Maintenance, Repair Procedures, Testing and Quality Control of electrical appliances (Lighting system, Fan, Mixer Grinder, wet grinder, water heater, Inverter/UPS, Electric kettle, Vacuum cleaner)					
Practical Exercises:					
1. Testing and Troubleshooting of Lighting system					
2. Testing and Troubleshooting of Fan					
3. Testing and Troubleshooting of Mixer Grinder					
4. Testing and Troubleshooting of water heater					
5. Testing and Troubleshooting of Inverter/UPS					
6. Testing and Troubleshooting of Electric kettle					
Unit- IV	TROUBLESHOOTING TECHNIQUES FOR ELECTRONIC APPLIANCES				10+12
Electronic Fault Diagnosis, Preventive Maintenance, Repair Procedures, Testing and Quality Control of electronic appliances (Television, Home theatre system, Washing machine, Refrigerators, Microwave ovens, Air conditioners, Security cameras)					
Practical Exercises:					
1. Testing and Troubleshooting of Television					
2. Testing and Troubleshooting of Home theatre system					
3. Testing and Troubleshooting of Washing machine					
4. Testing and Troubleshooting of Microwave ovens					
5. Testing and Troubleshooting of Air conditioners					
6. Testing and Troubleshooting of Security cameras					
Unit - V	ADVANCED SERVICING TECHNOLOGIES				7+2
Modern Diagnostic Tools (Infrared thermometers, smart multimeters), Smart Home Appliances and IoT: Internet-connected appliances, Remote diagnostics and firmware updates, troubleshooting using manufacturer-provided diagnostic software, Eco-friendly repair practices					
Practical Exercises:					
1. Generate a report to diagnose household appliances remotely using simulation software					
Total Periods: J 45+30					



Course Outcomes

On completion of the course, the student can

cos	Statements	K-Level
CO1	Discuss the job role of a Service Technician	K2
CO2	Explain the process of engaging with customers in service	K2
CO3	Demonstrate the process of fault diagnosis and repair procedures of electrical Appliances	K3
CO4	Demonstrate the process fault diagnosis and repair procedures of electronics Appliances	K3
CO5	Explain modern servicing technologies and eco-friendly repair practices.	K2

Knowledge Level: K1 - Remember, K2 - Understand, K3 -Apply, K4 -Analyze, K5 - Evaluate, K6 - Create

CO - PO- PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	-	-	-	-	-	1	1	2	-	1	-	-	-
CO2	2	-	-	-	-	-	1	1	2	-	1	-	-	-
CO3	3	3	2	2	2	-	1	1	1	-	1	2	-	1
CO4	3	3	2	2	2	-	1	1	1	-	1	2	-	1
CO5	3	3	2	2	2	-	-	-	-	-	1	-	-	-
co	2	3	2	2	2	-	1	1	1	-	1	2	-	1

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Reference Books

1	"Troubleshooting and Repairing Major Appliances", Eric Kleinert 3rd Edition
2	"Electrical Wiring Residential", Phil Simmons 17'h Edition Delmar Cengage Learning



U24GE7301	PROFESSIONAL DEVELOPMENT	L	T	p	C
		0	0	2	1
Course Objectives:	Apply MS Word, MS Excel, and MS PowerPoint effectively for professional tasks while developing emotional intelligence, change management strategies, and essential professional skills for workplace success				

Exp.No	Title
	MS WORD: 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
2	MS EXCEL 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
3	MS POWERPOINT 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
4.	Emotional Intelligence and Meta Communication Learn how to manage emotions and develop self-awareness to enhance communication and collaboration at work.



5	What is Lateral Thinking? - Origin and History - Importance of Lateral Thinking - How to use it in Life-How to use it at Work?
6	Professional Skills Communication Skills - Nonverbal Communication. Writing and Different Modes of Writing Career Skills - Resume Skills, Interview Skills. Group Discussion Skills, Exploring Career Opportunities Team Skills - Presentation Skills, Trust and Collaboration, Internal Communication Management Skills - Leadership, Managerial and Entrepreneurial Skills
7	Career Planning and Goal Setting, Knowledge about SDG, COGNITIVE AND NON-COGNITIVE SKILLS SELF-AWARENESS: Assessing personal strengths and weaknesses - Goal setting: SMART goals framework - Building a growth mindset for continuous learning, Decision Making Engineering AI Assistants: Enhancing productivity, Design & simulation assistance, Problem-Solving & Decision Support, Coding & Automation, Manufacturing & Process Optimization, Project Management & Documentation.
Total Periods: 30	

Course Outcomes

On completion of the course, the student can

COS	Statements	K - Level
C01	Explain the fundamental features and functionalities of MS Word, MS Excel, and MS PowerPoint	K2
C02	Interpret the emotional intelligence and their impact on personal and professional interactions.	K2
C03	Infer the principles of change management and its impact on organizations and individuals.	K2
C04	Describe the essential professional skills required for effective communication, teamwork, and workplace success.	K2
C05	Explain the role of career planning, goal setting, SDGs, skills, and self-awareness in growth.	K2

Knowledge Level: K1-Remember, K2-Understand, K3 -Apply, K4-Analyze, K5 - Evaluate, K6 - Create

CO - PO - PSO Articulation Matrix

	Programme Outcomes											PSO	
	01	02	03	04	05	06	07	08	09	10	11	01	02
C01	-	-	-	-	-	-	-	-	3	-	2	-	-
C02	-	-	-	-	-	-	-	-	3	-	2	-	-
C03	-	-	-	-	-	-	-	-	3	-	2	-	-
C04	-	-	-	-	-	-	-	-	3	-	2	-	-
COS	-	-	-	-	-	-	-	-	3	-	2	-	-
CO	-	-	-		-	-	-	-	3	-	2	-	-

Correlation levels 1, 2 and 3 are as defined below:

1.Slight 2. Moderate 3. Substantial (High)



Textbooks

1	"Microsoft Office 2019 Beginner: Learn The Basics of Microsoft Word, Excel, and PowerPoint" by M.L.Humphrey
2	"Emotional Intelligence" by Daniel Goleman was published by Bantam Books in 1995.
3	"Lateral Thinking: Creativity Step by Step" by Edward de Bono

Reference Books

1	Placement Interviews Skills for Success by Ananda murugan.S - 1st edition 2011
2	SOFT SKILLS: Personality, Body language and Communication skills Development GD, Interview Preparation & Questions by N.S. REDDY and NEO -2016
3	Communication Skills: Stepladders to Success for the Professional by Richard Ellis



U24EC4501	TRANSMISSION LINES AND RF SYSTEMS			L	T	P	C
				3	0	0	3
Course Objectives:	To introduce the various types of transmission lines and their characteristics, understand high-frequency lines, power and impedance measurements, impart technical knowledge in impedance matching using the Smith Chart, explore wave guides and active RF components, and learn the concepts of RF system design.						
Unit - I	TRANSMISSION LINE THEORY					09	
General theory of Transmission lines - General solution of the transmission line -Input impedance- Open and short-circuited lines -The infinite line - Wavelength, velocity of propagation - Waveform distortion - the distortion less line - Loading and different methods of loading - Line not terminated in Z_0 - Reflection coefficient -Transfer impedance - reflection and insertion loss.							
Unit - II	HIGH FREQUENCY TRANSMISSION LINES					09	
Transmission line equations at radio frequencies - Line of Zero dissipation - Voltage and current on the dissipation less line, Standing Waves, Nodes, Standing Wave Ratio - Input impedance of the dissipation less line terminated by an impedance - Open and short circuited lines - Power and impedance measurement on lines - Measurement of VSWR and wavelength.							
Unit - III	IMPEDANCE MATCHING IN HIGH FREQUENCY LINE					09	
Eighth wave line, Quarter wave line and Half wave line- Smith chart-Applications of Smith chart, Problem solving using Smith chart - Impedance matching by stubs- Single and double stub matching using Smith chart.							
Unit – IV	WAVEGUIDES					09	
Waves between parallel planes of perfect conductors- Transverse Electric waves and Transverse Magnetic waves, Characteristics of TE and TM waves, Transverse Electromagnetic waves, TM and TE waves in Rectangular waveguides, TM and TE waves in Circular waveguides.							
Unit - V	RF SYSTEM DESIGN CONCEPTS					09	
Active RF components: Semiconductor basics in RF, bipolar junction transistors, RF field effect transistors, High electron mobility transistors, Basic concepts of RF design: Mixers, Low noise amplifiers, Voltage control oscillators, Power amplifiers, transducer power gain and stability considerations.							
Total Periods:						45	

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the characteristics of transmission lines and it losses	K2
CO2	Interpret the standing wave ratio and input impedance in high frequency transmission lines	K2
CO3	Apply Smith chart techniques to solve transmission line problems	K3
CO4	Analyze the characteristics of TE, TM, and TEM waves between parallel conductors and waveguides	K4
CO5	Analyze the behaviour and performance of active RF semiconductor devices and design basic RF sub circuits.	K4

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	-	-	-	2	-	-	-	-	1	-	2	-
CO2	3	2	-	-	-	2	-	-	-	-	1	-	2	-
CO3	3	3	3	2	-	2	-	-	-	-	-	-	2	-
CO4	3	3	2	-	-	2	-	-	-	-	-	-	2	-
CO5	3	3	2	2	-	2	-	-	-	-	1	-	2	-
CO	3	2.6	2.3	2	-	2	-	-	-	-	1	-	2	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	John D Ryder, "Networks lines and fields", Prentice Hall of India, New Delhi, 2015.
2	E.C.Jordan and K.G.Balmain, "Electromagnetic Waves and Radiating Systems", Prentice Hall, 2015.
3	Reinhold Ludwig and Powel Bretchko, "RF Circuit Design: Theory and Applications", Pearson Education Asia, 2013.

Reference Books

1	Mathew M. Radmanesh, "Radio Frequency & Microwave Electronics", Pearson Education Asia, Second Edition, 2002
2	D. K. Misra, "Radio Frequency and Microwave Communication Circuits"- Analysis and Design, John Wiley & Sons, 2004.
3	Richard Chi-Hsi Li - , "RF Circuit Design" – A John Wiley & Sons, Inc, Publications.
4	W.Alan Davis, Krishna Agarwal, "Radio Frequency Circuit Design", John willy & Sons, 2001.



U24EC4502		VLSI AND CHIP DESIGN				L	T	P	C
						3	0	0	3
Course Objectives:		Understand the fundamentals of IC technology components and their characteristics and familiarize combinational logic circuits and sequential logic circuits and clocking strategies and comprehend ASIC Design functioning and Memory Architecture, building blocks							
Unit - I	MOS TRANSISTOR PRINCIPLES							09	
MOS logic families (NMOS and CMOS), Ideal and Non Ideal IV Characteristics, CMOS devices. MOS(FET) Transistor Characteristic under Static and Dynamic Conditions, Technology Scaling, power consumption									
Unit - II	COMBINATIONAL LOGIC CIRCUITS							09	
Propagation Delays, stick diagram, Layout diagrams, Examples of combinational logic design, Elmore's constant, Static Logic Gates, Dynamic Logic Gates, Pass Transistor Logic, Power Dissipation, Low Power Design principles.									
Unit - III	SEQUENTIAL LOGIC CIRCUITS AND CLOCKING STRATEGIES							09	
Static Latches and Registers, Dynamic Latches and Registers, Pipelines, Nonbistable Sequential Circuits. Timing classification of Digital Systems, Synchronous Design, Self-Timed Circuit Design .									
Unit – IV	INTERCONNECT , MEMORY ARCHITECTURE AND ARITHMETIC CIRCUITS							09	
Interconnect Parameters – Capacitance, Resistance, and Inductance, Electrical Wire Models, Sequential digital circuits: adders, multipliers, comparators, shift registers. Logic Implementation using Programmable Devices (ROM, PLA, FPGA), Memory Architecture and Building Blocks, Memory Core and Memory Peripherals Circuitry .									
Unit - V	ASIC DESIGN AND TESTING							09	
Microchip design process & issues in test and verification of complex chips, embedded cores and SOCs, Fault models, Test coding. ASIC Design Flow, Introduction to ASICs, Introduction to test benches, Writing test benches in Verilog HDL Automatic test pattern generation. design for testability, scan design , Test interface and boundary scan.									
Total Periods:								45	

Course Outcomes

On completion of the course, the student can able to

COs	Statements	K-Level
CO1	Rephrase the principles of MOS technology	K2
CO2	Interpret Combinational Logic Circuits and Design Principles	K2
CO3	Illustrate the Sequential Logic Circuits and Clocking Strategies	K2
CO4	Know the Memory architecture and building blocks	K2
CO5	Infer the ASIC Design Process and Testing	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	1	1	-	-	-	-	-	-	-	-	2	3	-
CO2	3	2	2	1	-	-	-	-	-	-	-	2	2	-
CO3	3	2	2	1	-	-	-	-	-	-	-	2	2	-
CO4	3	2	1	1	-	-	-	-	-	-	-	2	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	3	-	-
CO	3	2	2	1	-	-	-	-	-	-	-	2.2	1.4	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Jan D Rabaey, Anantha Chandrakasan, “ Digital Integrated Circuits: A Design Perspective”, PHI, 2024
2	Neil H E Weste, Kamran Eshraghian, “ Principles of CMOS VLSI Design: A System Perspective,” Addison Wesley, 2020
3	Michael J Smith, ” Application Specific Integrated Circuits, Addison Wesley
4	Samir Palnitkar,” Verilog HDL:A guide to Digital Design and Synthesis”, Second Edition, Pearson Education,2008
5	Parag K.Lala,” Digital Circuit Testing and Testability”, Academic Press, 1997

Reference Books

1	D.A. Hodges and H.G. Jackson, Analysis and Design of Digital Integrated Circuits, International Student Edition, McGraw Hill 2023
2	P. Rashinkar, Paterson and L. Singh, "System-on-a-Chip Verification-Methodology and Techniques", Kluwer Academic Publishers,2001
3	Samiha Mourad and Yervant Zorian, “Principles of Testing Electronic Systems”, Wiley 2000
4	M. Bushnell and V. D. Agarwal, "Essentials of Electronic Testing for Digital, MemMemory and Mixed-Signal VLSI Circuits", Kluwer Academic Publishers,2020

Web resources

1. www.cmosvlsi.com
2. www.vlsi.tutorials.com



U24EC4503	NETWORKS AND SECURITY	L	T	P	C
		3	0	0	3
Course Objectives:	To learn the Network Models and Data Link Layer functions, understand routing mechanisms in the Network Layer, and explore communication methods and congestion control in the Transport Layer. Additionally, to study key Network Security mechanisms and gain knowledge about various hardware security attacks along with their countermeasures.				
Unit - I	UNIT I NETWORK MODELS AND DATALINK LAYER				09
Overview of Networks and its Attributes – Network Models – OSI, TCP/IP, Addressing – Introduction to Datalink Layer – Error Detection and Correction – Ethernet (802.3)- Wireless LAN – IEEE 802.11, Bluetooth – Flow and Error Control Protocols – HDLC – PPP.					
Unit - II	UNIT II NETWORK LAYER PROTOCOLS				09
Network Layer – IPv4 Addressing – Network Layer Protocols (IP, ICMP and Mobile IP) Unicast and Multicast Routing – Intradomain and Interdomain Routing Protocols – IPv6 Addresses – IPv6 – Datagram Format – Transition from IPv4 to IPv6.					
Unit - III	UNIT III TRANSPORT LAYER PROTOCOLS				09
Introduction to Transport layer –Protocols- User Datagram Protocols (UDP) and Transmission Control Protocols (TCP) –Services – Features – TCP Connection – State Transition Diagram – Flow, Error and Congestion Control - Congestion avoidance (DECbit, RED) – QoS – Application requirements					
Unit – IV	UNIT IV APPLICATION LAYER PROTOCOLS				09
Application Layer Paradigms – Client Server Programming – World Wide Web and HTTP - DNS- - Electronic Mail (SMTP, POP3, IMAP, MIME) – Introduction to Peer to Peer Networks – Need for Cryptography and Network Security – Firewalls					
Unit - V	UNIT V NETWORK & HARDWARE SECURITY				09
Encryption – Public Key Cryptosystems – RSA Algorithm – Hash Functions – Secure Hash Algorithm, Digital Signature Algorithm - Hardware Trojans, Side – Channel Attacks – Physical Attacks and Countermeasures. Introduction to Block chain Technology.					
Total Periods:					45

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the architecture of computer networks, OSI and TCP/IP models, and illustrate error detection, correction, and flow control mechanisms.	K2
CO2	Apply the principles of IPv4 and IPv6 addressing schemes, network layer protocols, and routing techniques for efficient communication.	K3
CO3	Compare transport layer protocols, features, and apply congestion and flow control mechanisms to ensure Quality of Service (QoS).	K3
CO4	Illustrate the working of application layer protocols and explain the role of cryptography and firewalls in network security.	K2



COs	Statements	K-Level
CO5	Apply encryption, hashing, and digital signature algorithms, and explain hardware security threats, countermeasures, and block chain applications.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	3	2	-	-	-	-	-	-	-	2	-	-	2
CO2	3	3	2	-	-	-	-	-	-	-	2	-	-	2
CO3	3	3	-	-	-	-	-	-	-	-	2	-	-	2
CO4	3	3	-	-	-	-	-	-	-	-	2	-	-	2
CO5	3	3	2	-	-	-	-	-	-	-	2	-	-	2
CO	3	3	2	-	-	-	-	-	-	-	2	-	-	2

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Behrouz.A.Forouzan, Data Communication and Networking, Fifth Edition, TMH, 2017.(Unit – I - IV)
2	William Stallings, Cryptography and Network Security, Seventh Edition, Pearson Education, 2017(Unit- V)
3	Bhunja Swarup, Hardware Security –A Hands On Approach,Morgan Kaufmann, First edition, 2018.(Unit – V)

Reference Books

1	James.F.Kurose and Keith.W.Ross, Computer Networking – A Top – Down Approach, Sixth Edition, Pearson, 2017.
2	Doughlas .E.Comer, Computer Networks and Internets with Internet Applications, Fourth Edition, Pearson Education, 2008.



U24EC5F04	SATELLITE COMMUNICATION	L	T	P	C
		3	0	0	3
Course Objectives:	To understand the fundamentals of satellite orbits, satellite and earth segments, link power budget calculations, satellite access and coding techniques, and the applications of satellite communication systems.				
Unit - I	SATELLITE ORBITS				09
Kepler's laws and Newton's law of gravitation, orbital parameters, orbital perturbations and station keeping, geostationary and non-geostationary orbits, look angle determination, limits of visibility, eclipse, sub-satellite point, sun transit outage, satellite launching and injection, launch vehicles and propulsion systems.					
Unit - II	SPACESEGMENT AND SATELLITE SUBSYSTEMS				009
Spacecraft technology, satellite bus and payload, power systems, attitude and orbit control system (AOCS), thermal control system and propulsion, telemetry, tracking and command (TT&C), transponders and antenna subsystem.					
Unit - III	SATELLITE LINK DESIGN				09
Basic link analysis, EIRP, G/T, uplink and downlink design equations, free space loss, atmospheric effects, ionospheric scintillation, rain-induced attenuation and interference, system noise temperature, link margin, link design with and without frequency reuse.					
Unit – IV	SATELLITE ACCESS AND CODING TECHNIQUES				09
Modulation and multiplexing techniques for voice, data and video transmission, analog and digital communication systems, digital video broadcasting, multiple access techniques (FDMA, TDMA, CDMA, PAMA and DAMA), data compression, encryption and channel coding schemes.					
Unit - V	SATELLITE APPLICATIONS				09
INTELSAT and global satellite communication systems, INSAT system and its services, VSAT networks and applications, mobile satellite services, LEO, MEO and GEO satellite systems, satellite navigation systems – GPS architecture and operation, position location principles and differential GPS, direct broadcast satellites (DBS/DTH), satellite communication for 5G networks, IoT applications and non-terrestrial networks (NTN).					
Total Periods:					45

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	<i>Interpret the principles of satellite orbits, orbital parameters, perturbations, and station keeping mechanisms.</i>	K2
CO2	<i>Summarize the structure and functions of the space segment and earth segment, including satellite subsystems and payloads.</i>	K2
CO3	<i>Compute satellite link parameters such as EIRP, G/T, system noise temperature, and link margin under various propagation conditions.</i>	K3
CO4	<i>Implement suitable satellite access and coding techniques for voice, data, and video transmission systems.</i>	K3
CO5	<i>Apply satellite communication systems to real-world applications including navigation, broadcasting, 5G networks, IoT, and non-terrestrial networks.</i>	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO–PO–PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	-	-	-	-	-	-	-	-	-	1	2	-
CO2	3	2	-	-	-	-	-	-	-	-	-	1	2	-
CO3	3	2	2	-	-	-	-	-	-	1	-	-	2	2
CO4	2	2	2	-	-	-	-	-	-	1	-	-	2	2
CO5	2	2	2	-	-	1	-	-	-	1	1	-	2	3
CO	2.6	2	2	-	-	1	-	-	-	1	1	1	2	2.3

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Dennis Roddy, "Satellite Communication", 5th Edition, McGraw Hill International, 2024.
2	Timothy Pratt, Charles, W.Bostain, Jeremy E.Alnutt,"SatelliteCommunication",3rd Edition, Wiley Publications, 2021
3	Gérard Maral, Michel Bousquet and Zhili Sun, Satellite Communications Systems: Systems, Techniques and Technology, 6th Edition, Wiley, 2020.

Reference Books

1	Tri T. Ha, "Digital Satellite Communications", 2nd edition, Mc Graw Hill education, 2017.
2	Wilbur L.Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, "Satellite Communications Systems Engineering", 2nd edition, Prentice Hall/Pearson, 2013.
3	K. N. Raja Rao, Satellite Communication: Concepts and Applications, 2nd Edition, PHI Learning, 2025.
4	Marko Höyhty, Satellite Communications and Networks, Springer, 2025.
5	Bruce R. Elbert, "The Satellite Communication Applications", Hand Book, Artech House Boston London, 2003.



U24EC4504	LINEAR INTEGRATED CIRCUITS	L	T	P	C
		3	0	2	4
Course Objectives:	To introduce the basic building blocks of linear integrated circuits, understand the applications of Op-Amps, relate the theory of ADC and DAC, interpret the waveform generation concepts and understand special ICs				
Unit - I	BASICS OF OPERATIONAL AMPLIFIERS				7+4
Current mirror and current source, Voltage source, Introduction to Operational Amplifier, Op-amp stages- Op-Amp equivalent circuit – Ideal Op-Amp- internal circuit diagrams of IC 741, Op- Amp DC and AC performance characteristics, Voltage Follower circuit, Inverting and Non inverting amplifier,					
Practical Exercises:					
1.Experimental study of characteristics of Op-Amp					
2. Design and experimentation on Inverting, Non inverting amplifier using IC741					
Unit - II	APPLICATIONS OF OPERATIONAL AMPLIFIERS				10+8
Op Amp applications-Summing and Scaling amplifier, Instrumentation amplifier, Integrator, V-to-I and I-to-V converters, Integrator, Differentiator, Differential amplifier, rectifier, peak detector, filter classification- first order and second order Low-pass, high-pass and band-pass and band reject filters					
Practical Exercises:					
1.Design of adder, subtractor using op-amp					
2.Design of integrator and differentiator using IC741					
3.Design and performance analysis of Instrumentation amplifier in simulation					
4.Experimentation of filters using Op-Amp					
Unit - III	COMPARATORS, WAVEFORM GENERATORS AND PLL				10+8
Comparator and its applications, Schmitt trigger, free running and one shot multivibrator, Barkhausen criterion, Sine wave generator, phase- shift, wein bridge oscillator, Square/triangular, saw-tooth wave generator, Operation of the basic PLL, Voltage controlled oscillator, applications of PLL					
Practical Exercises:					
1.Design and performance analysis of comparator and Schmitt trigger using IC741					
2.Design and performance analysis of triangular wave generator using IC741					
3.Design and performance analysis of a Sinusoidal oscillator for specified frequency-Wien bridge using IC 741 in simulation					
4.Design and performance analysis of a RC phase shift oscillator using IC741 in simulation					
Unit – IV	ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS				9+4
Analog and Digital Data Conversion, D/A converter –characteristics- weighted resistor type, R-2R Ladder type, sample-and-hold circuit, A/D Converter – characteristics – Integrating type, Successive Approximation type and flash type converter					
Practical Exercises:					
1.Experimentation of A/D converters					
2.Experimentation of D/A converters					
Unit - V	555 TIMER & SPECIAL FUNCTION ICS				9+6
Timer IC 555, Astable and Monostable operation and application- IC Voltage regulator – Three terminal fixed and adjustable voltage regulator - IC 723 general purpose regulator - Introduction to AI based Intelligent system design for Op-Amp.					
Practical Exercises:					
1.Design and analysis of astable using IC555 in simulation					
2.Design and analysis of monostable multivibrator using IC555 in simulation					
3.Experimental study of voltage regulator using IC723					
Total Periods:					45+30



Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Implement Op-Amp configurations such as voltage follower, inverting, and non-inverting amplifiers for given specifications	K3
CO2	Construct circuits using operational amplifiers for arithmetic operations, amplification and filtration	K3
CO3	Compare various waveform generators (square, triangular, saw-tooth) based on design and output characteristics	K4
CO4	Apply the principles of A/D and D/A converters to solve relevant problems.	K3
CO5	Analyze the performance of IC 555 timer circuits and voltage regulators by interpreting the circuit behavior and characteristics	K4

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO-PO-PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	3	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	3	2	1	1	-	-	-	-	-	1	3	2	1
CO3	3	3	2	1	1	-	-	-	-	-	1	3	2	1
CO4	3	3	2	1	-	-	-	-	-	-	1	3	2	-
CO5	3	3	2	1	1	-	-	-	-	-	1	3	2	1
CO	3	3	2	1	1	-	-	-	-	-	1	3	2	1

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	D.Roy Choudhry, Shail Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd., 2018, Fifth Edition
2	Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", 4th Edition, Tata Mc Graw-Hill, 2016

Reference Books

1	Ramakant A. Gayakwad, "OP-AMP and Linear ICs", 4th Edition, Prentice Hall / Pearson Education, 2015.
2	Robert F.Coughlin, Frederick F.Driscoll, "Operational Amplifiers and Linear Integrated Circuits", Sixth Edition, PHI, 2001.
3	S.Salivahanan & V.S. Kanchana Bhaskaran, "Linear Integrated Circuits", TMH, 2nd Edition, 4th Reprint, 2016.



U24EC4505		EMBEDDED SYSTEMS AND IoT DESIGN				L	T	P	C
						3	0	2	4
Course Objectives:		To understand, analyze and model embedded and IoT systems by integrating embedded processor architecture, programming, I/O interfacing techniques, IoT concepts and architecture, open-platform based system development, and real-world application design.							
Unit - I	AT89S52 MICROCONTROLLER							9 + 9	
Microcontrollers for Embedded Systems – 8051 family overview – Features of AT89S52 – Architecture and CPU organization – Pin configuration and I/O ports – Addressing modes – Instruction set – Program and data memory organization – Stack and stack pointer – Interrupts – Timers/Counters (Timer 0 & Timer 1) – Serial communication (UART) – Assembly language programming.									
Practical Exercises:									
1. Program Development using KEIL μVision Environment									
2. Interfacing LED and LCD.									
Unit - II	EMBEDDED SYSTEM DESIGN AND ARM PROGRAMMING							9 + 9	
Embedded System Design Process – Model Train Controller – ARM Processor – Instruction Set Preliminaries – CPU – Programming Input and Output – Introduction to Embedded C Programming Concepts – Supervisor Mode – Exceptions and Trap – Models for Programs – Assembly, Linking and Loading – Compilation Techniques – Program Level Performance Analysis.									
Practical Exercises:									
1. Interfacing ADC and DAC									
2. Interfacing keyboard and Stepper Motor.									
Unit - III	PROCESSES AND OPERATING SYSTEMS							9	
Structure of a Real-Time System – Hard and Soft Real-Time Deadlines – Task Assignment and Scheduling – Multiple Tasks and Multiple Processes – Multirate Systems – Pre-emptive Real-Time Operating Systems – Priority Based Scheduling – Interposes Communication Mechanisms – Distributed Embedded Systems – Design Example: Audio Player, Engine Control Unit and Video Accelerator.									
Unit – IV	IoT ARCHITECTURE AND PROTOCOLS							9 + 6	
Internet of Things – Physical Design – Sensors and Actuators in IoT Systems – Logical Design – IoT Enabling Technologies – Domain Specific IoTs – IoT and M2M – IoT System Management with NETCONF – YANG – IoT Platform Design Methodology – IoT Reference Model – Domain Model – Communication Model – IoT Reference Architecture – IoT Protocols: MQTT, XMPP, Modbus, CANBUS and BACNet.									
Practical Exercises:									
1. Explore different communication methods with IoT devices (Zigbee, GSM, Bluetooth).									
2. Displaying sensor readings on a web-based application using MQTT.									
Unit - V	IoT SYSTEM DESIGN							9 + 6	
Basic Building Blocks of an IoT Device – Raspberry Pi Board – Linux on Raspberry Pi – Interfaces – Programming with Python – Introduction to Cloud Platforms for IoT Applications – Case Studies: Home Automation, Smart Cities, Environment and Agriculture.									
Practical Exercises:									
1. Setup a cloud platform to log the data.									
2. Smart lock system implementation.									
Total Periods:								45 + 30	

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the AT89S52 microcontroller architecture and programming.	K2
CO2	Apply ARM programming and embedded system design concepts.	K3
CO3	Analyze real-time operating system concepts in embedded systems.	K4
CO4	Illustrate IoT architecture, protocols, and communication technologies.	K2
CO5	Design and implement IoT-based embedded applications.	K4

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO–PO–PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	2	1	3	–	–	–	1	1	–	3	1	1
CO2	2	2	2	1	3	–	–	–	1	1	–	3	1	1
CO3	2	3	2	2	3	–	–	–	1	1	1	2	2	2
CO4	2	3	2	2	3	1	1	–	1	2	1	2	3	3
CO5	2	3	3	3	3	2	2	1	3	3	3	3	2	3
CO	2.2	2.6	2.2	1.8	3.0	0.6	0.6	0.2	1.4	1.6	1.0	2.6	1.8	2.0

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Muhammed Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, "The 8051 Microcontroller and Embedded Systems", Pearson Education, Second Edition, 2014
2	Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCOPress, 2017.

Reference Books

1	Michael J. Pont, "Embedded C", Pearson Education, 2007.
2	Wayne Wolf, "Computers as Components: Principles of Embedded Computer System Design", Elsevier, 2006.
3	Andrew N Sloss, D. Symes, C. Wright, "Arm System Developer's Guide", Morgan Kauffman/Elsevier, 2006.
4	Arshdeep Bahga, Vijay Madiseti, "Internet of Things – A hands-on approach", Universities Press, 2015

Web-links

1. <https://ww1.microchip.com/downloads/en/DeviceDoc/doc1919.pdf>
2. <https://www.electronicwings.com/8051/at89s52-microcontroller>
3. https://www.tutorialspoint.com/internet_of_things/internet_of_things_applications.htm



24GE1601		PROFESSIONAL ETHICS		L	T	P	C
				3	0	0	3
Course Objectives:		Develop ethical awareness in engineering, fostering human values, professional responsibility, safety, rights, and global perspective, enabling sustainable, socially conscious, and accountable decision-making throughout professional life.					
Unit - I	HUMAN VALUES, ETHICS AND PROFESSIONAL EXCELLENCE					9	
Introduction to Morals, Values and Ethics – Integrity, Honesty , Work ethic – Service learning , Civic virtue – Respect for others , Living peacefully, Caring and Sharing — Courage, Commitment , Cooperation – Valuing time & Professional Discipline - Empathy , Self Confidence , Character Building – Spirituality and Inner Development – Introduction to Yoga and meditation for professional excellence and stress management.							
Unit - II	ENGINEERING ETHICS					9	
Introduction to Engineering Ethics – Senses, Scope, and Importance in Professional Life - Variety of Moral Issues – Understanding Ethical Challenges in Engineering Practice - Types of Inquiry – Moral Dilemmas and Decision-Making Frameworks - Moral Autonomy – Kohlberg’s Theory of Moral Development - Gilligan’s Ethics of Care – Consensus, Controversy, and Ethical Reasoning- Models of Professional Roles – Responsibilities and Expectations in Engineering- Theories about Right Action – Utilitarianism, Deontology, Virtue Ethics- Influence of Self-Interest, Customs, and Religion on Ethical Decision-Making- Applications and Uses of Ethical Theories – Case Studies.							
Unit - III	ENGINEERING AS SOCIAL EXPERIMENTATION					9	
Engineering as Experimentation – Differences between laboratory experiments and engineering projects , Uncertainty, risk, and complexity in engineering experiments - Role of engineering in society and public welfare - Engineers as responsible Experimenters – Moral and Professional responsibilities of engineers - Codes of Ethics – Fundamental principles and Ethical dilemmas in engineering practice - A Balanced Outlook on Law – Case Studies.							
Unit – IV	OCCUPATIONAL SAFETY, PROFESSIONAL RESPONSIBILITIES AND LEGAL RIGHTS					9	
Introduction to Safety and Risk – Concepts, Importance, and Types of Workplace Hazards-Assessment of Safety and Risk – Methods and Tools for Identifying Risks-Risk–Benefit Analysis and Risk Reduction Strategies – Preventive Measures and Safety Planning-Respect for Authority and Ethical Workplace Conduct – Roles and Responsibilities- Collective Bargaining and Confidentiality- Conflicts of Interest and Occupational Crime – Identification and Mitigation Strategies-Professional Rights and Employee Rights-ntellectual Property Rights (IPR) – Importance, Types, and Professional Compliance-Discrimination and Equal Opportunity.							
Unit - V	GLOBAL AND PROFESSIONAL ISSUES					9	
Global Issues in Engineering – Overview and Relevance- Multinational Corporations- Environmental Ethics – Sustainable Practices and Impact Assessment- Computer Ethics – Cyber security, Privacy, and Professional Responsibility- Weapons Development – Ethical Considerations and Social Implications- Engineers as Managers, Consultants, and Advisors - Engineers as Expert Witnesses – Legal and Ethical Accountability- Moral Leadership and Code of Conduct- Corporate Social Responsibility – Ethics, Sustainability, and Societal Impact.							
Total Periods:						45	

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO1	Apply ethical principles, honesty, cooperation, time management, and service learning in real-life academic and professional contexts.	K3
CO2	Analyze engineering ethical issues and moral dilemmas using ethical theories, moral development models, and professional role frameworks for responsible decision-making.	K4
CO3	Analyze engineering practice as experimentation, addressing risk, uncertainty, public welfare, professional responsibilities, codes of ethics, law, and ethical case studies.	K4
CO4	Apply safety, risk, rights, confidentiality, conflicts, ethics, and intellectual property principles in professional workplace contexts.	K3



CO5	Apply ethical principles to multinational corporations, environmental and computer ethics, corporate social responsibility, leadership, and engineering practice.	K3
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Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO– PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO01	-	-	-	-	-	3	3	-	-	-	2	-	-	-
CO02	-	-	-	-	-	3	3	-	-	-	2	-	-	-
CO03	-	-	-	-	-	3	3	-	-	2	2	-	-	-
CO04	-	-	-	-	-	3	3	2	-	2	2	-	-	-
CO05	-	-	-	-	-	3	3	2	-	2	3	-	-	-
CO	-	-	-	-	-	3	3	2	-	2	2	-	-	-

Text Books

1	Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York, 2012.
2	Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Ray James, Elian Englehardt Wadsworth publishing co, 6/e, 2013
3	Professional Ethics by R. Subramanian (OUP India) , Oxford University Press (India), ISBN-13: 978-9367256060, 3 rd edition 2025.

Reference Books

1	Charles D Fleddermann, 'Engineering Ethics', Prentice Hall, New Mexico, 2012.
2	John R Boatright, "Ethics and the Conduct of Business", Pearson Education, 2013.
3	Edmund G Seebauer and Robert L Barry, 'Fundamentals of Ethics for Scientists and Engineers', Oxford University Press, 2013.
4	David Erman & Michele Shauf, 'Computers, Ethics and Society, Oxford University Press, 2012.



U24EC4601		WIRELESS COMMUNICATION			L	T		P	C
					3	0		2	4
Course Objectives:		To understand, analyze and model wireless communication systems by integrating radio propagation, modulation, multiple access, cellular system design, wireless standards and artificial intelligence techniques.							
Unit - I		WIRELESS COMMUNICATION FUNDAMENTALS					09 + 06		
		Wireless communication system model - Spectrum allocation and frequency bands - Licensed and unlicensed spectrum - Noise and interference in wireless systems - Performance metrics: BER, SNR, throughput, capacity - Evolution of wireless systems: 1G to 5G. Practical Exercises: 1. BER vs SNR analysis of a wireless system over AWGN channel 2. Interference analysis in wireless communication systems							
Unit - II		RADIO PROPAGATION AND WIRELESS CHANNEL MODELING					09 + 06		
		Wireless channel characteristics - Large scale propagation models: Free space model, Log distance path loss model, Okumura Hata and COST 231 models - Small scale fading: Multipath propagation, Doppler effect - Rayleigh and Rician fading models Practical Exercises: 1. Simulation of large-scale path loss models 2. Modeling and analysis of Rayleigh and Rician fading channels							
Unit - III		DIGITAL MODULATION, EQUALIZATION AND DIVERSITY					09 +06		
		Digital modulation schemes for wireless systems - BPSK, QPSK and QAM performance in fading channels - Inter symbol interference (ISI) - Equalization techniques: Zero Forcing (ZF), MMSE - Diversity techniques: time, frequency and spatial diversity Practical Exercises: 1. BER analysis of BPSK, QPSK and QAM in fading channels 2. Simulation of ZF and MMSE equalizers							
Unit – IV		CELLULAR SYSTEM DESIGN AND CAPACITY ENHANCEMENT					09 +06		
		Cellular concept and frequency reuse - Co-channel and adjacent channel interference - Channel assignment strategies - Cell splitting and sectoring - Microcell, picocell and femtocell concepts - Power control and handoff strategies Practical Exercises: 1. Capacity analysis of cellular systems using cell splitting and sectoring 2. Handoff and interference performance analysis							
Unit - V		WIRELESS NETWORKS, STANDARDS AND AI-ENABLED SYSTEMS					09 +06		
		Wireless Networking Concepts: Infrastructure vs Ad-hoc wireless networks - Wireless LAN, Wireless PAN and Cellular networks - Wireless Standards: Bluetooth, Wi-Fi, NFC, RFID, ZigBee and UWB (Principle and architecture) - Cellular standards: GSM, UMTS, LTE and 5G NR overviews - Artificial Intelligence in Wireless Networks: AI-based channel estimation, AI-assisted resource allocation and scheduling. Practical Exercises: 1. AI-based optimization of wireless network performance							
Total Periods:							75		



Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Apply wireless communication fundamentals to compute spectrum utilization, interference, and system performance metrics.	K3
CO2	Model wireless propagation and fading characteristics using large-scale and small-scale channel models.	K3
CO3	Evaluate digital modulation, equalization, and diversity techniques for improving reliability in wireless communication systems.	K4
CO4	Analyze cellular system design and capacity enhancement techniques including frequency reuse, cell splitting, and sectoring.	K4
CO5	Implement wireless networking concepts, wireless standards, and AI-assisted optimization techniques in wireless communication systems.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO– PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	1	1	-	2	-	-	-	1	-	-	1	3	-
CO2	3	1	1	-	2	-	-	-	1	-	-	1	3	-
CO3	3	1	2	2	3	-	-	-	1	-	-	1	3	-
CO4	3	2	1	2	2	-	-	-	1	-	-	1	3	-
CO5	3	1	3	-	3	2	-	-	1	-	-	1	2	3
CO	3	1.2	1.6	2	2.4	2	-	-	1	-	-	1	2.8	3

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Du, K.-L., & Swamy, M. N. S. (2010). <i>Wireless Communication Systems: From RF Subsystems to 4G Enabling Technologies</i> . Cambridge University Press. (Units I–IV)
2	Stuber, G. (2026). <i>Introductory Digital Wireless Communications</i> . Springer. (Units I–III)
3	Rappaport, T. S. (2024). <i>Wireless Communications: Principles and Practice</i> (2nd Edition). Cambridge University Press. (Units I–III)
4	Molisch, A. F. (2024). <i>Wireless Communications: From Fundamentals to Beyond 5G</i> (3rd Edition). Wiley-IEEE Press. (Units I–V)
5	Sharma, S., Deka, K., & Dixit, D. (2025). <i>Next-Generation Wireless Systems: Fundamentals and Applications</i> . Springer Singapore. (Units III–V)



Reference Books

1	Raghunandan, K. (2022). Introduction to Wireless Communications and Networks: A Practical Perspective. Springer.
2	Wireless Communication: Advancements and Challenges (2024). Prashant Ranjan, Ram Shringar Rao & Krishna Kumar. CRC Press.
3	El Ghzaoui, M., Das, S., Samudrala, V., & Medikondur, N. R. (2024). Next Generation Wireless Communication: Advances in Optical, mm-Wave, and THz Technologies. Springer.
4	Sur, S. N., Imoize, A. L., Bhattacharya, A., Kandar, D., & Banerjee, J. S. (2025). Artificial Intelligence for Wireless Communication Systems: Technology and Applications. CRC Press.
5	Smart Systems and Wireless Communication: Proceedings of SSWC 2024. (2025). Edited by R. Chaki, A. Cortesi, S. DasGupta & S. Saha. Springer.

Web-links

1. <https://fitech.io/en/studies/basic-course-on-wireless-communications/?utm>
2. <https://www.coursera.org/learn/wireless-communications?utm>
3. <https://www.rfwireless-world.com/Tutorials/?utm>

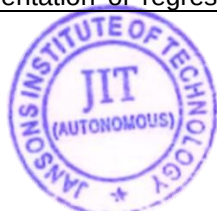


U24CS4502	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING			L	T	P	C
			3	0	2	4	
Course Objectives:	To equip students with a comprehensive understanding of Artificial Intelligence and Machine Learning techniques, including problem-solving strategies, probabilistic reasoning, supervised and unsupervised learning, ensemble methods, and neural networks, along with hands-on implementation of real-world AI models and algorithms.						
Unit - I	PROBLEM SOLVING					15	
Introduction to AI - AI Applications - Problem solving agents – Informed search algorithms – uninformed search strategies – Heuristic search strategies – Local search and optimization problems – constraint satisfaction problems (CSP)							
Suggested Activities:							
1. Implementation of Uninformed search algorithms (BFS, DFS)							
2. Implementation of Informed search algorithms (A*, memory-bounded A*)							
Unit - II	PROBABILISTIC REASONING					15	
Acting under uncertainty – Bayesian inference – naïve bayes models. Probabilistic reasoning – Bayesian networks –, Bayesian linear regression-- exact inference in BN – approximate inference in BN – causal networks							
Suggested Activities:							
1. Implement naïve Bayes models							
2. Implement Bayesian Networks							
Unit - III	SUPERVISED LEARNING					15	
Introduction to machine learning – Linear Regression Models: Least squares, single & multiple variables, gradient descent, Linear Classification Models: -- Logistic regression, Probabilistic generative model –Support vector machine-- Decision Tree-- Random forests							
Suggested Activities:							
1. Build Regression models							
2. Build decision trees and random forests							
Unit – IV	UNSUPERVISED LEARNING					15	
Clustering algorithms: K-means, hierarchical clustering, DBSCAN -- Dimensionality reduction: PCA, LDA -- Instance-based learning: KNN -- Gaussian mixture models -- Expectation Maximization (EM)							
Suggested Activities:							
1. Implement clustering algorithms							
2. Implement EM for Bayesian networks							
Unit - V	ENSEMBLE TECHNIQUES					15	
Combining multiple learners: Model combination schemes, Voting, Ensemble Learning - bagging, boosting, stacking, Maximum margin classifier -Applications of ensemble methods in supervised and unsupervised learning							
Suggested Activities:							
1. Implement bagging and boosting.							
2. Implement stacking ensemble models.							
Total Periods:						75	

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Apply artificial intelligence concepts, including problem-solving agents, uninformed and informed search algorithms, heuristic and local search, optimization techniques, and constraint satisfaction problems, through the implementation of BFS, DFS, A, and memory-bounded A algorithms.	K3
CO2	Analyze acting under uncertainty using probabilistic reasoning, Bayesian inference, naïve Bayes models, Bayesian networks, Bayesian linear regression, and exact and approximate inference in Bayesian and causal networks through the implementation of naïve Bayes models and Bayesian Networks.	K4
CO3	Build machine learning models by applying linear regression (least squares, single and multiple variables, gradient descent), linear classification techniques including logistic regression, probabilistic generative models, support vector machines, decision trees, and random forests through hands-on implementation of regression models, decision	K3



COs	Statements	K-Level
	trees, and random forests.	
CO4	Examine unsupervised and instance-based learning techniques including clustering algorithms (K-means, hierarchical, DBSCAN), dimensionality reduction methods (PCA, LDA), KNN, Gaussian mixture models, and Expectation Maximization (EM) through the implementation of clustering algorithms and EM for Bayesian networks.	K4
CO5	Dissect ensemble learning approaches by examining model combination schemes, voting mechanisms, bagging, boosting, stacking, and maximum margin classifiers, along with their applications in supervised and unsupervised learning through the implementation of bagging, boosting, and stacking ensemble models.	K4

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes												PSO		
	01	02	03	04	05	06	07	08	09	10	11	12	01	02	03
CO1	3	3	2	2	3	-	1	3	3	2	3	3	3	3	3
CO2	3	3	3	3	3	-	1	3	3	2	3	3	3	3	3
CO3	3	3	3	2	3	-	1	3	3	2	3	3	3	3	3
CO4	3	3	3	3	3	-	1	3	3	2	3	3	3	3	3
CO5	3	3	3	2	3	-	1	3	3	2	3	3	3	3	3
CO	3.00	3.00	2.80	2.40	3.00	-	1.00	3.00	3.00	2.00	3.00	3.00	3.00	3.00	3.00

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Stuart Russell and Peter Norvig, "Artificial Intelligence – A Modern Approach", Fourth Edition, Pearson Education, 2021.
2	Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Fourth Edition, 2020.

Reference Books

1	Deepak Khemani, "Artificial Intelligence", Tata McGraw Hill Education, 2013 (http://nptel.ac.in/)
2	Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, "Foundations of Machine Learning", MIT Press, 2012.
3	Kevin Night, Elaine Rich, and Nair B., "Artificial Intelligence", McGraw Hill, 2008.
4	Dan W. Patterson, "Introduction to Artificial Intelligence and Expert Systems", Pearson Education, 2007.



U24EC7701	PROJECT WORK – PHASE 1	L	T	P	C
		0	0	6	3
Course Objectives:	To enable students to identify and define a relevant business or research problem, conduct a preliminary literature review, and formulate clear objectives and an appropriate methodology, while initiating the project through planning or a pilot implementation.				
The students shall undertake a project individually or in groups on a business or research problem relevant to their programme specialization and approved by the department. In this phase, students shall identify the problem, finalize the title and objectives, conduct a brief literature review, and design the methodology. The project shall be developed and implemented with core modules integrated, tested, and maintained using version control practices in line with industry standards. A working prototype or functional system must be demonstrated. A Phase 1 project report shall be submitted as per the prescribed guidelines and presented for evaluation.					
Total Periods:					90

On completion of the course, the student can

COs	Statements	K - Level
CO01	Apply problem identification techniques to select and define a relevant business or research problem aligned with the programme specialization.	K3
CO02	Analyze existing literature to identify research gaps, theoretical foundations, and current practices related to the defined problem.	K4
CO03	Apply project planning principles to design clear objectives, scope, and an appropriate methodology for addressing the identified problem.	K3
CO04	Analyze initial implementation results or pilot outcomes to validate the feasibility and direction of the proposed project approach.	K4



U24EC7702	SUMMER INTERNSHIP				L	T	P	C
					0	0	0	2
Course Objectives:	To enable students to gain hands-on experience through collaboration with reputed industry academia, or research institutions, developing technical, professional, teamwork skills required to solve real-world problems in product development, software systems, business processes, automation, digitalization.							
The students are required to individually undergo summer internship training in reputed industries, research institutes, or laboratories for the prescribed duration. This internship provides practical exposure to real-world professional, technical, and research environments relevant to their field of study. During the training period, students are expected to actively participate in assigned tasks and learn industry-standard practices. The internship helps students bridge the gap between theoretical knowledge and practical application. It also enhances their technical competence, problem-solving ability, and professional attitude. Students must maintain proper records of their work and learning throughout the internship period. Upon successful completion of the training, each student shall prepare a complete internship report. The report should clearly document the nature of work carried out, tools and technologies used, and outcomes achieved. The completed report must be submitted within ten days from the commencement of the subsequent semester. Student performance will be assessed and evaluated strictly in accordance with the prescribed academic regulations.								
No. of Weeks:								04

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Infer a comprehensive understanding of software industry practices, development processes, tools, techniques, emerging technologies, automation methods, and professional standards followed in real-world industrial environments.	K2
CO2	Analyze complex business and technical problems, identify requirements, and design effective, feasible, and optimized software solutions using appropriate methodologies and problem-solving approaches.	K4
CO3	Develop, implement, test, and deploy software solutions on appropriate target platforms by applying suitable programming languages, frameworks, tools, and deployment strategies.	K3
CO4	Examine clear, well-structured technical documentation, including reports and project records, in accordance with professional standards, and effectively communicate technical concepts through oral presentations.	K4
CO5	Apply professional competence by working effectively individually or in teams, adhering to ethical practices, time management principles, and industry norms, while adapting to real-world organizational and project-based environments.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	1	2	2	1	2	2	2	2	3	2	2	2
CO2	3	2	1	2	2	1	2	2	2	2	3	2	2	2
CO3	3	2	1	2	2	1	2	2	2	2	3	2	2	2
CO4	3	2	1	2	2	1	2	2	2	2	3	2	2	2
CO5	3	2	1	2	2	1	2	2	2	2	3	2	2	2
CO	3	2	1	2	2	1	2	2	2	2	3	2	2	2

Correlation levels 1, 2 and 3 are as defined below: 1. Slight 2. Moderate 3. Substantial (High)



U24EC7801	PROJECT WORK – PHASE II / INTERNSHIP/APPRENTICESHIP	L	T	P	C
		0	0	14	7
Course Objectives:	To enable students to complete the project as per the approved methodology, analyze and interpret results, and effectively present the outcomes through a comprehensive report and viva-voce examination.				
The students shall continue and enhance the project completed in Phase 1 by implementing additional features, improvements, or advanced analysis. Alternatively, students may undertake a new project, internship, or apprenticeship related to their programme specialization with prior departmental approval. In the case of an internship or apprenticeship, students shall carry out the assigned industry or organization-based tasks and submit a detailed report as per the prescribed guidelines. Students shall submit a comprehensive final report and appear for a viva-voce examination conducted as per regulations.					
Total Periods:				210	

On completion of the course, the student can

COs	Statements	K - Level
CO1	Apply the approved methodology to implement and complete the project in accordance with defined objectives and scope.	K3
CO2	Analyze project data or system outputs using appropriate analytical tools and techniques to obtain meaningful results.	K4
CO3	Analyze and interpret project outcomes in relation to stated objectives and existing literature to assess effectiveness.	K4
CO4	Apply technical documentation and presentation skills to develop a comprehensive project report and present the work through viva-voce examination.	K3



U24GE8501		INTRODUCTION TO WOMEN AND GENDER STUDIES				L	T	P	C
						3	0	0	3
Course Objectives:		To infer key gender concepts and feminist theories to understand gender as a social construct. It explores women's movements, gendered language, and media representations across global and local contexts. Students will critically analyze gender roles, power structures, and representations in society and media.							
Unit - I	CONCEPTS						12		
Sex vs. Gender, masculinity, femininity, socialization, patriarchy, public/ private, essentialism, binarism, power, hegemony, hierarchy, stereotype, gender roles, gender relation, deconstruction, resistance, sexual division of labour - Gender Representation in Media and Literature -Feminist Movements and Gender Equality.									
Unit - II	FEMINIST THEORY						8		
Intersectional Feminism - Post Colonial Feminism (Indian Context) – Transfeminism and Queer Feminist Perspectives Liberal, Marxist, Socialist, Radical, Psychoanalytic, postmodernist, ecofeminist - Feminism and Cultural Representation - Contemporary Feminist Debates - Feminism and Literature - Feminism and Media Representation - Dalit Feminism (Indian Context).									
Unit - III	WOMEN’S MOVEMENTS: GLOBAL, NATIONAL AND LOCAL						8		
Rise of feminism in Europe and America. women’s movement in India - Women’s Suffrage Movement - Social Reform Movements and Women’s Rights in India - Women and the Indian Freedom Struggle - Education and Women’s Empowerment - Women and Legal Rights - Women in Politics and Leadership - Women and Economic Independence - Women’s Organizations and Activism - Women and Human Rights - Feminist Activism in the Digital Age - Contemporary Challenges in Feminism.									
Unit – IV	GENDER AND LANGUAGE						8		
Linguistic Forms and gender. gender and narratives - Gendered Communication Styles - Language and Gender Identity - Sexism in Language - Language and Power Relations - Politeness and Gender - Language and Gender Stereotypes - Gender Representation in Media Language - Gender and Discourse Analysis - Language Socialization and Gender - Language, Identity, and Culture - Future Directions in Gender and Language Studies.									
Unit - V	GENDER AND REPRESENTATION						9		
Advertising and popular visual media - Gender and Representation in Alternative Media - Gender and social media - Gender Stereotypes in Media - Representation of Women in Film and Television - Masculinity in Media Representation - Gender Representation in News Media - Objectification and the Female Body in Media - Gender and Celebrity Culture - Representation of LGBTQ+ Identities in Media - Gender and Fashion Media - Gender Representation in Gaming and Digital Entertainment.									
Total Periods:								45	

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the foundation of gender concepts, constructed and maintained in society.	K2
CO2	Differentiate major feminist theoretical frameworks, critique gender inequalities and social structures.	K2/K4
CO3	Examine the historical development and impact of women's movements globally and in India, and evaluate their role in shaping gender discourse and policy.	K2/K5
CO4	Analyze the relationship between language and gender, including linguistic forms and gendered narratives, and how they influence social perceptions.	K2
CO5	Critically assess the portrayal of gender in mainstream, alternative, and digital media, recognizing patterns of representation, bias, and resistance.	K2/K6

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes												PSO		
	01	02	03	04	05	06	07	08	09	10	11	12	01	02	03
CO1	-	-	-	-	-	3	-	3	-	-	-	3	-	-	-
CO2	-	-	-	-	-	3	-	2	-	-	-	3	-	-	-
CO3	-	-	-	-	-	3	-	2	-	-	-	3	-	-	-
CO4	-	-	-	-	-	3	-	3	-	-	-	3	-	-	-
CO5	-	-	-	-	-	3	-	3	-	-	-	3	-	-	-
CO	-	-	-	-	-	3	-	3	-	-	-	3	-	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Butler, Judith. <i>Gender Trouble: Feminism and the Subversion of Identity</i> . Routledge, 1990.
2	Beauvoir, Simone de. <i>The Second Sex</i> . Translated by Constance Borde and Sheila Malovany-Chevallier, Vintage, 2011.
3	Cameron, Deborah. <i>Gender and Language</i> . 2nd ed., Palgrave Macmillan, 2003.
4	Hall, Stuart, et al. <i>Representation: Cultural Representations and Signifying Practices</i> . Sage Publications, 2013.

Reference Links

1	https://archive.mu.ac.in/myweb_test/TYBA%20study%20material/Gender%20&%20Soc.pdf
2	https://revisesociology.com/2016/07/11/liberal-radical-marxist-feminist-perspectives-society-sociology/
3	https://ehne.fr/en/encyclopedia/themes/gender-and-europe/feminisms-and-feminist-movements/feminisms-and-feminist-movements-in-europe
4	https://egyankosh.ac.in/bitstream/123456789/58105/1/Unit13.pdf
5	https://gsdrc.org/topic-guides/gender/gender-and-media/



U24HS8501	ELEMENTS OF LITERATURE	L	T	P	C
		3	0	0	3
Course Objectives:	This course introduces the relevance of literature in developing reading, thinking, discussion, and writing skills while nurturing human sensibility. It provides basic knowledge of fiction, poetry, and drama and their key elements and techniques. It also presents major approaches to literary criticism and interpretation. Overall, it trains students to read and analyze literary texts with clarity and critical insight.				
Unit - I	RELEVANCE OF LITERATURE	9			
Enhances Reading, thinking, discussing, and writing skills, - Develops finer sensibility for better human relationship, - Increases understanding of the problem of humanity without bias, - Providing space to reconcile and get a cathartic effect.					
Unit - II	ELEMENTS OF FICTION	9			
Fiction – Narrative Techniques (Stream of Consciousness, Unreliable Narrator) fact, and literary truth, - Fictional modes and patterns, - Plot character and perspective - Characterization in Fiction - Narrative Perspective and Point of View - Time and Structure in Narrative - Setting and Atmosphere in Fiction					
Unit - III	ELEMENTS OF POETRY	9			
Poetry – Prosody (Meter, Rhyme, Rhythm) - Emotions and imaginations, - Figurative language, (Simile, metaphor, conceit, symbol, pun, and irony), - Personification and animation, - Rhetoric and trend - Imagery and Sensory Language - Tone, Mood, and Voice in Poetry - Sound Devices in Poetry - Symbolism and Allegory in Poetry - Forms and Structures of Poetry.					
Unit – IV	ELEMENTS OF DRAMA	9			
Drama as representational art (Modern Forms like Absurdist theatre, Postcolonial Drama beyond Tragedy/Comedy/ Satire) - Content mode and elements, - Theatrical performance, - Drama as narration, mediation, and persuasion, - Features of tragedy, comedy, and satire.					
Unit - V	LITERARY CRITICISM AND INTERPRETATION	9			
Approaches to Literary Criticism, - Modern Critical Theories, - Methods of Literary Interpretation, - Practical Literary Analysis - Historical and Biographical Criticism - Reader-Response Criticism - Feminist and Gender Criticism - Postcolonial Criticism - Structuralism and Post-Structuralism - Comparative and Interdisciplinary Approaches.					
Total Periods:					45

Course Outcomes

On completion of the course, the student can

COs	STATEMENTS	K-Level
CO1	Recall and explain the relevance of literature in enhancing reading, thinking, discussion, and writing skills and in developing human sensibility and unbiased understanding.	K2
CO2	Identify and explain the elements of fiction such as literary truth, fictional modes, plot, character, and narrative perspective.	K2/K3
CO3	Describe and illustrate poetic elements including figurative language, imagery, rhetoric, and poetic devices like simile, metaphor, symbol, and irony.	K2/K4
CO4	Explain and apply the elements of drama, theatrical modes, and the features of tragedy, comedy, and satire while reading dramatic texts.	K2
CO5	Summarize and apply major approaches to literary criticism and interpretation in practical literary analysis.	K2/K5

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO– PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	-	1	-	-	-	2	2	1	2	-	1	1	2	1
CO2	-	2	-	-	-	1	-	-	2	-	1	1	1	1
CO3	-	2	-	1	-	1	-	-	3	-	1	1	1	2
CO4	-	2	-	1	-	2	1	1	3	-	1	1	2	1
CO5	-	2	-	2	-	2	1	-	3	-	1	1	2	2
CO	-	2	-	1	-	2	1	0	3	0	1	1	2	1

Correlation levels 1, 2 and 3 are as defined below: 1. Slight 2. Moderate 3. Substantial (High)

Text Books:

1	Kennedy, X. J., and Dana Gioia. <i>An Introduction to Literature</i> . 13th ed., Pearson, 2016.
2	Roberts, Edgar V., and Henry E. Jacobs. <i>Literature: An Introduction to Reading and Writing</i> . 11th ed., Pearson, 2015.
3	Foster, Thomas C. <i>How to Read Literature Like a Professor</i> . Harper Perennial, 2014.
4	Mays, Kelly J., editor. <i>The Norton Introduction to Literature</i> . 13th ed., W. W. Norton, 2018. Film Studies: An Introduction. Buckland, Warren. <i>Film Studies: An Introduction</i> . Hodder Education, 2015.
5	Barry, Peter. <i>Beginning Theory: An Introduction to Literary and Cultural Theory</i> . 4th ed., Manchester UP, 2017.

Reference Books:

1	Eagleton, Terry. <i>Literary Theory: An Introduction</i> . Anniversary ed., University of Minnesota Press, 2008.
2	Richards, I. A. <i>Practical Criticism</i> . Routledge, 2001.
3	Abrams, M. H., and Geoffrey Galt Harpham. <i>A Glossary of Literary Terms</i> . 11th ed., Cengage Learning, 2015.
4	Damrosch, David. <i>The Cambridge Introduction to Literature</i> . Cambridge UP, 2012.
5	Tyson, Lois. <i>Critical Theory Today: A User-Friendly Guide</i> . 3rd ed., Routledge, 2014.



U24HS8502		FILM APPRECIATION				L	T	P	C
						3	0	0	3
Course Objectives:		In this course on film appreciation, the students will introduce broadly to the development of film as an art and entertainment form. It will also discuss the language of cinema as it evolved over a century. The students will be taught as to how to read a film and appreciate the various nuances of a film as a text. The students will be guided to study film joyfully.							
Unit - I	THE COMPONENT OF FILMS							9	
The material and equipment, - The story, screenplay, and script, -The actors, crew members, and the director, - The process of film making... Structure of a Film Narrative - Cinematography and Visual -Composition - Editing and Post-Production Techniques - Sound, Music, and Dialogue in Film - Genres and Styles of Cinema - Film Analysis and Interpretation.									
Unit - II	EVOLUTION OF FILM LANGUAGE							9	
Film language, form, movement etc., - Early cinema... silent film (Particularly French), - The emergence of feature films: Birth of a Nation – Digital Cinema & Streaming platforms – Globalization of Film Industries – Representation and Diversity in Modern Cinema									
Unit - III	FILM THEORIES AND CRITICISM/APPRECIATION							9	
Realist theory, - Psychoanalytic, Ideological, Feminists, - How to read documentaries, - Film Criticism / Appreciation - Documentary Styles and Techniques - Audience Reception and Film Interpretation - Cultural and Social Context in Film - Ethics and Representation in Documentary Films.									
Unit – IV	DEVELOPMENT OF FILMS							9	
Representative Soviet films, - Representative Japanese films, - Representative Italian films, - Representative Hollywood film and the studio system - French New Wave Cinema - German Expressionist Cinema - Indian Parallel Cinema - Global Film Movements and Cultural Influence - Film Festivals and International Recognition - Contemporary Trends in World Cinema.									
Unit - V	INDIAN FILMS							9	
The early era, - The important films made by the directors, - The ancient regional films, - The documentaries in India – Parallel Cinema Movement (Satyajit Ray, Shyam Benegal) – Contemporary Indian Cinema (Regional industries – Tamil, Malayalam, Marathi) - Music, Dance, and Narrative Style in Indian Films - Film Technology and Production in India - Indian Cinema in the Global Context.									
Total Periods:								45	

Course Outcomes

On completion of the course, the student can

COs	STATEMENTS	K-Level
CO1	Explain the fundamental components of films, including material and equipment, story, screenplay, script, roles of actors and crew, and the overall structure and process of filmmaking.	K2
CO2	Describe the evolution of film language and form, including movement, early cinema, silent film traditions, and the emergence of feature-length films.	K2
CO3	Interpret major film theories and approaches to film criticism and appreciation, including realist, psychoanalytic, ideological, and feminist perspectives, and apply methods to read documentaries.	K2/K4
CO4	Analyze the development of world cinema through representative Soviet, Japanese, Italian, and Hollywood films, including the impact of the studio system.	K2/K5
CO5	Summarize the growth of Indian cinema, including early era films, significant directors and their works, regional film traditions, and documentary filmmaking in India.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyse, K5 – Evaluate, K6 – Create



CO – PO– PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	1	1	-	-	2	-	-	-	2	-	1	1	-	1
CO2	1	2	-	-	-	-	-	-	2	-	1	1	-	1
CO3	-	2	-	1	-	2	2	-	2	-	1	2	1	2
CO4	-	2	-	1	-	2	-	-	2	-	1	1	1	1
CO5	1	2	-	-	-	2	1	-	2	-	1	1	2	1
CO	1	2	0	0	0	1	1	-	2	-	1	1	1	1

Correlation levels 1, 2 and 3 are as defined below: 1. Slight 2. Moderate 3. Substantial (High)

Text Books:

1	Bordwell, David, and Kristin Thompson. <i>Film Art: An Introduction</i> . 12th ed., McGraw–Hill Education, 2019.
2	Monaco, James. <i>How to Read a Film: Movies, Media, and Beyond</i> . 4th ed., Oxford UP, 2009.
3	Understanding Movies. Giannetti, Louis. <i>Understanding Movies</i> . 14th ed., Pearson, 2017.
4	Film Studies: An Introduction. Buckland, Warren. <i>Film Studies: An Introduction</i> . Hodder Education, 2015.
5	Looking at Movies. Barsam, Richard, and Dave Monahan. <i>Looking at Movies: An Introduction to Film</i> . 6th ed., W. W. Norton, 2019.

Reference Books:

1	Kracauer, Siegfried. <i>Theory of Film: The Redemption of Physical Reality</i> . Princeton UP, 1997.
2	Film Theory and Criticism. Braudy, Leo, and Marshall Cohen, editors. <i>Film Theory and Criticism</i> . 8th ed., Oxford UP, 2016.
3	What Is Cinema? Bazin, André. <i>What Is Cinema?</i> Translated by Hugh Gray, University of California Press, 2005.
4	The Oxford History of World Cinema. Nowell-Smith, Geoffrey, editor. <i>The Oxford History of World Cinema</i> . Oxford UP, 1996.
5	Introduction to Documentary. Nichols, Bill. <i>Introduction to Documentary</i> . 3rd ed., Indiana UP, 2017.



U24CY8501		DISASTER RISK REDUCTION AND MANAGEMENT		L	T	P	C
				3	0	0	0
Course Objectives:		To impart knowledge on concepts related to disaster, disaster risk reduction, disaster management and acquaint with the skills for planning and organizing disaster response					
Unit - I	HAZARDS, VULNERABILITY AND DISASTER RISKS					9	
Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Types of Disasters: Natural, Human induced, Climate change induced – Earthquake, Landslide, Flood, Drought, Fire etc. Technological disasters - Structural collapse, Industrial accidents, oil spills -Causes, Impacts including social, Economic, political, environmental, health, psychosocial, etc. Disaster vulnerability profile of India and Tamil Nadu - Global trends in disasters: urban disasters, pandemics, Complex emergencies, Inter relations between Disasters and Sustainable development Goals							
Unit - II	DISASTER RISK REDUCTION (DRR)					9	
Sendai Framework for Disaster Risk Reduction, Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community Based DRR, Structural- nonstructural measures, Roles and responsibilities of-community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Early Warning System. Advisories from Appropriate Agencies.- Relevance of indigenous Knowledge, appropriate technology and Local resources.							
Unit - III	DISASTER MANAGEMENT					9	
Components of Disaster Management – Preparedness of rescue and relief, mitigation, rehabilitation and reconstruction- Disaster Risk Management and post disaster management – Compensation and Insurance- Disaster Management Act (2005) and Policy - Other related policies, plans, programmers and legislation - Institutional Processes and Framework at State and Central Level- (NDMA –SDMA-DDMA-NRDF- Civic Volunteers)							
Unit – IV	TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT					9	
Early warning systems -Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment. - Elements of Climate Resilient Development –Standard operation Procedure for disaster response – Financial planning for disaster Management							
Unit - V	DISASTER MANAGEMENT: CASE STUDIES					9	
Discussion on selected case studies to analyse the potential impacts and actions in the contest of disasters. Landslide Hazard Zonation: Earthquake Vulnerability. Assessment of Buildings and Infrastructure: Case Studies. Drought Assessment: Case Studies. Coastal Flooding: Storm Surge Assessment. Floods: Fluvial and Pluvial. Flooding: Case Studies; Forest Fire: Case Studies. Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management. Field work, Mock drill.							
Total Periods:						45	

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the fundamental concepts of hazards, vulnerability, and risks, and describe the diverse impacts of natural and human-induced disasters on society and the environment.	K2
CO2	Summarize the disaster risk reduction (DRR) framework and the roles of various stakeholders in implementing prevention, mitigation, and early warning strategies	K2
CO3	Outline the institutional frameworks, legislative acts, and policies governing disaster management and post-disaster recovery in the Indian context.	K2
CO4	Describe the integration of modern tools like GIS and IT in disaster response, and discuss the essential components of climate-resilient infrastructure and relief operations.	K2
CO5	Interpret real-world disaster scenarios through case studies to understand the effectiveness of mitigation strategies and the importance of field-based preparedness like mock drills.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes												PSO		
	01	02	03	04	05	06	07	08	09	10	11	12	01	02	03
CO1	2	2	-	-	-	3	1	-	-	-	2	2	1	2	2
CO2	1	-	3	-	-	3	2	2	1	-	2	1	1	3	1
CO3	-	-	-	-	-	3	3	-	2	2	1	1	2	2	-
CO4	2	2	3	2	3	3	-	-	2	2	3	3	2	3	2
CO5	1	3	3	3	2	3	2	3	3	1	3	2	3	3	1
CO	1.5	2	3	2.5	2.5	3	2	2.5	2	2	2	2	2	2.5	1.5

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Taimpo (2016), Disaster Management and Preparedness, CRC Publications
2	Singh R (2017), Disaster Management Guidelines for earthquakes, Landslides, Avalanches and tsunami, Horizon Press Publications
3	Singhal J.P. "Disaster Management", Laxmi Publications, 2010.
4	Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012.

Reference Books

1	Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005.
2	Government of India, National Disaster Management Policy, 2009.
3	Shaw R (2016), Community based Disaster risk reduction, Oxford University Press

Website Link

1. https://onlinecourses.swayam2.ac.in/ini25_hs32/preview



U24GE8502	WELL BEING WITH TRADITIONAL PRACTICES- YOGA, AYURVEDA AND SIDDHA	L	T	P	C
		3	0	0	0
Course Objectives:	Promote an enjoyable and balanced lifestyle through engaging health-oriented activities, encourage practical lifestyle changes to prevent common health disorders, enable effective emotional regulation across all situations, develop awareness of affordable and nutritious dietary practices, and strengthen natural immunity to enhance resistance against various health problems.				
Unit - I	INTRODUCTION TO YOGA				9
Meaning and definition of Yoga- Origin and historical development of Yoga- Importance of Yoga in modern life- Objectives and aims of Yoga- - Types of yoga- The Eight Limbs of Yoga-What yoga can bring to our life -Yoga and meditation. Principles and guidelines for yoga practice- Yogic diet and nutrition -Asanas: Meaning, types, and benefits- Classification of Asanas-Tadasana –Vrikshasana - Trikonasana –Padahastasana.					
Unit - II	YOGA FOR HEALTH AND WELL-BEING AND YOGA MUDRAS				9
Yoga for stress management- Yoga for improving concentration and memory-Yoga and immunity- Yoga Mudras and their Significance - Chin Mudra and Jnana Mudra for Mental Clarity- Prana Mudra for Energy Activation - Varuna Mudra for Hydration and Skin Health- Gyan Mudra for Concentration and Memory - Anjali Mudra for Emotional Balance-Mudras for Stress Reduction and Relaxation.					
Unit - III	ROLE OF AYURVEDA IN MAINTAINING HEALTH				9
Introduction to Ayurveda-Objectives and scope of Ayurveda-Fundamental Principles-Panchamahabhuta Theory (Five elements) - Tridosha Theory – Vata, Pitta, Kapha-Sapta Dhatus (Seven body tissues)-Malas (Body waste products)-Agni (Digestive fire)-Ojas (Vital essence and immunity)- Basic Therapies-Panchakarma (Introduction)- Rasayana (Rejuvenation therapy)- Herbal formulations.					
Unit – IV	PREVENTIVE AND LIFESTYLE MEDICINE IN AYURVEDA				9
Body constitution analysis-Genetic correlations and Ayurveda-Ayurveda and Lifestyle Disorders: Diabetes (Madhumeha) management-Hypertension and cardiovascular health-Stress and psychosomatic disorders- Concept of Satva, Rajas, Tamas-Mental health management-Sadvritta and ethical living-Meditation and mind-body balance.					
Unit - V	SIDDHA PREVENTIVE HEALTHCARE PRACTICES				9
Philosophy and origin of the Siddha system- Five elements (Pancha Bootham) and their role in health- Concept of three humors (Mukkutram) in disease prevention- Kayakalpa therapy for rejuvenation and longevity- Varma therapy and its role in preventive care- Role of traditional dietetics (Pathiyam) in maintaining health- Geriatric care and healthy ageing in Siddha-Siddha Detoxification Practices - Concept of spiritual discipline in disease prevention - Mind–body harmony in Siddha philosophy.					
Total Periods:					45

Course Outcomes

On completion of the course, the student able to

CO	Statements	K-Level
CO1	Demonstrate knowledge of yoga practices that promote mental clarity and reduce stress.	K3
CO2	Apply yoga techniques and therapeutic mudras effectively to enhance emotional balance and improve overall mental well-being.	K3
CO3	Explain the fundamental principles of Ayurveda and their role in maintaining health.	K3
CO4	Analyze the role of body constitution, and Ayurvedic approaches in the management of lifestyle disorders and mental well-being.	K3
CO5	Describe the philosophy and principles of the Siddha system for rejuvenation and healthy aging.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO - PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	-	-	-	-	-	1	-	-	-	-	2	-	-	-
CO2	-	-	-	-	-	1	-	-	-	-	2	-	-	-
CO3	-	-	-	-	-	1	-	-	-	-	2	-	-	-
CO4	-	-	-	-	-	1	-	-	-	-	2	-	-	-
CO5	-	-	-	-	-	1	-	-	-	-	2	-	-	-
CO	-	-	-	-	-	1	-	-	-	-	2	-	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Yoga for Beginners - 35 Simple Yoga Poses to Calm Your Mind and Strengthen Your Body, by Cory Martin, Copyright © 2015 by Althea Press, Berkeley, California.
2	Yoga for Promotion of Positive Health- R. Nagarathna& H. R. Nagendra, 2 nd Edition Published by Swami Vivekananda Yoga Prakashana.
3	Principles of Ayurveda - Dr. C. S. Munichandra, Kumar Publications, BaghAmberpet, Hyderabad, Telangana, India.
4	Siddha Maruthuvam (Sirappu)- Dr. R. Thiyagarajan, Published by Department of Indian Medicine and Homeopathy.

Reference Books

1	Light on Yoga: The Bible of Modern Yoga- Iyengar, B.K.S. (2015). HarperCollins Publishers India Pvt. Ltd., New Delhi, India.
2	Saraswati, Swami Satyananda. (2008). Asana Pranayama Mudra Bandha, Yoga Publications Trust, Munger, Bihar, India (Bihar School of Yoga).
3	Light on Yoga: The Bible of Modern Yoga-Narayana, K, Scientific Publishers (India).
4	<i>Textbook of Ayurveda – Vol. I: Fundamental Principles</i> -Murthy, K. R. S., Chaukhamba Orientalia.
5	Ayurveda and Mental Health- Dr. N. S. Rathore, Dr. N. S. Rathore, SAGE Publications India Pvt. Ltd.
6	Siddha Therapy & Kayakalpa, Siddha Therapy & Kayakalpa,, CCRIMH / Siddha Research Publications,Janakpuri, New Delhi – 110058, India.
7	https://youtu.be/7CDb2cGnd4s .
8	https://youtu.be/oDaV3U-KOg?si=FmYM7TvQs1y59VS6
9	https://youtu.be/S6bqxsjikVs?si=hxNBRH6TtKtHB6Z5



U24GE8503		HISTORY OF SCIENCE AND TECHNOLOGY IN INDIA		L	T	P	C
				3	0	0	3
Course Objectives:		To make the student understand the historical evolution of science and technology in India across ancient, medieval, colonial, and post-independence periods, develop historical thinking for engineers, examine the interaction between science, technology, and society, and analyse policy frameworks, institutional growth, and the social impact of modern technologies in a globalizing India.					
Unit - I	PRINCIPLES AND PERSPECTIVES OF SCIENCE & TECHNOLOGY					9	
Meaning of History: Purpose, scope, and relevance to science and technology. Historical Thinking for Engineers: Objectivity, causation, generalization, Interpretation vs. evidence, Lessons from history for technological development. Science & Technology Concepts: Definitions of science and technology, Scope and importance for society and engineering, Interaction between science, technology, and society.							
Unit - II	EVOLUTION OF INDIAN SCIENCE THROUGH HISTORICAL PERSPECTIVES					8	
Overview of historiography of science and technology in India. Key contributors and their works: D.D. Kosambi, Dharmpal, Debiprasad Chattopadhyay, Rehman, S. Irfan Habib, Deepak Kumar, Dhruv Raina. Approaches and methods for studying the evolution of Indian science and technology.							
Unit - III	SCIENTIFIC AND TECHNOLOGICAL PROGRESS IN ANCIENT INDIA					9	
Technological developments- prehistoric period - Stone tools and early innovations- Use of fire and primitive techniques, Emergence of agriculture and its influence on technological progress- Impact of agriculture on tools and settlement, Science and technology in the Vedic and Later Vedic periods- Knowledge of astronomy, mathematics, and medicine, Scientific and technological advancements from the 1st century AD to C-1200- Progress in mathematics, astronomy, and medicine-Temple architecture, metallurgy, and engineering.							
Unit – IV	SCIENCE AND TECHNOLOGY IN INDIA: MEDIEVAL AND COLONIAL PERIODS					11	
Legacy of technology in Medieval India- Technological advancements in agriculture, irrigation, metallurgy, textiles, architecture, and craft production. Indo–Arab Interactions and Knowledge Exchange- Development in medical knowledge, interaction between Unani and Ayurveda and alchemy Astronomy and Mathematics: interaction with Arabic Sciences, Science and Technology on the eve of British conquest, Indian response to Western Science-Growth of techno-scientific institutions.							
Unit - V	SCIENCE AND TECHNOLOGY IN POST-INDEPENDENCE INDIA					8	
The relationship between science, technology, and development in post-independent India, Evolution and formulation of science and technology policies, Major developments and achievements in the field of science and technology, science and technology in a globalizing Indian economy - Social impacts of emerging technologies, with special reference to Information Technology and Biotechnology - ISRO, DRDO, BARC, CSIR contributions.							
Total Periods:						45	

Course Outcomes

On completion of the course, the student can

CO	Statements	K-Level
CO1	Explain the scope of history, apply historical thinking, and analyse the role of science and technology in society.	K2
CO2	Extend historiographical approaches to study and evaluate the evolution of Indian science and contributions of key scholars.	K2
CO3	Relate technological and scientific developments in ancient India to societal progress from the prehistoric period to the 12th century.	K2
CO4	Interpret scientific and technological developments and knowledge exchanges in medieval and colonial India.	K2
CO5	Summarize the evolution, policies, achievements, and societal impacts of science and technology in post-independence India.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO– PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	1	-	-	1	-	-	1	-	-	-	2	1	-	-
CO2	2	-	-	1	-	-	1	1	1	1	2	1	-	-
CO3	2	-	-	1	-	-	1	1	1	1	2	1	-	-
CO4	2	-	-	1	-	-	1	1	1	1	2	1	-	-
CO5	2	-	-	1	-	-	1	1	1	1	2	1	-	-
CO	2	-	-	1	-	-	1	1	1	1	2	1	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Dharampal, Indian Science and Technology in the Eighteenth Century . Impex India, 1st Edition, July 1971.
2	Dr.Binod Bihari Satpathy, History of Science, Technology, and Medicine in India, Himalaya Publishing House, 2025.
3	Suvobrata Sarkar. History of Science, Technology, Environment, Routledge India, Taylor & Francis, London, 2022.
4	Arun Kumar Jha & Seema Sahay. Aspects of Science and Technology in Ancient India. Routledge India, 2023.
5	Kuppuram G & Kumudamani K. History of Science and Technology in India. Sundeep Prakashan, 1990.

Reference Books

1	Subbarayappa B.V, Science in India: A Historical Perspective, Rupa Publications India, 2025
2	Nandan Bhattacharya, The History and Philosophy of Science: An Indian Perspective, Routledge India, 2023.
3	Sarma K.V, A History of the Kerala School of Hindu Astronomy, Vishveshvarananda Institute of Sanskrit & Indological Studies, 1972.
4	Jaggi O.P, History of Science and Technology in India , Atma Ram & Sons, 1977.
5	Kamlesh Mohan, Science and Technology in Colonial India , Routledge (Taylor & Francis Group), 2023.



U24GE8504		POLITICAL AND ECONOMIC THOUGHT FOR A HUMANE SOCIETY				L	T	P	C
						3	0	0	3
Course Objectives:		This course begins with an overview of human needs and desires and examines how various political and economic systems attempt to address them. It further explores critiques of these systems based on historical implementations and considers potential directions for the future.							
Unit - I	HUMANISM						9		
Considerations for humane society, holistic thought, human being's desires, harmony in self, harmony in relationships, society, and nature, societal systems - Human Dignity and Ethical Responsibility - Human Rights and Social Justice - Compassion and Empathy in Society - Peace and Conflict Resolution - Cultural Diversity and Human Unity - Sustainable Development and Human Welfare.									
Unit - II	CAPITALISM						9		
Free markets, demand-supply, perfect competition, laissez-faire, monopolies, imperialism. Liberal democracy. Fascism and totalitarianism. World war I and II. Cold war - Corporate Capitalism and Multinational Corporations - Financial Capitalism and Banking Systems - Stock Markets and Investment Culture - Capitalism and Technological Innovation - Capitalism and Economic Inequality.									
Unit - III	COMMUNISM						9		
Mode of production, theory of labour, surplus value, class struggle, dialectical materialism, historical materialism, Russian and Chinese models - Revolutionary Theory and Social Transformation - Communist Movements in the 20th Century - Cold War and the Spread of Communism - Communism in the Contemporary Global Context.									
Unit – IV	HOLISTIC SELF GOVERNANCE						9		
Welfare state. Relation with human desires. Empowered human beings, satisfaction. Gandhian thought. Swaraj, Decentralized economy & polity, Community. Control over one's lives - Harmony between Individual and Society - Decentralized Decision-Making Systems - Human Dignity and Social Justice - Cultural Values and Social Harmony.									
Unit - V	CIVILIZATIONAL SUSTAINABILITY						9		
Relationship with nature. Essential elements of Indian civilization. Technology as driver of society, Role of education in shaping of society. Future directions - Spiritual Ecology and Environmental Ethics - Climate Change and Global Sustainability - Resilience of Civilizations through Adaptation - Indigenous Ecological Wisdom - Cultural Heritage and Continuity.									
Total Periods:								45	

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Recall the fundamental concepts of humanism, holistic thought, human desires, harmony in self, relationships, society, nature, and societal systems.	K1
CO2	Explain the principles, features, and impacts of capitalism and communism, including market systems, class theories, and major global political-economic developments.	K2
CO3	Apply the concepts of human harmony, welfare state, decentralized governance, and community-based living to interpret social and governance models.	K3
CO4	Analyze different ideological frameworks such as capitalism, communism, fascism, and holistic self-governance, and compare their societal and economic outcomes.	K2/K4
CO5	Evaluate civilizational sustainability, the role of technology and education in shaping society, and formulate value-based approaches to self-governance inspired by thinkers like Mahatma Gandhi	K2/K5+

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



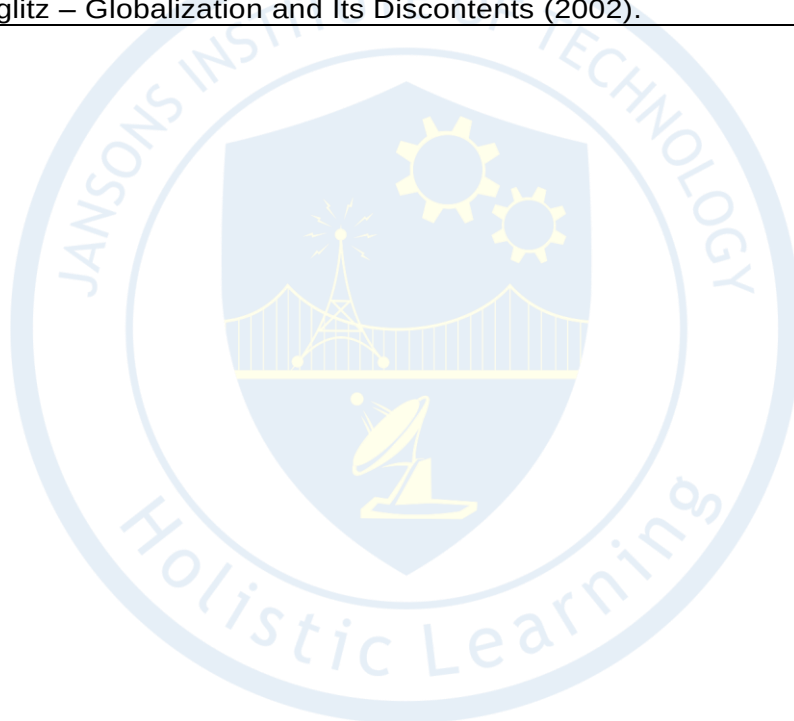
CO – PO– PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	1	1	-	-	-	2	2	-	-	-	1	-	1	-
CO2	-	2	-	-	-	2	2	-	1	-	1	-	1	1
CO3	-	2	1	-	-	3	2	1	1	-	2	1	2	2
CO4	-	3	1	1	-	3	2	-	2	-	2	1	2	2
CO5	-	2	2	1	-	3	3	1	2	1	3	2	3	2
CO	0	2	1	0	-	3	2	0	1	0	2	1	2	1

Correlation levels 1, 2 and 3 are as defined below: 1. Slight 2. Moderate 3. Substantial (High)

Reference Books

1	Thomas Piketty – Capital in the Twenty-First Century (2014).
2	Amartya Sen – Development as Freedom (1999).
3	Vandana Shiva – Staying Alive: Women, Ecology, and Development (1989).
4	Elinor Ostrom – Governing the Commons (1990).
5	Joseph Stiglitz – Globalization and Its Discontents (2002).



U24GE8505	STATE, NATION BUILDING AND POLITICS IN INDIA				L	T	P	C
					3	0	0	3
Course Objectives:	This course provides an understanding of the state, its functioning, and the role of politics and sovereignty in a globalized world. It covers the national movement, constitutional development, and the rationale for India's Parliamentary-federal system. The course also examines the philosophy of the Constitution and the evolving political system. Finally, it addresses contemporary challenges to national integration and nation-building, fostering a vision for a stronger India.							
Unit - I	NEED AND ROLE OF STATE AND POLITICS							9
State — Politics — Understanding the need and role of State and politics Concept of the State in India, Politics and Political Process in India, Constitutional Framework, Democracy and Governance, Citizenship, Rights and Social Justice								
Unit - II	CONCEPT OF SOVEREIGNTY							9
Development of Nation-State, sovereignty, sovereignty in a globalized world, □ Evolution of the Indian Nation-State, Post-Independence Nation-Building, Concept of Sovereignty in India, Challenges to Sovereignty in a Globalized World, Regional, Economic, and Political Dimensions of Sovereignty.								
Unit - III	STATE AND ITS ORGANS							9
Organs of State - Structure and Functions of the Executive, Role and Composition of the Legislature, Organization and Powers of the Judiciary, Principle of Separation of Powers and Checks & Balances, Forms of Government: Unitary vs. Federal and Presidential vs. Parliamentary.								
Unit – IV	THE CONSTITUTION OF INDIA							9
The idea of India— 1857 and the national awakening, 1885 Indian National Congress and development of national movement — its legacies, Constitution making and the Constitution of India, Goals, objective and philosophy—federal system.								
Unit - V	NATIONAL INTEGRATION AND CHALLENGES OF NATION-BUILDING							9
National integration and nation-building, Challenges of nation-building — State against democracy (Kothari) New social movements, The changing nature of Indian Political System, the future scenario.								
Total Periods:								45

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Recall the basic concepts of State, politics, sovereignty, citizenship, constitutional framework, and national integration in the context of India	K1
CO2	Explain the need and role of the State, organs of government, constitutional philosophy, and the evolution of the nation-state and sovereignty.	K2
CO3	Apply the principles of democracy, governance, separation of powers, and federal structure to interpret contemporary political and administrative processes.	K3
CO4	Analyze the structure and functions of the Executive, Legislature, and Judiciary, and examine challenges to sovereignty, globalization, and nation-building.	K4
CO5	Evaluate issues related to national integration, social justice, and new social movements, and develop reasoned perspectives on the future of the political system and governance models.	K5

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



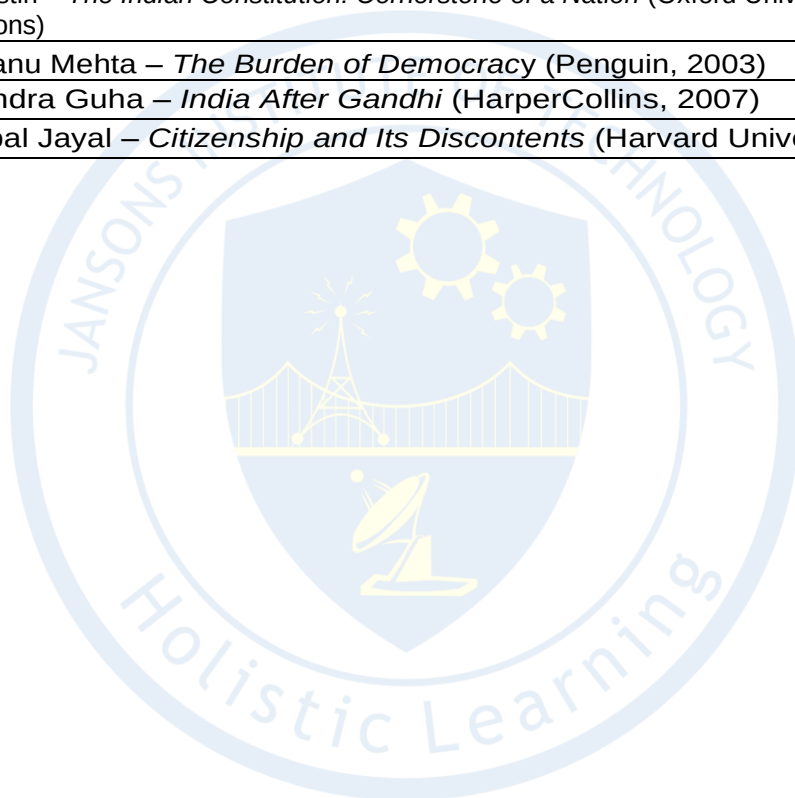
CO – PO– PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	1	1	-	-	-	2	1	-	-	-	1	-	1	-
CO2	1	2	-	-	-	2	2	-	1	-	1	-	1	-
CO3	-	2	1	-	-	3	2	1	1	-	2	1	2	1
CO4	-	3	-	1	-	3	2	-	2	-	2	1	2	2
CO5	-	2	1	1	-	3	3	2	3	1	3	2	3	2
CO	0	2	0	0	-	3	2	1	1	0	2	1	2	1

Correlation levels 1, 2 and 3 are as defined below: 1. Slight 2. Moderate 3. Substantial (High)

Reference Books

1	Madhav Khosla, <i>The Indian Constitution</i> , Oxford University Press. New Delhi, 2012.
2	Granville Austin – <i>The Indian Constitution: Cornerstone of a Nation</i> (Oxford University Press, 1966; revised editions)
3	Pratap Bhanu Mehta – <i>The Burden of Democracy</i> (Penguin, 2003)
4	Ramachandra Guha – <i>India After Gandhi</i> (HarperCollins, 2007)
5	Niraja Gopal Jayal – <i>Citizenship and Its Discontents</i> (Harvard University Press, 2013)



U24GE8506	INDUSTRIAL SAFETY		L	T	P	C
			3	0	0	3
Course Objectives:	It enables students to understand workplace exposures and hazards, and to conduct and participate in various industrial safety activities. The course also equips learners to assess hazards and their consequences using appropriate risk assessment techniques.					
Unit - I	SAFETY TERMINOLOGIES				9	
Hazard-Types of Hazard- Risk-Hierarchy of Hazards Control Measures-Lead indicators- lag Indicators-Flammability-Toxicity Time-weighted Average (TWA) - Threshold LimitValue (TLV) - Short Term Exposure Limit (STEL)-Immediately dangerous to life or health (IDLH)- acute and chronic Effects- Routes of Chemical Entry-Personnel Protective Equipment- Health and Safety Policy-Material Safety Data Sheet MSDS - Safety Culture and Safety Climate.						
Unit - II	STANDARDS AND REGULATIONS				9	
Indian Factories Act-1948- Health- Safety- Hazardous materials and Welfare- ISO 45001:2018 occupational health and safety (OH&S) - Occupational Safety and Health Audit IS14489:1998- Hazard Identification and Risk Analysis-code of practice IS 15656:2006 – Behaviour -Based Safety (BBS) and Legal Compliance.						
Unit - III	SAFETY ACTIVITIES				9	
Toolbox Talk- Role of safety Committee- Responsibilities of Safety Officers and Safety Representatives- Safety Training and Safety Incentives- Mock Drills- On-site Emergency Action Plan- Off-site Emergency Action Plan- Safety poster and Display- Human Error Assessment - Digital Safety Management Systems (E-Safety Reporting).						
Unit – IV	WORKPLACE HEALTH AND SAFETY				9	
Noise hazard- Particulate matter- musculoskeletal disorder improper sitting poster and lifting Ergonomics RULE & REBA- Unsafe act & Unsafe Condition- Electrical Hazards- Crane Safety- Toxic gas Release - Industrial Hygiene Monitoring and Control						
Unit - V	HAZARD IDENTIFICATION TECHNIQUES				9	
Job Safety Analysis-Preliminary Hazard Analysis-Failure mode and Effects Analysis- Hazard and Operability- Fault Tree Analysis- Event Tree Analysis Qualitative and Quantitative Risk Assessment- Checklist Analysis- Root cause analysis- What-If Analysis- and Hazard Identification and Risk Assessment - Bow-Tie Risk Analysis Method.						
Total Periods:					45	

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO1	Explain the basic concepts of safety.	K2
CO2	Describe statutory regulations and safety standards.	K2
CO3	Outline workplace safety activities.	K2
CO4	Interpret the impact of occupational exposures and their remedies.	K2
CO5	Summarize risk assessment techniques.	K2



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	1	3	1	-	-	-	-	-	-	-	2	-	1
CO2	2	3	2	2	-	-	-	-	-	-	-	-	3	1
CO3	2	3	2	3	-	-	-	-	-	-	-	2	2	-
CO4	2	2	3	2	-	-	-	-	-	-	-	-	2	1
CO5	2	2	3	2	-	-	-	-	-	-	-	2	3	1
CO	2	2	3	2	-	-	-	-	-	-	-	2	3	1

Text Books

1	R.K. Jain and Prof. Sunil S. Rao,(2019) Industrial Safety, Health and Environment Management Systems KHANNA PUBLISHER
2	L. M. Deshmukh (2021) Industrial Safety Management: Hazard Identification and Risk Control McGraw-Hill Education

Reference Books

1	Frank Lees (2012) 'Lees' Loss Prevention in Process Industries.Butterworth-Heinemann publications, UK, 4th Edition.
2	John Ridley & John Channing (2008) Safety at Work: Routledge, 7th Edition.
3	Dan Petersen (2003) Techniques of Safety Management: A System Approach.
4	Alan Waring.(1996). Safety management system: Chapman &Hall,England
5	Society of Safety Engineers (2020) , USA



U24MA8501	Exploring Vedic Mathematics	L	T	P	C
		3	0	0	0
Course Objectives:	Familiarize students with the concepts of Vedic mathematics and the contributions made by Indian mathematicians. Through the use of Vedic methods, it seeks to develop quick and precise computational abilities.				
Unit – I	Contribution of Indian Mathematicians	9			
Contribution of Indian Mathematicians: Pingala, Aryabhata I, Brahmagupta, Varahmihir, Bhaskara I, Aryabhata II, Bhaskara II, Neelkanth Somayya, Srinivasa Ramanujan, Bharti Krishna Tirtha – History of Vedic Mathematics and its Features.					
Unit – II	Vedic Mathematics: Addition and Subtraction	9			
Sutras and Upsutras – Addition: without carrying, Dot Method (Shudh Vidhi) – Subtraction: Nikhilam Navatashcaramam Dashatah (All from 9 Las from 10) – Fraction: Addition and Subtraction: Urdhva Tiryakbhyam (Vertically and Crosswise).					
Unit – III	Vedic Mathematics: Multiplication and Division	9			
Multiplication: Base Method: Nikhilam Sutra (any two numbers upto three digits) – Multiplication by Urdhva Tiryak Sutra: up to 3-digit numbers by multiplying vertically and diagonally, summing the results, and managing carries – Division by Urdhva Tirvak Sutra (Vinculum Method).					
Unit – IV	Vedic Mathematics: Squares and Cubes	9			
Squares of any two-digit numbers: Base Method – Square of numbers ending in 5: Ekadhikena Purvena Sutra (By one more than the previous) - Yavadunam Sutra (By the Deficiency) – Cubes: Yavadunam Sutra (By the Deficiency).					
Unit – V	Vedic Mathematics: Solution of Linear Equations	9			
Introduction of simple equations - Solutions of simple equations – Solutions of Linear Equations in one variable: Paravartya Yojayet (Transpose and Apply) - Solutions of Linear Equations in two variables: Ratio Comparison (Special Case), Sunyam Samyasamuccaye (When Sum is Same), Anurupye Sunyamanyat (If in ratio, the other is zero) - Practical applications of linear equations.					
Total Periods:					45

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO1	Investigate the history of Indian mathematics, emphasizing important contributions from mathematicians and the development of Vedic Mathematics, while acknowledging India's important role in worldwide mathematical advancement	K2
CO2	Utilize Vedic sutras and upsutras to execute addition and subtraction effectively using approaches like the dot method and Nikhilam sutra and tackle fractional addition and subtraction issues with precision and swiftness	K3
CO3	Apply the base technique and Urdhva Tiryak sutra for multiplication and division, while employing vinculum methods to streamline calculations and enhance computational speed with large numbers	K3
CO4	Employ Vedic techniques such as Ekadhikena Purvena and Yavadunam sutra to calculate squares and cubes, effectively addressing numerical problems while enhancing their mental math skills.	K3
CO5	Resolve basic linear equations with one or two variables through Vedic methods, and apply these methods in practical scenarios to enhance their problem solving and reasoning skills	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO–PO–PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	1	-	-	-	2	-	2	-	1	-	-	-	-
CO2	3	2	-	-	1	-	-	-	-	-	-	-	-	-
CO3	3	2	1	-	2	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	1	-	-	-	-	-	-	-	-	-
CO5	3	3	2	-	1	1	-	-	1	1	1	-	-	-
CO	2.8	2	1.5	-	0.8	1.5	-	-	1	1	1	-	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	T.S. Bhanumurthy, A Modern Introduction to Ancient Indian Mathematics, Wiley Eastern Ltd, New Delhi.
2	Rajes Kumar Thakur, The Essential of Vedic Mathematics, Rupa Publications, New Delhi, 2019.
3	Atul Gupta, The Power of Vedic Maths, Second Edition, Jaico Publishing House, Mumbai, 2010
4	Ramnandan Shastri, For Competitive Exams Vedic Mathematics Made Easy, Arihant Publishers, New Delhi, 2012.
5	Chaitanaya A. Patil, Learn Vedic Speed Mathematics Systematically & Step by Step, 2018

Reference Books

1	S. K. Kapoor, Learning Vedic Mathematics on First Principles, Lotus Press, 2007.
2	Vandana Singhal, Vedic Mathematics For All Ages, Motilal Banarsidas Publishers.
3	Dhaval Bathia, Vedic Mathematics Made Easy, First Edition, Jaico Publishing House, Mumbai, 2005
4	Bharathi Krishna Tirthaji, Vedic Mathematics, Original Edition, Motilal Banarsidass Publisher & New Delhi, 1990.
5	V.G. Unkalkar, Magical World of Mathematics: Vedic Mathematics, Vandana publishers, Bangalore.



U24MA8502	FUNDAMENTALS OF ASTROLOGY	L	T	P	C
		3	0	0	0
Course Objectives:	Provide basic knowledge of astronomical and astrological principles, as well as to foster comprehension of planetary effects and chart interpretation, including Muhurtham and horoscope matching.				
Unit – I	FOUNDATIONS OF ASTROLOGY	9			
Origin and introduction of Astrology - History of Astrology – Astrology: In terms of Science and Mathematics (Degree System) - Importance of Astrology. Detailed study of Universe and Galaxies related to astrology.					
Unit – II	ZODIAC AND PLANETS	9			
The Zodiac and the Solar system - signs of the Zodiac – Planets - Motion of Planets - Retrograde and Direct motion of Planets. Tithi, Vaara, Nakshatra, Yoga and Karana (Panchangm). Various systems in astrology (Nadi methods, Jamakkol Prasanam, Deva/Ashtamangala Prasanam)					
Unit – III	ASTRONOMICAL CONCEPTS	9			
Signs and Constellations – Vakkaram (reverse order) (Nodes (Rahu and Kethu) Sayana and Nirayana system - Latitude and Longitudes - Equator, Ecliptic - Lunar Eclipse, Solar Eclipse, Mundane astrology.					
Unit – IV	PLANETARY EFFECTS	9			
Significations of Signs and Planets - Effect of Planets in 12 Houses – Navamsam – varga chakram - Strength of Planets for house judgment - Dasha System - Effects of Conjunction of one or more Planets.					
Unit – V	CHART ANALYSIS BASICS	9			
Rules and general conditions for analyzing a chart - Judgement of Houses / Bhava sign in general - Matching of Horoscopes - Introduction to Muhurtham, Yogangal: Dharma karmaathi yogam, neecha banga raja yogam, sivaraja yogam, vibareetha raja yogam, parvatha raja yogam, Gaja Kesari yogam, Chandra-Mangala yogam.					
Total Periods:					45

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO1	Explain the origin, history, nature, and importance of Astrology as a science and art.	K2
CO2	Describe the Universe, zodiac, solar system, planets, and their direct and retrograde motions.	K2
CO3	Explain planets, signs, constellations, Rahu–Ketu, Sayana–Nirayana systems, and basic astronomical concepts.	K2
CO4	Describe significations of signs and planets, their effects in houses, planetary strength, Dasha, and conjunctions.	K2
CO5	Explain the general rules of chart analysis, house judgment, horoscope matching, and basics of Muhurtham.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO–PO–PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	--	-	-	1	-	2	-	-	1	-	-	-
CO2	3	3	2	-	-	1	-	2	-	-	1	-	-	-
CO3	3	3	2	1	-	1	-	2	-	-	1	-	-	-
CO4	3	3	3	2		2	-	2	1	-	1	-	-	-
CO5	3	3	3	3	1	2	-	2	2	1	1	-	-	-
CO	3	2.8	2.5	2	1	1.8	-	2	1.5	1	1	-	-	-

Correlation levels 1, 2 and 3 are as defined below:

1.Slight 2. Moderate 3.Substantial(High)

Text Books

1.	Pulippani Jothidam (300 Astrology Rules from an Ancient Tamil Work , <u>Nakkirar S.Natarajan</u> , <u>Sptarishi Publications</u> .
2.	Astrology For Beginners by <u>Bangalore Venkata Raman</u>
3.	GK win Degree System of Astrology: New Method of Astrology, <u>Tirupur S.Gopala Krishnan (GK)</u> , Gk publications
4.	Prashna Shastra: Scientific Applications of Horary Astrology (Set of 2 Volumes) , <u>Deepak Kapoor</u> , <u>Vinita Kapoor</u> Publisher.

Reference Book

1	Astrology For Beginners by <u>Motilal Banarsidass Publishing House</u>
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U24EC5A01	LOW POWER IC DESIGN		L	T	P	C
			2	0	2	3
Course Objectives:	To learn the fundamentals of low power low voltage VLSI design. and understand the impact of power on system performances, design approaches, low power low voltage memories.					
Unit - I	FUNDAMENTALS OF LOW POWER CIRCUITS					6+6
Need for Low Power Circuit Design, Sources of Power Dissipation – Switching Power Dissipation, Short Circuit Power Dissipation, Leakage Power Dissipation, Glitching Power Dissipation, Short Channel Effects –Drain Induced Barrier Lowering and Punch Through, Surface Scattering, Velocity Saturation, Impact Ionization, Hot Electron Effect.						
Practical Exercises:						
1. Modeling and sources of power consumption.						
2. Modeling and sources of power dissipation						
Unit - II	LOW-POWER DESIGN APPROACHES					6+9
Low-Power Design through Voltage Scaling: VTCMOS circuits, MTCMOS circuits, Architectural Level Approach – Pipelining and Parallel Processing Approaches. Switched Capacitance Minimization Approaches: System Level Measures, Circuit Level Measures, Mask level Measures						
Practical Exercises:						
1..Power estimation at circuit level						
2. Power estimation at transistor, level						
3, Power estimation at gate level						
Unit - III	LOW-VOLTAGE LOW-POWER ADDERS					6+6
Introduction, Standard Adder Cells, CMOS Adder’s Architectures – Ripple Carry Adders, Carry Look-Ahead Adders, Carry Select Adders, Carry Save Adders, LowVoltage Low Power Design Techniques –Trends of Technology and Power Supply Voltage, LowVoltage Low-Power Logic Styles						
Practical Exercises:						
1. Power optimization for combinational circuits- Carry Look-Ahead Adders						
2. Power optimization for combinational circuits- Carry Select Adders & Carry Save Adders						
Unit – IV	LOW-VOLTAGE LOW-POWER MULTIPLIERS					6+6
Introduction, Overview of Multiplication, Types of Multiplier Architectures, Braun Multiplier, BaughWooley Multiplier, Booth Multiplier, Introduction to Wallace Tree Multiplier						
Practical Exercises:						
1. Power optimization for sequential circuits- Braun Multiplier and Booth Multiplier						
2. Power optimization for sequential circuits- BaughWooley Multiplier						
Unit - V	LOW-VOLTAGE LOW-POWER MEMORIES					6+3
Basics of ROM, Low-Power ROM Technology, Future Trend and Development of ROMs, Basics of SRAM, Memory Cell, Precharge and Equalization Circuit, Low Power SRAM Technologies, Basics of DRAM, Self-Refresh Circuit, Future Trend and Development of DRAM.						
Practical Exercises:						
1. Power optimization for RT and algorithmic levels.						
Total Periods:						30 +30

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Understand the fundamentals of Low power circuit design.	K2
CO2	Apply the knowledge of architectural approaches	K3
CO3	Analyze and design Low-Voltage Low-Power combinational circuits	K4
CO4	Evaluate and design Low-Voltage Low-Power Memories	K4
CO5	Design and develop Low Power, Low Voltage Circuits	K4

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO– PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	3	2	3	2	-	-	-	-	-	-	2	2	2
CO2	2	2	1	3	3	-	-	-	-	-	-	2	2	1
CO3	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO4	2	3	3	2	3	-	-	-	-	-	-	2	3	3
CO5	3	3	3	3	2	-	-	-	-	-	-	2	2	3
CO	2.6	2.8	2.4	2.6	2.4	-	-	-	-	-	-	2	2	2

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Sung-Mo Kang, Yusuf Leblebici, "CMOS Digital Integrated Circuits – Analysis and Design", TMH, 2011.
2	Kiat-Seng Yeo, Kaushik Roy, "Low-Voltage, Low-Power VLSI Subsystems", TMH Professional Engineering, 2004.

Reference Books

1	Ming-BO Lin, "Introduction to VLSI Systems: A Logic, Circuit and System Perspective", CRC Press, 2012
2	Anantha Chandrakasan, "Low Power CMOS Design", IEEE Press, /Wiley International, 1998
3	Gary K. Yeap, "Practical Low Power Digital VLSI Design", Kluwer Academic Press, 2002
4	Bellamour, M. I. Elamasri, "Low Power CMOS VLSI Circuit Design", A Kluwer Academic Press, 1995.
5	Siva G. Narendran, Anatha Chandrakasan, "Leakage in Nanometer CMOS Technologies", Springer, 2005

Web-links

1. www.cmosvlsi.com



U24EC5A02	ASIC DESIGN	L	T	P	C
		3	0	0	3
Course Objectives:	To acquire knowledge about different types of ASICs design. and various types of Programmable ASICs architectures and interconnects.				
Unit - I	INTRODUCTION TO ASICS, CMOS LOGIC, ASIC LIBRARY DESIGN	09			
Types of ASICs - Design flow – CMOS transistors- CMOS Design rules –Combinational logic Cell Sequential logic cell - Transistor as Resistors - Transistor parasitic capacitance – Logical effort - Library cell design – Library architecture.					
Unit - II	PROGRAMMABLE ASICS, ASIC LOGIC CELLS AND ASIC I/O CELLS	09			
Anti fuse - Static RAM - EPROM and EEPROM technology - PREP benchmarks - Actel ACT - Xilinx LCA – Altera FLEX - Altera MAX DC & AC inputs and outputs - Xilinx I/O blocks					
Unit - III	PROGRAMMABLE ASIC INTERCONNECT, PROGRAMMABLE ASIC DESIGN SOFTWARE	09			
Entry: Actel ACT -Xilinx LCA - Xilinx EPLD - Altera MAX 5000 and 7000 - Altera MAX 9000 - Altera FLEX –Design systems - Logic Synthesis - Half gate ASIC -Low level design language - PLA tools EDIF- CFI design representation.					
Unit – IV	SYSTEM ON CHIP DESIGN	09			
Voice over IP SOC - Intellectual Property – SOC Design challenges- Methodology and design FPGA to ASIC conversion – Design for integration-SOC verification-Set top box SOC.					
Unit - V	PHYSICAL AND LOW POWER DESIGN	09			
Over view of physical design flow- tips and guideline for physical design- modern physical design techniques- power dissipation-low power design techniques and methodologies-low power design tools- tips and guideline for low power design.					
Total Periods:					45

Course Outcomes

On completion of the course, the student can able to

COs	Statements	K-Level
CO1	Recognize need for programmable devices and describe architecture of programmable devices.	K2
CO2	Know the programmable IC fabrication techniques CMOS switch methodologies	K2
CO3	Recall IC fabrication techniques of CMOS switch.	K2
CO4	Relate design and implementation flow for PLDs	K3
CO5	Understand Low power design techniques and methodologies	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO– PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	3	2	2	2	-	-	-	-	-	-	2	2	2
CO2	3	2	1	3	3	-	-	-	-	-	-	2	2	1
CO3	2	2	3	2	2	-	-	-	-	-	-	2	2	2
CO4	2	2	3	2	3	-	-	-	-	-	-	2	3	3
CO5	2	3	3	2	2	-	-	-	-	-	-	2	2	3
CO	3	3	2	2	3	-	-	-	-	-	-	2	2	2

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	M.J.S. Smith, —Application Specific Integrated CircuitsII, Pearson Education, 2008.
2	Wayne Wolf, —FPGA-Based System DesignII, Prentice Hall PTR, 2004

Reference Books

1	Farzad Nekoogar and Faranak Nekoogar, —From ASICs to SOCs: A Practical ApproachII, Prentice Hall PTR, 2003
2	Vijay K. Madiseti Chonlameth Arpikanondt, “A Platform-Centric Approach to System on-chip (SOC) Design”, Springer, 2005.
3	Youn-Long, Steve Lin, “Essential Issues of SoC Design: Designing Complex Systems On-chip”, Springer, 2006

Web-links

1. www.vhdl.org



U24EC5A03	VLSI TESTING AND DESIGN FOR TESTABILITY	L	T	P	C
		2	0	2	3
Course Objectives:	introduce the VLSI testing logic and fault simulation, testability measures and also to study the test generation for combinational and sequential circuits and the design for testability. fault diagnosis				
Unit - I	INTRODUCTION TO TESTING				6+6
Introduction – VLSI Testing Process and Test Equipment – Challenges in VLSI Testing - Test Economics and Product Quality – Fault Modeling – Relationship Among Fault Models.					
Practical Exercises:					
1. Stuck-at-fault by Simulation					
2. IDDQ Testing by Simulation					
Unit - II	LOGIC & FAULT SIMULATION AND TESTABILITY MEASURES				6+6
Simulation for Design Verification and Test Evaluation – Modeling Circuits for Simulation – Algorithms for True Value and Fault Simulation – Scoap Controllability and Observability					
Practical Exercises:					
1. DFT Synthesis of complex Sequential circuits: fixing of DFT rule violation,					
2. DFT Synthesis of complex Sequential circuits: fixing of DFT Scan insertion					
Unit - III	TEST GENERATION FOR COMBINATIONAL AND SEQUENTIAL CIRCUITS				6+6
Algorithms and Representations – Redundancy Identification – Combinational ATPG Algorithms – Sequential ATPG Algorithms – Simulation Based ATPG – Genetic Algorithm Based ATPG					
Practical Exercises:					
1. ATPG, Fault simulation and Analysis (Stuck-at-faults, Transition faults, at-speed test with OCC– LoC)					
2. ATPG, Fault simulation and Analysis (Stuck-at-faults, Transition faults, at-speed test with LoS)					
Unit – IV	DESIGN FOR TESTABILITY				6+6
Design for Testability Basics – Testability Analysis - Scan Cell Designs – Scan Architecture – Built-in Self-Test – Random Logic Bist – DFT for Other Test Objectives.					
Practical Exercises:					
1. Testing of Digital circuits using Logic BIST(Combinational)					
2. Testing of Digital circuits using Logic BIST(Sequential)					
Unit - V	FAULT DIAGNOSIS				6+6
Introduction and Basic Definitions – Fault Models for Diagnosis – Generation of Vectors for Diagnosis – Combinational Logic Diagnosis - Scan Chain Diagnosis – Logic BIST Diagnosis					
Practical Exercises:					
1. Testing of SoC containing Logic Core, Custom IP,					
2. Testing of SoC with Boundary scan					
Total Periods:					60

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	To Understand the VLSI Testing Process	K2
CO2	Develop Logic Simulation and Fault Simulation	K3
CO3	Develop Test for Combinational and Sequential Circuits	K3
CO4	To Understand the Design for Testability	K2
CO5	Analyse to Perform Fault Diagnosis process	K4

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO– PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	3	2	3	2	-	-	-	-	-	-	2	2	2
CO2	3	2	1	3	3	-	-	-	-	-	-	2	2	1
CO3	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO4	2	3	3	2	3	-	-	-	-	-	-	2	3	3
CO5	3	3	3	3	2	-	-	-	-	-	-	2	2	3
CO	3	3	2	3	2	-	-	-	-	-	-	2	2	2

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Laung-Terng Wang, Cheng-Wen Wu and Xiaoqing Wen, "VLSI Test Principles and Architectures", Elsevier, 2017 .
2	Michael L. Bushnell and Vishwani D. Agrawal, "Essentials of Electronic Testing for Digital, Memory & Mixed-Signal VLSI Circuits" , Kluwer Academic Publishers, 2017

Reference Books

1	Niraj K. Jha and Sandeep Gupta, "Testing of Digital Systems", Cambridge University Press, 2017.
2	Vishwani D. Agrawal and Michael L. Bushnell, Essentials of Electronic Testing for Digital Memory and Mixed Signal VLSI Circuits, Kluwer Academic Publishers, 2000.
3	Parag K. Lala, An Introduction to Logic Circuit Testing, Morgan &Claypool Publishers, 2009.

Web-links

1. www.vlsiminds.com
2. www.numberanalytics.com



U24EC5A04	VERIFICATION OF IC DESIGN	L	T	P	C
		2	0	2	3
Course Objectives:	To introduce the fundamentals of IC design verification and methodologies and flows with verification environments using HDL and to provide hands-on experience with verification tools				
Unit - I	INTRODUCTION TO IC DESIGN & VERIFICATION	6+6			
IC design flow – Front-end and back-end design – Need for verification – Types of ICs: analog, digital and mixed signal – Design versus verification – RTL design overview – Verification challenges Practical Exercises: 1. Study and configuration of EDA-based digital simulation tools for IC verification 2. Design and functional verification of basic logic gates using Verilog HDL					
Unit - II	VERIFICATION FUNDAMENTALS	6+6			
Functional verification concepts – Verification flow – Verification versus testing – Testbench architecture – Role of simulators – Verification languages overview – Simulation concepts Practical Exercises: 1. Design and verification of combinational logic circuits such as adders and multiplexers 2.Design and verification of sequential circuits using flip-flops with appropriate timing analysis					
Unit - III	HDL FOR VERIFICATION	6+6			
Review of Verilog/SystemVerilog – Modules and ports – Procedural blocks – Writing simple testbenches – Initial blocks – Tasks and functions – Clock and reset generation Practical Exercises: 1. Design and verification of synchronous and asynchronous counters 2.Design and verification of various shift register architectures					
Unit – IV	VERIFICATION TECHNIQUES	6+6			
Directed testing – Self-checking testbenches – Random testing concepts – Functional coverage basics – Assertions introduction – Debugging techniques Practical Exercises: 1. Development of self-checking and assertion-based testbenches 2. Implementation of constrained random testing for digital circuits					
Unit - V	ADVANCED VERIFICATION CONCEPTS	6+6			
System Verilog for verification – Object-oriented concepts (basic) – Introduction to UVM – Reusability in verification – Industry verification flow overview. Practical Exercises: 1. Functional coverage modeling and coverage analysis (introductory level) 2. Mini project involving complete verification of a selected digital functional block					
Total Periods:					60

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the need and importance of verification in IC design	K2
CO2	Describe verification flows and methodologies	K3
CO3	Develop simple testbenches using Verilog/System Verilog	K3
CO4	Apply basic verification techniques to digital designs	K3
CO5	Understand industry-level verification practices	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO– PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	3	2	3	2	-	-	-	-	-	-	2	2	2
CO2	3	2	1	3	3	-	-	-	-	-	-	2	2	1
CO3	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO4	2	3	3	2	3	-	-	-	-	-	-	2	3	3
CO5	3	3	3	3	2	-	-	-	-	-	-	2	2	3
CO	2.8	2.8	2.4	2.6	2.4	-	-	-	-	-	-	2	2	2

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Chris Spear and Greg Tumbush, SystemVerilog for Verification: A Guide to Learning the Testbench Language Features, Springer, 3rd Edition
2	Janick Bergeron, Writing Testbenches: Functional Verification of HDL Models, Springer
3	Ashok B. Mehta, ASIC/SoC Functional Design Verification: A Comprehensive Guide to Technologies and Methodologies, Springer.

Reference Books

1	Samir Palnitkar, Verilog HDL: A Guide to Digital Design and Synthesis, Pearson Education.
2	Stuart Sutherland, RTL Modeling with SystemVerilog for Simulation and Synthesis, Springer

Web-links

1. www.cmosvlsi.com
2. www.SystemVerilog.com
3. www.VLSIVerification.net
4. www.EDAPlayground.com



U24EC5A05		MIXED SIGNAL IC DESIGN TESTING				L	T	P	C
						3	0	0	3
Course Objectives:		study the concepts of MOS large signal model and small signal model and to provide in-depth understanding of the analog integrated circuit and building block analog learn the Analog and Digital layout design for mixed signal circuits, CMOS Analog and Mixed signal Circuits like Data Converters and filters							
Unit - I	MIXED – SIGNAL TESTING						09		
Common Types of Analog and Mixed- Signal Circuits – Applications of Mixed-Signal Circuits – PostSilicon Production Flow – Test and Packing – Characterization versus Production Testing – Test and Diagnostic Equipment – Automated Test Equipments – Wafer Probers – Handlers – E-Beam Probers – Focused Ion Beam Equipments – Forced - Temperature									
Unit - II	SUBMICRON CIRCUIT DESIGN						09		
Yield – Measurement Terminology – Repeatability, Bias, and Accuracy – Calibrations and Checkers -Tester Specifications – Reducing Measurement Error with Greater Measurement Time -Guardbands – Effects of Measurement Variability on Test Yield – Effects of Reproducibility and Process Variation on Yield – Statistical Process Control									
Unit - III	ANALOG AND DIGITAL LAYOUT DESIGN FOR MIXED SIGNAL						09		
Layout introduction: Introduction, MOS transistor layers, stick diagram, symbolic diagram. Digital layout design: Introduction, guide line of transistor layout, PMOS and NMOS transistor layout, CMOS transistor layout. Introduction to analog layout techniques and Passive component layout – capacitor, resistor and inductor, Floor planning of analog and digital components, power supply and ground pin issues, matching, shielding, interconnection issues.									
Unit – IV	ADC TESTING						09		
ADC Testing Versus DAC Testing – ADC Code Edge Measurements – Edge Code Testing Versus Center Code Testing, Step Search and Binary Search Methods, Servo Method, Linear Ramp-Histogram Method, Histograms to Code Edge Transfer Curves, Rising Ramps Versus Falling Ramps, Sinusoidal Histogram Method – DC Tests and Transfer Curve Tests – Dynamic ADC Tests -Tests for Common ADC Applications									
Unit - V	CLOCK AND SERIAL DATA COMMUNICATIONS CHANNEL MEASUREMENT						09		
Synchronous and Asynchronous Communications – Time-Domain Attributes of a Clock Signal -Frequency-Domain Attributes of a Clock Signal – Communicating Serially Over a Channel – Bit Error Rate Measurement – Methods to Speed Up BER Tests in Production – Deterministic Jitter Decomposition – Jitter Transmission Tests.									
Total Periods:								45	

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Understand the fundamentals of mixed signal circuits	K2
CO2	Define the various measurement terminologies	K2
CO3	Acquire knowledge of Analog to Digital Converters	K3
CO4	Understand the testing of Analog to Digital Converters	K2
CO5	Comprehend the attributes of a clock signal.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO– PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	3	2	3	2	-	-	-	-	-	-	2	2	2
CO2	2	2	1	3	3	-	-	-	-	-	-	2	2	1
CO3	2	3	3	2	2	-	-	-	-	-	-	2	2	2
CO4	2	3	3	2	3	-	-	-	-	-	-	2	3	3
CO5	3	3	3	3	2	-	-	-	-	-	-	2	2	3
CO	2	3	2	3	2	-	-	-	-	-	-	2	2	2

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)



Text Books

1	Jacob Baker, Harry W. Li, David E. Boyce, CMOS, Circuit Design, Layout, and Simulation, Wiley-IEEE Press, 1998
2	Gordon W. Roberts, Friedrich Taenzler, Mark Burns, "An Introduction to Mixed-signal IC Test and Measurement" Oxford University Press, Inc. 2012

Reference Books

1	R. Jacob Baker, CMOS: Mixed-Signal Circuit Design, Wiley, 2008, 2nd Edition.
2	Behzad Razavi, Design of Analog CMOS Integrated Circuits" McGraw Hill Education, 2017, 2nd Edition.

Web-links

1. www.cmosvlsi.com



U24EC5A06	DESIGN OF ANALOG IC	L	T	P	C
		2	0	2	3
Course Objectives:	The objective of this course is to provide the strong foundation of MOS Circuits and analyse the noise characteristics of amplifiers and evaluate performance parameters of amplifiers It further focus on the compensation techniques and additionally introduce the key concepts in fault detection and testing methodologies.				
Unit – I	SINGLE STAGE AMPLIFIERS				6+6
Basic MOS physics and equivalent circuits and models, CS, CG and Source Follower, differential amplifier with active load, Cascode and Folded Cascode configurations with active load, design of Differential and Cascode Amplifiers – to meet specified SR, noise, gain, BW, ICMR and power dissipation, voltage swing, high gain amplifier structures. PRACTICAL EXERCISES 1. Design a CMOS inverter and analyze its characteristics. 2. Design a Common source amplifier and analyze its performance.					
Unit – II	HIGH FREQUENCY AND NOISE CHARACTERISTICS OF AMPLIFIERS				6+6
Miller effect, association of poles with nodes, frequency response of CS, CG and Source Follower, Cascode and Differential Amplifier stages, statistical characteristics of noise, noise in Single Stage amplifiers, noise in Differential Amplifiers. PRACTICAL EXERCISES 1. Design a Common drain amplifier and analyze its performance. 2.. Design a Common gate amplifier and analyze its performance					
Unit - III	FEEDBACK AND SINGLE STAGE OPERATIONAL AMPLIFIERS				6+6
Properties and types of negative feedback circuits, effect of loading in feedback networks, operational amplifier performance parameters, single stage Op Amps, two-stage Op Amps, input range limitations, gain boosting, slew rate, power supply rejection, noise in Op Amps. PRACTICAL EXERCISES 1. Design a differential amplifier with resistive load using transistors. 2.. Design two stage ring oscillator circuit and compare its frequencies. .					
Unit – IV	STABILITY, FREQUENCY COMPENSATION				6+6
Multipole Systems, Phase Margin, Frequency Compensation, Compensation Of Two Stage Op Amps, Slewing In Two Stage Op Amps, Other Compensation Techniques. PRACTICAL EXERCISES 1. Design three stage ring oscillator circuit and compare its frequencies. 2. Design a five-stage ring oscillator circuit and compare its frequencies.					
Unit – V	LOGIC CIRCUIT TESTING				6+6
Faults in Logic Circuits- Basic Concepts of Fault Detection- Design for Testability- Ad Hoc Techniques, Level-Sensitive Scan Design, Partial Scan, Built-in Self-Test. PRACTICAL EXERCISES 1. Design a BIST for CMOS inverter and analyze its characteristics. 2. Design a Fault design technique					
Total Periods:					30 +30



Course Outcomes

On completion of the course, the student can

Cos	Statements	K-Level
CO1	Infer the basics of electronics and Design amplifiers to meet user specifications.	K2
CO2	Construct and analyse the frequency and noise performance of amplifiers	K3
CO3	Design and analyse feedback amplifiers and one stage op amps	K2
CO4	Interpret the different types of transistors to Analyse stability of op amp	K2
CO5	Model the Testing procedure of logic circuits	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes												PSO		
	01	02	03	04	05	06	07	08	09	10	11	12	01	02	03
CO1	2	2	2	2	2	1	-	-	-	-	-	-	2	1	1
CO2	2	3	3	2	2	2	-	-	-	-	-	-	2	1	1
CO3	2	2	3	2	2	2	-	-	-	-	-	-	3	1	1
CO4	3	2	2	2	2	2	-	-	-	-	-	-	3	1	1
CO5	3	2	3	3	3	3	-	-	-	-	-	-	3	1	1
CO	3	2	3	2	2	2	-	-	-	-	-	-	3	1	1

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Behzad Razavi, "Design Of Analog Cmos Integrated Circuits", Tata Mcgraw Hill, 2001.
2.	Parag K.Lala, "An Introduction to Logic Circuit Testing", Morgan & Claypool Publishers, 2009.

Reference Books

1	Willey M.C. Sansen, "Analog Design Essentials", Springer, 2006.
2	Grebene, "Bipolar And Mos Analog Integrated Circuit Design", John Wiley & Sons, Inc., 2003.
4	4. Jacob Baker "CMOS: Circuit Design, Layout, And Simulation, Wiley IEEE Press, 3rd Edition, 2010.



U24EC5B01		ADVANCED DIGITAL SIGNAL PROCESSING				L	T	P	C
						2	0	2	3
Course Objectives:		The objective of this course is to develop knowledge of discrete-time random signal processing and multirate signal processing. It further emphasizes spectrum estimation techniques, prediction theory, and advanced filtering approaches for practical DSP systems.							
Unit - I	MULTIRATE SIGNAL PROCESSING							6+6	
Review of Convolution, DFT and ZT, Multirate Signal Processing - Decimation, Interpolation, Sampling Rate Conversion by a rational factor – digital filter banks, sub band coding, Poly-phase Filter Banks for 5G and Software Defined Radio (SDR) Applications.									
Practical Exercise using SCILAB software tool:									
1. Design and Implementation of Multirate Systems.									
2. Design and analysis of polyphase filter bank for sampling rate conversion									
Unit - II	DISCRETE TIME RANDOM PROCESSES							6+6	
Stationary random processes, Autocorrelation, Rational Power Spectra-Filters for generating random Processes from white noise and inverse filter – AR, MA and ARMA processes – relationship between autocorrelation and the filter parameters.									
Practical Exercise using SCILAB software tool:									
1. Study of autocorrelation and Cross Correlation of random signals									
2. Generation and analysis of AR, MA, and ARMA random processes									
Unit - III	LINEAR PREDICTION AND FILTERING							6+6	
Linear Prediction – Forward and Backward - Wiener filters for filtering and prediction – FIR Wiener Filter – IIR Wiener Filter – Kalman Filtering for Sensor Fusion and Autonomous Systems.									
Practical Exercise using SCILAB software tool:									
1. Design and Implementation of Wiener Filter									
2. Design and Implementation of FIR Linear Predictor									
Unit – IV	ADAPTIVE FILTERING							6+6	
FIR adaptive filters – adaptive filters based on steepest descent method – LMS algorithm – Variants of LMS algorithm – Deep Learning based Adaptive Noise and Echo Cancellation– adaptive channel equalization – RLS Algorithm.									
Practical Exercise using SCILAB software tool									
1. Design of adaptive filters using LMS algorithm									
2. Performance comparison of LMS and RLS adaptive filtering algorithms									
Unit - V	SPECTRUM ESTIMATION							6+6	
Estimation of power spectra from finite duration observations of signals – Non parametric methods of spectrum estimation – the Bartlett and the Welch method – Parametric spectrum estimation – AR, MA and ARMA. Introduction to neural network–based spectrum estimation									
Practical Exercise using SCILAB software tool:									
1. Spectrum Estimation using Bartlett and Welch Methods									
2. Parametric spectrum estimation using AR models									
Total Periods:								30+30	



Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Summarize multi-rate signal processing techniques and explain their applications.	K2
CO2	Apply the concept of power spectral density to analyze discrete random signals and systems.	K3
CO3	Apply linear prediction and filtering techniques to discrete random signals for signal detection and estimation.	K3
CO4	Analyze adaptive filtering problems and demonstrate its application.	K4
CO5	Apply power spectrum estimation techniques to random signals.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix Programme Outcomes

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	3	3	2	2	2	-	-	-	-	1	2	2	-
CO2	3	3	3	2	2	2	-	-	-	-	2	2	2	-
CO3	3	3	3	2	2	2	-	-	-	-	2	2	2	-
CO4	3	3	3	2	2	2	-	-	-	-	2	2	2	-
CO5	3	3	2	2	1	1	-	-	-	-	1	2	2	-
CO	3	3	2.8	2	1.8	1.8	-	-	-	-	1.6	2	2	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	John G. Proakis & Dimitris G. Manolakis, —Digital Signal Processing – Principles, Algorithms & Applications, Fourth Edition, Pearson Education / Prentice Hall, 2007.
2	P. Vaidyanathan, "Multirate systems and filter banks", Prentice Hall Inc. 1993.

Reference Books

1	Monson H. Hayes, "Statistical digital signal processing and modeling", John Wiley and Sons Inc. New York, Indian reprint 2008.
2	Haykin, Adaptive Filter Theory, 4th Edition, Pearson Education, New Delhi, 2006.
3	Sophoncles J. Orfanidis, "Optimum Signal Processing ", McGraw Hill, 2000.



U24EC5B02		IMAGE PROCESSING		L	T	P	C
		3	0	0	3		
Course Objectives:		To learn the concepts of digital image fundamentals and steps of digital image processing.					
Unit - I	DIGITAL IMAGE FUNDAMENTALS					09	
Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels - Color image fundamentals - RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms - DFT, DCT.							
Unit - II	IMAGE ENHANCEMENT					09	
Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering–Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.							
Unit - III	IMAGE RESTORATION					09	
Image Restoration - degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering							
Unit – IV	IMAGE SEGMENTATION					09	
Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation –Region growing – Region splitting and merging – Morphological processing- erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm.							
Unit - V	IMAGE COMPRESSION AND RECOGNITION					09	
Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching. Introduction to deep learning–based image recognition							
Total Periods:						45	

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Demonstrate the fundamentals of digital image processing.	K2
CO2	Illustrate different pre-processing techniques for image enhancement.	K2
CO3	Summarize various restoration techniques to recover the degraded image.	K2
CO4	Explain suitable image segmentation techniques.	K2
CO5	Identify the various coding techniques for image compression, including learning-based approaches.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	3	-	-	2	-	-	-	-	-	2	2	2	-
CO2	3	3	-	-	2	-	-	-	-	-	2	2	2	-
CO3	3	3	-	-	2	-	-	-	-	-	2	2	2	-
CO4	3	3	-	-	2	-	-	-	-	-	2	2	2	-
CO5	3	3	-	-	3	-	-	-	-	-	2	2	2	-
CO	3	3	-	-	2.2	-	-	-	-	-	2	2	2	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Rafael C. Gonzalez, Richard E. Woods, 'Digital Image Processing', Pearson, Third Edition, 2010.
2	Anil K. Jain, 'Fundamentals of Digital Image Processing', Pearson, 2002.

Reference Books

1	Kenneth R. Castleman, 'Digital Image Processing', Pearson, 2006.
2	Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, 'Digital Image Processing using MATLAB', Pearson Education, Inc., 2011.
3	D.E. Dudgeon and R.M. Mersereau, 'Multidimensional Digital Signal Processing', Prentice Hall Professional Technical Reference, 1990.
4	William K. Pratt, 'Digital Image Processing', John Wiley, New York, 2002.
5	Milan Sonka et al 'Image processing, analysis and machine vision', Brookes/Cole, Vikas Publishing House, 2nd edition, 1999.
6	Vasudevan Pulari, <i>Deep Learning: A Comprehensive Guide</i> , Routledge, 2024.



U24EC5B03		VLSI SIGNAL PROCESSING				L	T	P	C
						2	0	2	3
Course Objectives:		To enable students to understand VLSI-oriented representation and optimization of DSP algorithms, analyze performance constraints such as throughput and latency using architectural techniques, and introduce hardware acceleration and AI-based signal processing from a VLSI perspective.							
Unit - I	DSP ALGORITHMS FROM A VLSI PERSPECTIVE							6+6	
DSP algorithms as computational graphs (DSP theory assumed), Computational complexity analysis of DSP algorithms – operation count and memory access, Hardware-oriented representation of algorithms – Block-level architectures, Signal Flow Graphs (SFG), Data Flow Graphs (DFG), Performance metrics in VLSI DSP systems – throughput, latency, area, power (qualitative), Architectural optimization overview – pipelining and parallel processing, Case study: Hardware realization of a DSP algorithm. Practical Exercise using SCILAB software tool: 1. Analyze operation count and memory access requirements of a DSP algorithm using MATLAB / Python. 2. Model a DSP algorithm using Signal Flow Graph and Data Flow Graph and estimate throughput.									
Unit - II	ITERATION BOUND AND PERFORMANCE ANALYSIS							6+6	
Data Flow Graphs for performance evaluation, Loops in DFG and their impact on throughput, Iteration Bound – definition and significance, Loop bound and critical loop, Algorithms for computing iteration bound, Relationship between iteration bound and clock period, Iteration bound of multirate data flow graphs. Practical Exercise using SCILAB software tool: 1. Compute iteration bound for given data flow graphs. 2. Compare throughput of a DSP system before and after pipelining.									
Unit - III	RETIMING TECHNIQUES FOR VLSI DSP SYSTEMS							6+6	
Introduction to retiming, Retiming concepts – node delay and edge weight, Properties of retiming, Retiming constraints and formulation, solving systems of inequalities for retiming, Retiming for clock period minimization, Retiming applied to DSP architectures. Practical Exercise using any HDL simulation tool supporting Verilog / VHDL: 1. Perform retiming on a DSP data flow graph and analyze clock period. 2. Compare retimed and non-retimed architectures using HDL simulation.									
Unit – IV	SYSTOLIC ARCHITECTURE DESIGN							6+6	
Introduction to systolic architectures, Characteristics and advantages, Systolic array design methodology, Scheduling and data movement in systolic systems, FIR filter systolic architectures, Selection of scheduling vector, Matrix–matrix multiplication using 2D systolic arrays, Systolic design for space representations containing delays. Practical Exercise using SCILAB software tool: 1. Design and simulate a systolic FIR filter architecture. 2. Implement matrix multiplication using systolic array concept.									
Unit - V	DSP HARDWARE, ACCELERATORS, AND AI APPLICATIONS							6+6	
Limitations of software-only DSP implementations, DSP processor architecture – MAC unit, address generation unit, Harvard architecture, Introduction to hardware accelerators for signal processing, Convolution as a hardware primitive and its VLSI mapping, Artificial Intelligence in VLSI Signal Processing – relationship between convolution and neural networks, MAC-intensive AI workloads, CNN inference as a signal processing task, Overview of AI accelerators and Neural Processing Units (NPUs). Practical Exercise using SCILAB software tool: 1. Implement hardware mapping of convolution operation using HDL / simulation tools. 2. Design and simulate a MAC-based neuron and analyze performance.									
Total Periods:								30+30	



Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Understand VLSI-oriented representation and performance metrics of DSP algorithms	K2
CO2	Analyze iteration bound and throughput limitations in DSP architectures	K4
CO3	Apply retiming techniques to optimize DSP system performance	K3
CO4	Design systolic architectures for signal processing applications	K4
CO5	Demonstrate AI-based acceleration techniques in VLSI signal processing	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix Programme Outcomes

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	1	2	1	1	2	-	-	-	-	-	2	2	3	3
CO2	2	3	2	2	2	-	-	-	-	-	2	2	3	3
CO3	1	2	1	1	2	-	-	-	-	-	1	2	2	2
CO4	3	-	3	3	-	-	-	-	-	-	2	3	3	3
CO5	3	-	3	3	-	-	-	-	-	-	2	2	3	3
CO	2	2.2 5	2	2	2	-	-	-	-	-	1.8	2.2	2.8	2.8

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Keshab K. Parhi, VLSI Digital Signal Processing Systems: Design and Implementation, Wiley-Interscience, 1999.
2	S. Y. Kung, VLSI Array Processors, Prentice Hall, 1988.

Reference Books

1	Behrooz Parhami, Computer Arithmetic: Algorithms and Hardware Designs, Oxford University Press, 2010.
2	Sanjit K. Mitra, Digital Signal Processing: A Computer-Based Approach, McGraw-Hill, 2011.
3	Vivienne Sze et al., Efficient Processing of Deep Neural Networks, Morgan & Claypool, 2020.



U24AD5F05		SPEECH PROCESSING		L	T	P	C
				2	0	2	3
Course Objectives:		Develop expertise in human speech production mechanisms, time-domain and frequency-domain processing techniques, classical HMM-based ASR systems, and end-to-end deep learning pipelines for advanced speech technologies including recognition, synthesis, emotion detection, and pathology analysis.					
Unit - I	FUNDAMENTALS OF SPEECH PRODUCTION					12	
Introduction to speech processing, Overview of the human speech production system, acoustic and physiological mechanisms of speech production, Glottal signal characteristics, source features, and significance of glottal activity regions, Speech signal characteristics and characteristics of different speech sounds, vowels and consonants.							
SUGGESTED ACTIVITIES							
1. Analyze human speech production mechanisms by studying recorded speech signals and identifying vowels, consonants, and glottal activity regions. 2. Visualize and interpret speech signal characteristics such as waveform patterns for different speech sounds to understand acoustic properties.							
Unit - II	SHORT TIME TIME-DOMAIN PROCESSING					12	
Short time processing of speech for estimation of excitation and vocal tract features, Time-Domain processing: Energy, magnitude, zero crossing rate, STACF, Linear Prediction Analysis. Evaluation of time-domain methods for speech analysis, normalization and preprocessing steps.							
SUGGESTED ACTIVITIES							
1. Implement short-time time-domain analysis techniques including energy, zero-crossing rate, and short-time autocorrelation for speech signals. 2. Perform linear prediction analysis (LPC) to estimate excitation and vocal tract characteristics and evaluate preprocessing and normalization methods.							
Unit - III	FREQUENCY DOMAIN AND SPECTRO TEMPORAL PROCESSING					12	
Frequency-domain processing and spectro-temporal representation of speech signal: Narrowband, wideband spectrograms, Cepstral Analysis, Mel-spectrogram, MFCC feature extraction, Comparative analysis of frequency-domain features for speech tasks.							
SUGGESTED ACTIVITIES							
1. Generate and analyze spectrograms (narrowband and wideband) to study time–frequency characteristics of speech signals. 2. Extract and compare frequency-domain features such as cepstral coefficients, Mel-spectrograms, and MFCCs for different speech tasks.							
Unit – IV	SPEECH DATA PREPARATION AND CLASSICAL MODELS					12	
Speech data preparation, augmentation, and feature engineering pipelines, Machine learning vs deep learning for speech classification tasks: age, gender, dialect/accent identification, Automatic speech recognition using statistical models, emphasis on Hidden Markov Models, and hybrid HMM-GMM systems.							
SUGGESTED ACTIVITIES							
1. Prepare and augment speech datasets and perform feature engineering for speech classification tasks such as age or gender identification. 2. Implement a classical ASR system using Hidden Markov Models (HMM) or hybrid HMM-GMM frameworks and evaluate recognition performance.							
Unit - V	DEEP LEARNING PIPELINES AND ADVANCED APPLICATIONS					12	
Deep learning ASR pipelines, end-to-end models, Overview of speech technologies: emotion recognition, speaker recognition/verification, speech synthesis, TTS, and speech pathology detection, Model evaluation metrics, deployment considerations, and emerging hybrid approaches.							
SUGGESTED ACTIVITIES							
1. Design an end-to-end deep learning pipeline for speech recognition or classification using modern neural network architectures. 2. Develop and evaluate a speech-based application such as emotion recognition, speaker verification, or text-to-speech, and analyze performance metrics.							
Total Periods:						60	



Course Outcomes

On completion of the course, the student can

COs	Statements	K- Level
CO1	Identify human speech production mechanisms and characterize speech signals including glottal source features and acoustic properties of vowels/consonants.	K3
CO2	Apply short time time-domain processing techniques to extract excitation and vocal tract features from speech signals with proper normalization.	K3
CO3	Utilize frequency and spectro-temporal representations to extract MFCC and advanced features for speech processing applications.	K3
CO4	Develop speech data preparation pipelines and classical ASR systems using HMM and hybrid statistical models for classification tasks.	K3
CO5	Construct end-to-end deep learning pipelines for ASR and advanced speech technologies including evaluation and deployment strategies.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	1	-	-	-	-	-	-	-	-	-	1	1	-
CO2	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	1	-	-	-	-	-	-	-	-	-	1	1	-
CO4	3	1	-	-	-	-	-	-	-	-	-	3	3	-
CO5	1	1	-	-	-	-	-	-	-	-	-	1	3	-
CO	2.20	1.00	-	-	-	-	-	-	-	-	-	1.50	2.00	-

Correlation levels 1, 2 and 3 are as defined below:

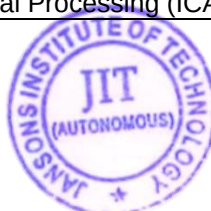
1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Lawrence R. Rabiner, Biing-Hwang Juang and B. Yegnanarayana, "Fundamentals of Speech Recognition", Pearson Education Inc., 2009
2	Douglas O'Shaughnessy, "Speech Communication", University Press, 2001.
3	Thomas F. Quatieri, "Discrete Time Speech Signal Processing", Pearson Education Inc., 2004

References:

1	Awni Hannun et al., "Deep Speech: Scaling up end-to-end speech recognition", arXiv preprint arXiv:1412.5567, 2014
2	Ronan Collobert, Christian Puhrsch and Gabriel Synnaeve, "Wav2letter: an end-to-end convnet-based speech recognition system", arXiv preprint arXiv:1609.03193, 2016
3	Anmol Gulati et al., "Conformer: Convolution-augmented transformer for speech recognition", arXiv preprint arXiv:2005.08100, 2020.
4	Jonathan Shen et al., "Natural TTS synthesis by conditioning wavenet on mel spectrogram predictions", IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP), 2018.



U24AD5G04		NATURAL LANGUAGE PROCESSING				L	T	P	C
						2	0	2	3
Course Objectives:		This course provides a strong foundation in Natural Language Processing by integrating linguistic principles with statistical methods for computational language analysis. It enables learners to implement and evaluate core NLP techniques and design practical applications such as question answering and dialogue systems using end-to-end NLP pipelines.							
Unit - I	INTRODUCTION							12	
Natural Language Processing – Components of NLP – Basics of Linguistics –Probability and Statistics for NLP – Words – Tokenization – Morphology –Finite State Automata									
SUGGESTED ACTIVITIES									
1. Implement tokenization, normalization, stemming/lemmatization on a given corpus using Python (NLTK / spaCy) and analyze token statistics. 2. Design and implement a Finite State Automaton (FSA) to recognize simple morphological patterns (e.g., plural forms, verb tense endings).									
Unit - II	STATISTICAL NLP AND SEQUENCE LABELING							12	
N-grams and Language Models – Smoothing Techniques – Text Classification –Naïve Bayes Classifier – Evaluation Metrics – Vector Semantics – TF-IDF –Word2Vec – Evaluation of Vector Models – Sequence Labeling –Part-of-Speech Tagging – Named Entities – Named Entity Recognition									
SUGGESTED ACTIVITIES									
1. Build unigram, bigram, and trigram language models with smoothing techniques and evaluate them using perplexity. 2. Implement Part-of-Speech tagging and Named Entity Recognition using classical (HMM/CRF) or Word2Vec-based features.									
Unit - III	CONTEXTUAL EMBEDDING AND PARSING							12	
Constituency Parsing – Context Free Grammar – Lexicalized Grammars –CKY Parsing – Earley's Algorithm – Parser Evaluation – Partial Parsing –Dependency Relations – Dependency Parsing – Transition-Based Parsing –Graph-Based Parsing									
SUGGESTED ACTIVITIES									
1. Implement CKY or Earley's parsing algorithm for a given Context-Free Grammar and evaluate parse accuracy. 2. Develop a dependency parser using transition-based or graph-based methods and analyze dependency relations.									
Unit – IV	COMPUTATIONAL SEMANTICS							12	
Word Senses and WordNet – Word Sense Disambiguation – Semantic Role Labeling –Proposition Bank – FrameNet – Selectional Restrictions –Information Extraction – Template Filling									
SUGGESTED ACTIVITIES									
1. Implement a WSD system using WordNet-based similarity measures and evaluate accuracy. 2. Design a template-filling system to extract structured information from unstructured text.									
Unit - V	DISCOURSE ANALYSIS AND SPEECH PROCESSING							12	
Discourse Coherence – Discourse Structure Parsing – Centering Theory –Entity-Based Coherence – Question Answering Systems –Factoid Question Answering – Classical QA Models –Chatbots – Dialogue Systems – Frame-Based Dialogue Systems –Dialogue-State Architecture									
SUGGESTED ACTIVITIES									
1. Develop a factoid Question Answering system using classical NLP pipelines and evaluate response accuracy. 2. Implement a frame-based dialogue system demonstrating dialogue-state tracking and intent handling.									
Total Periods:								60	



Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Apply fundamental NLP concepts, linguistic knowledge, and preprocessing techniques to analyze and structure raw textual data using computational methods.	K3
CO2	Implement statistical NLP models and sequence labeling techniques to perform text classification, language modeling, and named entity recognition with measurable performance metrics.	K3
CO3	Analyze syntactic structures by constructing and evaluating constituency and dependency parsers using formal grammars and parsing algorithms.	K4
CO4	Develop semantic processing systems to resolve word senses, extract semantic roles, and perform information extraction from unstructured text.	K3
CO5	Design discourse-aware applications such as question answering and dialogue systems by integrating discourse coherence models and dialogue-state architectures.	K4

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	-	2	-	1	2	3	3	-	3	3	3	3	3
CO2	1	-	1	-	1	3	2	2	-	2	2	-	1	-
CO3	3	-	3	-	3	3	3	3	-	3	3	3	3	3
CO4	3	3	3	-	3	-	-	-	-	-	-	2	3	2
CO5	2	2	2	-	2	-	-	-	-	-	-	2	3	2
CO	2.20	2.50	2.20	-	2.00	2.67	2.67	2.67	-	2.67	2.67	2.50	2.60	2.50

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Daniel Jurafsky and James H. Martin, "Speech and Language Processing", 3rd Edition, Pearson Education, 2023.
2	Jacob Eisenstein, "Natural Language Processing", MIT Press, 2023.
3	Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta, Harshit Surana, "Practical Natural Language Processing", 2nd Edition, O'Reilly Media, 2024.

Reference Books

1	Delip Rao, Brian McMahan, "Natural Language Processing with PyTorch", 2nd Edition, O'Reilly Media, 2023.
2	Steven Bird, Ewan Klein, Edward Loper, "Natural Language Processing with Python (Updated Edition)", O'Reilly Media, 2023.
3	Yoav Goldberg, "Neural Network Methods for Natural Language Processing", Updated Edition, Morgan & Claypool, 2022.



U24CS5A04		COMPUTER VISION			L	T	P	C
					2	0	2	3
Course Objectives:		To learn the fundamentals of image formation, processing, and feature analysis in motion estimation, 3D reconstruction, rendering, and recognition.						
Unit - I	INTRODUCTION TO IMAGE FORMATION AND PROCESSING						12	
Computer Vision - Geometric primitives and transformations - Photometric image formation - The digital camera - Point operators - Linear filtering - More neighborhood operators - Fourier transforms - Pyramids and wavelets - Geometric transformations - Global optimization.								
SUGGESTED ACTIVITY								
1.OpenCV Installation & working with Python								
2.Basic Image Processing: loading, cropping, resizing, thresholding								
Unit - II	FEATURE DETECTION, MATCHING AND SEGMENTATION						12	
Points and patches - Edges - Lines - Segmentation - Active contours - Split and merge - Mean shift and mode finding - Normalized cuts - Graph cuts and energy-based methods.								
SUGGESTED ACTIVITY								
1.Feature Matching: BFMatcher, FLANN-based matching								
2.Image Segmentation: Graphcut / Grabcut								
Unit - III	FEATURE-BASED ALIGNMENT & MOTION ESTIMATION						12	
2D and 3D feature-based alignment - Pose estimation - Geometric intrinsic calibration - Triangulation - Two-frame structure from motion - Factorization - Bundle adjustment - Constrained structure and 123 motion - Translational alignment - Parametric motion - Spline-based motion - Optical flow – Layered motion								
SUGGESTED ACTIVITY								
1. Camera Calibration with circular grid								
2.Pose Estimation (SolvePnP)								
Unit – IV	3D RECONSTRUCTION						12	
Shape from X - Active range finding - Surface representations - Point-based representations Volumetric representations - Model-based reconstruction - Recovering texture maps and albedosos.								
SUGGESTED ACTIVITY								
1. 3D Reconstruction: Depth map from stereo images								
Unit - V	IMAGE-BASED RENDERING AND RECOGNITION						12	
View interpolation Layered depth images - Light fields and Lumigraphs - Environment mattes - Video-based rendering- Object detection - Face recognition - Instance recognition - Category recognition - Context and scene understanding- Recognition databases and test sets.								
SUGGESTED ACTIVITY								
1. Object Detection and Tracking using Kalman Filter, Camshift								
Total Periods:							60	

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Apply geometric primitives, photometric image formation principles, and digital camera models for basic image processing operations, and annotation using OpenCV.	K3
CO2	Analyze image features through detection, matching (BFMatcher, FLANN), and segmentation (Graphcut/Grabcut).	K4
CO3	Construct calibration and pose estimation pipelines to align features and estimate motion in 2D/3D vision tasks.	K3
CO4	Develop depth maps and 3D representations from stereo images using reconstruction techniques.	K3
CO5	Utilize detection, tracking, and recognition methods (Kalman Filter, Camshift, face/object recognition) for scene understanding.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	3	2	2	3	-	2	3	2	1	3	3	3	2
CO2	3	3	3	3	3	1	2	3	3	2	3	3	3	3
CO3	3	3	3	3	3	1	2	3	3	2	3	3	3	3
CO4	3	3	3	3	3	1	2	3	3	2	3	3	3	3
CO5	3	3	3	3	3	1	2	3	3	2	3	3	3	3
CO	3.00	3.00	2.80	2.80	3.00	1.00	2.00	3.00	2.80	1.80	3.00	3.00	3.00	2.80

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer- Texts in Computer Science, Second Edition, 2022.
2	Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, Second Edition, 2015.

Reference Books

1	Computer Vision: Algorithms and Applications ,Richard Szeliski, 2nd Edition, 2022
2	E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press, 2012.
3	Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.



U24EC5C01		RF TRANSCEIVERS			L	T	P	C
					2	0	2	4
Course Objectives:		This course aims to equip learners with the knowledge and skills required to analyze and design high-frequency electronic systems, including transceiver architectures, amplifiers, filters, oscillators, mixers, PLLs, and frequency synthesizers.						
Unit - I	TRANSCEIVER SPECIFICATIONS AND ARCHITECTURES						12	
Transceiver Specifications: Two port Noise theory, Noise Figure, THD, IP2, IP3, Sensitivity, SFDR - Phase noise - Transceiver Architectures: Receiver: Homodyne, Heterodyne, Image reject, Low-IF Architectures - Transmitter: Direct-up conversion, Two-step up conversion schemes.								
Practical Exercises:								
1. Measurement of Noise Figure and Sensitivity of an RF Receiver using a Signal generator and Spectrum Analyzer.								
2. Study and Implementation of a Heterodyne Receiver Architecture to observe frequency conversion and image rejection.								
Unit - II	IMPEDANCE MATCHING NETWORKS AND AMPLIFIERS						12	
Review of S-parameters and Smith chart - Passive IC components - Impedance matching networks. Amplifiers: Common Gate, Common Source Amplifiers - OC Time constants in bandwidth estimation and enhancement - High frequency amplifier design - Low Noise Amplifiers: Power match and Noise match, single-ended and differential LNAs.								
Practical Exercises:								
1. Design of impedance matching network								
2. Design and characterization of LNA								
Unit - III	FEEDBACK SYSTEMS AND POWER AMPLIFIERS						12	
Feedback Systems: Stability of feedback systems, Gain and phase margin, Root-locus techniques, Time and Frequency domain considerations, Compensation - Power Amplifiers: General model - Class A, AB, B, C, D, E and F amplifiers - Linearization Techniques - Efficiency boosting techniques- ACPR metric.								
Practical Exercises:								
1. Study and implementation of compensation techniques in feedback amplifiers to improve stability and bandwidth.								
2. Design and performance analysis of a Class-B power amplifier measurement of efficiency and ACPR characteristics.								
Unit – IV	FILTERS, OSCILLATORS AND MIXERS						12	
Overview - basic resonator and filter configuration, special filter realizations, filter implementation - Basic oscillator model, high-frequency oscillator configuration, Colpitt's oscillator - basic characteristics of mixers, single and double-balanced mixers.								
Practical Exercises:								
1. Design of RF inductor and capacitor								
2. Design of low-pass and band-pass filter at RF								
Unit - V	PLL AND FREQUENCY SYNTHESIZERS						12	
PLL: Linearized Model, Noise properties, Phase detectors, Loop filters and Charge pumps- Frequency Synthesizers: Integer-N frequency synthesizers - Direct Digital Frequency Synthesizers								
Practical Exercises:								
1. Design and characterization of mixer								
2. Analysis and Design of a Phase-Locked Loop								
Total Periods:							60	



Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain transceiver specifications and architectures.	K2
CO2	Construct high-frequency and low noise amplifiers for bandwidth and noise performance.	K3
CO3	Demonstrate feedback system stability and evaluate power amplifier performance.	K3
CO4	Interpret the design and operating characteristics of filters, high-frequency oscillators, and mixers.	K3
CO5	Analyze PLL operation, noise characteristics, and the design of frequency synthesizers.	K4

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	2	2	3	-	-	-	-	-	1	1	1	-
CO2	3	3	2	2	3	-	-	-	-	-	1	1	1	-
CO3	3	3	3	2	3	-	-	-	-	-	1	1	2	-
CO4	3	3	3	2	3	-	-	-	-	-	1	1	2	-
CO5	2	2	3	3	3	-	-	-	-	-	1	1	2	-
CO	2.8	2.6	2.6	2.2	3	-	-	-	-	-	1	1	1.6	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Lee T, Design of CMOS RF Integrated Circuits, Cambridge, Second Edition, 2004
2	Razavi B, RF Microelectronics, Pearson Education, Second Edition, 2012

Reference Books

1	Ludwig R, and Bretchko P, RF Circuit Design Theory and Applications, Prentice Hall, Second Edition, 2008.
2	Razavi B, Design of Analog CMOS Integrated Circuits, McGraw Hill, Second Edition, 2017
3	Kyung-WhanYeom, Microwave Circuit Design - A Practical Approach using ADS, Pearson Education, 2015



U24EC5C02		ANTENNA DESIGN		L	T	P	C
				2	0	2	3
Course Objectives:		This course aims to introduce the fundamentals of antennas and their radiation characteristics. It focuses on the analysis and design of wire, aperture, array, broadband, and microstrip antennas. The course also emphasizes antenna performance evaluation and smart antenna concepts.					
Unit - I	ANTENNA FUNDAMENTALS						12
Radiation Pattern, Radiation intensity, Beam solid angle, Gain, Directive gain, Power gain, Radiation power density, Intensity, Directivity, Beamwidth. Bandwidth, Effective length, Effective area, Radiation Resistance, Friis Transmission formula, Antenna Field Zones, Polarization, Antenna noise temperature.							
Practical Exercises:							
1. Write a SCILAB code to compute received power using Friis transmission equation.							
Unit - II	WIRE AND APERTURE ANTENNAS						12
Radiation from Hertzian dipole, Power radiated and radiation resistance of Hertzian dipole. Radiation from half-wave dipole and Radiation resistance of half wave dipole, Loop antennas, Helical antennas, Aperture antennas: Horn antennas, Parabolic Reflectors, Slot antennas.							
Practical Exercises:							
1. Write a SCILAB code to obtain radiation pattern and calculate the radiation resistance and directivity of a Hertzian dipole.							
2. Write a SCILAB code to obtain radiation pattern and calculate the radiation resistance and directivity of a half-wave dipole.							
Unit - III	ANTENNA ARRAYS						12
Broadside and End fire array -Expression for electric field from two and four element arrays - N element linear array – Pattern multiplication- Binomial array.							
Practical Exercises:							
1. Write a SCILAB code to estimate the radiation pattern of a linear array and N element uniform array.							
Unit – IV	BROADBAND AND MICROSTRIP ANTENNAS						12
Broadband concept, Broadband/Frequency Independent antennas: Helical, Spiral, Log-periodic. Microstrip Patch antennas: Design, characteristics, advantages, and limitations.							
Practical Exercises:							
1. For a given set of design parameters, obtain the radiation pattern and gain of a rectangular microstrip patch antenna using SCILAB.							
Unit - V	ANTENNA MEASUREMENT AND SMART ANTENNAS						12
Radiation Pattern, Gain, Directivity, Impedance, Beam width and Efficiency Measurements. Concept and benefits of smart antennas, Fixed weight beamforming basics, Adaptive beamforming.							
Practical Exercises:							
1. Write a SCILAB code to estimate the weights of the array. Using the final weights estimate the array factor and the mean square error.							
Total Periods:							60

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Interpret the basic principles and evaluate antenna parameters	K2
CO2	Analyze radiation behaviour and performance characteristics of wire and aperture antennas	K4
CO3	Construct antenna arrays and analyze its radiation pattern	K3
CO4	Develop broadband and microstrip patch antennas to meet specified gain and radiation requirements.	K3
CO5	Analyze the fixed weight and adaptive beamforming in smart antennas	K4

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes												PSO		
	01	02	03	04	05	06	07	08	09	10	11	12	01	02	03
CO1	3	2	-	-	3	2	-	-	-	-	-	2	-	2	-
CO2	3	3	3	2	3	2	-	-	-	-	-	2	-	2	-
CO3	3	3	3	2	3	2	-	-	-	-	-	2	-	2	-
CO4	3	3	3	2	3	2	-	-	-	-	-	2	-	2	-
CO5	3	3	2	2	3	2	-	-	-	-	-	2	-	2	-
CO	3	2.8	2.8	2	3	2	-	-	-	-	-	2	-	2	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Constantine.A.Balanis "Antenna Theory Analysis and Design", Wiley,Fourth Edition, 2016
2	John D Krauss, Ronald J Marhefka and Ahmad S. Khan, "Antennas and Wave Propagation: Fifth Edition, Tata McGraw-Hill, 2017.
3	T. S. Rappaport, Smart antennas: Adaptive arrays, algorithms and wireless position location, IEEE Press, 1998.

Reference Books

1	R.E.Collin,"Antennas and Radiowave Propagation", Mc Graw Hill 1985.
2	S. Drabowitch, "Modern Antennas" Second Edition, Springer Publications, 2007.
3	Robert S.Elliott "Antenna Theory and Design" Wiley Student Edition, 2006.
4	Robert A.Monzingo, Randy L. Haupt and Thomas W.Miller, Introduction to Adaptive arrays, 2nd Edition, IET, 2011.
5	Thomas Kaiser, Smart Antennas: State of the Art, Hindawi, 2005.

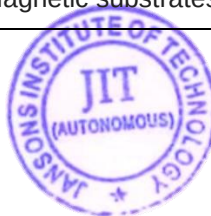


U24EC5C03		MICS AND RF SYSTEM DESIGN			L	T	P	C
					2	0	2	4
Course Objectives:		This course aims to develop an understanding of RF and microwave systems through the study of active components, RF filter design, and microwave integrated circuits including non-reciprocal components. It also focuses on antenna design and performance analysis using practical measurement techniques.						
Unit - I	ACTIVE RF COMPONENTS AND APPLICATIONS						12	
RF diodes, BJT, RF FET'S, High electron mobility transistors, matching and biasing networks- impedance matching using discrete components, Microstripline matching networks, amplifier classes of operation and biasing networks.								
Practical Exercises:								
1. Design and test an L-section impedance matching network using RF diodes/BJT/FET to achieve maximum power transfer and observe return loss in VSWR.								
Unit - II	RF FILTER DESIGN						12	
Overview, Basic resonator and filter configuration, special filter realizations, smith chart-based filter design, Filter Implementations, Richards Transformation, coupled filter.								
Practical Exercises:								
1. Design of low pass, high pass, band pass and band stop filter at RF using any software tool.								
Unit - III	INTRODUCTION TO MICROWAVE INTEGRATED CIRCUITS						12	
Overview of ABCD and S parameters - Overview of Planar transmission lines (Stripline, Microstripline, Slotline, CPW, Finline)-Design Parameters for Strip Line And Microstripline- Active Device Technologies- Design Approaches-Multichip Module Technology- Substrates.								
Practical Exercises:								
1. Simulate and measure S-parameters of microstrip or stripline structures for a given substrate and frequency range.								
2. Design a microstrip for a specified characteristic impedance using different substrate materials and analyze the effect on performance.								
Unit – IV	NON RECIPROCAL COMPONENTS FOR MICs						12	
Microstrip on Ferrimagnetic substrates, Microstrip circulators. Isolators and phase shifters, Design of microstrip circuits – high power and low power circuits.								
Practical Exercises:								
1.Design a microstrip circulator using a ferrimagnetic substrate and measure insertion loss, isolation, and return loss.								
2. Design a microstrip isolator using a ferrimagnetic substrate and measure insertion loss, isolation, and return loss.								
Unit - V	INTEGRATED ANTENNA DESIGN AND MEASUREMENTS						12	
Integrated Antenna Design- Photonic Band Gap Antennas - Micro Machined Antenna - Micro Electro Mechanical System Antennas - Test Fixture Measurements - Probe Station Measurements - Thermal and Cryogenic Measurements- Experimental Field Probing Techniques.								
Practical Exercises:								
1. Design and Simulation of Integrated / Photonic Band Gap Antenna Using any software tool.								
Total Periods:							60	

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Apply knowledge of S parameter theory to any RF active component design circuit for obtaining performance measure.	K3
CO2	Analyze microwave circuits for filters design.	K4
CO3	Analyze the performance of planar transmission lines and RF circuits using S-parameters.	K4
CO4	Construct microstrip circulators and isolators using ferrimagnetic substrates.	K3



COs	Statements	K-Level
CO5	Design microwave integrated antenna design circuit for the required Performance using professional software tools.	K4

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes												PSO		
	01	02	03	04	05	06	07	08	09	10	11	12	01	02	03
CO1	3	3	2	2	3	2	2	-	-	-	-	2	-	2	-
CO2	3	3	3	2	3	2	2	-	-	-	-	2	-	2	-
CO3	3	3	3	2	3	2	2	-	-	-	-	2	-	2	-
CO4	3	3	3	2	3	2	2	-	-	-	-	2	-	2	-
CO5	3	3	2	2	3	2	2	-	-	-	-	2	-	2	-
CO	3	3	2.6	2	3	2	2	-	-	-	-	2	-	2	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Reinhold Ludwig and Powel Bretchko, RF Circuit Design – Theory and Applications, Pearson Education Asia, Second Edition, 2009.
2	Bharathi Bhat, Shibani K. Koul, “Stripline-like Transmission Lines for Microwave Integrated Circuits”, New Age International Pvt Ltd Publishers, 2007.
3	Gupta KC and Amarjit Singh, “Microwave Integrated circuits”, Wiley Eastern, 1974.

Reference Books

1	MathewM. Radmanesh, Radio Frequency & Microwave Electronics, Pearson Education Asia, Second Edition, 2002.
2	Ulrich L. Rohde and David P. NewKirk, RF / Microwave Circuit Design, John Wiley & Sons USA 2000.
3	David Pozar ,Microwave Engineering, Addison Wesley 4th Edition,2011
4	RolandE. Best, Phase Locked Loops: Design, simulation and applications, McGraw Hill Publishers 5TH edition 2003
5	Ravender Goyal, “Monolithic MIC; Technology & Design”, Artech House, First Edition 1989.



U24EC5C04		RFID SYSTEM DESIGN & TESTING			L	T	P	C
					2	0	2	3
Course Objectives:		To discuss the fundamentals of near field and far field RFID communications, articulate the standards and protocols used in RFID systems, describe the operating principles of RFID tag and reader, introduce the security aspects and system architecture of RFID systems, illustrate the industrial and scientific applications of RFID systems						
Unit - I	INTRODUCTION						12	
RFID Principles: Near-field based RFID, Properties of Magnetic field , Far-field based RFID , Properties of Backscatter RF Systems, Modulation techniques, Frequency based property comparison of RFID Systems								
Practical Exercises:								
1.Simulate ASK, PSK, and backscatter modulation and analyze bandwidth and data rate.								
Unit - II	RFID STANDARDS AND PROTOCOLS						12	
RFID Industry standards: EPC global, ISO15693 Vicinity cards and RFID, ISO14443 Proximity cards and RFID, The NFC forum. Reading collocated RFID tags: Query Tree protocol, Query Slot protocol								
Practical Exercises:								
1.Determination of RFID tag performance for different standards								
Unit - III	OPERATING PRINCIPLES						12	
RFID Tag components: RFID tag types, the 1-Bit Transponder and Chipless Tags, RFID readers and middleware component. Communication fundamentals: Coupling, Data encoding, multi-path effect, Tag, Reader and sensor communication.								
Practical Exercises:								
1. Design of a passive RFID Tag Antenna								
Unit – IV	DATA INTEGRITY AND SECURITY						12	
The checksum procedure, Multiaccess procedures, Attacks on RFID Systems, Protection by Cryptographic measures								
Practical Exercises:								
1. Determination of read range of the RFID tag at UHF and Microwave frequencies								
Unit - V	RFID ENABLED SENSORS AND APPLICATIONS						12	
RFID enabled Sensors: Antenna design challenges, IC design, Integration of sensors and RFID, Power consumption and Link budget.								
Practical Exercises:								
1.Design of an RFID reader antenna								
Total Periods:							60	

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Classify RFID systems based on frequency, architecture and performance	K2
CO2	Interpret the standards for RFID technology	K2
CO3	Analyze various RFID tag components and tag	K3
CO4	Describe the privacy and security issues in RFID Systems	K2
CO5	Discuss the construction and applications of RFID enabled sensor	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	3	1	-	2	1	-	-	-	-	1	-	2	-
CO2	3	3	1	-	2	1	-	-	-	-	1	-	2	-
CO3	3	3	1	-	2	1	-	-	-	-	1	-	2	-
CO4	3	3	2	-	2	1	-	-	-	-	1	-	2	-
CO5	3	3	2	-	2	1	-	-	-	-	1	-	2	-
CO	3	3	1	-	2	1	-	-	-	-	1	-	2	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Roy Want, RFID Explained, Springer 2022.
2	Amin Rida, Li Yang, Manos M. Tentzeris, RFID Enabled Sensor Design and Applications, Artech House, 2010

Reference Books

1	Klaus Finkenzeller, RFID Handbook, 3rd Edition, Wiley, 2010
2	Syed Ahson, Mohammad Ilyas, RFID Handbook, CRC Press, 2008
3	Paris Kitsos, Security in RFID and Sensor Networks, CRC Press, 2016.



U24EC5C05		EMI / EMC PRE COMPLIANCE TESTING			L	T	P	C
					2	0	2	3
Course Objectives:		The objective of the course is to introduce the basic concepts of Electromagnetic Interference, teach the importance of measurement device for EMI, explain the EMI coupling & control principles, understand receivers & Analyzer functionalities and impart knowledge on design issues in EMI/EMC						
Unit - I	NATURE AND ORIGINS OF ELECTROMAGNETIC COMPATIBILITY					12		
Introduction, Visualizing the EMI problem, Source of EMI, EMI coupling to victim equipment, Intersystem and Intrasystem EMI, EMC standards and specifications								
Practical Exercises:								
1. Visualization of Electromagnetic Interference								
Unit - II	TYPES of EMI COUPLING					12		
Conducted, radiated and transient coupling; Common ground impedance coupling; Common mode and ground loop coupling; Differential mode coupling, Near field cable to cable coupling; Field to cable coupling, Power mains and Power supply coupling; Transient EMI								
Practical Exercises:								
1. Demonstrate and analyze EMI Coupling Mechanisms in Electronic Systems								
2. Use of LISN and measurement concept of Conducted emission								
Unit - III	MEASUREMENT DEVICES FOR EMI					12		
Introduction: Measurement by direct connection, Inductively coupled devices EMC antennas: Basic antenna parameters, Antennas for radiated emission testing, Wideband antennas , Magnetic field antennas, Type of antennas used in susceptibility testing								
Practical Exercises:								
1.Perform environment scan and detect various signals available								
Unit – IV	RECEIVERS, ANALYSERS AND MEASUREMENT EQUIPMENT					12		
EMI receiver, Spectrum Analyzers, RF power meter Frequency meters. Standards requiring immunity tests, Automatic EMC tests, Electromagnetic transient testing, Transient types, Continuous and transient signal, ESD-electrostatic discharge								
Practical Exercises:								
1.Basic spectrum measurement and power measurement with markers								
2. DPX, Spectrogram and transient capture with mask test and act on violation								
Unit - V	PRE-COMPLIANCE TESTING TO AVOID EMC PROBLEMS					12		
Need for Pre-Compliance Testing; Intersystem and Intrasystem EMC, developing an approach to EMC design, Process flow chart, EMC strategy, self-certification, Solutions to avoid EMC: ESD Shielding, EMI Filters, Grounding; Bonding, Isolation transformer, Transient suppressors; EMI Suppression Cables.								
.Practical Exercises:								
1. EMI spurious detection and measurement against EMI limit lines								
Total Periods:								60

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Summarize the various types and mechanisms of Electromagnetic Interference	K2
CO2	Distinguish the different types of Electromagnetic Interference coupling mechanisms	K2
CO3	Apply appropriate EMI measurement techniques to measure and analyze radiated and conducted emissions in electronic systems.	K3
CO4	Infer the operation of EMI measurement instruments	K2
CO5	Inspect the design issues in EMI/EMC	K4

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	-	-	-	-	1	-	-	-	-	1	-	1	-
CO2	3	1	-	-	-	1	-	-	-	-	1	-	1	-
CO3	3	1	-	-	-	1	-	-	-	-	1	-	1	-
CO4	3	1	-	-	-	1	-	-	-	-	1	-	1	-
CO5	3	1	-	-	-	1	-	-	-	-	1	-	1	-
CO	3	1	-	-	-	1	-	-	-	-	1	-	1	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	David Morgan , "A Handbook for EMC Testing and Measurement", IET Electrical Measurement, 2012
2	Tim Williams , "EMC for Product Designers", 5th Edition, Newnes Elsevier, 2017

Reference Books

1	V.P.Kodali, "Engineering EMC Principles, Measurements and Technologies", 2nd ed. IEEE Press, Newyork, (2001)
2	Paul, C.R., "Introduction to Electromagnetic Compatibility", 2nd ed., Wiley (2010)
3	David K. Cheng, "Field and Wave Electromagnetics", 2nd ed. Pearson Education, 2009



U24EC5C06		SIGNAL INTEGRITY			L	T	P	C
					2	0	2	3
Course Objectives:		This course develops understanding impedance matching, reflections and crosstalk in transmission lines. It analysis signal integrity using eye diagrams,jitter also introduces high-frequency differential signaling and applications.						
Unit - I	SIGNAL REFLECTION AND IMPEDANCE MATCHING TECHNIQUE						12	
Phenomenon of signal reflection-Signal reflection at transmitting end. Signal reflection at branch point- Multiple reflection in transmission line-Prevention of signal reflection by using impedance matching technique.								
Practical Exercises:								
1. Measurement of Standing Wave Ratio (SWR) in Transmission Line								
2. Measurement of Reflection Coefficient using Slotted Line Method								
Unit - II	CROSSTALK NOISE						12	
Crosstalk definition and classification-Crosstalk mechanism-Analysis of crosstalk noise in transmission line-Main factor of causing crosstalk noise.								
Practical Exercises:								
1. Measurement of Near-End Crosstalk (NEXT) in Parallel Transmission Lines								
2. Measurement of Crosstalk in Twisted Pair Transmission Lines								
Unit - III	DIFFERENTIAL SIGNAL TRANSMISSION CIRCUIT						12	
Pros and cons of using differential signalling compared with that of single-ended signaling-High-speed differential interfaces-Theory of differential signaling-Differential signal termination techniques.								
Practical Exercises:								
1. Comparison of Differential Signaling and Single-Ended Signaling Performance								
2. Measurement of Common-Mode Noise Rejection in Differential Signaling								
Unit – IV	FREQUENCY RESPONSE OF A CIRCUIT						12	
Frequency response of transmission line and circuit-Inter-symbol interference (ISI) and eye-pattern-Deterioration of a signal waveform due to ISI-Circuit techniques to prevent the deterioration-Linear time-invariant systems-Frequency response of pulse.								
Practical Exercises:								
1. Measurement of Frequency Response of Transmission Line								
2. Measurement of Inter-Symbol Interference (ISI) in Transmission Line								
Unit - V	EYE DIAGRAM AND JITTER						12	
Jitter Definition and Types of Jitter- Jitter decomposition-Eye diagram analysis and related measurement								
Practical Exercises:								
1. Measurement of Eye Pattern in Digital Communication System								
2. Measurement of Jitter in Digital Signals								
Total Periods:							60	

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain transmission line behavior, signal reflection, and impedance matching techniques.	K2
CO2	Analyze crosstalk mechanisms and evaluate noise in transmission lines.	K4
CO3	Examine differential signaling principles and assess high-speed interface performance	K3
CO4	Evaluate frequency response, inter-symbol interference, and signal distortion in circuits	K4
CO5	Analyze eye diagrams and jitter to assess overall signal integrity.	K4

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	3	2	2	3	-	-	-	-	-	1	1	1	-
CO2	3	3	2	2	3	-	-	-	-	-	1	1	1	-
CO3	3	3	3	2	3	-	-	-	-	-	1	1	2	-
CO4	3	3	3	2	3	-	-	-	-	-	1	1	2	-
CO5	3	3	3	2	3	-	-	-	-	-	1	1	2	-
CO	2.8	2.6	2.6	2.2	3	-	-	-	-	-	1	1	1.6	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Signal and Power integrity Simplified -Eric Bogatin, Pearson, 3rd Edition,2018
2	High Speed Digital Design by Howard Johnson and Martin Graham, Prentice Hall,1st Edition,1993

Reference Books

1	High Speed Signal Propagation and Howard Johnson, Prentice Hall,1st Edition,2003
2	Digital Signal Integrity: Analysis and Simulation with Applications – S. Srinivasa Rao, Springer, 1st Edition, 2020
3	Microwave Engineering – David M. Pozar, Wiley, 5th Edition, 2021



U24EC5D01		MEDICAL IMAGING SYSTEMS			L	T	P	C
					3	0	0	3
Course Objectives:		To study about X-ray generation and its applications in medical imaging. Also, explains the principles of computed tomography and various techniques used to visualize internal sections of the human body. In Addition helps to learn the working principles of different radio diagnostic imaging equipment and their clinical relevance and emphasizes radiation protection and safety measures essential in medical practices.						
Unit - I	X RAYS					09		
Nature of X-rays- X-Ray absorption – Tissue contrast. X- Ray Equipment (Block Diagram) – X-Ray Tube, the collimator, Bucky Grid, power supply, Digital Radiography - discrete digital detectors, storage phosphor and film scanning, X-ray Image Intensifier tubes – Fluoroscopy – Digital Fluoroscopy. Angiography, cine Angiography. Digital subtraction Angiography. Mammography								
Unit - II	COMPUTED TOMOGRAPHY					09		
Principles of tomography, CT Generations, X- Ray sources- collimation- X- Ray detectors – Viewing systems – spiral CT scanning – Ultra fast CT scanners. Image reconstruction techniques – back projection and iterative method.								
Unit - III	MAGNETIC RESONANCE IMAGING					09		
Fundamentals of magnetic resonance- properties of electromagnetic waves : speed , amplitude, phase, orientation and waves in matter - Interaction of Nuclei with static magnetic field and Radio frequency wave- rotation and precession – Induction of magnetic resonance signals – bulk magnetization – Relaxation processes T1 and T2. Block Diagram approach of MRI system – system magnet (Permanent, Electromagnet and Superconductors), generations of gradient magnetic fields, Radio Frequency coils (sending and receiving), shim coils, Electronic components, fMRI								
Unit – IV	NUCLEAR IMAGING					09		
Radioisotopes- alpha, beta, and gamma radiations. Radio Pharmaceuticals. Radiation detectors – gas filled, ionization chambers, proportional counter, GM counter and scintillation Detectors, Gamma camera – Principle of operation, collimator, photomultiplier tube, X-Y positioning circuit, pulse height analyzer. Principles of SPECT and PET								
Unit - V	RADIATION THERAPY AND RADIATION SAFETY					09		
Radiation therapy – linear accelerator, Telegamma Machine. SRS – SRT – Recent Techniques in radiation therapy – 3D CRT – IMRT – IGRT and Cyber knife – radiation measuring instruments Dosimeter, film badges, Thermo Luminescent dosimeters – electronic dosimeter – Radiation protection in medicine – radiation protection principles								
Total Periods:						45		

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Describe the working principle of the X-ray machine and its application	K2
CO2	Explain the principles and working of computed tomography systems and apply image reconstruction techniques such as back projection and iterative methods for tomographic imaging.	K2
CO3	Interpret the technique used for visualizing various sections of the body using Magnetic Resonance Imaging	K2
CO4	Summarize the principles of radioisotopes and radiopharmaceuticals, operation of radiation detectors, gamma cameras, and the basic working concepts of SPECT and PET imaging systems.	K2
CO5	Analyze different imaging techniques and choose appropriate imaging equipment for bet	K4

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	3	3	2	-	-	-	-	-	-	1	-	-	2
CO2	3	3	3	2	-	-	-	-	-	-	1	-	-	2
CO3	3	3	2	2	-	-	-	-	-	-	1	-	-	2
CO4	3	3	3	2	-	-	-	-	-	-	1	-	-	2
CO5	3	3	3	2	1	-	-	-	-	-	1	-	-	2
CO	3	3	3	2	1	-	-	-	-	-	1	-	-	2

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Isaac Bankman, I. N. Bankman , Handbook Of Medical Imaging: Processing and Analysis(Biomedical Engineering),Academic Press,2000
2	Jacob Beutel (Editor), M. Sonka (Editor), Handbook of Medical Imaging, Volume 2. Medical Image Processing and Analysis , SPIE Press 2000
3	Khin Wee Lai, DyahEkashantiOctorinaDewi “Medical Imaging Technology”, Springer Singapore, 2015

Reference Books

1	Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw – Hill, New Delhi, 2003.
2	Dougherty, Geoff (Ed.), “Medical Image Processing - Techniques and Applications “,Springer-Verlag New York, 2011



U24EC5D02	HUMAN ASSIST DEVICES	L	T	P	C
		3	0	0	3
Course Objectives:	To study the functions and importance of machines that takes over the functions of the heart and clearance of urea from the blood and understand the tests to assess the hearing loss and also explore prosthetic and orthotic devices, including functional electrical stimulation and sensory assist technologies, to enhance rehabilitation and patient care.				
Unit - I	HEART LUNG MACHINE AND ARTIFICIAL HEART			09	
Heart Lung machine - Different types of Oxygenators, Pumps, Monitoring Process, Shunting, The Indication for Cardiac Transplant, Driving Mechanism, Blood Handling System, Functioning and different types of Artificial Heart, Schematic for temporary bypass of left ventricle.					
Unit - II	CARDIAC ASSIST DEVICES			09	
Assisted through Respiration, Right and left Ventricular Bypass Pump, Auxiliary ventricle, Open Chest and Closed Chest type, Intra-Aortic Balloon Pumping, Prosthetic Cardiac valves, Principle of External Counter pulsation techniques.					
Unit - III	ARTIFICIAL KIDNEY			09	
Indication and Principle of Haemodialysis, Membrane dialysis, types of filter and membranes, Different types of hemodialyzers, Monitoring Systems, Wearable Artificial Kidney, Implanting Type.					
Unit – IV	RESPIRATORY AND HEARING AIDS			09	
Ventilator and its types-Intermittent positive pressure, Breathing Apparatus Operating Sequence, Electronic IPPB unit with monitoring for all respiratory parameters. Types of Deafness, Hearing Aids, SISI, masking techniques, wearable devices for hearing correction.					
Unit - V	PROSTHETIC AND ORTHODIC DEVICES			09	
Hand and arm replacement – different types of models, externally powered limb prosthesis, feedback in orthodic system, functional electrical stimulation, sensory assist devices.					
Total Periods:				45	

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the principles and functions and different types of artificial hearts available for clinical use.	K2
CO2	Summarize the various cardiac assist devices and their mechanisms in supporting circulatory function.	K2
CO3	Compare various types of heamodialyzers and their applications in renal replacement therapy.	K3
CO4	Describe the functioning of ventilators, respiratory aids, and hearing assistive devices for clinical and rehabilitation applications.	K3



COs	Statements	K-Level
CO5	Explain prosthetic and orthotic systems, including feedback and functional electrical stimulation mechanisms	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	2	-	-	-	-	-	-	-	-	2	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	2	-	-	-	-	-	-	-	-	2	-	-
CO5	3	3	2	-	-	-	-	-	-	-	-	-	-	1
CO	3	3	2	-	-	-	-	-	-	-	-	2	-	1

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Gray E Wnek, Gray L Browlin – Encyclopedia of Biomaterials and Biomedical Engineering –Marcel Dekker Inc New York 2004
2	John. G . Webster – Bioinstrumentation - John Wiley & Sons (Asia) Pvt Ltd - 2004
3	Joseph D.Bronzino, The Biomedical Engineering Handbook, Third Edition: Three Volume Set, CRC Press, 2006

Reference Books

1	Andreas.F. Von racum, “Hand book of bio material evaluation”, Mc-Millan publishers, 1980
2	Gray E Wnek, Gray L Browlin, “Encyclopedia of Biomaterials and Biomedical Engineering” Marcel Dekker Inc New York 2004
3	D.S. Sunder, “Rehabilitation Medicine”, 3rd Edition, Jaypee Medical Publication, 2010



U24EC5D03	THERAPEUTIC EQUIPMENT		L	T	P	C
			3	0	0	3
Course Objectives:		To learn the working principles and applications of cardiac and respiratory therapy equipment used in patient care. It provides knowledge of muscular and biomechanical therapeutic systems applied in rehabilitation and also about various body care and dental care equipment used in clinical practice and understand the principles of heat and photon-based therapeutic devices. The course also emphasizes patient safety, focusing on electrical hazards, protection methods, and compliance with medical safety standards in healthcare environments.				
Unit - I	CARDIAC AND RESPIRATORY THERAPY EQUIPMENT				09	
Electrocardiograph - Normal and Abnormal Waves, Cardiac Pacemaker Internal and External Pacemaker, AC and DC Defibrillator- Internal and External, Defibrillator Protection Circuit, Cardiac ablation catheter. Lung Volume and vital capacity -Types of Ventilators – Pressure, Volume, and Time controlled Flow, Patient Cycle Ventilators, Humidifiers, Nebulizers, Inhalators.						
Unit - II	MUSCULAR AND BIOMECHANICAL EQUIPMENT				09	
Muscle stimulators, nerve stimulators, Nerve conduction velocity measurement, Functional Electrical Stimulation. peripheral nerve stimulator, ultrasonic stimulators, Stimulators for pain and relief - Inferential Therapy Unit, TENS. GAIT Assessment and Therapy. Continuous Passive Motion unit, Cervical / Lumber Traction Machine -Traction Table.						
Unit - III	BODY AND DENTAL CARE EQUIPMENT				09	
Skin Treatment: Ultrasonic spot remove, vacuum therapy unit, Skin tightening, Wrinkle Reduction. Laser hair therapy machine. Dental Chair - Dental Hand pieces and Accessories: Evolution of rotary equipment, Low-speed handpiece, High-speed handpiece, Hand piece maintenance- Dental Radiography: Dental X-ray Machine.						
Unit – IV	HEAT & PHOTON THERAPY EQUIPMENT				09	
High frequency heat therapy, Principle, Short wave diathermy, Microwave diathermy, Ultrasonic therapy, Lithotripsy. Therapeutic UV and IR Lamps. Basic principles of Biomedical LASERS: Applications of lasers in medicine, CO2laser, He-Ne laser, Nd-YAG and Ruby laser.						
Unit - V	PATIENT SAFETY				09	
Physiological effects of electricity – Macro shock – Micro shock hazards – Patient’s electrical environment – Isolated Power system – Conductive surfaces – Electrical safety codes and standards – Basic Approaches to Protection against shock, Protection equipment design.						
Total Periods:					45	



Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the construction, operation, and applications of cardiac and respiratory therapy equipment.	K2
CO2	Identify the principles of muscular and biomechanical therapeutic equipment used for rehabilitation.	K3
CO3	Describe the functioning of body and dental care devices and their clinical relevance.	K2
CO4	Apply the principles of heat and photon therapy equipment, including diathermy and laser systems, in medical treatment.	K3
CO5	Interpret patient safety requirements and implement electrical protection standards in medical equipment usage.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	2	-	-	-	-	-	-	-	1	2	-	-
CO2	3	2	2	2	-	-	-	-	-	-	1	2	-	-
CO3	3	2	2	-	-	-	-	-	-	-	1	2	-	-
CO4	3	2	2	2	-	-	-	-	-	-	1	2	-	-
CO5	3	2	2	-	-	-	-	-	-	-	1	2	-	-
CO	3	2	2	2	-	-	-	-	-	-	1	2	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Khandpur. R.S., "Handbook of Biomedical Instrumentation". Second Edition. Tata McGrawHill Pub. Co., Ltd. 2003.
2	John.G.Webster. "Medical Instrumentation, Application and Design". Fourth Edition. Wiley & sons, Inc., NewYork. 2009.



Reference Books

1	Leslie Cromwell, Fred. J. Weibell & Erich. A.Pfeiffer. "Biomedical Instrumentation and Measurements". Second Edition. Prentice Hall Inc.2000.
2	John Low & Ann Reed. "Electrotherapy Explained, Principles and Practice". Second Edition. Butterworth Heinemann Ltd. 2000.
3	Joseph. J. Carr, John Michael Brown, "Introduction to Biomedical Equipment Technology",Prentice Hall and Technology, 2008.



U24EC5D04	BODY AREA NETWORKS	L	T	P	C
		3	0	0	3
Course Objectives:	To understand of Body Area Networks (BAN) and their role in healthcare and pervasive patient monitoring. It covers hardware design aspects, including wireless communication, antenna systems, and power management for body-worn devices. Also helps to learn various network topologies, protocols, and standards used in BAN applications and security issues such as interference, regulation and self-protection mechanisms				
UNIT I	INTRODUCTION				09
Definition, BAN and Healthcare, Pervasive Patient Monitoring using BAN, Technical Challenges Sensor design, biocompatibility, Energy Supply, System security and reliability, Context Awareness, Integrated Therapeutic Systems, Ideal BSN Architecture.					
UNIT II	HARDWARE FOR BAN				09
Wireless communication - RF communication in Body, Antenna design and testing, Matching Network, Propagation, Materials, Base Station, Power considerations, Wireless communication technologies for wearable systems, Body Area Network – Human Applications.					
UNIT III	NETWORK TOPOLOGIES, PROTOCOLS AND STANDARDS				09
Network Topologies - Stand –Alone BAN, Wireless personal Area Network Technologies. Standards - IEEE 802.15.1, IEEE P802.15.13, IEEE 802.15.14, Zigbee, Healthcare system standards					
UNIT IV	COEXISTENCE ISSUES WITH BAN				09
Interferences – Intrinsic - Extrinsic, Effect on transmission, Regulatory issues-Medical Device regulation in Asia, Security and Self-protection-Bacterial attacks, Virus infection, secured protocols, Self-protection.					
UNIT V	APPLICATIONS OF BAN				09
Monitoring patients with chronic disease, Hospital patients, Elderly patients, Cardiac arrhythmias monitoring, Multi patient monitoring systems, Multichannel Neural recording, Gait analysis, Smart Garments, Electronic pill					
Total Periods:					45

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Illustrate the concept of Body Area Networks, their need in healthcare, and the challenges in system design and integration.	K2
CO2	Apply knowledge of wireless communication, antenna design, and power management in the development of BAN hardware systems.	K3
CO3	Describe various network topologies, communication protocols, and international standards used in BAN applications.	K2
CO4	Explain the coexistence, interference, and security challenges in BAN and propose self-protection mechanisms	K2



COs	Statements	K-Level
CO5	Apply BAN concepts to healthcare applications such as chronic disease monitoring, neural recording, and smart wearable systems.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	3	2	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	2	-	-	-	-	-	-	-	-	-	-	2
CO4	3	3	2	-	-	-	-	-	-	-	-	-	-	2
CO5	3	3	2	-	-	-	-	-	-	-	-	-	-	2
CO	3	3	2	-	-	-	-	-	-	-	-	-	-	2

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Guang-Zhong Yang(Ed.), "Body Sensor Networks, "Springer, 2006.
2	Sandeep K.S. Gupta,Tridib Mukherjee,Krishna Kumar Venkatasubramanian, "Body Area Networks Safety, Security, and Sustainability," Cambridge University Press, 2013.

Reference Books

1	Annalisa Bonfiglio, Danilo De Rossi ,"Wearable Monitoring Systems", Springer, 2011.
2	Zhang, Yuan-Ting, "Wearable Medical Sensors and Systems",Springer, 2013.
3	Mehmet R. Yuce, Jamil Y.Khan, "Wireless Body Area Networks Technology, Implementation and applications", Pan Stanford Publishing Pte. Ltd, Singapore, 2012.



U24EC5D05	WEARABLE DEVICES	L	T	P	C
		3	0	0	3
Course Objectives:	To understand the need, design, and components of wearable systems and sensors, also analyse signal processing challenges, wearability issues, and energy harvesting techniques in wearable devices and learn about wireless health monitoring systems and body area network architectures, explore smart textiles and their fabrication methods for biomedical applications, and apply IoT concepts in healthcare, sports, and diagnostic monitoring.				
Unit - I	WEARABLE SYSTEMS AND SENSORS				09
Need for Wearable Systems, Drawbacks of Conventional Systems for Wearable Monitoring, Applications of Wearable Systems, Types of Wearable Systems, Components of wearable Systems. Sensors for wearable Systems -Inertia movement sensors, Respiration activity sensor, Inductive plethysmography, Impedance plethysmography, Wearable ground reaction force sensor					
Unit - II	SIGNAL PROCESSING AND ENERGY HARVESTING				09
Wearability issues -physical shape and placement of sensor, Technical challenges - sensor design, signal acquisition, Constraint on sampling frequency for reduced energy consumption. Power Requirements- Solar cell, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.					
Unit - III	WIRELESS HEALTH SYSTEMS				09
Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges- System security and reliability, BAN Architecture - Introduction, Wireless communication Techniques					
Unit – IV	SMART TEXTILE				09
Introduction to smart textile- Passive smart textile, active smart textile. Fabrication Techniques Conductive Fibres, Treated Conductive Fibres, Conductive Fabrics, Conductive Inks. Case study- smart fabric for monitoring biological parameters - ECG.					
Unit - V	APPLICATIONS OF WEARABLE SYSTEMS AND IOT				09
Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Multi parameter monitoring, Neural recording, Gait analysis, Sports Medicine. Definition and Characteristics of IoT, design, protocols, communication. Technologies: Smart watches, glasses, clothing and fitness trackers.					
Total Periods:					45

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the need, structure, and working principles of wearable systems and sensors.	K2
CO2	Identify signal processing challenges and suitable energy harvesting techniques for wearable systems.	K3
CO3	Analyze wireless health systems and BAN architectures with communication protocols.	K4
CO4	Examine fabrication methods of smart textiles and their biomedical applications.	K4



COs	Statements	K-Level
CO5	Apply wearable and IoT technologies to healthcare and sports monitoring application	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	3	2	-	-	-	-	-	-	-	-	1	-	1
CO2	3	3	2	2	-	-	-	-	-	-	-	1	-	1
CO3	3	3	2	2	-	-	-	-	-	-	-	1	-	1
CO4	3	3	2	2	1	-	-	-	-	-	-	1	-	1
CO5	3	3	3	2	3	-	-	-	-	-	-	1	-	1
CO	3	3	2	2	2	-	-	-	-	-	-	1	-	1

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Annalisa Bonfiglio and Danilo De Rossi, Wearable Monitoring Systems, Springer, 2011
2	.Zhang and Yuan-Ting, Wearable Medical Sensors and Systems, Springer, 2013
3	Edward Sazonov and Michael R Neuman, Wearable Sensors: Fundamentals, Implementation and Applications, Elsevier, 2014
4	Mehmet R. Yuce and JamilY.Khan, Wireless Body Area Networks Technology, Implementation applications,Pan Stanford Publishing Pte.Ltd, Singapore, 2012

Reference Books

1	Sandeep K.S, Gupta, Tridib Mukherjee and Krishna Kumar Venkatasubramanian, Body Area Networks Safety, Security, and Sustainability, Cambridge University Press, 2013.
2	Guang-Zhong Yang, Body Sensor Networks, Springer, 2006.



U24EC5D06	BRAIN COMPUTER INTERFACE AND APPLICATIONS	L	T	P	C
		3	0	0	3
Course Objectives:	To understand the fundamental concepts of brain-computer interfaces (BCI) and their significance in modern application and also students can learn about various signal acquisition techniques used to capture brain activity. In addition, the course will cover different signal processing methods employed in BCI systems to interpret and analyze neural signals effectively.				
Unit - I	INTRODUCTION TO BCI				9
Fundamentals of BCI – Structure of BCI system – Classification of BCI – Invasive, Non-invasive and Partially invasive BCI – EEG signal acquisition - Signal Preprocessing – Artifacts removal.					
Unit - II	ELECTROPHYSIOLOGICAL SOURCES				9
Sensorimotor activity – Mu rhythm, Movement Related Potentials – Slow Cortical Potentials-P300 - Visual Evoked Potential - Activity of Neural Cells - Multiple Neuro mechanisms.					
Unit - III	FEATURE EXTRACTION METHODS				9
Time/Space Methods – Fourier Transform, PSD – Wavelets – Parametric Methods – AR, MA, ARMA models – PCA – Linear and Non-Linear Features.					
Unit – IV	FEATURE TRANSLATION METHODS				9
Linear Discriminant Analysis – Support Vector Machines - Regression – Vector Quantization– Gaussian Mixture Modeling – Hidden Markov Modeling – Neural Networks.					
Unit - V	APPLICATIONS OF BCI				9
Functional restoration using Neuroprosthesis - Functional Electrical Stimulation, Visual Feedback and control – External device control, Case study: Brain actuated control of mobile Robot.					
Total Periods:					45

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
C01	Explain the fundamental concepts, classification, and signal acquisition techniques of brain-computer interface systems.	K2
C02	Describe electrophysiological signals and interpret neural activities associated with brain responses.	K2
C03	Apply feature extraction techniques such as time-frequency and parametric methods to analyze brain signals.	K3
C04	Analyze and compare machine learning and statistical methods for feature translation and classification of BCI signals.	K4
C05	Implement BCI techniques for applications in neuroprosthetics and external device control.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes												PSO		
	01	02	03	04	05	06	07	08	09	10	11	12	01	02	03
C01	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
C02	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-
C03	3	3	2	1	-	-	-	-	-	-	-	-	-	-	-
C04	3	3	2	2	-	-	-	-	-	-	-	-	2	2	-
C05	3	2	2	1	-	-	-	-	-	-	-	-	-	-	-
Avg	3	3	2	1	-	-	-	-	-	-	-	-	2	2	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Bernhard Graimann, Brendan Allison, Gert Pfurtscheller, "Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction", Springer, 2010.
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Reference Books

1	Edward Sazonov & Michael R. Neuman – Wearable Sensors: Fundamentals, Implementation and Applications
2	Jonathan Wolpaw – Brain-Computer Interfaces: Principles and Practice
3	Rajesh P. N. Rao – Brain-Computer Interfacing: An Introduction



U24EC5E01		IOT PROCESSORS		L	T	P	C
				2	0	2	3
Course Objectives:		The course introduces processor architectures and computing platforms used in IoT systems, covering their role in system design, low-power processing, instruction set architecture, peripherals, interfacing, real-time processing, security features, and connectivity support in modern IoT processor applications.					
Unit - I	IOT PROCESSOR FUNDAMENTALS AND ARCHITECTURES						9 + 3
	Evolution of IoT processors, role of processors in IoT architecture, IoT workload characteristics, sensing–communication–control processing needs, GPP–MCU–SoC comparison, processor selection metrics, IoT processor families, edge and cloud-assisted IoT architectures. Practical Exercises: 1. Study and comparison of IoT processor architectures 2. Development environment setup for IoT processors						
Unit - II	INSTRUCTION SET ARCHITECTURE AND LOW-POWER DESIGN						9 + 3
	Processor architecture overview, RISC vs CISC for IoT, ISA fundamentals, ARM Cortex-M architecture, low-power pipeline concepts, register organization and addressing modes, clocking methods and DVFS, sleep modes and power states, energy-efficient processor design for battery-powered IoT nodes Practical Exercises: 1. Instruction execution and register-level programming 2. Low-power mode implementation in IoT processors						
Unit - III	PROCESSOR INTERFACING AND PERIPHERAL SUBSYSTEMS						9 + 3
	On-chip peripheral architecture, GPIO, timers, counters, and watchdog units, Analog interfaces: ADC, DAC, and sensor front-end integration, Serial Communication interfaces, Memory subsystems, Interrupt handling and exception mechanisms, Processor interfacing for real-time sensor data acquisition and actuator control Practical Exercises: 1. Interfacing analog sensors using ADC 2. Communication peripheral interfacing						
Unit – IV	REAL-TIME PROCESSING, SECURITY, AND CONNECTIVITY SUPPORT						9 + 3
	Real-time processing in IoT, deterministic execution and latency constraints, interrupt priority and scheduling support, RTOS hardware support, IoT processor security threats, hardware security primitives, secure boot and trusted execution, cryptographic accelerators, wireless stack support, wireless connectivity technologies. Practical Exercises: 1. Interrupt handling and real-time task execution 2. Secure data transmission using IoT processors						
Unit - V	CONTEMPORARY IoT PROCESSOR PLATFORMS AND APPLICATIONS						9 + 3
	Commercial IoT processor platforms overview, ESP32 / ARM Cortex-M / RISC-V processors, edge intelligence support, AI/ML accelerator integration, IoT processor applications (smart home, industrial, healthcare, smart city), IoT processor design challenges, future trends in IoT processors. Practical Exercises: 1. Wireless connectivity using IoT processors 2. Mini IoT application using IoT processor platform						
Total Periods:						45 + 15	



Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the architecture, functional role, and performance characteristics of processors used in IoT systems, including microcontrollers and SoC-based platforms.	K2
CO2	Describe instruction set architectures, pipeline concepts, and low-power design techniques used in IoT processors.	K2
CO3	Apply processor interfacing techniques to configure peripherals, sensors, memory, and communication modules in IoT systems.	K3
CO4	Analyze real-time processing requirements, hardware security features, and wireless connectivity support in IoT processors	K4
CO5	Evaluate contemporary IoT processor platforms based on performance, power, scalability, and application requirements.	K5

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	POs											PSOs		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	-	-	2	-	-	-	-	-	1	3	1	2
CO2	3	3	2	1	3	-	-	-	-	-	2	3	1	3
CO3	3	2	3	2	3	-	-	-	2	-	1	3	2	3
CO4	3	3	2	3	3	2	-	1	-	-	2	3	1	3
CO5	2	3	3	2	3	2	1	1	-	-	2	2	1	3
CO	2.80	2.0	2.00	1.60	2.80	1.20	0.20	0.40	0.40	0	1.60	2.80	1.20	2.80

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Timothy Chou, "IoT Inc: How Your Company Can Use the Internet of Things to Win in the Outcome Economy", McGraw-Hill Education, 2nd Edition, 2024. (Provides strategic and architectural context for IoT systems aligned with industry use cases.)
2	Peter Waher, "Learning Internet of Things", Packt Publishing, 2nd Edition, 2021. (Covers IoT ecosystem, protocols, edge computing — good for practical design perspective.)
3	Rajkumar Buyya, "Mastering Internet of Things: Design and Performance", Elsevier, 2020. (Strong focus on design, performance and scalability — useful for processor and systems courses.)
4	Marco Schwartz (Ed.), "IoT Development Handbook: Practical Methods for Building Industrial IoT Solutions", O'Reilly Media, 2022. (Industry-oriented, up-to-date design patterns and best practices.)
5	Arshdeep Bahga, Vijay Madisetti, "Internet of Things: A Hands-on Approach", Universities Press (India) Pvt. Ltd., 2015.
6	James K. Peckol, "Embedded Systems: A Contemporary Design Tool", John Wiley & Sons, 2008.
7	Joseph Yiu, "The Definitive Guide to ARM® Cortex®-M3 and Cortex®-M4 Processors", Newnes, 3rd Edition, 2014.



Reference Books

1	Andrew N. Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide: Designing and Optimizing System Software", Morgan Kaufmann Publishers, 2004.
2	Rajkumar Buyya, Amir Vahid Dastjerdi, "Internet of Things: Architecture and Design Principles", John Wiley & Sons, 2016.
3	Jonathan W. Valvano, Ramesh Yerraballi, "Embedded Systems: Introduction to Arm® Cortex-M Microcontrollers", Cengage Learning, 2019.
4	Perry Xiao, "Designing Embedded Systems and the Internet of Things (IoT) with the ARM® mbed™", Newnes, 2018.



U24EC5E02		MEMS AND NEMS			L	T	P	C
					2	0	2	3
Course Objectives:		Understand the principles, fabrication, sensors, actuators, and applications of MEMS and NEMS with awareness of modern trends and technologies.						
Unit - I	INTRODUCTION TO MEMS AND NEMS						9 + 3	
Overview of Micro Electro Mechanical Systems (MEMS) and Nano Electro Mechanical Systems (NEMS), devices and technologies, laws of scaling, survey of materials, smart sensors, and applications of MEMS and NEMS.								
Practical Exercises:								
1. Study of basic MEMS and NEMS devices using datasheets and models.								
2. Analysis of scaling laws in MEMS and NEMS systems.								
Unit - II	MICRO-MACHINING AND MICROFABRICATION TECHNIQUES						9 + 3	
Photolithography, film deposition, etching processes, wafer bonding, bulk micromachining, silicon surface micromachining, and LIGA process.								
Practical Exercises:								
1. Study of photolithography process steps in MEMS fabrication.								
2. Study of thin film deposition and etching techniques.								
Unit - III	MICRO SENSORS AND MICRO ACTUATORS						9 + 3	
Transduction mechanisms in different energy domains, micromachined capacitive, piezoelectric, piezoresistive, electromechanical, and thermal sensors and actuators with applications.								
Practical Exercises:								
1. Characterization of a MEMS sensor (pressure / accelerometer / temperature).								
2. Study of working principles of MEMS actuators (electrostatic / piezoelectric / thermal).								
Unit – IV	NEMS TECHNOLOGY						9 + 3	
Atomic-scale precision engineering, nano-fabrication techniques, and applications of NEMS in measurement, sensing, actuation, and system design.								
Practical Exercises:								
1. Study of nano-fabrication techniques used in NEMS.								
2. Simulation of a basic NEMS device.								
Unit - V	MEMS AND NEMS APPLICATIONS						9 + 3	
Introduction to micro and nano fluids and applications, Bio-MEMS, optical NEMS, micro and nano motors, and recent trends in MEMS and NEMS.								
Practical Exercises:								
1. Study of microfluidic systems and their applications.								
2. Case study on real-time applications of MEMS and NEMS.								
Total Periods:							45 +15	

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the fundamentals, material properties, scaling laws, and applications of MEMS and NEMS.	K2
CO2	Analyze micro and nano fabrication techniques used in MEMS and NEMS devices.	K4
CO3	Demonstrate the working principles and characteristics of MEMS sensors and actuators.	K3
CO4	Apply MEMS and NEMS concepts to modeling, simulation, and analysis of sensors and actuators.	K3
CO5	Evaluate real-time applications, recent trends, and future scope of MEMS and NEMS for industrial and societal needs.	K5

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	–	–	2	–	–	–	–	–	–	2	1	3
CO2	3	3	2	–	3	–	–	–	–	–	–	3	2	3
CO3	3	2	3	2	3	–	–	–	2	–	–	3	2	3
CO4	3	3	2	3	3	2	–	2	–	–	–	2	3	3
CO5	3	3	2	2	3	2	2	2	–	–	2	2	1	3
CO	3	3	2	2	3	2	2	2	2	–	2	2	2	3

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Chang Liu, "Foundations of MEMS", Pearson International Edition, 2006.
2	Marc F madou " Fundamentals of micro fabrication" CRC Press 2002 2nd Edition Marc Madou.
3	M.H.Bao "Micromechanical transducers :Pressure sensors, accelerometers and gyroscopes",Elsevier, Newyork, 2000.
4	Maluf, Nadim "An introduction to Micro Electro-mechanical Systems Engineering "AR Tech house, Boston 2000.

Reference Books

1	Mohamed Gad – el – Hak "MEMS Handbook" Edited CRC Press 2002 2. Sabriesolomon "Sensors Handbook", Mc Graw Hill 1998.
2	Tai-Ran Hsu, "MEMS and Microsystems: design , manufacture, and Nanoscale"- 2nd Edition,John Wiley & Sons, Inc., Hoboken, New Jersey, 2008
3	Lyshevski, S.E. " Nano- and Micro-Electromechanical Systems: Fundamentals of Nano-and Microengineering " (2nd ed.). CRC Press,2005.



U24EC5E03		IOT BASED SYSTEM DESIGN			L	T	P	C
					3	0	0	3
Course Objectives:		The course provides an understanding of the fundamental concepts, architecture, and enabling technologies of Internet of Things (IoT) systems, including ecosystem components, middleware, and communication protocols. It covers networking models, access technologies, protocol stacks, and IoT tools, while highlighting application domains and case studies to show the impact of IoT in industrial, societal, and emerging technological environments.						
Unit - I	INTRODUCTION TO INTERNET OF THINGS						09	
Definition and evolution of IoT - Characteristics and enabling technologies - IoT architectures; Edge, Fog, Cloud - Ecosystem components, deployment levels, applications								
Unit - II	MIDDLEWARE AND PROTOCOLS OF IoT						09	
IoT middleware concepts and functions - Horizontal architecture and SOA middleware - Middleware architectures for RFID, WSN, SCADA, M2M - Interoperability, industrial protocols, 5G middleware								
Unit - III	COMMUNICATION AND NETWORKING						09	
IoT access technologies and IEEE/LPWAN features - IP addressing, constrained networks, routing - Transport and application-layer models - CoAP, MQTT, SCADA, data aggregation								
Unit – IV	IOT IMPLEMENTATION TOOLS						09	
IoT tools and Python programming - Embedded platforms and interfacing - Implementation of IoT concepts - Raspberry Pi–based IoT applications								
Unit - V	APPLICATIONS AND CASE STUDIES						09	
Domestic, industrial, societal applications - Smart home, smart city, environment - Agriculture, industry, healthcare Case studies								
Total Periods:							45	

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the fundamental concepts, characteristics, enabling technologies, and architectural models of Internet of Things (IoT) systems	K2
CO2	Describe and interpret IoT middleware architectures, interoperability concepts, and industrial communication protocols used in IoT ecosystems	K2
CO3	Apply IoT networking models, access technologies, IP addressing mechanisms, and application-layer protocols such as MQTT and CoAP	K3
CO4	Implement IoT tools, embedded platforms, and programming concepts to develop basic IoT system models and interface sensors with processing units.	K3
CO5	Analyze IoT application domains and case studies to determine their relevance in industrial, societal, and smart system contexts.	K4

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	POs											PSOs		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	-	-	2	-	-	-	-	-	1	2	-	2
CO2	3	2	2	-	2	-	-	-	-	-	1	2	-	2
CO3	3	2	-	1	2	-	-	-	-	-	1	2	1	2
CO4	2	2	3	2	3	-	-	1	-	-	1	3	-	3
CO5	2	2	2	-	2	1	-	-	1	-	2	2	-	3
CO	2.60	2.00	1.40	0.60	2.20	0.20	0.00	0.20	0.20	0	1.20	2.20	0.20	2.40

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)



Text Books

1	Anuradha Tripathy, "Internet of Things (IoT): Technologies, Applications, Challenges and Solutions", Routledge, 2022
2	Vivek Batra, Reema Goyal, "IoT Fundamentals with a Practical Approach"
3	Gunneswara Rao VSSS Kalaga, "Design of Internet of Things: Architecture, Applications and Platforms

Reference Books

1	Springer Handbook of Internet of Things, Edited by various experts, Springer, 2024.
2	CRC Press, "Internet of Things in Modern Computing: Theory and Applications", 2023.
3	Internet of Things Security and Privacy: Practical and Management Perspectives", CRC Press, 2023
4	Anil Kumar, "Connecting the Internet of Things: IoT Connectivity Standards and Solutions", Apress, 2023.
5	Rodrigo J. Hernandez, "Practical IoT Handbook: Programming IoT with Arduino, Python, and Raspberry Pi", 2025 edition



U24EC5E04		DRONE SERVICE TECHNOLOGY			L	T	P	C
					2	0	2	3
Course Objectives:		Understand drone fundamentals, design, programming, operation, and service applications while ensuring safety, regulatory compliance, and awareness of future trends.						
Unit - I	INTRODUCTION TO DRONE SERVICE TECHNOLOGY						6 + 6	
Drone concepts and terminology – Evolution and history of drones – Classification of drones based on propulsion and structure – Components overview – Role of drones in modern technology – Impact of drone services on business and industry – Drone services and entrepreneurship – Career opportunities and employability in drone technology.								
Practical Exercises:								
1. Study of Drone Terminology and Components.								
2. Simulation of Basic Drone System Block Diagram								
Unit - II	DRONE DESIGN, FABRICATION AND PROGRAMMING						6 + 6	
Classification of UAVs – Main components of drones and their technical characteristics – Functional analysis of drone subsystems – Drone configurations – Energy sources and power management – Levels of autonomy – Drone assembly procedures – Introduction to drone programming – Firmware concepts – Downloading and installing drone software – Running and testing programs – Multi-rotor stabilization – Flight modes – Wi-Fi and communication interfaces.								
Practical Exercises:								
1. Simulation of Drone Control Logic.								
2. Simulation of Drone Power Management Using Python.								
Unit - III	DRONE FLYING AND OPERATION						6 + 6	
Concept of drone operation – Pre-flight checks and calibration – Flight modes and control mechanisms – Manual and assisted flight – Operating drones in controlled environments – Drone control systems – Flight operation management tools – Sensors and onboard electronics – Data acquisition – Onboard and removable storage devices – Mobile devices and drone control applications.								
Practical Exercises:								
1. Simulation of Basic Drone Operation.								
2. Simulation of Flight Operation Management Tools.								
Unit – IV	DRONE SERVICE AND COMMERCIAL APPLICATIONS						6 + 6	
Selection of drones for service-based applications – Drones in agriculture and crop monitoring – Drones in logistics mail and parcel delivery – Drones in insurance and damage assessment – Drones for inspection of transmission lines and power distribution systems – Drones in surveillance, filming, and panoramic imaging – Service models and operational challenges.								
Practical Exercises:								
1. Simulation of Drone Selection for Service-Based Applications.								
2. Simulation of Drone Service Models.								
Unit - V	FUTURE DRONES, SAFETY AND REGULATIONS						6 + 6	
Safety risks in drone operations – Risk mitigation strategies – Guidelines for safe drone flying – National and international aviation regulations – Drone registration and licensing – Ethical and privacy concerns – Miniaturization of drones – Increasing autonomy and AI integration – Swarm drone technology – Future trends in drone services.								
Practical Exercises:								
1. Study of Safety Risks and Ethical Issues in Drone Operations								
2. Simulation of Drone Registration and Licensing Process								
Total Periods:								60

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain basic drone concepts, classifications, evolution, and societal impact.	K2
CO2	Analyze drone components, subsystems, power sources, and firmware using simulation.	K4



COs	Statements	K-Level
CO3	Demonstrate drone operation, flight modes, controls, sensors, and flight management through simulation.	K3
CO4	Evaluate drones for service and commercial applications and related operational challenges.	K5
CO5	Identify safety, regulations, ethics, and future trends, and apply safe drone practices.	K4

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	–	–	2	–	–	–	–	–	–	2	1	3
CO2	3	3	2	–	3	–	–	–	–	–	–	3	2	3
CO3	3	2	3	2	3	–	–	–	2	–	–	3	2	3
CO4	3	3	2	3	3	2	–	2	–	–	–	2	3	3
CO5	3	3	2	2	3	2	2	2	–	–	2	2	1	3
CO	3	3	2	2	3	2	2	2	2	–	2	2	2	3

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Daniel Tal and John Altschuld, "Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation", 2021 John Wiley & Sons, Inc
2	Terry Kilby and Belinda Kilby, "Make: Getting Started with Drones", Maker Media, Inc,
3	John Baichtal, "Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs", Que Publishing, 2016
4	Zavrsnik, "Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance", Springer, 2018.
5	Joseph Yiu, "The Definitive Guide to ARM® Cortex®-M3 and Cortex®-M4 Processors", Newnes, 3rd Edition, 2014.

Reference Books

1	Nitesh Tiwari, Shekhar Yadav, V. K. Giri, Fundamentals of Drone/UAV Technology, SK Kataria & Sons.
2	I. V. S. Yeswanth and A. V. S. Sridhar Kumar, Fundamentals of Drone Technology: Drones—The Future of the 21st Century, (Publisher varies).



U24EC5E05	FUNDAMENTALS OF NANO ELECTRONICS	L	T	P	C
		2	0	2	3
Course Objectives:	To understand the concepts of nano electronics and quantum and nano electronic devices, transistors, tunneling devices and basics of nanotube devices				
Unit – I	INTRODUCTION TO NANO ELECTRONICS				6+6
Scaling to nano - Light as a wave and particle- Electrons as waves and particles- origin of quantum mechanics - General postulates of quantum mechanics - Time independent Schrodinger wave equation- Electron confinement - Quantum dots, wires and well-Spin and angular momentum PRACTICAL EXERCISES 1 .Design a N-Channel JFET and analyze its characteristics. 2. Design a N-MOSFET Enhancement Mode and analyze its performance.					
Unit – II	QUANTUM ELECTRONICS				6+6
Quantum electronic devices - Short channel MOS transistor - Split gate transistor - Electron wave transistor - Electron spin transistor - Quantum cellular automata Quantum dot array, Quantum memory. PRACTICAL EXERCISES 1 .Implementation of Single Electron Transistor (SET) as a Coulomb Blockade Switch 2. Design a P-MOSFET Enhancement Mode and analyse its performance.					
Unit - III	NANO ELECTRONIC TRANSISTORS				6+6
Coulomb blockade - Coulomb blockade in Nano capacitors - Coulomb blockade in tunnel junctions .Single electron transistors, Semiconductor nanowire FETs and SETs, Molecular SETs and molecular electronics - Memory cell. PRACTICAL EXERCISES 1 .Implementation of Single Electron Transistor (SET) as a Charge Sensor .2. Implementation of Single Electron Transistor (SET) as a Memory Cell					
Unit – IV	NANO ELECTRONIC TUNNELING AND SUPER CONDUCTING DEVICES				6+6
Tunnel effect -Tunneling element -Tunneling diode - Three terminal resonant tunneling devices- Superconducting switching devices- Cryotron- Josephson tunneling device. PRACTICAL EXERCISES 1.Design of Tunnel Diode as a Negative Resistance Device 2. Implementation of Tunneling Field-Effect Transistor (TFET).					
Unit – V	NANOTUBES AND NANOSTRUCTURE DEVICES				6+6
Carbon Nanotube , Fullerenes -,Types of nanotubes , Formation of nanotubes ,Assemblies ,Purification of carbon nanotubes – Electronic properties – Synthesis of carbon nanotubes – Carbon nanotube- Resonant tunnelling diode interconnects – Carbon nanotube FETs and SETs –Nanotube for memory applications-Nano structures and nano structured devices. PRACTICAL EXERCISES 1 .Design of Resonant Tunneling Diode (RTD) 2 .Design of Carbon Nanotube for FET and SET.					
Total Periods					30 +30



Course Outcomes

On completion of the course, the student can

Cos	Statements	K-Level
CO1	Infer the basics of electronics and nano electronics including quantum wires, dots and wells	K2
CO2	Outline the mechanism behind quantum and Nano electronic devices	K2
CO3	Relate the performance aspects of tunneling and superconducting nano electronic devices	K2
CO4	Construct the different types of transistors and evaluate the performances	K3
CO5	Model the different types of tunneling devices	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes												PSO		
	01	02	03	04	05	06	07	08	09	10	11	12	01	02	03
CO1	2	2	2	2	2	1	-	-	-	-	-	-	2	1	1
CO2	2	3	3	2	2	2	-	-	-	-	-	-	2	1	1
CO3	2	2	3	2	2	2	-	-	-	-	-	-	3	1	1
CO4	3	2	2	2	2	2	-	-	-	-	-	-	3	1	1
CO5	3	2	3	3	3	3	-	-	-	-	-	-	3	1	1
CO	3	2	3	2	2	2	-	-	-	-	-	-	3	1	1

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Hanson, Fundamentals of Nanoelectronics, Pearson education, 2009.
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Reference Books

1	Jan Dienstuhl, Karl Goser, and Peter Glösekötter, Nanoelectronics and Nanosystems: From Transistors to Molecular and Quantum Devices, Springer-Verlag, 2004
2	Mircea Dragoman and Daniela Dragoman, Nanoelectronics: Principles and Devices, Artech House, 2009.
3	Robert Puers, Livio Baldi, Marcel Van de Voorde and Sebastiaan E. Van Nooten, Nanoelectronics: Materials, Devices, Applications, Wiley, 2017.
4	Brajesh Kumar Kaushik, Nanoelectronics: Devices, Circuits and Systems, Elsevier science,



U24EC5E06	WIRELESS SENSOR NETWORK DESIGN	L	T	P	C
		3	0	0	3
Course Objectives:	To provide an understanding of wireless sensor network architecture, communication protocols, data processing techniques, and design considerations for real-time and large-scale sensing applications.				
Unit - I	INTRODUCTION TO WIRELESS SENSOR NETWORKS	09			
Overview of WSN – Sensor node architecture – Components of sensor nodes – Types of sensors – WSN architecture – Applications (environmental monitoring, healthcare, industrial automation) – Design challenges and constraints.					
Unit - II	COMMUNICATION PROTOCOLS	09			
WSN protocol stack – Physical and MAC layer issues – MAC protocols (TDMA, CSMA) – Routing protocols (data-centric, hierarchical, location-based) – Energy-efficient communication techniques.					
Unit - III	ENERGY MANAGEMENT AND DATA HANDLING	09			
Energy consumption in sensor nodes – Power management techniques – Duty cycling – Data aggregation – Data compression – Storage and processing in WSN – Network lifetime optimization.					
Unit – IV	WSN DESIGN AND DEPLOYMENT	09			
Design considerations – Node deployment strategies – Coverage and connectivity – Localization techniques – Synchronization – Fault tolerance – Scalability issues.					
Unit - V	ADVANCED WSN AND IoT APPLICATIONS	09			
Integration of WSN with IoT – Smart city applications – Industrial IoT – Smart agriculture and healthcare – Introduction to machine learning in WSN – Future trends.					
Total Periods:					45

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Interpret the fundamental concepts and architecture of wireless sensor networks.	K2
CO2	Summarize communication protocols and energy-efficient mechanisms in WSN.	K2
CO3	Apply data handling and energy management techniques in sensor networks.	K3
CO4	Illustrate design and deployment strategies for wireless sensor networks.	K2
CO5	Classify advanced WSN applications and IoT-based systems.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO– PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	-	-	-	-	-	-	-	-	-	1	2	1
CO2	3	2	-	-	-	-	-	-	-	-	-	-	3	1
CO3	3	2	2	-	-	1	-	-	-	-	1	-	3	2
CO4	3	2	-	-	-	-	-	-	-	-	-	-	3	2
CO5	2	3	-	-	-	-	-	-	-	-	1	-	2	3
CO	2.8	2.2	2	-	-	1	-	-	-	-	1	1	2.6	1.8

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Wireless Sensor Networks: Technology, Protocols and Applications, Wiley, 2007.
2	Wireless Sensor Networks, Wiley, 2010.
3	Protocols and Architectures for Wireless Sensor Networks, Wiley, 2005.
4	Wireless Sensor Networks: An Information Processing Approach, Elsevier, 2004.

Reference Books

1	Wireless Sensor Networks, Pearson Education, 2008.
2	Wireless Communications, Cambridge University Press, 2005.

Web-links

1. <https://www.tutorialspoint.com/wimax/>
2. <https://telecomgrid.com/tutorial/wimax-ieee-802-16-tutorial/>
3. <https://app.sophia.org/tutorials/broadband-wireless-technologies>



U24EC5F01	SOFTWARE DEFINED RADIO	L	T	P	C
		3	0	0	3
Course Objectives:	To provide students with a comprehensive understanding of Software Defined Radio concepts, architectures, signal processing techniques, and implementation platforms for modern and future wireless communication systems.				
Unit - I	INTRODUCTION TO SDR	09			
Definition of SDR - Evolution of SDR - Conventional Radio vs SDR - SDR Architecture - Benefits and Limitations -Applications of SDR					
Unit - II	SDR FRONT-END & RF IMPLEMENTATION ISSUES	09			
RF Front-end in SDR - Receiver and Transmitter front-end requirements - Direct conversion and low-IF architectures -RF chain flexibility and reconfigurability - ADC/DAC requirements for SDR - RF impairments (noise, distortion, non-linearity) - Calibration and correction techniques					
Unit - III	DIGITAL SIGNAL PROCESSING IN SDR	09			
Sampling Theory - I/Q Modulation and Demodulation - Digital Down Conversion (DDC) - Digital Up Conversion (DUC) - Multirate Signal Processing (Decimation & Interpolation) - Synchronization (Carrier & Timing)					
Unit – IV	SDR SOFTWARE & PLATFORMS	09			
GNU Radio Overview - SDR Hardware Platforms (USRP, RTL-SDR, ADALM-Pluto) - SDR Flowgraph and Signal Blocks - Real-Time Processing Issues - SDR Implementation Examples (FM/AM/PSK)					
Unit - V	ADVANCED SDR CONCEPTS	09			
Cognitive Radio - Spectrum Sensing - Dynamic Spectrum Access - SDR in 5G / 6G - AI/ML Applications in SDR - SDR Security and Future Trends					
Total Periods:					45

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Interpret the fundamentals, architecture, and applications of Software Defined Radio systems.	K2
CO2	Interpret SDR front-end architectures, RF implementation issues, and ADC/DAC requirements.	K2
CO3	Implement digital signal processing techniques for modulation, demodulation, and baseband processing in SDR systems.	K3
CO4	Develop basic communication systems using SDR software tools and hardware platforms.	K3
CO5	Analyze advanced SDR concepts such as cognitive radio, spectrum sensing, and future wireless communication trends.	K4

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO– PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	-	-	-	-	-	-	-	-	1	-	2	1
CO2	3	2	-	-	-	-	-	-	-	-	-	-	3	1
CO3	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO4	3	2	3	-	-	-	-	-	-	-	-	-	3	2
CO5	2	3	2	2	-	2	-	-	-	-	3	-	2	3
CO	2.8	2.2	2.3	2	-	2	-	-	-	-	2	-	2.6	1.8

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Eugene Grayver, Implementing Software Defined Radio, Second Edition, Springer, 2020. (Units I , IV, V)
2	Walter H. W. Tuttlebee (Ed.), Software Defined Radio: Enabling Technologies, Wiley, 2021. (Units I, II and III)
3	Katsuyuki Haneda, 5G and Beyond Wireless Systems, Elsevier, 2022. (Units IV and V)

Reference Books

1	Travis F. Collins, Robin Getz, Di Pu and Alexander M. Wyglinski, Software-Defined Radio for Engineers, Artech House, 2022.
2	Robert W. Stewart, Kenneth W. Barlee, Dale S. W. Atkinson and Louise H. Crockett, Software Defined Radio using MATLAB and Simulink, IET, 2021.

Web-links

4. <https://www.gnuradio.org/>
5. <https://www.analog.com/pluto>
6. <https://www.mathworks.com/discovery/software-defined-radio.html>



U24EC5F02	WIRELESS BROADBAND NETWORKS	L	T	P	C
		3	0	0	3
Course Objectives:	To familiarize students with the fundamentals, architectures, and applications of wireless broadband networks with emphasis on modern cellular and broadband technologies.				
Unit - I	INTRODUCTION TO WIRELESS BROADBAND NETWORKS	09			
Basics of broadband communication – Wired and wireless broadband – Evolution of wireless networks from 1G to 5G – Wireless broadband applications – Components of wireless broadband networks – User equipment, base station, core network – Layered architecture of wireless networks – Overview of Mobile IP and mobility management – Concept of seamless connectivity.					
Unit - II	3G AND BROADBAND WIRELESS ACCESS TECHNOLOGIES	09			
Need for third generation systems – Overview of IMT-2000 – UMTS architecture and basic operation – UTRAN components – Packet data services in 3G – Introduction to broadband wireless access – WiMAX overview – IEEE 802.16 architecture – Applications of broadband wireless access networks.					
Unit - III	4G LTE BROADBAND NETWORKS	09			
Motivation for LTE – LTE system architecture – E-UTRAN and EPC – LTE protocol stack – LTE radio frame structure – Logical, transport and physical channels – Resource allocation and scheduling – Advantages of LTE over 3G systems.					
Unit – IV	WIRELESS BROADBAND TRANSMISSION TECHNIQUES	09			
Wireless channel characteristics – Path loss, shadowing and fading (qualitative) – Introduction to OFDM – MIMO concept and advantages – Beamforming basics – Quality of Service in wireless broadband networks – Security issues and challenges in wireless broadband communication.					
Unit - V	5G AND FUTURE WIRELESS BROADBAND NETWORKS	09			
Introduction to 5G wireless systems – 5G architecture and key features – 5G service categories: eMBB, URLLC and mMTC – Role of IoT in wireless broadband networks – Smart applications of broadband wireless communication – Introduction to future wireless networks and 6G vision.					
Total Periods:					45

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Outline the fundamentals and evolution of wireless broadband networks.	K2
CO2	Interpret the architectures and operation of 3G broadband wireless systems.	K2
CO3	Summarize the architecture and key features of LTE broadband networks.	K2
CO4	Infer basic wireless broadband transmission techniques and associated challenges.	K2
CO5	Illustrate emerging trends in 5G and future wireless broadband networks.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO– PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	1
CO2	3	2	-	-	-	-	-	-	-	-	-	-	3	1
CO3	3	2	-	-	-	-	-	-	-	-	-	-	3	2
CO4	3	2	-	-	-	-	-	-	-	-	-	-	3	2
CO5	2	3	-	-	-	-	-	-	-	-	1	-	2	3
CO	2.8	2.2	-	-	-	-	-	-	-	-	1	-	2.6	1.8

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Kaveh Pahlavan and Allen H. Levesque, Wireless Broadband Networks, Wiley, 2005.
2	Jochen Schiller, Mobile Communications, Pearson Education, 2nd Edition, 2003.
3	Mustafa Ergen, Mobile Broadband: Including WiMAX and LTE, Springer, 2009.
4	Saad Asif, 5G Mobile Communications: Concepts and Technologies, CRC Press, 2019.

Reference Books

1	Theodore S. Rappaport, Wireless Communications – Principles and Practice, Pearson Education, 2nd Edition, 2002.
2	S. Sesia, I. Toufik and M. Baker, LTE – The UMTS Long Term Evolution, Wiley, 2011.

Web-links

7. <https://www.tutorialspoint.com/wimax/>
8. <https://telecomgrid.com/tutorial/wimax-ieee-802-16-tutorial/>
9. <https://app.sophia.org/tutorials/broadband-wireless-technologies>



U24EC5F03	4G/5G COMMUNICATION NETWORKS	L	T	P	C
		2	0	2	3
Course Objectives:	To provide a comprehensive understanding of 4G and 5G communication networks, including their architecture, standards, key technologies and evolution, enabling students to analyze network performance, mobility management and resource allocation, and to explore emerging trends and applications in modern wireless broadband systems.				
Unit - I	EVOLUTION OF WIRELESS NETWORKS	06 + 06			
Mobile communication generations: 1G to 5G - Transition from circuit switching to packet switching - 4G LTE architecture and functional blocks - 5G NR architecture and functional blocks - Key performance improvements: speed, latency, reliability, capacity. Practical Exercises: 1. Simulation of LTE architecture 2. Simulation of 5G NR architecture					
Unit - II	4G LTE PHYSICAL LAYER	06 + 06			
OFDM basics, subcarrier spacing, and cyclic prefix - LTE frame structure, subframe and slot concepts - Resource blocks and scheduling - Modulation schemes: QPSK, 16QAM, 64QAM - Basics of MIMO and beamforming. Practical Exercises: 1. OFDM signal generation and spectrum plot 2. LTE frame generation and resource block mapping					
Unit - III	LTE RADIO ACCESS NETWORK	06 +06			
LTE air interface and channels - Handover types and procedures - LTE QoS, scheduling, and traffic handling - Security basics in LTE - LTE-Advanced enhancements: carrier aggregation. Practical Exercises: 1. Handover simulation based on signal strength.					
Unit – IV	5G NEW RADIO (NR) PHYSICAL LAYER	06 +06			
NR numerology and flexible frame structure - 5G OFDM and SC-FDMA - Massive MIMO and beamforming principles 5G modulation: QPSK, 16QAM, 64QAM, 256QAM - Link adaptation and scheduling basics. Practical Exercises: 1. Beamforming pattern simulation					
Unit - V	5G NETWORKS, STANDARDS & APPLICATIONS	06 +06			
5G deployment strategies: NSA and SA - Network slicing and virtualization concepts - 5G use cases: eMBB, mMTC, URLLC - Security challenges in 5G. Practical Exercises: 1. Simulation of 5G use case scenarios (eMBB / URLLC)					
Total Periods:					60

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Demonstrate the evolution of mobile networks and illustrate LTE and 5G NR architectures through comparison.	K3



COs	Statements	K-Level
CO2	Construct OFDM and LTE physical layer models to analyze frame structure, resource allocation, and modulation schemes.	K3
CO3	Implement LTE radio access functions including handoff, QoS, scheduling, and security in simulated scenarios.	K3
CO4	Apply 5G NR physical layer principles such as numerology, MIMO, beamforming, and modulation techniques for link performance.	K3
CO5	Analyze network slicing, virtualization, QoS, and security concepts for 5G network deployment and future trends.	K4

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO– PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	1	1	-	2	-	-	-	1	-	-	-	3	1
CO2	3	1	1	-	2	-	-	-	1	-	-	-	3	1
CO3	3	1	2	-	3	-	-	-	1	-	-	-	3	1
CO4	3	2	1	-	2	-	-	-	1	-	-	-	3	1
CO5	3	1	3	2	3	-	-	-	1	-	-	-	2	1
CO	3	1.2	1.6	2	2.4	-	-	-	1	-	-	-	2.8	1

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Rommer, S. et al., <i>5G Core Networks: Powering Digitalization</i> , Academic Press, 2019 .
2	Velrajan, S., <i>An Introduction to 5G Wireless Networks: Technology, Concepts and Use Cases</i> , 2020 .
3	Asif, S., <i>5G Mobile Communications: Concepts and Technologies</i> , CRC Press, 2019 .
4	Sauter, M., <i>From GSM to LTE-Advanced Pro and 5G: An Introduction to Mobile Networks and Mobile Broadband</i> , Wiley, 2021 .

Reference Books

1	Penttinen, J. T. J., <i>5G Simplified: ABCs of Advanced Mobile Communications</i> , 2019 .
2	Lei, W., Soong, A. C. K., et al., <i>5G System Design: An End to End Perspective</i> , Springer, 2021 .



Web-links

1. https://www.coursera.org/learn/5g-network-fundamentals?utm_source=chatgpt.com
2. https://www.futurelearn.com/courses/5g-and-wireless-communication-for-beginners?utm_source=chatgpt.com



U24EC5F04	SATELLITE COMMUNICATION	L	T	P	C
		3	0	0	3
Course Objectives:	To understand the fundamentals of satellite orbits, satellite and earth segments, link power budget calculations, satellite access and coding techniques, and the applications of satellite communication systems.				
Unit - I	SATELLITE ORBITS				09
Kepler's laws and Newton's law of gravitation, orbital parameters, orbital perturbations and station keeping, geostationary and non-geostationary orbits, look angle determination, limits of visibility, eclipse, sub-satellite point, sun transit outage, satellite launching and injection, launch vehicles and propulsion systems.					
Unit - II	SPACESEGMENT AND SATELLITE SUBSYSTEMS				009
Spacecraft technology, satellite bus and payload, power systems, attitude and orbit control system (AOCS), thermal control system and propulsion, telemetry, tracking and command (TT&C), transponders and antenna subsystem.					
Unit - III	SATELLITE LINK DESIGN				09
Basic link analysis, EIRP, G/T, uplink and downlink design equations, free space loss, atmospheric effects, ionospheric scintillation, rain-induced attenuation and interference, system noise temperature, link margin, link design with and without frequency reuse.					
Unit – IV	SATELLITE ACCESS AND CODING TECHNIQUES				09
Modulation and multiplexing techniques for voice, data and video transmission, analog and digital communication systems, digital video broadcasting, multiple access techniques (FDMA, TDMA, CDMA, PAMA and DAMA), data compression, encryption and channel coding schemes.					
Unit - V	SATELLITE APPLICATIONS				09
INTELSAT and global satellite communication systems, INSAT system and its services, VSAT networks and applications, mobile satellite services, LEO, MEO and GEO satellite systems, satellite navigation systems – GPS architecture and operation, position location principles and differential GPS, direct broadcast satellites (DBS/DTH), satellite communication for 5G networks, IoT applications and non-terrestrial networks (NTN).					
Total Periods:					45

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	<i>Interpret the principles of satellite orbits, orbital parameters, perturbations, and station keeping mechanisms.</i>	K2
CO2	<i>Summarize the structure and functions of the space segment and earth segment, including satellite subsystems and payloads.</i>	K2
CO3	<i>Compute satellite link parameters such as EIRP, G/T, system noise temperature, and link margin under various propagation conditions.</i>	K3
CO4	<i>Implement suitable satellite access and coding techniques for voice, data, and video transmission systems.</i>	K3



CO5	<i>Apply satellite communication systems to real-world applications including navigation, broadcasting, 5G networks, IoT, and non-terrestrial networks.</i>	K3
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Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO–PO–PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	-	-	-	-	-	-	-	-	-	1	2	-
CO2	3	2	-	-	-	-	-	-	-	-	-	1	2	-
CO3	3	2	2	-	-	-	-	-	-	1	-	-	2	2
CO4	2	2	2	-	-	-	-	-	-	1	-	-	2	2
CO5	2	2	2	-	-	1	-	-	-	1	1	-	2	3
CO	2.6	2	2	-	-	1	-	-	-	1	1	1	2	2.3

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Dennis Roddy, "Satellite Communication", 5th Edition, McGraw Hill International, 2024.
2	Timothy Pratt, Charles, W.Bostain, Jeremy E.Allnutt,"SatelliteCommunication",3rd Edition, Wiley Publications, 2021
3	Gérard Maral, Michel Bousquet and Zhili Sun, Satellite Communications Systems: Systems, Techniques and Technology, 6th Edition, Wiley, 2020.

Reference Books

1	Tri T. Ha, "Digital Satellite Communications", 2nd edition, Mc Graw Hill education, 2017.
2	Wilbur L.Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, "Satellite Communications Systems Engineering", 2nd edition, Prentice Hall/Pearson, 2013.
3	K. N. Raja Rao, Satellite Communication: Concepts and Applications, 2nd Edition, PHI Learning, 2025.
4	Marko Höyhty, Satellite Communications and Networks, Springer, 2025.
5	Bruce R. Elbert, "The Satellite Communication Applications", Hand Book, Artech House Boston London, 2003.



U24EC5F05	6G TECHNOLOGY	L	T	P	C
		2	0	2	3
Course Objectives:	To equip students with fundamental and advanced knowledge of 6G wireless communication technologies, enabling them to understand high-frequency spectrum usage, AI-enabled networking, and modern 6G architectures.				
Unit - I	EVOLUTION OF WIRELESS COMMUNICATION & 6G VISION	06 + 06			
Evolution of wireless communication from 1G to 5G - Limitations of 5G systems - Need for 6G communication: Vision, goals and performance requirements of 6G - Key differences between 5G and 6G - Emerging use cases such as holographic communication and digital twins. · Practical Exercises: 3. Simulation of data rate comparison across wireless generations.					
Unit - II	6G SPECTRUM & PHYSICAL LAYER TECHNOLOGIES	06 + 06			
Spectrum requirements for 6G communication - Millimeter wave and Terahertz communication - Channel characteristics at high frequencies - Massive MIMO and ultra-massive MIMO systems - Intelligent Reflecting Surfaces - Overview of new waveform for 6G. Practical Exercises: 3. Analysis of path loss characteristics at mmWave and Terahertz frequencies.					
Unit - III	AI-NATIVE 6G NETWORKS	06 +06			
Role of artificial intelligence in 6G networks - AI-based resource allocation and scheduling - Machine learning for channel estimation and prediction - Edge intelligence and federated learning - Self-learning and self-optimizing network concepts. Practical Exercises: 2. Simulation of resource allocation techniques using AI-based logic.					
Unit – IV	6G NETWORK ARCHITECTURE & INTEGRATION	06 +06			
6G network architecture and design principles - Cell-free communication concepts - Integration of terrestrial and non-terrestrial networks - Satellite-based communication and NTN architecture - UAV-assisted communication systems - Optical and wireless network convergence. Practical Exercises: 2. Coverage analysis of cell-based and cell-free communication systems.					
Unit - V	6G APPLICATIONS, SECURITY & CHALLENGES	06 +06			
Key 6G applications including extended reality, holographic communication, smart healthcare, and autonomous systems - Security and privacy challenges in 6G networks - Energy efficiency and sustainability issues - Open research challenges and future directions of 6G technology. Practical Exercises: 2. Latency analysis for emerging 6G applications.					
Total Periods:					60



Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Apply fundamental wireless communication parameters to simulate performance trends that motivate the vision and requirements of 6G technology.	K3
CO2	Employ Terahertz spectrum models and physical layer techniques for high-frequency communication in 6G systems.	K3
CO3	Implement artificial intelligence concepts for resource allocation, channel estimation, and network optimization in 6G systems using simulation tools.	K3
CO4	Analyze 6G network architectures by comparing cell-free communication, satellite integration, and UAV-assisted communication systems.	K4
CO5	Evaluate emerging 6G applications, security challenges, energy efficiency, and future research directions based on analytical and simulation results.	K5

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO– PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	1	1	-	2	-	-	-	1	-	2	-	3	1
CO2	3	1	1	-	2	1	-	-	1	-	2	-	3	1
CO3	3	1	2	-	3	1	-	-	1	-	2	-	3	1
CO4	3	2	1	-	2	-	-	-	1	-	2	-	3	1
CO5	3	1	3	2	3	2	-	-	1	-	2	-	2	1
CO	3	1.2	1.6	2	2.4	1.3	-	-	1	-	2	-	2.8	1

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Wei Xiang, Kan Zheng, Xuemin Shen, 6G Mobile Wireless Networks, Springer, 2022.
2	Anwer Al-Dulaimi, 6G Fundamentals: Vision and Enabling Technologies, Wiley, 2023.
3	asad, Bennis and Chen, A Vision of 6G Wireless Systems, IEEE/Wiley, 2021.



Reference Books

1	Zhang et al., Towards 6G: A New Era of Wireless Communications, Academic Press, 2022.
2	Tataria et al., 6G Wireless Systems: Vision, Requirements and Challenges, Elsevier, 2023.

Web-links

7. <https://fitech.io/en/studies/basic-course-on-wireless-communications/?utm>
8. <https://www.coursera.org/learn/wireless-communications?utm>
9. <https://www.rfwireless-world.com/Tutorials/?utm>



U24EC5F06	OPTICAL COMMUNICATION & NETWORKS	L	T	P	C
		3	0	0	3
Course Objectives:	To Study about the various optical fiber modes, configuration of optical fibers, transmission characteristics of optical fibers, optical sources, detectors and transmission techniques, optical fiber measurements and optical networks.				
Unit - I	INTRODUCTION TO OPTICAL FIBER COMMUNICATION				9
Introduction - The General Systems - Advantages of Optical Fiber Communication- Ray Theory Transmission: Total Internal Reflection, Acceptance Angle, Numerical Aperture, Skew Rays - Electromagnetic Mode Theory for Optical Propagation: Modes in a Planar Guide, Phase and group velocity - Cylindrical Fiber : Step index fibers, Graded index fibers - Single mode fibers: Cutoff wavelength.					
Unit - II	TRANSMISSION CHARACTERISTICS OF OPTICAL FIBERS				9
Attenuation - Material absorption losses in silica glass fibers: Intrinsic absorption, Extrinsic absorption - Linear scattering losses: Rayleigh Scattering, Mie Scattering -Nonlinear scattering losses: Stimulated Brillouin Scattering, Stimulated Raman Scattering – Fiber Bend Loss –Dispersion- Chromatic dispersion: Material dispersion, Waveguide dispersion- Intermodal dispersion : Multimode step index fiber, Multimode graded index fiber.					
Unit - III	OPTICAL SOURCES AND OPTICAL DETECTORS				9
The laser: Introduction - Basic concepts: Absorption and emission of radiation, Population inversion, Optical feedback and laser oscillation, Threshold condition for laser oscillation-Fabry Perot Laser. Hetero junctions- LED: Introduction-LED structures: Surface emitter LED, Edge emitter LED- LED Characteristics, LED Power and Quantum Efficiency. Optical Detectors: Introduction, Optical Detection Principles, Quantum Efficiency, Responsivity, PIN Photo Diode and Avalanche Photodiode-SNR of optical detectors.					
Unit – IV	OPTICAL FIBER MEASUREMENTS				9
Introduction- Total Fiber Attenuation Measurement, Fiber Dispersion Measurements in Time Domain and Frequency Domain, Fiber Cut off Wavelength Measurements, Numerical Aperture Measurements. Fiber Diameter Measurements, Reflectance and Optical Return Loss, Field Measurements					
Unit - V	OPTICAL NETWORKS				9
Introduction- Optical Network Concepts: Optical Networking Terminology, Optical Network Node and Switching Elements, Wavelength Division Multiplexed Networks, SONET. Wavelength Routing Networks: Routing and Wavelength Assignment- Optical Switching Networks: Optical Circuit Switched Networks, Optical Packet Switched Networks, Multiprotocol Label Switching, Optical Burst Switching Networks- Optical Network Deployment: Long Haul Networks, Metropolitan area networks, Access networks, Local Area Networks-Optical Ethernet: Network protection, restoration and survivability.					
Total Periods:					45

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
C01	Implement ray theory principles to model light propagation in optical fibers.	K3
C02	Summarize the Transmission Characteristics Associated with Dispersion and Polarization Techniques.	K2
C03	Relate Optical Sources and Detectors with Their Use in Optical Communication System	K2



C04	Apply optical fiber measurement techniques to evaluate fiber parameters.	K3
C05	Analyze optical network architectures, switching techniques, and wavelength routing mechanisms for efficient network deployment and performance.	K4

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO– PSO Articulation Matrix

	Programme Outcomes												PSO		
	01	02	03	04	05	06	07	08	09	10	11	12	01	02	03
C01	3	3	2	-	-	-	-	-	-	-	-	-	2	-	-
C02	3	3	2	-	-	-	-	-	-	-	-	-	-	-	2
C03	3	3	2	-	-	-	-	-	-	-	-	-	-	2	-
C04	3	3	2	1	-	-	-	-	-	-	-	-	2	-	-
C05	3	2	2	1	-	-	-	-	-	-	-	2	2	-	-
Avg	3	3	2	1	-	-	-	-	-	-	-	2	2	2	2

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	John M.Senior, "Optical Fiber Communication", Pearson Education, Fourth Edition.2010.
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Reference Books

1	Gred Keiser, "Optical Fiber Communication", McGraw Hill Education (India) Private Limited. Fifth Edition, Reprint 2013.
2	Govind P. Agrawal, "Fiber-Optic Communication Systems", Third Edition, John Wiley & Sons,2004.
3	J.Gower, "Optical Communication System", Prentice Hall Of India, 2001
4	Rajiv Ramaswami, "Optical Networks " , Second Edition, Elsevier , 2004.
5	P Chakrabarti, "Optical Fiber Communication", McGraw Hill Education (India)Private Limited,2016



U24GE6601	INTELLECTUAL PROPERTY RIGHTS			L	T	P	C
				3	0	0	3
Course Objectives:	To introduce students to the concepts, types, and legal frameworks of intellectual property and develop understanding of protection, enforcement, licensing, and commercialization while promoting awareness of ethical practices.						
Unit - I	INTRODUCTION TO IPR					9	
. Introduction and the need for intellectual property right (IPR) – Kinds of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication–Traditional Knowledge – Trade Secret – IPR in India : Genesis and development – IPR in abroad, Introduction to TRIPS and WTO, Paris convention, WIPO convention and TRIPS agreement.							
Unit - II	PATENTS					10	
Patents-Objective, Introduction, Requirement for patenting- Novelty, Inventive step (Non obviousness) and industrial application (utility), Non-patentable inventions, rights of patent owner, assignment of patent rights, patent specification (provisional and complete), parts of complete specification, claims, procedure for obtaining patents, E-filing, Examination of patent, Grant of patent, Revocation. Case studies in patent infringement.							
Unit - III	COPYRIGHT, TRADEMARKS AND DESIGN					10	
COPY RIGHT—Origin, Definition &Types of Copy Right, Registration procedure, plagiraism, Piracy, Infringement, Copy rights with special reference to software, Case studies. TRADE MARKS: Concept of Trademarks - Different kinds of marks- Registration of Trademarks - Rights of holder - Infringement, Remedies & Penalties. DESIGN - Design: meaning and concept of novel and original - Procedure for registration and term of protection, Semiconductor Integrated circuits and layout design Act-2000							
Unit – IV	GEOGRAPHICAL INDICATION, DIGITAL PRODUCTS AND LAWS					9	
GEOGRAPHICAL INDICATION (GI) - Geographical indication: meaning,difference between GI and trademarks - Procedure for registration, effect of registration and term of protection Digital Innovations– cyber security and IPR, Cyber Law and Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition and IP Laws – Case Studies.							
Unit - V	NATIONAL IPR POLICY AND TECHNOLOGY TRANSFER					7	
Overview of India’s National IPR Policy, government schemes promoting IPR; mechanisms of technology transfer and commercialization; role of Technology Transfer Offices (TTOs), incubation centres, and industry–institute partnerships in commercialization of intellectual property- career opportunities in IP.							
Total Periods:						45	

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the need and importance of Intellectual Property Rights in innovation and development of IPR in India and abroad.	K2
CO2	Evaluate patentability criteria, filing procedures, and infringement issues to assess the legal protection of inventions.	K4
CO3	Apply the provisions of copyright, trademark, and design laws to resolve issues related to registration, protection, and infringement in practical scenarios..	K3
CO4	Analyze the protection of Geographical Indications and digital intellectual assets in relation to cyber laws and unfair competition..	K4
CO5	Outline the mechanisms of technology transfer, commercialization, and career opportunities in the intellectual property domain.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	1	-	-	-	2	-	2	-	1	-	-	-	-
CO2	2	3	1	2	1	1	-	2	-	1	1	-	-	-
CO3	2	2	2	1	1	2	-	2	1	1	1	-	-	-
CO4	2	3	1	2	2	2	1	2	-	1	1	-	-	-
CO5	2	2	2	1	2	2	-	1	1	1		-	-	-
CO	2	2.2	1.5	1.5	1.5	1.2	1	1.2	1	1	1	-	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	N. K. Acharya, "Textbook of Intellectual Property Rights", 9th Edition, 2025, Asia Law House
2	Dr. G. B. Reddy, "Intellectual Property Rights and the Law", 11th Edition, 2020, Gogia Law Agency, ISBN: 9788189804030
3	V. K. Ahuja, "Law Relating to Intellectual Property Rights", LexisNexis India, ISBN: 9788131250922.



U24CY6605	FOOD, NUTRITION AND HEALTH			L	T	P	C
				3	0	0	3
Course Objectives:	Develop a comprehensive understanding of nutrition and health, critically evaluate the nutritive value of foods including BMI assessment and differentiation of junk, functional, and processed foods, and apply this knowledge to solve real-world nutrition and health challenges.						
Unit - I	FOOD RESOURCES, MICROBIOLOGY AND SAFETY SYSTEMS					9	
Introduction to Food resources (plant, animal, microbes); Current trends in production systems. Role of Functional and Super Foods in optimal nutrition. Dietary alternatives for sugar, protein and fat. Food and behaviour- physiological impacts in alcoholism, drug abuse and smoking. Food Regulations and Safety – Microbiological markers for evaluating product integrity – Ensuring microbiological safety in consumables – Strategic interventions and control measures – Implementation of the Hazard Analysis and Critical Control Point (HACCP) framework.							
Unit - II	NUTRIENTS AND FOOD ADDITIVES					9	
Overview of Macro nutrients- carbohydrates, proteins and lipids and Micronutrients-Minerals: Calcium, Magnesium, Iron, Zinc, Copper and Selenium. Vitamins. Nutritional Physiology: Mechanism of digestion, assimilation, and metabolic utilization of macro- and micronutrients. Food Additives Biotechnology – Types and role of bioflavors and pigment, microbial polysaccharides and recombinant enzymes in food sector.							
Unit - III	NANOTECHNOLOGY IN FOOD SCIENCE					9	
Nanomaterials in the Food Sector: integration of nanostructured materials in food packaging, guidelines on usage of nano materials in foods. Food Product Innovation: Systematic stages in food product development, shelf-life assessment, Nano-encapsulation and Controlled Release Systems.							
Unit – IV	DIET DISORDERS AND ENERGY CALCULATIONS					9	
Type I Disorders-Causes of life style factors and stress related diseases. Cardio-vascular diseases, hypertension, obesity. Type-II Disorders: Cancer, diabetics, ulcers, electrolyte and water imbalance. Health indices. Preventive and remedial measures. Energy balance and techniques to determine individual nutrient and energy needs. Planning a healthy diet.							
Unit - V	CONSUMERS ON GENETICALLY MODIFIED FOODS AND CURRENT CHALLENGES					9	
Concept of Genetically Modified foods, Global perspective of consumers on GM foods; Major concerns of transgenic, GM ingredients in food products. (labelling, bioavailability, safety aspects); current challenges and regulatory agencies involved in GM foods, Case studies- GM foods.							
Total Periods:						45	

On completion of the course, the student can

COs	Statements	K - Level
CO1	To be able to understand the nutritional values of the various types of foods	K2
CO2	To be able to Analyze the role of food in the metabolic activity of the healthy diet	K4
CO3	To be able to Infer the BMI calculation and stress related diseases.	K2
CO4	To be able to Elaborate the independent decision on the choice of food to prevent life style disorders and diseases	K2
CO5	To be able to Assess about the food laws governance	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO-PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	2	1	2	2	2	2	1	2	1	2	-	-	-
CO2	2	1	-	1	1	1	-	-	-	-	2	-	-	-
CO3	3	3	2	2	3	1	2	1	2	1	3	-	-	-
CO4	2	3	1	2	1	3	1	-	1	2	2	-	-	-
CO5	2	2	-	2	1	3	2	2	2	2	3	-	-	-
CO	2	2	1	2	2	2	1	1	1	1	2	-	-	-

Text Books

1	P.J. Fellows.2009. Food Processing Technology -Principles and Practice (Third Edition). A volume in Woodhead Publishing Series in Food Science, Technology and Nutrition.
2	Kalidas Shetty, Gopinadhan Paliyath, Anthony Pometto, Robert E. Levin. 2015. Food Biotechnology. CRC Press. Second edition.

Reference Books

1	Understanding Nutrition. 2010. Ellie Whitney, Sharon Rady Rolfes, 11e. Thompson Wadsworth.
2	Nutritional Sciences- From Fundamentals to Food.2013. Michelle McGuire, Kathy A. Beerman, 2
3	Food Science, Nutrition and Safety – Sukhneet Suri, Anita Malhotra, 2013, Pearson Education 1.
4	Essentials of Food Science – Vickie A Vaclavic, Elizabeth W Christian, Tad Campbell, 2020, Springer Nature.

****NANOTECHNOLOGY IN FOOD SCIENCE****

****Nanomaterials in the Food Sector: **** Integration of nanostructured materials in food packaging and guidelines for the safe use of nanomaterials in foods.

****Food Product Innovation: **** Systematic stages in food product development and methods for shelf-life assessment.

****Nano-encapsulation and Controlled Release Systems: **** Use of nanotechnology to enhance nutrient stability, improve bioavailability, and enable targeted delivery of bioactive compounds.

****Safety, Toxicity and Regulatory Issues: **** Risk assessment, toxicological evaluation, and regulatory frameworks related to the application of nanotechnology in food systems.



U24CY6602		RENEWABLE ENERGY SYSTEMS `		L	T	P	C
				3	0	0	3
Course Objectives:		The objectives of this course are to provide knowledge about various renewable energy technologies, to enable students to understand and design a photovoltaic (PV) system, to impart knowledge about wind energy systems, to introduce various possible hybrid energy systems, and to help students gain knowledge about the applications of different renewable energy technologies.					
Unit - I	ENERGY SCENARIO					9	
Primary energy sources – renewable vs. non-renewable primary energy sources – renewable energy resources in India – Current usage of renewable energy sources in India – Future potential of renewable energy in meeting energy demand, power production, and sustainable development – Development of renewable energy technologies – policy initiatives and challenges associated with large-scale implementation.							
Unit - II	SOLAR ENERGY					9	
Solar Radiation and its measurements – Solar Thermal Energy Conversion from plate Solar Collectors, Concentrating Collectors and its Types – Efficiency and performance of collectors – Direct Solar Electricity Conversion from Photovoltaic – types of solar cells and its application of battery charger, domestic lighting, street lighting, and water pumping, power generation schemes – Recent Advances in PV Applications: Building Integrated PV, Grid Connected PV Systems.							
Unit – III	WIND ENERGY					9	
Wind energy principles – wind site and its resource assessment – Measurement Equipments – Wind Resource Maps – Wind Power Density – wind assessment – Power Curve – Turbulence Intensity– Factors influencing wind – wind turbine components – wind energy conversion systems (WECS) – Classification of WECS devices – wind electric generating and control systems - Offshore wind farms & smart turbine control– characteristics and applications.							
Unit – IV	BIO-ENERGY					9	
Energy from biomass – Principle of biomass conversion technologies/process and their classification – Bio gas generation – types of biogas plants – selection of site for biogas plant– classification of biogas plants– Advantage and disadvantages of biogas generation – thermal gasification of biomass - Bio-refineries & waste-to-energy technologies – Application of biomass and biogas plants and their economics.							
Unit - V	OTHER TYPES OF ENERGY					9	
Energy conversion from Hydrogen and Fuel cells – Geo thermal energy Resources – types of wells – methods of harnessing the energy – potential in India – OTEC (Ocean Thermal Energy Conversion): Principles, utilization – setting of OTEC plants – thermodynamic cycles – Tidal and wave energy: Potential and conversion techniques –mini- hydel power plants and their economics.							
Total Periods:						45	

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the knowledge about various renewable energy technologies	K2
CO2	Interpret a photovoltaic (PV) system and understand its working.	K2
CO3	Infer the concept of various wind energy system.	K2
CO4	Explain the knowledge about various possible hybrid energy systems.	K2
CO5	Explain the knowledge about various application of renewable energy technologies.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO– PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	-	1	-	-	2	1	-	-	1	2	-	1	-
CO2	3	-	1	-	-	2	-	-	-	1	2	-	1	-
CO3	3	-	1	-	-	2	-	-	-	1	1	-	1	-
CO4	3	-	1	-	-	2	1	-	-	1	2	-	2	-
CO5	3	-	1	-	-	2	1	-	-	1	1	-	1	-
CO	3	-	1	-	-	2	1	-	-	1	2	-	1	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Mehmet Kanoglu, Yunus A Cengel, John M Cimbala — Fundamentals and Applications of Renewable Energy, McGraw Hill, 2020.
2	Kothari D.P, Singhal K.C - Renewable Energy Sources and Emerging Technologies, PHI Learning, India, 2013.
3	Godfrey Boyle - Renewable Energy: Power for a Sustainable Future, Oxford University Press, U.K., 2012
4	James F Manwell, Jon G McGowan, Anthony L Rogers - Wind Energy Explained: Theory, Design and Application, Wiley, U.K., 2010.
5	Sukhatme S.P - Solar Energy: Fundamentals, Design, Modeling & Applications, Tata McGraw Hill, India, 2008.

Reference Books

1	Twidell J.W & Wier A — Renewable Energy Resources, CRC Press (Taylor & Francis), 2006.
2	Tiwari A, Ghosal M.K — Renewable energy resources, Narosa Publishing House, India, 2007.
3	Anuj K Chandel, S. S. da Silva - Bioenergy: Biomass to Biofuels, Academic Press, U.S., 2017.
4	Chauhan D.S, Srivastava S.K — Non–Conventional Energy Resources, New Age Publishers, 2006.
5	Khan B.H — Non-Conventional Energy Resources, Tata Mc Graw Hill, 2006.



U24ME6605	INDUSTRIAL ENGINEERING	L	T	P	C
		3	0	0	3
Course Objectives:	Apply productivity, facilities planning, work study, ergonomics, and SPC principles to design efficient production systems and enhance organizational competitiveness through effective Production and Operations Management.				
Unit - I	INTRODUCTION			9	
	Scope of industrial engineering in apparel Industry, role of industrial engineers. Productivity: Definition - Productivity, Productivity measures. Reduction of work content due to the product and process, Reduction of ineffective time due to the management, due to the worker. Causes for low productivity in apparel industry and measures for improvement - Lean Productivity in Apparel Industry.				
Unit - II	WORK STUDY			9	
	Definition, Purpose, Basic procedure and techniques of work-study. Work environment – Lighting, Ventilation, Climatic condition on productivity. Temperature control, humidity control, noise control measures. Safety and ergonomics on work station and work environment Material Handling – Objectives, Classification and characteristics of material handling equipments, Specialized material handling equipments -Digital Work Study using Video Analysis				
Unit - III	METHOD STUDY			9	
	Definition, Objectives, Procedure, Process charts and symbols. Various charts – Charts indicating process sequence: Outline process chart, flow process chart (man type, material type and equipment type); Charts using time scale – multiple activity chart. Diagrams indicating movement – flow diagram, string diagram, cycle graph, chrono cycle graph, travel chart MOTION STUDY: Principle of motion economy, Two handed process chart, micro motion analysis – therbligs, SIMO chart - Method Improvement using ECRS Principle.				
Unit – IV	WORK MEASUREMENT			9	
	Definition, purpose, procedure, equipments, techniques. Time study - Definition, basics of time study- equipments. Time study forms, Stop watch procedure. Predetermined motion time standards (PMTS). Time Study rating, calculation of standard time, Performance rating – relaxation and other allowances. Calculation of SAM for different garments, GSD - SMV Optimization using GSD.				
Unit - V	WORK STUDY APPLICATION			9	
	Application of work study techniques in cutting, stitching and packing in garment industry. Workaids in sewing, Pitch diagram, Line balancing, Capacity planning, scientific method of training - Single Minute Exchange of Dies (SMED) in Garment Industry.				
Total Periods:				45	

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO1	Explain the fundamental concepts of Industrial Engineering and productivity.	K2
CO2	Describe the principles and procedure of method study.	K2
CO3	Explain the concepts and techniques of motion analysis.	K2



CO4	Summarize work measurement methods and Standard Allowed Minute (SAM).	K2
CO5	Outline the ergonomics process and its applications in the garment industry.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	2	3	1	2	-	-	-	-	-	-	2	2	-
CO2	2	3	2	2	2	-	-	-	-	-	-	2	3	-
CO3	2	2	2	2	2	-	-	-	-	-	-	2	2	-
CO4	3	2	3	2	1	-	-	-	-	-	-	3	2	-
CO5	2	2	3	2	2	-	-	-	-	-	-	2	2	-
CO	2	2	3	2	2	-	-	-	-	-	-	2	2	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	George Kanwaty, "Introduction to Work Study ", ILO, Geneva, 1996, ISBN: 9221071081 ISBN-13: 9789221071082
2	Enrick N. L., "Time study manual for Textile industry", Wiley Eastern (P) Ltd., 1989, ISBN: 0898740444 ISBN-13: 9780898740448
3	Khanna O. P., and Sarup A., "Industrial Engineering and Management", Dhanpat Rai Publications, New Delhi, 2010, ISBN: 818992835X / ISBN: 978-8189928353

References

1	Norberd Lloyd Enrick., "Industrial Engineering Manual for Textile Industry", Wiley Eastern (P) Ltd., New Delhi, 1988, ISBN: 0882756311 ISBN-13: 9780882756318
2	Chuter A. J., "Introduction to Clothing Production Management", Wiley-Black well Science, U.S. A., 1995, ISBN: 0632039396 ISBN-13: 9780632039395
3	GordanaColovic., "Ergonomics in the garment industry", Wood publishing India Pvt. Ltd., India, 2014, ISBN: 0857098225 ISBN-13: 9780857098221
4	Rajesh Bheda, "Managing Productivity in Apparel Industry "CBS Publishers & Distributors, 2008



U24CY6601	UNIVERSAL HUMAN VALUES	L	T	P	C
		2	1	0	3
Course Objectives:	To help students develop a holistic understanding of life and profession by appreciating the essential complementarity of values and skills, enabling sustained happiness and prosperity through correct understanding of human reality, ethical conduct, trustful and fulfilling human relationships, and mutually enriching interaction with nature, forming the foundation for universal human values and value-based living.				
Unit - I	HUMAN ASPIRATIONS AND HOLISTIC RESOLUTION FOR HARMONIOUS LIVING				9
Basic Human Aspirations – Identification, Method to fulfill the aspirations – Aspirations and Harmonious Living - Right Understanding and Resolution as the activities of the Self- All-encompassing Resolution for a Human Being, Details and solution of problems in the light of Resolution- Problems and Conflicts in Human life - Role of individuals in promoting collective well-being.					
Unit - II	RIGHT UNDERSTANDING - Knower, Known & the Process of Knowing				9
Need for right understanding - Understanding the human being (the knower, the experiencer and the doer) - Understanding nature/existence – its interconnectedness and co-existence; Understanding the role of human being in existence (human conduct) - Understanding Human being as the Co-existence of the Self and the Body - Distinguishing between the Needs of the Self and the Body - Role of Right understanding with Family, Peers, Society and Nation.					
Unit - III	UNDERSTANDING HUMAN BEING				9
Introduction to understanding human being - Misidentification and its consequences - Distinguishing between the Needs of Self and Body – Activities of the self – Potentialities inherent in the Self- Basis for harmony in the self – desire, thought & expectation – Basis for contradiction in the self - assumptions, beliefs, Internal conflict, dissatisfaction, and anxiety – Resolving contradiction through self-exploration.					
Unit – IV	UNDERSTANDING THE NATURE AND EXISTENCE				9
Introduction to Existence & Nature - Understanding Harmony in the Nature –need and process of inner evolution through self-exploration, self- awareness and self-evaluation, Order and harmony in nature – Bio order, Animal order, Human order, Physical order - Realizing Existence as Co-existence at all Levels - The Holistic Perception of Harmony in Existence – Harmony in Society – Dimensions of human order - Contemplation of Human Participation in Harmony- Comprehensive knowledge of existence.					
Unit - V	HUMAN CONDUCT AND SUSTAINABLE DEVELOPMENT				9
Introduction to Human Conduct and Sustainability: Need for value-based sustainable development, Overview of holistic development - Human Conduct Based on Right Understanding - All-Encompassing Resolution - Holistic way of living for Human Being with All- encompassing Resolution : realization, thought, behavior and work - Participation in the larger order leading to harmony at all levels from Self to Nature and entire Existence - Human Participation in Sustainable Development - Sustainable Development as an Outcome of Right Living - Holistic vision for sustainable and human development.					
Total Periods:					45

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO1	Identify basic human aspirations and apply holistic resolution for harmonious living.	K2



CO2	Understand the human being as the co-existence of self and body and develop right understanding.	K2
CO3	Analyze internal conflicts and resolve them through self-exploration and clarity of self-needs.	K4
CO4	Understand harmony in nature and existence through interconnectedness and co-existence.	K2
CO5	Apply right understanding to ethical human conduct and value-based sustainable development.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create.

CO – PO - PSO Articulation Matrix

	Programme Outcomes												PSO		
	01	02	03	04	05	06	07	08	09	10	11		01	02	03
CO1	-	-	-	-	-	1	3	1	1	-	3		-	-	-
CO2	-	-	-	-	-	1	3	1	1	-	3		-	-	-
CO3	-	-	-	-	-	1	3	2	1	-	3		-	-	-
CO4	-	-	-	-	-	1	3	1	1	-	3		-	-	-
CO5	-	-	-	-	-	2	3	2	1	-	3		-	-	-
CO	-	-	-	-	-	1	3	1	1	-	3		-	-	-

Text Books

1	A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2010. ISBN 978-8174467812-47-1.
2	Premvir Kapoor, Professional Ethics and Human Values, Khanna Book Publishing, New Delhi, 2022.

Reference Books

1	M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (includes Human Values), Eastern Economy 1 st Edition, ISBN13 - 978-8120325784, 2004, Prentice Hall India Learning Private Limited.
2	B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.
3	B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
4	A N Tripathy, 2003, Human Values, New Age International Publishers.
5	E G Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers, Oxford University Press.



U24MA6604	RESOURCE MANAGEMENT TECHNIQUES	L	T	P	C
		3	0	0	3
Course Objectives:	Provide fundamental knowledge of optimization and resource management techniques and to develop the ability to formulate mathematical models and apply analytical methods such as linear programming, integer programming, network models, and scheduling techniques for effective decision-making and efficient resource utilization.				
Unit - I	LINEAR PROGRAMMING				9
Principal components of decision problem – Modeling phases – LP Formulation and graphic solution – Components of LPP – Resource allocation problems – Simplex method – Sensitivity analysis – Artificial variable techniques – Corner point method – Applications of Linear programming.					
Unit - II	DUALITY AND NETWORKS				9
Definition of dual problem - Primal - Dual relationships - Dual simplex methods – Duality theorem – Post optimality analysis - Transportation and assignment model - Shortest route problem – Minimum spanning tree problem – Maximum flow problem – Applications of network optimization.					
Unit - III	INTEGER PROGRAMMING				9
Introduction to integer programming problems – Formulation of integer programming models – Types of integer programming – Cutting plan algorithm – Branch and bound methods, Multistage (Dynamic)programming – Applications of integer programming in Resource Allocation and Scheduling.					
Unit – IV	CLASSICAL OPTIMISATION THEORY				9
Unconstrained optimization – Necessary and sufficient conditions for optimality – Multivariable optimization – Equality constrained optimization – Lagrange multiplier method – Kuhn–Tucker conditions – Applications in engineering optimization.					
Unit - V	OBJECT SCHEDULING				9
Introduction to scheduling – sequencing problems – processing of n jobs through two machines – processing of n jobs through three machines – Johnson's rule – project networks – CPM and PERT techniques – resource allocation and leveling.					
Total Periods:					45

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO01	Formulate linear programming problems from practical situations.	K3
CO02	Apply simplex, transportation, and assignment methods to obtain optimal solutions.	K3
CO03	Apply integer programming to solve real-life applications.	K3
CO04	Apply classical optimization techniques to solve unconstrained and constrained problems using Newton–Raphson, Jacobian, Lagrangian, and Kuhn–Tucker methods.	K3
CO05	Use PERT and CPM for problems in project management	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO–PO–PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO01	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO02	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO03	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO04	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO05	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO	3	2	-	-	-	-	-	-	-	-	1	-	-	-

Correlation levels 1, 2 and 3 are as defined below:

1.Slight 2. Moderate 3.Substantial(High)

Text Books

1	H.A. Taha, "Operation Research", Prentice Hall of India, 2002.
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Reference Books

1	Paneer Selvam, 'Operations Research', Prentice Hall of India, 2002
2	Anderson 'Quantitative Methods for Business', 8 th Edition, Thomson Learning, 2002.
3	Winston 'Operation Research', Thomson Learning, 2003.
4	Vohra, 'Quantitative Techniques in Management', Tata Mc Graw Hill, 2002.
5	Anand Sarma, 'Operation Research', Himalaya Publishing House, 2003.



U24ME6601	ENTREPRENEURSHIP DEVELOPMENT			L	T	P	C
				3	0	0	3
Course Objectives:		To develop and strengthen entrepreneurial quality and motivation in students and to impart basic entrepreneurial skills and understanding to run a business efficiently and effectively.					
Unit - I	ENTREPRENEURSHIP						9
Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth - Entrepreneurial mindset and opportunity recognition.							
Unit - II	MOTIVATION						9
Major Motives Influencing an Entrepreneur – Achievement Motivation Training, Self Rating, Business Games, Thematic Apperception Test – Stress Management, Entrepreneurship Development Programs – Need, Objectives - Role of mentoring and networking in success.							
Unit - III	BUSINESS						9
Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies - Business model canvas							
Unit – IV	FINANCING AND ACCOUNTING						9
Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital, Costing, Break Even Analysis, Taxation – Income Tax, Excise Duty – Sales Tax - Start-up funding and venture capital.							
Unit - V	SUPPORT TO ENTREPRENEURS						9
Sickness in small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures - Business Incubators – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting - Digital entrepreneurship							
Total Periods:							45

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO1	Apply entrepreneurial concepts to identify and choose suitable business opportunities by understanding different types of entrepreneurs and factors influencing entrepreneurial growth.	K3
CO2	Utilize entrepreneurial motivation techniques to develop and organize strategies for achievement motivation, stress management, and participation in entrepreneurship development programs.	K3
CO3	Apply business planning principles to construct and develop preliminary project reports through market survey, opportunity identification, and techno-economic feasibility analysis.	K3
CO4	Utilize financial management concepts to plan and solve financial requirements of small enterprises by analyzing sources of finance, capital structure, costing, and break-even analysis.	K3
CO5	Apply entrepreneurial support mechanisms to identify and build growth strategies for small businesses using government policies, business incubators, and startup support systems.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	1	-	-	-	-	1	-	1	1	1	-	-	-
CO2	3	2	-	-	-	-	1	-	1	1	1	-	-	-
CO3	3	2	1	-	-	-	-	-	1	-	1	-	-	-
CO4	2	2	1	-	-	-	1	-	1	1	1	-	-	-
CO5	2	2	-	-	-	-	2	-	1	2	1	-	-	-
CO	3	2	1	-	-	-	1	-	1	1	1	-	-	-

Correlation levels 1, 2 and 3 are as defined below:

1.Slight 2. Moderate 3.Substantial(High)

Text Books

1	Donald F Kuratko, "Entrepreneurship – Theory, Process and Practice", 9 th Edition, Cengage Learning, 2014.
2	Khanka. S.S., "Entrepreneurial Development" S.Chand & Co. Ltd., Ram Nagar, New Delhi, 2013

Reference Books

1	EDII "Faulty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development", Institute of India, Ahmadabad, 1986.
2	Hisrich R D, Peters M P, "Entrepreneurship" 8th Edition, Tata McGraw-Hill, 2013.
3	Mathew J Manimala, "Enterprenuership theory at cross roads: paradigms and praxis" 2nd Edition Dream tech, 2005.
4	Rajeev Roy, "Entrepreneurship" 2nd Edition, Oxford University Press, 2011.



U24GE6604	COMMUNITY ENGAGEMENT AND SOCIAL RESPONSIBILITY	L	T	P	C
		3	0	0	3
Course Objectives:	To appreciate rural culture and wisdom, understand agricultural programs, analyze causes of rural distress and poverty, and apply classroom knowledge to real-world field conditions.				

S. No	Module Title	Module Content	Assignment	Teaching/ Learning Methodology	No. of Classes
1	Appreciation of Rural Society	Rural lifestyle, rural society, caste and gender relations, rural values with respect to community, nature and resources, elaboration of "soul of India lies in villages" (Gandhi), rural infrastructure.	Prepare a map (physical, visual or digital) of the village you visited and write an essay about interfamily relations in that village.	Classroom discussions	3
				Field visit**	5
				Assignment Map	3
2	Understanding rural and local economy and livelihood	Agriculture, farming, land ownership, water management, animal husbandry, non-farm livelihoods and artisans, rural entrepreneurs, rural markets, migrant labour.	Describe your analysis of the rural house hold economy, its challenges and possible pathways to address. Circular economy and migration patterns.	Field visit**	4
				Group discussions in class	5
				Assignment	3
3	Rural and local Institutions	Traditional rural and community organisations, Self-help Groups, Panchayati raj institutions (Gram Sabha, Gram Panchayat, Standing Committees), Nagarpalikas and municipalities, local civil society, local administration.	How effectively are Panchayati Raj and Urban Local Bodies (ULBs) institutions functioning in the village? What would you suggest to improve their effectiveness? Present a case study (written or audiovisual).	Classroom	3
				Field visit**	5
				Group presentation of assignment	3
4	Rural and National Development Programmes	History of rural development and current national programmes in India: Sarva Shiksha Abhiyan, Beti Bachao, Beti Padhao, Ayushman Bharat, Swachh Bharat, PM Awaas Yojana, Skill India, Gram Panchayat Decentralised Planning, National Rural Livelihood Mission (NRLM), Mahatma Gandhi National Rural Employment Guarantee Act 2005 (MGNREGA), SHRAM, Jal	Describe the benefits received and challenges faced in the delivery of one of these programmes in the local community; give suggestions about improving the implementation of the programme for the poor. Special	Classroom	3
				Each student selects one program for field visit**	5
				Written assignment	3



		Jeevan Mission, Scheme of Fund for Regeneration of Traditional Industries (SFURTI), Atma Nirbhar Bharat, etc.	focus on the urban informal sector and migrant households.		
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*3 Credits Course (2 Credit for Classroom and Tutorials and 1 Credit for Field Engagement) \

**at least 50% in the field, for all students

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Gain an understanding of rural life, Indian culture and ethos and social realities	K5
CO2	Develop a sense of empathy and bonds of mutuality with the local community	K5
CO3	Appreciate significant contributions of local communities to Indian society and economy	K5
CO4	Learn to value the local knowledge and wisdom of the community	K5
CO5	Identify opportunities for contributing to community's socio-economic improvements	K5

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes												PSO		
	01	02	03	04	05	06	07	08	09	10	11	12	01	02	03
CO1	-	-	-	-	-	3	2	3	1	-	-	3	-	-	-
CO2	-	-	-	-	-	3	2	3	3	-	-	3	-	-	-
CO3	-	-	-	-	-	3	3	3	2	-	-	3	-	-	-
CO4	-	-	-	-	-	3	2	3	1	-	-	3	-	-	-
CO5	-	-	-	-	-	3	3	3	3	-	-	3	-	-	-
CO	-	-	-	-	-	3	2	3	2	-	-	3	-	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight
2. Moderate
3. Substantial (High)



U24CS6601	DIGITAL MARKETING ESSENTIALS			L	T	P	C
				3	0	0	3
Course Objectives:	To understand the role and significance of digital marketing in today's dynamic business environment and to explore the organizations effectively implement digital marketing strategies. It also emphasizes measuring and evaluating the effectiveness of these digital initiatives to support informed decision-making.						
Unit - I	INTRODUCTION TO ONLINE MARKET						9
Online Market space- Digital Marketing Strategy- Components - Opportunities for building Brand Website - Planning and Creation - Content Marketing.							
Unit - II	SEARCH ENGINE OPTIMISATION						9
Search Engine optimisation - Keyword Strategy- SEO Strategy - SEO success factors -On-Page Techniques - Off-Page Techniques. Search Engine Marketing- How Search Engine works- SEM components- PPC advertising -Display Advertisement							
Unit - III	E- MAIL MARKETING						9
E- Mail Marketing - Types of E- Mail Marketing - Email Automation - Lead Generation - Integrating Email with Social Media and Mobile- Measuring and maximizing email campaign effectiveness. Mobile Marketing- Mobile Inventory/channels- Location based; Context based; Coupons and offers, Mobile Apps, Mobile Commerce, SMS Campaigns-Profiling and targeting							
Unit – IV	SOCIAL MEDIA MARKETING						9
Social Media Marketing - Social Media Channels- Leveraging Social media for brand conversations and buzz. Successful /benchmark Social media campaigns. Engagement Marketing- Building Customer relationships - Creating Loyalty drivers - Influencer Marketing.							
Unit - V	DIGITAL TRANSFORMATION						
Digital Transformation & Channel Attribution- Analytics- Ad-words, Email, Mobile, Social Media, Web Analytics - Changing your strategy based on analysis- Recent trends in Digital marketing.							
Total Periods:							45

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Apply digital marketing strategy concepts by analyzing the online marketplace and its components to plan and create effective brand websites.	K3
CO2	Identify SEO and SEM strategies by developing keyword plans and using on-page and off-page techniques to improve search engine visibility.	K3
CO3	Construct the email marketing techniques to create automated campaigns, generate leads, and measure campaign performance and use mobile marketing channels such as apps, SMS, and offers to target and engage customers effectively.	K3
CO4	Examine the social media marketing strategies by using platforms to create brand conversations and engagement and use engagement and influencer marketing to build customer relationships and loyalty.	K4
CO5	Analyze the digital analytics tools across channels such as AdWords, email, mobile, social media, and web to measure performance and attribute results, adapt digital marketing strategies and recent trends in digital marketing.	K4

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	3	2	3	3	-	3	3	3	3	3	3	3	3
CO2	3	3	2	3	3	-	3	3	3	3	3	3	3	3
CO3	3	3	2	3	3	-	3	3	3	3	3	3	3	3
CO4	3	3	2	3	3	-	3	3	3	3	3	3	3	3
CO5	3	3	2	3	3	-	3	3	3	3	3	3	3	3
CO	3.00	3.00	2.00	3.00	3.00	-	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Puneet Singh Bhatia, "Fundamentals of Digital Marketing", Third Edition, Pearson Education, 2023.
2	Ryan, D., & Kartajaya, H., & Setiawan, I, "Understanding Digital Marketing: A Complete Guide to Engaging Customers and Implementing Successful Digital Campaigns", Fifth Edition, Kogan Page, 2020.
3	Kotler, Philip, Hermawan Kartajaya, and Iwan Setiawan, "Marketing 4.0: Moving from Traditional to Digital", Seventh Edition, 2017.
4	Vandana Ahuja, "Digital Marketing", Seventh Edition, Oxford University Press, 2015.

Reference Books

1	Barker, Barker, Bormann and Neher, "Social Media Marketing: A Strategic Approach", Second Edition, South-Western, Cengage Learning, 2017.
2	Pulizzi, J Beginner's Guide to Digital Marketing , Mcgraw Hill Education



U24GE6606	PROJECT REPORT WRITING			L	T	P	C
				3	1	0	3
Course Objectives:	To understand the essentials of project writing, perceive the difference between general writing and technical writing, assimilate the fundamental features of report writing and to structure a technical and project report.						
Unit - I	Fundamentals of Writing Skills					9	
Writing Skills – Essential Grammar and Vocabulary – Passive Voice, Reported Speech, Concord, Signpost words, Cohesive Devices – Paragraph writing - Technical Writing vs. General Writing – Research Proposals – Interdisciplinary work							
Unit - II	Project Report Writing Essentials					9	
Project Report – Definition, Structure, Types of Reports, Purpose – Intended Audience – Plagiarism – Report Writing in STEM fields – Experiment – Statistical Analysis – Modern Tools							
Unit - III	Project Report Framework					9	
Framing a Title – Content – Acknowledgement – Funding Details - Abstract – Introduction – Aim of the Study – Background - Writing the research question - Need of the Study/Project Significance, Relevance – Determining the feasibility – Proof of the concept - Theoretical Framework.							
Unit – IV	Structure of the Project Report					9	
Structure of the Project Report – Literature Review, Research Design, Methods of Data Collection - Tools and Procedures - Data Analysis - Interpretation - Findings –Limitations -Recommendations – Conclusion – Bibliography.							
Unit - V	Finalizing a Report					9	
Proof reading a report – Avoiding Typographical Errors – Bibliography in required Format – Font – Spacing – Checking Tables and Illustrations – Presenting a Report Orally – Techniques – Standardization - Printing							
Total Periods:						45	

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO01	Explain about Writing Skills, Grammar and Vocabulary, Passive Voice, Reported Speech, Concord, Signpost words and Cohesive Devices.	K2
CO02	Build a structure and elements needed in a Project Report.	K3
CO03	Construct a comprehensive project report with clear findings, recommendations, and conclusions.	K3
CO04	Develop clear and concise project objectives, significance, relevance, feasibility and theoretical framework.	K3
CO05	Make use of Proof reading, Typographical Errors, Bibliography in required Format, Checking Tables and Illustrations towards presenting a project report.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO – Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	2	2	2	-	-	-	2	2	2	2	-	-	-
CO2	2	2	2	2	-	-	-	2	2	2	2	-	-	-
CO3	2	2	2	2	-	-	-	2	2	2	2	-	-	-
CO4	3	2	2	2	-	-	-	2	2	2	2	-	-	-
CO5	3	2	2	2	-	-	-	2	2	2	2	-	-	-
CO	2	2	2	2	-	-	-	2	2	2	2	-	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Weatherford and Darla Jean, Technical Writing for Engineering Professionals, Penn Well Corporation, 2016
2	Daniel G Riordan, Technical Report Writing Today, Cengage learning, 2014
3	Dr.A.Velayudham and Dr.M.Pavithra, Project Report Writing, Suchitra Publication, 2024
4	Dr.Arati A. Dandavate, Project Report Writing, Technical Publications 2024

Reference Books

1	Gerson and Gerson - Technical Communication: Process and Product, 7th Edition, Prentice Hall 2012.
2	Virendra K. Pamecha - Guide to Project Reports, Project Appraisals and Project Finance 2012



U24ME6607		MECHATRONICS		L	T	P	C
				3	0	0	3
Course Objectives:		To provide a comprehensive understanding of mechatronics systems by exploring their fundamentals, classifications, and emerging applications. It aims to study the operating principles and characteristics of various sensors and transducers employed in these systems, as well as to impart knowledge about the architecture, instruction set, and interfacing techniques of the 8085 microprocessor and its programmable peripheral devices. Additionally, the course focuses on the principles and applications of hydraulic, pneumatic, and PLC-based control systems used in automation. Students will also examine the operation of actuators, stepper and servo motors, and engage in the design process of mechatronics systems through practical industrial case studies.					
Unit - I	INTRODUCTION AND SENSORS					9	
Introduction to Mechatronics – Systems – Need for Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics. Sensors and Transducers: Static and Dynamic Characteristics of Sensor, Potentiometers – LVDT – Capacitance Sensors – Strain Gauges – Eddy Current Sensor – Hall Effect Sensor –Temperature Sensors – Light Sensors.							
Unit - II	8085 MICROPROCESSOR & PROGRAMMABLE PERIPHERAL INTERFACE					9	
Introduction – Pin Configuration - Architecture of 8085 – Addressing Modes – Instruction set, Timing diagram of 8085. Introduction – Architecture of 8255, Keyboard Interfacing, LED display – Interfacing, ADC and DAC Interface, Temperature Control – Stepper Motor Control – Traffic Control Interface.							
Unit - III	FLUID POWER SYSTEMS					9	
Introduction to fluid power, advantages and disadvantages of hydraulics vs. pneumatics. Properties of hydraulic fluids and air, Pascal's law and fluid flow principles. Simple Hydraulics Circuits – Simple Pneumatic Circuits.							
Unit – IV	PROGRAMMABLE LOGIC CONTROLLER					9	
Introduction – Architecture – Input / Output Processing – Programming with Timers, Counters and Internal relays – Data Handling – Selection of PLC.							
Unit - V	ACTUATORS AND MECHATRONICS SYSTEM DESIGN					9	
Types of Stepper and Servomotors – Construction – Working Principle – Characteristics, Stages of Mechatronics Design Process – Comparison of Traditional and Mechatronics Design Concepts with Examples – Case studies of Mechatronics Systems – Pick and Place Robot – Engine Management system – Automatic Car Park Barrier.							
Total Periods:						45	

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO1	Select sensors to develop mechatronics systems.	K2
CO2	Explain the architecture and timing diagram of microprocessor, and also interpret and develop programs.	K2
CO3	Design appropriate interfacing circuits to connect I/O devices with microprocessor.	K2
CO4	Apply PLC as a controller in mechatronics system.	K2
CO5	Design and develop the apt mechatronics system for an application.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	1	2	-	-	-	-	-	-	-	1	2	-	1
CO2	2	2	-	-	2	-	-	-	-	-	1	1	-	2
CO3	2	2	3	1	2	-	-	-	-	-	-	2	-	2
CO4	2	2	2	-	3	-	-	-	-	-	1	2	-	3
CO5	3	3	3	2	3	2	-	2	2	2	2	3	2	3
CO	2	2	2	1	2	-	-	-	-	-	1	2	-	2

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Bolton W., "Mechatronics", Pearson Education, 6th Edition, 2015.
2	Ramesh S Gaonkar, "Microprocessor Architecture, Programming, and Applications with the 8085", Penram International Publishing Private Limited, 6th Edition, 2013.

Reference Books

1	Bradley D.A., Dawson D., Buru N.C. and Loader A.J., "Mechatronics", Chapman and Hall, 1993.
2	Davis G. Alciatore and Michael B. Hstand, "Introduction to Mechatronics and Measurement systems", McGraw Hill Education, 2011.
3	Devadas Shetty and Richard A. Kolk, "Mechatronics Systems Design", Cengage Learning, 2010.
4	Nitaigour Premchand Mahalik, "Mechatronics Principles, Concepts and Applications", McGraw Hill Education, 2015.
5	Smaili. A and Mrad. F, "Mechatronics Integrated Technologies for Intelligent Machines", Oxford University Press, 2007.



U24AD6604	AI TECHNIQUES IN ENGINEERING APPLICATIONS			L	T	P	C
				3	0	0	3
Course Objectives:		To provide students with a strong foundation in applying Artificial Intelligence tools and techniques for engineering applications by introducing core AI libraries and frameworks such as Python, NumPy, Scikit-learn, and TensorFlow along with Edge AI, embedded AI, and FPGA/GPU concepts, enabling them to analyze and implement AI-based solutions through real-world case studies like fault detection, predictive maintenance, RF monitoring, and biomedical signal processing while promoting awareness of ethical practices and emerging trends in AI technology.					
Unit - I		INTRODUCTION TO AI				9	
AI overview and history – Intelligent agents – Problem formulation – Search strategies (BFS, DFS, A*) – Knowledge representation basics – Reasoning methods – AI applications in communication and signal systems.							
Unit - II		MACHINE LEARNING FUNDAMENTALS				9	
Supervised vs unsupervised learning – Regression and classification – Decision trees – KNN – Naive Bayes – Model training and testing – Overfitting and regularization – Performance metrics (accuracy, precision, recall, F1 score).							
Unit - III		NEURAL NETWORKS AND DEEP LEARNING				9	
Artificial neural networks – Perceptron model – Backpropagation – Multi-layer networks – CNN basics – RNN/LSTM introduction – Feature extraction – Deep learning for signal/image data – Applications in ECE domains.							
Unit - IV		AI IN SIGNAL, IMAGE AND COMMUNICATION SYSTEMS				9	
AI for signal processing – Noise filtering and prediction – Image classification concepts – Object detection basics – Speech processing overview – Channel estimation using ML – Spectrum sensing – IoT analytics – Smart communication systems.							
Unit - V		AI HARDWARE, TOOLS AND CASE STUDIES				9	
AI tools (Python, NumPy, Scikit-learn, TensorFlow basics) – Edge AI overview – FPGA/GPU basics for AI – Embedded AI introduction – Case studies: fault detection, predictive maintenance, RF monitoring, biomedical signal analysis – Ethics and future trends.							
Total Periods:						45	

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO01	Apply intelligent agent concepts and search strategies to formulate ECE-related problems and represent solutions using basic knowledge representation and reasoning methods.	K3
CO02	Contrast supervised and unsupervised learning models to solve classification and regression tasks and validate model performance using appropriate evaluation metrics.	K3
CO03	Analyze neural network architectures and learning mechanisms to interpret deep learning performance for signal and image-based ECE datasets.	K4
CO04	Inspect AI techniques for signal, image, and communication applications to perform prediction, detection, and estimation tasks in practical ECE scenarios.	K4
CO05	Examine AI tools and deployment platforms (Edge AI, Embedded AI, FPGA/GPU) to analyze real-world ECE case studies and identify ethical considerations and emerging trends.	K4

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	3	2	2	1	2	-	-	-	1	1	3	3	1
CO2	3	3	2	2	2	3	-	-	-	1	1	3	3	2
CO3	3	3	2	3	2	3	-	-	-	1	1	3	3	2
CO4	2	2	2	2	2	2	1	1	-	1	1	2	2	1
CO5	3	3	3	3	3	3	3	1	1	1	1	3	3	2
CO	2.80	2.80	2.20	2.40	2.00	2.60	2.00	1.00	1.00	1.00	1.00	2.80	2.80	1.60

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Kevin P. Murphy, Probabilistic Machine Learning: Advanced Topics, MIT Press, Adaptive Computation and Machine Learning Series, 2023 Edition.
2	Simon J. D. Prince, Understanding Deep Learning, MIT Press, 1st Edition, 2023.
3	Marc Peter Deisenroth, A. Aldo Faisal, and Cheng Soon Ong, Mathematics for Machine Learning, Cambridge University Press, 2023 Reprint Edition.

Reference Books

1	Christopher M. Bishop and Hugh Bishop, Deep Learning: Foundations and Concepts, Springer, 1st Edition, 2024.
2	Trevor Hastie, Robert Tibshirani, and Jerome Friedman, The Elements of Statistical Learning, Springer, 2023 Updated Edition.
3	Kevin P. Murphy, Probabilistic Machine Learning: An Introduction, MIT Press, 1st Edition, 2022.



U24AD6605	CLOUD AND FOG COMPUTING	L	T	P	C
		3	0	0	3
Course Objectives:	To enable students to understand cloud computing as a centralized support layer for fog-based systems, analyze cloud–fog resource interaction, apply virtualization and security concepts in distributed environments, and design fog-enabled solutions for real-time and IoT applications				
Unit - I	INTRODUCTION TO CLOUD COMPUTING			9	
Cloud Computing as a Centralized Backbone – Limitations of Traditional Cloud Computing – Latency and Bandwidth Constraints – Evolution from Cloud to Fog – Cloud–Fog–Edge Continuum – Role of Cloud in Supporting Fog Infrastructure – Hybrid Cloud Support for Fog Systems – Challenges and Risks in Cloud-Centric Architectures.					
Unit - II	RESOURCE MANAGEMENT AND SLA MANAGEMENT			9	
Distributed Resource Management – Virtualization in Cloud–Fog Environments – Container-Based Virtualization – Load Balancing across Cloud and Fog Nodes – Service Level Agreements for Distributed Systems – SLA Lifecycle – SLA Management for Latency-Sensitive Applications – SLA Violations and Recovery Strategies.					
Unit - III	CLOUD SECURITY			9	
Security Challenges in Cloud–Fog Systems – Distributed Data Security – Secure Communication between Cloud and Fog Layers – Identity and Access Management in Multi-Layer Systems – Trust Management in Fog Nodes – Intrusion Detection and Anomaly Detection in Distributed Environments – Privacy Preservation for IoT Data..					
Unit – IV	INTRODUCTION TO FOG COMPUTING			9	
Fog Computing Fundamentals – Motivation for Fog Computing – Characteristics of Fog Computing – Fog Computing vs Cloud Computing – Fog Computing vs Edge Computing – Role of Fog in IoT – Fog for Real-Time Analytics – Applications of Fog Computing in Smart Systems..					
Unit - V	FOG ARCHITECTURE			9	
Fog Computing Architecture – Fog Nodes and Gateways – Types of Fog Deployment – Resource Allocation in Fog – Task Offloading Strategies – Data Management in Fog Computing – Optimization Problems in Fog – Security Issues in Fog Computing – Applications and Design Challenges.					
Total Periods:				45	

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO01	Apply cloud-fog computing concepts to distributed and IoT-based systems.	K3
CO02	Develop cloud-fog architectures to support low-latency applications.	K3
CO03	Analyze resource management and SLA issues in cloud-fog environments.	K4
CO04	Compare cloud, fog, and edge computing paradigms for real-time systems.	K4
CO05	Utilize fog computing techniques to design solutions for smart applications.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO0 1	2	3	-	-	-	-	-	-	-	-	-	3	3	3
CO0 2	2	3	2	-	-	-	-	-	-	-	-	3	3	3
CO0 3	2	3	-	-	-	3	-	-	-	-	1	3	3	3
CO0 4	2	3	-	3	3	-	-	-	-	-	2	2	2	2
CO0 5	1	2	-	3	3	-	-	-	-	-	3	2	2	2
CO	1.80	2.80	2.00	3.00	3.00	3.00	-	-	-	-	2.00	2.60	2.60	2.60

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Rajkumar Buyya and Satish Narayana Srirama, Fog and Edge Computing: Principles and Paradigms, Wiley, Updated Edition, 2022.
2	Thomas Erl, Ricardo Puttini and Zaigham Mahmood, Cloud Computing: Concepts, Technology and Architecture, Pearson Education, Updated Edition, 2023.
3	Dan C. Marinescu, Cloud Computing: Theory and Practice, Morgan Kaufmann, 2nd Edition, 2023.

Reference Books

1	Zaigham Mahmood, Fog Computing: Concepts, Frameworks and Technologies, Springer, Updated Edition, 2022.
2	Kai Hwang, Geoffrey C. Fox and Jack J. Dongarra, Distributed and Cloud Computing: From Parallel Processing to the Internet of Things, Morgan Kaufmann, Updated Edition, 2023.
3	Rittinghouse, J.W. and Ransome, J.F., Cloud Computing: Implementation, Management, and Security, CRC Press, 3rd Edition, 2022.
4	Shadi Ibrahim and Rajkumar Buyya, Resource Management in Cloud and Edge Computing Systems, Springer, 2023.
5	Rico Fritzsche, Cybersecurity for Developers, Packt Publishing, 2023.



U24PH6603		FUNDAMENTALS OF QUANTUM COMPUTING			L	T	P	C
					3	0	0	3
Course Objectives:		Explaining the transition from classical to quantum bits, providing a foundation in quantum mechanics, quantum gates, and the physical realization of quantum hardware relevant to communication and computing systems.						
Unit - I	QUANTUM FOUNDATIONS & LINEAR ALGEBRA						9	
Introduction to Quantum Mechanics: Limitations of classical physics - wave-particle duality and Schrödinger's time dependent and time independent wave equation - Dirac Notation - Vector spaces, operators, and matrices - The State Vector - Mathematical Representation – Normalization - Hilbert Space: Definition of a complete inner product space; Geometric interpretation of quantum states; Orthogonality and Orthonormality - Postulates of Quantum Mechanics - The Qubit: representation on the Bloch Sphere.								
Unit - II	QUANTUM GATES AND CIRCUITS						9	
Single Qubit Gates: Mathematical representation and circuit symbols for Pauli-X (NOT), Pauli-Y, Pauli-Z (Phase flip), Hadamard (H) for creating superposition, and Phase (S, T) gates - Multi-qubit systems: Kronecker (Tensor) products; Hilbert space - Controlled Gates: Logic and matrix form of the Controlled-NOT (CNOT) gate; introduction to the Three-qubit Toffoli (CCNOT) gate - Quantum circuits and reversibility: the requirement of reversibility in quantum computing compared to classical CMOS logic - Measurement in different bases - No-cloning theorem.								
Unit - III	ENTANGLEMENT AND ALGORITHMS						9	
Bell States and Entanglement: Construction of the four Maximally Entangled States using H and CNOT gates - Quantum Teleportation: Transferring a quantum state using a shared Bell pair and classical communication (Block diagram and protocol) - Superdense coding: Protocol to send two classical bits of information using one qubit and prior entanglement - Introduction to Quantum Algorithms: Deutsch-Jozsa algorithm, Grover's Search algorithm (qualitative) and Shor's Factoring algorithm (impact on RSA cryptography).								
Unit – IV	PHYSICAL REALIZATION & HARDWARE						9	
Criteria for Quantum Hardware (DiVincenzo criteria). Superconducting Qubits: Physics of Josephson Junctions; Transmon qubits - basics of microwave control - Trapped Ion Qubits: laser-based gate operations - Photonic Quantum Computing & Quantum dots: Linear optical quantum computing (LOQC) using beam splitters and phase shifters; electron spin qubits in semiconductor quantum dots - Basics of Quantum Error Correction (QEC) and decoherence: Sources of noise (T1 and T2 relaxation); introduction to Quantum Error Correction - the 3-qubit bit-flip code.								
Unit - V	QUANTUM COMMUNICATION & NETWORKING						9	
Quantum Key Distribution (QKD): Step-by-step execution of the BB84 Protocol; detecting eavesdropping (Eve) through the laws of physics - Photonic sources and detectors for Quantum Communications: Single-photon sources (attenuated lasers, SPDC); Single-photon detectors (SNSPDs, Avalanche photodiodes) - Quantum Repeaters - the role of entanglement swapping and quantum memories in long-distance communication - Introduction to the Quantum Internet - Basics of Quantum Sensing and its applications.								
Total Periods:							45	



Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the mathematical framework of quantum mechanics and qubit representation.	K2
CO2	Interpret the basic quantum logic circuits using universal gate sets.	K2
CO3	Explain the principles of entanglement and its use in teleportation and algorithms.	K2
CO4	Illustrate physical technologies used to build quantum processors.	K2
CO5	Apply quantum principles to secure communication protocols like QKD.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO– PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	1	-	-	-	-	-	-	-	-	-	1	-	-
CO2	3	2	2	-	2	-	-	-	-	-	1	2	-	-
CO3	3	2	-	1	-	-	-	-	-	-	-	-	-	-
CO4	3	1	-	-	1	-	-	-	-	-	-	-	-	-
CO5	3	2	1	-	-	1	-	-	-	-	1	1	-	-
CO	3	2	1	1	1	1	-	-	-	-	1	1	-	-

Correlation levels 1, 2 and 3 are as defined below: 1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Nielsen, M. A. & Chuang, I. L. – Quantum Computation and Quantum Information – Cambridge University Press – 2010
2	Pathak, A. – Elements of Quantum Computation and Quantum Communication – CRC Press – 2013.
3	Kasirajan, V. – Fundamentals of Quantum Computing: Theory and Practice – Springer – 2021
4	Bernhardt, C. – Quantum Computing for Everyone – MIT Press – 2019.
5	McMahon, D. – Quantum Computing Explained – Wiley-Inter-science – 2007

Reference Books

1	Kaye, P., Laflamme, R. & Mosca, M. – An Introduction to Quantum Computing – Oxford University Press – 2007.
2	Rieffel, E. G. & Polak, W. H. – Quantum Computing: A Gentle Introduction – MIT Press – 2011.
3	Hidary, J. D. – Quantum Computing: An Applied Approach – Springer – 2019.
4	Yanofsky, N. S. & Mannucci, M. A. – Quantum Computing for Computer Scientists – Cambridge University Press – 2008.
5	Djordjevic, I. B. – Quantum Communication, Quantum Networks, and Quantum Sensing – Academic Press – 2022.



U24CE6601		APPLIED DESIGN THINKING				L	T	P	C
						3	0	0	3
Course Objectives:		To provide students with a comprehensive understanding of design thinking principles, emphasizing user-focused problem identification, application of structured design thinking tools and techniques, and systematic product development processes, enabling them to create value-driven solutions applicable across engineering, business, and societal contexts.							
Unit - I	INNOVATION AND DESIGN THINKING PRINCIPLES							9	
Principles and philosophy of Human-Centered Design –Understanding the Innovation process, discovering areas of opportunity, Interviewing & empathy, Design thinking framework – Stages of innovation process: Empathize, Define, Ideate, Prototype, Test – Problem identification and framing. Activity: Problem statement canva- case studies.									
Unit - II	USER-CENTRIC INNOVATION							9	
Importance of customer-centric innovation – Understanding problem incidence and problem significance- pain points- Defining the problem- Customer persona and validation- - Analysis of alternative solutions- impact on the customer. Activity: Empathy map-Customer interviews and field visit									
Unit - III	APPLIED DESIGN THINKING TOOLS							9	
Ideation tools- Brainstorming, SCAMPER, mind mapping- Proof of concept- Concept sketching, rapid prototyping- Concept of Minimum viable Prototype [MVP] - Designing & Crafting the value proposition- Value proposition Canva- Introduction to technology readiness level.									
Unit – IV	DESIGN THINKING TECHNIQUES AND PRODUCT DEVELOPMENT							9	
Creative thinking, constraints in design, designing today for tomorrow. Solution Exploration, Concepts Generation and MUP design- Conceptualize the solution; explore, iterate and learn; build the right prototype; Assess desirability, viability and feasibility.									
Unit - V	DESIGN THINKING APPLICATIONS							9	
Design thinking for strategic innovation, application of design, thinking in business and strategy, linking design thinking solution to business challenges, enterprise creativity,competitive logic of business strategy, design thinking for start-ups									
Total Periods:								45	

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the principles of Human-Centered Design, stages of the design thinking framework, and methods for problem identification and framing.	K2
CO2	Interpret customer needs using tools such as empathy mapping, customer persona, and problem significance analysis to understand user-centric innovation.	K2
CO3	Apply ideation techniques, prototyping methods, and value proposition design tools to develop feasible and innovative solutions.	K3
CO4	Demonstrate the use of design thinking techniques to conceptualize, develop, and refine product/service solutions considering desirability, viability, and feasibility.	K3
CO5	Analyze business challenges and strategic opportunities by integrating design thinking approaches for innovation, start-ups, and enterprise applications.	K4

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	2	1	-	-	1	-	-	-	-	-	-	-	-
CO2	2	3	2	2	-	2	-	-	1	1	-	-	-	-
CO3	2	2	3	2	3	-	-	-	2	1	2	-	-	-
CO4	2	3	2	2	-	1	1	-	2	1	2	-	-	-
CO5	2	3	2	2	1	2	1	1	2	1	2	-	-	-
CO	2	2.6	2.2	2	2.2	1.2	1	1	1.8	1	2	-	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Tim Brown,(2012) “Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation”, Harper Business.
2	Donella H. Meadows, (2015), “Thinking in Systems -A Primer”, Sustainability Institute
3	Steve Blank, (2013), The four steps to epiphany: Successful strategies for products that win, Wiley.

Reference Books

1	Alexander Osterwalder, Yves Pigneur, Gregory Bernarda, Alan Smith, Trish Papadacos, (2014), Value
2	https://blog.forgefor ward.in/valuation-risk-versus-validation-risk-in-product-innovations49f253ca86 24



U24AD6603		AUGMENTED REALITY/VIRTUAL REALITY TECHNOLOGY		L	T	P	C
				3	0	0	3
Course Objectives:		The course introduces the core concepts, technologies, and system components of Virtual Reality and Augmented Reality. It develops knowledge of VR modeling, programming, human factors, and real-world applications for immersive systems.					
Unit - I	INTRODUCTION						9
Introduction to Virtual Reality and Augmented Reality – Definition – Introduction to Trajectories and Hybrid Space-Three I's of Virtual Reality – Virtual Reality Vs 3D Computer Graphics – Benefits of Virtual Reality – Components of VR System – Introduction to AR-AR Technologies-Input 144 Devices – 3D Position Trackers – Types of Trackers – Navigation and Manipulation Interfaces – Gesture Interfaces – Types of Gesture Input Devices – Output Devices – Graphics Display – Human Visual System – Personal Graphics Displays – Large Volume Displays – Sound Displays – Human Auditory System.							
Unit - II	VR MODELING						9
Modeling – Geometric Modeling – Virtual Object Shape – Object Visual Appearance – Kinematics Modeling – Transformation Matrices – Object Position – Transformation Invariants –Object Hierarchies – Viewing the 3D World – Physical Modeling – Collision Detection – Surface Deformation – Force Computation – Force Smoothing and Mapping – Behavior Modeling – Model Management							
Unit - III	VR PROGRAMMING						9
VR Programming – Toolkits and Scene Graphs – World ToolKit – Java 3D – Comparison of World ToolKit and Java 3D							
Unit –IV	APPLICATIONS						9
Human Factors in VR – Methodology and Terminology – VR Health and Safety Issues – VR and Society-Medical Applications of VR – Education, Arts and Entertainment – Military VR Applications – Emerging Applications of VR – VR Applications in Manufacturing – Applications of VR in Robotics – Information Visualization – VR in Business – VR in Entertainment – VR in Education.							
Unit - V	AUGMENTED REALITY						9
Introduction to Augmented Reality-Computer vision for AR-Interaction-Modelling and Annotation Navigation-Wearable devices.							
Total Periods:							45

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO01	Apply fundamental Virtual Reality and Augmented Reality concepts to identify system components, tracking methods, input-output devices, and human visual and auditory considerations	K3
CO02	Apply geometric, kinematic, and physical modeling techniques to create three-dimensional virtual objects using transformations, object hierarchies, and collision detection.	K3
CO03	Develop interactive virtual environments using VR programming toolkits and scene graph concepts to construct realistic 3D scenes with audio and visual effects.	K3
CO04	Analyze Virtual Reality applications across healthcare, education, manufacturing, robotics, and entertainment by evaluating human factors, safety issues, and interaction requirements.	K4
CO05	Analyze Augmented Reality systems by examining computer vision methods, interaction techniques, modeling approaches, and wearable devices to design AR and MR applications	K4

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	2	1	3	2	1	1	2	1	2	3	3	3
CO2	3	3	3	2	3	-	-	1	1	2	2	3	3	3
CO3	3	3	3	2	3	-	1	2	2	3	3	3	3	3
CO4	3	3	2	3	3	3	3	2	3	2	3	3	3	3
CO5	3	3	3	3	3	3	2	2	3	3	3	3	3	3
CO	3.00	2.80	2.60	2.20	3.00	2.67	1.75	1.60	2.20	2.20	2.60	3.00	3.00	3.00

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Charles Palmer, John Williamson, "Virtual Reality Blueprints: Create compelling VR experiences for mobile", Packt Publisher, 2018
2	Dieter Schmalstieg, Tobias Hollerer – Augmented Reality: Principles and Practice, Pearson / Addison-Wesley Professional, 2022
3	John Vince, "Introduction to Virtual Reality", Springer-Verlag, 2004.
4	William R. Sherman, Alan B. Craig: Understanding Virtual Reality – Interface, Application, Design", Morgan Kaufmann, 2003

Reference Books

1	Ralf Doerner, Wolfgang Broll, Bernhard Jung, Paul Grimm, Martin Göbel, Frank Steinicke – Virtual and Augmented Reality: Foundations and Methods of Extended Realities (XR), Springer Nature, 2022
2	Naveen Kumar Singh, Shanu Gupta – Augmented and Virtual Reality, S.K. Kataria & Sons, 2025 (1st Edition)



U24CB5V01	FINANCIAL MANAGEMENT			L	T	P	C
				3	0	0	3
Course Objectives:	To understand key financial decisions, sources of finance, and capital budgeting concepts learning capital structure, dividend policy, and working capital management tools.						
Unit - I	INTRODUCTION TO FINANCIAL MANGEMENT						9
Definition and Scope of Finance Functions - Objectives of Financial Management - Profit Maximization and Wealth Maximization- Time Value of money- Risk and return concepts.							
Unit - II	SOURCES OF FINANCE						9
Long term sources of Finance -Equity Shares – Debentures - Preferred Stock – Features – Merits and Demerits. Short term sources - Bank Sources, Trade Credit, Overdrafts, Commercial Papers, Certificate of Deposits, Money market mutual funds etc							
Unit - III	INVESTMENT DECISIONS						9
Investment Decisions: capital budgeting – Need and Importance – Techniques of Capital Budgeting – Payback -ARR – NPV – IRR –Profitability Index. Cost of Capital - Cost of Specific Sources of Capital - Equity -Preferred Stock- Debt - Reserves - Concept and measurement of cost of capital - Weighted Average Cost of Capital.							
Unit – IV	FINANCING AND DIVIDEND DECISION						9
Operating Leverage and Financial Leverage- EBIT-EPS analysis. Capital Structure – determinants of Capital structure- Designing an Optimum capital structure. Dividend policy - Aspects of dividend policy - practical consideration - forms of dividend policy - - Determinants of Dividend Policy							
Unit - V	WORKING CAPITAL DECISION						9
Working Capital Management: Working Capital Management - concepts - importance -Determinants of Working capital. Cash Management: Motives for holding cash – Objectives and Strategies of Cash Management. Receivables Management: Objectives - Credit policies.							
Total Periods:							45

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Identify and be familiar with the basic layers and its functions in computer networks.	K3
CO2	Apply the basics of networks to show how data flows from one node to another	K3
CO3	Construct the different types of routing algorithms	K3
CO4	Experiment with different types of protocols for various functions in the network	K3
CO5	Develop the operation of different application layer protocols	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	3	2	2	3	2	2	3	3	2	3	3	3	3
CO2	3	3	2	2	3	2	2	3	3	2	3	3	3	3
CO3	3	3	2	2	3	2	2	3	3	2	3	3	3	3
CO4	3	3	2	2	3	2	2	3	3	2	3	3	3	3
CO5	3	3	2	2	3	2	2	3	3	2	3	3	3	3
CO	3.00	3.00	2.00	2.00	3.00	2.00	2.00	3.00	3.00	2.00	3.00	3.00	3.00	3.00

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)



Text Books

1	M.Y. Khan and P.K.Jain, Financial Management: Text, Problems & Cases, Eight Edition, Tata McGraw Hill, 2024
2	Prasanna Chandra, Financial Management: Theory & Practice, Eleventh Edition, McGraw Hill Education (India) Pvt. L, 2022
3	M. Pandey, Financial Management, Eleventh Edition, Vikas Publishing House Pvt. Ltd, 2015

Reference Books

1	James C. Vanhorne, Fundamentals of Financial Management, 13 th Edition, PHI Learning, 2019
2	Srivatsava, Mishra, Financial Management, Oxford University Press, 2011



U24CB5V02	FUNDAMENTALS OF INVESTMENT			L	T	P	C
				3	0	0	3
Course Objectives:	To analyze the investment environment, value bonds and equities, apply security valuation approaches, build efficient portfolios through diversification, and understand investor protection mechanisms in India.						
Unit – I	THE INVESTMENT ENVIRONMENT					9	
The investment decision process, Types of Investments – Commodities, Real Estate and Financial Assets, the Indian securities market, the market participants and trading of securities, security market indices, sources of financial information, Concept of return and risk, Impact of Taxes and Inflation on return.							
Unit – II	FIXED INCOME SECURITIES					9	
Bond features, types of bonds, estimating bond yields, Bond Valuation types of bond risks, default risk and credit rating.							
Unit – III	APPROACHES TO EQUITY ANALYSIS					9	
Introduction to Fundamental Analysis, Technical Analysis and Efficient Market Hypothesis, dividend capitalisation models, and price-earnings multiple approach to equity valuation							
Unit – IV	PORTFOLIO ANALYSIS AND FINANCIAL DERIVATIVES					9	
Portfolio and Diversification, Portfolio Risk and Return; Mutual Funds; Introduction to Financial Derivatives; Financial Derivatives Markets in India							
Unit – V	INVESTOR PROTECTION					9	
Role of SEBI and stock exchanges in investor protection; Investor grievances and their redressal system, insider trading, investors’ awareness and activism							
Total Periods:						45	

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Apply concepts of investment decision-making, classify asset types, interpret the functioning of Indian securities markets, and compute risk–return measures under taxation and inflationary conditions.	K3
CO2	Utilize bond valuation methods to calculate yields, differentiate bond features and categories, and appraise risks including default probability and credit ratings	K3
CO3	Employ analytical techniques to implement fundamental and technical approaches, examine market efficiency, and apply dividend-based and P/E multiple models for equity valuation	K3
CO4	Apply portfolio management principles to design diversified portfolios, quantify portfolio risk and return, assess mutual fund performance, and illustrate the role of financial derivatives in Indian markets.	K3
CO5	Apply regulatory frameworks to evaluate SEBI's functions, examine stock exchange practices, analyze grievance redressal mechanisms, and foster investor awareness and activism.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	2	3	-	3	3	3	3	-	3	3	3	3	3
CO2	2	2	3	-	3	3	3	3	-	3	3	3	3	3
CO3	2	2	3	-	3	3	3	3	-	3	3	3	3	3
CO4	2	2	3	-	3	3	3	3	-	3	3	3	3	3
CO5	2	2	3	-	3	3	3	3	-	3	3	3	3	3
CO	2.00	2.00	3.00	-	3.00	3.00	3.00	3.00	-	3.00	3.00	3.00	3.00	3.00

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Reference Books

1	Rustagi, R. P. Investment Management Theory and Practice. Sultan Chand & Sons, 2021.
2	Charles P. Jones, Gerald R. Jensen. Investments: analysis and management. Wiley, 14 TH Edition, 2019.
3	ZviBodie, Alex Kane, Alan J Marcus, Pitabus Mohanty, Investments, McGraw Hill Education (India), 11 Edition (SIE), 2019
4	Charles P. Jones, Gerald R. Jensen. Investments: analysis and management. Wiley, 14 TH Edition, 2019.
5	Chandra, Prasanna. Investment analysis and portfolio management. McGraw-hill education, 5 th , Edition, 2017.



U24CB5V0		BANKING, FINANCIAL SERVICES AND INSURANCE			L	T	P	C
					3	0	0	3
Course Objectives:		To provide students with a clear understanding of insurance principles and fee-based financial services within the Indian financial system.						
Unit – I	INTRODUCTION TO INDIAN BANKING SYSTEM						9	
Overview of Banking system – Structure – Functions –Banking system in India - Key Regulations in Indian Banking sector –RBI. Relationship between Banker and Customer - Retail & Wholesale Banking – types of Accounts - Opening and operation of Accounts.								
Unit – II	MANAGING BANK FUNDS/ PRODUCTS						9	
Liquid Assets - Investment in securities - Advances - Loans. Negotiable Instruments – Cheques, Bills of Exchange & Promissory Notes. Designing deposit schemes– Asset and Liability Management – NPA's – Current issues on NPA's – M&As of banks into securities market								
Unit – III	DEVELOPMENT IN BANKING TECHNOLOGY						9	
Payment system in India – paper based – e payment –electronic banking –plastic money – e-money –forecasting of cash demand at ATM's –The Information Technology Act, 2000 in India – RBI's Financial Sector Technology vision document – security threats in e-banking & RBI's Initiative.								
Unit – IV	FINANCIAL SERVICES						9	
Introduction – Need for Financial Services – Financial Services Market in India – NBFC – Leasing and Hire Purchase — mutual funds. Venture Capital Financing –Bill discounting –factoring – Merchant Banking								
Unit – V	INSURANCE						9	
Insurance –Concept - Need - History of Insurance industry in India. Insurance Act, 1938 –IRDA –Regulations – Life Insurance - Annuities and Unit Linked Policies - Lapse of the Policy – revival –settlement of claim								
Total Periods:							45	

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Apply the principles of banking operations by analyzing the structure and functions of the banking system in India, complying with key regulations by the RBI, managing banker-customer relationships, and effectively performing retail and wholesale banking operations including opening and operating various types of accounts.	K3
CO2	Develop strategies for effective asset and liability management in banks by designing deposit schemes, managing investments in securities, advances, and loans, handling negotiable instruments, and addressing contemporary issues such as NPAs and bank mergers in the securities market.	K3
CO3	Examine the payment systems in India, including paper-based and electronic modes, e-banking, plastic money, and e-money, by analyzing cash forecasting at ATMs, evaluating regulatory frameworks such as the Information Technology Act, 2000, RBI's technology vision, and assessing security threats and RBI initiatives in e-banking.	K4
CO4	Construct comprehensive financial service solutions by designing and integrating services such as NBFC operations, leasing and hire purchase schemes, mutual funds, venture capital financing, bill discounting, factoring, and merchant banking to meet the needs of the financial market in India.	K3
CO5	Analyze the structure and functioning of the insurance industry in India by examining the historical development, regulatory framework including the Insurance Act, 1938 and IRDA regulations, and evaluating life insurance products, annuities, unit-linked policies, policy lapses, revivals, and claim settlement processes.	K4

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	-	2	-	1	3	3	3	-	3	3	3	3	2
CO2	1	-	1	-	1	3	2	2	-	2	2	-	-	1
CO3	3	-	3	-	3	3	3	3	-	3	3	3	3	3
CO4	3	3	3	-	3	-	-	-	-	-	-	2	2	3
CO5	2	2	2	-	2	-	-	-	-	-	-	2	2	2
CO	2.20	2.50	2.20	-	2.00	3.00	2.67	2.67	-	2.67	2.67	2.50	2.50	2.20

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Padmalatha Suresh & Justin Paul, Management of Banking and Financial Services, Pearson, Delhi, 2017
2	M.Y. Khan Indian Financial System, McGraw Hill Education, 2015

Reference Books

1	Meera Sharma Management of Financial Institutions: With Emphasis on Bank and Risk Management, PHI Learning Pvt. Ltd., New Delhi, 2010.
2	Peter S. Rose & Sylvia C. Hudgins Bank Management and Financial Services, Tata McGraw Hill, New Delhi, 2017.
3	K.C. Shekhar & Lekshmy Shekhar Banking Theory and Practice, Vikas Publishing, 2015.
4	M.Y. Khan Indian Financial System, McGraw Hill Education, 2015.



U24CB5V04	INTRODUCTION TO BLOCKCHAIN AND ITS APPLICATION		L	T	P	C
			3	0	0	3
Course Objectives:	Apply blockchain and cryptocurrency concepts by constructing and demonstrating practical use cases involving distributed systems, consensus mechanisms, smart contracts, Ethereum networks, Web3 frameworks, Hyperledger protocols, and emerging blockchain platforms to solve real-world problems in decentralization, scalability, and privacy.					
Unit - I	INTRODUCTION TO BLOCKCHAIN					9
Blockchain: The growth of blockchain technology - Distributed systems - The history of blockchain and Bitcoin - Features of a blockchain - Types of blockchain, Consensus: Consensus mechanism - Types of consensus mechanisms - Consensus in blockchain. Decentralization: Decentralization using blockchain - Methods of decentralization - Routes to decentralization- Blockchain and full ecosystem decentralization - Smart contracts - Decentralized Organizations- Platforms for decentralization.						
Unit - II	INTRODUCTION TO CRYPTOCURRENCY					9
Bitcoin – Digital Keys and Addresses – Transactions – Mining – Bitcoin Networks and Payments – Wallets – Alternative Coins – Theoretical Limitations – Bitcoin limitations – Name coin – Prime coin – Zcash – Smart Contracts – Ricardian Contracts- Deploying smart contracts on a blockchain						
Unit - III	ETHEREUM					9
Introduction - The Ethereum network - Components of the Ethereum ecosystem - Transactions and messages - Ether cryptocurrency / tokens (ETC and ETH) - The Ethereum Virtual Machine (EVM), Ethereum Development Environment: Test networks - Setting up a private net - Starting up the private network						
Unit – IV	WEB3 AND HYPERLEDGE					9
Introduction to Web3 – Contract Deployment – POST Requests – Development Frameworks – Hyperledger as a Protocol – The Reference Architecture – Hyperledger Fabric – Distributed Ledger – Corda						
Unit - V	EMERGING TRENDS					9
Kadena – Ripple – Rootstock – Quorum – Tendermint – Scalability – Privacy – Other Challenges – Blockchain Research – Notable Projects – Miscellaneous Tools.						
Total Periods:						45

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Apply blockchain principles by constructing examples of distributed systems, consensus mechanisms, and decentralization methods to demonstrate how smart contracts and decentralized organizations function within different types of blockchain ecosystems.	K3
CO2	Build Bitcoin transactions by utilizing digital keys and addresses, demonstrating mining and wallet operations, and deploying smart contracts on blockchain platforms to explore the functionality and limitations of alternative cryptocurrencies.	K3
CO3	Choose appropriate components of the Ethereum ecosystem and development environment to build private networks, deploy transactions, and utilize the Ethereum Virtual Machine for practical blockchain applications.	K3
CO4	Construct decentralized applications by deploying smart contracts, configuring POST requests, and utilizing development frameworks, while implementing Hyperledger Fabric and Corda to demonstrate distributed ledger solutions.	K3
CO5	Develop blockchain-based solutions by experimenting with platforms such as Kadena, Ripple, Rootstock, Quorum, and Tendermint to address challenges of scalability, privacy, and interoperability, while analyzing notable projects and research tools.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	3	2	3	3	1	3	3	3	3	3	3	2	2
CO2	3	3	2	3	3	-	3	3	3	3	3	3	2	3
CO3	3	3	2	3	3	1	3	3	3	3	3	2	1	2
CO4	3	3	2	3	3	1	3	3	3	3	3	-	2	1
CO5	3	3	2	3	3	1	3	3	3	3	3	2	2	1
CO	3	3	2	3	3	1	3	3	3	3	3	2.5	1.8	1.8

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Imran. Bashir. Mastering block chain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained. Packt Publishing, 2nd Edition, 2018
2	Peter Borovykh , Blockchain Application in Finance, Blockchain Driven, 2nd Edition, 2018

Reference Books

1	Arshdeep Bahga, Vijay Madisetti, "Blockchain Applications: A Hands On Approach", VPT, 2017.
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U24CB5V05	FINTECH PERSONAL FINANCE AND PAYMENTS				L	T	P	C
					3	0	0	3
Course Objective:		Introduce learners to the fundamentals of FinTech and its role in personal finance, digital payment systems and platforms develop practical knowledge of personal financial planning using FinTech tools and familiarize with emerging trends in personal finance.						
Unit - I	INTRODUCTION TO FINTECH AND PERSONAL FINANCE						9	
Evolution of FinTech, Traditional vs Digital Financial Services, Basics of Personal Finance: Income, Expenses, Savings, Investments, Role of FinTech in Personal Financial Management, Overview of FinTech Ecosystem.								
Unit - II	DIGITAL PAYMENT SYSTEMS						9	
Digital Payment Instruments: Cards, Wallets, UPI, QR Codes, Payment Gateways and Aggregators, Mobile Banking and Internet Banking, Real-Time Payment Systems, Cross-Border Payments and Remittances.								
Unit - III	FINTECH TOOLS FOR PERSONAL FINANCIAL MANAGEMENT						9	
Budgeting and Expense Tracking Apps, Digital Savings and Investment Platforms, Robo-Advisors and Automated Wealth Management, Credit Scoring and Digital Lending Platforms, Buy Now Pay Later (BNPL) Models.								
Unit – IV	SECURITY, RISK, AND REGULATION IN FINTECH						9	
Cybersecurity Threats in Digital Payments, Data Privacy and Consumer Protection, Fraud Detection and Risk Management, Regulatory Frameworks (RBI, NPCI, Global Standards), Compliance and Ethical Issues in FinTech.								
Unit - V	EMERGING TRENDS AND FUTURE OF PERSONAL FINANCE						9	
AI and Big Data in Personal Finance, Blockchain and Cryptocurrencies in Payments, Open Banking and API-based Finance, Embedded Finance, Future Challenges and Opportunities in FinTech.								
Total Periods:							45	

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the fundamentals of FinTech and personal finance concepts	K2
CO2	Infer various digital payment systems and platforms	K2
CO3	Apply FinTech tools for budgeting, saving, and investing	K3
CO4	Solve security, risk, and regulatory issues in digital finance	K3
CO5	Identify emerging FinTech trends and their impact on personal finance	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	-	-	1	1	-	2	-	-	-	2	-	1
CO2	2	2	1	-	3	1	-	2	-	1	-	3	2	1
CO3	2	3	3	2	3	-	-	1	1	1	-	3	3	2
CO4	2	3	2	3	2	2	1	3	-	-	1	2	3	2
CO5	1	2	2	3	3	1	2	2	-	-	2	2	2	3
CO	2.00	2.40	2.00	2.67	2.40	1.25	1.50	2.00	1.00	1.00	1.50	2.40	2.50	1.80

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)



Text Books

1	Financial Technology (FinTech) and Digital Banking in India — Jaspal Singh (2022)
2	Finance For Fintech Professionals – World Scientific (2022 edition)
3	Fintech Regulation In Practice: Navigate the Complexities and Opportunities of Regulation by <i>Maha El Dimachki</i> , 2024 edition.
4	Trends and Challenges of Electronic Finance: Perspectives from Emerging Markets by Ananda S., Tamanna Dalwai & Dharmendra Singh, 2025 edition.

Reference Books

1	Felix I. Lessambo “Fintech Regulation and Supervision Challenges Within the Banking Industry” 2023 edition
2	Financial Services Technology: Processes, Architecture and Solutions by Randall E. Duran, 2023 Edition



U24CB5V06		FINTECH			L	T	P	C
					3	0	0	3
Course Objective:		To familiarize foundational understanding of FinTech concepts with digital payment systems electronic banking, blockchain, cryptocurrencies, FinTech applications in lending, insurance, wealth management, FinTech regulations and compliance frameworks.						
Unit - I	INTRODUCTION TO FINTECH						9	
Definition and scope of FinTech, Evolution of financial systems, Traditional finance vs FinTech, FinTech ecosystem: startups, regulators, banks, customers, Overview of global and Indian FinTech landscape.								
Unit - II	DIGITAL PAYMENTS AND ELECTRONIC BANKING						9	
Digital payment systems: UPI, wallets, cards, Online and mobile banking, Payment gateways and settlement systems, Role of FinTech in financial inclusion.								
Unit - III	BLOCKCHAIN AND CRYPTOCURRENCIES						9	
Blockchain fundamentals and architecture, Distributed Ledger Technology (DLT), Cryptocurrencies and crypto exchanges, Smart contracts and applications.								
Unit – IV	FINTECH IN LENDING, INSURANCE, AND WEALTH MANAGEMENT						9	
Peer-to-Peer (P2P) lending platforms, Digital lending and credit scoring, InsurTech models, Robo-advisors and wealth management tools.								
Unit - V	REGULATION, SECURITY, AND FUTURE TRENDS						9	
FinTech regulations and compliance frameworks, Cybersecurity and data privacy issues, Ethical challenges in FinTech, Emerging trends: AI, Big Data, Open Banking.								
Total Periods:							45	

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Understand the fundamentals, evolution, and ecosystem of FinTech	K2
CO2	Illustrate digital payment systems and electronic banking technologies	K2
CO3	Identify blockchain technology, cryptocurrencies, and smart contracts	K3
CO4	Apply FinTech concepts in lending, insurance, and wealth management domains	K3
CO5	Select regulatory, security, and ethical challenges and future trends in FinTech	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	-	-	1	-	-	-	-	-	-	2	1	-
CO2	2	3	1	-	2	-	-	-	-	-	-	3	2	1
CO3	2	3	2	1	2	-	-	-	-	-	-	3	2	1
CO4	1	2	3	2	2	-	-	-	-	-	-	3	3	2
CO5	1	2	-	3	3	1	1	2	-	1	2	2	2	3
CO	1.80	2.40	2.00	2.00	2.00	1.00	1.00	2.00	-	1.00	2.00	2.60	2.00	1.75

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)



Text Books

1	Ross P. Buckley, Douglas W. Arner & Dirk A. Zetsche "FinTech: Finance, Technology and Regulation — Cambridge University Press" 2024 edition
2	Fintech Regulation In Practice: Navigate the Complexities and Opportunities of Regulation, by Maha El Dimachki, 2024 edition.
3	Understanding Cybersecurity Management in FinTech: Challenges, Strategies, and Trends by Gurdip Kaur, Ziba Habibi Lashkari, and Arash Habibi Lashkari 2022 edition.

Reference Books

1	Jayanta Chakraborti, Shalini Aggarwal & Pardeep Kumar "FinTech 5.0: The Journey from Cryptocurrency to Neobanking" 2025 edition
2	Fintech and Cryptocurrency by Mohd Naved, V. Ajantha Devi, Aditya Kumar Gupta, 2023 edition.
3	Fintech Regulation and Supervision Challenges within the Banking Industry by Felix I. Lessambo, 2023 edition.
4	Applications and Trends in Fintech by David Kuo Chuen Lee, Joseph Lim, Kok Fai Phoon & Yu Wang, 2023 edition.



U24CB5W01		FOUNDATIONS OF ENTREPRENEURSHIP				L	T	P	C
						3	0	0	3
Course Objectives:		To develop a strong foundation in entrepreneurship and technopreneurship by understanding skills, ownership, environment, and technology-driven ventures through practical and global insights.							
Unit - I	INTRODUCTION TO ENTREPRENEURSHIP							9	
Entrepreneurship- Definition, Need, Scope - Entrepreneurial Skill & Traits - Entrepreneur vs. Intrapreneur; Classification of entrepreneurs, Types of entrepreneurs -Factors affecting entrepreneurial development – Achievement Motivation – Contributions of Entrepreneurship to Economic Development.									
Unit - II	BUSINESS OWNERSHIP & ENVIRONMENT							9	
Types of Business Ownership – Business Environmental Factors – Political-Economic- Sociological-Technological- Environmental-Legal aspects – Human Resources Mobilisation-Basics of Managing Finance- Essentials of Marketing Management - Production and Operations Planning – Systems Management and Administration									
Unit - III	FUNDAMENTALS OF TECHNOPRENEURSHIP							9	
Introduction to Technopreneurship - Definition, Need, Scope- Emerging Concepts- Principles - Characteristics of a technopreneur - Impacts of Technopreneurship on Society – Economy- Job Opportunities in Technopreneurship - Recent trends									
Unit – IV	APPLICATIONS OF TECHNOPRENEURSHIP							9	
Technology Entrepreneurship - Local, National and Global practices - Intrapreneurship and Technology interactions, Networking of entrepreneurial activities – Launching – Managing Technology based Product / Service entrepreneurship - – Success Stories of Technopreneurs - Case Studies									
Unit - V	EMERGING TRENDS IN ENTREPRENEURSHIP							9	
Effective Business Management Strategies For Franchising - Sub-Contracting- Leasing- Technopreneurs – Agripreneurs - Netpreneurs- Portfolio entrepreneurship - NGO Entrepreneurship – Recent Entrepreneurial Developments - Local – National – Global perspectives.									
Total Periods:								45	

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Make use of core entrepreneurship concepts to analyze traits, classifications, economic contributions, and growth factors through measurable evaluation.	K3
CO2	Identify business ownership types and environmental factors while applying HR, finance, marketing, and operations concepts in measurable scenarios.	K3
CO3	Utilize technopreneurship concepts to evaluate its principles, scope, and socio-economic impact through measurable contemporary scenarios.	K3
CO4	Apply technology entrepreneurship concepts across contexts by integrating intrapreneurship, networking, and product launch strategies to achieve measurable outcomes.	K3
CO5	Develop business strategies for diverse entrepreneurial models, including franchising and technopreneurship, through measurable local and global analyses.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	1	3	3	2	2	2	3	3	3	3	3	3	3	3
CO2	1	3	3	2	2	2	3	3	3	3	3	3	3	3
CO3	2	3	3	3	3	2	3	3	3	3	3	3	3	3
CO4	2	3	3	3	3	2	3	3	3	3	3	3	3	3
CO5	2	3	3	3	3	2	3	3	3	3	3	3	3	3
CO	1.60	3.00	3.00	2.60	2.60	2.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	S. S. Khanka, "Entrepreneurial Development", Revised Edition, S. Chand Publishing, 2023
2	Robert D. Hisrich, Michael P. Peters & Dean A. Shepherd, "Entrepreneurship", 11th Edition, McGraw-Hill Education, 2024
3	Peter F. Drucker, "Innovation and Entrepreneurship", Routledge Modern Classics Edition, 2025 Reprint
4	Brad Feld & Jason Mendelson, "Venture Deals", 4th Edition, Wiley, 2023

Reference Books

1	Donald F. Kuratko, "Entrepreneurship: Theory, Process, Practice", 12th Edition, Cengage Learning, 2023
2	Thomas H. Byers, Richard C. Dorf & Andrew J. Nelson, "Technology Ventures: From Idea to Enterprise", 5th Edition, McGraw-Hill Education, 2024
3	Tidd & Bessant, "Managing Innovation", 8th Edition, Wiley, 2024
4	Eric Ries, "The Lean Startup", Updated Edition, Crown Business, 2023



U24CB5W02		TEAM BUILDING & LEADERSHIP MANAGEMENT FOR BUSINESS				L	T	P	C
						3	0	0	3
Course Objectives:		It provides a comprehensive understanding of team dynamics, formation, and management, including virtual and multicultural teams, while developing measurable skills in leadership, coaching, mentoring, motivation, conflict resolution, and global practices.							
Unit - I	INTRODUCTION TO MANAGING TEAMS							9	
Introduction to Team - Team Dynamics - Team Formation – Stages of Team Development - Enhancing teamwork within a group - Team Coaching - Team Decision Making - Virtual Teams - Self Directed Work Teams (SDWTs) -Multicultural Teams.									
Unit - II	MANAGING AND DEVELOPING EFFECTIVE TEAMS							9	
Team-based Organizations- Leadership roles in team-based organizations - Offsite training and team development - Experiential Learning - Coaching and Mentoring in team building – Building High-Performance Teams - Building Credibility and Trust - Skills for Developing Others – Team Building at the Top - Leadership in Teamwork Effectiveness									
Unit - III	INTRODUCTION TO LEADERSHIP							9	
Introduction to Leadership - Leadership Myths – Characteristics of Leader, Follower and Situation - Leadership Attributes - Personality Traits and Leadership- Intelligence Types and Leadership - Power and Leadership - Delegation and Empowerment.									
Unit – IV	LEADERSHIP IN ORGANISATIONS							9	
Leadership Styles – LMX Theory- Leadership Theory and Normative Decision Model – Situational Leadership Model - Contingency Model and Path Goal Theory – Transactional and Transformational Leadership - Charismatic Leadership - Role of Ethics and Values in Organisational Leadership.									
Unit - V	LEADERSHIP EFFECTIVENESS							9	
Leadership Behaviour - Assessment of Leadership Behaviors - Destructive Leadership - Motivation and Leadership - Managerial Incompetence and Derailment Conflict Management - Negotiation and Leadership - Culture and Leadership - Global Leadership – Recent Trends in Leadership.									
Total Periods:								45	

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Build effective teams by applying team dynamics and development strategies to achieve measurable outcomes in coaching, decision-making, and multicultural or virtual environments.	K3
CO2	Construct high-performance teams by applying leadership, coaching, and mentoring to enhance trust, skills, and overall teamwork effectiveness with measurable outcomes.	K3
CO3	Develop a comprehensive understanding of leadership by analyzing traits, intelligence, and leader-follower dynamics while demonstrating measurable skills in delegation, empowerment, and use of leadership power.	K3
CO4	Utilize leadership styles and theories—LMX, situational, contingency, path-goal, transactional, transformational, and charismatic—to solve organizational challenges while integrating measurable ethics and values.	K3
CO5	Model effective leadership by evaluating motivation, conflict, negotiation, and cultural influences while addressing destructive and global leadership challenges with measurable strategies.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	1	-	-	-	-	-	-	2	-	3	-	2	2	2
CO2	1	3	2	1	2	-	-	2	2	3	-	3	3	3
CO3	1	3	3	2	3	-	-	2	2	3	-	3	3	3
CO4	1	3	2	2	3	-	3	3	2	3	-	3	3	3
CO5	1	3	2	3	3	-	3	2	2	3	-	3	3	3
CO	1.00	3.00	2.25	2.00	2.75	-	3.00	2.20	2.00	3.00	-	2.80	2.80	2.80

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	W.G. Dyer, J.H. Dyer & W.G. Dyer Jr., "Team Building: Proven Strategies for Improving Team Performance", 6th Edition, Wiley, 2024
2	Hughes, Ginnett & Curphy, "Leadership: Enhancing the Lessons of Experience", 10th Edition, McGraw-Hill Education, 2023
3	Daniel Levi, "Group Dynamics for Teams", 6th Edition, Sage Publications, 2023

Reference Books

1	Richard L. Daft, "The Leadership Experience", 8th Edition, Cengage Learning, 2022
2	Peter G. Northouse, "Leadership: Theory and Practice", 9th Edition, Sage Publications, 2022
3	Stephen P. Robbins & Timothy A. Judge, "Organizational Behavior", 19th Edition, Pearson, 2023



U24CB5W03		CREATIVITY & INNOVATION IN ENTREPRENEURSHIP				L	T	P	C
						3	0	0	3
Course Objectives:		To develop students' creativity and creative intelligence by understanding creative processes, tools, personality traits, and environments that enhance innovation. It also seeks to build competence in innovation, entrepreneurship, and designing responsible and innovative business models through systematic analysis, design thinking, and opportunity evaluation.							
Unit - I		CREATIVITY						9	
Creativity: Definition- Forms of Creativity-Essence, Elaborative and Expressive Creativities- Quality of Creativity- Existential, Entrepreneurial and Empowerment Creativities – Creative Environment- Creative Technology- - Creative Personality and Motivation									
Unit - II		CREATIVE INTELLIGENCE						9	
Creative Intelligence: Convergent thinking ability – Traits Congenial to creativity – Creativity Training--Criteria for evaluating Creativity-Credible Evaluation- Improving the quality of our creativity – Creative Tools and Techniques - Blocks to creativity- fears and Disabilities- Strategies for Unblocking- Designing Creativity Enabling Environment									
Unit - III		INNOVATION						9	
Innovation: Definition- Levels of Innovation- Incremental Vs Radical Innovation-Product Innovation and Process- Technological, Organizational Innovation – Indicators- Characteristics of Innovation in Different Sectors. Theories in Innovation and Creativity- Design Thinking and Innovation- Innovation as Collective Change-Innovation as a system									
Unit – IV		INNOVATION AND ENTREPRENEURSHIP						9	
Innovation and Entrepreneurship: Entrepreneurial Mindset, Motivations and Behaviours- Opportunity Analysis and Decision Making- Industry Understanding – Entrepreneurial Opportunities- Entrepreneurial Strategies – Technology Pull/Market Push – Product -Market fit									
Unit - V		INNOVATIVE BUSINESS MODELS						9	
Innovative Business Models: Customer Discovery-Customer Segments-Prospect Theory and Developing Value Propositions- Developing Business Models: Elements of Business Models – Innovative Business Models: Elements, Designing Innovative Business Models- Responsible Innovation and Creativity.									
Total Periods:								45	

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Select suitable forms of creativity by evaluating context, environment, personality, technology, and motivation in practical scenarios.	K3
CO2	Utilize creative intelligence through convergent thinking and training techniques while overcoming barriers to design measurable creativity-enhancing environments.	K3
CO3	Make use of innovation concepts by differentiating types and levels across domains and using design thinking to implement and measure innovation effectively.	K3
CO4	Develop an entrepreneurial mindset by evaluating motivations and opportunities and applying measurable strategies to achieve product–market fit.	K3
CO5	Construct innovative business models by defining customer segments and value propositions while implementing measurable, responsible innovation strategies.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	3	2	3	3	-	-	3	3	3	3	3	3	3
CO2	2	3	2	3	3	1	3	3	3	3	3	1	1	1
CO3	2	3	2	3	3	2	3	3	3	3	3	1	1	1
CO4	2	3	3	3	3	1	3	3	3	3	3	2	2	2
CO5	3	3	3	3	3	3	3	3	3	3	3	2	2	2
CO	2.40	3.00	2.40	3.00	3.00	1.75	3.00	3.00	3.00	3.00	3.00	1.80	1.80	1.80

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Paul Trott, "Innovation Management & New Product Development", 6th Edition, Pearson, 2023
2	Tidd & Bessant, "Managing Innovation: Integrating Technological, Market and Organizational Change", 8th Edition, Wiley, 2024
3	V. K. Narayanan & G. S. Balasubramanian, "Innovation: A Strategic Management Perspective", 2nd Edition, Cengage Learning India, 2023
4	Stephen P. Robbins & Timothy A. Judge, "Organizational Innovation and Change", Pearson, 2024

Reference Books

1	A. Dale Timpe, Creativity, Jaico Publishing House, 2003.
2	Brian Clegg, Paul Birch, Creativity, Kogan Page, 2009
3	Pradip N Khandwalla, Lifelong Creativity, An Unending Quest, Tata Mc Graw Hill, 2004.



U24CB5W04		PRINCIPLES OF MARKETING MANAGEMENT FOR BUSINESS			L	T	P	C
					3	0	0	3
Course Objectives:		It provides a comprehensive understanding of marketing management by covering concepts, marketing mix, research, product, pricing, promotion, distribution, and contemporary practices like CRM, relationship, and e-marketing for measurable skill development.						
Unit – I	INTRODUCTION TO MARKETING MANAGEMENT					9		
Introduction - Market and Marketing – Concepts- Functions of Marketing - Importance of Marketing - Marketing Orientations - Marketing Mix-The Traditional 4Ps - The Modern Components of the Mix - The Additional 3Ps - Developing an Effective Marketing Mix.								
Unit – II	MARKETING ENVIRONMENT					9		
Introduction - Environmental Scanning - Analysing the Organisation’s Micro Environment and Macro Environment - Differences between Micro and Macro Environment – Techniques of Environment Scanning - Marketing organization - Marketing Research and the Marketing Information System, Types and Components.								
Unit – III	PRODUCT AND PRICING MANAGEMENT					9		
Product- Meaning, Classification, Levels of Products – Product Life Cycle (PLC) – Product Strategies - Product Mix - Packaging and Labelling - New Product Development - Brand and Branding - Advantages and disadvantages of branding Pricing - Factors Affecting Price Decisions - Cost Based Pricing - Value Based and Competition Based Pricing - Pricing Strategies – National and Global Pricing.								
Unit – IV	PROMOTION AND DISTRIBUTION MANAGEMENT					9		
Introduction to Promotion – Marketing Channels- Integrated Marketing Communications (IMC) - Introduction to Advertising and Sales Promotion – Basics of Public Relations and Publicity - Personal Selling - Process - Direct Marketing - Segmentation, Targeting and Positioning (STP)- Logistics Management- Introduction to Retailing and Wholesaling.								
Unit – V	CONTEMPORARY ISSUES IN MARKETING MANAGEMENT					9		
Introduction - Relationship Marketing Vs. Relationship Management - Customer Relationship Management (CRM) - Forms of Relationship Management - CRM practices - Managing Customer Loyalty and Development – Buyer-Seller Relationships- Buying Situations in Industrial / Business Market - Buying Roles in Industrial Marketing - Factors that Influence Business – Services Marketing - E-Marketing or Online Marketing.								
Total Periods:								45

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Choose appropriate marketing concepts and functions to design an effective mix using traditional 4Ps, modern elements, and additional 3Ps for measurable organizational outcomes.	K3
CO2	Model effective marketing strategies by analyzing environmental factors and leveraging measurable insights from marketing research and information systems for informed decision-making.	K3
CO3	Organize product activities by classifying products, analyzing life cycles, and formulating branding strategies while applying measurable pricing approaches for domestic and global markets.	K3
CO4	Plan promotional and distribution activities by integrating marketing channels and communication tools while applying measurable strategies for STP, logistics, retailing, and wholesaling to achieve organizational goals.	K3
CO5	Utilize relationship marketing and CRM concepts to manage customer loyalty and interactions while implementing measurable strategies in services and e-marketing to improve business performance.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	3	3	3	3	3	3	3	3	3	3	2	2	2
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	2	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	2	3	3	3	3	2	3	3	3	3	3	3	3	3
CO5	2	3	3	3	3	2	3	3	3	3	3	3	3	3
CO	2.20	3.00	3.00	3.00	3.00	2.60	3.00	3.00	3.00	3.00	3.00	2.80	2.80	2.80

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)s

Text Books

1	V.S. Ramaswamy & S. Namakumari, "Marketing Management: Global Perspective, Indian Context", 7th Edition, Sage Publications India, 2023
2	S.A. Sherlekar & Dr. P. Krishnamoorthy, "Marketing Management", Revised Edition, Himalaya Publishing House, 2023
3	Dhruv Grewal & Michael Levy, "Marketing", 8th Edition, McGraw-Hill Education, 2024

Reference Books

1	Philip Kotler, Kevin Lane Keller, Alexander Chernev, "Marketing Management", 16th Edition, Pearson, 2022
2	C.B. Gupta & N. Rajan Nair, "Marketing Management: Text and Cases", 18th Edition, Sultan Chand & Sons, 2022
3	Tapan K. Panda & Sunil Sahadev, "Marketing Management: A Strategic Approach", Oxford University Press, 2023
4	Kerin, Hartley & Rudelius, "Marketing", 14th Edition, McGraw-Hill Education, 2023



U24CB5W05	HUMAN RESOURCE MANAGEMENT FOR ENTREPRENEURS				L	T	P	C
					3	0	0	3
Course Objectives:		It provides a comprehensive understanding of Human Resource Management by covering HR planning, recruitment, development, performance appraisal, compensation, and emerging trends to effectively manage organizational human capital.						
Unit – I	INTRODUCTION TO HRM						9	
Concept, Definition, Objectives- Nature and Scope of HRM - Evolution of HRM - HR Manager Roles- Skills - Personnel Management Vs. HRM - Human Resource Policies - HR Accounting - HR Audit - Challenges in HRM.								
Unit - II	HUMAN RESOURCE PLANNING						9	
HR Planning - Definition - Factors- Tools - Methods and Techniques - Job analysis- Job rotation- Job Description - Career Planning - Succession Planning - HRIS - Computer Applications in HR - Recent Trends								
Unit – III	RECRUITMENT AND SELECTION						9	
Sources of recruitment- Internal Vs. External - Domestic Vs. Global Sources -eRecruitment - Selection Process- Selection techniques -eSelection- Interview Types- Employee Engagement.								
Unit – IV	TRAINING AND EMPLOYEE DEVELOPMENT						9	
Types of Training - On-The-Job, Off-The-Job - Training Needs Analysis – Induction and Socialisation Process - Employee Compensation - Wages and Salary Administration – Health and Social Security Measures- Green HRM Practices								
Unit – V	CONTROLLING HUMAN RESOURCES						9	
Performance Appraisal – Types - Methods - Collective Bargaining - Grievances Redressal Methods – Employee Discipline – Promotion – Demotion - Transfer – Dismissal - Retrenchment - Union Management Relationship - Recent Trends - Case Studies - HR software exposure								
Total Periods:							45	

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Construct a comprehensive understanding of HRM by analyzing its concepts, scope, and challenges while applying measurable knowledge of HR roles, policies, and audits.	K3
CO2	Experiment with planning tools and techniques for job analysis, rotation, and descriptions while using measurable approaches for career planning, succession, HRIS, and current HR trends.	K3
CO3	Apply recruitment strategies by selecting suitable internal, external, and digital sources, and implementing measurable selection, interview, and engagement processes.	K3
CO4	Model effective training programs by analyzing training needs, managing induction, and integrating measurable compensation, benefits, and Green HRM practices.	K3
CO5	Choose appropriate performance appraisal, grievance, and collective bargaining methods while implementing measurable strategies for discipline, promotions, transfers, and union-management relations.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	2	2	2	1	1	2	1	3	3	3	2	2
CO2	3	2	2	2	2	1	1	3	1	3	3	3	2	2
CO3	3	2	2	2	2	1	1	3	1	3	3	3	2	2
CO4	3	2	2	2	2	1	1	3	1	3	3	3	2	2
CO5	3	2	2	2	2	1	1	3	1	3	3	3	2	2
CO	3.00	2.00	2.00	2.00	2.00	1.00	1.00	2.80	1.00	3.00	3.00	3.00	2.00	2.00

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)



Text Books

1	Dessler & Varkkey – Human Resource Management, 16th Ed., Pearson, 2023
2	Mondy & Noe – Human Resource Management, 16th Ed., Cengage, 2022
3	DeCenzo, Robbins & Verhulst – Fundamentals of Human Resource Management, 8th Ed., Wiley (Reprint 2023)

Reference Books

1	Aswathappa & Dash – Human Resource Management: Text and Cases, 10th Ed., McGraw Hill, 2024
2	Gomez-Mejia, Balkin & Cardy – Managing Human Resources, 8th Ed., Pearson/PHI, 2023
3	Ivancevich, Konopaske & Matteson – Organizational Behavior and Management, 12th Ed., McGraw Hill, 2022
4	P. Subba Rao – Essentials of Human Resource Management & Industrial Relations, 4th Ed., Himalaya Publishing, 2022



U24CB5W06	FINANCING NEW BUSINESS VENTURES				L	T	P	C
					3	0	0	3
Course Objectives:	It provides comprehensive knowledge of launching new ventures, including registration, location, government support, financing options, and fund-raising strategies for sustainable growth.							
Unit - I	ESSENTIALS OF NEW BUSINESS VENTURE							9
Setting up new Business Ventures – Need - Scope - Franchising - Location Strategy, Registration Process - State Directorate of Industries- Financing for New Ventures - Central and State Government Agencies - Types of loans – Financial Institutions - SFC, IDBI, NSIC and SIDCO.								
Unit - II	INTRODUCTION TO VENTURE FINANCING							9
Venture Finance – Definition – Historic Background - Funding New Ventures- Need – Scope – Types - Cost of Project - Means of Financing - Estimation of Working Capital - Requirement of funds – Mix of Debt and Equity - Challenges and Opportunities - NPV, IRR, Payback.								
Unit - III	SOURCES OF DEBT FINANCING							9
Fund for Capital Assets - Term Loans - Leasing and Hire-Purchase - Money Market instruments – Bonds, Corporate Papers – Preference Capital- Working Capital Management- Fund based Credit Facilities - Cash Credit - Over Draft.								
Unit – IV	SOURCES OF EQUITY FINANCING							9
Own Capital, Unsecured Loan - Government Subsidies, Margin Money- Equity Funding – Private Equity Fund- Schemes of Commercial banks - Angel Funding – Crowdfunding- Venture Capital								
Unit - V	METHODS OF FUND RAISING FOR NEW VENTURES							9
Investor Decision Process - Identifying the appropriate investors- Targeting investors- Developing Relationships with investors - Investor Selection Criteria- Company Creation- Raising Funds – Seed Funding- VC Selection Criteria – Process- Methods- Recent Trends								
Total Periods:								45

Course Outcomes

On completion of the course, the student can

Cos	Statements	K-Level
CO1	Develop a structured plan for launching new ventures by assessing scope, location, registration, franchising, and financing options through government agencies and financial institutions.	K3
CO2	Build a comprehensive understanding of venture finance by evaluating funding needs, cost components, working capital, debt–equity mix, and financing challenges using measurable parameters.	K3
CO3	Apply debt financing and working capital tools—including term loans, leasing, bonds, cash credit, and overdraft—in measurable financial scenarios.	K3
CO4	Identify suitable equity financing sources—including private equity, angel funding, crowdfunding, and venture capital—through measurable financial case analyses.	K3
CO5	Make use of investor decision process to identify and secure suitable funding sources, including seed and venture capital, using measurable investment criteria and trends.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	3	3	3	3	-	3	2	3	3	3	3	3	3
CO2	3	3	3	3	3	1	3	2	3	3	3	3	3	3
CO3	2	3	2	3	3	1	3	2	3	3	3	3	3	3
CO4	2	3	3	3	3	1	2	2	3	3	3	3	3	3
CO5	2	3	3	3	3	1	3	3	3	3	3	3	3	3
CO	2.40	3.00	2.80	3.00	3.00	1.00	2.80	2.20	3.00	3.00	3.00	3.00	3.00	3.00

Correlation levels 1, 2 and 3 are as defined below:

1. Slight
2. Moderate
3. Substantial (High)



Text Books

1	Brealey, Myers & Allen, "Principles of Corporate Finance", 14th Edition, McGraw-Hill Education, 2023
2	Ross, Westerfield & Jaffe, "Corporate Finance", 13th Edition, McGraw-Hill Education, 2024
3	Prasanna Chandra, "Projects: Planning, Analysis, Selection, Financing, Implementation & Review", 10th Edition, McGraw-Hill Education, 2022
4	Yescombe, E.R, "Principles of Project Finance", 3rd Edition, Academic Press (Elsevier), 2024
5	Andrew Metrick & Ayako Yasuda, "Venture Capital and the Finance of Innovation", 3rd Edition, Wiley, 2021

Reference Books

1	Brad Feld & Jason Mendelson, "Venture Deals", 4th Edition, Wiley, 2023
2	Thomas H. Byers, Richard C. Dorf & Andrew J. Nelson, "Technology Ventures: From Idea to Enterprise", 5th Edition, McGraw-Hill Education, 2024
3	Josh Lerner, Ann Leamon & Felda Hardyman, "Venture Capital, Private Equity, and the Financing of Entrepreneurship", 3rd Edition, Wiley, 2022



U24GE5X01	PRINCIPLES OF PUBLIC ADMINISTRATION	L	T	P	C
		3	0	0	3
Course Objectives:	The course aims to help students understand the meaning, scope, importance, and evolution of Public Administration. It introduces major administrative approaches, theories and thinkers, along with new trends in administration. The course also develops knowledge of key administrative processes such as leadership, communication, and decision making.				
UNIT - I	INTRODUCTION TO PUBLIC ADMINISTRATION				9
Meaning, nature and scope of Public Administration; importance of Public Administration; Public Administration as an art and science; role of Public Administration in a welfare state; evolution and growth of Public Administration.					
UNIT - II	NEW TRENDS IN PUBLIC ADMINISTRATION				9
New Public Administration – meaning and objectives; New Public Management – concept and features; Public Administration and Private Administration – meaning; similarities and differences; changing role of the government.					
UNIT - III	APPROACHES AND INTERDISCIPLINARY RELATIONS				9
Relationship of Public Administration with Political Science, History and Sociology; Classical Approach – meaning and features; Scientific Management Approach – principles and limitations.					
UNIT – IV	ADMINISTRATIVE THEORIES				9
Bureaucratic Approach – Max Weber and features of bureaucracy; merits and demerits of bureaucracy; Human Relations Approach – Elton Mayo and Hawthorne Experiments; Ecological Approach – Fred W. Riggs and his model.					
UNIT - V	ADMINISTRATIVE PROCESSES				9
Leadership – meaning, importance, styles and approaches; Communication – meaning, types, process and barriers; Decision Making – meaning, types, techniques and process.					
Total Periods:					45

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the meaning, nature, scope, and importance of Public Administration.	K2
CO2	Describe the evolution of Public Administration and recent trends such as New Public Administration and New Public Management.	K2
CO3	Illustrate the interdisciplinary relationships of Public Administration and the basic ideas of classical and scientific management approaches.	K2
CO4	Explain major administrative theories and contributions of thinkers like Max Weber, Elton Mayo, and Fred W. Riggs.	K2
CO5	Describe the concepts and processes of leadership, communication, and decision making in public administration.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	-	-	-	-	-	2	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	2	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	1	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	2	2	-	-	-	-	-	-	-
CO5	-	-	-	-	-	1	1	2	-	-	-	-	-	-
CO	-	-	-	-	-	2	2	2	-	-	-	-	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Avasthi and Maheswari: Public Administration in India, Agra:Lakshmi Narain Agarwal,2013.
2	Ramesh K Arora: Indian Public Administration, New Delhi: Wishwa Prakashan, 2012.

Reference Books

1	R.B. Jain: Public Administration in India,21st Century Challenges for Good Governance, New Delhi: Deep and Deep, 2002.
2	Rumki Basu: Public Administration:Concept and Theories, New Delhi:Sterling, 2013
3	R. Tyagi, Public Administration, Atma Ram & Sons, New Delhi, 1983.



U24GE5X02	CONSTITUTION OF INDIA			L	T	P	C
				3	0	0	3
Course Objectives:		The course introduces students to the historical development and making of the Indian Constitution. It explains the fundamental rights, duties, directive principles, and key constitutional institutions at the Union and State levels.It develops awareness of constitutional values such as secularism, social justice, and minority safeguards for understanding democratic governance.					
UNIT - I		CONSTITUTIONAL BACKGROUND				9	
Constitutional development in India from 1909 to 1947; making of the Indian Constitution; Constituent Assembly – composition, role, and functioning.							
UNIT - II		RIGHTS, DUTIES AND DIRECTIVE PRINCIPLES				9	
Fundamental Rights-meaning, significance, and enforcement; Fundamental Duties -purpose and importance; Directive Principles of State Policy-objectives and relevance in governance.							
UNIT - III		UNION GOVERNMENT				9	
President-powers and functions; Parliament-structure, composition, and functions; Supreme Court-composition, powers, and role in the constitutional framework.							
UNIT – IV		STATE GOVERNMENT				9	
Governor -powers and functions; State Legislature-composition and functions; High Court -structure, powers, and jurisdiction.							
UNIT - V		CONSTITUTIONAL VALUES				9	
Secularism-meaning and significance; Social Justice-principles and application; safeguards for minorities under the Constitution.							
Total Periods:						45	

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the historical development and the making of the Indian Constitution.	K2
CO2	Infer the role and functioning of the Constituent Assembly.	K2
CO3	Illustrate the Fundamental Rights, Fundamental Duties, and Directive Principles of State Policy.	K2
CO4	Compare the structure, powers, and functions of key Union and State government institutions including the President, Parliament, Supreme Court, Governor, State Legislature, and High Courts.	K2
CO5	Describe constitutional values such as secularism, social justice, and safeguards for minorities in India.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	-	-	-	-	-	2	-	-	1	-	-	-	-	-
CO2	-	-	-	-	-	2	-	-	1	-	-	-	-	-
CO3	-	-	-	-	-	2	-	-	2	-	-	-	-	-
CO4	-	-	-	-	-	2	2	-	2	-	-	-	-	-
CO5	-	-	-	-	-	1	2	2	3	1	-	-	-	-
CO	-	-	-	-	-	2	2	2	2	1	-	-	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Basu. D.D.: Introduction to Indian Constitution ; Prentice Hall; New Delhi
2	Kapur. A.C: Indian Government and Political System; S.Chand and Company Ltd., New Delhi.

Reference Books

1	Johari J.C.: Indian Politics, Vishal Publications Ltd, New Delhi
2	Agarwal R.C: Indian Political System; S.Chand & Co., New Delhi



U24GE5X03	PUBLIC PERSONNEL ADMINISTRATION	L	T	P	C
		3	0	0	3
Course Objectives:	The course introduces students to the meaning, scope, and importance of personnel administration and different types of personnel systems.It also explains recruitment, training, promotion, service conditions, employee relations, and compensation in public organizations.				
UNIT - I	INTRODUCTION TO PERSONNEL ADMINISTRATION			9	
Meaning, scope, and importance of personnel administration; types of personnel systems – bureaucratic, democratic, and representative systems.					
UNIT - II	CIVIL SERVANTS AND ADMINISTRATION			9	
Generalist vs. specialist roles; relationship of civil servants with the political executive; integrity and ethical conduct in administration.					
UNIT - III	RECRUITMENT, TRAINING, AND PROMOTION			9	
Recruitment – direct recruitment and recruitment from within; training – kinds and objectives; promotion policies and procedures.					
UNIT – IV	SERVICES AND SERVICE CONDITIONS			9	
All India Services – structure and functions; service conditions of personnel; role and functions of the State Public Service Commission.					
UNIT - V	EMPLOYEE RELATIONS AND COMPENSATION			9	
Employer-employee relations; wage and salary administration; allowances, benefits, and incentives.					
Total Periods:				45	

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Illustrate the meaning, scope, importance, and types of personnel administration systems.	K2
CO2	Infer the role of civil servants, their relationship with the political executive, and ethical standards in administration.	K2
CO3	Explain the processes of recruitment, training, and promotion in public services.	K2
CO4	Describe the structure, functions, and service conditions of All India Services and State Public Service Commissions.	K2
CO5	Compare employer-employee relations and the principles of wage, salary administration, allowances, and benefits.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	-	-	-	-	-	2	-	2	-	-	-	-	-	-
CO2	-	-	-	-	-	3	-	3	-	-	-	-	-	-
CO3	-	-	-	-	-	2	-	2	-	-	-	-	-	-
CO4	-	-	-	-	-	3	2	2	-	-	-	-	-	-
CO5	-	-	-	-	-	3	2	3	-	-	-	-	-	-
CO	-	-	-	-	-	2	2	2	-	-	-	-	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Stahl Glean O: Public Personnel Administration
2	Parnandikar Pai V.A: Personnel System for Development Administration
3	Bhambhiru . P: Bureaucracy and Policy in India

Reference Books

1	Dwivedi O.P and Jain R.B: India's Administrative state.
2	Muttalis M.A: Union Public Service Commission.
3	Bhakara Rao. V: Employer Employee Relations in India



U24GE5X04	ADMINISTRATIVE THEORIES	L	T	P	C
		3	0	0	3
Course Objectives:	To understand the concepts, scope, and evolution of Public Administration.To study organizational theories, behaviour, motivation, leadership, and decision-making.To learn the contributions of major administrative thinkers and their relevance to modern administration.				
UNIT - I	INTRODUCTION TO PUBLIC ADMINISTRATION			9	
Meaning, nature, scope, and significance of Public Administration; Evolution of Public Administration as a discipline; Identity and status of Public Administration.					
UNIT - II	ORGANIZATIONAL THEORIES			9	
Theories of organization with special reference to Scientific Management Theory, Classical Organizational Model, and Human Relations Theory.					
UNIT - III	ORGANIZATIONAL BEHAVIOUR AND DESIGN			9	
Organizational goals and behaviour; Groups in organizations and group dynamics; Principles and approaches to organizational design.					
UNIT – IV	MOTIVATION, LEADERSHIP, AND DECISION-MAKING			9	
Motivation theories: content, process, and contemporary theories; Leadership theories: traditional and modern approaches; Decision-making process and techniques.					
UNIT - V	ADMINISTRATIVE THINKERS			9	
Contributions of Kautilya, Woodrow Wilson, C. I. Barnard, and Peter F. Drucker to administrative thought.					
Total Periods:				45	

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Interpret the concepts, scope, importance, and development of Public Administration as an academic discipline.	K2
CO2	Summarize the fundamental organizational theories including Scientific Management, Classical, and Human Relations approaches.	K2
CO3	Discuss organizational objectives, group behaviour, group processes, and organizational design concepts.	K2
CO4	Outline motivation theories, leadership styles, and the methods involved in administrative decision-making.	K2
CO5	Describe the ideas and contributions of prominent administrative thinkers and their relevance to administration.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	-	-	-	-	-	2	-	2	-	-	-	-	-	-
CO2	-	-	-	-	-	2	-	2	-	-	-	-	-	-
CO3	-	-	-	-	-	2	-	3	-	-	-	-	-	-
CO4	-	-	-	-	-	3	2	3	-	-	-	-	-	-
CO5	-	-	-	-	-	3	2	2	-	-	-	-	-	-
CO	-	-	-	-	-	2	2	2	-	-	-	-	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Crozier M : The Bureaucratic phenomenon (Chand)
2	Blau. P.M and Scott. W : Formal Organizations (RKP)
3	Presthus. R : The Organizational Society (MAC)

Reference Books

1	Alvi, Shum Sun Nisa : Eminent Administrative Thinkers.
2	Keith Davis : Organization Theory (MAC)



U24GE5X05	INDIAN ADMINISTRATIVE SYSTEM			L	T	P	C
				3	0	0	3
Course Objectives:		To provide students with a comprehensive understanding of the structure, functioning, and constitutional framework of Indian administration, and to develop insight into contemporary administrative issues, governance, and accountability mechanisms.					
UNIT - I	EVOLUTION AND CONSTITUTIONAL FRAMEWORK OF INDIAN ADMINISTRATION					9	
Evolution and Constitutional Context of Indian Administration, Constitutional Authorities: Finance Commission, Union Public Services Commission, Election Commission, Comptroller and Auditor General of India, Attorney General of India.							
UNIT - II	DISTRICT AND LOCAL ADMINISTRATION IN INDIA					9	
Role, powers, and functions of the District Collector. Relationship between the District Collector and the Superintendent of Police. Role of the Block Development Officer in planning and implementation of development programmes. Structure and functioning of local government institutions.							
UNIT - III	PANCHAYATI RAJ AND URBAN LOCAL GOVERNANCE					9	
Main features of the 73rd Constitutional Amendment Act, 1992 with special reference to Panchayati Raj Institutions. Salient features of the 74th Constitutional Amendment Act, 1992 relating to urban local bodies.							
UNIT – IV	CONTEMPORARY ISSUES IN INDIAN ADMINISTRATION					9	
Coalition politics in India and its impact on governance and administration. Concepts of integrity and vigilance in Indian administration, including mechanisms to promote ethical governance.							
UNIT - V	CORRUPTION AND INSTITUTIONAL MECHANISMS FOR ACCOUNTABILITY					9	
Nature and causes of corruption in public administration. Ombudsman system in India. Structure, powers, and functions of Lokpal and Lokayukta.							
Total Periods:						45	

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Illustrate the evolution and constitutional framework of the Indian administrative system.	K2
CO2	Describe the roles and functions of district and local administrative institutions in India	K2
CO3	Summarize the features of the 73rd and 74th Constitutional Amendment Acts and their significance in local governance.	K2
CO4	Discuss contemporary issues such as coalition politics, integrity, and vigilance in Indian administration.	K2
CO5	Explain the nature of corruption and the role of Lokpal, Lokayukta, and ombudsman institutions in ensuring accountability.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	-	-	-	-	-	2	-	2	-	-	-	-	-	-
CO2	-	-	-	-	-	3	-	3	-	-	-	-	-	-
CO3	-	-	-	-	-	2	-	2	-	-	-	-	-	-
CO4	-	-	-	-	-	3	2	2	-	-	-	-	-	-
CO5	-	-	-	-	-	3	2	3	-	-	-	-	-	-
CO	-	-	-	-	-	2	2	2	-	-	-	-	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	S.R. Maheswari : Indian Administration
2	Khera. S.S : Administration in India
3	Ramesh K. Arora : Indian Public Administration

Reference Books

1	T.N. Chaturvedi : State administration in India
2	Basu, D.D : Introduction to the Constitution of India



U24GE5X06		PUBLIC POLICY ADMINISTRATION			L	T	P	C
					3	0	0	3
Course Objectives:		To familiarize students with different approaches to policy analysis, enabling them to critically assess and select appropriate frameworks for evaluating public policies.						
UNIT - I	FOUNDATIONS AND SCOPE OF PUBLIC POLICY						9	
Meaning and Definition of Public Policy - Nature, Scope and Importance of public policy – Public policy relationship with social sciences especially with political science and Public Administration.								
UNIT - II	APPROACHES AND MODELS OF POLICY ANALYSIS						9	
Approaches in Policy Analysis - Institutional Approach – Incremental Approach and System's Approach – Dror's Optimal Model								
UNIT - III	PUBLIC POLICY PROCESS AND STAGES OF POLICY MAKING						9	
Major stages involved in Policy making Process – Policy Formulation – Policy Implementation – Policy Evaluation.								
UNIT – IV	INSTITUTIONAL ACTORS IN PUBLIC POLICY MAKING						9	
Institutional Framework of Policy making – Role of Bureaucracy – Role of Interest Groups and Role of Political Parties.								
UNIT - V	OVERVIEW OF MAJOR PUBLIC POLICIES IN INDIA						9	
Introduction to the following Public Policies – New Economic Policy – Population Policy – Agriculture policy - Information Technology Policy.								
Total Periods:							45	

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the meaning, scope, and significance of public policy	K2
CO2	Extend and apply various approaches to policy analysis	K2
CO3	Identify and describe the major stages of the policy-making process	K2
CO4	Examine the roles of key stakeholders in the policy-making process	K2
CO5	Compare the specific public policies, such as the New Economic Policy, Population Policy, Agriculture Policy, and Information Technology Policy	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	-	-	-	-	-	2	-	2	-	-	-	-	-	-
CO2	-	-	-	-	-	2	-	2	-	-	-	-	-	-
CO3	-	-	-	-	-	2	-	3	-	-	-	-	-	-
CO4	-	-	-	-	-	3	2	3	-	-	-	-	-	-
CO5	-	-	-	-	-	3	2	2	-	-	-	-	-	-
CO	-	-	-	-	-	2	2	2	-	-	-	-	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Reference Books

1	Rajesh Chakrabarti & Kaushik Sanyal : Public Policy in India, Oxford University Press, 2016
2	Kuldeep Mathur : Public Policy and Politics in India, Oxford University Press, 2016.
3	Bidyutv Chakrabarty: Public Policy: Concept, Theory and Practice, 2015.
4	Pradeep Saxena : Public Policy Administration and Development
5	Sapru R.K. : Public Policy: Formulation, Implementation and Evaluation, Sterling Publishers, 2016.



U24CB5Y01		STATISTICS FOR MANAGEMENT				L	T	P	C
						3	1	0	4
Course Objectives:		Provide foundational knowledge in sampling distributions, estimation, hypothesis testing, and both parametric and non-parametric methods, also develop analytical skills in correlation and regression for effective data interpretation and decision making.							
Unit - I	INTRODUCTION							9+3	
Basic definitions and rules for probability - Conditional probability independence of events - Baye's theorem - Random variables - Moments - Moment generating functions - Probability distributions: Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.									
Unit - II	SAMPLING DISTRIBUTION AND ESTIMATION							9+3	
Introduction to sampling distributions - Sampling distribution of mean and proportion - Application of central limit theorem - sampling techniques - Estimation: Point and Interval estimates for population parameters of large sample and small samples - Determining the sample size.									
Unit - III	TESTING OF HYPOTHESIS - PARAMETIRC TESTS							9+3	
Hypothesis testing: one sample and two sample tests for means and proportions of large samples (z test) - One sample and two sample tests for means of small samples (t-test) - F-test for two sample standard deviations - ANOVA one way and two-way classification.									
Unit – IV	NON-PARAMETRIC TESTS							9+3	
Chi-square test for single sample standard deviation - Chi-square tests for independence of attributes and goodness of fit - Sign test for paired data - Rank sum test - Kolmogorov-Smirnov - test for goodness of fit - Comparing two populations - Mann-Whitney U test - Kruskal Wallis test - One sample run test.									
Unit - V	CORRELATION AND REGRESSION							9+3	
Correlation - Scatter diagram - Karl Pearson's coefficient of correlation - Coefficient of determination - Rank Correlation (Spearman's rank correlation) - Concept of regression - Regression lines and regression coefficients - Estimation of regression equation - Method of Least Squares - Standard Error of estimate and interpretation of results.									
Total Periods:								60	

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Apply the quantitative techniques to obtain objective solutions in business decision-making.	K3
CO2	Use an appropriate analytical technique to solve business problems.	K3
CO3	Construct an appropriate statistical technique to analyse data sets and interpret he results accurately.	K3
CO4	Make use of the relevant analytical and research skills in both research and business environments.	K3
CO5	Develop the statistical techniques to solve problems in workplace settings.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create.

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	-	1	-	-	-	-	-	1	1	-	-	-
CO2	3	2	-	1	-	-	-	-	-	1	1	-	-	-
CO3	3	2	-	1	-	-	-	-	-	1	1	-	-	-
CO4	3	2	-	1	-	-	-	-	-	1	1	-	-	-
CO5	3	2	-	1	-	-	-	-	-	1	1	-	-	-
CO	3	2	-	1	-	-	-	-	-	1	1	-	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight
2. Moderate
3. Substantial (High)



Text Books

1	Richard I. Levin, David S. Rubin, Masood H.Siddiqui, Sanjay Rastogi, Statistics for Management, Pearson Education, 8th Edition, 2017.
2	Ken Black, Applied Business Statistics, 7th Edition, Wiley India Edition, 2012.
3	David R. Anderson, Dennis J. Sweeney, Thomas A.Williams, Jeffrey D.Camm, James J.Cochran, Statistics for business and economics, 13th edition, Thomson (South – Western) Asia, Singapore, 2016.
4	T N Srivastava and Shailaja Rego, Statistics for Management, Tata McGraw Hill, 3rd Edition 2017.

Reference Books

1	Prem. S. Mann, Introductory Statistics, Wiley Publications, 9th Edition, 2015.
2	N. D. Vohra, Business Statistics, Tata McGraw Hill, 2017.
3	Gupta. S.C. and Kapoor. V. K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 12 th Edition, 2020.
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, 4 th Edition, 2012.



U24CB5Y02		DATA MINING FOR BUSINESS INTELLIGENCE				L	T	P	C
						3	0	0	3
Course Objectives:		To understand the concepts of data mining and business intelligence, explore data preprocessing and warehousing, apply major data mining techniques, analyze business decision-making using BI systems, and interpret insights using visualization and reporting tools.							
Unit - I	INTRODUCTION TO DATA MINING & BUSINESS INTELLIGENCE							9	
Basics of Data Mining – KDD Process – Types of Data – Types of Patterns – Importance of Data Mining for Business – Role of BI in Decision Making – BI Architecture – Business Metrics and KPIs – Applications of Data Mining in Marketing, Finance, Retail and Healthcare – Introduction to Real-time BI and Big Data Analytics									
Unit - II	DATA PREPROCESSING & DATA WAREHOUSING							9	
Data Quality – Missing Data Handling – Noise and Outlier Detection – Data Cleaning – Data Integration and Transformation – Discretization and Normalization – Data Reduction Techniques – ETL: Extraction, Transformation and Loading – Data Warehouse Characteristics – OLTP vs OLAP – Star and Snowflake Schemas – Fact and Dimension Tables – OLAP Operations (Roll-up, Drill-down, Slice, Dice, Pivot).									
Unit - III	DATA MINING TECHNIQUES							9	
Classification: Decision Trees, Naïve Bayes, k-Nearest Neighbour – Prediction and Regression Basics – Clustering: k-Means, Hierarchical Clustering – Cluster Evaluation – Association Rule Mining: Apriori and FP-Growth Algorithms – Support, Confidence and Lift – Model Evaluation Measures: Accuracy, Precision, Recall, F-measure, ROC and AUC – Overfitting and Model Pruning.									
Unit – IV	BUSINESS INTELLIGENCE SYSTEMS & TOOLS							9	
BI Lifecycle – Data Analysis and Insights – Principles of Data Visualization – Dashboards and Scorecards – Static and Interactive Reporting – KPI Dashboards – Introduction to BI Tools (Power BI, Tableau, Qlik Sense) – Basic Operations: Data Importing, Modeling and Visualization – SQL Server BI Tools: SSIS, SSAS, SSRS – Role of OLAP Cubes in BI.									
Unit - V	APPLICATIONS OF DATA MINING IN BUSINESS							9	
Customer Analytics – Customer Segmentation – Churn Prediction – Lifetime Value Prediction – Marketing Analytics: Recommendation Systems, Cross-sell and Up-sell Analysis – Fraud Detection and Risk Analysis – Retail Analytics: Market Basket Analysis, Demand Forecasting – Case Studies in Banking, Healthcare, Telecom and E-commerce – Ethical, Legal and Privacy Issues in Data Mining..									
Total Periods:								45	

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Outline the fundamentals of data mining and business intelligence concepts.	K2
CO2	Explain data preprocessing techniques and data warehouse operations for analytical processing	K2
CO3	Apply classification, clustering, and association rule mining techniques for business datasets.	K3
CO4	Utilize business intelligence tools for reporting, visualization, and KPI dashboard development.	K3
CO5	Analyze real-world business problems and interpret insights using data mining applications.	K4

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	2	1	2	1	-	1	1	1	1	1	2	1	1
CO2	2	2	2	2	2	-	1	1	1	1	1	2	2	1
CO3	3	3	2	3	3	1	1	1	2	1	1	3	2	1
CO4	2	2	3	3	3	1	1	1	2	2	1	2	3	2
CO5	3	3	2	3	2	2	2	2	2	2	1	3	2	2
CO	2.40	2.40	2.00	2.60	2.20	1.33	1.20	1.20	1.60	1.40	1.00	2.40	2.00	1.40

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Jiawei Han, Jian Pei, Hanghang Tong, Data Mining: Concepts and Techniques, Fourth Edition, Morgan Kaufmann / Elsevier, 2022.
2	Galit Shmueli, Peter C. Bruce, Peter Gedeck, Nitin R. Patel, Inbal Yahav, Data Mining for Business Analytics: Concepts, Techniques and Applications in Python, Second Edition, Wiley, 2023.
3	Dr. Jyotiranjana Hota, Data Mining and Business Intelligence: Data-Driven Strategy for Business Transformation, First Edition, Wiley / Academic Press, 2025
4	Ivo D. Dinov, Data Science and Predictive Analytics: Biomedical and Health Applications Using R, Second Edition, Springer, 2023.

Reference Books

1	Foster Provost, Tom Fawcett, Data Science for Business: What You Need to Know About Data Mining and Data-Analytic Thinking, Second Edition, O'Reilly Media, 2023.
2	Dean Abbott, Applied Predictive Analytics: Principles and Techniques for the Professional Data Analyst, Second Edition, Wiley, 2023.
3	Jack A. Hyman, Luca Massaron, Paul McFedries et al., Data Analytics and Visualization All-in-One for Dummies, Wiley, 2024
4	R.N. Prasad, Seema Acharya, Fundamentals of Business Analytics, First Edition, Wiley India, 2011.
5	Subhash Sharma, Applied Business Analytics: Integrating Business Process, Big Data, and Advanced Analytics, First Edition, McGraw-Hill Education, 2017.



U24CB5Y03		HUMAN RESOURCE ANALYTICS				L	T	P	C
						3	0	0	3
Course Objectives:		To introduce the foundations and importance of Human Resource Analytics, explain the role of HR data and metrics in decision-making, illustrate analytical and predictive methods for workforce insights, and describe the strategic and ethical implications of applying analytics in HR functions.							
Unit - I	INTRODUCTION TO HR ANALYTICS							9	
Understanding HR Analytics – Evolution of HR Analytics – Role of Data in HR Decision Making – Types of HR Data – HR Metrics and KPIs – HR Scorecards – Importance of Evidence-Based HR – Applications of HR Analytics in Recruitment, Performance Management, Retention and Engagement.									
Unit - II	HR DATA MANAGEMENT & METRICS							9	
HRIS: Concepts and Components – Workforce Data Sources – Data Cleaning and Validation – Employee Demographic Data, Job Data, Compensation Data – HR Metrics: Recruitment Metrics, Training Metrics, Performance Metrics, Retention Metrics – HR Dashboards – Data Visualization for HR Reporting.									
Unit - III	ANALYTICAL METHODS IN HR							9	
Descriptive Analytics in HR – Workforce Trends and Pattern Identification – Predictive Analytics Concepts – Regression Analysis for HR – Predicting Attrition, Performance, Absenteeism – Identifying High-Potential Employees – Predictive Models for Hiring and Promotion – Data Interpretation for HR Decision Support.									
Unit – IV	HR ANALYTICS TOOLS & APPLICATIONS							9	
Introduction to HR Analytics Tools (Excel, Power BI, Tableau, SPSS, Python basics) – HR Dashboard Creation – Employee Survey Analytics – Competency Mapping Analytics – Talent Acquisition Analytics – Compensation Analytics – Case Studies in HR Analytics Implementation – Challenges in Deploying HR Analytics.									
Unit - V	STRATEGIC & ETHICAL DIMENSIONS OF HR ANALYTICS							9	
Strategic HR Analytics – Linking HR Analytics to Business Outcomes – Workforce Planning and Optimization – ROI of HR Initiatives – Ethical Issues in HR Data – Data Privacy, Bias, Transparency & Fairness – Responsible Use of Analytics – Future Trends in People Analytics and AI in HR.									
Total Periods:								45	

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the fundamental principles and applications of Human Resource Analytics.	K2
CO2	Discuss HR data sources, HR metrics, and analytical reporting for workforce insights.	K2
CO3	Interpret HR analytical methods for predicting employee performance and retention.	K2
CO4	Summarize the use of HR analytics tools for visualization, dashboards, and decision support.	K2
CO5	Illustrate strategic, ethical, and organizational dimensions of HR Analytics in real-world contexts.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	3	-	-	3	-	3	3	-	2	2	3	3	3
CO2	3	3	-	-	3	-	3	3	-	3	3	3	3	3
CO3	3	3	-	-	3	-	3	3	-	3	3	3	3	3
CO4	3	3	-	-	3	-	3	3	-	3	3	3	3	3
CO5	3	3	-	-	3	-	3	3	-	3	3	3	3	3
CO	3.00	3.00	-	-	3.00	-	3.00	3.00	-	2.80	2.80	3.00	3.00	3.00

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)



Text Books

1	Jonathan Ferrar, David Green, Excellence in People Analytics: How to Use Workforce Data to Create Business Value, Second Edition, Kogan Page, 2023.
2	Ben Waber, People Analytics: How Social Sensing Technology Will Transform Business and What It Tells Us About the Future of Work, Updated Edition, FT Press / Pearson, 2022.
3	JDipak Kumar Bhattacharyya, HR Analytics: Understanding Theories and Applications, Second Edition, Sage Publications India, 2023.
4	Martin R. Edwards, Kirsten Edwards, Predictive HR Analytics: Mastering the HR Metric, Second Edition, Kogan Page, 2023.

Reference Books

1	Tracey Smith, HR Analytics: The What, Why and How, Second Edition, Kogan Page, 2023.
2	Bernard Marr, Data-Driven HR: How to Use Analytics and Metrics to Drive Performance, Updated Edition, Kogan Page, 2022.
3	Jean Paul Isson, Jesse Harriott, People Analytics in the Era of Big Data: Changing the Way You Attract, Acquire, Develop and Retain Talent, Second Edition, Wiley, 2022.



U24CB5Y04	MARKETING AND SOCIAL MEDIA WEB ANALYTICS			L	T	P	C
				3	0	0	3
Course Objectives:		To showcase the opportunities that exist today to leverage the power of the marketing, web and social media					
Unit - I	MARKETING ANALYTICS					9	
Basics of marketing analytics-Marketing budget and performance measurement-Marketing metrics and their applications-Financial impact of marketing strategies-Geographic analysis and data exploration-Market basket analysis-Customer Lifetime Value (CLV) and Marketing ROI Analysis.							
Unit - II	COMMUNITY BUILDING AND MANAGEMENT					9	
Evolution and basics of social media-Goals and audience of social media-Influencers and social media theories-Community building strategies-Promoting and linking social media platforms-Viral marketing and digital PR-Managing online identity and communities-social media for business use-Social Media Content Strategy and Engagement Planning-Social Media Crisis Management and Community Moderation							
Unit - III	SOCIAL MEDIA POLICIES AND MEASUREMENTS					9	
Social media policies and etiquette-Privacy and ethical issues-Future trends in social media-Social media tracking and analytics-Campaign performance analysis-Understanding user behavior on social platforms-Sentiment Analysis and Social Listening Techniques.							
Unit – IV	WEB ANALYTICS					9	
Introduction to web analytics-Data collection methods-Qualitative and business analysis-KPIs and planning-Web analytics strategy components-Web data analysis and reporting-User Journey Mapping and Conversion Funnel Analysis-A/B Testing and Website Optimization Techniques							
Unit - V	SEARCH ANALYTICS					9	
Search engine optimization (SEO)-User engagement and behaviour-Web traffic and usability analysis-Content management systems-Data visualization and RSS feeds-Mobile platforms and user-centered design-Understanding search pattern-Keyword Research and Competitive Search Analysis.							
Total Periods:						45	

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO1	Identify fundamental concepts tools and metrics of marketing web and social media analytics related to performance measurement data interpretation and digital marketing decision making	K3
CO2	Outline the structure evolution and purpose of social media platforms community building practices and management strategies including policies ethics and privacy considerations	K2
CO3	Analyze marketing web and social media data to understand user behavior engagement patterns and campaign performance effectiveness	K3
CO4	Develop data driven insights and strategies to support marketing decision making and solve marketing related problems	K3
CO5	Build basic analytical reports dashboards and summaries to monitor key performance indicators for marketing web and social media analytics	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes										PSO			
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	-	1	-	1	2	2	2	-	2	2	2	2	1
CO2	1	-	1	-	1	2	1	1	-	1	1	1	1	-
CO3	3	-	3	-	3	3	3	3	-	3	3	3	3	3
CO4	2	2	3	-	3	-	1	1	-	1	1	1	2	1
CO5	1	1	2	-	2	-	2	2	-	2	2	2	2	2
CO	1.80	1.50	2.00	-	2.00	2.33	1.80	1.80	-	1.80	1.80	1.80	2.00	1.75

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Social Media and Web Analytics – Gupta, Mukul & Gupta et al. (2025 edition) – Comprehensive coverage of social media analytics, web metrics, tools, and integration of web & social analytics.
2	Web and Social Media Analytics – M. M. Sankar, Fezeena Khadir & Senthilmurugan (2023) – Focuses specifically on analytics practices for web and social media including recent tools & trends.
3	Essentials of Marketing Analytics – Joseph F. Hair, Dana E. Harrison & Haya Ajjan (Recent edition) – Covers fundamental marketing analytics concepts and models, useful for Units I, IV & V

Reference Books

1	Digital Marketing and Social Media Web Analytics – Bharti Publications (Latest edition) – Designed for students studying digital marketing and analytics basics including web and social data.
2	Social Media Analytics and Practical Applications – Kumar & Qiu (Routledge) – Focus on practical techniques and case examples of social media analytics in business.
3	Social Analytics: Network and Text Methods with NodeXL and R – Miranda (Prospect Press) – Good for Unit II/III topics involving analysis tools (network/text analytics).



U24CB5Y05	OPERATION AND SUPPLY CHAIN ANALYTICS				L	T	P	C
					3	0	0	3
Course Objective:	To provide in-depth knowledge of advanced quantitative models and analytical methods used in operations and supply chain management and to understand recent developments in the field							
Unit - I	INTRODUCTION							9
Basics of analytics including descriptive predictive and prescriptive analytics-Concept of data driven supply chains-Transformation of supply chains using analytics-Challenges in implementation and implementation roadmap-Supply Chain Analytics Architecture and Data Sources.								
Unit - II	WAREHOUSING DECISIONS							9
Mathematical programming models for warehouse decisions-Facility location models such as P median and dynamic location models-Layout planning and space determination methods-Heuristic approaches for warehouse optimization-Automation and Technology Enabled Warehouse Analytics.								
Unit - III	INVENTORY MANAGEMENT							9
Inventory aggregation and lot sizing models-Multi echelon inventory systems-Aggregate inventory planning-Supply chain risk analysis including transit supply and delivery risks-Risk pooling strategies in inventory management-Demand Forecasting Models for Inventory Control.								
Unit – IV	TRANSPORTATION NETWORK MODELS							9
Basics of graphs and network models-shortest path minimal spanning tree and maximum flow problems-Transportation and transshipment models-Set covering and set partitioning problems-Traveling salesman and vehicle routing heuristics-Scheduling algorithms for supply chain operations-Network Design and Capacity Planning Models.								
Unit - V	MCDM MODELS							9
Multi criteria decision making models in supply chain management-Analytic Hierarchy Process and Analytic Network Process-Data Envelopment Analysis-Fuzzy logic based decision models-TOPSIS and its applications in supply chains-Integrated MCDM Approaches for Supply Chain Partner Selection								
Total Periods:								45

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Analyze supply chain data using descriptive predictive and prescriptive analytics to evaluate operational performance and identify patterns in inventory transportation and warehousing systems	K4
CO2	Extend quantitative supply chain models to address multi echelon inventory dynamic lot sizing and risk considerations under real world constraints	K2
CO3	Explain the principles and functioning of transportation network models facility location methods and inventory management techniques used in supply chain analytics	K2
CO4	Outline multi criteria decision making models such as AHP ANP DEA fuzzy logic and TOPSIS and their role in supporting supply chain decisions	K2
CO5	Apply analytical tools techniques and optimization methods to solve warehousing inventory transportation and supply chain decision problems	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	1	1	-	1	1	2	2	-	2	2	2	1	1
CO2	1	-	1	-	2	3	1	1	-	1	1	1	1	-
CO3	3	-	3	-	3	3	3	2	-	3	2	3	3	2
CO4	2	3	2	-	2	-	1	1	-	1	1	2	1	1
CO5	1	2	3	-	3	-	2	2	-	2	2	3	2	3
CO	1.80	2.00	2.00	-	2.20	2.33	1.80	1.60	-	1.80	1.60	2.20	1.60	1.75

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Supply Chain and Operations Analytics: Areas, Analytics Formulations, and Results — Bhattacharya, Maitra & Bhattacharyya (Routledge / 2022–2024). A modern, application-focused book that covers analytics formulations across supply chain and operations.
2	Introduction to Supply Chain Analytics — Dmitry Ivanov (Springer, recent edition) — concise, up-to-date treatment of management, modeling and technology perspectives in SCA. Good as a companion text.

Reference Books

1	Supply Chain Analytics — T. A. S. Vijayaraghavan (Wiley India, 2021) — practical coverage of analytics techniques applied to forecasting, inventory and distribution.
2	Supply Chain Analytics: Concepts, Techniques and Applications (Springer / Palgrave style titles, ~2021–2023) — an accessible introduction to concepts, methods and case studies in SCA.



U24CB5Y06		FINANCIAL ANALYTICS				L	T	P	C
						3	0	0	3
Course Objectives:		To provide knowledge of corporate finance and financial market analytics using quantitative methods for investment evaluation, risk analysis, and portfolio management. It introduces time-series analysis, technical indicators, and basic machine learning techniques for market prediction. The course also develops skills to design and evaluate credit risk models for informed financial decision-making.							
Unit - I	CORPORATE FINANCE ANALYSIS							9	
Introduction to corporate financial analytics – Basics of financial predictive modeling – Project evaluation and cash flow estimation – Cost of capital and sensitivity analysis – Indifference point and financial break-even modeling – Capital budgeting techniques: Payback Period, NPV, IRR, MIRR – Scenario and what-if analysis – Financial distress and bankruptcy prediction: Beaver’s ratios, Ohlson logistic model, Altman Z-score and early warning indicators.									
Unit - II	FINANCIAL MARKET							9	
Risk and return estimation for bonds and stocks – Adjustments for stock splits, dividends, and mergers – Multi-series visualization – Data acquisition from web portals and APIs – Data cleaning and normalization – Nature of financial time-series data – Trend and seasonality – Exponential Weighted Moving Averages – Value at Risk (VaR) – ARMA, ARCH, and GARCH models for volatility.									
Unit - III	PORTFOLIO ANALYSIS							9	
Modern Portfolio Theory – Risk–return trade-off – CAPM and beta estimation – Sharpe ratio and portfolio performance measures – Markowitz mean–variance optimization – Cluster analysis for portfolio categorization – Introduction to derivatives – Binomial option pricing – Black–Scholes model – Option implied volatility and basic Greeks.									
Unit – IV	TECHNICAL ANALYSIS							9	
Technical indicators and chart patterns – RSI, ROC, MACD, Moving Averages, Candlestick charts and trend analysis – Design and simulation of trading strategies – Fundamental vs technical signals – Machine learning for price prediction – ANN and SVM – Model validation and overfitting in financial data.									
Unit - V	CREDIT RISK ANALYSIS							9	
Foundations of credit risk – Data pre-processing and feature engineering – Decision trees for risk classification – Logistic regression for credit scoring – Evaluation of credit models using accuracy, ROC, and AUC – Bias and explain ability in financial models – Design of simple end-to-end credit risk decision systems.									
Total Periods:								45	

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO1	Apply corporate finance analytics techniques to evaluate investment projects by estimating cash flows, analyzing cost of capital, and performing capital budgeting using Payback, NPV, IRR, and MIRR methods, enabling practical financial decision-making and identification of financial viability in corporate scenarios.	K3
CO2	Analyze financial market data to estimate and predict risk and return for bond and stock investments by performing data acquisition, cleansing, visualization, and time-series modeling using EWMA, VaR, ARMA, ARCH, and GARCH techniques for volatility assessment.	K4
CO3	Evaluate portfolio performance and associated risk by applying modern portfolio theory concepts such as CAPM, Sharpe ratio, and mean–variance optimization, and by using clustering techniques and option pricing models to assess diversified investment portfolios.	K4
CO4	Examine market trends and price movements by interpreting technical indicators and chart patterns, simulating trading strategies, and applying machine learning models such as ANN and SVM to predict share prices while assessing model accuracy and overfitting.	K4
CO5	Develop credit risk assessment models by pre-processing financial data and applying decision tree and logistic regression techniques, and evaluate credit scoring performance using standard metrics to support data-driven financial decision systems.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	1	-	1	1	-	-	-	-	-	-	2	1	-
CO2	2	2	-	2	1	-	-	-	-	-	-	2	2	-
CO3	1	2	1	1	1	-	-	-	-	-	-	1	2	1
CO4	1	2	2	2	2	-	-	-	-	-	-	1	2	2
CO5	2	2	2	1	2	-	-	-	-	-	-	2	2	2
CO	1.60	1.80	1.67	1.40	1.40	-	-	-	-	-	-	1.60	1.80	1.67

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	John C. Hull, Options, Futures, and Other Derivatives, Pearson Education, 2022
2	James Chen , <i>Essentials of Financial Analytics: Data-Driven Finance and Investment</i> , Wiley, 2023.
3	Tomasz R. Bielecki and Marek Rutkowski , <i>Credit Risk: Modeling, Valuation and Hedging</i> , Springer, 2022.

Reference Books

1	Marcos López de Prado , <i>Machine Learning for Asset Managers</i> , Cambridge University Press, 2022.
2	Ben Sita , <i>Financial Modeling in Python</i> , Wiley, 2023.



U24GE5Z01		SUSTAINABLE INFRASTRUCTURE DEVELOPMENT		L	T	P	C
				3	0	0	3
Course Objectives:		To provide comprehensive knowledge on sustainable development principles and their integration into planning, design, operation and management of infrastructure systems while ensuring environmental protection, social equity and economic viability.					
Unit - I		CONCEPT OF SUSTAINABLE DEVELOPMENT				9	
Fundamental concepts and evolution of sustainable development. Environmental, social and economic pillars of sustainability and the triple bottom line approach. Sustainability indicators. UN Sustainable Development Goals and their linkage to infrastructure growth. Impacts of climate change on infrastructure systems and adaptive planning strategies. Environmental Impact Assessment and Life Cycle Assessment methodologies for infrastructure evaluation. Concepts of carbon neutrality and sustainable resource efficiency in infrastructure projects.							
Unit - II		ECO-URBAN INFRASTRUCTURE				9	
Principles of sustainable urban planning and integrated land use development. Smart cities mission, intelligent urban services and digital infrastructure. Public transportation systems, non-motorized transport and transit-oriented development. Green building concepts, sustainable housing strategies and rating systems such as LEED and GRIHA. Low-impact development techniques and urban heat island mitigation measures. Urban resilience planning and inclusive infrastructure for equitable community development.							
Unit - III		SUSTAINABLE WATER AND WASTE SYSTEMS				9	
Sustainable water resource planning, water supply systems and demand-side management. Rainwater harvesting, aquifer recharge and watershed management practices. Wastewater treatment technologies, reuse strategies and decentralized sanitation systems. Integrated solid waste management and circular economy principles. Resource recovery from waste and waste-to-energy technologies. Plastic waste management and sustainable material recovery systems.							
Unit – IV		GREEN ENERGY AND CLEAN TECHNOLOGY				9	
Application of renewable energy systems including solar, wind, biomass and hybrid energy solutions in infrastructure. Energy efficiency measures and green technologies in buildings and utilities. Sustainable transportation planning, electric vehicles, alternative fuels and mass transit systems. Carbon footprint analysis, greenhouse gas mitigation and climate action strategies. Energy auditing and demand-side energy management. Concepts of green hydrogen and emerging clean energy technologies..							
Unit - V		RESILIENT AND SMART INFRASTRUCTURE				9	
Concept of resilient infrastructure and disaster risk reduction strategies. Climate-resilient design approaches and adaptation techniques for infrastructure systems. Smart infrastructure technologies including IoT-enabled monitoring, GIS-based planning and data-driven decision making. Public–Private Partnership (PPP) frameworks in sustainable infrastructure development. Infrastructure financing mechanisms and green bonds. Case studies on sustainable and resilient infrastructure projects.							
Total Periods:						45	

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO1	Explain principles of sustainable development, SDGs, EIA and LCA in infrastructure projects.	K2
CO2	Apply sustainable urban planning concepts including green buildings, smart cities and public transport systems.	K3
CO3	Analyze sustainable water, waste management and circular economy practices in infrastructure systems.	K4
CO4	Illustrate renewable energy, sustainable transportation and carbon reduction strategies	K2
CO5	Develop resilient and smart infrastructure solutions considering societal, environmental and economic factors	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze



CO - PO Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	1	2	1	2	3	1	-	1	2	-	-	-
CO2	3	2	3	2	2	2	3	1	2	1	2	-	-	-
CO3	2	3	3	2	2	2	3	1	2	1	2	-	-	-
CO4	3	2	3	2	2	2	3	1	1	1	2	-	-	-
CO5	2	3	3	2	2	3	3	2	2	2	3	-	-	-
CO	3	2	3	2	2	2	3	1	1	1	2	-	-	-

Text Books

1	Grigg, N. S. (1988). Infrastructure engineering and management (1st ed.). Wiley- Interscience. ISBN- 13: 9780471849742.
2	Proag, V. (2021). Infrastructure planning and management: An integrated approach (1st ed.). Springer International Publishing. ISBN- 13: 978- 3- 030- 48558- 0.

Reference Books

1	Theis, T., & Tomkin, J. (2018). Sustainability: A comprehensive foundation (1st ed.). 12th Media Services. ISBN- 13: 9781680921533.
2	Mulder, K. (2006). Sustainable development for engineers: A handbook and resource guide (1st ed.). Routledge. ISBN- 13: 9781874719199.
3	Rogers, P. P., Jalal, K. F., & Boyd, J. A. (2007). An introduction to sustainable development (1st ed.). Earthscan. ISBN- 13: 9781844075218.



U24GE5Z02	SUSTAINABLE AGRICULTURE AND ENVIRONMENTAL MANAGEMENT	L	T	P	C
		3	0	0	3
Course Objectives:	To impart knowledge on ecological principles, sustainable resource management, smart irrigation, waste-to-energy technologies, and sustainability assessment for developing environmentally responsible and resilient agricultural systems.				
Unit - I	ECOLOGICAL AND SUSTAINABLE APPROACHES IN MODERN AGRICULTURE				9
Ecosystem Concepts and Structure – Biotic and Abiotic components of Ecosystem - Ecosystem Processes - Energy Flow and Ecological Pyramid - Ecological services and agriculture – Industrial Agriculture and Food System Challenges–Technology-driven intensification vs ecological imbalance, Life Cycle Assessment (LCA) tools for food systems - Concept and Dimensions of Sustainability - Characteristics and Practices of Sustainable Agriculture - Regenerative vs. Sustainable Agriculture Systems - Future-Ready Ecological Agriculture.					
Unit - II	SUSTAINABLE SOIL, NUTRIENT AND PEST MANAGEMENT				9
Concept of Sustainable Soil - Soil Organic Matter & Carbon Management - Soil Degradation & Restoration - Sustainable Nutrient Management – Principles - Integrated & Precision Nutrient Management - Soil–Plant–Microbe Interactions - Sustainable Pest Management – Concepts - Ecological & Biological Pest Control - Emerging Innovations & Integrated Approaches.					
Unit - III	WATER MANAGEMENT AND SMART IRRIGATION IN AGRICULTURE				9
Soil Water Dynamics in Climate - Plant Yield Response to Water & Water Productivity - Reducing Evaporation - Enhancing Soil Moisture Conservation - Rainwater Harvesting & Nature-Based Solutions - Irrigation Scheduling , Decision Support System - Improving Agricultural Water Productivity - Localized & Micro-Irrigation Systems - Fertigation - Nutrient–Water Integration - Advanced Irrigation Systems & Sustainable Water Use Innovations.					
Unit – IV	ENERGY AND AGRICULTURAL WASTE MANAGEMENT				9
Introduction to Agricultural Wastes - Composition and Characterization of Agricultural Wastes - Sustainable Technologies for Waste Management - Value-Added Products from Agricultural Wastes - Renewable Energy from Agricultural Wastes - Advanced Waste-to-Energy Technologies - Circular Economy & Resource Optimization - Case Studies & Emerging Trends.					
Unit - V	EVALUATING SUSTAINABILITY IN AGROECOSYSTEMS				9
Introduction to Sustainability in Agriculture - Principles and Dimensions of Sustainable Agriculture - Indicators of Sustainability in Agriculture - On-Farm Evaluation of Agro ecosystem Sustainability - Alternative Agriculture: Concepts & Approaches - Alternative Farming Techniques - Community Food Systems: Goals & Components - Sustainable Agriculture to Community Food Systems – Case Studies.					
Total Periods:					45

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO1	Discuss ecosystem structure, sustainability principles, and agricultural systems supporting ecological farming practices.	K2
CO2	Apply principles of sustainable soil, nutrient, and pest management to improve agroecosystem productivity and resilience.	K3
CO3	Implement water management and smart irrigation techniques to enhance water use efficiency and crop productivity.	K3
CO4	Analyze agricultural waste and energy strategies to promote circular economy and renewable energy applications.	K4
CO5	Assess alternative agriculture practices and community food system components to determine their role in sustainable development.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create.



CO – PO – PSO Articulation Matrix

CO Code	Programme Outcome (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	2	1	2	1	2	3	2	1	-	-	2	1	2
CO2	2	3	2	2	2	2	3	2	1	-	-	2	2	2
CO3	2	3	2	2	3	2	3	1	1	-	-	3	3	2
CO4	2	2	2	2	2	3	3	2	1	1	1	3	2	3
CO5	2	3	2	3	2	3	3	2	2	1	1	2	2	3
Avg.	2	3	2	2	2	2	3	2	1	1	1	2	2	2

Text Books

1	Sustainable Agriculture for Food Security: A Global Perspective, Balkrishna, A., CRC Press, 2021.
2	Principles of Agronomy for Sustainable Agriculture, Villalobos, F.J. & Fereres, E., Springer, 2016.
3	Agriculture Waste Management and Bioresource: The Circular Economy Perspective — Suruchi Singh, Pardeep Singh, Anu Sharma & Moharana Choudhury, John Wiley & Sons, ISBN 978-1119808138, 2022.

Reference Books

1	Approaches to Sustainable Agriculture – Exploring the Pathways Towards the Future of Farming, Oberc, B.P. & Arroyo Schnell, A., IUCN, Belgium, 2020.
2	Principles of Sustainable Soil Management in Agroecosystems – Edited by Rattan Lal & B.A. Stewart, CRC Press, ISBN 978-1466513464, 2013.
3	Farm Irrigation Management: Principles and Practices — Latief Ahmad, Kahkashan Qayoom & Sameera Qayoom (CRC Press, 2026).
4	Sustainable Energy Solutions in Agriculture, Bundschuh, J. & Chen, G., CRC Press, 2014.
5	Organic Farming for Sustainable Agriculture, Nandwani, D., Springer, 2016.



U24GE5Z03		SUSTAINABLE BIOMATERIALS			L	T	P	C
					3	0	0	3
Course Objectives:		To Impart knowledge of biomaterials and their properties. To learn about Fundamentals aspects of Biopolymers and their applications. To learn about bioceramics and biopolymers. To introduce the students about metals as biomaterials and their usage as implants. To make the students understand the significance of bionanomaterials and its applications.						
Unit - I	INTRODUCTION TO BIOMATERIALS						9	
Introduction: Definition of biomaterials, requirements & classification of biomaterials- Types of Biomaterials- Degradable and resorbable biomaterials- engineered natural materials-Biocompatibility-Hydrogels-pyrolitic carbon for long term medical implants-textured and porous materials-Bonding types- crystal structure-imperfection in crystalline structure-surface properties and adhesion of materials –strength of biological tissues-performance of implants-tissue response to implants- Impact and Future of Biomaterials								
Unit - II	BIO POLYMERS						9	
Molecular structure of polymers -Molecular weight - Types of polymerization techniques–Types of polymerization reactions- Physical states of polymers- Common polymeric biomaterials Polyethylene -Polymethylmethacrylate (PMMA-Polylactic acid (PLA) and polyglycolic acid (PGA) Polycaprolactone (PCL) - Other biodegradable polymers –Polyurethan- reactions polymers for medical purposes - Collagens- Elastin- Cellulose and derivatives-Synthetic polymeric membranes and their biological applications								
Unit - III	BIO CERAMICS AND BIOCOMPOSITES						9	
Study of the general properties and classifications of bioceramics including silicate glass, alumina (Al ₂ O ₃), zirconia (ZrO ₂), carbon, and calcium phosphates (CaP)- Focus on Resorbable Ceramics- surface reactive ceramics- Biomedical Composites Polymer Matrix Composite (PMC)-Ceramic Matrix Composite (CMC)-Metal Matrix Composite (MMC) glass ceramics - Applications in orthopedic implants and tissue engineering scaffolds are emphasized - The role of composites in enhancing mechanical and biological performance								
Unit – IV	METALS AS BIOMATERIALS						9	
Overview of biomedical metals - their types - properties, and performance in biological environments. Detailed study of stainless steel, cobalt–chromium alloys - titanium alloys – tantalum - Nitinol, and magnesium - based biodegradable metals - Discussion on surface modification for osteointegration, corrosion behavior, and biological tolerance of implant metals - highlights clinical applications in medical implants and devices - Performance evaluation of metals in biological environments.								
Unit - V	NANOBIOMATERIALS						9	
Introduction to Meatlicnanobiomaterials–Nanopolymers-Nanoceramics- Nanocomposites-Carbon based nanobiomaterials - transport of nanoparticles- release rate-positive and negative effect of nanosize nanofibres-Nano and micro features and their importance in implant performance-Nanosurface and coats-Applications nanoantibiotics-Nanomedicines- Biochips – Biomimetics- BioNEMs -Biosensor Bioimaging/Molecular Imaging-Challenges, safety concerns, and future perspectives of nanobiomaterials								
Total Periods:							45	

Course Outcomes

On completion of the course, the student can

CO	Statements	K-Level
CO1	Explain the definition, classification, properties, and biocompatibility requirements of biomaterials and relate them to implant performance and tissue response.	K2
CO2	Describe the structure, properties, polymerization methods, and biomedical applications of major biopolymers including biodegradable and natural polymers.	K2
CO3	Apply knowledge of bioceramics and biocomposites to identify suitable materials for orthopedic implants and tissue engineering applications.	K3
CO4	Apply the properties and behavior of metallic biomaterials to select appropriate metals for specific biomedical implants and devices.	K3
CO5	Explain the characteristics, synthesis, and biomedical applications of nanobiomaterials and their role in advanced diagnostics and therapy.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	-	-	-	2	1	-	-	-	1	1	2	1
CO2	3	2	-	-	-	-	-	-	-	-	1	1	1	2
CO3	3	3	2	1	2	2	-	-	-	-	1	2	2	2
CO4	3	3	2	1	2	2	-	-	-	-	1	2	2	2
CO5	3	2	1	1	2	2	1	-	-	-	2	3	3	2
CO	3	2	1	1	1	1	-	-	-	-	1	2	2	2

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	C. Mauli Agrawal, Joo L. Ong, Mark R. Appleford, Gopinath Mani, "Introduction to Biomaterials: Basic Theory with Engineering Applications", Cambridge University Press, 2014.
2	Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen, Jack E. Lemons, "Biomaterials Science: An Introduction to Materials in Medicine", Third Edition, Academic Press, 2013.
3	Joon Park, R. S. Lakes, "Biomaterials: An Introduction", Third Edition, Springer, 2007.
4	Vasif Hasirci, Nesrin Hasirci, "Fundamentals of Biomaterials", Springer, 2018.
5	Sujata V. Bhat, "Biomaterials", Narosa Publishing House, 2002.

Reference Books

1	Donglu Shi, "Introduction to Biomaterials", Tsinghua University Press, 2006.
2	M. Jaffe, W. Hammond, P. Tolias, T. Arinze, "Characterization of Biomaterials", Woodhead Publishing, 2013.
3	Leopold Javier Rios Gonzalez, "Handbook of Research on Bioenergy and Biomaterials: Consolidated and Green Processes", Apple Academic Press, 2021.
4	Devarajan Thangadurai, Jeyabalan Sangeetha, Ram Prasad, "Functional Bionanomaterials", Springer, 2020.
5	Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen, Jack E. Lemons, "Biomaterials Science: An Introduction to Materials in Medicine", Fourth Edition, Elsevier, 2020.



U24GE5Z04		MATERIALS FOR ENERGY SUSTAINABILITY			L	T	P	C
					3	0	0	3
Course Objectives:		To familiarize students with the challenges and demands of energy sustainability by providing fundamental knowledge of electrochemical devices, various types of fuel cells, novel photovoltaic materials, and supercapacitors, along with the materials used in these energy systems and their practical applications in modern energy technologies.						
Unit - I	SUSTAINABLE ENERGY SOURCES						9	
Introduction to energy demand and challenges ahead – sustainable source of energy (wind, solar etc.) – electrochemical energy systems for energy harvesting and storage – materials for sustainable electrochemical systems building – India centric solutions based on locally available materials – Economics of wind and solar power generators vs. conventional coal plants – Nuclear energy.								
Unit - II	ELECTROCHEMICAL DEVICES						9	
Electrochemical Energy – Difference between primary and secondary batteries – Secondary battery (Li-ion battery, Sodium-ion battery, Li-S battery, Li-O2 battery, Nickel Cadmium, Nickel Metal Hydride) – Primary battery (Alkaline battery, Zinc-Carbon battery) – Materials for battery (Anode materials – Lithiated graphite, Sodiased hard carbon, Silicon doped graphene, Lithium Titanate) (Cathode Materials – S, LiCoO2, LiFePO4, LiMn2O4) – Electrolytes for Lithium-ion battery (ethylene carbonate and propylene carbonate based).								
Unit – III	FUEL CELLS						9	
Principle of operation of fuel cells – types of fuel cells (Proton exchange membrane fuel cells, alkaline fuel cell, direct methanol fuel cells, direct borohydride fuel cells, phosphoric acid fuel cells, solid oxide fuel cells, and molten carbonate fuel cells) – Thermodynamics of fuel cell – Fuel utilization – electrolyte membrane (proton conducting and anion conducting) – Catalysts (Platinum, Platinum alloys, carbon supported platinum systems and metal oxide supported platinum catalysts) – Anatomy of fuel cells (gas diffusion layer, catalyst layer, flow field plate, current conductors, bipolar plates and monopolar plates).								
Unit – IV	PHOTOVOLTAICS						9	
Physics of the solar cell – Theoretical limits of photovoltaic conversion – bulk crystal growth of Si and wafering for photovoltaic application – Crystalline silicon solar cells – thin film silicon solar cells – multijunction solar cells – amorphous silicon based solar cells – photovoltaic concentrators – Cu(InGa)Se2 solar cells – Cadium Telluride solar cells – dye sensitized solar cells – Perovskite solar cells – Measurement and characterization of solar cells – Materials used in solar cells (metallic oxides, CNT films, graphene, OD fullerenes, single-multi walled carbon nanotubes, two-dimensional Graphene, organic or Small molecule-based solar cells materials).								
Unit - V	SUPERCAPACITORS						9	
Supercapacitor –types of supercapacitors (electrostatic double-layer capacitors, pseudo capacitors and hybrid capacitors) – design of supercapacitor-three and two electrode cell-parameters of supercapacitor- Faradaic and non – Faradaic capacitance – electrode materials (transition metal oxides (MO), mixed metal oxides, conducting polymers (CP), Mxenes, nanocarbons, non-noble metal, chalcogenides, hydroxides and 1D-3D metal-organic frame work (MOF), activated carbon fibres (ACF)- Hydroxides-Based Materials – Polyaniline (PANI), a ternary hybrid compositeconductive polypyrrole hydrogels.								
Total Periods:							45	

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the basic concepts and importance of energy sustainability.	K2
CO2	Interpret the principles of different electrochemical devices.	K2
CO3	Explain the working of fuel cells and their application.	K2
CO4	Illustrate various Photovoltaic applications and the materials used in them.	K2
CO5	Interpret the types of supercapacitors and the performance of various materials.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO– PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	-	2	-	-	2	1	-	-	1	2	-	1	-
CO2	3	-	2	-	1	2	-	-	-	1	2	-	1	1
CO3	3	-	2	-	1	2	-	-	-	1	1	-	1	1
CO4	3	-	2	-	1	2	1	-	-	1	2	-	2	1
CO5	3	-	2	-	1	2	1	-	-	1	1	-	1	-
CO	3	-	2	-	1	2	1	-	-	1	2	-	1	1

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	John A Kilner, Stephen J Skinner, Stuart J C Irvine and Peter P Edwards — Functional materials for sustainable energy applications, Woodhead Publishing, Elsevier, 2012.
2	Wolf Vielstich, Arnold Lamm, Hubert A Gasteiger and Harumi Yokokawa — Handbook of Fuel Cells: Fuel Cell Technology and Applications, Wiley, 2003.
3	Conway B E — Electrochemical Supercapacitors: Scientific Fundamentals and Technological Applications, Kluwer Academic / Plenum Publishers, New York, 1999.
4	Parnia Forouzandeh, Vignesh Kumaravel and Suresh C Pillai — Electrode Materials for Supercapacitors: A Review of Recent Advances, Catalysts, 2020.
5	Viswanathan B and Aulice Scibioh M — Materials for Supercapacitor Applications, CRC Press, 2013.

Reference Books

1	Amanda Ndubuisi, Sara Abouali, Kalpana Singh and Venkataraman Thangadurai — Recent Advances, Practical Challenges, and Perspectives of Intermediate Temperature Solid Oxide Fuel Cell Cathodes, J. Mater. Chem. A, 2022.
2	Crompton T R — Batteries reference book, Newners, 3rd Edition, 2002.
3	Neeraj Kant and Pushpendra Singh — Review of Next Generation Photovoltaic Solar Cell Technology and Comparative Materialistic Development, Materials Today Proceedings, 2022.
4	Peter Wurfel and Uli Wurfel — Physics of Solar Cells: From Principles to New Concepts, Wiley-VCH, 2016.
5	François Beguin and Elzbieta Frackowiak — Handbook of Supercapacitors, Wiley-VCH, 2013.



U24GE5Z05		GREEN TECHNOLOGY				L	T	P	C
						3	0	0	3
Course Objectives:		To impart knowledge of green chemistry and green engineering principles, pollution control, waste management, and green synthesis, and to develop skills for designing safe, energy-efficient, and sustainable chemical processes using green metrics and nanotechnology.							
Unit - I	PRINCIPLES OF GREEN CHEMISTRY						9		
Historical Perspectives and Basic Concepts. The twelve Principles of Green Chemistry and green engineering. Green chemistry metrics- atom economy, E factor, reaction mass efficiency, and other green chemistry metrics, application of green metrics analysis to synthetic plans.									
Unit - II	POLLUTION TYPES						9		
Pollution – types, causes, effects, and abatement. Waste – sources of waste, different types of waste, chemical, physical and biochemical methods of waste minimization and recycling									
Unit - III	GREEN REAGENTS AND GREEN SYNTHESIS						9		
Environmentally benign processes- alternate solvents- supercritical solvents, ionic liquids, water as a reaction medium, energy-efficient design of processes- photo, electro and sono chemical methods, microwave-assisted reactions									
Unit – IV	DESIGNING GREEN PROCESSES						9		
Safe design, process intensification, in process monitoring. Safe product and process design – Design for degradation, Real-time Analysis for pollution prevention, inherently safer chemistry for accident prevention.									
Unit - V	GREEN NANOTECHNOLOGY						9		
Nanomaterials for water treatment, nanotechnology for renewable energy, nanotechnology for environmental remediation and waste management, nanotechnology products as potential substitutes for harmful chemicals, environmental concerns with nanotechnology.									
Total Periods:							45		

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Experiment with the principles of green chemistry and green engineering, including historical concepts and green metrics.	K3
CO2	Solve problems related to pollution, waste management, and chemical hazards using sustainable approaches.	K3
CO3	Construct chemical processes and products using environmentally benign methods, alternate solvents, and energy-efficient techniques.	K3
CO4	Design safe and sustainable chemical processes and products with real-time monitoring and process intensification.	K3
CO5	Utilize advanced technologies, including nanotechnology, for green synthesis, environmental remediation, and renewable energy applications.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	3	2	2	3	2	2	3	3	2	3	3	3	3
CO2	2	3	3	3	3	2	3	3	3	2	2	3	3	2
CO3	3	3	3	3	3	2	3	3	3	2	3	3	3	3
CO4	3	3	3	3	3	2	3	3	3	2	3	3	3	3
CO5	3	3	3	3	3	2	3	3	3	2	3	3	3	3
CO	2.80	3.00	2.80	2.80	3.00	2.00	2.80	3.00	3.00	2.00	2.80	3.00	3.00	2.80

Correlation levels 1, 2 and 3 are as defined below:

1. Slight
2. Moderate
3. Substantial (High)



Text Books

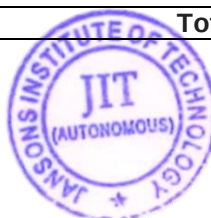
1	Samir B. Billatos and Nadia A. Basaly, Green Technology and Design for the Environment, First Edition, Taylor & Francis (CRC Press), 2017
2	Green Chemistry – An introductory text - M. Lancaster, RSC, 2016.
3	Green Chemistry metrics - Alexi Lapkin and David Constable (Eds) , Wiley publications, 2008.

Reference Books

1	Environmental chemistry, Stanley E Manahan, Taylor and Francis, 2017.
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U24GE5Z06		ENVIRONMENTAL QUALITY MONITORING AND ANALYSIS		L	T	P	C
				3	0	0	3
Course Objectives:		To provide comprehensive knowledge of environmental standards, regulations, and monitoring frameworks, develop understanding of air and water sampling and monitoring techniques, familiarize students with analytical and instrumental methods, introduce environmental monitoring programmes and risk assessment approaches, and expose learners to automated data acquisition systems and modern environmental data management practices.					
Unit - I	ENVIRONMENTAL STANDARDS AND MONITORING FRAMEWORK					9	
Introduction to environmental monitoring - scope, objectives, and importance in environmental protection and sustainable development. Concept and need for environmental standards. Classification of environmental standards such as ambient standards, emission standards, effluent discharge standards, and occupational exposure standards. Overview of global environmental standards and guidelines prescribed by international agencies such as WHO, UNEP, USEPA, and ISO. Environmental regulatory framework in India with reference to MoEF & CC, Central Pollution Control Board (CPCB), and State Pollution Control Boards (SPCBs). National Ambient Air Quality Standards (NAAQS) and their significance. Water quality standards for drinking water, surface water, groundwater, and wastewater discharge. Role of environmental standards in regulatory compliance and environmental management. Emerging trends in environmental monitoring and regulation.							
Unit - II	MONITORING OF ENVIRONMENTAL PARAMETERS AND SAMPLING TECHNIQUES					9	
Overview of current environmental issues including air pollution, water pollution, climate change, and waste management. Global environmental monitoring programmes and initiatives. International environmental conventions and protocols related to environmental protection. Applications of environmental monitoring in pollution control, environmental impact assessment, and public health protection. Significance of environmental sampling and basic principles of sampling design. Sampling strategies - grab sampling, composite sampling, random sampling, and systematic sampling. Techniques for water sampling including surface water, groundwater, and wastewater. Ambient air sampling methods and monitoring networks. Stack and flue gas sampling techniques and their applications.							
Unit - III	ANALYTICAL AND INSTRUMENTAL METHODS FOR ENVIRONMENTAL ANALYSIS					9	
Classification of analytical and instrumental methods used in environmental monitoring. Principles and applications of spectrophotometric methods for environmental analysis. Analysis of organic and inorganic pollutants in environmental samples. Determination of important water quality parameters such as nitrogen, phosphorus, chemical oxygen demand (COD), and biochemical oxygen demand (BOD) in sewage and wastewater. Analysis of particulate matter and gaseous air pollutants including oxides of nitrogen, oxides of sulfur, carbon monoxide, and hydrocarbons. Introduction to advanced analytical instruments such as gas chromatography, atomic absorption spectroscopy, and mass spectrometry. Quality assurance and quality control practices in environmental analysis.							
Unit – IV	ENVIRONMENTAL MONITORING PROGRAMMES AND RISK ASSESSMENT					9	
Concept and components of Environmental Monitoring Programme (EMP). Planning and implementation of environmental monitoring programmes. Water quality monitoring programmes at national and regional levels. National Water Quality Monitoring Programme (NWQMP) in India. Key physical, chemical, and biological parameters used for water quality monitoring. Monitoring protocols, data interpretation, and reporting methods. Introduction to environmental risk assessment and its significance. Steps involved in risk assessment including hazard identification, exposure assessment, dose–response assessment, and risk characterization. Application of risk assessment in environmental management and decision-making.							
Unit - V	AUTOMATED DATA ACQUISITION, SENSORS, AND DATA MANAGEMENT					9	
Introduction to automated and real-time environmental monitoring systems. Data acquisition for environmental process monitoring and control. Components and working principle of a Data Acquisition System (DAS). Sensors and transducers used in environmental monitoring and their classification. Types of data acquisition systems including offline and online monitoring systems. Implementation of real-time monitoring, control, and telemetry systems. Environmental data management systems including data collection, storage, processing, and visualization. Data quality assurance, validation, and quality control techniques. Regulatory overview and role of digital technologies such as IoT, remote sensing, and GIS in modern environmental monitoring.							
Total Periods:						45	



Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO01	Explain the concepts, classification, and regulatory framework of environmental standards at national and international levels.	K2
CO02	Apply appropriate environmental monitoring and sampling techniques for air, water, and industrial emissions.	K3
CO03	Analyze environmental samples using conventional and instrumental analytical methods to determine key pollution parameters.	K4
CO04	Evaluate environmental monitoring programmes and conduct environmental risk assessment for informed decision-making.	K5
CO05	Analyze automated environmental data acquisition and management systems considering regulatory requirements.	K4

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

CO Code	Programme Outcome (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
C000.1	3	1				2	3	1			1			
C000.2	3	2	2	2	1	2	3				1			
C000.3	3	3	2	3	2		2				1			
C000.4	2	3	2	2		3	3	2			1			
C000.5	2	2	3	2	3	2	3				2			
Avg.	3	2	2		1	2	3	1			1			

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Environmental monitoring Handbook, Frank R. Burden, © 2002 by The McGraw-Hill Companies, Inc.
2	Handbook of environmental analysis: chemical pollutants in the air, water, soil, and solid wastes / Pradyot Patnaik, © 1997 by CRC Press, Inc
3	Peavy, H.S., Row, R., and Tchobanoglous, G., <i>Environmental Engineering</i> , McGraw Hill, New York.
4	Metcalf & Eddy, <i>Wastewater Engineering: Treatment and Reuse</i> , McGraw Hill.

Reference Books

1	Environmental monitoring / edited by G. Bruce Wiersma, © 2004 by CRC Press LLC.
2	H. H. Willard, L. L. Merit, J. A. Dean and F. A. Settle, <i>Instrumental Methods of Analysis</i> , CBP Publishers and Distributors, New Delhi, 1988.
3	Heaslip, G. (1975) <i>Environmental Data Handling</i> . John Wiley & Sons. New York.
4	Sawyer, C.N., McCarty, P.L., and Parkin, G.F., <i>Chemistry for Environmental Engineering and Science</i> , McGraw Hill.
5	CPCB and WHO Environmental Monitoring Guidelines.

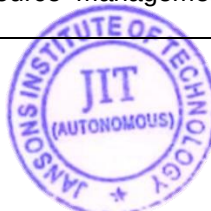


U24ME5H03	PRINCIPLES OF MANAGEMENT	L	T	P	C
		3	0	0	3
Course Objectives:	The course aims to explore the evolution of management, its functions, and principles, while focusing on their application in organizations. It also covers HR activities and analyzes the alignment between individual and company goals in business.				
Unit - I	INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS			9	
Definition of Management – Science or Art – Manager Vs Entrepreneur- types of managers managerial roles and skills – Evolution of Management –Scientific, human relations, system and contingency approaches– Types of Business organization- Sole proprietorship, partnership, company-public and private sector enterprises- Organization culture and Environment – Current trends and issues in Management - Social responsibility and ethical management.					
Unit - II	PLANNING			9	
Nature and purpose of planning – Planning process – Types of planning – Objectives – Setting objectives – Policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process - Risk assessment and scenario planning					
Unit - III	ORGANISING			9	
Nature and purpose – Formal and informal organization – Organization chart – Organization structure – Types – Line and staff authority – Departmentalization – delegation of authority – Centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management - Workforce diversity and inclusion					
Unit – IV	DIRECTING			9	
Foundations of individual and group behaviour– Motivation – Motivation theories – Motivational techniques – Job satisfaction – Job enrichment – Leadership – types and theories of leadership – Communication – Process of communication – Barrier in communication – Effective communication – Communication and IT - Emotional intelligence in leadership					
Unit - V	CONTROLLING			9	
System and process of controlling – Budgetary and non - Budgetary control techniques – Use of computers and IT in Management control – Productivity problems and management – Control and performance – Direct and preventive control – Reporting - Continuous performance improvement.					
Total Periods:				45	

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO1	Select the fundamental principles of management to identify and organize managerial roles, organizational structures, business forms, and ethical responsibilities in modern organizations.	K3
CO2	Utilize planning techniques to develop and plan organizational objectives, policies, strategic decisions, and risk assessment strategies for effective management.	K3
CO3	Apply organizing principles to identify and develop appropriate organizational structures, authority relationships, and human resource management practices in organizations.	K3



CO4	Utilize leadership, motivation, and communication concepts to develop and organize effective strategies for directing individuals and teams in organizational settings.	K3
CO5	Choose controlling techniques to identify and solve performance and productivity issues using management control systems, reporting methods, and continuous improvement practices.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	1	-	-	-	2	1	2	3	1	1	-	-	-
CO2	1	2	1	-	-	2	2	2	2	2	2	-	-	-
CO3	1	1	1	-	-	2	2	1	2	2	2	-	-	-
CO4	1	-	-	-	-	1	2	2	2	2	2	-	-	-
CO5	1	1	-	-	-	2	2	2	2	2	2	-	-	-
CO	1	1	1	-	-	2	2	2	2	2	2	-	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Harold Koontz & Heinz Weihrich, "Essentials of Management", Tata McGraw Hill, 1998.
2	Stephen P. Robbins & Mary Coulter, "Management", Prentice Hall (India) Pvt. Ltd., 10th Edition, 2009.

Reference Books

1	Robert Kreitner & Mamata Mohapatra, "Management", Biztantra, 2008.
2	Stephen A. Robbins & David A. Decenzo & Mary Coulter, "Fundamentals of Management", 7th Edition, Pearson Education, 2011.
3	Tripathy PC & Reddy PN, "Principles of Management", Tata McGraw Hill, 1999



U24ME5F06	TOTAL QUALITY MANAGEMENT		L	T	P	C
			3	0	0	3
Course Objectives:	To understand the fundamentals of quality management, including the evolution of quality, Total Quality Management (TQM) framework, its principles, contributions of quality gurus, and implementation of Quality Management Systems (QMS) and Environmental Management Systems (EMS) in organizations; to apply quality improvement methodologies and tools such as Six Sigma, benchmarking, FMEA, QFD, TPM, Cost of Quality (COQ), Business Process Reengineering (BPR), and other traditional and modern quality tools; and to analyze performance improvement and loss reduction techniques, including Taguchi's Quality Loss Function and other performance measurement methods for continuous and continuous improvement.					
Unit - I	INTRODUCTION					9
Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality –Definition of TQM-- Basic concepts of TQM - Gurus of TQM (Brief introduction) -- TQM Framework- Barriers to TQM –Benefits of TQM.						
Unit - II	TQM PRINCIPLES					9
Leadership - Deming Philosophy, Quality Council, Quality statements and Strategic planning- Customer Satisfaction –Customer Perception of Quality, Feedback, Customer complaints, Service Quality, Kano Model and Customer retention – Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition & Reward and Performance Appraisal-- Continuous process improvement –Juran Trilogy, PDSA cycle, 5S and Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating and Relationship development.						
Unit - III	TQM TOOLS & TECHNIQUES I					9
The seven traditional tools of quality - new management tools - Six-sigma Process Capability- Bench marking - Reasons to benchmark, Benchmarking process, What to Bench Mark, Understanding Current Performance Planning, Studying Others, learning from the data, Using the findings, Pitfalls and Criticisms of Benchmarking - FMEA - Intent, Documentation, Stages: Design FMEA and Process FMEA.						
Unit – IV	TQM TOOLS & TECHNIQUES II					9
Quality circles – Quality Function Deployment (QFD) - Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures- Cost of Quality - BPR. Sustainable Quality and Green TPM						
Unit - V	QUALITY MANAGEMENT SYSTEM					9
Introduction-Benefits of ISO Registration-ISO 9000 Series of Standards-Sector-Specific Standards - AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements-Implementation-Documantation- Internal Audits-Registration-ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction—ISO 14000 Series Standards— Concepts of ISO 14001—Requirements of ISO 14001-Benefits of EMS.						
Total Periods:						45

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO1	Ability to apply TQM concepts in a selected enterprise.	K2
CO2	Ability to apply TQM principles in a selected enterprise.	K2
CO3	Ability to understand Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.	K2
CO4	Ability to understand Taguchi's Quality Loss Function, Performance Measures and apply QFD, TPM, COQ and BPR.	K2
CO5	Ability to apply QMS and EMS in any organization.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO - PO - PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	-	3	-	-	-	-	-	-	-	-	-	2	-	3
CO2	-	-	-	-	-	3	-	-	-	-	-	-	2	-
CO3	-	-	-	-	3		-	-	3	-	-	-	2	3
CO4	-	2	-	-	3	2	3	2	-	-	-	3	2	-
CO5	-		3	-		3	3	2	-	-	-	-	-	-
CO	-	2	3	-	3	3	3	2	3	-	-	3	2	3

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Dale H.Besterfield, Carol B.Michna,Glen H. Bester field,MaryB.Sacre, HemantUrdhwareshe and RashmiUrdhwareshe, "Total Quality Management", Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression,2013.
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Reference Books

1	Joel.E. Ross, "Total Quality Management – Text and Cases",Routledge.,2017.
2	. Kiran.D.R, "Total Quality Management: Key concepts and case studies, Butterworth – Heinemann Ltd, 2016.
3	. Oakland, J.S. "TQM – Text with Cases", Butterworth – Heinemann Ltd., Oxford, Third Edition, 2003.
4	Suganthi,L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006 .



U24ME5G03	ENGINEERING ECONOMICS AND FINANCIAL ACCOUNTING	L	T	P	C
		3	0	0	3
Course Objectives:	To enable students, apply engineering economic principles, use microeconomic and macroeconomic concepts in real-life decision making, understand pricing methods, and analyze cost-related economic factors effectively.				
Unit - I	DEMAND & SUPPLY ANALYSIS	9			
Managerial Economics - Relationship with other disciplines - Firms Types, objectives and goals - Managerial decisions - Decision analysis. Demand - Types of demand - Determinants of demand - Demand function – Demand elasticity - Demand forecasting - Supply - Determinants of supply - Supply function -Supply elasticity - Market Equilibrium					
Unit - II	PRODUCTION AND COST ANALYSIS	9			
Production Laws and functions - Returns to scale - Production optimization - Least cost input - Isoquants - Managerial uses of production function. Cost Concepts - Cost function - Determinants of cost - Short run and Long run cost curves - Cost Output Decision - Estimation of Cost.					
Unit - III	PRICING	9			
Determinants of Price - Pricing under different objectives and different market structures - Price discrimination - Pricing methods in practice – Pricing of joint products					
Unit – IV	FINANCIAL ACCOUNTING (ELEMENTARY TREATMENT)	9			
Introduction – Accounting standards - Balance sheet and related concepts - Profit & Loss Statement and related concepts - Financial Ratio Analysis - Cash flow analysis - Funds flow analysis - Comparative financial statements - Analysis & Interpretation of financial statements.					
Unit - V	CAPITAL BUDGETING (ELEMENTARY TREATMENT)	9			
Capital significance and types - Investments - Risks and return evaluation of investment decision - Average rate of return - Payback Period - Net Present Value - Internal rate of return					
Total Periods:				45	

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO1	Acquire the skills to relate the basics of economics and cost analysis to engineering and take economically sound decisions	K2
CO2	Explain the economic theories, cost concepts and pricing policies	K2
CO3	Understand the market structures and integration concepts	K2
CO4	Compare the measures of national income, the functions of banks and concepts of globalization	K2
CO5	Infer the concepts of financial management for project appraisal	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	1	2	-	-	1	-	-	-	-	1	1	1	-	-
CO2	1	2	-	-	1	-	-	-	-	1	1	1	-	-
CO3	1	1	-	-	-	-	1	-	-	1	1	1	-	-
CO4	1	1	-	-	-	-	1	-	-	2	1	1	-	-
CO5	1	1	1	-	-	-	-	-	-	2	1	1	-	-
CO	1	2	1	-	1	-	1	-	-	1	1	1	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Panneer Selvam, R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, 2001.
2	Managerial Economics: Analysis, Problems and Cases - P. L. Mehta, Edition, 13. Publisher, Sultan Chand, 2007.

Reference Books

1	Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2011.
2	Donald.G. Newman, Jerome.P.Lavelle, "Engineering Economics and analysis" Engg. Press, Texas, 2010.
3	Degarmo, E.P., Sullivan, W.G and Canada, J.R, "Engineering Economy", Macmillan, New York, 2011.
4	Zahid A khan: Engineering Economy, "Engineering Economy", Dorling Kindersley, 2012
5	Dr. S. N. Maheswari and Dr. S.K. Maheshwari: Financial Accounting, Vikas, 2009



U24HS1601	KNOWLEDGE MANAGEMENT	L	T	P	C
		3	0	0	3
Course Objectives:	To equip students with an understanding of the evolution of Knowledge Management, introduces essential tools and technologies, and exposes them to practical applications across domains. It also familiarizes learners with real-world case studies to analyse how knowledge strategies are designed and implemented in organizations.				
Unit - I	INTRODUCTION				9
Introduction to Knowledge Management – Definition, Scope and Objectives – Foundations of Knowledge Management – Cultural and Organizational Issues in Knowledge Management – Knowledge Management Processes – Management Aspects of Knowledge Management – Decision Support Systems- Evolution of Knowledge Management: From Information Management to Knowledge Management – Key Challenges in Knowledge Management – Ethical Issues in Knowledge Management - Introduction to Data, Information, Knowledge and Wisdom (DIKW) Framework – Overview of Knowledge Representation and Knowledge-Based Systems in organizations.					
Unit - II	CREATING THE CULTURE OF LEARNING AND KNOWLEDGE SHARING				9
Organizations and Knowledge Management – Building Learning Organizations – Knowledge Markets and Collaboration among Distributed Teams – Tacit Knowledge Management and Quality Assurance - Knowledge Creation and Knowledge Sharing Models – Knowledge Sharing in Digital and Data-Driven Organizations – Overview of Human–AI assisted Knowledge Work – Data Literacy for Knowledge Culture.					
Unit - III	KNOWLEDGE MANAGEMENT TOOLS & TECHNIQUES				9
Telecommunications and Networks in Knowledge Management – Internet and Search Engines for Knowledge Management– Information Technology Support for Knowledge Management– Vocabulary Control and Ontologies – Information Mapping and Retrieval – Information Coding and Repackaging - Introduction to NLP for Knowledge Extraction - Knowledge Graphs for Enterprise Knowledge Management - Overview of Machine Learning Techniques for Knowledge Discovery					
Unit – IV	KNOWLEDGE MANAGEMENT APPLICATION				9
Components of a Knowledge Strategy - Case Studies (From Library to Knowledge Center, Knowledge Management in the Health Sciences, Knowledge Management in Developing Countries) - Intelligent Decision Support Systems - Knowledge Management in Digital Enterprises and Industry 4.0 environments.					
Unit - V	FUTURE TRENDS AND CASE STUDIES				9
Advanced topics and case studies in knowledge management - Development of a knowledge management map/plan that is integrated with an organization's strategic and business plan - Overview of Generative AI in Knowledge Creation - Big Data Analytics for Organizational Knowledge - Future Trends: Explainable AI (XAI), Responsible AI and Knowledge Governance - A case study on Corporate Memories for supporting various aspects in the process life-cycles of an organization					
Total Periods:					45

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO1	Apply fundamental knowledge management concepts to analyze organizational knowledge processes, cultural factors, and decision-support mechanisms, and evaluate how the transition from information management to knowledge management influences ethical, managerial, and technological practices in modern enterprises.	K3



CO2	Examine organizational learning structures and knowledge-sharing cultures to analyze cooperation among distributed specialists, assess the role of tacit knowledge, and determine how learning organizations sustain quality and continuous improvement.	K4
CO3	Utilize knowledge management tools and technologies such as networks, search systems, information mapping, and vocabulary control to organize, retrieve, and repackage information, and analyze their effectiveness in supporting enterprise knowledge workflows.	K3
CO4	Develop knowledge management strategies by analyzing organizational needs, synthesizing components of knowledge frameworks, and evaluating real-world case studies to design application-oriented knowledge solutions for diverse domains.	K4
CO5	Formulate a future-oriented knowledge management plan by analyzing emerging trends, integrating knowledge maps with business strategies, and evaluating corporate memory systems to support organizational processes and lifecycle management.	K4

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	2	3	3	1	2	2	2	2	1	3	3	2
CO2	3	3	2	2	3	1	2	2	2	2	1	3	3	2
CO3	2	3	3	3	3	1	2	2	3	2	2	3	3	3
CO4	2	3	3	3	3	2	2	2	3	2	2	3	3	3
CO5	2	2	3	3	3	2	2	2	2	2	1	3	3	3
CO	2.40	2.60	2.60	2.80	3.00	1.40	2.00	2.00	2.40	2.00	1.40	3.00	3.00	2.60

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Michael J. Earl, Knowledge Management in Organizations, Oxford University Press, 2024
2	Donald Hislop, Knowledge Management in Organizations: A Critical Introduction, Oxford University Press, 2023
3	Jay Liebowitz, <i>Knowledge Management Handbook: Collaboration and Social Networking</i> , CRC Press, 2022

Reference Books

1	Alavi & Leidner, KM and Organizational Memory, Springer, 2023
2	Ralf Müller & Thomas Urbach (Eds.), Handbook on Knowledge Management, Springer, 2022



U24ME5H04	INDUSTRIAL MANAGEMENT	L	T	P	C
		3	0	0	3
Course Objectives:	This course enables learners to understand decision making, organizing, leadership, and to analyse managerial roles and functions. It also provides essential knowledge of Supply Chain Management for effective organizational performance.				
Unit - I	INTRODUCTION			9	
Technology Management - Definition - Functions - Evolution of Modern Management - Scientific Management Development of Management Thought. Approaches to the study of Management, Forms of Organization -Individual Ownership - Partnership - Joint Stock Companies - Co-operative Enterprises - Public Sector Undertakings, Corporate Frame Work- Share Holders - Board of Directors - Committees - Chief Executive Line and Functional Managers,-Financial-Legal-Trade Union - Role of Management in Industrial Organizations					
Unit - II	FUNCTIONS OF MANAGEMENT			9	
Planning - Nature and Purpose - Objectives - Strategies – Policies and Planning Premises - Decision Making - Organizing - Nature and Process - Premises - Departmentalization - Line and staff - Decentralization - Organizational culture, Staffing - selection and training .Placement - Performance appraisal - Career Strategy – Organizational Development. Leading - Managing human factor - Leadership .Communication, Controlling - Process of Controlling - Controlling techniques, productivity and operations management - Preventive control, Industrial Safety- Time Management.					
Unit - III	ORGANIZATIONAL BEHAVIOUR			9	
Definition - Organization - Managerial Role and functions -Organizational approaches, Individual behaviour - causes - Environmental Effect - Behaviour and Performance, Perception - Organizational Implications. Personality - Contributing factors - Dimension – Need Theories - Process Theories - Job Satisfaction, Learning and Behaviour-Learning Curves, Work Design and approaches- Motivation in Organizations.					
Unit – IV	GROUPDYNAMICS			9	
Group Behaviour - Groups - Contributing factors - Group Norms, Communication - Process - Barriers to communication - Effective communication, leadership - formal and informal characteristics – Managerial Grid - Leadership styles - Group Decision Making - Leadership Role in Group Decision, Group Conflicts - Types - Causes - Conflict Resolution -Inter group relations and conflict, Organization centralization and decentralization - Formal and informal - Organizational Structures Organizational Change and Development - Change Process – Resistance to Change - Culture and Ethics - Team Building.					
Unit - V	MODERN CONCEPTS			9	
Management by Objectives (MBO) - Management by Exception (MBE), Strategic Management - Planning for Future direction - SWOT Analysis -Evolving development strategies, information technology in management Decisions support system-Management Games Business Process Re- engineering (BPR) –Enterprises Resource Planning (ERP) - Supply Chain Management (SCM) - Activity Based Management (AM) - Global Perspective - Principles and Steps Advantages and disadvantage - Lean Management – Basic Concept.					
Total Periods:				45	



Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO1	Summarize the basic concepts of industrial management.	K2
CO2	Discuss group conflicts and their causes in organizations.	K2
CO3	Illustrate the components and purpose of SWOT analysis.	K2
CO4	Interpret learning curves in industrial applications.	K2
CO5	Outline the concepts of placement and performance in organizations.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	1	-	-	-	-	-	-	-	-	-	2	1	-
CO2	-	3	2	3	-	-	-	-	-	-	-	-	-	2
CO3	2	3	2	3	-	-	-	-	-	-	-	1	2	3
CO4	2	2	3	3	-	-	-	-	-	-	-	-	3	3
CO5	2	2	-	-	-	-	-	-	-	-	-	2	-	-
CO	2	2	2	3	-	-	-	-	-	-	-	2	2	3

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	M. Govindarajan and S. Natarajan, "Principles of Management", Prentice Hall of India, New Delhi, 2019.
2	Koontz. H. and Weihrich. H., "Essentials of Management: An International Perspective", 12th Edition, Tata McGrawhill, New Delhi, 2021.

Reference Books

1	Joseph J, Massie, "Essentials of Management", 8th Edition, Pearson Education, 2018.
2	Saxena, P. K., "Principles of Management: A Modern Approach", Global India Publications, 2021.
3	S.Chandran, "Organizational Behaviours", Vikas Publishing House Pvt. Ltd., 1994.
4	Richard L. Daft, "Organization Theory and Design", South Western College Publishing, 16th Edition, 2019.
5	Maynard H.B, "Industrial Engineering Hand book", McGraw-Hill, sixth 2008



U24GE7203		DUETSCH - I		L	T	P	C
				2	0	2	3
Course Objectives:		In this course equip the students with foundational proficiency in the German language by developing their basic grammar, vocabulary, pronunciation, and conversational skills, enabling them to communicate effectively in everyday, workplace, travel, and social contexts.					
Unit - I	INTRODUCTION TO GERMAN SOUNDS AND BASIC WORDS					9	
Die Satzmelodie - Das Alphabet - Die Laute sch [S] und sp [Sp] - Diphthonge: ei [ai] - Begrüßen – Sich und andere vorstellen - Buchstabieren - Zählen							
Unit - II	FAMILY					9	
Angaben zur Person: Name, Alter, Familie - Länder - Städte - Berufe - Sprachen - Hobbys - Zahlen Personalpronomen und Verben im Präsens - Personalpronomen - Aussagesätze - Fragesätze - Bestimmter Artikel - Possessivartikel							
Unit - III	FIRST CONVERSATION AT WORKPLACE					9	
Gespräche mit Kollegen - Die Büroeinrichtung und die Abteilungen beschreiben - Nach Preisen fragen - Über Freizeitaktivitäten sprechen - Nomengruppe im Nominativ: bestimmter und unbestimmter Artikel - Possessivartikel - Pronomen - Verben im Präsens - Modalverb: können - Negation - Lokale Präpositionen: aus, in, bei, nach							
Unit – IV	TRAVEL					9	
Ein Hotelzimmer reservieren - Sich im Hotel anmelden - Probleme im Hotelzimmer benennen - Sich in einer Stadt orientieren - Informationen über Museen erfragen (Öffnungszeiten/Eintrittspreise) - Nomengruppe im Akkusativ - Komposita - Verben im Präsens - Verben mit Akkusativ - Modalverb: möchte(n) - Temporale und lokale Präpositionen							
Unit - V	FOOD AND DRINK					9	
Essen und Trinken bestellen - Nahrungsmittel einkaufen - Einfache Rezepte lesen Informationen über Essgewohnheiten geben und erfragen - Nomengruppe im Akkusativ - Plural der Nomen - Modalverb: mögen - Präteritum von sein und haben - Personalpronomen im Akkusativ							
Total Periods:						45	

Course Outcomes

On completion of the course, the student can

COs	STATEMENTS	K-Level
CO1	Explain basic German sounds, alphabet patterns, pronunciation rules, and commonly used introductory expressions in everyday communication.	K2
CO2	Describe personal information, family details, professions, and hobbies using appropriate personal pronouns, articles, and present tense verb forms.	K2
CO3	Interpret and respond to simple workplace conversations using correct grammatical structures such as modal verbs, negation, and prepositions	K2
CO4	Explain travel-related interactions including hotel reservations, city navigation, and museum inquiries using appropriate accusative forms and modal verbs	K2
CO5	Discuss food and drink preferences, ordering processes, and basic shopping conversations using plural forms, accusative pronouns, and simple past forms of <i>sein</i> and <i>haben</i> .	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO– PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	-	-	-	-	-	1	-	2	3	-	2	-	-	1
CO2	-	-	-	-	-	1	-	2	3	-	2	-	-	1
CO3	-	-	-	-	-	2	-	3	3	1	2	1	1	2
CO4	-	-	-	-	-	2	-	2	3	1	2	-	1	2
CO5	-	-	-	-	-	1	-	2	3	-	2	-	1	1
CO	-	-	-	-	-	1	-	3	3	0	2	-	1	1

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books:

1	Dengler, Stefanie, et al. <i>Netzwerk A1: Kursbuch</i> . Ernst Klett Sprachen, 2017.
2	Funk, Hermann, et al. <i>Menschen A1: Kursbuch</i> . Hueber Verlag, 2012.
3	Funk, Hermann, et al. <i>Menschen A1: Arbeitsbuch</i> . Hueber Verlag, 2012.
4	Koithan, Ute, et al. <i>Aspekte neu A1 Plus</i> . Klett Sprachen, 2016.

Reference Books:

1	Dreyer, Hilke, and Richard Schmitt. <i>Lehr- und Übungsbuch der deutschen Grammatik</i> . Hueber Verlag, 2015.
2	Reimann, Monika. <i>Grundstufen-Grammatik für Deutsch als Fremdsprache</i> . Hueber Verlag, 2010.
3	Lemcke, Christiane, et al. <i>Berliner Platz 1 NEU</i> . Langenscheidt, 2016.
4	Hall, Karin, and Barbara Scheiner. <i>Übungsgrammatik für die Grundstufe</i> . Hueber Verlag, 2014.
5	Di Donato, Robert, et al. <i>Deutsch Na Klar! An Introductory German Course</i> . McGraw-Hill Education, 2014.



U24GE7204	JAPANESE - I			L	T	P	C
			0	0	2	1	
Course Objectives:		To develop foundational proficiency in the Japanese language by enabling students to understand the Japanese writing system (Hiragana, Katakana, and basic Kanji), acquire essential grammar and vocabulary, and communicate effectively in everyday, workplace, travel, and social situations.					
Unit - I	INTRODUCTION TO JAPANESE					9	
Japanese written system - Japanese sounds - Hiragana (あ、い、う、え、お...) -Hiragana variations - Katakana - Katakana variations							
Unit - II	MYSELF					9	
Countries - Languages - Occupations - Self-introduction - Family - People - Numbers - My family - wa...desu - mo particle- to particle - ni particle - no particle.							
Unit - III	FIRST CONVERSATION AT WORKPLACE					9	
Food - Drinks - 7 Kanji - Food for lunch - Eating places - ga suki desu - sukijanai - o particle - de particle - My breakfast - My lunch							
Unit – IV	TRAVEL					9	
Home - Furniture - 4 kanjis - Places to visit nearby - Rooms - Things in the room - ni + ga + arimasu - ni + ga + imasu - general counter - My home - My room							
Unit - V	FOOD AND DRINK					9	
Daily routines - Time - 10 kanjis - Free-time activities - Places - Calendar - telling time - ni particle - kara... made... - time expression - ii adjective							
Total Periods:						45	

Course Outcomes

On completion of the course, the student can

COs	STATEMENTS	K-Level
CO1	Explain the Japanese writing system including Hiragana, Katakana, basic Kanji, and fundamental pronunciation patterns.	K2
CO2	Describe personal information, family details, occupations, and nationalities using basic Japanese sentence structures and particles (wa, mo, to, ni, no).	K2
CO3	Interpret and respond to simple workplace and daily-life conversations related to food, preferences, and common expressions using appropriate particles (ga, o, de).	K2
CO4	Explain travel-related and home-based conversations using sentence patterns such as <i>ni + ga + arimasu/imasu</i> and basic counters.	K2
CO5	Discuss daily routines, time expressions, free-time activities, and calendar-related conversations using correct particles and adjective forms.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create



CO – PO– PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	-	-	-	-	-	1	-	2	3	-	2	-	-	1
CO2	-	-	-	-	-	1	-	2	3	-	2	-	-	1
CO3	-	-	-	-	-	2	-	3	3	1	2	1	1	2
CO4	-	-	-	-	-	2	-	2	3	1	2	-	1	2
CO5	-	-	-	-	-	1	-	2	3	-	2	-	1	1
CO	-	-	-	-	-	1	-	3	3	0	2	-	1	1

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books:

1	Banno, Eri, et al. <i>Genki I: An Integrated Course in Elementary Japanese</i> . 3rd ed., The Japan Times Publishing, 2020.
2	The Japan Foundation. <i>Marugoto: Japanese Language and Culture Starter A1 – Katsudoo (Coursebook for Communicative Language Activities)</i> . Sanshusha Publishing, 2014.
3	The Japan Foundation. <i>Marugoto: Japanese Language and Culture Starter A1 – Rikai (Coursebook for Communicative Language Competences)</i> . Sanshusha Publishing, 2014.
4	Tohsaku, Yookoso! Yasu-Hiko. <i>Yookoso! An Invitation to Contemporary Japanese, Book 1</i> . 3rd ed., McGraw-Hill Education, 2014.
5	Nakama, Yukiko Abe Hatasa, et al. <i>Nakama 1: Japanese Communication, Culture, Context</i> . 3rd ed., Cengage Learning, 2017.

Reference Books:

1	Makino, Seiichi, and Michio Tsutsui. <i>A Dictionary of Basic Japanese Grammar</i> . The Japan Times Publishing, 1989.
2	Hadamitzky, Wolfgang, and Mark Spahn. <i>Japanese Kanji and Kana: A Complete Guide to the Japanese Writing System</i> . Tuttle Publishing, 2011.
3	Miura, Akira. <i>Essential Japanese Grammar: A Comprehensive Guide to Contemporary Usage</i> . Tuttle Publishing, 1998.
4	Henshall, Kenneth G. <i>A Guide to Remembering Japanese Characters</i> . Tuttle Publishing, 2015.
5	Sasaki, Isami, et al. <i>Minna no Nihongo I: Main Textbook</i> . 2nd ed., 3A Corporation, 2012.

