



# VIVEKANANDHA

## COLLEGE OF ENGINEERING FOR WOMEN

(An Autonomous Institution Affiliated to Anna University – Chennai)  
(Approved by AICTE - Accredited by NBA New Delhi and ISO 9001:2015 Certified)  
Elayampalayam, Tiruchengode – 637 205, Namakkal District, Tamilnadu.



### B.E. ELECTRONICS AND COMMUNICATION ENGINEERING

#### CURRICULA & SYLLABI


#### REGULATION 2023

(After 19<sup>th</sup> BoS)

Curriculum and Syllabus (1<sup>st</sup> to 6<sup>th</sup> Semester)

(Applicable to the students admitted in the academic year 2024 – 2025)

#### CHOICE BASED CREDIT SYSTEM [CBCS]

  
BOS Chairman,  
Faculty of Electronics and Communication Engineering,  
Vivekanandha College of Engineering  
for Women (Autonomous),  
Tiruchengode, Namakkal - 637 205.



**VIVEKANANDHA  
COLLEGE OF ENGINEERING FOR WOMEN  
(Autonomous Institution, Affiliated to Anna University Chennai)**



**COLLEGE VISION**

To impart value based education in Engineering and Technology to empower young women to meet the societal exigency with a global outlook.

**COLLEGE MISSION**

- To provide holistic education through innovative teaching-learning practices
- To instill self confidence among rural students by supplementing with co-curricular and extra-curricular activities
- To inculcate the spirit of innovation through training, research and development
- To provide industrial exposure to meet the global challenges
- To create an environment for continual progress through lifelong learning

**DEPARTMENT VISION**

- To Produce Innovative, Creative, Ethical and Socially responsible Electronics and Communication women engineers to meet the global challenges

**DEPARTMENT MISSION**

- To create a unique learning environment in Electronics and Communication Engineering to mould a strong engineer with professional ethics
- To provide practical exposure to compete in the global market
- Fostering culture of innovation, research and lifelong learning

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**B.E. ELECTRONICS AND COMMUNICATION ENGINEERING**

**Regulation 2023**

**CHOICE BASED CREDIT SYSTEM**

**PROGRAM EDUCATIONAL OBJECTIVES (PEOs):**

PEO1: To offer strong theoretical and practical knowledge with managerial skills and entrepreneurial competencies.

PEO2: To impart analytic and questioning skills to broaden innovative ideas for Research and Development based on Industry requirements.

PEO3: To achieve a high level technical expertise in Electronics and Communication Engineering and inculcate professional ethics and social concern

**PROGRAM SPECIFIC OUTCOMES (PSOs):**

At the end of this program, graduate will be able to:

PSO 1: Comprehend the basic concepts of electronics and communication and apply in the day to day life to design and execute complete engineering systems.

PSO2: Design, verify and validate electronic functional elements for numerous applications including signal processing, communications, computer networks and VLSI.

PSO 3: Demonstrate the intellectual level with peer engineers and others to work together to arrive at a cost-effective, appropriate solution for various problems.

**PROGRAM OUTCOMES (POs):**

PO 1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 2. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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

PO 4. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

  
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- PO 5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- PO 6. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- PO 7. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- PO 8. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- PO 9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- PO 10. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- PO 11. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- PO 12. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.





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	<b>VIVEKANANDHA COLLEGE OF ENGINEERING FOR WOMEN</b> (Autonomous Institution, Affiliated to Anna University, Chennai) Elayampalayam, Tiruchengode – 637 205								
Programme	<b>B.E.</b>	Programme Code		<b>103</b>	Regulation		<b>2023</b>		
Department	<b>Electronics and Communication Engineering</b>			Semester		<b>I</b>			
<b>CURRICULUM</b>									
(Applicable to the students admitted from the academic year 2024 – 2025 onwards)									
Course Code	Course Name	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P		C	CA	ESE
<b>THEORY</b>									
U23MA101	Matrices and Calculus*	BSC	3	1	0	4	40	60	100
U23EN101	English for Communication*	HSMC	3	0	0	3	40	60	100
U23CH101	Engineering Chemistry§	BSC	3	0	0	3	40	60	100
U23CS101	Programming for Problem Solving*	ESC	3	0	0	3	40	60	100
U23TA101	தமிழர் மரபு / Heritage of Tamils*	HSMC	1	0	0	1	40	60	100
<b>THEORY INTEGRATED WITH PRACTICAL</b>									
U23GE101	Engineering Graphics*	ESC	2	0	3	3	50	50	100
<b>PRACTICAL INTEGRATED WITH THEORY</b>									
U23GE102	Design Thinking*	EEC	1	0	2	1	50	50	100
<b>PRACTICAL</b>									
U23CH102	Chemistry Laboratory§	BSC	0	0	2	1	60	40	100
U23CS102	Programming for Problem Solving Laboratory*	ESC	0	0	2	1	60	40	100
<b>MANDATORY COURSES</b>									
-	Induction Programme*	3 Weeks				0	-	-	-
U23MCFY2	Indian Constitution§	MC	2	0	0	0	100	-	100
<b>Total</b>						<b>20</b>	<b>520</b>	<b>480</b>	<b>1000</b>

BSC - Basic Science Courses, ESC- Engineering Science Courses, MC-Mandatory courses, HSMC-Humanities and Social Sciences including management courses, EEC – Employability Enhancement courses, CA- Continuous Assessment, ESE - End Semester Examination.

\*Common for all branches

§ Common for ECE, EEE & BME

  
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Programme	<b>B.E.</b>	Programme Code	<b>103</b>	Regulation	<b>2023</b>				
Department	<b>Electronics and Communication Engineering</b>			Semester	<b>II</b>				
<b>CURRICULUM</b> (Applicable to the students admitted from the academic year 2024 – 2025 onwards)									
Course Code	Course Name	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P		C	CA	ESE
<b>THEORY</b>									
U23MA202	Complex Analysis and Ordinary Differential Equations*	BSC	3	1	0	4	40	60	100
U23PH201	Engineering Physics \$	BSC	3	0	0	3	40	60	100
U23EC201	Semiconductor Devices and Technology	PCC	3	0	0	3	40	60	100
U23TA202	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology*	HSMC	1	0	0	1	40	60	100
<b>THEORY INTEGRATED WITH PRACTICAL</b>									
U23CS203	Python Programming@	ESC	3	0	2	4	50	50	100
U23EN202	Professional Communication*	HSMC	2	0	3	3	50	50	100
<b>PRACTICAL</b>									
U23PH202	Physics Laboratory\$	BSC	0	0	2	1	60	40	100
U23GE204	Engineering Practices Laboratory*	ESC	0	0	3	1	60	40	100
<b>MANDATORY COURSES</b>									
U23MCFY1	Environmental Science and Engineering\$	MC	2	0	0	0	100	-	100
<b>Total</b>						<b>20</b>	<b>480</b>	<b>420</b>	<b>900</b>



BSC - Basic Science Courses, ESC Engineering Science Courses, MC - Mandatory courses, HSMC-Humanities and Social Sciences including Management courses, PCC – Professional Core Courses, CA- Continuous Assessment, ESE - End Semester Examination.

\*Common for all branches

@Common for EEE, ECE, BME & BT

\$ Common for ECE, EEE & BME

  
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Programme	<b>B.E.</b>	Programme Code	<b>103</b>	Regulation	<b>2023</b>				
Department	<b>Electronics and Communication Engineering</b>			Semester	<b>III</b>				
<b>CURRICULUM</b>									
(Applicable to the students admitted from the academic year 2023 – 2024 onwards)									
Course Code	Course Name	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P		C	CA	ESE
<b>THEORY</b>									
U23MA303	Transforms and Partial Differential Equations*	BSC	3	1	0	4	40	60	100
U23EC301	Circuit Analysis	PCC	3	0	0	3	40	60	100
U23EC302	Signals and Systems	PCC	3	0	0	3	40	60	100
U23IT302	Data Structures <sup>#</sup>	PCC	3	0	0	3	40	60	100
U23CTCP1	Verbal, Quantitative, Aptitude and Reasoning-I <sup>@</sup>	EEC	2	0	0	1	40	60	100
<b>THEORY INTEGRATED WITH PRACTICAL</b>									
U23EC303	Digital Logic Circuit Design	PCC	3	0	1	4	50	50	100
<b>PRACTICAL</b>									
U23EC304	Devices and Circuits Laboratory	PCC	0	0	2	1	60	40	100
U23IT303	Data Structures Lab <sup>#</sup>	PCC	0	0	2	1	60	40	100
U23CTCP2	Personality Development <sup>@</sup>	EEC	1	0	2	1	60	40	100
<b>Total Credits</b>						<b>21</b>	<b>430</b>	<b>470</b>	<b>900</b>

CA - Continuous Assessment, ESE - End Semester Examination, BSC - Basic Science Courses, PCC – Professional Core Courses, EEC - Employability Enhancement Courses.



<sup>#</sup> Common for IT, CSE, CST, BME, ECE, EEE

\* Common for BME, CIVIL, AGRI, Bio-Tech, ECE, EEE

<sup>@</sup> Common for all branches

  
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Programme	B.E.	Programme Code	103	Regulation	2023				
Department	Electronics and Communication Engineering			Semester	IV				
<b>CURRICULUM</b> (Applicable to the students admitted from the academic year 2023 – 2024 onwards)									
Course Code	Course Name	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P		C	CA	ESE
<b>THEORY</b>									
U23MA406	Probability and Random Processes	BSC	3	1	0	4	40	60	100
U23EC401	Electromagnetics and Transmission Lines	PCC	3	0	0	3	40	60	100
U23EC402	Electronic Circuits	PCC	3	0	0	3	40	60	100
U23EC403	Analog Integrated Circuits	PCC	3	0	0	3	40	60	100
U23ADL01	Additional Language <sup>@</sup>	EEC	3	0	0	1	40	60	100
<b>THEORY INTEGRATED WITH PRACTICAL</b>									
U23EC404	Digital Signal Processing	PCC	3	0	1	4	50	50	100
<b>PRACTICAL</b>									
U23EC405	Electronic Circuits Laboratory	PCC	0	0	2	1	60	40	100
U23EC406	Analog Integrated Circuits Laboratory	PCC	0	0	2	1	60	40	100
<b>CAREER TRACK COURSES</b>									
	Career Track Course I <sup>@</sup>	EEC	2/0	0	2/0	1	40/60	60/40	100
<b>Total Credits</b>						<b>21</b>	<b>410/430</b>	<b>490/470</b>	<b>900</b>

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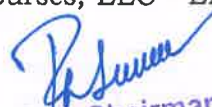


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Programme	<b>B.E.</b>	Programme Code	<b>103</b>	Regulation			<b>2023</b>			
Department	<b>Electronics and Communication Engineering</b>			Semester			<b>V</b>			
<b>CURRICULUM</b> (Applicable to the students admitted from the academic year 2023 – 2024 onwards)										
Course Code	Course Name	Category	Periods / Week			Credit	Maximum Marks			
			L	T	P		C	CA	ESE	Total
<b>THEORY</b>										
U23EC501	Control System Engineering	PCC	3	1	0	4	40	60	100	
U23EC502	Processor and Real Time Systems	PCC	3	0	0	3	40	60	100	
U23EC503	Analog and Digital Communication	PCC	3	0	0	3	40	60	100	
	Professional Elective I	PEC	3	0	0	3	40	60	100	
	Open Elective I	OEC	3	0	0	3	40	60	100	
<b>THEORY INTEGRATED WITH PRACTICAL</b>										
U23EC504	Waveguides and Antennas	PCC	3	0	1	4	50	50	100	
<b>PRACTICAL</b>										
U23EC505	Processor and Real Time Systems Laboratory	PCC	0	0	2	1	60	40	100	
U23EC506	Analog and Digital Communication Laboratory	PCC	0	0	2	1	60	40	100	
U23EC507	Mini Project-I	EEC	0	0	2	1	100	-	100	
<b>CAREER TRACK COURSE</b>										
	Career Track Course II	EEC	3	0	0	1	40	60	100	
<b>Total Credits</b>						<b>24</b>	<b>510</b>	<b>490</b>	<b>1000</b>	

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Programme	<b>B.E.</b>	Programme Code	<b>103</b>	Regulation	<b>2023</b>				
Department	<b>Electronics and Communication Engineering</b>			Semester	<b>VI</b>				
<b>CURRICULUM</b> (Applicable to the students admitted from the academic year 2023 - 2024 onwards)									
Course Code	Course Name	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P		C	CA	ESE
<b>THEORY</b>									
U23EC601	VLSI Design	PCC	3	0	0	3	40	60	100
U23EC602	Computer Networks	PCC	3	0	0	3	40	60	100
	Professional Elective II	PEC	3	0	0	3	40	60	100
	Professional Elective III	PEC	3	0	0	3	40	60	100
	Open Elective II	OEC	3	0	0	3	40	60	100
<b>THEORY INTEGRATED WITH PRACTICAL</b>									
U23EC603	Industrial Internet of Things (IIoT)	PCC	3	0	1	4	50	50	100
<b>PRACTICAL</b>									
U23EC604	VLSI Design Laboratory	PCC	0	0	2	1	60	40	100
U23EC605	Computer Networks Laboratory	PCC	0	0	2	1	60	40	100
U23EC606	Mini Project -II	EEC	0	0	2	1	100	-	100
<b>CAREER TRACK COURSE</b>									
	Career Track Course III	EEC	3	0	0	1	40	60	100
<b>MANDATORY COURSES</b>									
U23EC607	Comprehensive Examination	MC	3	0	0	1	100	-	100
<b>Total Credits</b>						<b>24</b>	<b>610</b>	<b>490</b>	<b>1100</b>

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Programme	<b>B.E.</b>	Programme Code	<b>103</b>	Regulation		<b>2023</b>			
Department	<b>Electronics and Communication Engineering</b>			Semester		<b>VII</b>			
<b>CURRICULUM</b> (Applicable to the students admitted from the academic year 2023 – 2024 onwards)									
Course Code	Course Name	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P		C	CA	ESE
<b>THEORY</b>									
U23EC701	RF and Microwave Engineering	PCC	3	0	0	3	40	60	100
U23EC702	AI for Electronics Engineers	PCC	3	0	0	3	40	60	100
	Professional Elective IV	PEC	3	0	0	3	40	60	100
	Professional Elective V	PEC	3	0	0	3	40	60	100
	Professional Elective VI	PEC	3	0	0	3	40	60	100
	Open Elective III	OEC	3	0	0	3	40	60	100
<b>PRACTICAL</b>									
U23EC703	Optical and Microwave Engineering Laboratory	PCC	0	0	2	1	60	40	100
U23EC704	Internship Training cum Project Phase I	EEC	0	0	2	3	100	-	100
<b>Total Credits</b>						<b>22</b>	<b>400</b>	<b>400</b>	<b>800</b>

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Programme	<b>B.E.</b>	Programme Code	<b>103</b>	Regulation	<b>2023</b>				
Department	<b>Electronics and Communication Engineering</b>			Semester	<b>VIII</b>				
<b>CURRICULUM</b> (Applicable to the students admitted from the academic year 2023 – 2024 onwards)									
Course Code	Course Name	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P		C	CA	ESE
<b>PRACTICAL</b>									
U23EC801	Project Phase II	EEC	0	0	20	10	60	40	100
<b>Total Credits</b>						10	60	40	100

CA - Continuous Assessment, ESE - End Semester Examination, PEC - Professional Elective Courses, EEC - Employability Enhancement Courses, OEC-Open Elective Courses

Cumulative Course Credit: **162 (2023-2027 Batch onwards)**

  
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### CAREER TRACK COURSES

Sem	Course Code	Course Name	Category	Periods/Week			Credit	Maximum Marks		
				L	T	P		C	CA	ESE
<b>Track 1 - Entrepreneurship</b>										
IV	U23CTCE1	Entrepreneurial Mindset and Business Model Canvas	EEC	-	-	2	1	60	40	100
V	U23CTCE2	Product Innovation, Commercialization and Finance	EEC	2	-	-	1	40	60	100
VI	U23CTCE3	Intellectual Property Rights	EEC	2	-	-	1	40	60	100
<b>Track 2 - Competitive Examination</b>										
IV	U23CTCP3	Verbal , Quantitative Aptitude and Reasoning -II	EEC	2	-	-	1	40	60	100
V	U23CTCG1	History & Culture of India and Indian Geography	EEC	2	-	-	1	40	60	100
VI	U23CTCG2	Indian economy and Freedom struggle in India & Tamil Nadu	EEC	2	-	-	1	40	60	100
<b>Track 3 - Higher Studies</b>										
IV	U23CTCP3	Verbal, Quantitative Aptitude and Reasoning -II	EEC	2	-	-	1	40	60	100
V	U23CTCH1	Higher Studies in Abroad & India	EEC	2	-	-	1	40	60	100
VI	U23CTCH2	Social Networking for Higher Studies	EEC	2	-	-	1	40	60	100
<b>Track 4 - Placement</b>										
IV	U23CTCP3	Verbal , Quantitative Aptitude and Reasoning -II	EEC	2	-	-	1	40	60	100
V	U23CTCP4	Leveraging Arithmetic and Codes Snippet	EEC	2	-	-	1	40	60	100
VI	U23CTCP5	Integrated Reasoning and Pseudo Code	EEC	2	-	-	1	40	60	100



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**VERTICAL COURSES For B.E. ECE Honours (Specialization) / Honours / Minors**

S.No.	VERTICAL COURSES For B.E. ECE Honours (Specialization) / Honours / Minors						
	Vertical I	Vertical II	Vertical III	Vertical IV	Vertical V	Vertical VI	Vertical VII
	<b>Semiconductor and VLSI Design</b>	<b>Signal Processing</b>	<b>Communication System</b>	<b>Embedded Systems and Internet of Things (IoT)</b>	<b>Networking</b>	<b>Artificial Intelligence</b>	<b>Electronic Engineering Administration System</b>
1	Digital IC Design	DSP Architecture and Programming	Mobile Communication	Embedded System Design and Real Time Applications	Mobile Adhoc Networks	Neural Networks and its Applications	Medical Electron
2	Analog IC Design	Digital Image Processing	Optical Communication	Software for Embedded system	Wireless Body Area Network	Deep Learning	Management Quality and Ethical Values
3	Semiconductor Device Modeling	Digital Video Processing	Satellite Communication	Sensor for Industrial Applications	Wireless Sensor Networks	Artificial Intelligence and Machine Learning	Remote Sensing
4	VLSI Technology	Medical Image Processing	5G and 6G Communication Networks	IoT System Design and Processor	Wireless Sensor Network for Robotics	Computer Vision	Industry 4.0 & 5.0
5	Low Power VLSI Design	Biomedical Signal Processing	MIMO Communications	Embedded System Interfacing and Testing	Optical Networks	Augmented Reality/Virtual Reality	Automotive Electronics
6	ASIC Design	Software Defined Radio	Advanced Wireless Communication Techniques	Industrial IoT and Industry 5.0	Cryptography and Network Security	Generative AI	Soft Computing
7	System-on-Chip Design	Radar Signal Processing	Quantum Communication	IoT Security and Trust	Cyber Security	AI based Robotics Automation	PCB Design and Fabrication
8	Quantum Computing	Robotics Sensors and Signal Processing	Green Communication and Technology	Cloud Technologies and its Applications	AI Enabled next generation network	Ethics of Artificial Intelligence	Rocketry and Space Mechanic
9	Online Course	Online Course	Online Course	Online Course	Online Course	Online Course	Online Course


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Programme	<b>B.E.</b>	Programme Code	<b>103</b>	Regulation	<b>2023</b>			
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>			Semester				
<b>CURRICULUM</b> (Applicable to the students admitted from the academic year 2023-2024 onwards)								
<b>VERTICALS – I SEMICONDUCTOR AND VLSI DESIGN</b>								
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P		C	CA	ESE
U23ECV11	Digital IC Design	3	0	0	3	40	60	100
U23ECV12	Analog IC Design	3	0	0	3	40	60	100
U23ECV13	Semiconductor Device Modeling	3	0	0	3	40	60	100
U23ECV14	VLSI Technology	3	0	0	3	40	60	100
U23ECV15	Low Power VLSI Design	3	0	0	3	40	60	100
U23ECV16	ASIC Design	3	0	0	3	40	60	100
U23ECV17	System-on-Chip Design	3	0	0	3	40	60	100
U23ECV18	Quantum Computing	3	0	0	3	40	60	100
U23ECV19	Online Course	3	0	0	3	40	60	100




  
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Programme	<b>B.E.</b>	Programme Code	<b>103</b>	Regulation	<b>2023</b>			
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>			Semester				
<b>CURRICULUM</b> (Applicable to the students admitted from the academic year 2023-2024 onwards)								
<b>VERTICALS – II SIGNAL PROCESSING</b>								
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P		C	CA	ESE
U23ECV21	DSP Architecture and Programming	3	0	0	3	40	60	100
U23ECV22	Digital Image Processing	3	0	0	3	40	60	100
U23ECV23	Digital Video Processing	3	0	0	3	40	60	100
U23ECV24	Medical Image Processing	3	0	0	3	40	60	100
U23ECV25	Biomedical Signal Processing	3	0	0	3	40	60	100
U23ECV26	Software Defined Radio	3	0	0	3	40	60	100
U23ECV27	Radar Signal Processing	3	0	0	3	40	60	100
U23ECV28	Robotics Sensors and Signal Processing	3	0	0	3	40	60	100
U23ECV29	Online Course	3	0	0	3	40	60	100

  
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Programme	<b>B.E.</b>	Programme Code	<b>103</b>	Regulation	<b>2023</b>			
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>			Semester				
<b>CURRICULUM</b> (Applicable to the students admitted from the academic year 2023-2024 onwards)								
<b>VERTICALS – III COMMUNICATION SYSTEM</b>								
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P		C	CA	ESE
U23ECV31	Mobile Communication	3	0	0	3	40	60	100
U23ECV32	Optical Communication	3	0	0	3	40	60	100
U23ECV33	Satellite Communication	3	0	0	3	40	60	100
U23ECV34	5G and 6G Communication Networks	3	0	0	3	40	60	100
U23ECV35	MIMO Communications	3	0	0	3	40	60	100
U23ECV36	Advanced Wireless Communication Techniques	3	0	0	3	40	60	100
U23ECV37	Quantum Communication	3	0	0	3	40	60	100
U23ECV38	Green Communication and Technology	3	0	0	3	40	60	100
U23ECV39	Online Course	3	0	0	3	40	60	100

  
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Programme	<b>B.E.</b>	Programme Code	<b>103</b>	Regulation	<b>2023</b>			
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>			Semester				
<b>CURRICULUM</b> (Applicable to the students admitted from the academic year 2023-2024 onwards)								
<b>VERTICALS-IV EMBEDDED SYSTEMS AND INTERNET OF THINGS (IOT)</b>								
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P		C	CA	ESE
U23ECV41	Embedded System Design and Real Time Applications	3	0	0	3	40	60	100
U23ECV42	Software for Embedded system	3	0	0	3	40	60	100
U23ECV43	Sensor for Industrial Applications	3	0	0	3	40	60	100
U23ECV44	IoT System Design and Processor	3	0	0	3	40	60	100
U23ECV45	Embedded System Interfacing and Testing	3	0	0	3	40	60	100
U23ECV46	Industrial IoT and Industry 5.0	3	0	0	3	40	60	100
U23ECV47	IoT Security and Trust	3	0	0	3	40	60	100
U23ECV48	Cloud Technologies and its Applications	3	0	0	3	40	60	100
U23ECV49	Online Course	3	0	0	3	40	60	100

  
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Programme	<b>B.E.</b>	Programme Code	<b>103</b>	Regulation	<b>2023</b>			
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>			Semester				
<b>CURRICULUM</b> (Applicable to the students admitted from the academic year 2023-2024 onwards)								
<b>VERTICALS-V NETWORKING</b>								
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P		C	CA	ESE
U23ECV51	Mobile Adhoc Networks	3	0	0	3	40	60	100
U23ECV52	Wireless Body Area Network	3	0	0	3	40	60	100
U23ECV53	Wireless Sensor Networks	3	0	0	3	40	60	100
U23ECV54	Wireless Sensor Network for Robotics	3	0	0	3	40	60	100
U23ECV55	Optical Networks	3	0	0	3	40	60	100
U23ECV56	Cryptography and Network Security	3	0	0	3	40	60	100
U23ECV57	Cyber Security	3	0	0	3	40	60	100
U23ECV58	AI Enabled next generation network	3	0	0	3	40	60	100
U23ECV59	Online Course	3	0	0	3	40	60	100

*P. Suresh*

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Programme	<b>B.E.</b>	Programme Code	<b>103</b>	Regulation	<b>2023</b>			
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>			Semester				
<b>CURRICULUM</b> (Applicable to the students admitted from the academic year 2023-2024 onwards)								
<b>VERTICALS-VI ARTIFICIAL INTELLIGENCE</b>								
Course Code	Course Name	Periods / Week			Credit C	Maximum Marks		
		L	T	P		CA	ESE	Total
U23ECV61	Neural Networks and its Applications	3	0	0	3	40	60	100
U23ECV62	Deep Learning	3	0	0	3	40	60	100
U23ECV63	Artificial Intelligence and Machine Learning	3	0	0	3	40	60	100
U23ECV64	Computer Vision	3	0	0	3	40	60	100
U23ECV65	Augmented Reality/Virtual Reality	3	0	0	3	40	60	100
U23ECV66	Generative AI	3	0	0	3	40	60	100
U23ECV67	AI based Robotics Automation	3	0	0	3	40	60	100
U23ECV68	Ethics of Artificial Intelligence	3	0	0	3	40	60	100
U23ECV69	Online Course	3	0	0	3	40	60	100

  
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Programme	<b>B.E.</b>	Programme Code	<b>103</b>	Regulation	<b>2023</b>			
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>			Semester				
<b>CURRICULUM</b> (Applicable to the students admitted from the academic year 2023-2024 onwards)								
<b>VERTICALS-VII ELECTRONICS ENGINEERING AND ADMINISTRATION SYSTEM</b>								
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ESE	Total
U23ECV71	Medical Electronics	3	0	0	3	40	60	100
U23ECV72	Management Quality and Ethical Values	3	0	0	3	40	60	100
U23ECV73	Remote Sensing	3	0	0	3	40	60	100
U23ECV74	Industry 4.0 & 5.0	3	0	0	3	40	60	100
U23ECV75	Automotive Electronics	3	0	0	3	40	60	100
U23ECV76	Soft Computing	3	0	0	3	40	60	100
U23ECV77	PCB Design and Fabrication	3	0	0	3	40	60	100
U23ECV78	Rocketry and Space Mechanics	3	0	0	3	40	60	100
U23ECV79	Online Course	3	0	0	3	40	60	100



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## **LIST OF OPEN ELECTIVES**



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Programme	<b>BE</b>	Programme Code	<b>103</b>	Regulation	<b>2023</b>				
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>			Semester					
<b>CURRICULUM</b> (Applicable to the students admitted from the academic year 2023-2024 onwards)									
<b>LIST OF OPEN ELECTIVE</b>									
Course Code	Course Name	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P		C	CA	ESE
<b>OPEN ELECTIVE-I</b>									
U23ECO1	Principles of Communication	OE	3	0	0	3	40	60	100
U23ECO2	Basics of VLSI	OE	3	0	0	3	40	60	100
U23ECO3	Industry 4.0 & 5.0	OE	3	0	0	3	40	60	100
<b>OPEN ELECTIVE-II</b>									
U23ECO4	Satellite Communication	OE	3	0	0	3	40	60	100
U23ECO5	4G and 5G Network	OE	3	0	0	3	40	60	100
U23ECO6	Robotic system and control	OE	3	0	0	3	40	60	100
<b>OPEN ELECTIVE-III</b>									
U23ECO7	Industrial Electronics	OE	3	0	0	3	40	60	100
U23ECO8	Sensor and its Applications	OE	3	0	0	3	40	60	100
U23ECO9	Nano Electronics	OE	3	0	0	3	40	60	100



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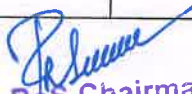
Programme	<b>B.E. / B.Tech.</b>	Programme Code	<b>101</b>	Regulation	<b>2023</b>
Department	<b>COMPUTER SCIENCE AND ENGINEERING</b>			Semester	-



**CURRICULUM**

(Applicable to the students admitted from the academic year 2023- 2024 onwards)

**LIST OF OPEN ELECTIVES**

Course Code	Course Name	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P		C	CA	ESE
<b>THEORY</b>									
U23CSOE1	Fundamentals of OS	OEC	3	0	0	3	40	60	100
U23CSOE2	Web Designing	OEC	3	0	0	3	40	60	100
U23CSOE3	Multimedia and Animation Basics	OEC	3	0	0	3	40	60	100
U23CSOE4	Software Engineering	OEC	3	0	0	3	40	60	100
U23CSOE5	Mobile Application Development	OEC	3	0	0	3	40	60	100
U23CSOE6	Principles of cloud computing	OEC	3	0	0	3	40	60	100
U23CSOE7	Machine Learning with Python	OEC	3	0	0	3	40	60	100
U23CSOE8	Ethical Hacking	OEC	3	0	0	3	40	60	100
U23CSOE9	Open Source Software	OEC	3	0	0	3	40	60	100
U23CSOE10	AI Foundations	OEC	3	0	0	3	40	60	100

  
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Programme	<b>B.Tech.</b>	Programme Code	<b>105</b>	Regulation	<b>2023</b>			
Department	<b>BIOTECHNOLOGY</b>			Semester	<b>-</b>			
<b>CURRICULUM</b> (Applicable to the students admitted from the academic year 2023 - 2024 onwards)								
<b>LIST OF OPEN ELECTIVES</b>								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P		C	CA	ESE
<b>OPEN ELECTIVE - I</b>								
U23BTOE1	Biology for Engineers	3	0	0	3	40	60	100
U23BTOE2	Food and Nutrition	3	0	0	3	40	60	100
U23BTOE3	Biosensors	3	0	0	3	40	60	100
<b>OPEN ELECTIVE -II</b>								
U23BTOE4	Basics of Bioinformatics	3	0	0	3	40	60	100
U23BTOE5	Human Health and Nutritional Disorders	3	0	0	3	40	60	100
U23BTOE6	Biobusiness	3	0	0	3	40	60	100
<b>OPEN ELECTIVE -III</b>								
U23BTOE7	Food Processing and Preservation Technology	3	0	0	3	40	60	100
U23BTOE8	Forensic Technology	3	0	0	3	40	60	100
U23BTOE9	Organic farming for sustainable agriculture	3	0	0	3	40	60	100





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Programme	<b>B.E. / B.Tech.</b>	Programme Code	<b>104</b>	Regulation	<b>2023</b>				
Department	<b>INFORMATION TECHNOLOGY</b>		Semester		-				
<b>CURRICULUM</b> (Applicable to the students admitted from the academic year 2023- 2024 onwards)									
<b>LIST OF OPEN ELECTIVES</b>									
Course Code	Course Name	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P		C	CA	ESE
<b>THEORY</b>									
U23ITOE1	IT Essentials	OEC	3	0	0	3	40	60	100
U23ITOE2	Machine Learning	OEC	3	0	0	3	40	60	100
U23ITOE3	Data Science and Analytics	OEC	3	0	0	3	40	60	100
U23ITOE4	Cyber Threats Intelligence	OEC	3	0	0	3	40	60	100
U23ITOE5	Offensive Security Essentials	OEC	3	0	0	3	40	60	100
U23ITOE6	Object Oriented Programming	OEC	3	0	0	3	40	60	100
U23ITOE7	Creative UX/UI Design	OEC	3	0	0	3	40	60	100


  
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Programme	<b>B.E. / B.Tech.</b>	Programme Code	<b>107</b>	Regulation	<b>2023</b>				
Department	<b>COMPUTER SCIENCE AND TECHNOLOGY</b>		Semester	-					
<b>CURRICULUM</b> (Applicable to the students admitted from the academic year 2023- 2024 onwards)									
<b>LIST OF OPEN ELECTIVES</b>									
Course Code	Course Name	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P		C	CA	ESE
<b>THEORY</b>									
U23CTOE1	Fundamentals of Artificial Intelligence	OEC	3	0	0	3	40	60	100
U23CTOE2	Fundamentals of Information Security	OEC	3	0	0	3	40	60	100
U23CTOE3	Fundamentals of Data Science	OEC	3	0	0	3	40	60	100
U23CTOE4	Fundamentals of Machine Learning	OEC	3	0	0	3	40	60	100
U23CTOE5	Fundamentals of Data Visualization	OEC	3	0	0	3	40	60	100
U23CTOE6	Marketing Analytics	OEC	3	0	0	3	40	60	100





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Programme	<b>B.E.</b>	Programme Code	<b>106</b>	Regulation	<b>2023</b>				
Department	<b>BIOMEDICAL ENGINEERING</b>			Semester	-				
<b>CURRICULUM</b> (Applicable to the students admitted from the academic year 2023- 2024 onwards)									
<b>LIST OF OPEN ELECTIVES</b>									
Course Code	Course Name	Category	Periods / Week			Credit C	Maximum Marks		
			L	T	P		CA	ESE	Total
<b>OPEN ELECTIVE-I</b>									
U23BMOE1	Introduction to Medical Instrumentation	OE	3	0	0	3	40	60	100
U23BMOE2	Telemedicine	OE	3	0	0	3	40	60	100
U23BMOE23	Hospital Engineering and Information Systems	OE	3	0	0	3	40	60	100
<b>OPEN ELECTIVE-II</b>									
U23BMOE4	Advanced Medical Equipments	OE	3	0	0	3	40	60	100
U23BMOE5	Virtual Instrumentation	OE	3	0	0	3	40	60	100
U23BMOE6	Embedded Systems in Medical Applications	OE	3	0	0	3	40	60	100
<b>OPEN ELECTIVE-III</b>									
U23BMOE7	Hospital Management	OE	3	0	0	3	40	60	100
U23BMOE8	Medical Informatics	OE	3	0	0	3	40	60	100
U23BMOE9	Clinical Engineering	OE	3	0	0	3	40	60	100

  
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Programme	<b>B.E. / B.Tech.</b>	Programme Code	<b>102</b>	Regulation	<b>2023</b>				
Department	<b>ELECTRICAL AND ELECTRONICS ENGINEERING</b>		Semester	-					
<b>CURRICULUM</b> (Applicable to the students admitted from the academic year 2023- 2024 onwards)									
<b>LIST OF OPEN ELECTIVES</b>									
Course Code	Course Name	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P		C	CA	ESE
<b>THEORY</b>									
U23EEOE1	Energy Conservation & Management	OEC	3	0	0	3	40	60	100
U23EEOE2	Electrical Safety	OEC	3	0	0	3	40	60	100
U23EEOE3	Wind and Solar Energy Systems	OEC	3	0	0	3	40	60	100
U23EEOE4	Introduction to Electric Vehicle	OEC	3	0	0	3	40	60	100
U23EEOE5	Environment Sustainability	OEC	3	0	0	3	40	60	100

  
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Programme	<b>B.Tech.</b>	Programme Code	<b>109</b>	Regulation	<b>2023</b>				
Department	<b>Artificial Intelligence and Data Science</b>		Semester		-				
<b>CURRICULUM</b>									
<b>LIST OF OPEN ELECTIVES</b>									
Course Code	Course Name	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P		C	CA	ESE
<b>THEORY</b>									
U23ADOE1	Introduction to Cyber Security	OEC	3	0	0	3	40	60	100
U23ADOE2	Foundation of Data science	OEC	3	0	0	3	40	60	100
U23ADOE3	Fundamentals of AI	OEC	3	0	0	3	40	60	100
U23ADOE4	Digital Marketing Analytics	OEC	3	0	0	3	40	60	100
U23ADOE5	Fundamentals of Information Security	OEC	3	0	0	3	40	60	100
U23ADOE6	Cloud Computing	OEC	3	0	0	3	40	60	100





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**MINOR DEGREE VERTICALS – ECE**

**VERTICALS – VII: ELECTRONICS ENGINEERING AND ADMINISTRATION SYSTEM**



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Programme	<b>B.E.</b>	Programme Code	<b>103</b>	Regulation	<b>2023</b>				
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>		Semester		-				
<b>CURRICULUM</b> (Applicable to the students admitted from the academic year 2023- 2024 onwards)									
Course Code	Course Name	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P		C	CA	ESE
<b>THEORY</b>									
U23ECV71	Medical Electronics	PEC	3	0	0	3	40	60	100
U23ECV72	Management Quality and Ethical Values	PEC	3	0	0	3	40	60	100
U23ECV73	Remote Sensing	PEC	3	0	0	3	40	60	100
U23ECV74	Industry 4.0 & 5.0	PEC	3	0	0	3	40	60	100
U23ECV75	Automotive Electronics	PEC	3	0	0	3	40	60	100
U23ECV76	Soft Computing	PEC	3	0	0	3	40	60	100
U23ECV77	PCB Design and Fabrication	PEC	3	0	0	3	40	60	100
U23ECV78	Rocketry and Space Mechanics	PEC	3	0	0	3	40	60	100
U23ECV79	Online Course	PEC	3	0	0	3	40	60	100



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**MINOR DEGREE VERTICALS OFFERED FROM BME**

**VERTICAL V - HEALTHCARE MANAGEMENT**



	<b>VIVEKANANDHA COLLEGE OF ENGINEERING FOR WOMEN</b> (Autonomous Institution, Affiliated to Anna University, Chennai)Elayampalayam, Tiruchengode – 637 205								
Programme	<b>B.E.</b>	Programme Code	<b>106</b>	Regulation	<b>2023</b>				
Department	<b>BIOMEDICAL ENGINEERING</b>			Semester			-		
<b>CURRICULUM</b> (Applicable to the students admitted from the academic year 2023- 2024 onwards)									
Course Code	Course Name	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P		C	CA	ESE
<b>THEORY</b>									
U23BMV51	Hospital Systems Management	PEC	3	0	0	3	40	60	100
U23BMV52	Database Management Systems	PEC	3	0	0	3	40	60	100
U23BMV53	Biomedical Engineering Entrepreneurship	PEC	3	0	0	3	40	60	100
U23BMV54	Energy Audit and Management for Hospitals	PEC	3	0	0	3	40	60	100
U23BMV55	Quality Assurance and Regulatory Aspects for Medical Devices	PEC	3	0	0	3	40	60	100
U23BMV56	Medical Ethics and Intellectual Property Rights	PEC	3	0	0	3	40	60	100
U23BMV57	Troubleshooting of Medical Devices	PEC	3	0	0	3	40	60	100
U23BMV58	Medical Waste management	PEC	3	0	0	3	40	60	100
U23BMV59	NPTEL/IEEE Online Course	PEC	3	0	0	3	40	60	100

  
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**MINOR DEGREE VERTICALS – CSE**

**CYBER SECURITY**



	<b>VIVEKANANDHA COLLEGE OF ENGINEERING FOR WOMEN</b> (Autonomous Institution, Affiliated to Anna University, Chennai) Elayampalayam, Tiruchengode – 637 205								
Programme	<b>B.E.</b>	Programme Code	<b>101</b>	Regulation	<b>2023</b>				
Department	<b>COMPUTER SCIENCE AND ENGINEERING</b>		Semester		-				
<b>CURRICULUM</b> (Applicable to the students admitted from the academic year 2023- 2024 onwards)									
Course Code	Course Name	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P		C	CA	ESE
<b>-THEORY</b>									
U23CSV31	Information Security	PEC	3	0	0	3	40	60	100
U23CSV32	Cyber security	PEC	3	0	0	3	40	60	100
U23CSV33	Malware Analysis	PEC	3	0	0	3	40	60	100
U23CSV34	Cyber law and Ethics	PEC	3	0	0	3	40	60	100
U23CSV35	Block chain Technology	PEC	3	0	0	3	40	60	100
U23CSV36	Social Network Security	PEC	3	0	0	3	40	60	100
U23CSV37	Ethical Hacking	PEC	3	0	0	3	40	60	100
U23CSV38	Security and Privacy in cloud	PEC	3	0	0	3	40	60	100
U23CSV39	Digital Forensics	PEC	3	0	0	3	40	60	100



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**MINOR DEGREE VERTICAL - EEE**

**VERTICALS - V: ADVANCED ENERGY AND ELECTRONIC SYSTEM**

	<b>VIVEKANANDHA COLLEGE OF ENGINEERING FOR WOMEN</b> (Autonomous Institution, Affiliated to Anna University, Chennai) Elayampalayam, Tiruchengode - 637 205								
Programme	<b>B.E.</b>	Programme Code	<b>102</b>	Regulation	<b>2023</b>				
Department	<b>ELECTRICAL AND ELECTRONICS ENGINEERING</b>			Semester		-			
<b>CURRICULUM</b> (Applicable to the students admitted from the academic year 2023- 2024 onwards)									
Course Code	Course Name	Category	Periods / Week			Credit C	Maximum Marks		
			L	T	P		CA	ESE	Total
<b>THEORY</b>									
U23EEV51	Energy Storage Systems	PEC	3	0	0	3	40	60	100
U23EEV52	VLSI Design	PEC	3	0	0	3	40	60	100
U23EEV53	Digital Signal Processing	PEC	3	0	0	3	40	60	100
U23EEV54	Energy Management and Auditing	PEC	3	0	0	3	40	60	100
U23EEV55	Utilization and Conservation of Electrical Energy	PEC	3	0	0	3	40	60	100
U23EEV56	Biomedical Instrumentation	PEC	3	0	0	3	40	60	100
U23EEV57	Online Course	PEC	3	0	0	3	40	60	100






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**MINOR DEGREE VERTICALS – CST**



**DATA SCIENCE**

	<b>VIVEKANANDHA COLLEGE OF ENGINEERING FOR WOMEN</b> (Autonomous Institution, Affiliated to Anna University, Chennai) Elayampalayam, Tiruchengode – 637 205									
Programme	<b>B.E.</b>	Programme Code	<b>107</b>	Regulation	<b>2023</b>					
Department	<b>COMPUTER SCIENCE AND TECHNOLOGY</b>			Semester	-					
<b>CURRICULUM</b>										
(Applicable to the students admitted from the academic year 2023- 2024 onwards)										
Course Code	Course Name	Category	Periods / Week			Credit	Maximum Marks			
			L	T	P		C	CA	ESE	Total
<b>THEORY</b>										
U23CTV11	Data Warehousing and Data Mining	PEC	3	0	0	3	40	60	100	
U23CTV12	Big Data Analytics	PEC	3	0	0	3	40	60	100	
U23CTV13	Exploratory Data Analytics	PEC	3	0	0	3	40	60	100	
U23CTV14	Social Media Analytics	PEC	3	0	0	3	40	60	100	
U23CTV15	Predictive Analytics	PEC	3	0	0	3	40	60	100	
U23CTV16	Image and Video Analytics	PEC	3	0	0	3	40	60	100	
U23CTV17	Recommender Systems	PEC	3	0	0	3	40	60	100	
U23CTV18	Storage Technologies	PEC	3	0	0	3	40	60	100	
U23CTV19	Time Series Analysis and Forecasting	PEC	3	0	0	3	40	60	100	

  
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**MINOR DEGREE VERTICALS - IT**

**IoT and CLOUD**

	<b>VIVEKANANDHA COLLEGE OF ENGINEERING FOR WOMEN</b> (Autonomous Institution, Affiliated to Anna University, Chennai) Elayampalayam, Tiruchengode - 637 205									
Programme	<b>B.E.</b>	Programme Code	<b>104</b>	Regulation	<b>2023</b>					
Department	<b>INFORMATION TECHNOLOGY</b>		Semester		-					
<b>CURRICULUM</b> (Applicable to the students admitted from the academic year 2023- 2024 onwards)										
Course Code	Course Name	Category	Periods / Week			Credit	Maximum Marks			
			L	T	P		C	CA	ESE	Total
<b>THEORY</b>										
U23ITV41	Cloud Computing	PEC	3	0	0	3	40	60	100	
U23ITV42	Distributed Systems	PEC	3	0	0	3	40	60	100	
U23ITV43	Smart Sensor Technologies	PEC	3	0	0	3	40	60	100	
U23ITV44	Software Defined Networks	PEC	3	0	0	3	40	60	100	
U23ITV45	Parallel Programming	PEC	3	0	0	3	40	60	100	
U23ITV46	Virtualization	PEC	3	0	0	3	40	60	100	
U23ITV47	Edge and Fog Computing	PEC	3	0	0	3	40	60	100	
U23ITV48	Amazon Web Services	PEC	3	0	0	3	40	60	100	
U23ITV49	Industry 4.0	PEC	3	0	0	3	40	60	100	

*[Signature]*



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**For Minor Degree in Biotechnology**

**Vertical - V QUALITY AND REGULATORY AFFAIRS**

	<b>VIVEKANANDHA COLLEGE OF ENGINEERING FOR WOMEN</b> (Autonomous Institution, Affiliated to Anna University, Chennai) Elayampalayam, Tiruchengode - 637 205								
Programme	<b>B.Tech</b>	Programme Code	<b>105</b>	Regulation	<b>2023</b>				
Department	<b>BIOTECHNOLOGY</b>		Semester		-				
<b>CURRICULUM</b> (Applicable to the students admitted from the academic year 2023- 2024 onwards)									
Course Code	Course Name	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P		C	CA	ESE
<b>THEORY</b>									
U23BTV51	Good Manufacturing Practices	PEC	3	0	0	3	40	60	100
U23BTV52	Entrepreneurship & IPR	PEC	3	0	0	3	40	60	100
U23BTV53	Audit and Regulatory Compliance	PEC	3	0	0	3	40	60	100
U23BTV54	Supply Chain Management	PEC	3	0	0	3	40	60	100
U23BTV55	QA and QC in Biotechnology	PEC	3	0	0	3	40	60	100
U23BTV56	Industrial Biosafety	PEC	3	0	0	3	40	60	100
U23BTV57	Product development and Technology transfer	PEC	3	0	0	3	40	60	100
U23BTV58	Innovation and Design Thinking for Biotechnologists	PEC	3	0	0	3	40	60	100
U23BTV59	Resource Management & Lean Start-up Management	PEC	3	0	0	3	40	60	100

  
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Programme	<b>B.E</b>	Programme Code			<b>103</b>	Regulation		<b>2023</b>							
Department	<b>Electronics and Communication Engineering</b>					Semester			<b>I</b>						
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks									
		L	T	P		C	CA	ESE	Total						
<b>U23MA101</b>	<b>Matrices and Calculus</b>	3	1	0	4	40	60	100							
<b>Course Objective</b>	The Main Objective of the course is														
	<ul style="list-style-type: none"> <li>To develop the use of matrix algebra techniques that is needed by engineers for practical applications.</li> <li>To familiarize the students with differential calculus.</li> <li>To familiarize the student with functions of several variables. This is needed in many branches of engineering.</li> <li>To make the students understand various techniques of integration.</li> <li>To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.</li> </ul>														
<b>Course Outcome</b>	At the end of the course the students will be able to										Knowledge level				
	<b>CO1:</b> Use the matrix algebra methods for solving practical problems.										K1,K3				
	<b>CO2:</b> Apply differential calculus tools in solving various application problems.										K2,K4				
	<b>CO3:</b> Able to use differential calculus ideas on several variable functions.										K3,K5				
	<b>CO4:</b> Apply different methods of integration in solving practical problems.										K2,K5				
<b>Pre-requisites</b>	<b>CO5:</b> Apply multiple integral ideas in solving areas, volumes and other practical problems.										K3,K5				
	-														
<b>CO / PO Mapping</b> (3/2/1 indicates strength of correlation) 3-Strong, 2 - Medium, 1 - Weak													<b>CO/PSO Mapping</b>		
<b>COs</b>	<b>Programme Outcomes (POs)</b>												<b>PSOs</b>		
	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PS O1</b>	<b>PSO 2</b>	<b>PS O 3</b>
<b>CO 1</b>	3	2		1	1								2		
<b>CO 2</b>	3	3	2		1								2		
<b>CO 3</b>	3		2	1									2		
<b>CO 4</b>	3	2	2	1	1								2		
<b>CO 5</b>	3		1	1	1								2		
<b>Course Assessment Methods</b>															
<b>Direct</b>															
1. Continuous Assessment Test I, II & III															
2. Assignment.															
3. End-Semester examinations															
<b>Indirect</b>															
1. Course - end survey															

  
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<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>MATRICES</b>	Periods	<b>12</b>
Characteristic equation – Eigen values and Eigenvectors of a real matrix– Properties of Eigen values and Eigenvectors – Cayley-Hamilton theorem(excluding proof) – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms. Simple application in encoding message using 2×2 matrix.			
<b>Unit – II</b>	<b>DIFFERENTIAL CALCULUS</b>	Periods	<b>12</b>
Limit, Continuity, Differentiability, Rules of differentiation, Differentiation of various functions, Rolle’s theorem (excluding proof), Mean value theorem(excluding proof), Taylor’s theorem(excluding proof), Maxima and Minima. Applications: Newton’s law of cooling – Heat flow problems.			
<b>Unit – III</b>	<b>FUNCTIONS OF SEVERAL VARIABLES</b>	Periods	<b>12</b>
Partial differentiation – Homogeneous functions and Euler’s theorem(excluding proof) – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor’s series for functions of two variables(excluding proof) – Maxima and minima of functions of two variables. Applications: Lagrange’s method of undetermined multipliers.			
<b>Unit – IV</b>	<b>INTEGRAL CALCULUS</b>	Periods	<b>12</b>
Definite and Indefinite Integrals- Methods of integration: Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions –Reduction formula $\int_0^{\frac{\pi}{2}} \cos^n x dx, \int_0^{\frac{\pi}{2}} \sin^n x dx .$			
<b>Unit – V</b>	<b>MUTIPLE INTEGRALS</b>	Periods	<b>12</b>
Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals.			
<b>Total Periods</b>			<b>60</b>
<b>Text Books</b>			
1.	Stewart, J. Calculus: Early Transcendentals (8 <sup>th</sup> Edition), Cengage Learning, 2015.		
2.	Grewal B.S., “Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 43 <sup>rd</sup> Edition, 2014.		
<b>References</b>			
1.	Kreyszig E, Advanced Engineering Mathematics (10 <sup>th</sup> Edition), John Wiley (2015).		
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.	Thomas. G. B., Hass. J, and Weir. M.D, “Thomas Calculus “, 14th Edition, Pearson India, 2018.		
4.	Anton H, Calculus: Early Transcendentals, 10th Edition, Wiley (2016).		
5.	B V Ramana, Higher Engineering Mathematics, Tata McGraw Hill Education Pvt Ltd., New Delhi (2016)		
<b>E-Resources</b>			
1.	<a href="https://freevideolectures.com">https://freevideolectures.com</a> , All Courses , Calculus , UCLA		
2.	<a href="http://www.learnerstv.com/Free-engineering-Video-lectures">www.learnerstv.com/Free-engineering-Video-lectures</a>		
3.	<a href="http://www.nptel.ac.in">www.nptel.ac.in</a>		



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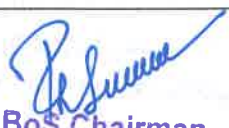
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	<b>VIVEKANANDHA COLLEGE OF ENGINEERING FOR WOMEN</b> (Autonomous Institution Affiliated to Anna University Chennai) Elayampalayam, Tiruchengode – 637 205														
Programme	B.E	Programme code	103	Regulation	2023										
Department	<b>Electronics and Communication Engineering</b>		Semester		I										
Course code	Course name	Periods per week			Credit	Maximum Marks									
		L	T	P	C	CA	ESE	Total							
<b>U23EN101</b>	<b>English for Communication</b>	3	0	0	3	40	60	100							
Objective	<p>The main objective of this course is to:</p> <ul style="list-style-type: none"> <li>• Improve the communicative ability of learners.</li> <li>• Make learners read widely in order to practice writing</li> <li>• Make learners develop vocabulary and strengthen grammatical understanding</li> <li>• Assist students in the development of intellectual flexibility, creativity, and cultural literacy so that they may engage in life-long learning.</li> <li>• Identify and begin to apply the language features of academic and professional writing and speaking</li> </ul>														
Outcomes	The students who complete this course successfully are expected to:					Knowledge Level									
	<b>CO1:</b> Use appropriate vocabulary in a professional context					K1									
	<b>CO2:</b> Write appropriately based on the knowledge gained through reading of a variety of materials					K1									
	<b>CO3:</b> Use language through their grammatical acquisition					K2									
	<b>CO4:</b> Read and infer meanings of technical texts					K2									
Pre-Requisites	<b>Nil</b>														
<b>CO / PO Mapping</b>												<b>CO/PSO Mapping</b>			
(3/2/1 indicates strength of correlation) 3-Strong, 2 - Medium, 1 - Weak															
Cos	Programme Outcomes (Pos)												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1						2			3	3		3			2
CO 2						2			3	3		3			2
CO 3						2			3	3		3			2
CO 4						2			3	3		3			2
CO 5						2			3	3		3			2
<b>Course Assessment Methods</b>															
<b>Direct</b>															
1. Continuous Assessment Test I, II & III															
2. Assignments															
3. End-Semester examinations															
<b>Indirect</b>															
1. Course – end survey															

  
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Content of the syllabus			
<b>Unit – I</b>		Periods	<b>9</b>
<b>Listening</b> -Introduction to Different Types of Listening, Listening to Casual Conversations, <b>Speaking</b> -Introduction to develop the Art of Speaking, Giving Self Introduction, <b>Reading</b> -Understanding the Basics of Reading Skills, Reading Instructions and Technical Manuals, <b>Writing</b> - Introduction to writing strategies, Writing Definitions, <b>Focus on Language</b> - - Technical terms (Jargon), Word Formation with Prefixes and Suffixes, Using Active Voice and Passive Voice, Basic sentence patterns, Tenses (past, present, perfect and continuous tenses).			
<b>Unit – II</b>		Periods	<b>9</b>
<b>Listening</b> - Listening to lectures, listening to description of equipment, <b>Speaking</b> -Strategies for Developing Conversational Skills, Short Conversations through Role Play Activities, <b>Reading</b> - Reading Comprehension, Reading e-mails, Reading Headlines, Predicting the Content, <b>Writing</b> - Note making, Writing Descriptions, <b>Focus on Language</b> - Collocations, One word substitution, Subject – verb agreement			
<b>Unit – III</b>		Periods	<b>9</b>
<b>Listening</b> - Listening to different kinds of interviews (Face – to – face, radio, TV and telephone interviews), <b>Speaking</b> -Describing an Object, Asking Questions, Participating in Discussions <b>Reading</b> - Intensive reading, Reading passages for gist. <b>Writing</b> - Writing short & lengthy e-mails with emphasis on Brevity, Clarity, Coherence and Cohesion), <b>Focus on Language</b> -Sequential Connectives, Impersonal Passive			
<b>Unit – IV</b>		Periods	<b>9</b>
<b>Listening</b> -Note Taking, <b>Speaking</b> - Improving Fluency through Narration. <b>Reading</b> -Reading passages for specific information- Phone messages, Reading and Transferring Information. <b>Writing</b> - Effective writing strategies, Informal writing, Writing a Memo, <b>Focus on Language</b> - Cause and Effect, Conditional Statements (if – clauses and types), Usage of Modal Verbs.			
<b>Unit – V</b>		Periods	<b>9</b>
<b>Listening</b> - Listening to understand Modulation, Listening to Welcome Speeches, <b>Speaking</b> -Delivering Welcome Address, Understanding Segmental and Suprasegmental Features-Practicing Stress, Pause and Intonation, <b>Reading</b> - Reading for a purpose, Reading Business Documents, Interpreting Charts and Graphs,. <b>Writing</b> - Describing a Process. <b>Focus on Language</b> -Synonyms and Antonyms, Common Errors in English.			
		<b>Total Periods</b>	<b>45</b>
<b>Text Books:</b>			
1.	Sumant. S, Pereira Joyce, Shameem.M, Selvarajan.R-English Communication Skills,Vijay Nicole imprints Pvt.Ltd, 2015.		
2.	Sokkaalingam, S.RM., The Art Of Speaking EnglishVersatile Publishing House,2018.		
<b>References:</b>			

  
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1.	Dr. Padma Ravindran, Poorvadevi, M. Y. Abdur Razack- English for life, English for work, students Book, Ebek language laboratory pvt ltd, 2011.
2.	Dutt Rajeevan, Prakash. A Course in Communication Skill (Anna University, Coimbatore edition): Cambridge University Press India Pvt.Ltd, 2007.
3.	S.P. Dhanavel, English and Communication Skills for Students of Science and Engineering, Orient Blackswan Pvt, Ltd, 2009.
4.	Technical English – I & II, Sonaversity, Sona College of Technology, Salem, First Edition, 2012.
5.	Meenakshmi Raman and Sangeeta Sharma- Technical communication English Skills for Engineers; oxford University Press, 2008.
<b>E-Resources.</b>	
1.	<a href="http://www.sparknotes.com/lit/the-alchemist/summary.html">http://www.sparknotes.com/lit/the-alchemist/summary.html</a>
2.	<a href="https://www.stephencovey.com/7habits/7habits.php">https://www.stephencovey.com/7habits/7habits.php</a>
3.	<a href="http://en.wikipedia.org/wiki/The_Seven_Habits_of_Highly_Effective_People">http://en.wikipedia.org/wiki/The_Seven_Habits_of_Highly_Effective_People</a>

  
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Elayampalayam, Tiruchengode – 637 205



Programme	B.E	Programme code	103	Regulation	2023			
Department	<b>Electronics and Communication Engineering</b>			Semester	I			
Course code	Course name	Periods per week			Credit	Maximum Marks		
		L	T	P	C	CA	ESE	Total
<b>U23CH101</b>	<b>Engineering Chemistry</b>	3	0	0	3	40	60	100

Objective	The main objective of this course is to:							
	<ul style="list-style-type: none"> <li>Recognize the basic technology requirements in water treatment</li> <li>Gain knowledge in basics and preparations, properties and applications of Polymers.</li> <li>Enrich the Knowledge of the students with the basics of Nano materials, their properties and applications.</li> <li>Familiarize about the Non renewable, renewable energy and different types of storage devices in the engineering application.</li> <li>Gain knowledge in destruction and protection of metals for engineering applications.</li> </ul>							

Outcomes	The students who complete this course successfully are expected to:							Knowledge Level
	<b>CO1:</b> Implement innovative solutions in wastewater treatment process.							K3
	<b>CO2:</b> Familiarize with the applications of polymers in the field of engineering.							K3
	<b>CO3:</b> Identify the synthesis methods of Nanoparticles and their industrial applications							K2
	<b>CO4:</b> Recognize the renewable, non renewable energy and storage devices for domestic and industrial applications.							K3
<b>CO5:</b> Categorize the metal corrosion in different environment and find out appropriate control techniques to avoid corrosion.							K3	

Pre-Requisites	<b>Nil</b>
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CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 - Medium, 1 - Weak													CO/PSO Mapping		
Cos	Programme Outcomes (Pos)												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	3	2	1	2	2	2					1	1	2
CO 2	3	2	2	2		2	2	1					2	2	2
CO 3	3	2	2	3	2	1	2	1					2	1	1
CO 4	3	3	2	2	1	1	3	2					3	2	2
CO 5	3	3	3	2	1	2	2	1					2	1	2

  
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**Course Assessment Methods****Direct**

1. Continuous Assessment Test I, II & III
2. Assignment
3. End-Semester examinations

**Indirect**


Course – end survey

**Content of the syllabus**

Unit – I	<b>WATER TECHNOLOGY</b>	Periods	9
Introduction-Sources and impurities in Water, Soft and Hard water, Water quality parameters, Types of Hardness – Determination of Hardness by EDTA method, Domestic Water Treatment. Boiler Feed Water –Requisites, Problems due to hard water in boilers – Scale and Sludge formation in boilers-Caustic Embrittlement-Boiler corrosion, Treatment of boiler feed Water – Internal conditioning (Carbonate, Phosphate, and Calgon conditioning) External conditioning – Ion exchange process, Zeolite process, Brackish water –Water purification by Reverse osmosis.			
Unit – II	<b>POLYMER CHEMISTRY</b>	Periods	9
Introduction – Occurrence, definitions – Functionality – Degree of Polymerization, Classification of polymers – structure (Linear, Branched & network polymer structure) block, random & graft copolymers, Tacticity, Tg, molecular weight – number and weight average method. Types of polymerizations: Addition, condensation and copolymerization. Mechanism of polymerization (Free radical). Preparation, properties and applications of PE, PMMA, PC, Nylon6, Nylon 6 6, Poly urethane, Poly isoprene and vulcanization of rubber, Teflon, PET, and Bakelite.			
Unit – III	<b>NANO CHEMISTRY</b>	Periods	9
Basics- distinction between molecules, nanoparticles and bulk materials; size dependent properties. Nanoparticles: nanocluster, nanorod, nanotube (CNT) and nanowires. Synthesis: Top down process- Laser ablation, Spray Pyrolysis, Chemical Vapour deposition, Electro deposition. Bottom up process- Precipitation, Sol-gel, Thermolysis – hydrothermal, solvothermal –Properties and applications of nano materials in medical and electronic devices.			
Unit – IV	<b>ENERGY RESOURCES AND STORAGE DEVICES</b>	Periods	9
Nonrenewable energy – Nuclear energy, nuclear reaction and its types, nuclear power plant and its working (Light water nuclear power plant & Breeder reactor).Renewable energy and its sources – Solar Energy – Photo voltaic cells, Importance of Solar cells – p-n junctions in Solar cells – Working of Photovoltaic cell, Recent advances in solar cell materials, Wind energy – Types of Wind Power Plants (WPPs), Components and working of WPPs. Batteries and fuel cells: Types of batteries –Alkaline battery, lead storage battery, Ni-Cd battery, lithium battery, Fuel cell – H <sub>2</sub> -O <sub>2</sub> fuel cell-applications.			
Unit – V	<b>CORROSION AND ITS CONTROL</b>	Periods	9
Introduction, Types of corrosion – chemical and electrochemical corrosion, mechanism, Pilling –Bedworth rule, Types of electrochemical corrosion – Galvanic corrosion, Pitting corrosion, Crevice corrosion, Corrosion on wire fence and Pipeline corrosion, Factors influencing rate of corrosion, corrosion control methods – Sacrificial anode and impressed cathodic current. Protective coatings – Paints: constituents and functions, Metallic coatings – steps involved in cleaning the surface for Electroplating, Electroplating (Au), Electro less plating (Ni).			
<b>Total Periods</b>			<b>45</b>

**Text Books:**



1. O.G.Palanna, "Engineering Chemistry" Tata Mc GrawHill PVT,Ltd. Second Edition -2017
2. Dr.S.Mageswari, Dr.K.Balachandran, M.S.Viswaksenan, "Engineering Chemistry", RK publication, First Edition-2022

  
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<b>References:</b>	
1.	Engineering Chemistry: Jain & Jain, Dhanpat Rai Publishing Company Edition- 16- 2015.
2.	Arun Bahl, B.S. Bahl, G.D. Tuli, Essentials of Physical Chemistry, Published by S. Chand & Company Ltd, 2014.
3.	Engineering Chemistry: Sashi Chawla, Dhanpat Rai & Co (pvt.)ltd. Edition- 5- 2013.
4.	Dr.S.Vairam ,Dr.Suba Ramesh, Engineering Chemistry: First Edition, Wiley publication,Reprint-2016
<b>E-Resources.</b>	
1	<a href="https://www.who.int/water_sanitation_health/dwq/arsenicun6.pdf">https://www.who.int/water_sanitation_health/dwq/arsenicun6.pdf</a>
2	<a href="https://www.schandpublishing.com/books/tech-professional/applied-science/a-textbook-polymer-chemistry/9788121941129/#.XdZ214MzY2w">https://www.schandpublishing.com/books/tech-professional/applied-science/a-textbook-polymer-chemistry/9788121941129/#.XdZ214MzY2w</a>
3	<a href="https://www.elsevier.com/books/nanochemistry/klabunde/978-0-444-59397-9">https://www.elsevier.com/books/nanochemistry/klabunde/978-0-444-59397-9</a>



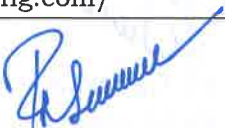
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	<b>VIVEKANANDHA COLLEGE OF ENGINEERING FOR WOMEN</b> (Autonomous Institution, Affiliated to Anna University ,Chennai) Elayampalayam, Tiruchengode – 637 205														
Programme	<b>B.E</b>	Programme Code		103	Regulation	<b>2023</b>									
Department	<b>Electronics and Communication Engineering</b>			Semester		<b>I</b>									
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks									
		L	T	P	C	CA	ESE	Total							
<b>U23CS101</b>	<b>Programming for Problem Solving</b>	3	0	0	3	40	60	100							
<b>Course Objective</b>	The main objective of this course is to: <ul style="list-style-type: none"> <li>Learn the fundamentals of computers, languages, number systems and acquire problem solving skills in C Programming</li> </ul>														
<b>Course Outcome</b>	At the end of the course, the student should be able to,						Knowledge Level								
	<b>CO1:</b> Examine number systems and to apply problem solving techniques						K3								
	<b>CO2:</b> Learn the basics of C programming with branching and looping statements						K2								
	<b>CO3:</b> Experiment the C programs using Arrays and Pointers for simple applications						K3								
	<b>CO4:</b> Solve C programs with the Functions and Strings						K3								
<b>CO5:</b> Apply Structures, Union and File concepts to solve simple real world problems						K3									
Pre-Requisites	<b>Nil</b>														
<b>CO / PO Mapping</b> (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak Programme Outcomes (POs)													<b>CO/PSO Mapping</b>		
<b>COs</b>													<b>PSOs</b>		
	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO1</b>	<b>PSO 2</b>	<b>PSO 3</b>
<b>CO 1</b>	3	2	1	1	2							2	3	3	
<b>CO 2</b>	2	1	1		2							2	2	2	
<b>CO 3</b>	3	2	1	1	2							2	3	3	
<b>CO 4</b>	3	2	1	1	2							2	3	3	
<b>CO 5</b>	3	2	1	1	2							2	3	3	
<b>Course Assessment Methods</b>															
<b>Direct</b>															
1. Continuous Assessment Test I, II & III															
2. Assignment / Quiz / Seminar															
3. End-Semester examination															
<b>Indirect</b>															
1. Course - end survey															
<b>Content of the syllabus</b>															

  
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<b>Unit – I</b>	<b>INTRODUCTION TO PROBLEM SOLVING</b>	Periods	<b>9</b>
Basic organization of Computer - Programming languages - Compilers – Interpreter - Flowchart – Pseudocode – Algorithm. <b>Number Systems</b> – Decimal, Binary, Octal and Hexadecimal conversions			
<b>Unit - II</b>	<b>BASICS OF C PROGRAMMING</b>	Periods	<b>9</b>
Introduction to C – Features - Data Types – Constants – Variables - I/O Statement - Operators –Expressions - Decision Making and Branching – Looping Statements - Break, Go to, Continue.			
<b>Unit – III</b>	<b>ARRAYS AND POINTERS</b>	Periods	<b>9</b>
<b>Arrays:</b> Concepts – Need – one dimensional array – array declaration – features – array initialization - Two- Dimensional Arrays- Multidimensional Arrays. <b>Pointers:</b> Introduction, pointer declaration-accessing variable through pointer- Pointers and Arrays, Pointers and strings – Pointers structures - Pointer Arithmetic - Array of Pointers – dynamic memory allocation - malloc, realloc, free.			
<b>Unit - IV</b>	<b>FUNCTIONS AND STRINGS</b>	Periods	<b>9</b>
<b>Functions:</b> Introduction, function declaration, defining and accessing functions, User-defined Functions- storage classes-function prototypes-parameter passing methods-recursion. <b>Strings:</b> Concepts – Strings manipulation - String Input / Output Functions- Strings standard functions - Arrays of Strings.			
<b>Unit – V</b>	<b>STRUCTURES, UNIONS AND FILE SYSTEMS</b>	Periods	<b>9</b>
<b>Structures:</b> Introduction- nested structures- Arrays of Structures - Structures and Functions - Pointers to Structures – Unions. <b>File:</b> opening, defining, closing, File Modes, File Types , Writing contents into a file, Reading file contents, Appending an existing file, File permissions and rights, Changing permissions and rights.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	S.Kuppuswami, S.Maliga, C. S. Kanimozhi and K.Kousalya, “Problem Solving and Programming”, Tata McGraw Hill, 2019.		
2.	E. Balagurusamy, “Programming in ANSI C”, 8 <sup>th</sup> Edition, Mc Graw Hill, 2019.		
<b>References</b>			
1.	Herbert Schildt, C: The Complete Reference, Mc Graw Hill, 4th Edition, 2017		
2.	Kernighan BW and Ritchie DM, “The C Programming Language”, 2 <sup>nd</sup> Edition, Prentice Hall of India, 2017.		
3.	Dr.V.Rameshbabu, Dr.R.Samyutha, M.Muni Rathnan, “Computer Programming”, VRB Publishers Pvt.Ltd, 2016.		
<b>Tools Required</b>			
Codetandra/HackerRank/ HackerEarth / Any online Problem Solving Platforms			
<b>E-Resources</b>			
1.	<a href="https://www.geeksforgeeks.org/c-language-set-1-introduction/">https://www.geeksforgeeks.org/c-language-set-1-introduction/</a>		
2.	<a href="https://www.programiz.com/c-programming">https://www.programiz.com/c-programming</a>		
3.	<a href="https://www.cprogramming.com/">https://www.cprogramming.com/</a>		

  
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Programme	<b>B.E</b>	Programme code	<b>103</b>	Regulation	<b>2023</b>			
Department	<b>Electronics and Communication Engineering</b>			Semester	<b>I</b>			
Course code	Course name	Periods per week			Credit	Maximum Marks		
		L	T	P	C	CA	ESE	Total
<b>U23TA101</b>	<b>தமிழர்மரபு /Heritage of Tamils</b>	1	0	0	1	40	60	100
<b>Content of the syllabus</b>								
அலகு 1	மொழி மற்றும் இலக்கியம்				<b>Periods</b>	<b>3</b>		
இந்தியமொழிக் குடும்பங்கள் - திராவிடமொழிகள் - தமிழ் ஒருசெம்மொழி-தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்றதன்மை-சங்க இலக்கியத்தில் பகிர்தல் அறம் திருக்குறளில் மேலாண்மைக் கருத்துக்கள் தமிழ்க் காப்பியங்கள் தமிழகத்தில் சமணபௌத்தசமயங்களின் தாக்கம் - பக்தி இலக்கியம்,ஆழ்வார்கள் மற்றும் நாயன்மார்கள் - சிற்றிலக்கியங்கள் - தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கியவளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.								
அலகு 2	மரபு-பாறைஓவியங்கள் முதல் நவீனஓவியங்கள் வரை-சிற்பக் கலை				<b>Periods</b>	<b>3</b>		
நடுகல் முதல் நவீனசிற்பங்கள் வரை-ஐம்பொன் சிலைகள் பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள்,பொம்மைகள் - தேர் செய்யும் கலை - சுடுமண் சிற்பங்கள் - நாட்டுப்புறத் தெய்வங்கள் - குமரிமுனையில் திருவள்ளூர் சிலை - இசைக் கருவிகள் - மிருதங்கம்,பறை,வீணை. யாழ்,நாதஸ்வரம் - தமிழர்களின் சமூகபொருளாதாரவாழ்வில் கோவல்களின் பங்கு.								
அலகு 3	நாட்டுப்புறக் கலைகள் மற்றும் வீரவிளையாட்டுகள்:				<b>Periods</b>	<b>3</b>		
தெருக்கூத்து,கரகாட்டம்,வில்லுப்பாட்டு,கணியான் கூத்து,ஓயிலாட்டம், தோல்பாவைக்கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.								
அலகு 4	தமிழர்களின் திணைக் கோட்பாடுகள்:				<b>Periods</b>	<b>3</b>		
தமிழகத்தின் தாவரங்களும்,விலங்குகளும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றியஅறக்கோட்பாடு - சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும்,கல்வியும் - சங்ககாலநகரங்களும் துறைமுகங்களும் - சங்ககாலத்தில் ஏற்றுமதிமற்றும் இறக்குமதி-கடல்கடந்தநாடுகளில் சோழர்களின் வெற்றி.								
அலகு 5	இந்தியதேசிய இயக்கம் மற்றும் இந்தியபண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு:				<b>Periods</b>	<b>3</b>		
இந்தியவிடுதலைப்போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் - சுயமரியாதை இயக்கம் - இந்தியமருத்துவத்தில்,சித்தமருத்துவத்தின் பங்கு- கல்வெட்டுகள்,கையெழுத்துப்படிக்கள் - தமிழ்ப் புத்தகங்களின் அச்சுவரலாறு.								
					<b>Total Periods</b>	<b>15</b>		

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Programme	<b>B.E</b>	Programme code	<b>103</b>	Regulation	<b>2023</b>			
Department	<b>Electronics and Communication Engineering</b>			Semester	<b>I</b>			
Course code	Course name	Periods per week			Credit	Maximum Marks		
		L	T	P	C	CA	ESE	Total
<b>U23TA101</b>	<b>தமிழர்மரபு /Heritage of Tamils</b>	1	0	0	1	40	60	100
<b>Content of the syllabus</b>								
<b>UNIT I</b>	<b>LANGUAGE AND LITERATURE</b>				<b>Periods</b>	<b>3</b>		
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 and-Bakthi Literature Azhwarsand Nayanmars- Forms of minor Poetry- Development of Modern literature in Tamil-Contribution of Bharathiyar and Bharathidhasan.								
<b>UNIT II</b>	<b>HERITAGE-ROCK ART PAINTINGS TO MODERN ART-SCULPTURE</b>				<b>Periods</b>	<b>3</b>		
Hero stone to modern sculpture -Bronzeicons- Tribe sandtheir hand crafts- Artof templecar making- Massive Terracotta sculptures Village deities, Thiruvalluvar Statueat Kanyakumari, Making of musicalinstruments- Mridhngam ,Parai Veenai, Yazhand Nadhaswaram-Roleof Temple sin Social and Economic Life of Tamils.								
<b>UNIT III</b>	<b>FOLK AND MARTIAL ARTS</b>				<b>Periods</b>	<b>3</b>		
Therukoothu, Karagattam, VilluPattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, Silambattam, Valari, Tigerdance -Sportsand Games of Tamils.								
<b>UNIT IV</b>	<b>THINAI CONCEPT OF TAMILS</b>				<b>Periods</b>	<b>3</b>		
Flora and Fauna of Tamils &Ahamand Puram Concept from Tholkappiyamand Sangam Literature- Aram Concept of Tamils -Educationand Literacy during Sangam Age -Ancient Cities and Ports of Sangam Age-Exportand Importduring Sangam Age- Over seas Conquestof Cholas.								
<b>UNIT V</b>	<b>CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE</b>				<b>Periods</b>	<b>3</b>		
Contribution of amils to Indian Freedom Struggle -The Cultural Influence of Tamils over theother parts of India -Self -Respect Movement- Role of Siddha Medicine in Indigenous Systems of Medicine-Inscriptions &Manuscripts-Print History of Tamil Books.								

**Total Period: 15**

**TEXT-CUM-REFERENCE BOOKS**

1	தமிழக வரலாறும் - மக்களும்பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு: தமிழ் நாடு பாட நூல் மற்றும் கல்வியியல்பணிகள்கழகம்).
2	கணினித்தமிழ் - முனைவர்இல. சுந்தரம். (விகடன்பிரசுரம்).
3	கீழடி - வைகை நதிக்கரையில் சங்க நகரநாகரிகம் (தொல்லியல்துறைவெளியீடு)
4	பொருளை - ஆற்றங்கரைநாகரிகம். (தொல்லியல்வெளியீடு)
5	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL - (in print)
6	Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies)

  
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7	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8	The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10	Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.



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**VIVEKANANDHA COLLEGE OF ENGINEERING FOR WOMEN**  
(Autonomous Institution, Affiliated to Anna University, Chennai)  
Elayampalayam, Tiruchengode – 637 205



Programme	<b>B.E</b>	Programme Code	<b>103</b>	Regulation	<b>2023</b>										
Department	<b>Electronics and Communication Engineering</b>			Semester	<b>I</b>										
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks									
		L	T	P	C	CA	ESE	Total							
<b>U23GE101</b>	<b>Engineering Graphics</b>	2	0	3	3	50	50	100							
<b>Course Objective</b>	<b>The main objective of this course is to:</b>														
	<ul style="list-style-type: none"> <li>Develop skills to enhance their ability to know the concept of engineering graphics and to draw the points kept in various positions, lines and planes.</li> <li>Project the drawing of various solids.</li> <li>Sketch sectioned views of solids.</li> <li>Draw the development of surfaces.</li> <li>Draw the isometric and orthographic projections for any given object to the required standard.</li> </ul>														
<b>Course Outcomes</b>	At the end of the course, the student should be able to						Knowledge Level								
	<b>CO1:</b> Construct plane curves and develop projection of points , lines and plane surfaces						K2								
	<b>CO2:</b> Construct projection of solids with various conditions.						K4								
	<b>CO3:</b> Design the section of solids and analyze the true shape of the section						K3								
	<b>CO4:</b> Design and develop the different solid surfaces.						K2								
<b>Pre - requisites</b>	Nil						<b>CO5:</b> Construct isometric and orthographic projection of different solids.								
							K1								
<b>CO / PO Mapping</b> (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak													<b>CO/PSO Mapping</b>		
<b>COs</b>	<b>Programme Outcomes (POs)</b>												<b>PSOs</b>		
	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>	<b>PSO 3</b>
<b>CO 1</b>	3	3	3	3	3	-	-	-	-	-	-	-	2	2	-
<b>CO 2</b>	3	3	2	2	2	-	-	-	-	-	-	-	2	-	-
<b>CO 3</b>	3	2	2	2	3	-	-	-	-	-	-	-	2	3	-
<b>CO 4</b>	3	2	3	3	2	-	-	-	-	-	-	-	3	-	-
<b>CO 5</b>	3	3	2	3	3	-	-	-	-	-	-	-	3	2	-
<b>Course Assessment Methods</b>															
<b>Direct</b>															
1. Continuous Assessment Test I, II & III															
2. Assignment															
3. End-Semester examination															
<b>Indirect</b>															
1. Course - end survey															

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<b>Content of the Syllabus</b>			
<b>Concepts &amp; Conventions (Not for Examination)</b>	Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.	<b>Periods</b>	<b>1</b>
<b>Unit – I</b>	<b>PROJECTION OF POINTS, LINES AND PLANE SURFACES</b>	<b>Periods</b>	<b>3+8</b>
Introduction to Plane curves, Orthographic projection – principles – projection of points, straight lines (only first angle projections) and plane surfaces (polygonal and circular).			
<b>Unit - II</b>	<b>PROJECTION OF SOLIDS</b>	<b>Periods</b>	<b>3+8</b>
Projections of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane.			
<b>Unit - III</b>	<b>SECTION OF SOLIDS</b>	<b>Periods</b>	<b>3+8</b>
Sectioning of solids - prisms, pyramids, cylinder and cone in simple vertical position by cutting planes inclined to one reference plane and perpendicular to the other - Obtaining true shape of section.			
<b>Unit - IV</b>	<b>DEVELOPMENT OF SURFACES</b>	<b>Periods</b>	<b>3+8</b>
Development of lateral surfaces of simple solids like prisms, pyramids, cylinders and cones – development of simple truncated solids involving prisms, pyramids, cylinders and cones.			
<b>Unit - V</b>	<b>ISOMETRIC PROJECTIONS, ORTHOGRAPHIC VIEWS FROM PICTORIAL VIEWS</b>	<b>Periods</b>	<b>5+10</b>
<b>Isometric Projection and Introduction to AutoCAD / Solid Edge:</b> Principles of isometric projection - Isometric scale -Isometric projections of simple solids like prisms, pyramids, cylinders and cones & orthographic views from pictorial views.			
<b>Demonstration only:</b> <b>Computer Aided Drafting (Auto CAD / Solid Edge):</b> Introduction to drafting packages and demonstration of their use.			
<b>Total Periods</b>			<b>60</b>
<b>Text Books:</b>			
T1.	Basant Agrawal and C.M Agrawal ,“Engineering Drawing ”,Tata McGraw Hill ,Third Edition,2019		
T2	Jain and Gautam ,“Engineering Graphics & Design ”,Khanna Publishing House, 2018		
<b>Reference Books :</b>			
R1.	Dr.P.Kannan and Dr.J.Bensam Raj, “Engineering Graphics”, JBR Tri Sea Publishers Pvt. Ltd, 2018.		
R2.	K.V Natarajan, "Engineering Drawing and Graphics", M/s. N.Dhanalakshmi, Chennai, 2014.		
R3.	K.Venugopal and V. Prabhu Raja, “Engineering Graphics”New Age International Publishers, 2011.		
R4.	N.S Parthasarathy and Velamurali, “ Engineering Graphics”, Oxford University, New Delhi,2015		
R5.	Bhatt N.D and Panchal V.M, “Engineering Drawing”, Charotar Publishing House,50 <sup>th</sup> Edition,2010		
<b>e-RESOURCES:</b>			
E1.	<a href="http://nptel.ac.in/courses/105104148">http://nptel.ac.in/courses/105104148</a> , “Engineering Graphics” - Dr. Nihar Ranjan Patra , IIT Kanpur		
E2.	<a href="http://cfd.annauniv.edu/webcontent.htm">http://cfd.annauniv.edu/webcontent.htm</a> , “Engineering Graphics” - Dr.Velamurali		
E3.	<a href="http://link.springer.com/">http://link.springer.com/</a> “Engineering Graphics”-Springer Nature.		



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Programme	<b>B.E</b>	Programme code	<b>103</b>	Regulation	<b>2023</b>										
Department	<b>Electronics and Communication Engineering</b>			Semester	<b>I</b>										
Course Code	Course name	Periods per week			Credit	Maximum Marks									
<b>U23GE102</b>	<b>Design Thinking</b>	L	T	P	C	CA	ESE	Total							
		1	0	2	1	50	50	100							
<b>Course Objective</b>	The student should be made to, <ul style="list-style-type: none"> <li>familiarize with design thinking concepts and principles</li> <li>practice the methods, processes and tools of design thinking.</li> <li>apply the design thinking approach and have ability to model real world situations.</li> </ul>														
<b>Course Outcome</b>	At the end of the course, the student should be able to,							<b>KL</b>							
	<b>CO1:</b> Understand and apply the concept of team building activity							K2							
	<b>CO2:</b> Understand Design Thinking and apply the design thinking approach to empathize situations in real world							K3							
	<b>CO3:</b> Identify various methods of empathy and define the problem							K3							
	<b>CO4:</b> Develop creative ideas through design thinking							K4							
<b>CO5:</b> Understand benefits of learning through observation, experience and application							K5								
<b>Pre-requisites</b>	-														
<b>CO / PO Mapping</b>													<b>CO/PSO Mapping</b>		
(3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak															
<b>COs</b>	<b>Programme Outcomes (POs)</b>												<b>PSOs</b>		
		<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO 1</b>	2	3	3	3	3	2	2	3	3	3	2	2	3	3	2
<b>CO 2</b>	3	3	3	3	3	3	3	3	3	3	3	3	2	2	3
<b>CO 3</b>	3	3	1	2	2	2	2	1	2	1			2	2	3
<b>CO 4</b>	3	3	3	3	3	2	2	2	2	2	2	1	2	2	3
<b>CO 5</b>	3	3	3	3	1	2	2	2	1	2	2	1	2	2	3
<b>Course Assessment Methods</b>															
<b>Direct</b>															
1. Continuous Assessment Test through activities, assignment & Quiz															
2. Models (Chart/paper/3D)															
3. Prototype & Presentation															
<b>Indirect</b>															
1. Course - end survey															
<b>Content of the syllabus</b>															
<b>SESSION-I</b>													Periods	<b>6</b>	
Introduction – Team Building - Types – 4 C's of Team Building – Levels of Team Building – Benefits of Team Work – Team Building Activity.															

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<b>SESSION II</b>		Periods	<b>9</b>
Introduction to Design Thinking – Purpose of Design Thinking – Design Thinking Framework, Empathy and related case studies			
<b>SESSION III</b>		Periods	<b>6</b>
Define : Examine and Reflect on the problem.			
<b>SESSION IV</b>		Periods	<b>12</b>
Generating Ideas – Identifying ideas – Bundling the ideas and create concepts – Rapid Prototyping – Idea Refinement.			
<b>SESSION V</b>		Periods	<b>12</b>
Importance & testing the design with people - Retest and redefine results			
<b>Total Periods</b>			<b>45</b>
<b>Textbooks</b>			
1.	Solving Problems with Design Thinking - Ten Stories of What Works by Jeanne Liedtka 2013.		
2.	Idris Mootee, "Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School", John Wiley & Sons 2013.		
3.	Yousef Haik and Tamer M. Shahin, "Engineering Design Process", Cengage Learning, 2 <sup>nd</sup> edition, 2011		
4.	Design of Business: Why Design Thinking is the Next Competitive Advantage by Roger L. Martin 2009.		
5.	Change by Design: How Design thinking transforms organizations and empires Innovation, 2009, Harper Business, Brown, Tim and Berry.		
<b>References</b>			
1.	Design thinking toolbox by Michael Lewick, Wiley 2020		
2.	Design thinking playbook by Michael Lewrick, Wiley 2019		
3.	Creative Confidence: Unleashing the Creative Potential Within Us All by Tom 2014		
4.	The Design of Everyday Things: by Don Norman 2013		
<b>E-Resources</b>			
1.	<a href="https://www.collectivecampus.io/blog/6-resources-to-help-you-learn-design-thinking">https://www.collectivecampus.io/blog/6-resources-to-help-you-learn-design-thinking</a>		
2.	<a href="https://thisisdesignthinking.net/on-design-thinking/design-thinking-resources/">https://thisisdesignthinking.net/on-design-thinking/design-thinking-resources/</a>		
3.	<a href="http://hs.griet.ac.in/pdf/studymaterialsgr20/Design%20Thinking%20Lab%202020-21.pdf">http://hs.griet.ac.in/pdf/studymaterialsgr20/Design%20Thinking%20Lab%202020-21.pdf</a>		
4.	<a href="https://www.mindtools.com/brainstm.html">https://www.mindtools.com/brainstm.html</a>		
5.	<a href="https://www.quicksprout.com/. /how-to-reverse-engineer-your-competit">https://www.quicksprout.com/. /how-to-reverse-engineer-your-competit</a>		
6.	<a href="https://www.youtube.com/watch?v=2mjSDIBaUIM">https://www.youtube.com/watch?v=2mjSDIBaUIM</a>		
7.	<a href="http://thevirtualinstructor.com/foreshortening.html">thevirtualinstructor.com/foreshortening.html</a>		
<b>Activity Based Learning/Practical Based Learning</b>			
<a href="http://dschool.stanford.edu/dgift/">http://dschool.stanford.edu/dgift/</a>			
<b>Online Course</b>			
1.	<a href="https://onlinecourses.nptel.ac.in/noc19_mg60/preview">https://onlinecourses.nptel.ac.in/noc19_mg60/preview</a>		
2.	<a href="https://www.ibm.com/design/thinking/page/badges/core-skills">https://www.ibm.com/design/thinking/page/badges/core-skills</a>		



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Programme	<b>B.E</b>	Programme code	<b>103</b>	Regulation	<b>2023</b>			
Department	<b>Electronics and Communication Engineering</b>			Semester	<b>I</b>			
Course code	Course name	Periods per week			Credit	Maximum Marks		
		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>CA</b>	<b>ESE</b>	<b>Total</b>
<b>U23CH102</b>	<b>CHEMISTRY LABORATORY</b>	0	0	2	1	60	40	100


<b>Objective</b>	The main objective of this course is to:							
	<ul style="list-style-type: none"> <li>Gather basic simple acid-base reactions and study the mechanism of acid mixture with base.</li> <li>Learn pH and potential of hydrogen in a sample solution.</li> <li>Study the redox reaction through potential difference.</li> <li>Infer iron forms complex with thiocyanate.</li> <li>Gather knowledge on hardness producing salts and removal of hardness through estimation.</li> <li>Collect data required for dissolved oxygen present in water sample.</li> <li>Understand alkalinity and available chlorine present in water sample.</li> </ul>							

<b>Outcomes</b>	The students who complete this course successfully are expected to:							Knowledge Level
	<b>CO1:</b> Infer knowledge on neutralization reaction between acid, acid mixture with base and identify the concentrations.							K3
	<b>CO2:</b> Identify the concentration of sample using pH.							K3
	<b>CO3:</b> Spot the concentration of sample solution through redox reaction by potentiometric method							K4
	<b>CO4:</b> Estimate Iron by complexation reaction spectrometric ally.							K4
	<b>CO5:</b> Determine hardness and dissolved oxygen present in domestic water supply and Identify alkalinity and available chlorine present in the given sample.							K4

<b>Pre-requisites</b>	Nil
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CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 - Medium, 1 - Weak													CO/PSO Mapping		
COs	Programme Outcomes (POs)												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO 2	PSO 3
CO 1	3	3		2	2	1	1						2	2	2
CO 2	3	3		2	2	2	2						2	1	2
CO 3	3	3		2	2	1							1	2	2
CO 4	3	3	1	2	2	1							2	2	
CO 5	2	3	1	2		2	3						2	2	

**Course Assessment Methods**  
Direct

  
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1. Pre lab and Post lab Test 2. Execution of Experiment and Viva-voce 3. End semester examination		
<b>Indirect</b>		
Course - end survey		
<b>S.No</b>	<b>Name of the Experiment</b>	<b>Course Outcome</b>
1.	Estimation of HCl using NaOH by Conductometric titration	CO1
2.	Estimation of Mixture of acid using NaOH by Conductometric titration.	CO1
3.	Estimation of Barium Chloride using Sodium Sulphate by Conductometric precipitation titration	CO1
4.	Determination of HCl using NaOH by pH metry	CO2
5.	Estimation of Ferrous iron by Potentiometric titration.	CO3
6.	Estimation of Ferric ion by Spectrophotometry	CO4
7.	Determination of Total, Temporary and Permanent hardness of water by EDTA method.	CO5
8.	Estimation of Dissolved Oxygen content in water by Winkler's method	CO5
9.	Estimation of Alkalinity in water sample.	CO5
10.	Estimation of available Chlorine in bleaching powder.	CO5
<b>Total Periods</b>		<b>30</b>


**Lab Manuals suggested:**

1.	Chemistry laboratory I & II by Dr.A.Ravikrishnan,Sri Krishna Pub,Revised Edition-2017
2.	Chemistry laboratory Manual by Dr.Veeraiyan, Revised Edition-2017

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Department	<b>Electronics and Communication Engineering</b>			Semester	<b>I</b>										
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks									
		L	T	P	C	CA	ESE	Total							
<b>U23CS102</b>	<b>Programming for Problem Solving Laboratory</b>	0	0	2	1	60	40	100							
<b>Course Objective</b>	The main objective of the course is to <ul style="list-style-type: none"> <li>Develop simple C programs to illustrate the applications of User Defined and Derived Data Types such as Arrays, Pointers, Structures, and Functions.</li> </ul>														
<b>Course Outcome</b>	At the end of the course, the student should be able to,						Knowledge Level								
	<b>CO1:</b> Develop C programs for computer based solution of simple real world problems using Conditional and Looping statements						K3								
	<b>CO2:</b> Implement simple C Programs using Strings and Arrays						K3								
	<b>CO3:</b> Implement C program for simple applications using Pointers						K3								
	<b>CO4:</b> Write C programs that perform operations on File						K4								
<b>CO5:</b> Demonstrate C Programs using Structures						K3									
<b>CO / PO Mapping</b> (3/2/1 indicates strength of correlation) 3-Strong, 2 - Medium, 1 - Weak												<b>CO/PSO Mapping</b>			
<b>COs</b>	<b>Programme Outcomes (POs)</b>											<b>PSOs</b>			
	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>	<b>PSO 3</b>
<b>CO 1</b>	3	2	1	1	2							2	3	3	
<b>CO 2</b>	3	2	1	1	2							2	3	3	
<b>CO 3</b>	3	2	1	1	2							2	3	3	
<b>CO 4</b>	3	2	1	1	2							2	3	3	
<b>CO 5</b>	3	2	1	1	2							2	3	3	
<b>Course Assessment Methods</b>															
<b>Direct</b>															
1. Pre lab and post lab test															
2. End-Semester examination															
<b>Indirect</b>															
1. Course - end survey															
<b>List of Experiments</b>													<b>CO's</b>		
1. Write a C program that accepts an employee's ID, total worked hours in a month and the amount he received per hour. Print the ID and salary (with two decimal places) of the employee for a particular month.													CO1		
2. Write a program in C to calculate the sum of three numbers with input on one line separated by a comma.													CO1		
3. Write a program in C to find the sum of the series $[x - x^3 + x^5 + \dots]$ .													CO1		
4. Write a program in C to find the number and sum of all integers between 100 and 200 which are divisible by 9.													CO1		

  
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5. Write a program in C to count the total number of duplicate elements in an array.	CO2
6. You are given an input string 'S'. Your task is to find and return all possible permutations of the input string. <b>Note:</b> 1. The input string may contain the same characters, so there will also be the same permutations. 2. The order of permutation does not matter. <b>Sample Input</b> xyz sample Output xyz, xzy, yxz, yzx, zxy, zyx <b>Sample Output :</b> All the possible permutations for string "XYZ" will be "XYZ", "XZY", "YXZ", "YZX", "ZXY" and "ZYX".	CO2
7. Find the Smallest and Largest Element in an Array <b>Method 1:</b> Traverse the array iteratively and keep track of the smallest and largest element until the end of the array. <b>Method 2:</b> Traverse the array recursively and keep track of the smallest and largest element until the end of the array. <b>Method 3:</b> Sort the array using STL and return the first element as the smallest element and the last element as the largest element. <b>For example, consider the array.</b> arr = {1, 2, 3, 4, 5} <b>Sample output:</b> Smallest element: 1 Largest element: 5	CO2
8. Write a C program to find the sum of all the multiples of 3 and 5 below 100 using pointers. We have to find the number of numbers which are multiples of both 3 and 5 in the first 100 natural numbers. Multiples of both 3 and 5 in the first 100 natural numbers are the multiples of LCM of 3 and 5. LCM of 3 and 5 = 3×5=15 <b>Sample output:</b> Multiples of 15 below 100 are 15, 30, 45, 60, 75 and 90.	CO3
9. Write a C program to count number of characters, words and lines in a text file. Logic to count characters, words and lines in a file in C program. How to count total characters, words and lines in a text file in C programming. <b>Example Source file</b> I love programming. Working with files in C programming is fun. I am learning C programming at VCEW. <b>Sample output</b> Total characters = 100 Total words = 18 Total lines = 3	CO4
10. Write a C program to implement Student database using Structure <b>Sample output:</b> <b>Enter details of student:</b> Name :abi RollNo:101 Percentage :89.7 <b>Entered details:</b> Name: abi RollNo: 101	CO5





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Percentage: 89.70		
		<b>Total Periods</b>
		<b>30</b>
<b>Tools Required</b>		
Codetandra / HackerRank / HackerEarth / Any online Problem Solving Platforms		
<b>E-Resources</b>		
1.	<a href="https://www.programiz.com/c-programming">https://www.programiz.com/c-programming</a>	
2.	<a href="https://www.cprogramming.com/">https://www.cprogramming.com/</a>	
3.	<a href="https://beginnersbook.com/2015/02/simple-c-programs/">https://beginnersbook.com/2015/02/simple-c-programs/</a>	



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Programme	<b>B.E</b>	Programme Code				<b>103</b>	Regulation			<b>2023</b>					
Department	<b>Electronics and Communication Engineering</b>					Semester			<b>I</b>						
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks									
		L	T	P		C	CA	ESE	Total						
<b>U23MCFY2</b>	<b>Indian Constitution</b>	2	0	0	0	100	NA	100							
<b>Course Objective</b>	The main objective of this course is to: i) To know about the basic structure of Indian constitution. ii) To know about our Central government Executive system of India iii) To know about our State government Executive system of India iv) To learn the Election system, Amendments and Emergency Provisions given by the constitution. v) To know about the Special Constitutional Provisions in India														
<b>Outcome Course</b>	At the end of the course, the student should be able to,											Knowledge level			
	• Understand the functions of the Indian government											K1			
	• Know about our Central Government, political structure & codes, procedures											K1			
	• Understand our State Executive & Elections system of India.											K1			
	• Remember the Election system, Amendments and Emergency Provisions given by the constitution.											K2			
• Understand our Special Constitutional Provisions in India											K2				
<b>Pre-requisites</b>	---														
<b>CO / PO Mapping</b> (3/2/1 indicates strength of correlation) 3-Strong, 2 - Medium, 1 - Weak													<b>CO/PSO Mapping</b>		
<b>COs</b>	<b>Programme Outcomes (POs)</b>												<b>PSOs</b>		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS 01	PSO 2	PSO 3
CO 1						3		3	2						
CO 2						3		3	3						
CO 3						3		3	2						
CO 4						3		3	3						
CO 5						3		3	3						
<b>Course Assessment Methods</b>															
<b>Direct</b>															
1. Continuous Assessment Test I, II & III 2. Assignment															
<b>Indirect</b>															
Course - end survey															



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<b>Content of the syllabus</b>			
<b>Unit - I</b>	<b>INTRODUCTION</b>	Periods	<b>6</b>
Historical Background – Constituent Assembly of India – Fundamental Rights – Citizenship – Constitutional Remedies for citizens			
<b>Unit - II</b>	<b>STRUCTURE AND FUNCTION OF CENTRAL</b>	Periods	<b>6</b>
Union Government – Structures of the Union Government and Functions – President – Vice President – Prime Minister – Cabinet – Parliament – Supreme Court of India			
<b>Unit - III</b>	<b>STRUCTURE AND FUNCTION OF STATE</b>	Periods	<b>6</b>
State Government – Structure and Functions – Governor – Chief Minister – Cabinet – State Legislature – Judicial System in States – High Courts and other Subordinate Courts			
<b>Unit - IV</b>	<b>ELECTION PROVISIONS, EMERGENCY PROVISIONS, AMENDMENT OF THE CONSTITUTION</b>	Periods	<b>6</b>
Election Commission of India-composition, powers and functions and electoral process. Types of emergency-grounds, procedure, duration and effects. Amendment of the constitution- meaning, procedure and limitations.			
<b>Unit - V</b>	<b>SPECIAL CONSTITUTIONAL PROVISIONS</b>	Periods	<b>6</b>
Directive Principles of State Policy: Importance and its relevance. Special Constitutional Provisions for Schedule Castes, Schedule Tribes & Other Backward Classes, Women & Children.			
<b>Total Periods</b>			<b>30</b>
<b>Text Books</b>			
1.	Durga Das Basu, “Introduction to the Constitution of India “, Prentice Hall of India, New Delhi.		
<b>References</b>			
1.	R.C.Agarwal, (1997) “Indian Political System”, S.Chand and Company, New Delhi		
2.	Indian polity, M.Laksmikanth, Tatamchrawhill publications		
<b>E-Resources</b>			
1.	<a href="https://mhrd.gov.in/">https://mhrd.gov.in/</a>		
2.	<a href="https://niti.gov.in/content/niti-aayog-library">https://niti.gov.in/content/niti-aayog-library</a>		
3.	www.drishtias.com/		



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Programme	<b>B.E</b>	Programme Code	<b>103</b>	Regulation	<b>2023</b>										
Department	<b>Electronics and Communication Engineering</b>			Semester	<b>II</b>										
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks									
		L	T	P	C	CA	ESE	Total							
<b>U23MA202</b>	<b>Complex Analysis and Ordinary Differential Equations</b>	3	1	0	4	40	60	100							
<b>Course Objective</b>	<p>The Main Objective of the course is to</p> <ul style="list-style-type: none"> <li>Understand the Analytic functions and Bilinear transformations.</li> <li>Proficiently understand the Complex Integration.</li> <li>Demonstrate Vector Differentiation and Integration..</li> <li>To know about the Ordinary Differential Equations.</li> <li>Identify the Laplace Transform of Derivatives and Integrals.</li> </ul>														
<b>Course Outcome</b>	At the end of the course, the student should be able to,						Knowledge level								
	<b>CO1:</b> Analyze the construction of analytic functions.						K3, K4								
	<b>CO2:</b> Apply the concepts of cauchy's integral theorem and residue theorem in evaluation of complex integrals.						K2, K3								
	<b>CO3:</b> Apply Green's, Stoke's and Gauss Divergence theorems.						K1, K5								
	<b>CO4:</b> Understand the concepts of solving second order differential equations.						K2, K5								
<b>Pre-requisites</b>	-						-								
	-						-								
<b>CO / PO Mapping</b> (3/2/1 indicates strength of correlation) 3-Strong, 2 - Medium, 1 - Weak												<b>CO/PSO Mapping</b>			
<b>COs</b>	<b>Programme Outcomes (POs)</b>												<b>PSOs</b>		
	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO1</b>	<b>PSO 2</b>	<b>PSO 3</b>
<b>CO 1</b>	3		2	1	1								2		
<b>CO 2</b>	3	2	1	1									2		
<b>CO 3</b>	3	2		1									2		
<b>CO 4</b>	3	2		1	1								2		
<b>CO 5</b>	3	2	1	1									2		
<b>Course Assessment Methods</b>															
<b>Direct</b>															
1. Continuous Assessment Test I, II & III															
2. Assignment.															
3. End-Semester examinations															
<b>Indirect</b>															
1. Course - end survey															

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<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>ANALYTIC FUNCTIONS</b>	Periods	<b>12</b>
Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions $c+z$ , $cz$ , $1/z$ and Bilinear transformation.			
<b>Unit – II</b>	<b>COMPLEX INTEGRATION</b>	Periods	<b>12</b>
Problem solving using Cauchy’s integral theorem and integral formula- Taylor’s and Laurent’s expansions- Residues- Cauchy’s residue theorem- Application: Contour integration over unit circle.			
<b>Unit – III</b>	<b>VECTOR DIFFERENTIATION &amp; INTEGRATION</b>	Periods	<b>12</b>
Vector Differentiation: Vector and Scalar Functions- Derivatives- Curves, Gradient of a Scalar Field-Directional Derivative -Divergence of a Vector Field - Curl of a Vector Field – Line, Surface and Volume integrals (concepts only), Green’s theorem in a plane(excluding proof), Gauss Divergence theorem(excluding proof), Stoke’s theorem (Excluding proof).			
<b>Unit – IV</b>	<b>ORDINARY DIFFERENTIAL EQUATIONS</b>	Periods	<b>12</b>
Second order Linear ordinary differential equations with constant coefficients, Cauchy’s - Euler equations (excluding proof)- Legendre’s Linear differential equations(excluding proof) - Method of variation of parameters.			
<b>Unit – V</b>	<b>LAPLACE TRANSFORMS</b>	Periods	<b>12</b>
Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems(excluding proof) -Transforms of derivatives and integrals – Initial and final value theorems(excluding proof) – Inverse transforms – Convolution theorem(excluding proof) – Transform of periodic functions – Application to solution of linear second order ordinary differential equations with constant coefficients.			
<b>Total Periods</b>			<b>60</b>
<b>Text Books</b>			
1.	Grewal B.S., “Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 43rd Edition, 2014.		
2.	Ravish R Sing , Mukul Bhatt, “Engineering Mathematics”, Mc Graw Hill Education Pvt. Ltd-2018		
3.	Sivaramakrishna Das. P, Vijayakumari.C, “ Engineering Mathematics – II”, Pearson India Education Pvt. Ltd-2022.		
<b>References</b>			
1.	Wylie, R.C. and Barrett, L.C., “Advanced Engineering Mathematics” , Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.		
2.	Kreyszig, E., Advanced Engineering Mathematics (10th Edition), John Wiley (2015).		
3.	Alan Jefferis , Advanced Engineering Mathematics, Academic Press- New Delhi-2003		
4.	Yunus A.Cengel, William J.Palm III,” Differential equations for Engineers & Scientists”, Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.		
5.	John Bird, Higher Engineering Mathematics, Anuradha Agencies(2004)		
<b>E-Resources</b>			
1.	<a href="https://en.wikipedia.org/wiki/Ordinary_differential_equation">https://en.wikipedia.org/wiki/Ordinary_differential_equation</a>		
2.	<a href="http://www.learnerstv.com/Free-engineering-Video-lectures">www.learnerstv.com/Free-engineering-Video-lectures</a>		
3.	<a href="http://www.nptel.ac.in">www.nptel.ac.in</a>		

  
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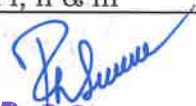


Programme	<b>B.E.</b>	Programme Code	<b>103</b>	Regulation	<b>2023</b>			
Department	<b>Electronics and Communication Engineering</b>		Semester	<b>II</b>				
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks		
		L	T	P	C	CA	ESE	Total
<b>U23PH201</b>	<b>ENGINEERING PHYSICS</b>	3	0	0	3	40	60	100
<b>Course Objective</b>	<p>The student should be made to,</p> <ul style="list-style-type: none"> <li>understand the basic concepts of properties of matter</li> <li>gain knowledge about the conduction properties of metals</li> <li>Identify the different types of crystal structures and crystal growth techniques. Study the production and applications of ultrasonics.</li> <li>Correlate better understanding the carrier concentration and its variations with temperature in a semiconductor. Study the properties of modern engineering materials and its uses</li> <li>categorize the types of laser and fiber optics</li> </ul>							
<b>Course Outcome</b>	At the end of the course, the student will be able to						Knowledge Level	
	<ul style="list-style-type: none"> <li>understand the elastic properties of the materials</li> </ul>						K2	
	<ul style="list-style-type: none"> <li>gain knowledge about the conduction properties of metals</li> </ul>						K3	
	<ul style="list-style-type: none"> <li>determine packing factor for various unit cells and understand different types of crystal imperfections and learn the engineering, medical applications.</li> </ul>						K1	
	<ul style="list-style-type: none"> <li>discuss the basic idea of semiconducting materials and realize the function of modern engineering materials</li> </ul>						K1	
<b>Pre-requisites</b>	---						K3	
	---							

COs	CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 - Medium, 1 - Weak												CO/PSO Mapping		
	Programme Outcomes (POs)												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS 01	PSO 2	PSO 3
CO 1	3	2	3	1	2									2	
CO 2	3	2	3	3	1										
CO 3	3	3		3	1								2		
CO 4	3		2	1	1							3	2		
CO 5	3			1	2	2							2		

**Course Assessment Methods**

<b>Direct</b>
1. Continuous Assessment Test I, II & III

  
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2. Assignments and Mind map 3. End-Semester examinations			
<b>Indirect</b>			
Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>PROPERTIES OF MATTER</b>	Periods	<b>9</b>
<b>Elasticity:</b> Types of moduli of elasticity - Stress - Strain Diagram – uses. Young’s modulus: Uniform bending (qualitative) Experimental determination by non-uniform bending - Twisting couple on a wire – Application: Torsional pendulum. <b>Viscosity:</b> Co-efficient of viscosity - Poiseuilles' formula - Experimental determination – uses.			
<b>Unit - II</b>	<b>ELECTRICAL PROPERTIES OF METALS</b>	Periods	<b>9</b>
<b>Classical theory:</b> Classical free electron theory of metals- Expressions for electrical conductivity and Thermal Conductivity of metals – Wiedemann-Franz law (Qualitative) - Success and failures. <b>Quantum theory:</b> de Broglie’s hypothesis - Schrodinger’s time independent and time dependent wave equations (Qualitative) - Particle in a one-dimensional box - Fermi – Dirac Statistics - Density of energy states (Qualitative).			
<b>Unit – III</b>	<b>CRYSTAL PHYSICS AND ULTRASONICS</b>	Periods	<b>9</b>
Crystallography - Unit cell - Crystal systems - Bravais lattices- Lattice planes - Miller indices - Inter-planar spacing in cubic lattice- Calculation of number of atoms per unit cell- Atomic radius – Coordination number- Packing Factor for HCP structures. <b>Ultrasonics:</b> Introduction - Properties and Generation of Ultrasonics – Magnetostriction and Piezoelectric Oscillator methods – Applications: Sound Navigation and Ranging (SONAR), Non – Destructive Testing (NDT) and Sonogram.			
<b>Unit - IV</b>	<b>SEMICONDUCTING &amp; MODERN ENGINEERING MATERIALS</b>	Periods	<b>9</b>
<b>Semiconductors:</b> Elemental and Compound semiconductors - Intrinsic semiconductor: (Qualitative only) – Carrier concentration – Fermi level – Electrical conductivity - Band gap determination. Extrinsic semiconductors: Carrier concentration in n – type and p – type semiconductor (Qualitative) – Variation of Fermi level with temperature. Application; Construction and working of LED. <b>Metallic glasses:</b> preparation, properties and applications - Shape memory alloys (SMA): Characteristics and applications of NiTi alloy.			
<b>Unit – V</b>	<b>LASER AND FIBER OPTICS</b>	Periods	<b>9</b>
<b>Laser:</b> Interactions of Radiations with matters - Characteristics of laser – Derivation of Einstein’s A and B coefficients. Types: CO2 laser - Semiconductor laser: Homo junction - Applications. <b>Optical fiber:</b> Principle of propagation of light through optical fiber - Numerical aperture and acceptance angle (Qualitative) -Types of optical fibers -Fiber optical communication system (block diagram) - Application: Temperature sensor.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	R.K. Gaur and Gupta. S.L, Engineering Physics, Dhanpat Rai Publishers, 2017.		





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2.	S.O Pillai., Solid state physics, New Age International Private Limited.
3.	Dr.P.Mani, "Engineering Physics", Shri Dhanam publisher, Chennai – 600 042
<b>References</b>	
1.	B.K. Pandey, S. Chaturvedi. "Engineering Physics", 1 <sup>st</sup> Edition, Cengage Learning India Pvt Ltd, (2012).
2.	Fundamentals Of Physics Extended 8/Ed 8th Edition, David Halliday, Robert ResnickJearl Walker, Wiley India Pvt Ltd, 2008.
3.	Lawrence H.Vanvlack, "Elements of materials Science Engineering, 6 <sup>th</sup> Edition, Pearson Publication.
4.	S.O.Pillai, "Solid State Physics", New Age International Publishers
5.	Dr.V.Rajendran, "Engineering Physics", Tata McGraw Hill Education Private Limited, New Delhi
<b>E-Resources</b>	
1.	<a href="http://www.e-booksdirectory.com">www.e-booksdirectory.com</a>
2.	<a href="http://Home.iitk.ac.in">Home.iitk.ac.in</a>
3.	<a href="http://physics.cu.ac.bd/">physics.cu.ac.bd/</a>



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Programme	<b>B.E.</b>	Programme Code					<b>103</b>	Regulation			2023				
Department	<b>Electronics and Communication Engineering</b>					Semester			<b>II</b>						
Course Code	Course Name		Periods Per Week			Credit	Maximum Marks								
			L	T	P		C	CA	ESE	Total					
<b>U23EC201</b>	<b>Semiconductor Devices and Technology</b>		3	0	0	3	40	60	100						
<b>Course Objectives</b>	The main objective of the course is to <ul style="list-style-type: none"> <li>• Know about the basics of semiconductors and PN junction devices</li> <li>• Familiarize the transistors BJT and FET.</li> <li>• Learn about MOSFET Devices in detail.</li> <li>• Familiarization of opto and power electronic devices.</li> <li>• Gain knowledge on high frequency semiconductor devices.</li> </ul>														
<b>Course Outcome</b>	At the end of the course, the student should be able to,									Knowledge Level					
	CO1: Understand the theory of Semiconductors and various diodes									K3					
	CO2: know the operation of Bipolar Junction Transistor and FET									K3					
	CO3: Demonstrate the operation of JFET and MOSFET and their characteristics.									K3					
	CO4: Extend the Optoelectronic and power electronic Devices									K2					
CO5: understand the HF Semiconductor devices.									K2						
<b>Pre-requisites</b>	Basic Electrical and Electronics Engineering														
<b>CO / PO Mapping</b> (3/2/1 indicates strength of correlation) 3-Strong, 2 - Medium, 1 - Weak											<b>CO/PSO Mapping</b>				
<b>COs</b>		<b>Programme Outcomes (POs)</b>										<b>PSOs</b>			
	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO1</b>	<b>PSO 2</b>	<b>PSO 3</b>
<b>CO 1</b>	3	3	2	2								1	3		1
<b>CO 2</b>	3	3	2	2								1	3		1
<b>CO 3</b>	3	3	2	2								1	3		1
<b>CO 4</b>	3	2	2	2	1							1	3		1
<b>CO 5</b>	3	2	2	2	1		1					1	3		1
<b>Course Assessment Methods</b>															
<b>Direct</b>															
1. Continuous Assessment Test I,II & III															
2. Assignment															
3. End-Semester examinations															
<b>Indirect</b>															
1. Course-end Survey															
<b>Content of the syllabus</b>															

  
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<b>Unit – I</b>	<b>Semiconductor Device physics and pn junction Devices</b>	Periods	<b>9</b>
Semiconductor Materials- Charge Carriers in Semiconductors- Carrier Concentrations- Conductivity and Mobility- The Hall Effect, p-n Junctions- Forward- and Reverse-Biased Junctions- Reverse-Bias Breakdown. The p-n Junction Diode- The Zener diode- Applications.			
<b>Unit – II</b>	<b>Bipolar Junction Transistors and Field-Effect Transistors</b>	Periods	<b>9</b>
Fundamentals of BJT Operation- Amplification with BJTs- Generalized Biasing-VI characteristics of CE, CB and CC configurations- Switching- Frequency Limitations of Transistors. Field-Effect Transistors- Transistor Operation- The Load Line- Amplification and Switching- The Junction FET- Pinch-off and Saturation- Gate Control- Current-Voltage Characteristics.			
<b>Unit – III</b>	<b>Metal-Oxide Semiconductor Field-Effect Transistors (MOSFET)</b>	Periods	<b>9</b>
The Basic MOSFET Operation - MOSFET Structures – Concepts of Current-Voltage Relationships: Output Characteristics- Transfer Characteristics- Mobility Models- Short Channel MOSFET. Introduction to CMOS technology.			
<b>Unit – IV</b>	<b>Optoelectronic and power electronic Devices</b>	Periods	<b>9</b>
Photodiodes- Phototransistors- Solar Cells – Photo detectors- Light-Emitting Diodes- Lasers- UJT –Types and applications. Various types of Thyristor devices and its applications <b>(Qualitative Treatment only)</b> .			
<b>Unit – V</b>	<b>HF Semiconductor devices</b>	Periods	<b>9</b>
Tunnel Diodes. Pin diode-Crystal diode-Schotky barrier diode-Varactor diode, IMPATT Diode- Gunn Diode- p-n-p-n Diode. <b>(Qualitative Treatment only)</b> .			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	Jacob Millman and Christos C Halkias, Electronic Devices and Circuits, 4th edition, McGraw Hill Education, 2015.		
2.	BenG Streetman and Sanjay Banerjee , “Solid State Electronic Devices, 7th edition Pearson Prentice Hall, 2015		
3.	Donald A. Neamen, -Semiconductor Physics and Devices ,Tata McGraw Hill, Third Edition,2012		
<b>References</b>			
1.	S. M. Sze, -Semiconductor Devices: Physics and Technology, Wiley, Second Edition,2008		
2.	Adel S. Sedra, Kenneth C. Smith and Arun N. Chandorkar, "Microelectronic Circuits", 7th Edition, Oxford University Press, New York, 2017.		
3.	Yang, – Fundamental of Semiconductor devices, Tata McGraw Hill, International Edition,2007		
<b>E-Resources</b>			
1.	<a href="https://www.electronics-tutorials.ws/diode/diode_2.html">https://www.electronics-tutorials.ws/diode/diode_2.html</a>		
2.	<a href="https://nptel.ac.in/courses/117102061/">https://nptel.ac.in/courses/117102061/</a>		
3.	<a href="https://www.sciencedirect.com/topics/physics-and-astronomy/optical-device">https://www.sciencedirect.com/topics/physics-and-astronomy/optical-device</a>		




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Programme	<b>B.E</b>	Programme code	<b>103</b>	Regulation		<b>2023</b>			
Department	<b>Electronics and Communication Engineering</b>			Semester		<b>II</b>			
Course code	Course name	Periods per week			Credit	Maximum Marks			
		L	T	P	C	CA	ESE	Total	
<b>U23TN202</b>	<b>தமிழரும் தொழில்நுட்பமும் / Tamils and Technology*</b>	1	0	0	1	40	60	100	
<b>Content of the syllabus</b>									
<b>myF 1</b>	<b>நெசவு மற்றும் பானைத்தொழில்நுட்பம்</b>				<b>Periods</b>	<b>3</b>			
சங்ககாலத்தில் நெசவுத்தொழில் - பானைத்தொழில்நுட்பம் - கருப்புசிவப்புபாண்டங்கள் - பாண்டங்களில் கீறல்குறியீடுகள்.									
<b>myF 2</b>	<b>வடிவமைப்பு மற்றும் கட்டிடத்தொழில்நுட்பம்</b>				<b>Periods</b>	<b>3</b>			
சங்ககாலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்ககாலத்தில் வீட்டுப்பொருட்களில் வடிவமைப்பு- சங்ககாலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள்-மாமல்லபுரச்சிற்பங்களும், கோவில்களும் - சோழர்காலத்துப்பெருங்கோயில்கள் மற்றும் பிறவழி பாட்டுத்தலங்கள் -நாயக்கர் காலக்கோயில்கள்-மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால்-செட்டிநாட்டு வீடுகள்- பிரிட்டிஷ்காலத்தில் சென்னையில் இந்தோ-சாரோசெனிக்கட்டிடக்கலை.									
<b>myF 3</b>	<b>உற்பத்தித்தொழில்நுட்பம்</b>				<b>Periods</b>	<b>3</b>			
கப்பல் கட்டும்கலை - உலோகவியல் - இரும்புத்தொழிற்சாலை - இரும்பை உருக்குதல் ,எஃகு - வரலாற்றுச்சான்றுகளாக-செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள், கண்ணாடி மணிகள் - சுடுமண் மணிகள் - சங்கு மணிகள் - எலும்புத்துண்டுகள் - தொல்லியல்சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.									
<b>myF 4</b>	<b>வேளாண்மைமற்றும்நீர்ப்பாசனத்தொழில்நுட்பம்</b>				<b>Periods</b>	<b>3</b>			
அணை, ஏரி, குளங்கள் ,மதகு - சோழர்காலக்குமுழித்தாம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மைச்சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு - மீன்வளம் - முத்து மற்றும் முத்துக்குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்.									
<b>myF 5</b>	<b>அறிவியல் தமிழ் மற்றும் கணினித்தமிழ்</b>				<b>Periods</b>	<b>3</b>			
அறிவியல் தமிழின் வளர்ச்சி - கணினித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மின் பொருட்கள் உருவாக்கம் - தமிழ் இணையக்கல்விக்கழகம் - தமிழ் மின்நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்க்குவைத்திட்டம்.									
<b>Total Periods</b>								<b>15</b>	

  
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Programme	<b>B.E</b>	Programme code	<b>103</b>	Regulation	<b>2023</b>			
Department	<b>Electronics and Communication Engineering</b>			Semester	<b>II</b>			
Course code	Course name	Periods per week			Credit	Maximum Marks		
		L	T	P	C	CA	ESE	Total
<b>U23TA202</b>	TAMILS AND TECHNOLOGY	1	0	0	1	40	60	100
<b>Content of the syllabus</b>								
<b>UNIT I</b>	<b>WEAVING AND CERAMIC TECHNOLOGY</b>				<b>Periods</b>	<b>3</b>		
Weaving Industry during Sangam Age - Ceramic technology - Black and Red Ware Potteries (BRW) -Graffiti on Potteries								
<b>UNIT II</b>	<b>DESIGN AND CONSTRUCTION TECHNOLOGY</b>				<b>Periods</b>	<b>3</b>		
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)- ThirumalaiNayakarMahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.								
<b>UNIT III</b>	<b>MANUFACTURING TECHNOLOGY</b>				<b>Periods</b>	<b>3</b>		
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.								
<b>UNIT IV</b>	<b>AGRICULTURE AND IRRIGATION TECHNOLOG</b>				<b>Periods</b>	<b>3</b>		
Dam, Tank, ponds, Sluice, Significance of KumizhiThoempu 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.								
<b>UNIT V</b>	<b>SCIENTIFIC TAMIL &amp; TAMIL COMPUTING</b>				<b>Periods</b>	<b>3</b>		
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.								
<b>Total Periods</b>							<b>15</b>	

  
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**TEXT-CUM-REFERENCE BOOKS**

1	தமிழகவரலாறும் - மக்களும்பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாட நூல்மற்றும்கல்வியியல்பணிகள்கழகம்).
2	கணிணித்தமிழ் - முனைவர்இல. சுந்தரம். (விகடன்பிரசுரம்).
3	கீழடி - வைகை நதிக்கரையில் சங்க நக ரநாகரிகம் (தொல்லியல்துறைவெளியீடு)
4	பொருறை - ஆற்றங்கரை நாகரிகம். (தொல்லியல்வெளியீடு)
5	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL - (in print)
6	Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies)
7	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8	The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10	Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) - Reference Book.





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Programme	<b>B.E.</b>	Programme Code			<b>103</b>	Regulation	<b>2023</b>									
Department	<b>Electronics and Communication Engineering</b>					Semester	<b>II</b>									
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks										
		L	T	P		C	CA	ESE	Total							
<b>U23CS203</b>	<b>Python Programming</b>	3	0	2	4	50	50	100								
<b>Course Objective</b>	The student should be made to,															
	<ul style="list-style-type: none"> <li>• Understand the fundamentals of Python programming</li> <li>• Handle list, tuples, sets and Dictionaries data types</li> <li>• Learn function prototypes and string functions.</li> <li>• Use files and modules for data processing</li> <li>• Understand packages in Python and data visualization</li> </ul>															
<b>Course Outcome</b>	At the end of the course, the student should be able to,										Knowledge Level					
	<b>CO1:</b> Interpret the fundamental Python syntax and semantics and be fluent in the use of Python control flow statements.										K3					
	<b>CO2:</b> Perform operations on list, tuples, sets and Dictionaries using python.										K3					
	<b>CO3:</b> Implement function prototypes and string functions.										K3					
	<b>CO4:</b> Apply files and modules and perform operations on CSV files.										K3					
<b>CO5:</b> Perform data visualization and apply Python packages for CSV files										K3						
<b>Pre-requisites</b>	Nil															
<b>CO / PO Mapping</b> (3/2/1 indicates strength of correlation) 3-Strong, 2 - Medium, 1 - Weak													<b>CO/PSO Mapping</b>			
<b>COs</b>		<b>Programme Outcomes (POs)</b>											<b>PSOs</b>			
		<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO1</b>	<b>PSO 2</b>	<b>PSO 3</b>
<b>CO 1</b>		3	2	1	-	1	-	-	-	-	-	-	2	3	2	
<b>CO 2</b>		3	3	1	1	2	-	-	-	-	-	-	2	3	2	
<b>CO 3</b>		3	3	1	2	2	-	-	-	-	-	-	2	3	2	
<b>CO 4</b>		3	3	1	2	2	-	-	-	-	-	-	2	3	2	
<b>CO 5</b>		3	3	1	2	2	-	-	-	-	-	-	2	3	2	
<b>Course Assessment Methods</b>																
<b>Direct</b>																
1. Continuous Assessment Test I, II & III																
2. Assignments / Quiz																
3. End-Semester examinations																
<b>Indirect</b>																
1. Course - End survey																
<b>Content of the syllabus</b>																
<b>Unit – I</b>		<b>INTRODUCTION TO PYTHON</b>											Periods	<b>9</b>		
Introduction to Python, features, installing Python, writing and executing Python program —																

  
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native data types, comments, constants, variables, operators, expression, conditional statements, control statements, continue, pass, break.			
<b>Unit - II</b>	<b>LISTS, TUPLES, SETS AND DICTIONARIES</b>	Periods	<b>9</b>
Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Sets: methods and operators, Dictionaries: operations and methods.			
<b>Unit - III</b>	<b>FUNCTIONS AND STRINGS</b>	Periods	<b>9</b>
Functions definition, declaration, arguments, parameters – formal and local, parameter passing methods - function prototypes, recursion; Strings: string slices, immutability, string functions and methods, string module, regular expressions.			
<b>Unit - IV</b>	<b>FILES AND MODULES</b>	Periods	<b>9</b>
Files and exception: Text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, accessing CSV file.			
<b>Unit - V</b>	<b>PACKAGES AND DATA VISUALIZATION</b>	Periods	<b>9</b>
Text processing, Numerical processing: numpy package – mean, median and mode, pandas package – vector, dataframe, data visualization: matplotlib, Time operations.			
<b>Total Period</b>			<b>45</b>
<b>Suggested List of Experiments</b>			
<b>List of Experiments</b>			<b>CO's</b>
1. Write a program to demonstrate different number data types in Python.			CO1
2. Write a program to perform different Arithmetic Operations on numbers in Python.			CO1
3. Write a program to create, append and remove lists and demonstrate the tuples in python.			CO2
4. Write a program to demonstrate working with dictionaries in python.			CO2
5. Write a program to create, concatenate and print a string and accessing sub-string from a given string.			CO3
6. Write a Python function to calculate the factorial of a number (a non-negative integer). The function accepts the number as an argument.			CO3
7. Write a program to compute the number of characters, words and lines in a file.			CO4
8. To write a Python program to find the most frequent words in a text read from a file.			CO4
9. Find mean, median, mode for the given set of numbers in a list.			CO5
10. Draw a horizontal bar chart with Matplotlib			CO5
<b>Lecture:45, Practical:30, Total:75</b>			
<b>Text Books</b>			
1.	Anurag Gupta,G.P BISWAS ,” Python Programming – Problem solving, packages and Libraries, Edition 1, Tata McGraw Hill, 2019		
2.	E Balagurusamy, “Problem Solving and Python Programming”, Edition1, Tata McGraw Hill, 2018		
3.	ReemaThareja, “Python Programming using Problem Solving Approach”, OXFORD University Press, 2017.		
<b>References</b>			
1.	Allen B. Downey, “Think Python: How to Think Like a Computer Scientist“, 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016.		

  
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2.	John V Guttag, –Introduction to Computation and Programming Using Python“, Revised and expanded Edition, MIT Press , 2021
3.	Guido van Rossum (Author), The Python Development Team (Author),An Introduction to Python Tutorial and What’s New ,2022,Shroff Publishers first edition
<b>E-Resources</b>	
1.	<a href="http://greenteapress.com/wp/think-python/">http://greenteapress.com/wp/think-python/</a>
2.	<a href="https://www.python.org/about/gettingstarted/">https://www.python.org/about/gettingstarted/</a>
3.	<a href="https://beginnersbook.com/2018/03/python-tutorial-learn-programming/">https://beginnersbook.com/2018/03/python-tutorial-learn-programming/</a>
4.	<a href="https://www.tutorialspoint.com/python/index.htm">https://www.tutorialspoint.com/python/index.htm</a>
5.	<a href="https://www.learnpython.org/">https://www.learnpython.org/</a>
6.	<a href="https://www.udemy.com/topic/python/free">https://www.udemy.com/topic/python/free</a>



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Programme	<b>B.E</b>	Programme code	<b>103</b>	Regulation	<b>2023</b>			
Department	<b>Electronics and Communication Engineering</b>			Semester	<b>II</b>			
Course code	Course name	Periods per week			Credit	Maximum Marks		
		L	T	P	C	CA	ESE	Total
<b>U23EN202</b>	<b>Professional Communication</b>	2	0	3	3	50	50	100
<b>Objective</b>	The main objective of this course is to:							
	<ul style="list-style-type: none"> <li>• Provide suitable reading &amp; writing tasks to develop communicative ability for academic and professional progress</li> <li>• Inculcate channelized reading to make learners proficient in the chosen professional writing contexts.</li> <li>• Improve learners' vocabulary and grammar to supplement their language use at professional contexts</li> <li>• Assist students in the development of intellectual flexibility, creativity, and cultural literacy so that they may engage in life-long learning.</li> </ul> Identify and begin to apply the language features of academic and professional writing and speaking							
<b>Outcomes</b>	The students who complete this course successfully are expected to:						Knowledge Level	
	<b>CO1:</b> Acquire sufficient command over language to speak at an academic or professional context						K1	
	<b>CO2:</b> Write technically well at professional contexts through exposing them to similar readings.						K1	
	<b>CO3:</b> Use language at length at technical and professional situations through enrichment of vocabulary and strengthening of grammatical knowledge.						K2	
	<b>CO4:</b> Ethically gather, understand, evaluate and synthesize information from a variety of written and electronic sources.						K2	
	<b>CO5:</b> Be proficient in oral communication and writing.						K3	
<b>Pre-requisites</b>	<b>Nil</b>							

CO / PO Mapping													CO/PSO Mapping		
(3/2/1 indicates strength of correlation) 3-Strong, 2 - Medium, 1 - Weak															
COs	Programme Outcomes (POs)												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO 2	PSO 3
CO 1						2			3	3		3			2
CO 2						2			3	3		3			2
CO 3						2			3	3		3			2
CO 4						2			3	3		3			2
CO 5						2			3	3		3			2

*[Signature]*  
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**Course Assessment Methods**

<b>Direct</b>
1.Continuous Assessment Test I & II
2.Continuous Assessment Test III in the Communication Skills Lab
3.Assignments
4.End-Semester examinations
<b>Indirect</b>
1.Course – end survey

**Content of the syllabus**



<b>Unit - I</b>		<b>Periods</b>	<b>15</b>	
<b>Listening-</b> Listening for Cultural Awareness, Listening to Professional Conversations, Talks, Interviews and Lectures <b>Speaking-</b> Developing Confidence to get rid of Fear on the Dias, Discussion at a Corporate Context. <b>Reading-</b> Inferential Reading, Reading Short Messages and Technical Articles, <b>Writing-</b> Introduction to Letter Writing, Writing Formal and Informal Letters, Thanking Letters, Letters Calling for Quotations, Letters Placing an Order, Seeking clarification, Letters of Complaint. <b>Focus on Language-</b> Adjectives and Degrees of Comparisons				
<b>Unit - II</b>		<b>Periods</b>	<b>15</b>	
<b>Listening-</b> Listening to specific information relating to technical content, Listening for statistical information <b>Speaking-</b> Expressing opinions, Formal Discussions, Describing Role Play at Business Context and Consolidating Ideas. <b>Reading-</b> Reading Technical Articles in Journals and Comparing Articles. <b>Writing-</b> Letter seeking permission to undergo practical training and to undertake project work. <b>Focus on Language-</b> Simple, compound and complex sentences and Transformation of Sentences.				
<b>Unit - III</b>		<b>Periods</b>	<b>15</b>	
<b>Listening-</b> Listening to understand the overall meaning, Listening to Interviews and Presentations. <b>Speaking-</b> Giving Instructions and Showing Directions and Rephrasing Instructions. <b>Reading-</b> Skimming and Scanning, Reading Job Advertisements. <b>Writing-</b> Applying for a Job, Writing a CV. <b>Group Discussion:</b> Introduction – Topic Analysis – Thematic Expressions-Objective and content of discussion.				
<b>Unit - IV</b>		<b>Periods</b>	<b>15</b>	
<b>Listening-</b> Listening and retrieving Information. <b>Speaking-</b> Developing fluency and Coherence, Accent Neutralization, Voice Modulation, and Intonation, Improving Voice Quality. <b>Reading-</b> Reading and understanding Advertisements. <b>Writing-</b> Letters to the Editor, Letter of Complaint, Various kinds of Reports, Permission to go for Industrial visits. <b>Presentation skills:</b> Making Self Introduction effectively-Elements of effective presentation – Structure of presentation – Presentation tools – Voice Modulation – Audience analysis – Body language – Accents analysis – Stylistics.				
<b>Unit - V</b>		<b>Periods</b>	<b>15</b>	
<b>Listening-</b> Listening to Fragmented Texts and Filling in the Blanks. <b>Speaking-</b> Mind Mapping, Developing Coherence and Self-Expression, Making presentations, Paralinguistic and Extra linguistic Features (body language), <b>Reading-</b> Predicting content, Interpreting Reports. <b>Writing-</b> Writing Proposals, Agenda, Minutes of the Meeting. <b>Soft Skills:</b> Introduction - Change in Today's Workplace: Soft Skills as a Competitive Weapon - Antiquity of Soft Skills - Classification of Soft skills - Ability to work as a team.				
			<b>Total Periods</b>	<b>75</b>
<b>Text books</b>				
1.	Sumant.S,Pereira Joyce, English for Communication, Vijay Nicole Imprints Pvt.Ltd., 2014.			
2.	Sokkaalingam, S.RM., The Art Of Speaking English Versatile Publishing House,2018.			

  
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<b>Reference books</b>	
1.	Norman Whitby - Business Benchmark Pre-Intermediate to Intermediate, Students Book, Cambridge University Press, 2008. , 1997.
2.	Dutt, Rajeevan, Prakash .A Course in Communication Skills (Anna University, Coimbatore edition) :. Cambridge University Press India Pvt.Ltd, 2007.
3.	Meenakshi Raman and Sangeeta Sharma-'Technical Communication English Skills for Engineers'; Oxford University Press, 2008.
4.	S.P. Dhanavel, English and Communication Skills for Students of Science and Engineering, Orient Blackswan Pvt, Ltd, 2009.
5.	Technical English – I & II, Sonaversity, Sona College of Technology, Salem, First Edition, 2012.
<b>E-Resources</b>	
1.	<a href="http://www.kalevleetaru.com/Publish/Book_Review_Who_Moved_My_Cheese.pdf">http://www.kalevleetaru.com/Publish/Book_Review_Who_Moved_My_Cheese.pdf</a>
2.	<a href="http://www.bookbrowse.com/reviews/index.cfm/book_number/304/who-moved-my-cheese">http://www.bookbrowse.com/reviews/index.cfm/book_number/304/who-moved-my-cheese</a>
3.	<a href="http://www.imdb.com/title/tt0482629/plotsummary">http://www.imdb.com/title/tt0482629/plotsummary</a>



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	<b>VIVEKANANDHA COLLEGE OF ENGINEERING FOR WOMEN</b> (Autonomous Institution, Affiliated to Anna University, Chennai) Elayampalayam, Tiruchengode – 637 205														
Programme	<b>B.E.</b>	Programme Code					<b>103</b>	Regulation		<b>2023</b>					
Department	<b>Electronics and Communication Engineering</b>					Semester			<b>II</b>						
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks									
		L	T	P		C	CA	ESE	Total						
<b>U23PH202</b>	<b>PHYSICS LABORATORY</b>	0	0	2	1	60	40	100							
<b>Course Objective</b>	<ul style="list-style-type: none"> <li>➤ Understand elastic behavior of Materials</li> <li>➤ Predict viscous force in liquids.</li> <li>➤ Gain knowledge in measuring the lowest thickness materials</li> <li>➤ To Identify wavelengths of prominent lines using polychromatic lamp</li> <li>➤ Observe heat conduction in bad conductor</li> <li>➤ Understand the principle of interferometer</li> <li>➤ To learn about the characteristics of Lasers</li> </ul>														
<b>Course Outcome</b>	At the end of the course, the student will be able to										Knowledge Level				
	<b>CO1:</b> Measure the young's modulus of the materials, Rigidity modulus – Torsion pendulum										K3				
	<b>CO2:</b> Calculate Coefficient of viscosity of liquid and thickness of thin wire using Air wedge										K3				
	<b>CO3:</b> Observe and measure the different wavelengths of mercury Spectrum and dispersive power of a prism										K3				
	<b>CO4:</b> Illustrate the conductivity of bad conductors. To know how to determine the velocity of ultrasonic waves in liquid										K3				
	<b>CO5:</b> To understand the importance of laser beam compared to ordinary light										K2				
<b>CO / PO Mapping</b> (3/2/1 indicates strength of correlation) 3-Strong, 2 - Medium, 1 - Weak													<b>CO/PSO Mapping</b>		
COs	Programme Outcomes (POs)												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS 01	PSO 2	PSO 3
CO 1	3	1											2		
CO 2	3	3	1	2	2								2		
CO 3	3	2			2								3		
CO 4	3	3		1									1		
CO 5	3	1	1		1								2		
<b>Course Assessment Methods</b>															





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<b>Direct</b>		
1. Prelab and post lab test		
2. Execution of experiment and Viva-Voce		
3. End-Semester examinations		
<b>Indirect</b>		
Course - end survey		
<b>Content of the syllabus</b>		
PHYSICS		
<b>S.No.</b>	<b>Experiments</b>	<b>CO</b>
1.	Determination of Young's modulus of the material - Uniform bending	CO1
2.	Determination of Young's modulus of the material - Non uniform bending	CO1
3.	Determination of Rigidity modulus – Torsion pendulum	CO1
4.	Determination of Coefficient of viscosity of a liquid – Poiseuille's method	CO2
5.	Determination of thickness of a thin material – Air wedge method	CO2
6.	Determination of wavelength of mercury spectrum – spectrometer grating	CO3
7.	Determination of Dispersive power of a prism – Spectrometer	CO3
8.	Determination of thermal conductivity of metallic glass using Lee's Disc Method	CO4
9.	Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer	CO4
10.	Determination of Wavelength and particle size using Laser	CO5
<b>Total Periods</b>		<b>30</b>
<b>Lab Manual</b>		
1.	R. Jayaraman, Engineering Physics Laboratory Manual, Pearson Pub, Edition-2021.	
2.	A.K. Katiyar & C.K. Pandey Engineering Physics: Theory and Practical, Wiley Pub, 2nd Edition.	



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Programme	<b>B.E</b>		Programme Code			<b>103</b>		Regulation		<b>2023</b>					
Department	<b>Electronics and Communication Engineering</b>							Semester		<b>II</b>					
Course Code	Course Name					Periods Per Week			Credit		Maximum Marks				
						L	T	P	C		CA	ESE	Total		
<b>U23GE204</b>	<b>Engineering Practices Laboratory</b>					0	0	3	1		60	40	100		
<b>Course Objective</b>	<p>The students should made to</p> <ol style="list-style-type: none"> <li>1. Know the plumbing line assemblies.</li> <li>2. Weld lap joint, butt joint and T-joint.</li> <li>3. Learn the assembling and dismantling methodology of home appliances.</li> <li>4. Learn the resistor value identification through colors coated on resistor.</li> <li>5. Learn the basics of signal generation in CRO.</li> <li>6. Learn the soldering techniques in PCB board for designing the projects.</li> </ol>														
<b>Course Outcomes</b>	At the end of the course, the student should be able to,										Knowledge Level				
	<b>CO1:</b> Perform basic machining operations and finish the job to the requirements and quantify the accuracy.										K2				
	<b>CO2:</b> Make various joints such as cross lap joint and Tee lap joint in the carpentry.										K2				
	<b>CO3:</b> Understand the basics of house wiring techniques and the measurements of basic electrical quantities.										K2				
	<b>CO4:</b> Understand the resistor value identification through colors coated on resistor.										K2				
<b>CO5:</b> Understand the soldering techniques in PCB board for designing the projects.										K2					
<b>Pre - requisites</b>	Nil														
<b>CO / PO Mapping</b> (3/2/1 indicates strength of correlation) 3-Strong, 2 - Medium, 1 - Weak															
Programme Outcomes (POs)													<b>CO/PSO Mapping</b> PSOs		
<b>COs</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>	<b>PSO 3</b>
<b>CO 1</b>	3	2	3	2	2	-	-	-	2	-	-	-	2	2	-
<b>CO 2</b>	3	2	3	2	2	-	-	-	2	-	-	-	3	2	-
<b>CO 3</b>	3	2	2	3	2	2	-	-	2	-	-	-	2	-	-
<b>CO 4</b>	3	2	2	3	2	2	-	-	2	-	-	-	2	-	-
<b>CO 5</b>	3	2	3	3	2	2	-	-	2	-	-	-	3	3	-
<b>Course Assessment Method</b>															
<b>Direct</b>															
1.Pre lab and Post lab test 2. Record mark 3.End- Semester Examinations															
<b>Indirect</b>															
1.Course -End survey															

  
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<b>Content of the Syllabus</b>	
<b>GROUP A (CIVIL &amp; MECHANICAL ENGINEERING)</b>	
<b>(CIVIL ENGINEERING PRACTICE)</b>	
<b>1.Plumbing :</b> a) Single Tap G.I / PVC pipe connection involving the fitting like valves, taps & bends. b) Two Tap G.I / PVC pipe connection involving the fitting like valves, taps & bends.	CO2
<b>2.Carpentry:</b> a) To make a Cross Lap Joint from the given work piece. b) Preparation of ' T' Lap Joint from the given work piece.	CO2
<b>MECHANICAL ENGINEERING PRACTICE</b>	
<b>3.Welding:</b> a) To join the metal plates by a Butt Joint in arc welding machine. b) To join the metal plates by a Lap Joint in arc welding machine.	CO1
<b>4.Basic Machining:</b> a) To perform simple facing & turning operation. b) To perform of step turning operation.	CO1
<b>5.Sheet Metal Work:</b> a) To make a rectangular tray from the given sheet metal. b) To make a basket from the given sheet metal.	CO1
<b>6.Special Laboratory</b> a) Study of 3D Printing machine and its applications. b) Study of CO <sub>2</sub> Laser engraving & cutting machine and its applications. c) Study of Wood routing machine and its applications.	CO1
<b>GROUP B (ELECTRICAL &amp; ELECTRONICS ENGINEERING)</b>	
<b>ELECTRICAL ENGINEERING PRACTICE</b>	
1. Residential house wiring and stair case wiring using switches, fuse, indicator & lamp.	CO3
2. LED lamp assembly.	CO3
3. Measurement of voltage, current, power & power factor using R-Load.	CO3
4. Measurement of energy using single phase meter.	CO3
5. Measurement of resistance to earth of electrical equipment.	CO3
6. Measurement of illumination in different lamps.	CO3
7. Study of batteries.	CO3
<b>ELECTRONICS ENGINEERING PRACTICE</b>	
1. Study of Electronic components and equipments –Resistor, color coding, Inductor, Capacitor and CRO	CO4
2. Logic gates AND, OR, NOR, NAND and NOT.	CO4
3. Generation of Clock Signal.	CO4
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB	CO5
<b>Total Period:45</b>	
<b>Reference Books:</b>	
<b>R1</b>	Dr.P.Kannan, Mr.T.Satheeskumar & Mr.K.Rajasekar, “Engineering Practices Laboratory” Manual. First Edition, 2017.
<b>R2</b>	Mr.T.Jeyapooan, Mr.M.Saravana Pandian, “Engineering Practices Lab” Manual, Vikas Publishing House Pvt Ltd, 2017.

  
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Programme	<b>B.E</b>	Programme code	<b>103</b>	Regulation	<b>2023</b>			
Department	<b>Electronics and Communication Engineering</b>			Semester	<b>II</b>			
Course code	Course name	Periods per week			Credit	Maximum Marks		
		L	T	P	C	CA	ESE	Total
<b>U23MCFY1</b>	<b>Environmental Science and Engineering</b>	2	0	0	0	100	0	100
Objective	<p>The main objective of this course is to:</p> <ul style="list-style-type: none"> <li>Familiarize basics of ecosystem and creating environmental awareness.</li> <li>Congregate about environmental pollution.</li> <li>Contrast on solid waste and social issues.</li> <li>Acquire knowledge in environmental legislation and protection.</li> </ul> <p>Summarize population growth, human rights and Environment.</p>							
Outcomes	The students who complete this course successfully are expected to:							Knowledge Level
	<b>CO1:</b> Acquire knowledge about Eco-system, Natural resources and Bio- diversity.							K1
	<b>CO2:</b> Be aware of Environmental Pollution and its control.							K3
	<b>CO3:</b> Infer and express Solid waste management and Social issues.							K3
	<b>CO4:</b> Acquire Knowledge about Environmental legislation and protection.							K3
	<b>CO5:</b> Awareness about population growth, human rights and Environment							K2
Pre-requisites	<b>Nil</b>							

COs	CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 - Medium, 1 - Weak												CO/PSO Mapping		
	Programme Outcomes (POs)												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO 2	PSO 3
CO 1	1	2	2			2	3				2	2			
CO 2	3	2	2		1	2	3			1	3	3		2	
CO 3	3	2	2		1	3	3			1	2	3		2	
CO 4	1	1	1			2	3			1	2	2		1	
CO 5	1	2	1			2	2			1	3	1		1	

**Course Assessment Methods**

**Direct**

- 1.Continuous Assessment Test I, II & III
- 2.Assignment

**Indirect**

1. Course - end survey

  
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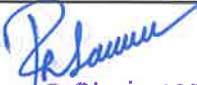
<b>Content of the syllabus</b>				
Unit - I	<b>INTRODUCTION TO ENVIRONMENTAL SCIENCE AND ENGINEERING</b>	Periods	6	
Nature and scope of environmental education- Natural Resources – (Forest, Water, Food,& Land Resources) problems and remedial measures, Ecosystem and Biodiversity- Ecosystem-Structure, Characteristics and functions of ecosystem - Biodiversity – Definition – Conservation of Biodiversity (in-situ and Ex-situ)-Values and Threats of Biodiversity Environmental awareness and sustainable development.				
Unit - II	<b>ENVIRONMENTAL POLLUTION AND ITS CONTROL</b>	Periods	6	
Water pollution-causes, effects and control measures of water pollution- Waste water treatment process (Secondary-BOD,COD) - Air Pollution – Types of Air pollutants-CO <sub>2</sub> , SO <sub>2</sub> , NO <sub>2</sub> , PAN-Sources- control measures (Electro static precipitator, Bag house filter, Wet Scrubber and cyclone separator).				
Unit - III	<b>SOCIAL ISSUES AND SUSTAINABILITY</b>	Periods	6	
Solid waste Management-Types (E-Waste, Hazardous waste, Bio-waste)-Disposal method. Sustainability-Definition-Sustainable development Goals-Environmental issues-global warming and Ozone depletion, Climate change, Acid rain, Carbon foot print-Possible solutions to Environmental issues				
Unit - IV	<b>SUSTAINABILITY PRACTICES AND ENVIRONMENTAL LEGISLATION</b>	Periods	6	
Zero waste and R-Concept-Circular economy, Material life cycle assessment-EIA, Energy efficiency and management-Environmental Legislation-Air act, Water Act-Wildlife protection act-Environmental protection act.				
Unit - V	<b>HUMAN POPULATION AND THE ENVIRONMENT</b>	Periods	6	
Population growth, Human rights, Value education, environment and Human health, Family welfare Program, Women and Child welfare, Role of information technology in environment – Satellite, Data base, Geographical Information System (GIA), Environmental impact Analysis (EIA) and Human health				
			Total Periods	30
<b>Text books</b>				
1.	Dr.S. Vairam - “Environment Science and Engineering” Gems publication. Edition 2018			
2.	Dr.S.Mageswari, Dr.G.Vijayakumar, Ms.A.Preethi, Environmental Science and Engineering, RK Publications, Revised Edition 2022.			
<b>Reference books</b>				
1.	Linda Williams- “Environmental Science”-Tata McGRAW – Hill Edition. Edition-I-2008			
2.	T.G.Miller Jr-“Environmental Science”-Wadsworth publishing Co. Edition -10-2004			
3.	William P. Cunningham, Barbara Woodworth Saigo- Tata McGraw Hill.Edition-4-2011			
4.	NPTEL Course Notes			
5.	Cunnighum and cooper-“Environmental Science”-Jaico Publ, House Edition-4-2007			
<b>E-Resourses</b>				
1	<a href="https://libraries.ou.edu/">https://libraries.ou.edu/</a>			
2	<a href="https://libguides.reading.ac.uk/">https://libguides.reading.ac.uk/</a>			
3	<a href="https://www.loc.gov/">https://www.loc.gov/</a> , <a href="https://rdl.lib.uconn.edu/">https://rdl.lib.uconn.edu/</a>			




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Programme	<b>B.E</b>	Programme Code	<b>103</b>	Regulation	<b>2023</b>										
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>			Semester	<b>III</b>										
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks									
		L	T	P	C	CA	ESE	Total							
<b>U23MA303</b>	<b>Transforms and Partial Differential Equations</b>	3	1	0	4	40	60	100							
<b>Course Objective</b>	<p>The Main Objective of the course is</p> <ul style="list-style-type: none"> <li>To solve boundary value problems by using Fourier series.</li> <li>To introduce the basic concepts of PDE for solving standard partial differential equations.</li> <li>To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.</li> <li>To acquaint the student with Fourier transform techniques used in wide variety of situations.</li> <li>To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.</li> </ul>														
<b>Course Outcome</b>	At the end of the course, the student should be able to,						Knowledge level								
	<b>CO1:</b> Understand the concepts of Fourier series which plays a vital role in engineering applications.						K4								
	<b>CO2:</b> Understand how to solve the given standard partial differential equations.						K4								
	<b>CO3:</b> Appreciate the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.						K5								
	<b>CO4:</b> Understand the mathematical principles on transforms which will provide them the ability to formulate and solve some of the physical problems of engineering.						K5								
<b>CO5:</b> Use Z transform techniques for analyzing discrete time systems.						K3									
<b>Pre-requisites</b>	-														
<b>CO / PO Mapping</b> (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak													<b>CO/PSO Mapping</b>		
<b>COs</b>	<b>Programme Outcomes (POs)</b>												<b>PSOs</b>		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2		1	1								2		
CO 2	3	2	1	1									2		
CO 3	3	2	1		1								2		
CO 4	3	2	1	1									2		
CO 5	3	2	1	1	1								2		
<b>Course Assessment Methods</b>															
<b>Direct</b>															
1.Continuous Assessment Test I, II & III															
2.Assignment															
3.End-Semester examinations															

  
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<b>Indirect</b>			
1.Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>FOURIER SERIES</b>	Periods	<b>9+3</b>
Dirichlet's conditions – General Fourier series – Change of interval – Odd and even functions – Half range Sine series – Half range Cosine series – Harmonic analysis.			
<b>Unit - II</b>	<b>PARTIAL DIFFERENTIAL EQUATIONS</b>	Periods	<b>9+3</b>
Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solution of Standard types of first order partial differential equations -Lagrange's linear equation – Solution of homogeneous linear partial differential equations of higher order with constant coefficients.			
<b>Unit – III</b>	<b>APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS</b>	Periods	<b>9+3</b>
Classification of second order quasi linear partial differential equations – Solutions of one dimensional wave equation – One dimensional heat equation – Steady state solution of two dimensional heat equation (excluding insulated edges).			
<b>Unit - IV</b>	<b>FOURIER TRANSFORM</b>	Periods	<b>9+3</b>
Fourier Integral theorem (without proof) – Fourier transform pair – Properties (without proof) – Transforms of simple functions – Fourier Sine and Cosine transforms – Properties (without proof) – Convolution theorem and Parseval's identity (Statement and applications only).			
<b>Unit – V</b>	<b>Z –TRANSFORM</b>	Periods	<b>9+3</b>
Definition – Z-transform of some basic functions – Elementary properties – Inverse Z-transform: Partial fraction method –Initial and Final value theorem- Convolution theorem – Applications of Z-transforms: Solution of difference equations.			
<b>Total Periods</b>			<b>45+15=60</b>
<b>Text Books</b>			
1.	Grewal B.S., "Higher Engineering Mathematics", 45 <sup>th</sup> Edition, Khanna Publishers, Delhi, 2024.		
2.	Churchill, R.V. and Brown, J. W., Fourier series and boundary value problems.(8 <sup>th</sup> Edition), McGraw-Hill, 2011.		
<b>References</b>			
1.	Veerarajan T, Engineering Mathematics, McGraw Hill Education, 2013.		
2.	Kreyszig, E., Advanced Engineering Mathematics (10th Edition), John Wiley (2015).		
3.	Ramana.B.V., " Higher Engineering Mathematics" , Tata Mc Graw Hill Publishing Company Limited, New Delhi, 2008.		
4.	P.R.Vittal, " Differential equations Fourier and Laplace Transforms", Margham Publishers, 2nd Edition, 1999.		
5.	Ray Wylie. C and Barrett.C, " Advanced Engineering Mathematics " Tata Mc Graw Hill Education Pvt Ltd, Sixth Edition ,New Delhi 2012.		
<b>E-Resources</b>			
1.	<a href="https://learnengineering.in">https://learnengineering.in</a>		
2.	<a href="http://www.learnerstv.com/Free-engineering-Video-lectures">www.learnerstv.com/Free-engineering-Video-lectures</a>		
3.	<a href="http://www.nptel.ac.in">www.nptel.ac.in</a>		



  
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Programme	B.E.	Programme Code			103	Regulation		2023							
Department	<b>Electronics and Communication Engineering</b>				Semester		III								
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks									
		L	T	P		C	CA	ESE	Total						
U23EC301	<b>Circuit Analysis</b>	3	0	0	3	40	60	100							
<b>Course Objective</b>	The students should made <ul style="list-style-type: none"> <li>To introduce electric circuits and its analysis</li> <li>To Impart knowledge on solving circuits using network theorems</li> <li>To know the phenomenon of resonance and coupled circuits.</li> <li>To study the transient response of circuits for various inputs</li> <li>To learn about two port networks and its parameters.</li> </ul>														
<b>Course Outcome</b>	At the end of the course, the student should be able to,						<b>Knowledge Level</b>								
	<b>CO1:</b> Understand the basic laws & network theorems and its applications to solving networks for DC inputs.						K1								
	<b>CO2:</b> Explain the basic network theorems and its applications to solving networks for AC inputs.						K2								
	<b>CO3:</b> Illustrate the concepts of Transient Circuits.						K2								
	<b>CO4:</b> Observe the concepts of series & parallel resonance and coupled circuits.						K3								
<b>CO5:</b> Classify the two-port networks, parameters and its interconnections.						K2									
<b>Pre-requisites</b>	Basic concepts of physics, particularly about Electricity and Magnetism.														
<b>CO / PO Mapping</b> (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak															
<b>CO/PSO Mapping</b>															
<b>Programme Outcomes (POs)</b>															
<b>COs</b>													<b>PSOs</b>		
	<b>P O 1</b>	<b>P O 2</b>	<b>P O 3</b>	<b>P O 4</b>	<b>P O 5</b>	<b>P O 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>P O 9</b>	<b>P O 10</b>	<b>P O 11</b>	<b>PO 12</b>	<b>PSO1</b>	<b>PS O 2</b>	<b>PSO 3</b>
<b>CO 1</b>	3	2	1									3	3		2
<b>CO 2</b>	3	2	1									3	3		2
<b>CO 3</b>	3		1		1							3	3		3
<b>CO 4</b>	3	2	1									3	3		2
<b>CO 5</b>	3	2	1									3	3		2
<b>Course Assessment Methods</b>															
<b>Direct</b>															
1. Continuous Assessment Test I, II & III															
2. Assignment and Quiz															
3. End-Semester examinations															
<b>Indirect</b>															
1. Course - end Survey															

  
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<b>Content of the Course</b>			
<b>Unit – I</b>	<b>DC Circuits</b>	<b>Periods</b>	<b>9</b>
Fundamentals of DC circuits and basic Kirchoff's Laws- Star-Delta Transformation -Mesh Analysis-Nodal Analysis - Superposition Theorem-Thevenin Theorem, Norton Theorem-Maximum Power Transfer Theorem.			
<b>Unit - II</b>	<b>AC Circuits</b>	<b>Periods</b>	<b>9</b>
Fundamentals of AC circuits -Mesh Analysis-Nodal Analysis – Star-Delta Transformation-Superposition Theorem-Thevenin Theorem, Norton Theorem-Maximum Power Transfer Theorem			
<b>Unit – III</b>	<b>Transient Analysis</b>	<b>Periods</b>	<b>9</b>
DC response of RL, RC and RLC Circuits – Sinusoidal response of RL, RC and RLC circuits-Impulse response of RL, RC and RLC circuits.			
<b>Unit - IV</b>	<b>Resonance and Coupled Circuits</b>	<b>Periods</b>	<b>9</b>
Series Resonance-Impedance, resonant frequency, Quality Factor (Q), Bandwidth, power dissipation and half power frequency. Parallel Resonance-Impedance, resonant frequency, Quality Factor (Q), Bandwidth, power dissipation and half power frequency. Self and Mutual Inductances, Coefficient of coupling.			
<b>Unit – V</b>	<b>Two Port Network</b>	<b>Periods</b>	<b>9</b>
Two-port Network-Open-Circuit Impedance (Z) Parameters-Short-Circuit Admittance (Y) Parameters-Transmission (ABCD) Parameters-Hybrid (H) Parameters, Relationship between two port parameters, interconnections of Two port networks			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	Charles K. Alexander, Matthew N. O. Sadiku, ‘Fundamentals of Electric Circuits’, McGraw-Hill Publications, Reprint 2022.		
2.	Sudhakar A. and Shyammohan S. Palli, “Circuits and Networks Analysis and Synthesis”, 5th Edition, McGraw-Hill Education, New Delhi, 2017.		
<b>References</b>			
1.	Hayt W.H., Kemmerly J.E., Durbin S.M., “Engineering Circuit Analysis”, 9th Edition, Tata McGraw-Hill, New Delhi, 2020.		
2.	Ravish R. Singh, “Network Analysis and Synthesis”, McGraw-Hill Education, New Delhi, 2017.		
<b>E-Resources</b>			
1.	<a href="https://nptel.ac.in/courses/117106108/">https://nptel.ac.in/courses/117106108/</a>		
2.	<a href="http://www.ee.iitm.ac.in/videlectures/doku.php?id=ec1010_2014nk:start">http://www.ee.iitm.ac.in/videlectures/doku.php?id=ec1010_2014nk:start</a>		
3.	<a href="https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-002-circuits-and-electronics-spring-2007/lecture-notes">https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-002-circuits-and-electronics-spring-2007/lecture-notes</a>		

  
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		L	T	P	C	CA	ESE	Total																																																																																																																																														
U23EC302	Signals and Systems	3	0	0	3	40	60	100																																																																																																																																														
Course Objective	The main objective of the course is to , <ul style="list-style-type: none"> <li>• Introduce the classifications of continuous time and discrete time signals and systems</li> <li>• Study continuous-time signals frequency domain characteristics.</li> <li>• Comprehend continuous-time system analysis and implementation.</li> <li>• Learn sampling process and discrete-time signals frequency domain characteristics.</li> <li>• Know discrete -time system analysis and implementation.</li> </ul>																																																																																																																																																					
	Course Outcome	At the end of the course, the student should be able to,							Knowledge Level																																																																																																																																													
CO1: Classify the signal as continuous/discrete, periodic/apperiodic, energy/power and system as linear/nonlinear.							K2																																																																																																																																															
CO2: Observe continuous-time signals using Fourier and Laplace Transform.							K3																																																																																																																																															
CO3: Implement continuous-time systems and analyze using Fourier and Laplace Transform							K3																																																																																																																																															
CO4: Examine discrete-time signals using DTFT and Z Transform.							K3																																																																																																																																															
CO5: Implement discrete-time systems and analyze using DTFT and Z Transform							K3																																																																																																																																															
Pre-requisites	-																																																																																																																																																					
<table border="1"> <thead> <tr> <th colspan="13">CO / PO Mapping</th> <th colspan="3">CO/PSO Mapping</th> </tr> <tr> <th rowspan="3">COs</th> <th colspan="12">(3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak</th> <th colspan="3" rowspan="2">PSOs</th> </tr> <tr> <th colspan="12">Programme Outcomes (POs)</th> </tr> <tr> <th>PO 1</th> <th>PO 2</th> <th>PO 3</th> <th>PO 4</th> <th>PO 5</th> <th>PO 6</th> <th>PO 7</th> <th>PO 8</th> <th>PO 9</th> <th>PO 10</th> <th>PO 11</th> <th>PO 12</th> <th>PSO 1</th> <th>PSO 2</th> <th>PSO 3</th> </tr> </thead> <tbody> <tr> <td>3</td> <td>CO 1</td> <td>3</td> <td>3</td> <td>2</td> <td>1</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>1</td> <td>3</td> <td>3</td> </tr> <tr> <td>3</td> <td>CO 2</td> <td>3</td> <td>3</td> <td>2</td> <td>1</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>1</td> <td>3</td> <td>3</td> </tr> <tr> <td>3</td> <td>CO 3</td> <td>3</td> <td>3</td> <td>2</td> <td>1</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>1</td> <td>3</td> <td>3</td> </tr> <tr> <td>3</td> <td>CO 4</td> <td>3</td> <td>3</td> <td>2</td> <td>1</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>1</td> <td>3</td> <td>3</td> </tr> <tr> <td>3</td> <td>CO 5</td> <td>3</td> <td>3</td> <td>2</td> <td>1</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>1</td> <td>3</td> <td>3</td> </tr> </tbody> </table>												CO / PO Mapping													CO/PSO Mapping			COs	(3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak												PSOs			Programme Outcomes (POs)												PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	3	CO 1	3	3	2	1								1	3	3	3	CO 2	3	3	2	1								1	3	3	3	CO 3	3	3	2	1								1	3	3	3	CO 4	3	3	2	1								1	3	3	3	CO 5	3	3	2	1								1	3	3
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<b>Course Assessment Methods</b>			
<b>Direct</b>			
1. Continuous Assessment Test I, II & III			
2. Assignment: Simulation using tool			
3. End-Semester examinations			
<b>Indirect</b>			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>CLASSIFICATION OF SIGNALS AND SYSTEMS</b>	Periods	<b>9</b>
Continuous Time Signals(CT Signals) -Discrete Time Signals(DT Signals) – Unit (Step ,Ramp, impulse), Exponential, Sine, Cosine signal- Classifications of CT and DT Signals- Classifications of CT Systems and DT Systems -Basic System Properties.			
<b>Unit - II</b>	<b>ANALYSIS OF CONTINUOUS TIME SIGNALS</b>	Periods	<b>9</b>
Fourier Series Analysis – Spectrum of Continuous Time Signals - Fourier Transform and Properties - Laplace Transform and Properties.			
<b>Unit – III</b>	<b>LINEAR TIME INVARIANT -CONTINUOUS TIME SYSTEMS</b>	Periods	<b>9</b>
CT system Characterized by Differential Equation - Block diagram representation -Impulse Response - Convolution integral - Frequency Response - Analysis of LTI-CT system using Fourier and Laplace Transforms.			
<b>Unit - IV</b>	<b>ANALYSIS OF DISCRETE TIME SIGNALS</b>	Periods	<b>9</b>
Sampling of CT Signals and Aliasing - DTFT and Properties - Z-Transform and Properties.			
<b>Unit – V</b>	<b>LINEAR TIME INVARIANT – DISCRETE TIME SYSTEMS</b>	Periods	<b>9</b>
DT system Characterized by Difference Equations - Block Diagram Representation - Impulse Response - Convolution Sum - Analysis of LTI-DT Systems using DTFT and Z-Transforms .			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	Allan V.Oppenheim, S.Wilsky and S.H.Nawab, Signals and Systems, Pearson Education, 2012.		
2.	Simon Haykins and Barry Van Veen, Signals and Systems John Wiley & sons, Inc, 2004.		
<b>References</b>			
1.	Robert A. Gabel and Richard A.Roberts, “Signals & Linear Systems”, John Wiley, 3rd Edition, 2009.		
2.	Rodger E. Ziemer, William H. Tranter, D. Ronald Fannin. “Signals & systems”, 4th Edition, PearsonEducation, 2002.		
3.	Edward W Kamen & Bonnie“s Heck, “Fundamentals of Signals and Systems”, Pearson Education, 2007.		
4.	B. P. Lathi, "Principles of Linear Systems and Signals", Oxford, 2nd Edition, 2009.		
<b>E-Resources</b>			
1.	<a href="https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/lecture-notes/">https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/lecture-notes/</a>		
2.	<a href="https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/assignments/">https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/assignments/</a>		

  
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Programme	B.E	Programme Code					Regulation	2023							
Department	<b>Electronics and Communication Engineering</b>					Semester		III							
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks									
		L	T	P	C	CA	ESE	Total							
U23IT302	Data Structures	3	0	0	3	40	60	100							
Course Objective	The main objective of this course is to: <ul style="list-style-type: none"> <li>• Understand the significance of Data structures and List ADT's.</li> <li>• Learn the concepts and applications of Stacks, Queues</li> <li>• Understand the Tree ADT and types of balancing the tree</li> <li>• Learn the fundamentals of Graph ADT, various Traversal algorithms, Types and finding the Minimum spanning Tree</li> <li>• Learn the different types of Sorting and Searching Techniques and Hashing</li> </ul>														
Course Outcome	At the end of the course, the student should be able to,							Knowledge level							
	CO1: Implement List ADT and its types.							K1							
	CO2: Implement Stack ADT, Queue ADT, Priority Queue and Parsing the Arithmetic Expression in C							K2							
	CO3: Implement Tree ADT, Binary search tree, AVL and Splay tree in C							K3							
	CO4: Develop C Programs to Implement the concept of Topological ordering and Minimum spanning Tree of a Graph ADT							K4							
	CO5: Implement various sorting and searching algorithms in C							K4							
Pre-requisites	-														
CO / PO Mapping															
(3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak															
COs	Programme Outcomes (POs)											CO/PSO Mapping			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	3	3	3	2	1				2	2	3	3	
CO 2	3	3	3	3	3	2	1				2	2	3	3	
CO 3	3	3	3	3	3	2	1				2	2	3	3	
CO 4	3	3	3	3	3	2	1				2	2	3	3	
CO 5	3	3	3	3	3	2	1				2	2	3	3	
Course Assessment Methods															
Direct															
1. Continuous Assessment Test I, II & III 2. Assignment / Quiz / Seminar 3. End-Semester examinations															
Indirect															
1. Course - end survey															
Content of the syllabus															
Unit – I	INTRODUCTION										Periods	9			


  
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Abstract Data Types (ADTs) – List ADT – Array-based implementation – Linked list implementation – Singly linked lists – Doubly-linked lists - Circularly linked lists – Applications of lists – Polynomial ADT			
<b>Unit - II</b>	<b>STACKS, QUEUES AND DEQUEUES</b>	Periods	<b>9</b>
Stack ADT – Array based implementation – List based implementation – Balancing Symbols – Evaluating arithmetic expressions - Infix to Postfix conversion – Queue ADT – Array based implementation – List based implementation – Circular Queue ADT – Priority Queue- Double Ended Queue.			
<b>Unit – III</b>	<b>TREES</b>	Periods	<b>9</b>
Tree ADT – Binary Trees – Binary Search Tree - Tree- Traversal Algorithms - Search Trees : AVL Tree – Splay Tree- Balancing Tree- B+.			
<b>Unit - IV</b>	<b>GRAPHS</b>	Periods	<b>9</b>
Graph ADT – Types of Graphs – Graph Traversals – Topological Ordering – Dijkstra’s Algorithm – Minimum Spanning Tree – Prims Algorithm – Kruskal’s Algorithm.			
<b>Unit – V</b>	<b>SORTING, SEARCHING AND HASHING</b>	Periods	<b>9</b>
Types of Sorting - Bubble Sort – Selection Sort – Insertion Sort – Shell Sort – Quick Sort – Radix Sort – Merge Sort- Linear Search – Binary Search- Heap Search -. Hashing – Open Addressing – Separate Chaining – Hash Functions.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books:</b>			
1.	Reema Thareja ,” Data structure using c “,Oxford University Press , Second Edition ,2023.		
2.	Mark Allen Weiss, “Data Structures and Algorithm Analysis in C”, Pearson India , Second Edition ,2002.		
<b>REFERENCE BOOKS:</b>			
1.	Charles E. Leiserson, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein ,”Introduction to Algorithms “, Fourth Edition , MIT Press , 2022.		
2.	Narasimha Karumanchi - Data structures and algorithms made easy, 1 <sup>st</sup> Edition ,2016.		
3.	R. Venkatesan and S. Lovelyn Rose,”Data Structures “,2nd Edition, Wiley Publications,2019.		
4.	Robert Sedgewick and Kevin Wayne, “Algorithms”,4 <sup>th</sup> Edition, Addison-Wesley, 2011.		
5.	Peter Brass, “Advanced Data Structures”, 1 <sup>st</sup> Edition, Cambridge,2008.		
<b>E-Resources:</b>			
1.	<a href="https://www.javatpoint.com/data-structure-tutorial">https://www.javatpoint.com/data-structure-tutorial</a>		
2.	<a href="https://www.geeksforgeeks.org/data-structures">https://www.geeksforgeeks.org/data-structures</a>		
3.	<a href="https://www.udemy.com/course/data-structures-and-algorithms-deep-dive-using-java">https://www.udemy.com/course/data-structures-and-algorithms-deep-dive-using-java</a>		
4.	<a href="https://dl.ebooksworld.ir/books/Introduction.to.Algorithms.4th.Leiserson.Stein.Rivest.Cormen.MIT.Press.9780262046305.EBooksWorld.ir.pdf">https://dl.ebooksworld.ir/books/Introduction.to.Algorithms.4th.Leiserson.Stein.Rivest.Cormen.MIT.Press.9780262046305.EBooksWorld.ir.pdf</a>		




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Programme	<b>B.E.</b>		Programme code	<b>103</b>		Regulation	<b>2023</b>								
Department	<b>Electronics and Communication Engineering</b>					Semester			<b>III</b>						
Course Code	Course Name					Periods per week			Credit	Maximum Marks					
	L	T	P	C	CA	ESE	Total								
<b>U23CTCP1</b>	<b>Verbal, Quantitative Aptitude and Reasoning - I</b>					2	0	0	1	40	60	100			
<b>Course Objective</b>	The student should be made to, <ul style="list-style-type: none"> <li>Identify and begin to apply the language features</li> <li>Understand the mathematical techniques for solving the real life problems</li> <li>Use number theory arguments to justify relationships involving divisors, multiples and factoring</li> <li>Help in preparation of competitive exams</li> </ul>														
<b>Course Outcome</b>	At the end of the course, the student should be able to,										<b>Knowledge Level</b>				
	CO1: Use language through acquisition of grammar rules										K2				
	CO2: Demonstrate the use of mathematical reasoning by justifying the patterns and relationships										K2				
	CO3: Face external competitive exams										K3				
	CO4: Solve a question in a fraction of minute using shortcut methods										K3				
CO5: Enhance their problem solving skills and logical Skills										K4					
<b>Pre-Requisites</b>	-														
<b>CO / PO Mapping</b> (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 – Weak												<b>CO/PSO Mapping</b>			
<b>COs</b>	<b>Programme Outcomes (POs)</b>												<b>PSOs</b>		
	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
<b>CO 1</b>		2		3	2					3		3	1	1	3
<b>CO 2</b>	3	3		2	2					3		3	3	3	3
<b>CO 3</b>	3	3		3	2					3		3	2	2	2
<b>CO 4</b>	3	3		2	3					2		2	3	2	3
<b>CO 5</b>		2		2	2					2		2	3	3	3
<b>Course Assessment Methods</b>															
<b>Direct</b>															
1. Continuous Assessment Test I, II & III															
2. Assignment/Quiz															
3. End-Semester Examination															
<b>Indirect</b>															
1. Course -end survey															
<b>Content of the syllabus</b>															

  
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Unit -I	VERBAL ABILITY ( ERROR SPOTTING )	Periods	5
<p><b>CONJUNCTIONS: Error on coordinative conjunction:</b> The seven coordinating conjunctions are (<b>fan boys</b>): <b>for, and, nor, but, or, yet, so, Errors on Subordinate Conjunction</b> After, although, as soon as, because, before, by the time, in case, now that, since, unless, when, whether or not, while, yet...., <b>Errors on correlative conjunction</b> (Either.....or, neither.....nor, not only.... but also, as....as, both....and, whether.... or, so...as, such...that, the)</p> <p><b>CONDITIONAL CLAUSES:</b> Errors on Zero condition, Errors on first condition of If clauses, Errors on second condition of If clauses, Errors on three condition of If clauses</p> <p><b>ADVERBS:</b> Errors on conjunctive adverb, Errors on adverbs of frequency, Errors on adverbs of time, Errors on adverbs of manner, Errors on adverbs of place, Errors on adverbs of degree</p> <p><b>ADJECTIVES:</b> Errors on descriptive adjectives, Errors on demonstration adjectives, Errors on distributive adjectives, Errors on interrogative adjectives, Errors on numeral, Errors on quantitative adjectives, Errors on proper adjectives, Errors on possessive adjectives</p> <p><b>DETERMINERS:</b> Definite Article, Indefinite Article, Quantifying Article – few, many, Possessive Article, (my, your, his, her, its, our, your, their....)</p> <p><b>NOUNS:</b> Pronoun, Common Noun, Collective Noun, Abstract Noun, Material Noun</p> <p><b>SUBJECT – VERB AGREEMENT:</b></p> <p>Singular Subjects and Singular Verbs, Errors on plural subjects with plural verbs, Errors on indefinite pronouns, Errors on compound subjects, Errors on collective noun, Errors on singular or plural verb</p>			
Unit–II	NUMBER SYSTEMS	Periods	6
<p><b>NUMBER SYSTEMS</b> (Divisibility Rule, Unit Digit, Remainder Theorem( 1 Or -1, Cancellation, Wilson, Fermets), Progressions( Arithmetic, Geometric, Harmonic), Log, Surds And Indices, Simplification)</p>			
Unit – III	AVERAGE AND LCM & HCF PROBLEMS	Periods	8
<p><b>AVERAGE</b> (Basic Model, Partial Average, 3. Overall Average, Inclusion/Exclusion of A Value in a Group, Increased or Included or Added or More and Replaced, Substituted, Cricket Based Model, Misread Model, Allegation and Mixture, Mean, Median and Mode, Miscellaneous)</p> <p><b>LCM and HCF</b> (Find The LCM, HCF and Its fractions, Product of Two Numbers Model, LCM, HCF with Remainders Model, Smallest/Largest Based Model, Tolling Together Model, HCF Related Questions (Keyword: Distinct, Divided, Equal Number of Rows (Distributed Equally)), Mensuration Related Questions, No. of Pairs Model, LCM, HCF With Ratios Model, Algebraic Expressions Model, Reduce To Lowest Terms</p>			
Unit– IV	RATIO AND PROPORTION	Periods	5
<p><b>RATIO</b> ( Zig Zag Model, Finding The Individual Component, Coins &amp; Values Based Ratios, Number Based Ratios, Increment/Decrement Based Ratios, Miscellaneous)- <b>PROPORTION</b> ( Continuous, Third, Fourth, Mean)</p>			

  
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Unit-V	LOGICAL REASONING	Periods	6
<b>CODING-DECODING-</b> Types of Coding and Decoding (Letter Coding, Conditional Coding, Crypt arithmetic –Addition, Crypt arithmetic – Subtraction)			
<b>BLOOD RELATION</b> (Type 1: Pointing or Introducing, Type 2: Family Tree or Relational Puzzle, Type 3: Coded Relation)			
<b>NUMBER SERIES</b> (Pattern 1: Perfect Square Series, Pattern 2: Perfect Cube Series, Pattern 3: Geometric Series, Pattern 4: Ratio series, Pattern 5: Multi Stage Series)			
<b>SYLLOGISM</b> (Type 1: BASIC SYLLOGISM, Type 2: Either or Neither nor, Type 3: Only – Only a few)			
<b>Total Periods</b>			<b>30</b>
<b>Text books</b>			
1.	Rajeev Varma, “Fast Track Objective Arithmetics”, Arihant Publications, 2024		
2.	R.S. Aggarwal, “Modern Approach to Logical Reasoning”, S Chand Publishing, 2022		
3.	SP Bakshi, “Objective General English”, Arihant Publications, 2024		
<b>References</b>			
1.	R.S. Aggarwal, “Quantitative Aptitude for Competitive Examinations”, S Chand Publishing, 2013		
2.	Dinesh Khattar, “The Pearson guide to Quantitative Aptitude for Competitive Examinations”, 3 <sup>rd</sup> edition, 2016		
3.	Arun Sharma, “How to Prepare for Logical reasoning for CAT”, McGraw Hill Education; 2014		
4.	Jaikishan and Premkishan, “How to Crack Test of Reasoning”, Arihant Publications, 2016		
5.	R.S. Agarwal, “A modern Approach to verbal and non-verbal reasoning”, S Chand Publishing, 2018		
<b>E-Resources</b>			
1.	Aptitude: <a href="https://www.indiabix.com">https://www.indiabix.com</a>		
2.	Reasoning: <a href="https://placement.freshersworld.com">https://placement.freshersworld.com</a>		
3.	Verbal: <a href="https://testbook.com">https://testbook.com</a>		



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Programme	<b>B.E.</b>	Programme code	<b>103</b>	Regulation	<b>2023</b>										
Department	<b>Electronics and Communication Engineering</b>			Semester	<b>III</b>										
Course code	Course Name	Periods /Week			Credit	Maximum Marks									
		L	T	P	C	CA	ESE	Total							
<b>U23EC303</b>	<b>Digital Logic Circuit Design</b>	3	0	1	4	50	50	100							
<b>Course Objective</b>	The student should be made to,														
	<ul style="list-style-type: none"> <li>Learn about basic postulates of Boolean algebra and simplification of Boolean expressions to deduce optimal digital Circuits.</li> <li>Gain the knowledge of Karnaugh Map Minimization procedures for the analysis and design of combinational circuits and sequential circuits</li> <li>Implement the functions and extremity of Sequential Circuits in digital design.</li> <li>Inculcate the concept of memories and programmable logic devices and</li> <li>Learn the concepts of modeling using VERILOG</li> </ul>														
<b>Course Outcome</b>	At the end of the course, the student should be able to,							Knowledge Level							
	<b>CO1:</b> Simplify the Boolean functions and Boolean expression for logic minimization							K4							
	<b>CO2:</b> Construct the combinational circuits using Logic Gates							K3							
	<b>CO3:</b> Construct the synchronous sequential circuits using Flip Flops							K3							
	<b>CO4:</b> Analyze the characteristics and structure of different memory systems and Programmable Logic Devices							K4							
	<b>CO5:</b> Analyze the combinational circuits with different levels of modeling using HDL							K4							
<b>Pre-requisites</b>	-														
CO/PO Mapping												CO/PSO Mapping			
COs	Program Outcomes (POs)											PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2								1	2	3	2	
CO2	3	2	2	2					2			2	3	2	
CO3	3	2	2		2							2	3	2	
CO4	3	2	2	3					3			2	3	2	
CO5	3	2	2									2	3	2	
<b>Course Assessment Methods</b>															
<b>Direct</b>															
1. Continuous Assessment Test I, II & III 2. Assignment: Case Studies, Real Time Applications 3. End-Semester examinations															

*[Signature]*

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<b>Indirect</b>			
1.Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>NUMBER SYSTEM &amp; MINIMIZATION TECHNIQUES</b>	Periods	<b>9</b>
Number Systems and Conversion –Complements-Signed Binary Numbers – Logic Gates- NAND-NOR Implementation- Implementation of Logic Function Using Gates & Universal Gates - Boolean Postulates and Laws – De-Morgan’s Theorem – Principle of Duality – Boolean Expression – Minimization of Boolean Expression - Sum of Products(SOP) – Product of sums(POS) – Karnaugh Map Minimization – Don’t Care Conditions – Quine McClusky Method of Minimization			
<b>Unit – II</b>	<b>DESIGN OF COMBINATIONAL CIRCUITS</b>	Periods	<b>9</b>
Design Procedure –Design of Adder, Subtractor, Parallel binary adder and subtractor – Carry look ahead adder-BCD adder- Multiplexer /Demultiplexer-Decoder, Encoder- Parity Checker, Parity Generators-Code Converters, Magnitude Comparator.			
<b>Unit – III</b>	<b>SYNCHRONOUS SEQUENTIAL CIRCUITS</b>	Periods	<b>9</b>
Sequential Logic Elements-Latches, Flip-Flops- Realization of One Flip-flop to other. Registers: Shift Registers, Universal Shift Register- Counters: Up-Counter, Down-Counter, Up-down Counter, Ripple and Ring Counter- State Diagram -State Table – State Minimization - State Assignment – Excitation Table and Maps – Design and Analysis of Synchronous Sequential Circuits			
<b>Unit – IV</b>	<b>ASYNCHRONOUS SEQUENTIAL CIRCUITS &amp; PROGRAMMABLE LOGIC DEVICES</b>	Periods	<b>9</b>
Introduction to asynchronous circuits -Cycles – Races –Hazards: Static Dynamic, Essential, Hazards elimination – Design of Hazard Free Switching Circuits. Classification of Memories – ROM – ROM Organization-Types – RAM Organization – Write Operation –Read Operation-Types- Programmable Logic Devices – Programmable Logic Array(PLA) – Programmable Array Logic (PAL) – Implementation of Combinational Logic Circuits Using PROM, PLA, PAL.			
<b>Unit – V</b>	<b>HARDWARE DESCRIPTION LANGUAGE</b>	Periods	<b>9</b>
Verilog Basics –Operators- Overview of Verilog HDL-Modules and ports-Gate level modeling- Data flow Modeling-Behavioral level Modeling-Design of combinational circuits (Adder, Subtractor, Multiplexer /Demultiplexer-Decoder, Encoder) and sequential circuits (Flip-flop, Registers, Ripple Counter)using Verilog HDL.			
Total Periods			<b>45</b>
<b>TEXT BOOKS:</b>			
1.	M.MorrisMano, Digital Design, 5th Edition, Prentice Hall of India Pvt.Ltd.,2003/ PearsonEducation (Singapore) Pvt.Ltd., NewDelhi, 2018.		
2.	Palnitkar Samir, "Verilog HDL: Guide to Digital Design and Synthesis", 2nd Edition, Pearson Education, New Delhi, 2017 for Unit III		
3.	JohnF.Wakerly, Digital Design,Fourth Edition,Pearson /PHI,2016		
<b>REFERENCES:</b>			
1	Salivahanan S. & Arivazhagan S., "Digital Circuits and Design", 5th Edition, Oxford University Press, New Delhi, 2018.		
2	Floyd T L, "Digital Fundamentals", 11th Edition, Pearson Education, New Delhi, 2015.		
3	Charles H.Roth. Fundamentals of Logic Design, Thomson Learning, 2004.		

  
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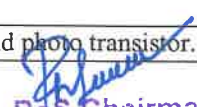
<b>WEB REFERENCES:</b>	
1	<a href="https://nptel.ac.in/courses/117106086/">https://nptel.ac.in/courses/117106086/</a>
2	<a href="https://nptel.ac.in/content/syllabus_pdf/108105113.pdf">https://nptel.ac.in/content/syllabus_pdf/108105113.pdf</a>

**Total Period:15**

<b>LIST OF EXPERIMENTS / EXERCISES:</b>	
1	Design and Verification of digital logic gates
2	Design of Combinational Circuits (Adder, Subtractor).
3	Design of Code Converters (Gray to Binary & Binary to Gray).
4	Design of Multiplexer and De-multiplexer.
5	Design of Encoder and Decoder using logic gates.
6	Design and implementation of flip flops using basic gates.
7	Design of Synchronous and ripple counter using logic gates.
8	Design of adders, Encoders & Decoders, MUX/DEMUX using MODELSIM
9	Design of Registers using MODELSIM
<b>REFERENCES/ MANUAL /SOFTWARE:</b>	
1. Laboratory Manual	
2. Modelsim	


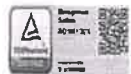
  
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Course code	Course Name	Periods/Week			Credit	Maximum Marks										
		L	T	P	C	CA	ESE	Total								
U23EC304	Devices and Circuits Laboratory	0	0	2	1	60	40	100								
<b>Course Objective</b>	The student should be made															
	<ul style="list-style-type: none"> <li>To know the characteristics Diode</li> <li>To learn the characteristics of Transistors.</li> <li>To construct characteristics of power electronic devices</li> <li>To understand Kirchoff's laws and Network Theorems</li> <li>To simulate various electronic circuits using P-SPICE software</li> </ul>															
<b>Course Outcome</b>	At the end of the course, the students should be able to,							Knowledge Level								
	CO1: Demonstrate V-I characteristics of PN junction diode , Zener diode							K2								
	CO2: Explain the characteristics of BJT and FET							K3								
	CO3: Analyze the characteristics of power electronic devices							K4								
	CO4: Illustrate kirchoff's law and network theorems.							K2								
<b>Pre-requisites</b>	Engineering Practices Lab															
CO/PO Mapping												CO/PSO Mapping				
COs		Program Outcomes (POs)											PSOs			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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	
<b>Course Assessment Methods</b>																
<b>Direct</b>																
1.Prelab and Postlab																
2.Assignment																
3.End-Semester Examinations																
<b>Indirect</b>																
1. Course-end survey																
<b>List of Experiments</b>															<b>Course Outcome</b>	
1.	Characteristics of PN Junction Diode and Zener Diode.														CO1	
2.	Input and Output Characteristics of BJT -Common Emitter configuration														CO2	
3.	FET Characteristics														CO2	
4.	Characteristics of photodiode and photo transistor.														CO3	

  
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5.	Characteristics of UJT.	CO3
6.	Experimental verification of Kirchhoff's voltage and current laws.	CO4
7.	Experimental verification of Thevenin's and Norton theorem.	CO4
8.	Experimental verification of Superposition Theorem.	CO4
9.	Frequency Response of CE and CC amplifier using Pspice	CO5
10.	Pspice simulation of MOSFET amplifiers	CO5
<b>Total Periods</b>		<b>45</b>
<b>REFERENCES/ MANUAL /SOFTWARE:</b>		
1. Laboratory Manual		
2. Pspice		



  
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Programme	B.E.	Programme Code			103	Regulation	2023								
Department	<b>Electronics and Communication Engineering</b>				Semester		III								
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks									
		L	T	P	C	CA	ESE	Total							
U23IT303	<b>Data Structures Laboratory</b>	0	0	2	1	60	40	100							
Course Objective	The main objective of the course is to <ul style="list-style-type: none"> <li>Familiarize the operations on Linear Data Structures and Nonlinear Data Structures</li> <li>Understand the concepts of various Searching and Sorting Techniques</li> <li>Understand the basic operations on Search Trees</li> <li>Known to the basics of various graph Traversal methods.</li> </ul>														
Course Outcome	At the end of the course, the student should be able to,							KL							
	CO1: Implement List based and Array based Linear and Nonlinear Data Structures							K3							
	CO2: Implement Stack ADT, Queue ADT, and Parsing the Arithmetic Expression in C							K3							
	CO3: Suggest appropriate Search Tree for solving a given problem							K4							
	CO4: Appropriately use the various graph Traversal for a given problem							K4							
Pre-requisites	-														
CO / PO Mapping													CO/PSO Mapping		
(3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak															
COs	Programme Outcomes (POs)												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	1	1	2			1	1	1	1	1	1	1	
CO 2	3	2	1	1	2			1	1	1	1	1	1	1	
CO 3	3	2	1	1	2			1	1	1	1	1	1	1	
CO 4	3	2	1	1	2			1	1	1	1	1	1	1	
CO 5	3	2	1	1	2			1	1	1	1	1	1	1	
Course Assessment Methods															
Direct															
1. Prelab and Post Lab / Viva Questions 2. Record 3. End-Semester Examination															
Indirect															
1. Course - end survey															
Suggested List of Experiments														CO's	

  
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1. Consider a scenario where a firm wants to maintain the data of its employees. The data containing employee number, name, and salary and department are saved in a singly linked list. Create following functions for the employee list. i. Insert at Front: Insertion of a record at the front. ii. Insert at End: Insertion of a record at the end. iii. Delete First: Deletion of first record. iv. Delete Last: Deletion of last record. v. Search: Searching any record based on employee number and dept no. vi. Display: Displaying all records.	CO1
2. Write a C program to add two polynomials using Linked List.	CO1
3. Write a C program to implement different operations on Stack and Queue using Arrays.	CO2
4. Write a C program that implements push(), pop(), display(), isEmpty() and peek() functions of Stack using Linked List.	CO2
5. Write a C program that implements enqueue(), dequeue(), size(), isEmpty() and display() functions of Queue using Linked List.	CO2
6. Write a C program to convert an Infix expression : $a + b * c + (d * e + f) * g$ into the Postfix expression.	CO2
7. Write a C program to perform the following BST Operations - Creating node, insertion, in-order traversal and pre-order traversal.	CO3
8. Write a C program which results the implementation of Insertion, Deletion and Search operations in AVL Tree.	CO3
9. Write a C program to perform Depth First Search and Breadth First Search traversal on a graph.	CO4
10. Write a C program for constructing a minimum cost spanning tree of a graph using Prim's Algorithm.	CO4
11. Write a C program to Search an element using Linear Search process and Sort given elements using Insertion sort.	CO5
12. Write a C program to implement Linear Probing and Separate Chaining Collision resolution technique.	CO5
<b>Total Periods</b>	<b>45</b>
<b>E-Resources:</b>	
1.	<a href="https://www.programiz.com/c-programming">https://www.programiz.com/c-programming</a>
2.	<a href="https://www.cprogramming.com/">https://www.cprogramming.com/</a>
3.	<a href="https://beginnersbook.com/2015/02/simple-c-programs/">https://beginnersbook.com/2015/02/simple-c-programs/</a>
<b>Tools / Software Required:</b>	
1.	Codetandra / HackerRank / HackerEarth / Any online Problem Solving Platforms

  
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Programme	B.E.			Programme code	103		Regulation	2023							
Department	Electronics and Communication Engineering						Semester		III						
Course code	Course name				Periods per week			Credit	Maximum Marks						
					L	T	P	C	CA	ESE	Total				
U23CTCP2	Personality Development				1	0	2	1	60	40	100				
Course Objective	The student should be made to, <ul style="list-style-type: none"> <li>Equip comprehensive understanding of various psychological and cognitive assessment tools</li> <li>Analyze, interpret, and apply these tools to improve personal and professional development</li> <li>Enhance communication</li> <li>Manage stress effectively</li> </ul>														
	Course Outcome	At the end of the course, the student should be able to,									Knowledge Level				
CO1: Enhance Self-Awareness									K2						
CO2: Improve Communication Skills									K1						
CO3: Acquire Better Academic and Life Satisfaction									K2						
CO4: Enhance Problem-Solving Abilities									K3						
CO5: Effective Stress Management									K3						
Pre-requisites	-														
CO / PO Mapping												CO/PSO Mapping			
(3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 – Weak															
COs	Programme Outcomes (POs)												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO 2	PSO3
CO 1					2				2	2		2	1	1	2
CO 2					2				2	2		2	3	3	3
CO 3					2				1	2		2	3	3	3
CO 4					2				2	1		2	3	3	3
CO 5					2				2	1		2	2	2	3
<b>Course Assessment Methods</b> <b>Direct</b> 1. Self-Assessment 2. Viva-Voce 3. End-Semester Examination <b>Indirect</b> 1. Course-end survey															
<b>Content of the Syllabus</b>															
	S. No.	List of Experiments										CO			
	1.	Rosenberg's and Hare's Self Esteem tool										CO1			
	2.	Myers Brigg's 16 types of Personality										CO1			
	3.	Social Functioning scale										CO3			
	4.	Huebner, Laughlin, Ash, & Gilman's Multidimensional Students Life Satisfaction Scale										CO3			

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5.	Body language Assessment	CO2
6.	Fleming's VARK Learning Theory, bloom's taxonomy based on learners' queries	CO2
7.	Alexi's Presentation Secrets Assessment	CO2
8.	Deductive and inductive logical reasoning assessment	CO4
9.	Procter and Gamble Assessment Gamified Tests	CO4
10.	Psychometric Test	CO3
11.	Stress buster Assessment	CO5

**Total Periods : 30**

**References**



1. Allan Pease, "Body language – how to read other's thoughts by their gestures", Sheldon press, London publication, Tenth Impression 1988
2. Alexei Kapterev, "Presentation Secrets", John Wiley and Sons, 2024


**E-Resources**

1. <https://scales.arabpsychology.com>
2. <https://DOMWebserver.Hitchcock.org/mbti/>
3. <https://www.assessmentday.com/free/deductive-reasoning-1/DeductiveFreeTest-Solutions.pdf>
4. [www.prepinsta.com](http://www.prepinsta.com)





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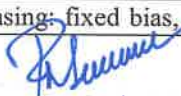
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		L	T	P	C	CA	ESE	Total																																																																																																																																	
<b>U23EC401</b>	<b>Electromagnetics and Transmission Lines</b>	3	0	0	3	40	60	100																																																																																																																																	
<b>Course Objective</b>	The main objective of this course is <ul style="list-style-type: none"> <li>To understand the basic concepts of Static electric fields</li> <li>To study the steady magnetic fields concepts and Maxwell's equations</li> <li>To apply Maxwell's equations to describe the Propagation of EM waves.</li> <li>To learn about the two conductors transmission lines in general.</li> <li>To describe the RF transmission lines using general transmission line concepts.</li> </ul>																																																																																																																																								
<b>Course Outcome</b>	At the end of the course, the student will be able to,						Knowledge Level																																																																																																																																		
	<b>CO1:</b> Describe the concepts of Electrostatics, basic laws and theorems.						K2																																																																																																																																		
	<b>CO2:</b> Explain the concepts of Steady magnetic fields, basic laws and theorems to derive Maxwell's equations.						K2																																																																																																																																		
	<b>CO3:</b> Analyze the Maxwell's equations and apply for the study of Electromagnetic wave propagation in different mediums.						K4																																																																																																																																		
	<b>CO4:</b> Apply the general transmission line theory of two conductor transmission lines and matching networks						K3																																																																																																																																		
	<b>CO5:</b> Analyze and design the RF transmission lines and able to use Smith chart and for transmission line applications.						K4																																																																																																																																		
<b>Pre-requisites</b>	Vector algebra, Differential and Integral calculus																																																																																																																																								
<table border="1"> <thead> <tr> <th colspan="12">CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak</th> <th colspan="3">CO/PSO Mapping</th> </tr> <tr> <th rowspan="2">COs</th> <th colspan="11">Programme Outcomes (POs)</th> <th colspan="3">PSOs</th> </tr> <tr> <th>PO 1</th> <th>PO 2</th> <th>PO 3</th> <th>PO 4</th> <th>PO 5</th> <th>PO 6</th> <th>PO 7</th> <th>PO 8</th> <th>PO 9</th> <th>PO 10</th> <th>PO 11</th> <th>PO 12</th> <th>PS O1</th> <th>PSO 2</th> <th>PS O 3</th> </tr> </thead> <tbody> <tr> <td>CO 1</td> <td>3</td> <td>3</td> <td>3</td> <td>3</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>3</td> <td>1</td> <td>2</td> </tr> <tr> <td>CO 2</td> <td>3</td> <td>3</td> <td>2</td> <td>3</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>3</td> <td>1</td> <td>2</td> </tr> <tr> <td>CO 3</td> <td>3</td> <td>3</td> <td>2</td> <td>3</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>3</td> <td>1</td> <td>2</td> </tr> <tr> <td>CO 4</td> <td>3</td> <td>2</td> <td>2</td> <td>2</td> <td>2</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>3</td> <td>1</td> <td>2</td> </tr> <tr> <td>CO 5</td> <td>3</td> <td>2</td> <td>1</td> <td>2</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>3</td> <td>1</td> <td>2</td> </tr> </tbody> </table>													CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak												CO/PSO Mapping			COs	Programme Outcomes (POs)											PSOs			PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PSO 2	PS O 3	CO 1	3	3	3	3									3	1	2	CO 2	3	3	2	3									3	1	2	CO 3	3	3	2	3									3	1	2	CO 4	3	2	2	2	2								3	1	2	CO 5	3	2	1	2									3	1	2
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<b>Unit –I</b>	<b>ELECTROSTATICS</b>	Periods	<b>9</b>
Co-ordinate systems-Gradient, Divergence and Curl and its physical interpretation-, -Fundamental relations of the Electrostatic fields.-Gauss's Law –Potential Function-Field due to various charge distributions-- Divergence theorem- Energy stored in electric field- Poisson's and Laplace's Equations			
<b>Unit-II</b>	<b>STEADY MAGNETIC FIELD AND MAXWELL's EQUATIONS</b>	Periods	<b>9</b>
Biot- Savart's Law-Faraday's Law-Magnetic flux density-Magnetic field strength-Ampere's Law in differential vector form-permeability-Energy stored in magnetic field-Magnetic Vector potential-The Equation of continuity for time varying fields-Inconsistency of Ampere's law-Maxwell's equations-Boundary conditions.			
<b>Unit –III</b>	<b>ELECTROMAGNETIC WAVES</b>	Periods	<b>9</b>
Solution for free space conditions-Uniform plane wave propagation-Wave equation for conducting medium-Sinusoidal time variations-Wave propagation in Conductors and Dielectrics-Poynting vector and the flow of power.			
<b>Unit-IV</b>	<b>TRANSMISSION LINE THEORY</b>	Periods	<b>9</b>
A line of cascaded T-Sections-Transmission lines –General Solution -Physical significance of the equations-infinite line – wavelength, velocity of propagation , Distortion less line – Reflection on a line not terminated in Zo- Reflection coefficient – Line Calculation-Open and short circuited lines.			
<b>Unit –V</b>	<b>RF TRANSMISSION LINES</b>	Periods	<b>9</b>
Voltage and currents on the dissipation less line –Standing waves, Nodes, Standing wave ratio –input impedance of the dissipation less line–input impedance of open and short circuited lines – The quarter wave line –The Smith chart and its applications– single stub matching with the Smith chart-Problem solving using Smith chart.			
<b>Total Periods</b>			<b>45</b>
<b>TextBooks</b>			
1.	Jordan,E.C. and Balmain,K.G.,—Electromagnetic Waves and Radiating SystemsI,2ndEdition,Pearson education / Prentice-Hall of India.2015.		
2.	J.D.Ryder,- Networks,Lines and FieldsI, PHI, New Delhi, 2 <sup>nd</sup> edition 2010.		
<b>References</b>			
1.	Mathew N.O. Sadiku, Principles of Electromagnetics, 4th Edition, Oxford University Press. Fourth edition 2015.		
2.	Hayt,W.H.and Buck,J.A.,—Engineering ElectromagneticsI,7thEdition,TataMcGraw-Hill. 2012.		
3.	Kraus,J.D .and Fleisch, D.A.,-Electromagnetics with Applications,McGraw-Hill.2010.		
4.	Anand K.Verma,-,Introduction to Modern Planar Transmission Lines: Physical, Analytical, and Circuit Models Approach, Wiley – IEEE press , 2021		
<b>E-Resources</b>			
1.	<a href="http://en.wikipedia.org/wiki/Electrostatics">http://en.wikipedia.org/wiki/Electrostatics</a> .		
2.	<a href="http://www.Maxwells-equations.com/density/electric-flux.php">http://www.Maxwells-equations.com/density/electric-flux.php</a> .		

  
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	<b>VIVEKANANDHA COLLEGE OF ENGINEERING FOR WOMEN</b> (Autonomous Institution, Affiliated to Anna University, Chennai) Elayampalayam, Tiruchengode – 637 205														
Programme	B.E.	Programme Code			103	Regulation		2023							
Department	Electronics and Communication Engineering				Semester		IV								
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks									
		L	T	P	C	CA	ESE	Total							
U23EC402	Electronic Circuits	3	0	0	3	40	60	100							
Course Objective	The students should made <ul style="list-style-type: none"> <li>To understand the various types of biasing in BJT/JFET/MOSFET</li> <li>To study the operation and characteristics of Small signal amplifiers</li> <li>To understand frequency response of BJT and FET amplifiers at various frequencies.</li> <li>To learn the design and analysis of Feedback and Oscillator circuits</li> <li>To apply power amplifier circuits in different modes of operation to analog circuits</li> </ul>														
Course Outcome	At the end of the course, the student should be able to,							Knowledge Level							
	CO1: Design various biasing circuits of BJT/JFET/MOSFET							K2							
	CO2: Understand the concept of small signal Amplifiers							K2							
	CO3: Analyze the BJT amplifiers at low and high frequencies							K2							
	CO4: Interpret the performance of amplifiers using feedback concepts							K2							
Pre-requisites	Semiconductor Devices for Modern Electronics														
<b>CO / PO Mapping</b> (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak												<b>CO/PSO Mapping</b>			
COs	Programme Outcomes (POs)											PSOs			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO 2	PSO 3
CO 1	2	3	3	3		2							3		2
CO 2	2	3	3	3		2							3		2
CO 3	2	3	3	3		2							3		2
CO 4	2	3	3	3		2							3		2
CO 5	2	3	3	3		2							3		2
<b>Course Assessment Methods</b>															
<b>Direct</b>															
1. Continuous Assessment Test I, II & III															
2. Assignment and Quiz															
3. End-Semester examinations															
<b>Indirect</b>															
1. Course - end Survey															
<b>Content of the Course</b>															
Unit – I	BIASING OF BJT AND JFET/MOSFET										Periods	9			
Need for biasing - Method of Transistor biasing: fixed bias, voltage divider bias - Biasing of JFET: self															

  
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bias, voltage divider bias-Biasing of MOSFET.			
<b>Unit - II</b>	<b>SMALL SIGNAL AMPLIFIERS</b>	<b>Periods</b>	<b>9</b>
BJT amplifiers-Single stage amplifiers-Analysis of single stage amplifiers-Distortion in amplifiers-Millers theorem-FET amplifiers-Analysis of FET and MOSFET amplifiers-Cascade Connection.			
<b>Unit – III</b>	<b>BJT AND JFET FREQUENCY RESPONSE</b>	<b>Periods</b>	<b>9</b>
Logarithms-Decibels-Low frequency response of BJT Amplifier-Low frequency response of FET Amplifier-Miller effect capacitance –High frequency response of BJT Amplifier-High frequency response of FET Amplifier- Multistage Frequency Effects.			
<b>Unit - IV</b>	<b>FEEDBACK AND OSCILLATOR CIRCUITS</b>	<b>Periods</b>	<b>9</b>
Feedback concepts-Feedback connection types (Negative feedback) -Practical feedback circuits-Oscillator operation-Phase shift oscillator-Wein bridge oscillator- LC oscillator-Crystal oscillator-UJT Oscillator.			
<b>Unit – V</b>	<b>POWER AMPLIFIERS</b>	<b>Periods</b>	<b>9</b>
Definition and amplifier types-Direct coupled Class A amplifier-Transformer coupled class A amplifier-Class B amplifier operation and circuits, Amplifier distortion-Class C and Class D amplifiers-Thermal stability and heat sink.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	S.Salivahanan, N.Suresh Kumar, “Electronic Devices and Circuits”, 5th Edition, McGraw-Hill Education, New Delhi, 2023.		
2.	Robert L. Boylestad and Louis Nashelsky, “Electronics devices and Circuit theory”, 11th Edition, Pearson, 2015.		
<b>References</b>			
1.	J.Millman&C.C.Halkias,”Integrated Electronics”, 2nd Edition, TMH, 2010.		
2.	Adel S. Sedra and Kenneth C. Smith, “Micro Electronic Circuits Theory And Application,” 5th Edition		
<b>E-Resources</b>			
1.	<a href="https://onlinecourses.nptel.ac.in/noc23_ee77/preview">https://onlinecourses.nptel.ac.in/noc23_ee77/preview</a>		
2.	<a href="https://www.it.iitb.ac.in/nmeict/workshopsConducted.html">https://www.it.iitb.ac.in/nmeict/workshopsConducted.html</a>		
3.	<a href="https://www.coursera.org/">https://www.coursera.org/</a>		



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	Programme	B.E	Programme Code	103	

Department	<b>Electronics and Communication Engineering</b>			Semester	<b>IV</b>
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Course Code	Course Name	Periods Per Week			Credit	Maximum Marks		
		L	T	P	C	CA	ESE	Total
U23EC403	<b>Analog Integrated Circuits</b>	3	0	0	3	40	60	100

<b>Course Objective</b>	The student should be made to,
	<ul style="list-style-type: none"> <li>• Illustrate the various configurations &amp; characteristics Operational Amplifier.</li> <li>• Interpret the linear &amp; nonlinear applications of Op-amp.</li> <li>• Understand the functions of filters, rectifiers and voltage regulators.</li> <li>• Categorize the types of data converters with their applications.</li> <li>• Elaborate the concept of various waveform generators and some special ICs.</li> </ul>

<b>Course Outcome</b>	At the end of the course, the student should be able to,	Knowledge Level
	CO1: Describe about op-amp configurations and compare the AC and DC characteristics.	K2
	CO2: Demonstrate the various applications of Op-amp.	K2
	CO3: Analyze the functional blocks of filters, rectifiers and regulators circuits.	K3
	CO4: Examine the operation of ADCs and DACs.	K3
	CO5: Analyze the internal circuits of waveform generators and Special function ICs	K4

<b>Pre-requisites</b>	-
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COs	CO/PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak												CO/PSO Mapping		
	Programme Outcomes (POs)										PSOs				
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3			2	2	2	2			2		2	3	2	
CO2	2		2			2	2		2	2		2	2	2	
CO3	3		3			3	2		2	2			3		2
CO4	2			2		2	2		2	2		2	3		2
CO5	2		2			2	2		2	2		2	2	2	

<b>Course Assessment Methods</b>	
<b>Direct</b>	<ol style="list-style-type: none"> <li>1. Continuous Assessment Test I, II &amp; III.</li> <li>2. Assignment: Simulation using tool, Quiz and Seminar.</li> <li>3. End-Semester examinations.</li> </ol>
<b>Indirect</b>	<ol style="list-style-type: none"> <li>1. Course-end survey.</li> </ol>

<b>Content of the syllabus</b>			
Unit- I	<b>OPERATIONAL AMPLIFIERS</b>	Periods	<b>9</b>

  
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Introduction to Op-amp and Ideal Op-amp characteristics - Inverting and Non inverting amplifier configurations- General operational amplifier stages & Internal schematic of op-amp – Typical op-amp Parameters – DC and AC Performance characteristics - Open and Closed Loop configurations.			
<b>Unit– II</b>	<b>APPLICATIONS OF OPAMP</b>	Periods	<b>9</b>
Basic circuits of Op-amp: Voltage Follower, Scaling & averaging amplifier, Summing & Difference Amplifier - Linear applications: Instrumentation amplifier, Differentiator & Integrator- V to I & I to V converters –Non-linear applications: Log & antilog amplifier, Comparator & Schmitt trigger, Analog Multiplier & its applications.			
<b>Unit– III</b>	<b>FILTERS,RECTIFIERS &amp; REGULATORS</b>	Periods	<b>9</b>
Active filters : First Order Low Pass and High Pass Butterworth filters - Precision Diode & Precision rectifier, Half wave rectifier & Full wave rectifiers – Need for voltage regulation – Linear Voltage regulators , Monolithic Switching regulators– IC 723 General purpose voltage regulator.			
<b>Unit– IV</b>	<b>DATA CONVERSION DEVICES</b>	Periods	<b>9</b>
Digital to Analog conversion: Specifications, Weighted resistor type, R-2R Ladder type & Inverted R-2R ladder type - Analog to Digital conversion: Specifications, Flash type, Successive Approximation type-Single Slope & Dual Slope type – Sample & Hold circuits.			
<b>Unit– V</b>	<b>SIGNAL GENERATORS &amp; SPECIAL ICs</b>	Periods	<b>9</b>
Function generator ICL8038 - Sinewave generator, Sawtooth generator - IC 555 Timer : Functional block diagram , Astable & Monostable mode operation & Applications – Voltage controlled Oscillator –Phase Locked Loop IC 565 : Block diagram & applications - Audio Power amplifier - Video Amplifier - Optocouplers and Fiber optic IC.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	Sergio Franco - Design with Operational Amplifiers and Analog Integrated Circuits – 4th Edition McGraw-Hill Education, 2015		
2.	D.Roy Choudhry, Shail Jain, -Linear Integrated Circuits, New Age International Pvt. Ltd., 2022, Sixth Edition.		
<b>References</b>			
1.	S Salivahanan & V S Kanchana Bhaaskaran, Linear Integrated Circuits, McGraw Hill Education; Third edition (25 August 2018)		
2.	Ramakant A. Gayakwad, -Operational Amplifiers and Linear IC, 4th Edition, Prentice Hall / Pearson Education, 2015.		
3.	K.Lal Kishore,—OperationalAmplifierandLinearIntegratedCircuitsI,PearsonEducation;First edition,2012.		
<b>E-Resources</b>			
1.	<a href="https://www.tutorialspoint.com/linear_integrated_circuits_applications/basics_of_linear_integrated_circuits_applications.htm">https://www.tutorialspoint.com/linear_integrated_circuits_applications/basics_of_linear_integrated_circuits_applications.htm</a>		
2.	<a href="https://www.brainkart.com/subject/Linear-Integrated-Circuits_220/">https://www.brainkart.com/subject/Linear-Integrated-Circuits_220/</a>		
3.	<a href="https://unacademy.com/course/linear-integrated-circuits/P9EAB7F3">https://unacademy.com/course/linear-integrated-circuits/P9EAB7F3</a>		
4.	<a href="https://onlinecourses.nptel.ac.in/noc24_ee73/preview">https://onlinecourses.nptel.ac.in/noc24_ee73/preview</a>		

  
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Course Code	Course Name	Periods Per Week			Credit	Maximum Marks									
		L	T	P		C	CA	ESE	Total						
U23EC404	Digital Signal Processing	3	0	1	4	50	50	100							
<b>Course Objective</b>	The main objective of the course is to ,														
	<ul style="list-style-type: none"> <li>Learn the DFT &amp; FFT and its properties</li> <li>Identify the characteristics of FIR filters and methods to design FIR filters</li> <li>Know the characteristics of IIR filters and methods to design IIR filters</li> <li>Study the effects of finite word length effects &amp; Multirate Signal Processing</li> <li>Understand about Digital Signal Processor architecture and addressing modes</li> </ul>														
<b>Course Outcome</b>	At the end of the course, the student should be able to,							Knowledge Level							
	CO1: Apply DFT&FFT for the analysis of digital signals & systems							K3							
	CO2: Design and implement Finite Impulse Response filters for the given specifications							K6							
	CO3: Design and implement Infinite Impulse Response filters for the given specifications							K6							
	CO4: Analyze the effects of finite word length of infinite response & Multirate Signals.							K4							
	CO5: Interpret the architecture and addressing modes of DSP processor							K2							
<b>Pre-requisites</b>	Signal and Systems														
<b>CO / PO Mapping</b> (3/2/1 indicates strength of correlation) 3-Strong, 2 - Medium, 1 - Weak													<b>CO/PSO Mapping</b>		
<b>COs</b>	<b>Programme Outcomes (POs)</b>									<b>PSOs</b>					
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	P O 10	P O 11	P O 12	PS O 1	PS O 2	PS O 3
CO 1	3	3	3	1	1							1	3	2	2
CO 2	3	3	3	1	1							1	3	2	2
CO 3	3	3	3	1	1							1	3	2	2
CO 4	3	3	3	1	1							1	3	2	2
CO 5	3	3	3	1	1							1	3	2	2
<b>Direct</b>															
1. Continuous Assessment Test I, II & III															
2. Assignment: Simulation using tool															
3. End-Semester examinations															
<b>Indirect</b>															
1. Course - end survey															
<b>Content of the syllabus</b>															
<b>Unit – I</b>		<b>DISCRETE FOURIER TRANSFORM</b>									Periods		<b>9</b>		
Review of discrete-time signals & systems, Discrete Fourier Transform : Properties , Circular Convolution, Fast Fourier Transform: Radix-2 FFT, Decimation-in-time and Decimation-in-frequency algorithms & its applications															
<b>Unit - II</b>		<b>FINITE IMPULSE RESPONSE FILTERS</b>									Periods		<b>9</b>		



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Design of FIR filters -Symmetric and Anti-symmetric FIR filters - Design of linear phase FIR filters using windows (Rectangular, Hamming and Hanning window) - Design of linear phase FIR filters using Frequency sampling method –Structures of FIR Filter( Direct form structure, Cascade form Structure)			
<b>Unit – III</b>	<b>INFINITE IMPULSE RESPONSE FILTERS</b>	Periods	<b>9</b>
Characteristics of commonly used analog filters - Butterworth filters, Chebyshev filters, Design of IIR filters from analog filters(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.			
<b>Unit - IV</b>	<b>FINITE WORD LENGTH EFFECTS &amp; MULTIRATE SIGNAL PROCESSING</b>	Periods	<b>9</b>
Representation of numbers- Quantization of filter coefficients - Round off effects in digital filters - Decimation by an factor D, Interpolation by an factor I, Sampling rate conversion by a rational factor I/D.			
<b>Unit – V</b>	<b>DIGITAL SIGNAL PROCESSORS</b>	Periods	<b>9</b>
Von Neumann Architecture, Harvard Architecture, Modified Harvard Architecture – Pipelining –On chip Peripherals - Architecture of TMS320C5X – Addressing modes.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	John G. Proakis & Dimitris G.Manolakis, —Digital Signal Processing – Principles, Algorithms & Applications, Fourth Edition, Pearson Education / Prentice Hall, 2007.(Unit I – IV)		
2.	B.Venkataramani & M. Bhaskar, “Digital Signal Processor Architecture, Programming and Application”, TMH 2002.(Unit V)		
<b>References</b>			
1.	Emmanuel C. Ifeachor & Barrie. W. Jervis, —Digital Signal ProcessingI, Second Edition, Pearson Education / Prentice Hall, 2002.		
2.	Alan V Oppenheim, Ronald W Schafer, John R Buck, “Discrete Time SignalProcessing”, Pearson, 2009.		
3.	Sanjit K. Mitra, —Digital Signal Processing – A Computer Based ApproachI, Tata Mc Graw Hill, 2007.		
4.	Andreas Antoniou, —Digital Signal ProcessingI, Tata Mc Graw Hill, 2006.		
<b>E-Resources</b>			
1.	<a href="https://engineering.purdue.edu/~ee538/DSP_Text_3rdEdition.pdf">https://engineering.purdue.edu/~ee538/DSP_Text_3rdEdition.pdf</a>		
2.	<a href="https://www.scribd.com/doc/217906199/Digital-signal-processors-A-Venkatramani">https://www.scribd.com/doc/217906199/Digital-signal-processors-A-Venkatramani</a>		
3.	<a href="https://nptel.ac.in/courses/117102060/">https://nptel.ac.in/courses/117102060/</a>		

**Total Periods: 15**

**LIST OF EXPERIMENTS: MATLAB Experiments:**



1. Generation of different types of Signals.
2. Computation of DFT of signal input sequence.
3. Design and Implementation of Linear and Circular Convolution.
4. Design and Simulation of FIR (LPF, HPF, BPF&BSF) filters.
5. Design and Simulation of IIR (LPF, HPF, BPF&BSF) filters.

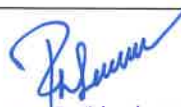
**DSP PROCESSOR Experiments:**

6. Generation of Signals.
7. Computation of a DFT of a signal.
8. Design and Implementation of Linear and Circular Convolution.
9. Design and Implementation of FIR filters.
10. Design and Implementation of IIR filters.

  
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Programme	<b>B.E.</b>	Programme Code		<b>103</b>	Regulation	<b>2023</b>									
Department	<b>Electronics and Communication Engineering</b>				Semester	<b>IV</b>									
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks									
		L	T	P		C	CA	ESE	Total						
<b>U23MA406</b>	<b>Probability and Random Processes</b>	3	1	0	4	40	60	100							
<b>Course Objective</b>	<p>The main objective of the course is to</p> <ul style="list-style-type: none"> <li>• Know and differentiate between discrete and continuous random variables.</li> <li>• Proficiently understand the expected value, variance, and higher-order moments of random variables (for both discrete and continuous types).</li> <li>• Understand means, correlations/ covariances of random processes.</li> <li>• Identify relationship between wiener-Khintchine relation and spectral densities.</li> <li>• Evaluate the response of a linear system to stationary processes.</li> </ul>														
<b>Course Outcome</b>	At the end of the course, the student should be able to,					Knowledge level									
	<b>CO1:</b> Understand the density and distribution functions for discrete and continuous variables.					K3									
	<b>CO2:</b> Use the central limit theorem to compute probabilities.					K3									
	<b>CO3:</b> Recognize the Random processes is WSS and whether the two random processes are jointly WSS.					K5									
	<b>CO4:</b> Compute the autocorrelation function and the power spectral density function of a wide-sense stationary process.					K4									
<b>CO5:</b> Analyze the response of random inputs to linear time invariant systems.					K4										
<b>Pre-requisites</b>															
<b>CO / PO Mapping</b> (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak													<b>CO/PSO Mapping</b>		
<b>COs</b>	<b>Programme Outcomes (POs)</b>												<b>PSOs</b>		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
<b>CO 1</b>	3	2	1	1	1								2		
<b>CO 2</b>	3	2		1									2		
<b>CO 3</b>	3	2	1		1								2		
<b>CO 4</b>	3	2	1	1									2		
<b>CO 5</b>	3	2	1	1									2		
<b>Course Assessment Methods</b>															
<b>Direct</b>															
<ol style="list-style-type: none"> <li>1. Continuous Assessment Test I, II &amp; III</li> <li>2. Assignment.</li> <li>3. End-Semester examinations</li> </ol>															
<b>Indirect</b>															
1.Course - end survey															

  
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<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>RANDOM VARIABLES</b>	Periods	<b>9+3</b>
Discrete and continuous random variables – Moments - Moment generating functions and their properties. Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.			
<b>Unit - II</b>	<b>TWO DIMENSIONAL RANDOM VARIABLES</b>	Periods	<b>9+3</b>
Joint distributions - Marginal and conditional distributions – Covariance - Correlation and Regression - Central limit theorem.			
<b>Unit – III</b>	<b>CLASSIFICATION OF RANDOM PROCESSES</b>	Periods	<b>9+3</b>
Definition and examples - first order, second order, strictly stationary, auto correlation and its properties, wide-sense stationary and ergodic processes - Markov process - Poisson and Normal processes.			
<b>Unit - IV</b>	<b>CORRELATION AND SPECTRAL DENSITIES</b>	Periods	<b>9+3</b>
Cross correlation - Properties – Power spectral density – Cross spectral density - Properties – Wiener-Khintchine relation – Relationship between cross power spectrum and cross correlation function.			
<b>Unit – V</b>	<b>LINEAR SYSTEMS WITH RANDOM INPUTS</b>	Periods	<b>9+3</b>
Linear time invariant system - System transfer function – Linear systems with random inputs – Auto correlation and cross correlation functions of input and output.			
<b>Total Periods</b>			<b>45+15=60</b>
<b>Text Books</b>			
1.	Ibe, O.C., Fundamentals of Applied probability and Random processes, Elsevier, 2007		
2.	Peebles Jr. P.Z., Probability Random Variables and Random Signal Principles, Tata McGraw-Hill Publishers, Fourth Edition, New Delhi, 2015.		
<b>References</b>			
1.	Miller, S.L and Childers, S.L., Probability and Random Processes with applications to Signal Processing and Communications, Elsevier Inc., First Indian Reprint 2007.		
2.	Stark, H. and Woods, J.W., Probability and Random Processes with Applications to Signal Processing, Pearson Education (Asia), 3 <sup>rd</sup> Edition, 2009.		
3.	Papoulis, A. and Pillai, S.U., Probability, Random Variables and Stochastic Processes, 4 <sup>th</sup> Edition, McGraw Hill, 2002.		
4.	Hwei Hsu, H. “Schaum’s Outline of Theory and Problems of Probability, Random Variables and Random Processes”, Tata McGraw-Hill edition, New Delhi, 2012.		
5.	Leon-Garcia, A, “Probability and Random Processes for Electrical Engineering”, Pearson Education Asia, Second Edition, 2011.		
<b>E-Resources</b>			
1.	<a href="https://www.maths.ed.ac.uk">https://www.maths.ed.ac.uk</a>		
2.	<a href="http://www.learnerstv.com/Free-engineering-Video-lectures">www.learnerstv.com/Free-engineering-Video-lectures</a>		
3.	<a href="http://www.nptel.ac.in">www.nptel.ac.in</a>		

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Programme	<b>B.E.</b>	Programme code	<b>103</b>	Regulation	<b>2023</b>										
Department	<b>Electronics and Communication Engineering</b>			Semester	<b>IV</b>										
Course code	Course Name	Periods/Week			Credit	Maximum Marks									
		L	T	P	C	CA	ESE	Total							
<b>U23EC405</b>	<b>Electronic Circuits Laboratory</b>	0	0	2	1	60	40	100							
<b>Course Objective</b>	The students should made to <ul style="list-style-type: none"> <li>To learn the amplifier and feedback amplifiers</li> <li>To design and analyze of oscillators and large signal amplifiers</li> <li>To design and simulate the Mini project using P-SPICE software</li> </ul>														
<b>Course Outcome</b>	At the end of the course, the students should be able to,						Knowledge Level								
	CO1: Realize the amplifiers and Feedback amplifiers from various parameters						K2								
	CO2: Design of oscillators and large signal amplifiers						K2								
	CO3: Apply P-spice & Develop a working model of an electronic circuit						K3								
<b>Pre-requisites</b>	Basic Electrical and Electronics Engineering														
<b>CO / PO Mapping</b> (3/2/1 indicates strength of correlation) 3-Strong, 2 - Medium, 1 - Weak															
COs	Programme Outcomes (POs)										CO/PSO Mapping				
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	P O 10	P O 11	P O 12	PS O 1	PS O 2	PS O 3
CO 1	3	2			2			2	2	2			2		
CO 2	3	2			2			2	2	2			2		
CO 3	3	2			2			2	2	2			2		
CO 4	3	2			2			2	2	2			2		
CO 5	3	2			2			2	2	2			2		
<b>Course Assessment Methods</b>															
<b>Direct</b>															
1.Pre lab and Postlab 2.Assignment 3.End-Semester examinations															
<b>Indirect</b>															
1. Course-end survey															
<b>List of Experiments</b>															<b>Course Outcome</b>
1.	Common Emitter amplifier														CO1
2.	Common Source amplifier														CO1
3.	Series feedback amplifiers: Frequency response, input and output Impedance calculation														CO2
4.	Shunt feedback amplifiers: Frequency response, input and output Impedance calculation														CO2
5.	Design of Wein bridge oscillator														CO3
6.	Design of transistor RC phase shift oscillator														CO3



  
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7.	Design of LC–Hartley and Colpitt oscillator	CO4
8.	Class A Power Amplifier	CO4
9.	Complementary symmetry Class B Power Amplifier	CO4
10.	Mini project (using BJT/JFET/MOSFET)	CO5
Total Periods		45
Suggested Lab Manuals:		
1.DavidA.Bell,—Laboratory manual for Electronic Devices and Circuits I,PHI,4 <sup>th</sup> Edition,2001		
<b>E-Resources</b>		
1.	<a href="https://www.electronics-tutorials.ws/">https://www.electronics-tutorials.ws/</a>	
2.	<a href="https://nptel.ac.in/courses/117102061/">https://nptel.ac.in/courses/117102061/</a>	
3.	<a href="https://www.sciencedirect.com/topics/physics-and-astronomy/optical-device">https://www.sciencedirect.com/topics/physics-and-astronomy/optical-device</a>	



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Programme	B.E	Programme Code			103	Regulation	2019		
Department	<b>Electronics and Communication Engineering</b>				Semester		IV		
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks			
		L	T	P	C	CA	ESE	Total	
U23EC406	<b>Analog Integrated Circuits Laboratory</b>	0	0	2	1	60	40	100	
<b>Course Objective</b>	The student should be made to, <ul style="list-style-type: none"> <li>Analyze the performance characteristics of opamp.</li> <li>Design &amp; test mathematical operations and applications using OP-Amp.</li> <li>Illustrate characteristics and of filter and voltage regulators.</li> <li>Implement analog to digital &amp; digital to analog conversion techniques.</li> <li>Examine the operation of Timer IC &amp; PLL</li> </ul>								
<b>Course Outcome</b>	At the end of the course, the student should be able to,							Knowledge Level	
	CO1: Evaluate the characteristics and different modes of operation of opamp.							K2	
	CO2: Design and construct Integrator & differentiator circuits.							K2	
	CO3: Understand performance of filter and regulators							K3	
	CO4: Demonstrate the types of ADC & DAC.							K3	
CO5: Examine the operation of PLL							K2		
<b>Pre-requisites</b>	-								

CO/PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak													CO/PSO Mapping		
COs	Programme Outcomes (POs)												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	2			2			2	2	2			2	2	2
CO2	3	2			2			2	2	2			2	2	
CO3	2	2			2			2	2	2			3	2	2
CO4	3	2			2			2	2	2			2	2	
CO5	3	2			2			2	2	2			2		

#### Course Assessment Methods

<b>Direct</b>
1. Prelab and Postlab
2. Assignment
3. End-Semester examinations
<b>Indirect</b>
1. Course-end survey

List of Experiments		Course Outcome
1.	Measurement of op-amp parameters: i) Input bias current ii) Input offset voltage	CO1
2.	Construction of Inverting and Non inverting amplifiers using Op-Amp.	CO1
3.	Construction and simulation of Integrator and Differentiator using Op-Amp.	CO2

  
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4.	Design and simulation of an Instrumentation Amplifier & Schmitt Trigger using op-amp.	CO2
5.	Design & simulation of first order & second order filter types.	CO3
6.	Construction of Voltage Regulator using 78XX/79XX series.	CO3
7.	Implementation & of Simulation 4bit D/A Converter using R-2R ladder network & 4bit A/D Converter using flash type.	CO4
8.	Construction & testing of sample & hold circuit.	CO4
9.	Construction and simulation of different modes of multivibrator using IC555 timer.	CO5
10.	Design and testing of Phase locked loop.	CO5
<b>Total Periods</b>		<b>45</b>
<b>Text Books</b>		
1.	D.Roy Choudhry, Shail Jain, -Linear Integrated Circuits, New Age International Pvt. Ltd., 2018, Fifth Edition.	
2.	Op-Amps and Linear Integrated Circuits, Ramakant A Gayakwad, 4th Edition, Pearson Education, 2018.	
<b>E-Resources</b>		
1.	<a href="https://www.electronics-tutorials.ws/opamp/opamp_1.html">https://www.electronics-tutorials.ws/opamp/opamp_1.html</a>	
2.	<a href="https://www.allaboutcircuits.com/video-tutorials/op-amp-basics-introduction-to-the-operational-amplifier/">https://www.allaboutcircuits.com/video-tutorials/op-amp-basics-introduction-to-the-operational-amplifier/</a>	
3.	<a href="https://www.circuitbread.com/tutorials?tuts=operational+amplifiers">https://www.circuitbread.com/tutorials?tuts=operational+amplifiers</a>	
4.	<a href="https://www.electroschematics.com/tag/741-circuits/">https://www.electroschematics.com/tag/741-circuits/</a>	



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## CAREER TRACK COURSE – I



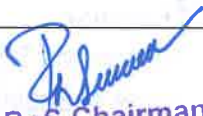
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Programme	B.E.	Programme code	103	Regulation	2023											
Department	Electronics and Communication Engineering			Semester	IV											
Course code	Course Name	Periods per week			Credit	Maximum Marks										
		L	T	P	C	CA	ESE	Total								
U23CTCE1	<b>Entrepreneurial Mindset and Business Model Canvas</b>	0	0	2	1	60	40	100								
<b>Course Objective</b>	The student should be made to, <ul style="list-style-type: none"> <li>• Cultivate an entrepreneurial mindset that embraces innovation and risk-taking.</li> <li>• Learn the components of the Business Model Canvas and develop skills using the Business Model Canvas as a tool for business planning.</li> <li>• Design innovative business models based on customer needs and market opportunities.</li> <li>• Understand the process of transforming a business model into a comprehensive business plan.</li> <li>• Understand the application processes and legal implications of business licenses and permits.</li> </ul>															
<b>Course Outcome</b>	At the end of the course, the student should be able to,							<b>KL</b>								
	<b>CO1:</b> Explain the key traits and behaviors of successful entrepreneurs.							K2								
	<b>CO2:</b> Identify and describe the components of the Business Model Canvas.							K2								
	<b>CO3:</b> Design innovative business models tailored to specific customer needs and market conditions.							K6								
	<b>CO4:</b> Demonstrate the ability to write comprehensive business plans, incorporating elements such as market analysis, financial projections, and operational strategies.							K4								
<b>Pre-requisites</b>	-							K2								
<b>CO / PO Mapping</b> (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak												<b>CO/PSO Mapping</b>				
COs	Programme Outcomes (POs)												PSOs			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PSO4
CO 1	1	1	2	1	1			1	2	1	3	3	1	1		1
CO 2	2	1	3	3	2			1	2	1	3	3	1	1	2	
CO 3	2	1	3	2	3			1	2	1	3	3				2
CO 4	1	1	3	1	2			1	2	1	3	3				2
CO 5	1	1	3	1	2			1	2	1	3	3	1	1		1
<b>Course Assessment Methods</b>																
<b>Direct</b>																
1. Continuous Assessment through Reviews																
2. End Semester Examinations																
<b>Indirect</b>																
1. Course - end survey																
<b>Content of the syllabus</b>																


  
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<b>Unit - I</b>	<b>Introduction to Entrepreneurial Mindset</b>	Periods	<b>6</b>
Introduction-Evolution of the Concept of Entrepreneur - Characteristics of Successful Entrepreneurs - The Charms of Becoming an Entrepreneur - The Entrepreneurial Decision Process -Need and types of Entrepreneur - Role of Entrepreneurship in Economic Development -Women Entrepreneurship and Rural Entrepreneurship - Case Study - Opportunities Identification and Selection			
<b>Unit - II</b>	<b>Understanding the Business Model Canvas</b>	Periods	<b>6</b>
Definition of a Business Model- Types of Business Models -Customer Segments - Value Propositions -Channels and Partners - Customer Relationships - Revenue Model and Streams			
<b>Unit - III</b>	<b>Designing and Testing Business Models</b>	Periods	<b>6</b>
Key Resources - Key Activities - Key Partnerships - Cost Structure - Prototyping Business Models - Evaluating Business Models			
<b>Unit - IV</b>	<b>Business Model to Business Plan</b>	Periods	<b>6</b>
Business Plan - reasons for writing a Business Plan - who reads a business plan and what they're looking for - guidelines for writing an effective business plan - business plan Outline - present a business plan to potential investors.			
<b>Unit - V</b>	<b>Licenses, Permits and Funding</b>	Periods	<b>6</b>
Ethical culture in the entrepreneurial ventures - Dealing Effectively with legal Issues - Obtaining business licenses and permits - forms of Business Organization - Creating new-venture team - Skill Profile - case study - Need for Funding -Sources of Personal Funding, equity funding, debt financing			
<b>Total Periods</b>			<b>30</b>
<b>Text Books</b>			
1	Khanka. S.S., "Entrepreneurial Development" S.Chand and Co. Ltd., New Delhi, 2011, Revised Edition		
2	Osterwalder, A., & Pigneur, Y. "Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers" John Wiley & Sons, Inc., 2010		
3.	R. Duane Ireland Bruce R. Barringer "Entrepreneurship: Successfully Launching New Ventures", Pearson Education. 2020, 6 <sup>th</sup> Edition		
<b>References</b>			
1.	Donald F Kuratko, "Entrepreneurship - Theory, Process and Practice", Cengage Learning, 2016. 10 <sup>th</sup> Edition		
2.	Ries, E." The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses ", Currency, 2017, 9th Edition		
<b>E-Resources</b>			
1.	<a href="https://fastercapital.com/content/Entrepreneurship-Education-via-Business-Model-Canvas.html">https://fastercapital.com/content/Entrepreneurship-Education-via-Business-Model-Canvas.html</a>		
2.	<a href="https://online.bath.ac.uk/articles/business-models">https://online.bath.ac.uk/articles/business-models</a>		
3.	<a href="https://creately.com/guides/business-model-canvas-explained/">https://creately.com/guides/business-model-canvas-explained/</a>		



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Course Code	Course Name	Periods per week			Credit	Maximum Marks									
		L	T	P		C	CA	ESE	Total						
U23CTCP3	Verbal, Quantitative Aptitude and Reasoning - II	2	0	0	1	40	60	100							
<b>Course Objective</b>	The student should be made to,														
	<ul style="list-style-type: none"> <li>Identify and begin to apply the language features</li> <li>Understand the mathematical techniques for solving the real life problems</li> <li>Use number theory arguments to justify relationships involving divisors, multiples and factoring</li> <li>Perform well in all competitive exams</li> </ul>														
<b>Course Outcome</b>	At the end of the course, the student should be able to,							<b>Knowledge Level</b>							
	CO1: Use language through acquisition of grammar rules							K2							
	CO2: Demonstrate the use of mathematical reasoning by justifying the patterns and relationships							K2							
	CO3: Face external competitive exams							K3							
	CO4: Solve a question in a fraction of minute using shortcut methods							K3							
	CO5: Enhance their problem solving skills and logical Skills							K4							
<b>Pre-requisites</b>	-														
<b>CO / PO Mapping</b> (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 – Weak													<b>CO/PSO Mapping</b>		
<b>COs</b>	<b>Programme Outcomes (POs)</b>												<b>PSOs</b>		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO 1		2		3	2					3		3	1	1	3
CO 2	3	3		2	2					3		3	3	3	3
CO 3	3	3		3	2					3		3	2	2	2
CO 4	3	3		2	3					2		2	3	2	3
CO 5		2		2	2					2		2	3	3	3
<b>Course Assessment Methods</b>															
<b>Direct</b>															
1.Continuous Assessment Test I, II & III															
2.Assignments / Seminar/Quiz															
3.End-Semester Examination															
<b>Indirect</b>															
1.Course -end survey															
<b>Content of the syllabus</b>															
<b>Unit -I</b>		<b>VERBAL ABILITY</b>										Periods		<b>4</b>	
Verbal Analogy, Sentence completion, Gen-Z lexis															
<b>STATEMENT ANALYSIS:</b> Statements and Conclusions, Statements and Assumptions, Statements and															

  
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Agreements, Cause and effect, Making Judgements.			
<b>Unit-II</b>	<b>PROFIT AND LOSS</b>	Periods	<b>8</b>
<p><b>PROBLEMS ON PROFIT AND LOSS PERCENTAGE:</b> Profit Percentage, Cost Price and Selling Price are equal, Cost Price and Selling Price are different, Selling Price alone, Selling Price same for two objects, Selling Price and Cost Price are compared, Mixture, Profit Percentage and Loss Percentage are equal, False rate, Problems on Cost Price, Selling Price, Profit, Discount, Successive Discount and Discount Percentage.</p> <p><b>SIMPLE AND COMPOUND INTEREST:</b> Simple Interest: Find Principal, Amount, Rate of Interest, Number of Years, Simple Interest based on lend into two parts, in case of instalments. Compound Interest: Find Principal, Amount, Rate of Interest, Number of Years, Compound Interest, Simple Interest in co-relation with Compound Interest, Instalments, Population, Present Worth.</p>			
<b>Unit - III</b>	<b>TIME AND WORK</b>	Periods	<b>6</b>
Chain Rule, Combination of people working together, Individuals working together, Joining and Relieving, Efficiency Ratio Model, Works and Wages, Pipes open together: Doubling, Efficiency Ratio Model, Pipes opening and Closing, Capacity based model.			
<b>Unit-IV</b>	<b>TIME, SPEED AND DISTANCE</b>	Periods	<b>6</b>
Basic models, Ratio based model, Average speed based model, Relative speed based model, Algebra based model, Problems on Trains, Boats and Streams, Race and Games. Circular Track, Game based model.			
<b>Unit-V</b>	<b>LOGICAL REASONING</b>	Periods	<b>6</b>
<p><b>DIRECTION SENSE:</b> Direct yourself, based on Angle, Directional reference point, correct map based on wrong map, Direction in Clocks, Shadowing.</p> <p><b>SEATING ARRANGEMENT:</b> Linear Seating Arrangement, Single row Uni-Directional and Bi-Directional, Dual row, Triple row, Square, Rectangular and Triangular Arrangement, Seating Arrangement in photograph, Circular Arrangement, Inside and Outside (Linear and Circular), Concentric Arrangement.</p>			
<b>Total Periods</b>			<b>30</b>
<b>Text books</b>			
1.	Rajeev Varma, "Fast Track Objective Arithmetics", Arihant Publications, 2024		
2.	R.S. Aggarwal, "Modern Approach to Logical Reasoning", S Chand Publishing, 2022		
3.	SP Bakshi, "Objective General English", Arihant Publications, 2024		
<b>References</b>			
1	R.S. Aggarwal, "Quantitative Aptitude for Competitive Examinations", S Chand Publishing, 2013		
2.	Dinesh Khattar, "The Pearson guide to Quantitative Aptitude for Competitive Examinations", 3 <sup>rd</sup> edition, 2016		
3.	Arun Sharma, "How to Prepare for Logical reasoning for CAT", McGraw Hill Education, 2014		
4.	Jaikishan and Premkishan, "How to Crack Test of Reasoning", Arihant Publications, 2016		
5.	R.S. Agarwal, "A modern Approach to verbal and non-verbal reasoning", S Chand Publishing, 2018		
<b>E-Resources</b>			
1.	Aptitude: <a href="https://www.indiabix.com">https://www.indiabix.com</a>		
2.	Reasoning: <a href="https://placement.freshersworld.com">https://placement.freshersworld.com</a>		
3.	Verbal: <a href="https://testbook.com">https://testbook.com</a>		



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**VIVEKANANDHA COLLEGE OF ENGINEERING FOR WOMEN**  
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Programme	B.E.	Programme Code	103	Regulation	2023			
Department	ELECTRONICS AND COMMUNICATION ENGINEERING			Semester	V			
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks		
		L	T	P	C	CA	ESE	Total
U23EC501	Control System Engineering	3	1	0	4	40	60	100
Course Objective	The student should be made to							
	<ul style="list-style-type: none"> <li>Introduce the fundamentals of control systems including system modeling and representation for mechanical and electrical systems.</li> <li>Analyze time-domain responses of first and second-order systems and understand the effects of different controllers.</li> <li>Develop skills in frequency domain analysis for assessing system behavior and stability.</li> <li>Understand time-domain stability analysis using classical methods such as Routh-Hurwitz and Root Locus techniques.</li> <li>Introduce the concepts of state-space modeling and digital control systems, including sampling and hold operations.</li> </ul>							
Course Outcomes	At the end of the course, the student should be able to,							Knowledge Level
	CO1: Model and represent physical systems (mechanical, electrical, electromechanical) using transfer functions and block diagrams.							K3
	CO2: Analyze time-domain responses of first and second-order systems and determine time-domain specifications and steady-state errors.							K3
	CO3: Perform frequency domain analysis using Bode and polar plots, and correlate frequency and time domain specifications.							K4
	CO4: Assess system stability using Routh-Hurwitz, Root Locus, and Nyquist criteria and evaluate the effect of poles and zeros.							K4
	CO5: Develop state-space models, evaluate system controllability and observability, and analyze sampled data control systems.							K3
Pre-requisites	Signals and Systems							

COs	CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak											CO/PSO Mapping			
	Programme Outcomes (POs)											PSOs			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO 1	3	2	1	1								2	3	2	
CO 2	3	3	2	2	2								3	2	2
CO 3	3	3	2	2	2				2	2		2	3	2	
CO 4	3	3	2	2	2				2	2		2	3	2	2
CO 5	3	2	1	1									3	2	

**Course Assessment Methods**

Direct



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1. Continuous Assessment Test I, II & III			
2. Assignment			
3. End-Semester examinations			
<b>Indirect</b>			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>SYSTEM REPRESENTATION</b>	Periods	<b>9</b>
Basic elements in control systems – Open and closed loop systems – Modeling of Mechanical systems- Translational and Rotational Systems-Modeling of Electrical Networks- Electrical analogy of mechanical systems – Transfer function - DC Motors- -Block Diagram Reduction-Signal Flow Graph.			
<b>Unit – II</b>	<b>TIME RESPONSE ANALYSIS</b>	Periods	<b>9</b>
Standard test signals- Time response of First and Second order system response- Time domain specifications – Error coefficients – Steady state error- Generalized error series –Introduction to P, PI, PID controllers - Effect of P, PI, PID controllers on time response.			
<b>Unit – III</b>	<b>FREQUENCY RESPONSE ANALYSIS</b>	Periods	<b>9</b>
Frequency response – Correlation between frequency domain and time domain specifications -Bode plot – Polar plot –Stability Analysis in Frequency Domain--Introduction to Compensators.			
<b>Unit – IV</b>	<b>STABILITY ANALYSIS IN TIME DOMAIN</b>	Periods	<b>9</b>
The Concepts of Stability - Necessary Conditions for Stability – Routh Hurwitz Criterion – Nyquist Stability Criteria -Root Locus construction —Effect of poles and zeros on system stability.			
<b>Unit – V</b>	<b>STATE VARIABLE ANALYSIS AND DIGITAL CONTROL SYSTEM</b>	Periods	<b>9</b>
Introduction to state space analysis - Phase variable and canonical forms - State transition matrix - Solutions to state space equation -Controllability and Observability of systems. Sampled Data control systems – Sample & Hold – Open loop & Closed loop sampled data systems.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	J.Nagrath & M.Gopal, “Control System Engineering”, New Age International Publishers, 5 <sup>th</sup> Edition, 2017.		
2.	A. Nagoor Kani, “Control Systems ” REA Publications, 3 <sup>rd</sup> Edition, 2017		
<b>References</b>			
1.	Richard C. Dorf & Robert H. Bishop, “Modern Control System”, Prentice Hall, 14 <sup>th</sup> Edition, 2022.		
2.	M.Gopal, “Control System – Principles and Design”, Tata McGraw Hill, 4th Edition, 2012.		
3.	K. Ogata, ‘Modern Control Engineering’, 5th edition, PHI, 2012.		
4.	S.K.Bhattacharya, Control System Engineering, 3rd Edition, Pearson, 2013.		
<b>E-Resources</b>			
1.	<a href="http://gppuri.in/pdf/lecturenotes/Control%20system%20note%20for%206th%20sem%20electrical.pdf">http://gppuri.in/pdf/lecturenotes/Control%20system%20note%20for%206th%20sem%20electrical.pdf</a>		
2.	<a href="https://www.sanfoundry.com/1000-control-systems-questions-answers/">https://www.sanfoundry.com/1000-control-systems-questions-answers/</a>		

  
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Programme	B.E.	Programme Code	103	Regulation	2023			
Department	ELECTRONICS AND COMMUNICATION ENGINEERING			Semester	V			
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks		
		L	T	P	C	CA	ESE	Total
U23EC502	Processor and Real Time Systems	3	0	0	3	40	60	100
Course Objective	The student should be made to							
	<ul style="list-style-type: none"> <li>Understand the architecture, instruction set, and programming model of the 8086 microprocessor.</li> <li>Explore various interfacing techniques and peripheral devices used in microprocessor-based systems.</li> <li>Gain knowledge of the 8051 microcontroller and its interfacing with peripheral devices.</li> <li>Introduce the fundamentals and applications of embedded systems and modern processors like ARM, Arduino, and Raspberry Pi.</li> <li>Learn communication protocols and components used in the design of typical embedded systems.</li> </ul>							
Course Outcomes	At the end of the course, the student should be able to,							Knowledge Level
	CO1: Describe the architecture, addressing modes, and instruction set of the 8086 microprocessor and write simple assembly programs.							K2
	CO2: Apply knowledge of interfacing concepts to connect microprocessors with peripherals like 8255, 8259, and ADC/DAC components.							K3
	CO3: Demonstrate an understanding of the 8051 microcontroller architecture and develop simple assembly programs for I/O, timers, and serial communication.							K3
	CO4: Analyze the classification, characteristics, and applications of embedded systems and describe modern platforms like ARM, Arduino, and Raspberry Pi.							K4
	CO5: Explain the role of sensors, actuators, and various communication protocols (I2C, SPI, UART, USB, Bluetooth, etc.) in embedded system design.							K2
Pre-requisites	Digital Logic Design							

COs	CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak											CO/PSO Mapping			
	Programme Outcomes (POs)											PSOs			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO 1	3	3	2	2							2		3	2	2
CO 2	3	3	2	2							2		3	2	
CO 3	3	2	2	2				2			2		2	2	
CO 4	3	2	2	2							2		2		2
CO 5	3	2	2	2									2		2



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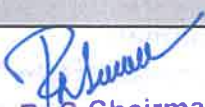
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<b>Course Assessment Methods</b>			
<b>Direct</b>			
1. Continuous Assessment Test I, II & III			
2. Assignment			
3. End-Semester examinations			
<b>Indirect</b>			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>INTRODUCTION TO MICROPROCESSORS</b>	<b>Periods</b>	<b>9</b>
Basics of 8086 – Pin Diagram of 8086 - 8086 Architecture – Pipelining- Memory Banking – Memory Segmentation – Addressing Modes – Instruction sets – Assembler Directives – Minimum Mode and Maximum Mode signals, Timing Diagrams - Programmers Model-Simple Programs involving Logical, Branch and Call Instructions.			
<b>Unit – II</b>	<b>I/O INTERFACE</b>	<b>Periods</b>	<b>9</b>
8259 Programmable Interrupt Controller – 8255 Programmable Peripheral Interface – 4x4 Keyboard Interface - D/A and A/D Interface- 8254 programmable interval timer – 8257 Direct Memory Access – Memory System Design – Memory mapped I/O- I/O Mapped I/O.			
<b>Unit – III</b>	<b>INTRODUCTION TO MICROCONTROLLER</b>	<b>Periods</b>	<b>9</b>
Basics of Microcontrollers – Architecture – I/O ports – Memory Organization – SFRs - Addressing Modes – Instruction sets – Simple Assembly Language Programming-Timers-Serial Ports-Interrupts. Interface: LCD & Keyboard Interfacing – ADC, DAC – Memory Designing - External Memory Interface.			
<b>Unit – IV</b>	<b>INTRODUCTION TO EMBEDDED SYSTEMS</b>	<b>Periods</b>	<b>9</b>
ARM PROCESSOR: Fundamentals, Registers, Current program status register, Pipeline; Classification of embedded systems based on generation and complexity - Purpose of embedded systems - Applications of embedded systems - Characteristics of embedded systems - Operational and Non-operational attributes of embedded systems. Introduction to Arduino and Raspberry pi.			
<b>Unit – V</b>	<b>TYPICAL EMBEDDED SYSTEM</b>	<b>Periods</b>	<b>9</b>
Core of the embedded System-Sensors and Actuators-Onboard communication interfaces I2C, SPI, parallel interface; External communication interfaces-RS232, USB, Bluetooth, Wi-Fi, ZigBee, GPRS.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	Douglas V. Hall, “Microprocessors and Interfacing”, McGraw Hill Education, Revised 3 <sup>rd</sup> Edition, 2017.		
2.	Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, 2nd Edition, Pearson Education, 2011.		
3.	Shibu K V, “Introduction to Embedded Systems”, Mc Graw Hill Education, 2nd Edition, 2017.		
<b>References</b>			
1.	Yu-Cheng Liu, Glenn A. Gibson, “Microcomputer Systems: The 8086 / 8088 Family Architecture, Programming and Design”, 2nd Edition, Prentice Hall of India, 2014.		
2.	Krishna Kant, “Microprocessor and Microcontroller Architecture, programming and system design using 8085, 8086, 8051 and 8096”, PHI, 2007, 7th Reprint, 2015.		
3.	Kenneth J. Ayala, “The 8051 Microcontroller, 3rd Edition, Thompson Delmar Learning”, 2012.		
4.	A.K. Ray, K.M. Bhurchandi, “Advanced Microprocessor and Peripherals”, Tata McGraw-Hill, 3rd Edition, 2017.		

  
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Programme	B.E.	Programme Code				103	Regulation			2023					
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>					Semester			V						
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks									
		L	T	P	C	CA	ESE	Total							
U23EC503	<b>Analog and Digital Communication</b>	3	1	0	4	40	60	100							
<b>Course Objective</b>	The student should be made to														
	<ul style="list-style-type: none"> <li>Understand the need for modulation and analyze different amplitude and angle modulation schemes and their demodulation techniques.</li> <li>Gain knowledge of noise sources in communication systems and analyze their effect on analog modulation.</li> <li>Introduce fundamental concepts of digital communication such as sampling, quantization, and pulse code modulation.</li> <li>Study baseband transmission techniques and evaluate the performance using concepts like ISI, pulse shaping, and eye diagrams.</li> <li>Understand and compare various digital bandpass modulation schemes and analyze their spectral and performance characteristics.</li> </ul>														
<b>Course Outcomes</b>	At the end of the course, the student should be able to,											Knowledge Level			
	CO1: Explain the principles and techniques of amplitude modulation schemes such as AM, DSB-SC, SSB, and VSB along with their generation and detection methods.											K2			
	CO2: Analyze angle modulation techniques including narrowband and wideband FM, and evaluate the effects of noise in FM systems.											K4			
	CO3: Apply the concepts of sampling, quantization, and PCM in digital communication systems and assess their impact on signal fidelity.											K3			
	CO4: Analyze the characteristics of baseband transmission techniques such as line coding, ISI, pulse shaping, and correlative coding using PSD and eye patterns.											K4			
	CO5: Compare various digital modulation techniques such as ASK, PSK, FSK, QAM, and DPSK, and understand the structure and synchronization needs of their receivers.											K3			
<b>Pre-requisites</b>	Digital Systems														
<b>CO / PO Mapping</b> (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak													<b>CO/PSO Mapping</b>		
COs	Programme Outcomes (POs)											PSOs			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO 1	3	3	2							2			3		2
CO 2	3	2	2										3		2
CO 3	3	2	3							2			3		
CO 4	3	2									2			3	
CO 5	3	2												3	
<b>Course Assessment Methods</b>															
Direct															

  
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1. Continuous Assessment Test I, II & III			
2. Assignment			
3. End-Semester examinations			
<b>Indirect</b>			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit-I</b>	<b>AMPLITUDE MODULATION</b>	Periods	<b>9</b>
Introduction: Modulation and its need - Generation and demodulations of AM, DSBSC, SSB and VSB signals-voltage, current and power relationship- frequency spectrum for sinusoidal AM -AM transmitter and receiver.			
<b>Unit-II</b>	<b>FREQUENCY MODULATION &amp; NOISE THEORY</b>	Periods	<b>9</b>
Frequency modulation, Narrowband FM, Wideband FM – Generation of FM: Direct and Indirect method – FM demodulation– Non-linear effects in FM systems – Noise in FM receivers – Capture effect – Pre-emphasis and de-emphasis in FM. Noise – Shot noise, Partition noise, Burst noise, Thermal noise and white noise; Narrow band noise			
<b>Unit - III</b>	<b>DIGITAL COMMUNICATION</b>	Periods	<b>9</b>
Digital Communication: Functional Description- Channel Classification - Low pass sampling-Aliasing-Signal Reconstruction-Quantization-Uniform and Non Uniform Quantization-Quantization Noise-Logarithmic Companding of Speech signal-PCM-TDM			
<b>Unit - IV</b>	<b>BASEBAND TRANSMISSION TECHNIQUES</b>	Periods	<b>9</b>
Properties of Line codes-Power spectral density of Unipolar/Polar RZ,NRZ-Bipolar NRZ, Manchester ISI, Nyquist criterion for distortion less transmission-Pulse Shaping-Correlative coding-Mary Schemes-Eye pattern-Equalization.			
<b>Unit - V</b>	<b>BAND PASS MODULATION TECHNIQUES</b>	Periods	<b>9</b>
Amplitude Shift Keying, Phase Shift Keying- Frequency Shift Keying -Quadrature Amplitude Modulation-Quadrature Phase Shift Keying-Carrier synchronization, Structure of Non coherent receivers- Principle of DPSK.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	Simon Haykin, "Communication Systems", 4th Edition, John Wiley & Sons, New Delhi, 2017.		
2.	B.P.Lathi, -Modern Digital and Analog Communication Systems, 4rd Edition, OxfordPress, 2017.		
<b>References</b>			
1.	GautamSahe, Taub& Schilling, "Principles of Communication Systems", 4th Edition, McGraw-Hill, New Delhi, 2019.		
2.	John.G.Proakis, -Digital Communication, 4th Edition, Pearson Education, 2008.		
3.	Amitabha Bhattacharya, -Digital Communications, Tata McGraw Hill, 2017		
4.	Sam K.Shanmugam—Digital &Analog Communication systems John Wiley, 2008.		
<b>E-Resources</b>			
1.	<a href="https://uodiyala.edu.iq/uploads/PDF%20ELIBRARY%20UODIYALA/EL37/(Electrical%20Engineering)%20Prentice%20Hall%20-%20Digital%20And%20Analog%20Communication%20Systems.pdf">https://uodiyala.edu.iq/uploads/PDF%20ELIBRARY%20UODIYALA/EL37/(Electrical%20Engineering)%20Prentice%20Hall%20-%20Digital%20And%20Analog%20Communication%20Systems.pdf</a>		
2.	<a href="https://ggnindia.dronacharya.info/Downloads/Sub-info/RelatedBook/4thSem/Communication-System-text-book-6.pdf">https://ggnindia.dronacharya.info/Downloads/Sub-info/RelatedBook/4thSem/Communication-System-text-book-6.pdf</a>		
3.	<a href="https://www.tutorialspoint.com/digital_communication/digital_communication_pulse_code_modulation.htm">https://www.tutorialspoint.com/digital_communication/digital_communication_pulse_code_modulation.htm</a>		





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Programme	<b>B.E</b>		Programme Code				<b>103</b>		Regulation		<b>2023</b>				
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>						Semester		<b>V</b>						
Course Code	Course Name					Periods Per Week			Credit	Maximum Marks					
	L	T	P	C	CA	ESE	Total								
<b>U23EC504</b>	<b>Waveguides and Antennas</b>					3	0	1	4	50	50	100			
<b>Course Objective</b>	The main objective of this course is to <ul style="list-style-type: none"> <li>Understand the propagation of electromagnetic waves in guided structures like rectangular and circular waveguides.</li> <li>Study the basic principles and parameters of antennas and their radiation characteristics.</li> <li>Explore radiation mechanisms of elemental and dipole antennas and the concept of antenna arrays.</li> <li>Learn the design and characteristics of practical antennas including reflector, microstrip, and modern communication antennas.</li> <li>Introduce antenna measurement techniques and simulate various antennas using software and hardware tools.</li> </ul>														
	<b>Course Outcome</b>	At the end of the course, the student should be able to,										Knowledge Level			
		<b>CO1:</b> Explain the behavior of TE, TM, and TEM waves in parallel planes and rectangular/circular waveguides and analyze their field distributions and propagation characteristics.										K3			
		<b>CO2:</b> Understand the fundamental antenna parameters and apply the Friis transmission equation for basic antenna communication link analysis.										K3			
		<b>CO3:</b> Analyze the radiation patterns and resistance of simple antennas such as dipoles and evaluate linear and binomial antenna arrays.										K4			
		<b>CO4:</b> Describe the construction, working principles, and feeding techniques of practical antennas including microstrip and horn antennas.										K2			
<b>CO5:</b> Perform measurements of radiation pattern, gain, and impedance of antennas and interpret results using both simulation and experimental setups.										K4					
<b>Pre-requisites</b>	Vector algebra, Differential and Integral calculus														
<b>CO / PO Mapping</b> (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak													<b>CO/PSO Mapping</b>		
<b>COs</b>	<b>Programme Outcomes (POs)</b>												<b>PSOs</b>		
	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PS O1</b>	<b>PS O2</b>	<b>PS O3</b>
<b>CO 1</b>	3	3	3	3	2								3	1	2
<b>CO 2</b>	3	3	2	3	2							2	3	1	2
<b>CO 3</b>	3	3	2	3	2							2	3	1	2
<b>CO 4</b>	3	2	2	2	2							2	3	1	2
<b>CO 5</b>	3	2	1	2								2	3	1	2
<b>Course Assessment Methods</b>															
<b>Direct</b>															
1. Continuous Assessment Test I, II & III 2. Assignment 3. End-Semester examinations															
<b>Indirect</b>															

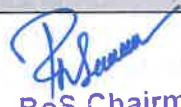
  
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1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit -I</b>	<b>GUIDED WAVES AND RECTANGULAR WAVEGUIDES</b>	Periods	<b>12</b>
Waves between parallel planes- TE waves, TM waves, Characteristics of TE and TM Waves. TEM waves. Wave Guides-Rectangular waveguides, TE waves, TM waves, Characteristics of TE and TM Waves, Waveguide Excitation.			
<b>Unit-II</b>	<b>CIRCULAR WAVEGUIDES AND ANTENNA FUNDAMENTALS</b>	Periods	<b>12</b>
Circular wave guides –Bessel function-TE and TM waves in circular wave guides, Characteristics of TE and TM Waves. Antenna: Radiation Mechanism. Antenna Parameters: Radiation Pattern, Radiation intensity, Directivity, Antenna efficiency, Beamwidth, Beam efficiency, Bandwidth, Polarization, input impedance, Antenna radiation efficiency, Effective area, Radiation resistance, Friis transmission equation			
<b>Unit -III</b>	<b>BASIC ANTENNA AND ANTENNA ARRAYS</b>	Periods	<b>12</b>
Retarded vector potential-Radiation from current element, Power radiated by current element and its radiation resistance. Radiation from half wave dipole, Power radiated by half wave dipole and its radiation resistance. Array antennas-Types. Two element array, N-element linear array, Binomial array.			
<b>Unit-IV</b>	<b>PRACTICAL ANTENNAS</b>	Periods	<b>12</b>
<b>Practical Antennas –I</b> Folded dipole, Loop antennas - Helical antennas - Yagi-Uda antenna -Rhombic antenna - Horn antennas, Log periodic antennas (Qualitative treatment only). <b>Practical Antennas –II</b> Reflector antennas-Types, working, Feed mechanism. Microstrip antennas-Types- Rectangular and Circular patch-Feed mechanism (Qualitative treatment only).. <b>Modern Antennas-</b> Base station antennas, PIFA, UWB antennas, RFID Antennas, Automotive antennas, MIMO antenna (Qualitative treatment only).			
<b>Unit -V</b>	<b>ANTENNAS MEASUREMENTS AND PRACTICAL EXPERIMENTS</b>	Periods	<b>12</b>
Measurement of Antenna Radiation pattern ,Gain and Impedance <b>Experiments Using Software / Hardware</b> 1.simulation of rectangular waveguide 2.Simulation of dipole array antenna 3.Simulation of Microstrip antenna 4.Measurement of Radiation pattern and Gain of Horn antenna 5. Measurement of Radiation pattern and Gain of Reflector antenna			
<b>Total Periods</b>			<b>60</b>
<b>TextBooks</b>			
1.	J.D.Ryder,- Networks, Lines and Fields, PHI, New Delhi, 4 <sup>th</sup> edition 2015		
2.	Jordan, E.C. and Balmain, K.G.,—Electromagnetic Waves and Radiating Systems,2 <sup>nd</sup> Edition, Pearson education / Prentice-Hall of India.2020		
3.	Constantine A. Balanis, "Antenna Theory Analysis and Design", John Wiley & Sons, 2015.		
<b>References</b>			
1.	K.D.Prasad," Antenna and Wave Propagation" Sathya prakasan Tech India Publications-New Delhi- 2021.		
2.	Kraus, J.D .and Fleisch, D.A.,-Electromagnetics with Applications, McGraw-Hill, 5 <sup>th</sup> Edition 2017.		
3.	Mathew N.O. Sadiku, Principles of Electromagnetics, 4th Edition, Oxford University Press. Fourth edition 2015.		
<b>E-Resources</b>			
1.	<a href="http://en.wikipedia.org/wiki/waveguides">http://en.wikipedia.org/wiki/waveguides</a> .		
2.	<a href="http://www.antenna theory.com">http://www.antenna theory.com</a>		



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Programme	B.E	Programme Code		103	Regulation	2023									
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>				Semester	V									
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks									
		L	T	P	C	CA	ESE	Total							
U23EC505	<b>Processor and Real Time Systems Laboratory</b>	0	0	2	1	60	40	100							
Course Objective	The student should be made to,														
	<ul style="list-style-type: none"> <li>Develop assembly language programs for 8086 using arithmetic, logic, string, and data transfer instructions.</li> <li>Implement and test embedded programs on 8051 microcontroller kits using various instruction sets and interfacing techniques.</li> <li>Understand and implement basic interfacing using Arduino for real-time applications.</li> <li>Explore and apply interrupt and serial communication programming using PIC microcontrollers.</li> <li>Gain hands-on experience using MASM, hardware kits, and microcontroller interfacing for embedded applications.</li> </ul>														
Course Outcome	At the end of the course, the student should be able to,							Knowledge Level							
	CO1: Write and execute 8086 assembly language programs for arithmetic, sorting, and string operations using MASM and hardware kits.							K3							
	CO2: Develop and execute 8051 microcontroller programs involving arithmetic, logical, and bit manipulation operations.							K3							
	CO3: Demonstrate communication between 8051 microcontroller and PC using serial interface.							K2							
	CO4: Interface basic I/O components like switches and LEDs using Arduino and analyze the behavior of embedded I/O operations.							K4							
	CO5: Implement and test interrupt handling and USART communication using PIC microcontrollers.							K3							
Pre-requisites	Electronics and Digital Systems														
<b>CO / PO Mapping</b> (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 – Weak													<b>CO/PSO Mapping</b>		
COs	Programme Outcomes (POs)											PSOs			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO 1	3				2		2			2			3	2	
CO 2	3	2	2		2	2				2			2		2
CO 3	3	2	2		2	2				2			2	2	
CO 4	3				2	2				2	2		2		
CO 5	3	2			2					2					2
<b>Course Assessment Methods</b>															
Direct															

  
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1. Pre lab and Post lab / Viva Questions		
2. Record		
3. End-Semester examinations		
<b>Indirect</b>		
1. Course - end survey.		
<b>Content of the syllabus</b>		
<b>List of Experiments</b>		<b>Course Outcome</b>
<b>8086 Programs using kits and MASM</b>		
1.	Programs for 16 bit Arithmetic operations.	CO1
2.	Programs for Sorting using MASM / Kit	CO1
3.	Block Transfer program using String Instructions.	CO2
4.	String Reversal and String Comparison	CO2
5.	Find Highest in a series, even odd numbers, positive, negative and zero.	CO3
<b>8051 Experiments using kits</b>		
1.	Programming using Arithmetic, Logical and Bit Manipulation instructions of 8051 microcontroller.	CO3
2.	Communication between 8051 Microcontroller kit and PC.	CO4
<b>Arduino</b>		
1.	Interfacing switch and LED with Arduino/Raspberry Pi.	CO4
<b>PIC</b>		
1.	Interrupt programming using PIC.	CO5
2.	USART programming using PIC.	CO5
		<b>Total Periods</b> 45
<b>Text Books</b>		
1.	Yu-Cheng Liu, Glenn A. Gibson, "Microcomputer Systems: The 8086 / 8088 Family – Architecture, Programming and Design", 2nd Edition, Prentice Hall of India, 2014.	
2.	Muhammed Ali Mazidi, Rolind D Mckinlay, Danny Causey "PIC Microcontroller and Embedded Systems", Pearson Edition 2011.	
3.	Michael-Margolis, Arduino-Cookbook., Revised edition, O'Reilly, 1st edition, 2011.	
4.	D.Dale.Wheat, Arduino.Internals, TIA publication, 5th edition, 2011.	
<b>E-Resources</b>		
1.	<a href="https://pdfcoffee.com/1pdfnetmicrocomputer-systems-the-8086-8088-family-architecture-pdf-pdf-free.html">https://pdfcoffee.com/1pdfnetmicrocomputer-systems-the-8086-8088-family-architecture-pdf-pdf-free.html</a>	
2.	<a href="http://www.starcoceans.org/kernel-and-driver/PIC%20Microcontroller%20and%20Embedded%20Systems%20Using%20ASM%20%26%20C%20for%20PIC18.pdf">http://www.starcoceans.org/kernel-and-driver/PIC%20Microcontroller%20and%20Embedded%20Systems%20Using%20ASM%20%26%20C%20for%20PIC18.pdf</a>	
3.	<a href="https://www.worldcat.org/title/pic-microcontroller-and-embedded-systems-using-assembly-and-c-for-pic18/oclc/77476437">https://www.worldcat.org/title/pic-microcontroller-and-embedded-systems-using-assembly-and-c-for-pic18/oclc/77476437</a>	

  
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Programme	<b>B.E</b>	Programme Code				<b>103</b>	Regulation	<b>2023</b>							
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>					Semester		<b>V</b>							
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks									
		L	T	P		C	CA	ESE	Total						
<b>U23EC506</b>	<b>Analog and Digital Communication Laboratory</b>	0	0	2	1	60	40	100							
<b>Course Objective</b>	The student should be made to														
	<ul style="list-style-type: none"> <li>Design and implement amplitude, frequency, and pulse modulation and demodulation circuits.</li> <li>Analyze and interpret the waveforms of PCM, sampling, and time division multiplexing systems.</li> <li>Implement and test pre-emphasis, de-emphasis, and PLL circuits used in communication systems.</li> <li>Simulate line coding techniques and understand their spectral and timing characteristics.</li> <li>Design and simulate digital modulation and demodulation schemes using MATLAB.</li> </ul>														
<b>Course Outcome</b>	At the end of the course, the student should be able to,										Knowledge Level				
	<b>CO1:</b> Design and implement analog modulation/demodulation techniques including AM, FM, PAM, PWM, and PPM, and analyze their output waveforms.										K3				
	<b>CO2:</b> Analyze and interpret the performance of pulse code modulation (PCM) and time division multiplexing (TDM) systems using practical experiments.										K4				
	<b>CO3:</b> Assemble and test circuits for pre-emphasis, de-emphasis, and phase-locked loop (PLL), and explain their roles in communication systems.										K3				
	<b>CO4:</b> Simulate and analyze different line coding techniques such as RZ, NRZ, Manchester, and Bipolar using MATLAB or equivalent tools.										K4				
	<b>CO5:</b> Design and simulate digital modulation and demodulation schemes (ASK, PSK, FSK) and evaluate their performance using MATLAB.										K3				
<b>Pre-requisites</b>	Circuits and Devices Lab														
<b>CO / PO Mapping</b> (3/2/1 indicates strength of correlation) <b>3-Strong, 2 – Medium, 1 – Weak</b>													<b>CO/PSO Mapping</b>		
<b>COs</b>	<b>Programme Outcomes (POs)</b>											<b>PSOs</b>			
	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PS O1</b>	<b>PSO 2</b>	<b>PS O3</b>
<b>CO 1</b>	3	2			2					2			3		
<b>CO 2</b>	3	2			2	2				2			3	3	2
<b>CO 3</b>	3	2			2	2				2	2		3		
<b>CO 4</b>	3		2		3	2							3	3	2
<b>CO 5</b>	3		2		3						2		3		
<b>Course Assessment Methods</b>															

  
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<b>Direct</b>		
1. Pre lab and Post lab Test/ Viva Questions		
2. Record		
3. End-Semester examinations		
<b>Indirect</b>		
1. Course - end survey.		
<b>Content of the syllabus</b>		
<b>List of Experiments</b>		<b>Course Outcome</b>
1.	Design and construction of transistor based Amplitude modulator and Demodulator.	CO1
2.	Design an IC based Frequency Modulator circuit	CO1
3.	Generation and detection of Pulse Modulation – PAM / PWM / PPM.	CO2
4.	Analysis of PCM system and interpret the modulated and demodulated waveforms.	CO2
5.	Sampling & Time Division Multiplexing using PAM signals.	CO2
6.	Designing, Assembling and Testing of Pre-Emphasis & De-emphasis Circuits.	CO3
7.	Designing, Assembling and Testing of Phase locked loop.	CO3
8.	Simulation of different Line Coding (Unipolar/Polar RZ, NRZ-Bipolar NRZ, RZ, Manchester).	CO4
9.	Analysis of Delta Modulator and Adaptive Delta Modulator.	CO4
10.	Design and implementation of Analog and Digital Modulation & Demodulation (AM, FM, ASK, PSK, FSK) and its simulation using MATLAB.	CO5
<b>Total Periods</b>		<b>45</b>
<b>Text Books</b>		
1.	B.P.Lathi, "Modern Digital and Analog Communication Systems", 4 <sup>th</sup> Edition, Oxford Press, 2017.	
2.	Sam K.Shanmugam —Digital & Analog Communication systems John Wiley,2008.	
<b>E-Resources</b>		
1.	<a href="https://www.scribd.com/document/521202529/190280111135-Sandip-ADM">https://www.scribd.com/document/521202529/190280111135-Sandip-ADM</a>	
2.	<a href="https://www.scribd.com/document/528340984/null">https://www.scribd.com/document/528340984/null</a>	
	<a href="https://byjus.com/physics/pulse-code-modulation/">https://byjus.com/physics/pulse-code-modulation/</a>	



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Programme	B.E.	Programme Code			103	Regulation	2023								
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>				Semester	VI									
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks									
		L	T	P	C	CA	ESE	Total							
U23EC601	<b>VLSI Design</b>	3	0	0	3	40	60	100							
Course Objective	The student should be made to <ul style="list-style-type: none"> <li>Understand MOS transistor characteristics, CMOS fabrication methods, and layout design rules.</li> <li>Explore programmable logic devices like PROM, PAL, PLA, CPLD, and FPGA, along with their architecture and implementation.</li> <li>Learn the importance of CMOS testing and design-for-testability techniques for reliable VLSI design.</li> <li>Develop the ability to describe, model, and simulate digital systems using Verilog HDL.</li> <li>Design and implement digital systems (e.g., ALUs, controllers, RAMs, filters) using Verilog for practical applications.</li> </ul>														
Course Outcomes	At the end of the course, the student should be able to,							Knowledge Level							
	CO1: Describe the characteristics of MOS transistors and explain CMOS fabrication methods, layout rules, and related design considerations.							K2							
	CO2: Explain the architecture and implementation flow of programmable logic devices such as FPGAs and CPLDs.							K2							
	CO3: Apply test strategies such as scan design, BIST, and boundary scan for fault detection in CMOS circuits and programmable devices.							K3							
	CO4: Design and implement combinational and sequential logic circuits using Verilog HDL.							K3							
CO5: Analyze and develop complex digital subsystems such as ALUs, RAMs, and controllers using Verilog for system-level applications.							K4								
Pre-requisites	Digital System Design														
CO/PO Mapping													CO/PSO Mapping		
(3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak															
COs	Programme Outcomes (POs)									PSOs					
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3		2			2			2				2	2	
CO2	3	2								2	2		1	2	
CO3	3	2	3										2	2	
CO4	3	2	3	2	2				2	2			2	2	2
CO5	3	2	2	2	2								2	2	3
Course Assessment Methods															
Direct															
1. Continuous Assessment Test I, II & III															
2. Assignment															
3. End-Semester examinations															
Indirect															
1. Course-end survey															

  
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<b>Content of the syllabus</b>			
<b>Unit –I</b>	<b>MOS TRANSISTOR AND CMOS PROCESS TECHNOLOGY</b>	Periods	<b>9</b>
Integrated Circuit Design Techniques, VLSI Design Flow -MOS transistor, Ideal I-V characteristics, C-V characteristics, Non ideal I-V effects, DC transfer characteristics. Switch level RC delay models. CMOS Fabrication methods - P-well, N-well, Twin Tub, SOI. CMOS process enhancements, Layout design Rules, CMOS Logic. Technology related CAD issues, Manufacturing issues.			
<b>Unit –II</b>	<b>PROGRAMMABLE IC TECHNOLOGIES</b>	Periods	<b>9</b>
PROM, PLA, PAL ,CPLD Programmable IC Technologies : Introduction to FPGA , FPGA Implementation Process , FPGA EDA Tools , FPGA Internal Architectures , Actel ACT1 , Function generators , Xilinx FPGA Internal Architecture , LUT- Programmable Interconnections .			
<b>Unit –III</b>	<b>CMOS TESTING</b>	Periods	<b>9</b>
Need for testing- Testers, Test fixtures and test programs- Logic verification- Silicon debug principles-Manufacturing test – FPGA Building Block Architectures, FPGA Interconnect Routing Procedures Design for testability- Ad hoc Design, Scan Design, IDDQ Testing , Built in Self Test (BIST) –Boundary scan.			
<b>Unit –IV</b>	<b>VERILOG HDL</b>	Periods	<b>9</b>
Basic concepts- identifiers- Design of combinational and sequential circuit design -Adder, Decoder, equality detector, comparator, priority encoder, half adder, full adder, Ripple carry adder, D latch and D flip flop.			
<b>Unit –V</b>	<b>SYSTEM DESIGN USING VERILOG</b>	Periods	<b>9</b>
ALU : Magnitude Comparator , Multiplication Unit, Adder/Subtractor, MAC Unit , Universal Shift Register , Barrel Shifter , Random Number Generator, Traffic Light Controller : Vending Machine Controller, Single and Dual Port RAM , Real Time Clock , PCI Arbiter Design , Nth Order W-bit FIR & IIR Filter with Constant Coefficients , FIFO.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	Neil Weste & David Harris, "CMOS VLSI Design – A circuits & System Perspective", 4th Edition, Pearson education, New Delhi, 2017		
2.	Palnitkar Samir, "Verilog HDL: Guide to Digital Design and synthesis", 2 <sup>nd</sup> Edition, Pearson Education, New Delhi, 2017.		
<b>References</b>			
1.	Ming Bo Lin, Wiley, Digital System Designs and Practices using Verilog HDL and FPGAs, 2015.		
2.	Samir Palnitkar, Verilog HDL, Pearson Education, 2 <sup>nd</sup> Edition, 2004.		
3.	Ion Grout, Digital Systems Design with FPGAs and CPLDs, Elsevier, 2008.		
4.	Wayne Wolf,—Modern VLSI Design: System On Chip, Pearson Education, 2007		
5.	Sung-Mokang, Yusufleblebici, Chulwoo Kim—CMOS Digital Integrated Circuits: Analysis & Design, 4th edition McGraw Hill Education, 2014		
<b>E-Resources</b>			
1.	<a href="https://picture.iczhiku.com/resource/eetop/syiWFAeQEZAEPvVX.pdf">https://picture.iczhiku.com/resource/eetop/syiWFAeQEZAEPvVX.pdf</a>		
2.	<a href="https://d1.amobbs.com/bbs_upload782111/files_33/ourdev_585395BQ8J9A.pdf">https://d1.amobbs.com/bbs_upload782111/files_33/ourdev_585395BQ8J9A.pdf</a>		
3.	<a href="https://electronicsbookcafe.wordpress.com/wp-content/uploads/2015/08/neil-weste-solutions4thed.pdf">https://electronicsbookcafe.wordpress.com/wp-content/uploads/2015/08/neil-weste-solutions4thed.pdf</a>		
4.	<a href="https://archive.nptel.ac.in/courses/108/107/108107129/">https://archive.nptel.ac.in/courses/108/107/108107129/</a>		



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Programme	B.E.	Programme Code				103	Regulation	2023	
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>					Semester		VI	
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks			
		L	T	P	C	CA	ESE	TOTAL	
U23EC602	<b>Computer Networks</b>	3	0	0	3	40	60	100	
Course Objective	The student should be made to								
	<ul style="list-style-type: none"> <li>Provide an understanding of the fundamental concepts of the Data communication, Internet, network architecture, and protocol layering models.</li> <li>Explore data link layer protocols, flow and error control mechanisms, and link layer addressing.</li> <li>Study network layer functionality, including IP addressing, routing algorithms, and mobile IP protocols.</li> <li>Understand transport layer protocols and application layer services, along with basics of network security.</li> <li>Examine modern communication standards including Ethernet technologies and Bluetooth architecture.</li> </ul>								
Course Outcomes	At the end of the course, the student should be able to,							Knowledge Level	
	CO1: Describe the components of Data communication, protocol layering, switching techniques, and explain OSI Models.							K2	
	CO2: Apply data link layer techniques including addressing, flow control, error control, and analyze multiple access protocols.							K3	
	CO3: Analyze and compare routing algorithms (Link State, Distance Vector), IP addressing schemes (IPv4, IPv6), and mobile IP concepts.							K4	
	CO4: Apply transport layer protocols (TCP/UDP), describe application layer services like HTTP, FTP, SMTP, and explain network security mechanisms.							K3	
	CO5: Explain and differentiate between various communication standards such as Bluetooth, IEEE standards, and different versions of Ethernet.							K2	
Pre-requisites	-								

COs	CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak											CO/PSO Mapping		
	Programme Outcomes (POs)											PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O 2
CO 1	3	3	2							2		3		
CO 2	3	3	2	2								3	2	2
CO 3	3	3	2	2					2		2	3		
CO 4	3	2	2	2								3	2	
CO 5	3	2	2						2			2	2	2



Course Assessment Methods

  
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<b>Direct</b>			
1.Continuous Assessment Test I, II & III			
2.Assignment			
3.End-Semester examinations			
<b>Indirect</b>			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>DATA COMMUNICATIONS &amp; NETWORK MODEL</b>	<b>Periods</b>	<b>9</b>
Data Communications: Components, Representations, Data Flow, Networks: Physical Structures, Network Types: LAN, WAN, Switching, Internet. Protocol Layering: Scenarios, Principles, Logical Connections, TCP/IP Protocol Suite: Layered Architecture, Layers in TCP/IP suite, Description of layers, Encapsulation and Decapsulation, Addressing, Multiplexing and Demultiplexing, The OSI Model: OSI Versus TCP/IP.			
<b>Unit – II</b>	<b>DATA LINK LAYER</b>	<b>Periods</b>	<b>9</b>
Link Layer Services – Multiple Access Protocols - Link Layer Addressing : Ethernet-Hubs and Switches – Link Virtualization – MPLS- Data link control- Link description-Flow control -Stop & wait ,Sliding window-Error control -Go-Back-N, Selective reject			
<b>Unit – III</b>	<b>NETWORK &amp; INTERNET PROTOCOLS</b>	<b>Periods</b>	<b>9</b>
Overview of network layer- Router- Routing Algorithms – LinkState Routing – Distance Vector Routing – Routing OSPF – BGP- -Internet Protocol (IP)-IPV4-IPV6- Mobile IP – Managing mobility in cellular networks			
<b>Unit – IV</b>	<b>TRANSPORT &amp; APPLICATION LAYER</b>	<b>Periods</b>	<b>9</b>
Transport Layer Services –User Datagram Protocol (UDP) –Transmission Control Protocol (TCP) - Principles of Network Applications – Web and HTTP – File Transfer Protocol-SMTP- Cryptography –Digital signatures– securing e-mail –operational security			
<b>Unit – V</b>	<b>COMMUNICATION STANDARDS</b>	<b>Periods</b>	<b>9</b>
BLUETOOTH-Architecture-Bluetooth Layers –Radio Layer –Baseband Layer, IEEE STANDARDS –Data Link Layer – Physical Layer, STANDARD ETHERNET – MAC Sublayer –Physical Layer, FASTETHERNET MAC Sublayer-Physical Layer, GIGA BIT ETHERNET-MAC Sublayer – Physical Layer - Ten-Giga bit Ethernet			
			<b>Total Periods</b>
<b>Text Books</b>			
1.	James F.Kurose & Keith W.Ross, “Computer Networking A Top-down Approach Featuring the Internet”, PHI, eighth edition, 2022.		
2.	Andrew S.Tannenbaum, Nick feamster,David J .Wetherall, “Computer Networks”, Pearson Education, Sixth edition ,2022.		
3.	Behrouz Foruzan, Data communication and Networking, Tata McGraw-Hill, 6 <sup>th</sup> edition, 2022.		
<b>References</b>			
1.	Larry L.Peterson & S.Peter Davie, “Computer Networks”, Harcourt, 2019.		
2.	William Stallings, “Data and Computer Communication”, 8 <sup>th</sup> Edition PHI 2017.		
<b>E-Resources</b>			
1.	<a href="https://abdulkadirsyam.files.wordpress.com/2010/02/computer-networking-a-top-down-approach-featuring-the-internet.pdf">https://abdulkadirsyam.files.wordpress.com/2010/02/computer-networking-a-top-down-approach-featuring-the-internet.pdf</a>		
2.	<a href="https://www.cse.iitk.ac.in/users/dheeraj/cs425/">https://www.cse.iitk.ac.in/users/dheeraj/cs425/</a>		

  
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Programme	B.E.	Programme Code			103	Regulation		2023																																																																																																																																					
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>				Semester			VI																																																																																																																																					
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks																																																																																																																																							
		L	T	P		C	CA	ESE	Total																																																																																																																																				
U23EC603	<b>Industrial Internet of Things (IIoT)</b>	3	0	1	4	50	50	100																																																																																																																																					
<b>Course Objective</b>	The student should be made																																																																																																																																												
	<ul style="list-style-type: none"> <li>To develop knowledge in Industrial Internet of Things (IIoT) fundamentals.</li> <li>To gain conceptual understanding of networking and wireless communication protocols used in IIoT deployment</li> <li>Explore IIoT implementation systems involving sensors, actuators, embedded platforms, and communication protocols.</li> <li>Identify vulnerabilities in IoT systems and assess privacy and security risks.</li> <li>Investigate real-world IIoT applications through case studies and implement project-based learning using embedded platforms.</li> </ul>																																																																																																																																												
<b>Course Outcomes</b>	At the end of the course, the student should be able to,										Knowledge Level																																																																																																																																		
	<b>CO1:</b> Differentiate between IoT and Industrial IoT with respect to purpose, scale, and architecture.										K2																																																																																																																																		
	<b>CO2:</b> Design WSN (Wireless Sensor Network)–based connectivity solutions for IIoT using appropriate system components such as sensors, gateways, routers, and servers.										K3																																																																																																																																		
	<b>CO3:</b> Compare and apply various wired/wireless communication protocols including Wi-Fi, BLE, ZigBee, Modbus, BACnet, SPI, I2C, COAP, MQTT, 6LoWPAN, LWM2M, and AMQP.										K4																																																																																																																																		
	<b>CO4:</b> Analyze layered security architecture and attacker models relevant to IIoT systems.										K2																																																																																																																																		
	<b>CO5:</b> Design and develop IIoT applications for domains like healthcare, energy, and facility management using embedded and edge development boards.										K3																																																																																																																																		
<b>Pre-requisites</b>	-																																																																																																																																												
<table border="1"> <thead> <tr> <th colspan="13">CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak</th> <th colspan="3">CO/PSO Mapping</th> </tr> <tr> <th rowspan="2">COs</th> <th colspan="12">Programme Outcomes (POs)</th> <th colspan="3">PSOs</th> </tr> <tr> <th>PO 1</th> <th>PO 2</th> <th>PO 3</th> <th>PO 4</th> <th>PO 5</th> <th>PO 6</th> <th>PO 7</th> <th>PO 8</th> <th>PO 9</th> <th>PO 10</th> <th>PO 11</th> <th>PO 12</th> <th>PSO 1</th> <th>PSO 2</th> <th>PSO 3</th> </tr> </thead> <tbody> <tr> <td>CO 1</td> <td>2</td> <td>-</td> <td>-</td> <td>3</td> <td>2</td> <td>2</td> <td>-</td> <td>-</td> <td>-</td> <td>3</td> <td>3</td> <td>3</td> <td>2</td> <td>2</td> <td>1</td> </tr> <tr> <td>CO 2</td> <td>2</td> <td>2</td> <td>-</td> <td>2</td> <td>2</td> <td>2</td> <td>-</td> <td>-</td> <td>-</td> <td>3</td> <td>3</td> <td>3</td> <td>2</td> <td>2</td> <td>1</td> </tr> <tr> <td>CO 3</td> <td>2</td> <td>2</td> <td>-</td> <td>2</td> <td>2</td> <td>1</td> <td>-</td> <td>-</td> <td>-</td> <td>2</td> <td>3</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> </tr> <tr> <td>CO 4</td> <td>2</td> <td>2</td> <td>1</td> <td>1</td> <td>2</td> <td>2</td> <td>-</td> <td>-</td> <td>-</td> <td>3</td> <td>2</td> <td>3</td> <td>2</td> <td>2</td> <td>1</td> </tr> <tr> <td>CO 5</td> <td>2</td> <td>2</td> <td>-</td> <td>2</td> <td>2</td> <td>1</td> <td>-</td> <td>-</td> <td>-</td> <td>2</td> <td>3</td> <td>1</td> <td>1</td> <td>2</td> <td>1</td> </tr> </tbody> </table>															CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak													CO/PSO Mapping			COs	Programme Outcomes (POs)												PSOs			PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	CO 1	2	-	-	3	2	2	-	-	-	3	3	3	2	2	1	CO 2	2	2	-	2	2	2	-	-	-	3	3	3	2	2	1	CO 3	2	2	-	2	2	1	-	-	-	2	3	1	1	1	1	CO 4	2	2	1	1	2	2	-	-	-	3	2	3	2	2	1	CO 5	2	2	-	2	2	1	-	-	-	2	3	1	1	2	1
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CO 3	2	2	-	2	2	1	-	-	-	2	3	1	1	1	1																																																																																																																														
CO 4	2	2	1	1	2	2	-	-	-	3	2	3	2	2	1																																																																																																																														
CO 5	2	2	-	2	2	1	-	-	-	2	3	1	1	2	1																																																																																																																														
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1.Continuous Assessment Test I, II & III																																																																																																																																													
2.Assignment																																																																																																																																													

  
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3.End-Semester examinations			
<b>Indirect</b>			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>INDUSTRIAL IOT INTRODUCTION</b>	Periods	<b>13</b>
Introduction to IOT, IIOT & IOT Vs. IIOT, History of IIOT, Components of IIOT -Sensors, Interface, Networks, Key terms – IOT Platform, Interfaces, API, clouds, Data Management Analytics, Mining & Manipulation; Role of IIOT in Manufacturing Processes Use of IIOT in plant maintenance practices, Sustainability through Business excellence tools Challenges & Benefits in implementing IIOT			
<b>Unit – II</b>	<b>IIOT ARCHITECTURE</b>	Periods	<b>12</b>
IIOT components; Various Architectures of IOT and IIOT, Advantages & disadvantages, Industrial Internet-Reference Architecture; IIOT System components: Sensors, Gateways, Routers, Modem, Cloud brokers, servers and its integration, WSN, WSN network design for IOT			
<b>Unit – III</b>	<b>SENSORS AND PROTOCOLS</b>	Periods	<b>11</b>
Introduction to sensors, Roles of sensors in IIOT, Various types of sensors, Design of sensors, sensor architecture, special requirements for IIOT sensors, Role of actuators, types of actuators. Need of protocols; Types of Protocols, Wi-Fi, Wi-Fi direct, Zigbee, Z wave, Bacnet, BLE, Modbus, SPI, I2C, IIOT protocols – COAP, MQTT, 6lowpan, lwm2m, AMPQ. Hardwire the sensors with different protocols such as HART, MODBUS-Serial & Parallel, Ethernet, BACNet.			
<b>Unit – IV</b>	<b>PRIVACY AND SECURITY</b>	Periods	<b>11</b>
Introduction to web security, Conventional web technology and relationship with IIOT, Vulnerabilities of IoT, Privacy, Security requirements, Threat analysis, Trust, IoT security tomography and layered attacker model, Identity establishment, Access control, Message integrity, Non-repudiation and availability			
<b>Unit – V</b>	<b>INDUSTRIAL IoT- APPLICATIONS AND CASE STUDIES OF IIoT SYSTEMS</b>	Periods	<b>13</b>
Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management. IIoT application development with Embedded PC based development boards, Development of mini Project on new version of Operating systems and Edge development board.			
<b>Total Periods</b>			<b>60</b>
<b>Text Books</b>			
1.	Veneri, Giacomo, and Antonio Capasso. Hands-on Industrial Internet of Things: Create a Powerful Industrial IoT Infrastructure Using Industry 4.0, 1st edition, Packt Publishing Ltd, 2018.		
2.	Industry 4.0: The Industrial Internet of Things”, by Alasdair Gilchrist (Apress), 2017		
<b>References</b>			
1.	The Internet of Things: Key Applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi, 2nd Edition, Willy Publications 2017		
2.	“The Concept Industry 4.0 An Empirical Analysis of Technologies and Applications in Production Logistics”, Bartodziej, Christoph Jan Springer: Publication in the field of economic science. 2016		
3.	Embedded System: Architecture, Programming and Design by Rajkamal, TMH3. 2017		
4.	“Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems”, Dr. Ovidiu Vermesan, Dr. Peter Friess, River Publishers, 2013		
<b>E-Resources</b>			
1.	<a href="https://download.e-bookshelf.de/download/0007/6832/86/L-G-0007683286-0014731014.pdf">https://download.e-bookshelf.de/download/0007/6832/86/L-G-0007683286-0014731014.pdf</a>		
2.	<a href="https://www.ifm.eng.cam.ac.uk/uploads/DIAL/industrial-internet-of-things-report.pdf">https://www.ifm.eng.cam.ac.uk/uploads/DIAL/industrial-internet-of-things-report.pdf</a>		

  
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Programme	B.E	Programme Code		103	Regulation		2023	
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>			Semester		VI		
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks		
		L	T	P	C	CA	ESE	Total
U23EC604	VLSI Design Laboratory	0	0	2	1	60	40	100
Course Objective	The student should be made to,							
	<ul style="list-style-type: none"> <li>Simulate basic digital components and systems using Verilog HDL.</li> <li>Design and simulate sequential circuits and arithmetic logic units like multipliers and counters.</li> <li>Perform synthesis, place &amp; route, and post-layout simulation for digital circuits.</li> <li>Implement digital designs on FPGA platforms for real-time applications.</li> <li>Design and simulate CMOS-based logic gates and flip-flops using industry-standard EDA tools</li> </ul>							
Course Outcome	At the end of the course, the student should be able to,						Knowledge Level	
	CO1: Design and simulate basic combinational and sequential circuits such as adders, subtractors, comparators, and counters using Verilog HDL.						K3	
	CO2: Develop and simulate finite state machines and 4-bit multipliers using Verilog HDL for digital system applications.						K3	
	CO3: Perform synthesis, placement, routing, and post-simulation for Verilog designs using FPGA tools.						K4	
	CO4: Design and implement complex digital systems like real-time clocks and array multipliers using FPGA development boards.						K3	
CO5: Simulate CMOS logic gates and flip-flops using IC design tools like Cadence, Tanner, or MAGMA and understand their transistor-level behavior.						K2		
Pre-requisites	-							

COs	CO/POMapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak												CO/PSO Mapping		
	Programme Outcomes (POs)												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3		3		2					3			3		2
CO2	3	3			2	3								2	
CO3	3		3		2					2			3		
CO4	3	3			3	3								2	2
CO5	3				3					2			3		


#### Course Assessment Methods

##### Direct

1. Prelab and Postlab Test/ Viva Questions.
2. Record
3. End-Semester Examinations

##### Indirect

1. Course-end survey.



  
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Content of the syllabus		
List of Experiments		
Xilinx experiments		Course Outcome
1.	Design and simulation of Full adder, full subtractor	CO1
2.	Design and simulation of Multiplexer, Decoder and 4 bit comparator	CO1
3.	Verilog HDL based design entry and simulation of Ripple counter, Synchronous counter and BCD counter	CO2
4.	Design and simulation of simple state machines	CO
5.	Design and simulation of 4bit multiplier using Verilog HDL	CO3
6.	Synthesis, Place &Route and post Place &Route simulation of the components simulated in (1-5)above.	CO3
FPGA Based Experiments		
7.	Design and implementation of 4X4 array multiplier and Wallace tree in FPGA	CO4
8.	Design and Implement a real time clock using FPGA	CO4
IC Design Experiments (Based on Cadence/MAGMA/Tanner)		
9.	Design and simulation of basic gates using CMOS transistors	CO5
10.	Design and simulation of D-Flip flop using CMOS transistors	CO5
<b>Total Periods</b>		<b>45</b>
Text Books		
1.	Palnitkar Samir, "Verilog HDL: Guide to Digital Design and synthesis", 2 <sup>nd</sup> Edition, Pearson Education, New Delhi, 2017.	
2.	Neil Weste & David Harris, "CMOS VLSI Design-A circuits & System Perspective", 4th Edition, Pearson education, New Delhi, 2017	
E-Resources		
1.	<a href="https://syssec.ethz.ch/content/dam/ethz/special-interest/infk/inst-infsec/system-security-group-dam/education/Digitaltechnik_14/09_Verilog_Sequential.pdf">https://syssec.ethz.ch/content/dam/ethz/special-interest/infk/inst-infsec/system-security-group-dam/education/Digitaltechnik_14/09_Verilog_Sequential.pdf</a>	
2.	<a href="https://ia800803.us.archive.org/12/items/DigitalLogicAndComputerDesignByM.MorrisMano2ndEdition/Digital%20Logic%20And%20Computer%20Design%20By%20M.%20Morris%20Mano%20%20282nd%20Edition%29.pdf">https://ia800803.us.archive.org/12/items/DigitalLogicAndComputerDesignByM.MorrisMano2ndEdition/Digital%20Logic%20And%20Computer%20Design%20By%20M.%20Morris%20Mano%20%20282nd%20Edition%29.pdf</a>	
3.	<a href="https://syssec.ethz.ch/content/dam/ethz/special-interest/infk/inst-infsec/system-security-group-dam/education/Digitaltechnik_14/09_Verilog_Sequential.pdf">https://syssec.ethz.ch/content/dam/ethz/special-interest/infk/inst-infsec/system-security-group-dam/education/Digitaltechnik_14/09_Verilog_Sequential.pdf</a>	



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Programme	B.E		Programme Code			103		Regulation		2023					
Department	ELECTRONICS AND COMMUNICATION ENGINEERING						Semester		VI						
Course Code	Course Name		Periods Per Week			Credit	Maximum Marks								
			L	T	P		C	CA	ESE	Total					
U23EC605	Computer Networks Laboratory		0	0	2	1	60	40	100						
Course Objective	The student should be made to, <ul style="list-style-type: none"> <li>Understand and implement various network topologies and transmission protocols.</li> <li>Apply encryption, decryption, and error control techniques for secure and reliable communication.</li> <li>Implement and analyze data link layer protocols such as Stop &amp; Wait, Go-Back-N, and Selective Repeat.</li> <li>Study client-server communication using socket programming and routing protocols.</li> <li>Simulate and evaluate the performance of networks using congestion control and MAC protocols through tools like NS2/NS3.</li> </ul>														
Course Outcome	At the end of the course, the student should be able to,										Knowledge Level				
	CO1: Demonstrate the functioning of different network topologies and apply basic encryption, decryption, and error control techniques.										K2				
	CO2: Implement and analyze reliable data transfer protocols including Stop & Wait, Go-Back-N, Selective Repeat, and HDLC.										K3				
	CO3: Develop socket programs for client-server models and use standard network utilities like ping, echo, and talk.										K3				
	CO4: Simulate and evaluate routing algorithms such as Distance Vector and Link State, and study RIP protocol behavior.										K4				
CO5: Use network simulators to analyze MAC protocols (CSMA/CD, CSMA/CA) and congestion control mechanisms										K4					
Pre-requisites	-														
CO / PO Mapping													CO/PSO Mapping		
(3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 – Weak															
COs	Programme Outcomes (POs)											PSOs			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO 1	3		2		3	2				2			3		2
CO 2	3		2		3	2							3	2	
CO 3	3		2		3	2							3		
CO 4	3		2		2					2			3	3	2
CO 5	3		2		2	2							3		2
Course Assessment Methods															
Direct															
1. Pre lab and Post lab Test/ Viva Questions. 2. Record 3. End-Semester examinations															


  
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<b>Indirect</b>		
1. Course - end survey.		
<b>Content of the syllabus</b>		
<b>List of Experiments</b>		<b>Course Outcome</b>
1.	Network Topology - Star, Bus, Ring	CO1
2.	Encryption and decryption.	CO1
3.	Implementation of Error Detection / Error Correction Techniques	CO1
4.	Implementation of (i) Stop and Wait Protocol and sliding window (ii) Go back-N and selective repeat protocols	CO2
5.	Implementation and study of High Level Data Link Control	CO2
6.	Write a socket Program for Client – Server model and Echo/Ping/Talk commands	CO3
7.	Implementation of distance vector routing algorithm and Link state routing algorithm	CO4
8.	To create scenario and study the performance of network with CSMA / CA protocol and compare with CSMA/CD protocols.	CO5
9.	Study of Network simulator (NS) and simulation of Congestion Control Algorithms using NS	CO4
10.	Design & Simulation of Networking Protocols Using Cisco Packet Tracer	CO5
<b>Total Periods</b>		<b>45</b>
<b>Text Books</b>		
1.	James F.Kurose & Keith W.Ross, “Computer Networking A Top-down Approach Featuring the Internet”, PHI, 8 <sup>th</sup> Edition, 2022.	
2.	Andrew S.Tannenbaum, Nick Feamster, David J .Wetherall, “Computer Networks”, Pearson Education, Sixth edition, 2022.	
<b>E-Resources</b>		
1.	<a href="https://abdulkadirsyam.files.wordpress.com/2010/02/computer-networking-a-top-down-approach-featuring-the-internet.pdf">https://abdulkadirsyam.files.wordpress.com/2010/02/computer-networking-a-top-down-approach-featuring-the-internet.pdf</a>	
2.	<a href="https://www.cse.iitk.ac.in/users/dheeraj/cs425/">https://www.cse.iitk.ac.in/users/dheeraj/cs425/</a>	

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Programme	BE			Programme Code	103			Regulation			2023				
Department	ELECTRONICS AND COMMUNICATION ENGINEERING						Semester			V & VI					
Course Code	Course Name	Periods Per Week		Credit	Maximum Marks										
		L	T		P	C	CA	ESE	Total						
U23EC507 & U23EC606	MINI PROJECT-I & MINI PROJECT-II	0	0	2	1	100		-	100						
<b>Course Objective</b>	The student should be made to														
	<ul style="list-style-type: none"> <li>Understand the process of identifying a relevant research area under ECE.</li> <li>Interpret and summarize scientific literature related to the chosen project topic.</li> <li>Develop an appropriate experimental design or prototype based on the identified problem.</li> <li>Analyze experimental results or design data and derive meaningful conclusions.</li> <li>Evaluate the outcomes of the project and document findings with future research scope.</li> </ul>														
<b>Course Outcome</b>	At the end of the course, the student should be able to,											Knowledge Level			
	CO1: Demonstrate a clear understanding of the selected project problem by explaining its significance, scope, and relevance to the chosen domain.											K2			
	CO2: Conduct a comprehensive literature review to justify the project rationale and formulate specific, measurable research objectives.											K3			
	CO3: Critically analyze the problem and develop an appropriate methodology or design strategy to address it.											K4			
	CO4: Implement the proposed methodology through experiments, modeling, or simulations, and analyze the results using suitable tools and techniques.											K5			
CO5: Evaluate the overall outcomes of the project, compile a comprehensive technical report, and propose future scope or applications.											K6				
<b>Pre-requisites</b>	Analog and Digital Electronics														
<b>CO / PO Mapping</b> (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak													<b>CO/PSO Mapping</b>		
<b>COs</b>	<b>Programme Outcomes (POs)</b>												<b>PSOs</b>		
	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO1</b>	<b>PSO 2</b>	<b>PSO 3</b>
<b>CO 1</b>	3	2	1					1	2		1	2	1	1	
<b>CO 2</b>	3	3	2					1	3		2	3	2	2	
<b>CO 3</b>	2	3	3	2	2			2	2	1	2	3	3	2	
<b>CO 4</b>	2	2	3	3	3			2	2	1	3	3	3	3	
<b>CO 5</b>	2		2	2	1	1		1	3	3	2	3	2	3	3
<b>Course Assessment Methods</b>															
<b>Direct</b>															
1. Project Reviews-I,II & III															
<b>Indirect</b>															
1. Course - End survey															

  
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Programme	B.E.	Programme Code			103	Regulation		2023	
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>				Semester		VI		
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks			
		L	T	P		C	CA	ESE	Total
U23EC607	<b>Comprehensive Examination</b>	3	0	0	1	100			100
<b>Course Objective</b>	The student should be made to								
	<ul style="list-style-type: none"> <li>• Provide a strong foundation in applied mathematics essential for understanding engineering problems, including linear algebra, calculus, and probability.</li> <li>• Equip with the analytical techniques necessary to model, analyze, and solve electrical and electronic circuits and control systems.</li> <li>• Develop an understanding of electronic devices, electromagnetics, and their applications in communication and signal processing systems.</li> <li>• Impart practical knowledge of analog and digital circuits, semiconductor memories, and the fundamentals of computer organization.</li> <li>• Introduce the principles of communication systems, both analog and digital, and explore key concepts in information theory and modulation techniques.</li> </ul>								
<b>Course Outcomes</b>	At the end of the course, the student should be able to,								Knowledge Level
	CO1: Apply mathematical concepts such as linear algebra, calculus, and probability to solve engineering problems related to circuits and signals.								K3
	CO2: Analyze and interpret the behavior of electrical circuits, control systems, and signal processing systems using techniques like Routh-Hurwitz, Nyquist, Bode, and root-locus.								K4
	CO3: Analyze the characteristics and performance of electronic devices such as BJT, MOSFET, and optoelectronic components, and their roles in analog and digital applications.								K4
	CO4: Design and troubleshoot analog and digital circuits using diodes, amplifiers, op-amps, combinational and sequential logic, and data converters.								K3
CO5: Analyze analog and digital communication systems, including modulation techniques, information theory metrics, and error performance in noisy channels.								K4	
<b>Pre-requisites</b>									

COs	CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak											CO/PSO Mapping		
	Programme Outcomes (POs)											PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O 2
CO 1	3	2	1	1							2	3	2	
CO 2	3	3	2	2	2							3	2	2
CO 3	3	3	2	2	2			2	2		2	3	2	
CO 4	3	3	2	2	2			2	2		2	3	2	2
CO 5	3	2	1	1								3	2	

  
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<b>Course Assessment Methods</b>			
<b>Direct</b>			
1.Continuous Assessment Test I, II & III			
2.Assignment			
<b>Indirect</b>			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>Engineering Mathematics</b>	<b>Periods</b>	<b>9</b>
Linear Algebra- Calculus-Differential Equations-Vector Analysis-Complex Analysis-Probability and Statistics.			
<b>Unit – II</b>	<b>Networks, Signals and Control Systems</b>	<b>Periods</b>	<b>9</b>
Circuit analysis- Continuous-time signals-Discrete-time signals -Basics control system components, Feedback principle, Transfer function, Block diagram representation, Signal flow graph, Transient and steady-state analysis, Routh-Hurwitz and Nyquist stability criteria, Bode and root-locus plots, compensators, State variable model and solution.			
<b>Unit – III</b>	<b>Electronic Devices and Electromagnetics</b>	<b>Periods</b>	<b>9</b>
Energy bands-Carrier transport-PN junction, Zener diode, BJT, MOS capacitor, MOSFET, LED, photo diode and solar cell. Maxwell's equations-Plane waves and properties-Transmission lines- waveguides- light propagation in optical fibers, dipole and monopole antennas, linear antenna arrays.			
<b>Unit – IV</b>	<b>Analog and Digital Circuits</b>	<b>Periods</b>	<b>9</b>
Diode circuits-BJT and MOSFET amplifiers-Op-amp circuits-Number representations-Combinatorial circuits-Sequential circuits-Data converters-Semiconductor memories-Computer organization			
<b>Unit – V</b>	<b>Communications</b>	<b>Periods</b>	<b>9</b>
Random processes: auto correlation and power spectral density, white noise, filtering through LTI systems. Analog communications- angle modulation and demodulation, spectra of AM and FM, super heterodyne receivers. Information theory- entropy, mutual information and channel capacity theorem. Digital communications- DPCM, ASK, PSK, FSK, QAM, matched filter receiver, SNR and BER, error correction.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	GATE 2026 Electronics and Communication, ACE Engineering Publications, May2025		
2.	GATE ECE PYQ Book, Kailash Choudhary, Two Brothers Publications, 5 <sup>th</sup> Edition, 2025		
3.	IFAS GATE Electronics & Communication Engineering 2026 Book, IFAS Publications		
<b>E-Resources</b>			
1.	<a href="https://sites.google.com/smail.iitm.ac.in/electronics-and-communication-/engineering-mathematics?authuser=0">https://sites.google.com/smail.iitm.ac.in/electronics-and-communication-/engineering-mathematics?authuser=0</a>		
2.	<a href="https://gate.nptel.ac.in/">https://gate.nptel.ac.in/</a>		
3.	<a href="https://gatenotes.in//gate-ece-notes.php">https://gatenotes.in//gate-ece-notes.php</a>		



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Course Code	Course Name	Periods per week			Credit	Maximum Marks								
		L	T	P		C	CA	ESE	Total					
U23CTCE3	Intellectual Property Rights	2	0	0	1	40	60	100						
Course Objective	The student should be made to,													
	<ul style="list-style-type: none"> <li>Know about Intellectual property rights and classification.</li> <li>Understand about Patents, Registration &amp; Procedure and other information</li> <li>Learn about Copyrights, Registration &amp; Procedure and other information</li> <li>Understand about Trademark, Registration &amp; Procedure and other information</li> <li>Know about other forms of IP, Registration &amp; Procedure and other information</li> </ul>													
Course Outcome	At the end of the course, the student should be able to,							KL						
	CO1: Explain the different types of intellectual property rights and their classifications.							K2						
	CO2: Demonstrate the knowledge of types of inventions that can be patented and the rights conferred by a patent.							K2						
	CO3: Explain the concept of copyright and its importance in protecting creative works.							K2						
	CO4: Demonstrate knowledge of the process for registering a trademark and the legal enforcement of trademark rights							K3						
	CO5: Identify and explain other forms of intellectual property, such as trade secrets, industrial designs, and geographical indications.							K3						
Pre-requisites	-													
<b>CO / PO Mapping</b>												<b>CO/PSO Mapping</b>		
(3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak														
COs	Programme Outcomes (POs)											PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	1			3	2			2	1	1		2		
CO 2	1			3	2			2	1	1		2		
CO 3	1			3	2			2	1	1		2		
CO 4	1			3	2			2	1	1		2		
CO 5	1			3	2			2	1	1		2		
<b>Course Assessment Methods</b>														
<b>Direct</b>														
1. Continuous Assessment Test I, II & III														
2. Assignments / Seminar/Quiz														
<b>Indirect</b>														
1. Course - end survey														
<b>Content of the syllabus</b>														
Unit - I	<b>Introduction</b>											Periods	6	
Introduction and need for Intellectual Property Rights- Types of Intellectual Property Rights - Patent, Copyright, Trademark, Design, Geographical Indication- Trade secret.-TRIPS and other treaties.														

  
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<b>Unit – II</b>	<b>Patents</b>	<b>Periods</b>	<b>6</b>
Patents-Elements of patentability: Novelty, Non Obviousness (Inventive Steps), Industrial Application – Non-Patentable Subject Matter- Registration Procedure, Rights and Duties of Patentee, Assignment and license, Restoration of lapsed Patents, Surrender and Revocation of Patents.			
<b>Unit – III</b>	<b>Copyright</b>	<b>Periods</b>	<b>6</b>
Nature of Copyright – Subject matter of Copyright: original literary, dramatic, musical, artistic works; Cinematograph films and sound recordings – Registration Procedure, Term of protection, Ownership of copyright, Assignment and license of copyright.			
<b>Unit – IV</b>	<b>Trademark</b>	<b>Periods</b>	<b>6</b>
Concept of trademarks – Different kinds of trademarks ( Brand names, Logos, Signatures, Symbols, Well known marks, certification marks and service marks) – Non Registrable Trademarks – Registration of Trademarks – Rights of holder and assignment and license of marks.			
<b>Unit - V</b>	<b>Other forms of IP</b>	<b>Periods</b>	<b>6</b>
<b>Design:</b> Meaning and Concept of Novel and Original Design - Procedure for Registration- Effect of Registration and term of Protection			
<b>Geographical Indication(GI):</b> Meaning and Difference between GI and trademarks- Procedure for Registration- Effect of Registration and term of Protection- overview of IP laws in India-WIPO			
<b>Total Periods</b>			<b>30</b>
<b>Text Books</b>			
1.	K. V. Nithyananda” Intellectual Property Rights: Protection and Management” Cengage Learning India -2019 ISBN: 9789386668578		
2.	Neeraj Pandey, Khushdeep Dharni “Intellectual Property Rights” PHI Learning Pvt. Ltd., 2014		
<b>References</b>			
1.	Deborah E Bouchoux “Intellectual Property : The Law of Trademarks, Copyrights, Patents and Trade Secrets” Cengage Learning India		
2.	Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013		
3.	Prabuddha Ganguli, Intellectual Property Rights: Unleashing the Knowledge Economy, McGraw Hill Education, 2011		
4.	Ahuja, V K. (2017). Law relating to Intellectual Property Rights. India, IN: LexisNexis.		
<b>E-Resources</b>			
1	<a href="https://www.nitap.ac.in/storage/pdf/f63d0ea9127821f83a5a4ad9f1531be8-10-04-11of%20IPR.pdf">https://www.nitap.ac.in/storage/pdf/f63d0ea9127821f83a5a4ad9f1531be8-10-04-11of%20IPR.pdf</a>		
2	<a href="https://www.copyright.gov.in/Documents/Copyrightrules1957.pdf">https://www.copyright.gov.in/Documents/Copyrightrules1957.pdf</a>		
3	<a href="https://www.bdu.ac.in/cells/assets/docs/ipr/course/resources/IPR-Course-Chapter2.pdf">https://www.bdu.ac.in/cells/assets/docs/ipr/course/resources/IPR-Course-Chapter2.pdf</a>		
4	<a href="https://thelegalschool.in/blog/types-of-trademark">https://thelegalschool.in/blog/types-of-trademark</a>		
5	<a href="https://dst.gov.in/sites/default/files/E-BOOK%20IPR.pdf">https://dst.gov.in/sites/default/files/E-BOOK%20IPR.pdf</a>		





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U23CTCH2	<b>SOCIAL NETWORKING FOR HIGHER STUDIES</b>	2	0	0	1	40	60	100																																																																																																																																																					
<b>Course Objective</b>	The main objective of the course is to: <ul style="list-style-type: none"> <li>• Understand the fundamentals of networking, its benefits, and the distinction between quality and quantity in professional networking for career growth.</li> <li>• Gain practical knowledge of digital networking tools such as LinkedIn, Facebook, Twitter, Google+, and open learning networks to enhance professional connections.</li> <li>• Develop strong interpersonal and communication skills, including empathy, active listening, and networking etiquette, to build meaningful professional relationships.</li> <li>• Learn effective networking strategies, including business communication, emotional intelligence, and copyright considerations, to create a successful networking plan.</li> <li>• Explore the impact of digital footprints, long-term networking strategies, and case studies related to overseas education and scholarships, enabling students to leverage networking for academic and career advancements.</li> </ul>																																																																																																																																																												
<b>Course Outcome</b>	At the end of the course, the student should be able to						<b>Knowledge Level</b>																																																																																																																																																						
	<b>CO1:</b> To explain the fundamentals of networking, its benefits, and the importance of quality networking in professional and academic growth.						K2																																																																																																																																																						
	<b>CO2:</b> To utilize digital networking tools such as LinkedIn, Facebook, Twitter, and Google+ for professional connections and career opportunities.						K3																																																																																																																																																						
	<b>CO3:</b> To analyze and apply effective listening skills, empathy, and networking etiquette for building strong professional relationships.						K4																																																																																																																																																						
	<b>CO4:</b> To develop interpersonal and business communication skills, understand emotional intelligence, and create a networking plan for career development.						K3																																																																																																																																																						
	<b>CO5:</b> To assess digital footprints, implement long-term networking strategies, and evaluate case studies on overseas education and scholarships.						K3																																																																																																																																																						
<b>Pre-requisites</b>	-																																																																																																																																																												
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<ol style="list-style-type: none"> <li>1. Continuous Assessment Test I, II &amp; III</li> <li>2. Assignment, Seminar and Quiz</li> <li>3. End-Semester examinations</li> </ol>			
<b>Indirect</b>			
<ol style="list-style-type: none"> <li>1. Course - end survey</li> </ol>			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>INTRODUCTION</b>	<b>Periods</b>	<b>6</b>
Networking, Benefits, Quality vs Quantity in Networking, Networking for new opportunities, Networking for Professional Partnership, Local and In-person networking			
<b>Unit - II</b>	<b>DIGITAL NETWORKING</b>	<b>Periods</b>	<b>6</b>
Tools for Online Networking – Linkedin, Facebook, Twitter, Google+, LMS, Open Learning Networks.			
<b>Unit – III</b>	<b>EMPATHIZING</b>	<b>Periods</b>	<b>6</b>
Art of Listening, Empathy, Listening Models, Networking etiquette, Digital Storytelling, Lead Generation			
<b>Unit - III</b>	<b>COMMUNICATION</b>	<b>Periods</b>	<b>6</b>
Interpersonal Skills, Personality and Emotional Intelligence, Business Communication, Copyrights, Networking Plan			
<b>Unit - V</b>	<b>DIGITAL FOOTPRINTS</b>	<b>Periods</b>	<b>6</b>
Introverts & Extroverts, Maintain Your Connections, Long-Term Networking Strategies, Case Studies-Scholarship for higher education in various countries –Case study			
<b>Total Periods</b>			<b>30</b>
<b>Text Books</b>			
1.	Andrea R Nirenberg "Essentials of Business networking" Tips, Tools and Tactics you can use, Pearson Education		
2.	Miriam Salpter "Social Networking for career success "Learning express, Newyork		
3.	Andrea R Nirenberg "Network like you means it" handbook for business and personal networking		
4.	Elizabeth A Segal "Social Empathy-Art of understanding others" Columbia University press, New York		
<b>References</b>			
1.	S.P.Bakshi, "Objective English" Arihant Publications.		
2.	Peter W Cardon "Business Communication" Tata Mcgraw Hill Publications, Third edition		
<b>E-Resources</b>			
1.	<a href="https://www.udemy.com/course/networking101/">https://www.udemy.com/course/networking101/</a>		
2.	<a href="https://learndigital.withgoogle.com/digitalunlocked/course/effective-networking">https://learndigital.withgoogle.com/digitalunlocked/course/effective-networking</a>		
3.	<a href="https://www.linkedin.com/learning/professional-networking">https://www.linkedin.com/learning/professional-networking</a>		
4.	<a href="https://alison.com/course/personal-business-networking-skills-for-maximum-success">https://alison.com/course/personal-business-networking-skills-for-maximum-success</a>		
5.	<a href="https://www.edx.org/professional-certificate/uwashingtonx-english-for-businessnetworking">https://www.edx.org/professional-certificate/uwashingtonx-english-for-businessnetworking</a>		



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Programme	<b>B.E. / B.Tech</b>	Programme code	<b>103</b>	Regulation	<b>2023</b>										
Department	<b>Electronics and Communication Engineering</b>			Semester	<b>VI</b>										
Course Code	Course Name	Periods per week			Credit	Maximum Marks									
		L	T	P	C	CA	ESE	Total							
<b>U23CTCP5</b>	<b>Integrated Reasoning and Pseudo Code</b>	2	0	0	1	40	60	100							
<b>Course Objective</b>	The student should be made to, <ul style="list-style-type: none"> <li>• Develop Proficiency in Verbal Communication and Writing.</li> <li>• Master Mensuration, Geometry, and Coordinate Geometry Concepts.</li> <li>• Apply Pseudo Code in Problem-Solving.</li> <li>• Enhance Logical Reasoning and Analytical Thinking.</li> </ul>														
<b>Course Outcome</b>	At the end of the course, the student should be able to,							<b>Knowledge Level</b>							
	CO1: Demonstrate strong Verbal and Written Communication skills.							K3							
	CO2: Apply Mensuration and Geometry Concepts to Solve Real-World Problems.							K3							
	CO3: Design and Implement structure based Pseudo Codes.							K3							
	CO4: Optimize DSA based Pseudo codes for Effective Problem-Solving.							K4							
CO5: Enhance Logical and Analytical Reasoning Skills for Complex Problem Solving.							K2								
<b>Pre-requisites</b>	-														
<b>CO / PO Mapping</b> (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 – Weak												<b>CO/PSO Mapping</b>			
<b>COs</b>	<b>Programme Outcomes (POs)</b>												<b>PSOs</b>		
	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
<b>CO 1</b>	1	2	2	2		1		1	1	3		2	2	2	3
<b>CO 2</b>	3	3	3	3		2			1			1	2	2	1
<b>CO 3</b>	3	3	3	3	2	2		1	2	2		2	2	3	3
<b>CO 4</b>	3	3	3	3	2			1	2	3		2	2	3	3
<b>CO 5</b>	3	3	3	3	3	3		1	2	3		2	3	3	3
<b>Course Assessment Methods</b>															
<b>Direct</b>															
1.Continuous Assessment Test I, II & III															
2.Assignments / Seminar/Quiz															
3.End-Semester Examinations															
<b>Indirect</b>															
1.Course -end survey															
<b>Content of the syllabus</b>															
<b>Unit -I</b>	<b>Verbal Ability</b>											Periods	<b>4</b>		
Reading Comprehension, Essay Writing															
<b>Unit-II</b>	<b>Mensuration and Geometry</b>											Periods	<b>8</b>		

*[Signature]*  
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Tiruchengode, Namakkal - 637 205.

<b>MENSURATION:</b> 2D - Area and Perimeter – Triangles, Square, Rectangle, Parellelogram, Rhombus, Trapezoid, Circles, quadrilaterals and Polygons. 3D - Surface area and Volume – Cuboids, Cube, Cylinder, Cone, Sphere, Prism and Pyramids.			
<b>GEOMETRY:</b> points, lines, planes, angles and shapes, including triangles, quadrilaterals, and circles and polygons along with topics like congruence, similarity, area and volume, Co-ordinate Geometry.			
<b>Unit – III</b>	<b>Structure based Pseudo code</b>	<b>Periods</b>	<b>6</b>
Pseudo codes: Accenture, Capgemini, TCS , DXC, Hexaware based on string, condition, control, function and recursive			
<b>Unit- IV</b>	<b>DSA based Pseudo code</b>	<b>Periods</b>	<b>6</b>
Pseudo codes on DSA- Sorting and Graph based on array, tree (inorder, preorder, post order, binary tree, binary search tree, tree rotation, b and b <sup>++</sup> , balanced tree,			
<b>Unit-V</b>	<b>Logical Reasoning</b>	<b>Periods</b>	<b>6</b>
<b>Analogy</b> –Number and Alphabet analogy; <b>Inequalities</b> –Comparisons-Logical Deduction-Coded Relationships; <b>Ranking and ordering</b> -Ranking from left/right or top/bottom, Total number of people/objects; <b>Cubes and Cuboids</b> – number of sides painted ,Cutting of cubes vertically & Horizontally, Folding of cubes; <b>Non Verbal</b> – Series, mirror image ,water image, grouping of images, classification, hidden figures, <b>Heights and Distances</b> -Finding the height of an object, Finding the distance between two objects, Finding the distance of an object.			
<b>Total Periods</b>			<b>30</b>
<b>Text books</b>			
1.	Fast Track Objective Arithmetic by Rajeev Varma, Arihant Publication- 2023-24 edition.		
2.	Quantitative Aptitude for CAT - Dinesh k Sinha		
3.	GEOMETRICKS: 356 Short Tricks of Geometry in Math By <u>A.K.VISHWAKARMA</u> (Author), Kindle Edition- 2019		
4.	A Modern Approach to Logical Reasoning by R.S. Aggarwal, S. Chand & Company Ltd.-2022 edition.		
5.	A Complete Book Of Logical Reasoning, Adda247 Publications.		
6.	Objective General English by SP Bakshi – Arihant Publication-2023 edition.		
7.	Industry based Pseudo code		
<b>References</b>			
1.	R.S. Aggarwal “An Advanced Approach to Data Interpretation for Competitive Examinations” S.Chand Twelfth Edition.		
2.	Dinesh Khattar- The Pearson guide to Quantitative Aptitude for Competitive Examinations 3 <sup>rd</sup> edition.		
3.	Arun Sharma, "How to Prepare for Data Interpretation for CAT" McGraw Hill,2025		
4.	How to Crack Test of Reasoning by Arihant Experts-2024 edition		
5.	A modern Approach to verbal and non-verbal reasoning by R.S. Aggarwal-2023 edition		
<b>E-Resources</b>			
1.	Aptitude: <a href="https://pt.scribd.com/">https://pt.scribd.com/</a>		
2.	Reasoning: <a href="https://placement.freshersworld.com">https://placement.freshersworld.com</a>		
3.	Verbal: <a href="https://testbook.com">https://testbook.com</a>		



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Elayampalayam, Tiruchengode – 637 205



Programme	B.E.	Programme Code	103	Regulation	2023			
Department	ELECTRONICS AND COMMUNICATION ENGINEERING			Semester				
Course Code	Course Name	Periods Per Week		Credit	Maximum Marks			
U23ECV11	DIGITAL IC DESIGN	L	T	P	C	CA	ESE	Total
		3	0	0	3	40	60	100

**Course Objective**

The main objective of the course is to

- Understand the fundamentals and fabrication processes involved in CMOS digital integrated circuit design.
- Explore device-level characteristics including threshold voltage, secondary effects, and wire models using SPICE.
- Analyze the performance metrics of CMOS inverters such as delay, noise margin, and power consumption.
- Study various CMOS logic styles including static, dynamic, and pass-transistor logic circuits.
- Understand the design of sequential circuits and memory architectures used in VLSI systems

**Course Outcome**

At the end of the course, the student should be able to,	Knowledge level
<b>CO1:</b> Describe the CMOS fabrication process and identify quality metrics used in digital IC design.	K2
<b>CO2:</b> Analyze MOS transistor behavior including threshold voltage and secondary effects using SPICE models, and evaluate interconnect wire models.	K4
<b>CO3:</b> Evaluate the performance of CMOS inverters in terms of delay, power, and noise margin, considering the effects of technology scaling.	K4
<b>CO4:</b> Compare different logic circuit design styles such as static CMOS, dynamic CMOS, and pass-transistor logic based on functionality and efficiency.	K3
<b>CO5:</b> Design and analyze sequential logic and memory structures including latches, registers, ROM, RAM, CAM, and flash memory.	K3

**Pre-requisites**

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CO / PO Mapping													CO/PSO Mapping		
(3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak															
COs	Programme Outcomes (POs)											PSOs			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O 2	PS O 3
CO1	3	3	2					1				2	3	3	
CO2	3	3	2	1									2	2	
CO3	3	3	2	1								2	3	2	2
CO4	3	2	2	2				2				1		2	
CO5	3	2	2					2		2		1	3	2	

**Course Assessment Methods**

Direct

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1. Continuous Assessment Test I, II & III 2. Assignment: Simulation using tool 3. End-Semester examinations			
<b>Indirect</b>			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>INTRODUCTION</b>	Periods	<b>9</b>
Historical Perspective- Issues in Digital Integrated Circuit Design- Fabrication of CMOS IC and packaging- Quality Metrics of a Digital Design.			
<b>Unit - II</b>	<b>MOS TRANSISTOR</b>	Periods	<b>9</b>
Threshold Voltage-Secondary Effects-SPICE Models. WIRE: Introduction, A First Glance-Interconnect Parameters - Capacitance, Resistance, and Inductance-Electrical wire models-SPICE wire models.			
<b>Unit – III</b>	<b>CMOS INVERTER</b>	Periods	<b>9</b>
Transfer Characteristics-Noise margin, Capacitances, Propagation Delay, Power- Propagation Delay: First-Order Analysis, Propagation Delay from a Design Perspective, Power, Energy, and Energy-Delay: Dynamic Power Consumption, Static Consumption, Perspective: Technology Scaling and its Impact on the Inverter Metrics .			
<b>Unit - IV</b>	<b>COMBINATIONAL LOGIC CIRCUITS IN CMOS</b>	Periods	<b>9</b>
Static CMOS, Pass-Transistors, Dynamic CMOS, Dynamic Logic, Cascading.			
<b>Unit – V</b>	<b>MEMORY STRUCTURES</b>	Periods	<b>9</b>
Sequential Logic Circuits: Timing Metrics, Static and Dynamic Latches, Registers, C2MOS, NORA-CMOS-Memory and Array Structures: ROM, RAM, CAM, Peripheral Circuitry, PLA and Flash Memory.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	J.M. Rabaey, A. Chandrakasan and B. Nikolic, Digital Integrated Circuits- A Design Perspective, 2nd ed., PHI, 2003.		
2.	N.H.E. Weste and K. Eshraghian, Principles of CMOS VLSI Design - a System Perspective, 4 <sup>th</sup> Edition, Pearson Education Asia, 2013		
<b>References</b>			
1.	J. P. Uyemura, Introduction to VLSI Circuits and Systems, John Wiley & Sons (Asia) Pte Ltd, 2002		
2.	R. Jacob Baker, CMOS Circuit Design, Layout, and Simulation, IEEE Press, 2010.		
3.	S.M. Kang and Y. Leblevici, CMOS Digital Integrated Circuits Analysis and Design, 3rd ed., McGraw Hill, 2003		
4.	Ken Martin, “Digital Integrated Circuit Design”, Oxford Publications, 2014.		
<b>E-Resources</b>			
1.	<a href="https://onlinecourses.nptel.ac.in/noc24_ee43/preview">https://onlinecourses.nptel.ac.in/noc24_ee43/preview</a>		
2.	<a href="https://www.youtube.com/watch?v=ks1hIkHdB48">https://www.youtube.com/watch?v=ks1hIkHdB48</a>		
3.	<a href="https://www.youtube.com/watch?v=y0ArIOItJUQ">https://www.youtube.com/watch?v=y0ArIOItJUQ</a>		



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Programme	B.E.	Programme Code	103	Regulation	2023			
Department	ELECTRONICS AND COMMUNICATION ENGINEERING			Semester				
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks		
		L	T	P	C	CA	ESE	Total
U23ECV12	Analog IC Design	3	0	0	3	40	60	100

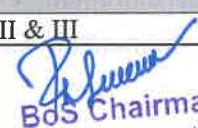
Course Objective	The main objective of the course is to							
	<ul style="list-style-type: none"> <li>Understand and analyze the operation of MOSFET-based single-stage amplifiers and differential configurations.</li> <li>Evaluate high-frequency and noise characteristics of analog amplifier circuits.</li> <li>Explore negative feedback, performance parameters, and advanced operational amplifier architectures.</li> <li>Study stability criteria and compensation methods in multistage amplifier design.</li> <li>Introduce logic circuit fault detection and design-for-testability techniques in analog/mixed-signal systems.</li> </ul>							

Course Outcome	At the end of the course, the student should be able to,	Knowledge level
	CO1: Analyze single-stage and differential MOS amplifier configurations (CS, CG, Cascode) to meet specifications such as gain, bandwidth, and power dissipation.	K4
	CO2: Evaluate the frequency response and noise performance of MOS amplifier stages using Miller effect and pole-node analysis.	K4
	CO3: Explain the role of negative feedback in operational amplifiers and analyze the impact of gain boosting, PSRR, and slew rate in high-performance Op-Amps.	K3
	CO4: Determine stability and apply frequency compensation techniques in the design of two-stage operational amplifiers.	K3
	CO5: Describe fault models and apply design-for-testability techniques such as scan design and built-in self-test in logic circuits.	K2

Pre-requisites	Linear Integrated circuits basics, Amplifier working concept
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CO / PO Mapping												CO/PSO Mapping			
(3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak															
COs	Programme Outcomes (POs)											PSOs			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O 2	PS O 3
CO1	3	3	3	3	2	2						2	3	3	3
CO2	3	3	2	2	1	2						2	3	2	3
CO3	3	3	2	2	2	2						2	3	2	3
CO4	3	3	3	2	2	1						2	1	2	2
CO5	3	3	3	2	2	2						3	2	1	2

Course Assessment Methods	Direct
	1. Continuous Assessment Test I, II & III

  
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2. Assignment: Simulation using tool			
3. End-Semester examinations			
<b>Indirect</b>			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>SINGLE STAGE AMPLIFIERS</b>	Periods	<b>9</b>
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.			
<b>Unit - II</b>	<b>HIGH FREQUENCY AND NOISE CHARACTERISTICS OF AMPLIFIERS</b>	Periods	<b>9</b>
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.			
<b>Unit – III</b>	<b>FEEDBACK AND SINGLE STAGE OPERATIONAL AMPLIFIERS</b>	Periods	<b>9</b>
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.			
<b>Unit - IV</b>	<b>STABILITY , FREQUENCY COMPENSATION</b>	Periods	<b>9</b>
Multipole Systems, Phase Margin, Frequency Compensation, Compensation of Two Stage Op-Amps, Slewing In Two Stage Op Amps, Other Compensation Techniques.			
<b>Unit – V</b>	<b>LOGIC CIRCUIT TESTING</b>	Periods	<b>9</b>
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.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	Behzad Razavi, “Design Of Analog Cmos Integrated Circuits”, Tata Mcgraw Hill, Second Edition, 2017.		
2.	Parag K.Lala, “An Introduction to Logic Circuit Testing”, Morgan & Claypool Publishers, 2009.		
<b>References</b>			
1.	Willey M.C. Sansen, “Analog Design Essentials”, Springer, 2006.		
2.	Grebene, “Bipolar And MOS Analog Integrated Circuit Design”, John Wiley & Sons, Inc., 2011.		
3.	Phillip E.Allen, Douglas R .Holberg, “CMOS Analog Circuit Design”, Oxford University Press, 2nd Edition, 2002.		
4.	Jacob Baker “CMOS: Circuit Design, Layout, And Simulation, Wiley IEEE Press, 3rd Edition, 2010.		
<b>E-Resources</b>			
1.	Recorded Lecture Available at <a href="http://www.ee.iitm.ac.in/vlsi/courses/ee5320_2021/start">http://www.ee.iitm.ac.in/vlsi/courses/ee5320_2021/start</a>		



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Programme	B.E.	Programme Code	103	Regulation	2023			
Department	ELECTRONICS AND COMMUNICATION ENGINEERING			Semester				
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks		
		L	T	P	C	CA	ESE	Total
U23ECV13	Semiconductor Device Modeling	3	0	0	3	40	60	100
Course Objective	The student should be made to							
	<ul style="list-style-type: none"> <li>Introduce the fundamentals of metal-semiconductor junctions and heterojunctions including Schottky diodes and 2D electron gas.</li> <li>Study the characteristics and scaling issues of long- and short-channel MOSFETs for CMOS design.</li> <li>Analyze the delay and performance factors in CMOS devices due to parasitic effects and device parameters.</li> <li>Understand the operation, characteristics, and modeling of bipolar junction transistors (BJTs).</li> <li>Explore the design and structure of modern bipolar devices including emitter, base, and collector optimization.</li> </ul>							
Course Outcomes	At the end of the course, the student should be able to,							Knowledge Level
	CO1: Explain the principles of metal-semiconductor contacts, Schottky barrier diodes, and heterojunctions including two-dimensional electron gas formation.							K2
	CO2: Analyze the electrical behavior of long-channel and short-channel MOSFETs and their implications for CMOS scaling and design.							K4
	CO3: Evaluate the impact of parasitic elements and device sensitivity on CMOS delay and overall performance in advanced CMOS devices.							K4
	CO4: Describe the electrical characteristics and model the behavior of bipolar transistors for both steady-state and time-dependent circuit analysis.							K3
	CO5: Apply design considerations to optimize emitter, base, and collector regions in modern bipolar transistor structures.							K3
Pre-requisites	-							

COs	CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak												CO/PSO Mapping		
	Programme Outcomes (POs)												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO 1	3		2			2			2				2	2	
CO 2	3	2							2	2			1	2	2
CO 3	3	2	3										2	2	
CO 4	3	2	3	2					2	2			2	2	2
CO 5	3	2	2	2									2	2	

**Course Assessment Methods**

<b>Direct</b>
1.Continuous Assessment Test I, II & III
2.Assignment

  
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3.End-Semester examinations			
<b>Indirect</b>			
1. Course – end survey			
<b>Content of the syllabus</b>			
<b>Unit –I</b>	<b>METAL SEMICONDUCTOR</b>	Periods	<b>9</b>
Metal Semiconductor and Heterojunctions: Schottky barrier diode, Metal semiconductor Ohmic contact, Heterojunction: Two-dimensional electron gas.			
<b>Unit –II</b>	<b>MOSFET DEVICES</b>	Periods	<b>9</b>
Long-channel MOSFETs, Short-channel MOSFETs. CMOS Device Design: MOSFET Scaling, Threshold voltage, MOSFET channel length.			
<b>Unit –III</b>	<b>CMOS PERFORMANCE FACTORS</b>	Periods	<b>9</b>
Basic CMOS circuit elements, Parasitic elements, Sensitivity of CMOS delay to device parameters, Performance factors of advanced CMOS devices.			
<b>Unit –IV</b>	<b>BIPOLAR DEVICES</b>	Periods	<b>9</b>
N-P-N Transistors, Ideal current-voltage characteristics, Characteristics of a typical n-p-n transistor, Bipolar device models for circuit and time-dependent analyses, Breakdown voltages.			
<b>Unit –V</b>	<b>BIPOLAR DEVICE DESIGN</b>	Periods	<b>9</b>
Design of the emitter design, Design of the base region, Design of the collector design, Modern bipolar transistor structures.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	Yuan Taur, Tak.H.Ning, Fundamentals of Modern VLSI Devices, Cambridge University Press, 2021.		
2.	Donald Neamen, Semiconductors Physics and Devices, Tata McGraw Hill, Reprint 2024		
<b>References</b>			
1.	Analysis And Design Of Analog Integrated Circuits 6 <sup>th</sup> Edition, Paul R. Gray, Paul J. Hurst, Robert G Meyer, 2024, Wiley Publications		
2.	Tyagi, Introduction to Semiconductor Materials and Devices, Wiley Publications, 2002.		
3.	Semiconductor Devices, Basic Principles Jasprit Singh, Wiley Publications, 2007		
4.	S.M. Sze (Ed), Physics of Semiconductor Devices, 2nd Edition, Wiley Publications, 2012.		
5.	Physics of Semiconductor Devices 3/e S. M. Sze, Wiley Publications, 2019.		
<b>E-Resources</b>			
1.	<a href="http://www.ecerelatedbooks.com/2018/03/fundamentals-of-modern-vlsi-devices-by.html">http://www.ecerelatedbooks.com/2018/03/fundamentals-of-modern-vlsi-devices-by.html</a>		
2.	<a href="http://www.fulviofrisone.com/attachments/article/403/Semiconductor%20Physics%20And%20Devices%20-%20Donald%20Neamen.pdf">http://www.fulviofrisone.com/attachments/article/403/Semiconductor%20Physics%20And%20Devices%20-%20Donald%20Neamen.pdf</a>		
3.	<a href="https://pdflife.one/download/4660813-semiconductors-m-s-tyagi">https://pdflife.one/download/4660813-semiconductors-m-s-tyagi</a>		



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Programme	B.E.	Programme Code	103	Regulation	2023			
Department	ELECTRONICS AND COMMUNICATION ENGINEERING			Semester				
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks		
		L	T	P	C	CA	ESE	Total
U23ECV14	VLSI Technology	3	0	0	3	40	60	100
Course Objective	The student should be made to							
	<ul style="list-style-type: none"> <li>Understand crystal growth, wafer preparation, epitaxial growth, and oxidation processes in IC fabrication.</li> <li>Explore lithography techniques and plasma etching methods used in micro- and nano-fabrication.</li> <li>Study thin-film deposition processes and solid-state diffusion mechanisms in semiconductor materials.</li> <li>Examine ion implantation techniques and metallization used for device formation and interconnects.</li> <li>Understand integration of process steps and VLSI device packaging technologies.</li> </ul>							
Course Outcomes	At the end of the course, the student should be able to,						Knowledge Level	
	CO1: Explain the principles of silicon crystal growth, epitaxy, and oxidation processes, including mechanisms, kinetics, and oxidation-induced defects.						K2	
	CO2: Describe various lithography methods and plasma etching techniques and analyze their role in achieving feature size control and anisotropy.						K3	
	CO3: Analyze deposition techniques for thin films and apply diffusion models for understanding dopant behavior in solids.						K4	
	CO4: Apply ion implantation theory, annealing methods, and metallization techniques used in modern VLSI processing.						K3	
	CO5: Compare and evaluate different IC fabrication technologies and packaging methods used in VLSI device integration.						K4	
Pre-requisites	Chemical processing and basics of IC Manufacturing technology							

COs	CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak												CO/PSO Mapping		
	Programme Outcomes (POs)												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O 2	PS O 3
CO 1			3						2				2	2	
CO 2			3						2	2			1	2	2
CO 3		2	3										2	2	
CO 4		2	3						2	2			2	2	2
CO 5		2	3										2	2	

**Course Assessment Methods**

<b>Direct</b>
1.Continuous Assessment Test I, II & III
2.Assignment
3.End-Semester examinations

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<b>Indirect</b>			
1. Course – end survey			
<b>Content of the syllabus</b>			
<b>Unit –I</b>	<b>CRYSTAL GROWTH, WAFER PREPARATION, EPITAXY AND OXIDATION</b>	Periods	<b>9</b>
Electronic Grade Silicon, Czochralski crystal growing, Silicon Shaping, processing consideration, Vapor phase Epitaxy, Molecular Beam Epitaxy, Silicon on Insulators, Growth Mechanism and kinetics, Thin Oxides, Oxidation Techniques and Systems, Oxide properties, Redistribution of Dopants at interface, Oxidation of Poly Silicon, Oxidation induced Defects.			
<b>Unit –II</b>	<b>LITHOGRAPHY AND RELATIVE PLASMA ETCHING</b>	Periods	<b>9</b>
Optical Lithography, Electron Lithography, X-Ray Lithography, Ion Lithography, Plasma properties, Feature Size control and Anisotropic Etch mechanism, relative Plasma Etching techniques and Equipments.			
<b>Unit –III</b>	<b>DEPOSITION AND DIFFUSION</b>	Periods	<b>9</b>
Deposition process, Polysilicon, Silicon Dioxide- Silicon Nitride- plasma assisted Deposition, Models of Diffusion in Solids, Flick's one dimensional Diffusion Equation – Atomic Diffusion Mechanism –Measurement techniques			
<b>Unit –IV</b>	<b>ION IMPLEMENTATION AND METALLIZATION</b>	Periods	<b>9</b>
Range theory- Implant equipment. Annealing-Shallow junction – High energy implantation – Metallization Applications- Metallization choices- Physical vapor deposition – Patterning.			
<b>Unit –V</b>	<b>VLSI PROCESS INTEGRATION AND PACKAGING OF VLSI DEVICES</b>	Periods	<b>9</b>
NMOS IC Technology – CMOS IC Technology – MOS Memory IC technology – Bipolar IC Technology – IC Fabrication. Package types– banking design consideration – VLSI assembly technology – Package fabrication technology			
<b>Total Periods</b>			<b>45</b>
<b>References</b>			
1.	Behzad Razavi, “Design Of Analog CMOS Integrated Circuits”, Tata Mc graw Hill, Second Edition, 2017.		
2.	Sze, S.M., “VLSI Technology”, Second Edition, McGraw-Hill, New York, 2003.		
3.	Mukherjee, Amar., “Introduction to NMOS and CMOS VLSI System Design”, Prentice Hall India, New Delhi, 2000.		
4.	Plummer, James D., Deal, Michael D. and Griffin, Peter B., “Silicon VLSI Technology: Fundamentals Practice and Modeling”, Prentice Hall India, New Delhi, 2000.		





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Programme	B.E		Programme Code			103		Regulation		2023																																																																																																																																																
Department	ELECTRONICS AND COMMUNICATION ENGINEERING					Semester																																																																																																																																																				
Course Code	Course Name		Periods Per Week			Credit		Maximum Marks																																																																																																																																																		
			L	T	P	C	CA	ESE	Total																																																																																																																																																	
U23ECV15	Low Power VLSI Design		3	0	0	3		40	60	100																																																																																																																																																
Course Objective	The main objective of the course is to <ul style="list-style-type: none"> <li>Understand the sources and physics of power dissipation in CMOS circuits.</li> <li>Explore logic and circuit-level techniques for power optimization in digital systems.</li> <li>Learn strategies for designing low-power CMOS circuits including arithmetic, memory, clock, and layout techniques.</li> <li>Analyze and estimate power consumption using various analytical and simulation methods.</li> <li>Study power-aware synthesis techniques and software-level optimizations for energy-efficient design.</li> </ul>																																																																																																																																																									
	Course Outcomes	At the end of the course, the student should be able to										Knowledge Level																																																																																																																																														
CO1: Explain the sources of power consumption in CMOS devices and the principles underlying low power design.										K2																																																																																																																																																
CO2: Apply logic and circuit-level techniques to reduce power dissipation in components such as adders and multipliers.										K3																																																																																																																																																
CO3: Analyze and design low power CMOS systems with optimization in clocking, memory, interconnect, and layout structures.										K4																																																																																																																																																
CO4: Use logic and simulation-based power estimation techniques to evaluate power performance in digital circuits.										K3																																																																																																																																																
CO5: Implement behavioral-level transformations and software optimization techniques for reducing power dissipation during synthesis.										K4																																																																																																																																																
Pre-requisites	VLSI and chip design																																																																																																																																																									
<table border="1"> <thead> <tr> <th colspan="13">CO / PO Mapping</th> <th colspan="3">CO/PSO Mapping</th> </tr> <tr> <th colspan="13">(3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak</th> <th colspan="3"></th> </tr> <tr> <th rowspan="2">Cos</th> <th colspan="11">Programme Outcomes (POs)</th> <th colspan="3">PSOs</th> </tr> <tr> <th>PO 1</th> <th>PO 2</th> <th>PO 3</th> <th>PO 4</th> <th>PO 5</th> <th>PO 6</th> <th>PO 7</th> <th>PO 8</th> <th>PO 9</th> <th>PO 10</th> <th>PO 11</th> <th>PO 12</th> <th>PS O1</th> <th>PS O2</th> <th>PS O3</th> </tr> </thead> <tbody> <tr> <td>CO 1</td> <td>2</td> <td>3</td> <td>2</td> <td>3</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>2</td> <td>3</td> <td>2</td> <td>2</td> </tr> <tr> <td>CO 2</td> <td>3</td> <td>3</td> <td>2</td> <td>2</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>2</td> <td>3</td> <td>2</td> <td>2</td> </tr> <tr> <td>CO 3</td> <td>3</td> <td>3</td> <td>3</td> <td>2</td> <td>2</td> <td></td> <td>1</td> <td></td> <td></td> <td></td> <td></td> <td>2</td> <td>2</td> <td>2</td> <td>2</td> </tr> <tr> <td>CO 4</td> <td>3</td> <td>3</td> <td>2</td> <td>2</td> <td>2</td> <td></td> <td>1</td> <td></td> <td></td> <td></td> <td></td> <td>2</td> <td>1</td> <td>2</td> <td>2</td> </tr> <tr> <td>CO 5</td> <td>3</td> <td>3</td> <td>3</td> <td>2</td> <td>2</td> <td></td> <td>1</td> <td></td> <td></td> <td></td> <td></td> <td>2</td> <td>2</td> <td>2</td> <td>2</td> </tr> </tbody> </table>													CO / PO Mapping													CO/PSO Mapping			(3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak																Cos	Programme Outcomes (POs)											PSOs			PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	CO 1	2	3	2	3								2	3	2	2	CO 2	3	3	2	2								2	3	2	2	CO 3	3	3	3	2	2		1					2	2	2	2	CO 4	3	3	2	2	2		1					2	1	2	2	CO 5	3	3	3	2	2		1					2	2	2	2
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<b>Course Assessment Methods</b> <table border="1"> <tr> <td><b>Direct</b></td> </tr> <tr> <td>1. Continuous Assessment Test I, II &amp; III</td> </tr> <tr> <td>2. Assignment and Seminar</td> </tr> <tr> <td>3. End-Semester examinations</td> </tr> <tr> <td><b>Indirect</b></td> </tr> </table>													<b>Direct</b>	1. Continuous Assessment Test I, II & III	2. Assignment and Seminar	3. End-Semester examinations	<b>Indirect</b>																																																																																																																																									
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1.Course – end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>POWER DISSIPATION IN CMOS</b>	Periods	<b>9</b>
Hierarchy of limits of power – Sources of power consumption – Physics of power dissipation in CMOS FET devices- Basic principle of low power design.			
<b>Unit – II</b>	<b>POWER OPTIMIZATION</b>	Periods	<b>9</b>
Logical level power optimization – Circuit level low power design – Circuit techniques for reducing power Consumption in adders and multipliers.			
<b>Unit – III</b>	<b>DESIGN OF LOW POWER CMOS CIRCUITS</b>	Periods	<b>9</b>
Computer Arithmetic techniques for low power systems – Reducing power consumption in memories – Low power clock, Interconnect and layout design – Advanced techniques – Special techniques.			
<b>Unit – IV</b>	<b>POWER ESTIMATION</b>	Periods	<b>9</b>
Power estimation techniques – Logic level power estimation – Simulation power analysis– Probabilistic power analysis.			
<b>Unit – V</b>	<b>SYNTHESIS AND SOFTWARE DESIGN FOR LOW POWER</b>	Periods	<b>9</b>
Synthesis for low power –Behavioral level transforms- Sources of Software Power dissipation- Power Estimation- Power Optimization			
Total Periods			<b>45</b>
<b>Text Book</b>			
1.	Kaushik Roy, Sarat.C.Prasad, Low power CMOS VLSI circuit design, 1st reprint, Wiley India, 2009.		
2.	Dimitrios Soudris, Chirstian Pignet, Costas Goutis, “Designing CMOS Circuits for Low Power”, Kluwer Academic Publishers, 2011		
<b>References</b>			
1.	J.B. Kuo and J.H Lou, “Low Voltage CMOS VLSI Circuits”, Wiley 1999.		
2.	A.P.Chandrakasan and R.W. Broadersen, “Low Power Digital CMOS Design”, Kluwer Academic Publishers , 1995.		
3.	Gary Yeap, “Practical Low Power Digital VLSI Design”, Kluwer, 1998.		
4.	Abdellatif Bellaouar, Mohamed.I. Elmasry, “Low Power Digital VLSI Design”, Kluwer Academic Publishers, 1995.		
5.	James B. Kuo, Shin – chia Lin, “Low Voltage SOI CMOS VLSI Devices and Circuits”, John Wiley & sons, Inc 2004.		
<b>E-Resources</b>			
E1	<a href="https://nptel.ac.in/courses/106105161/58">https://nptel.ac.in/courses/106105161/58</a> Prof.Indiranilsengupta		
E2	<a href="https://nptel.ac.in/courses/106105034/19">https://nptel.ac.in/courses/106105034/19</a> Prof.Ajit Pal		
E3	<a href="https://archive.nptel.ac.in/courses/106/105/106105034/38">https://archive.nptel.ac.in/courses/106/105/106105034/38</a>		




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Programme	B.E.	Programme Code				103	Regulation			2023		
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>					Semester						
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks						
		L	T	P		C	CA	ESE	Total			
U23ECV16	<b>ASIC Design</b>	3	0	0	3	40	60	100				
<b>Course Objective</b>	The main objective of the course is to											
	<ul style="list-style-type: none"> <li>Introduce the types of ASICs, their design flow, and the basics of CMOS logic and technology used in ASIC libraries.</li> <li>Study programmable ASIC architectures, including I/O cell design and characteristics.</li> <li>Understand logic synthesis using Verilog and programmable interconnect techniques.</li> <li>Learn partitioning, floor planning, and placement strategies for ASIC physical design.</li> <li>Explore global and detailed routing algorithms and methodologies used in ASIC layout.</li> </ul>											
<b>Course Outcomes</b>	At the end of the course, the student should be able to,										Knowledge Level	
	<b>CO1:</b> Explain the different types of ASICs, CMOS logic principles, and technologies used in ASIC library design.										K2	
	<b>CO2:</b> Describe the architecture of programmable ASICs such as Actel ACT and Xilinx LCA and analyze the function of various I/O cells.										K3	
	<b>CO3:</b> Apply Verilog for logic synthesis and implement combinational and sequential logic circuits using appropriate constructs and timing considerations.										K3	
	<b>CO4:</b> Analyze and implement partitioning, floor planning, and placement algorithms including KL and iterative methods in the ASIC physical design flow.										K4	
<b>CO5:</b> Apply global and detailed routing techniques using algorithms such as Maze and Left Edge for area-efficient ASIC design.										K4		
<b>Pre-requisites</b>	Know about different programmable ASICs, logic cells, I/O cells and interconnects and to perform synthesis and physical design flow in ASIC design											

CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak													CO/PSO Mapping		
COs	Programme Outcomes (POs)											PSOs			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO 1	2	1						2				1	1		
CO 2	2	1	1					2				2	1		
CO 3	2	1	2	2				2				2	2	2	
CO 4	3	3	3	2	2		2	3				2	3	2	2
CO 5	3	3	3	2	2		2	3				2	3	2	2

  
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**Course Assessment Methods****Direct**

1. Continuous Assessment Test I, II & III
2. Assignment
3. End-Semester examinations

**Indirect**

1. Course - end survey

**Content of the syllabus**

Unit – I	Introduction to ASICs, CMOS Logic, ASIC Library Design:	Periods	9
Types of ASICs - Design flow – CMOS transistors- Transistor as resistors - Transistor parasitic capacitance – Logical effort-Antifuse - Static RAM - EPROM and EEPROM technology			
Unit – II	Programmable ASICs and I/O Cells	Periods	9
Actel ACT - Xilinx LCA - DC & AC inputs and outputs – Clock & power inputs			
Unit – III	Programmable Interconnects and Logic Synthesis	Periods	9
Actel ACT – Xilinx LCA - Verilog logic synthesis – Delays, Blocking and Non blocking assignment, Combinational logic, multiplexers, Case statement, decoders, arithmetic and Sequential logic			
Unit – IV	Partitioning, Floor planning and Placement	Periods	9
Physical design flow -System partitioning - FPGA partitioning : KL algorithm –Floor planning –Types –Placement – Constructive and iterative placement algorithms			
Unit – V	Routing	Periods	9
Global routing - Detailed routing –Area routing-Maze Algorithm-Channel routing- Left Edge Algorithm- Special routing			

**Text Books**

1.	Roger Woods, John McAllister, Gaye Lightbody, Dr. Ying Yi “ FPGA-based Implementation of Signal Processing Systems”, 2nd Edition, Wiley, 2017
2.	Steve Kilts, “Advanced FPGA Design: Architecture, Implementation, and Optimization” Wiley Inter-Science, 2016
3.	Smith M.J.S., "Application Specific Integrated Circuits", 12th Edition, Pearson Education Pvt. Ltd., New Delhi, 2013.

**References**

1.	D. Brown, R.J. Francis, J. Rox, Z.G. Uranesic, “ Field Programmable Gate Arrays”, Kluwer Academic Publishers, 2014.
2.	Wayne Wolf, "FPGA-Based System Design", 1st Edition, PHI, New Delhi, 2009.
3.	Erik Larson, "Introduction to Advanced System-on-Chip Test Design and Optimization", 1st Edition, Springer, USA, 2005.
4.	Jose E. Franco, Yannis Tsividis, “Design of Analog - Digital VLSI Circuits for Telecommunication and Signal Processing”, Prentice Hall, 2013.



**E-Resources**

1.	<a href="https://d1.amobbs.com/bbs_upload782111/files_9/ourdev_212152.pdf">https://d1.amobbs.com/bbs_upload782111/files_9/ourdev_212152.pdf</a>
2.	<a href="https://www.multisoftsystems.com/embedded-systems/asic-design-verification-training">https://www.multisoftsystems.com/embedded-systems/asic-design-verification-training</a>
3.	<a href="https://nptel.ac.in/courses/106106089/magma_tutorial/magma_tutorial.html">https://nptel.ac.in/courses/106106089/magma_tutorial/magma_tutorial.html</a>



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Programme	B.E.		ProgrammeCode				103	Regulation		2023					
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>						Semester								
Course Code	Course Name		PeriodsPerWeek			Credit	MaximumMarks								
			L	T	P		C	CA	ESE	Total					
U23ECV17	<b>System on Chip Design</b>		3	0	0	3	40	60	100						
<b>Course Objective</b>	The student should be made to														
	<ul style="list-style-type: none"> <li>Introduce the fundamental concepts of System-on-Chip (SoC) architecture, including platform-based design and low-power considerations.</li> <li>Explore models of computation, system validation, and hardware/software co-design methodologies.</li> <li>Study computation-communication partitioning and the role of NoC in communication-centric SoC design.</li> <li>Analyze Network-on-Chip topologies, energy-efficient design techniques, and protocol optimizations.</li> <li>Examine real-world SoC/NoC implementations through academic and industrial case studies.</li> </ul>														
<b>Course Outcomes</b>	At the end of the course, the student should be able to,										Knowledge Level				
	CO1: Explain the principles of SoC design, including platform-based and multiprocessor SoC architectures with low-power design strategies.										K2				
	CO2: Apply system modeling techniques for hardware/software co-design, validation, and synthesis of SoC applications.										K3				
	CO3: Analyze computation and communication partitioning strategies and describe the architecture of Network-on-Chip for SoC systems.										K4				
	CO4: Design and evaluate NoC components such as topology, signaling, protocol, and power optimization techniques.										K4				
	CO5: Compare real-world NoC and SoC implementations (e.g., Intel's Tera-FLOP, FAUST, RAW) and assess their architectural and performance characteristics.										K3				
<b>Pre-requisites</b>	Chip design and Network integration with chip design														
<b>CO/PO Mapping</b> (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak															
COs	Programme Outcomes (POs)										CO/PSO Mapping				
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	P O1 0	P O1 1	P O1 2	PS O1	PS O2	PS O3
CO1	3		2			2			2				2	2	
CO2	3	2								2	2		1	2	2
CO3	3	2	3										2	2	
CO4	3	2	3	2					2	2			2	2	2
CO5	3	2	2	2									2	2	

  
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<b>Course Assessment Methods</b>			
<b>Direct</b>			
1. Continuous Assessment Test I, II & III 2. Assignment 3. End-Semester examinations			
<b>Indirect</b>			
1. Course-end survey			
<b>Content of the syllabus</b>			
<b>Unit –I</b>	<b>INTRODUCTION</b>	Periods	<b>9</b>
Introduction to SoC Design., Platform-Based SoC Design., Multiprocessor SoC and Network on Chip, Low-Power SoC Design			
<b>Unit –II</b>	<b>SYSTEM DESIGN WITH MODEL OF COMPUTATION AND CO-DESIGN</b>	Periods	<b>9</b>
System Models, Validation and Verification, Hardware/Software Code sign Application Analysis, Synthesis of system			
<b>Unit –III</b>	<b>COMPUTATION – COMMUNICATION PARTITIONING AND NETWORK ON CHIP-BASED SOC</b>	Periods	<b>9</b>
Communication System: Current Trend, Separation of Communication and Computation. Communication Centric SoC Design, Communication Synthesis, Network-Based Design, Network on Chip, Architecture of NoC			
<b>Unit –IV</b>	<b>NOC DESIGN</b>	Periods	<b>9</b>
Practical Design of NoC, NoC Topology-Analysis Methodology, Energy Exploration, NoC Protocol Design, LowPower Design for NoC: Low-Power Signaling, On-Chip Serialization, Low-Power Clocking, Low-Power Channel Coding, Low-Power Switch, Low-Power Network on Chip Protocol			
<b>Unit –V</b>	<b>NOC /SOC CASE STUDIES</b>	Periods	<b>9</b>
Real Chip Implementation-BONE Series-, BONE 1-4, Industrial Implementations-, Intel's Tera-FLOP 80-Core NoC, Intel's Scalable Communication Architecture, Academic Implementations-FAUST, RAW; design case study of SoC – digital camera.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	Hoi-jun yoo, Kangmin Lee, Jun Kyoung kim, Low power NoC for high performance SoC design, CRC press, 2018.		
2.	Vijay K. Madisetti Chonlameth Arpikanondt, A PlatformCentric Approach to System-on-Chip (SOC) Design, Springer, 2005		
<b>References</b>			
1.	Michael J. Flynn and Wayne Luk, Computer System Design: System-on- Chip, Wiley Publications, 2011.		
2.	Steve Furber, ARM System on Chip Architecture, Addison Wesley Professional, 2000		
3.	Ricardo Reis, Design of System on a Chip: Devices and Components, Springer, 2011		
4.	Jason Andrews, Co-Verification of Hardware and Software for ARM System on Chip Design, Newnes, 2004		
5.	Prakash Rashinkar, Peter Paterson and Leena Singh L, System on Chip Verification – Methodologies and Techniques, Kluwer Academic Publishers, 2002.		
<b>E-Resources</b>			
1.	<a href="http://www.ecerelatedbooks.com/2018/03/fundamentals-of-modern-vlsi-devices-by.html">http://www.ecerelatedbooks.com/2018/03/fundamentals-of-modern-vlsi-devices-by.html</a>		
2.	<a href="http://www.fulviofrisone.com/attachments/article/403/Semiconductor%20Physics%20And%20Devices%20-%20Donald%20Neamen.pdf">http://www.fulviofrisone.com/attachments/article/403/Semiconductor%20Physics%20And%20Devices%20-%20Donald%20Neamen.pdf</a>		
3.	<a href="https://pdflife.one/download/4660813-semiconductors-m-s-tyagi">https://pdflife.one/download/4660813-semiconductors-m-s-tyagi</a>		

  
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Programme	B.E.	Programme Code			103	Regulation		2023	
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>				Semester				
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks			
		L	T	P	C	CA	ESE	Total	
U23ECV18	<b>Quantum Computing</b>	3	1	0	4	40	60	100	
Course Objective	The student should be made to								
	<ul style="list-style-type: none"> <li>Introduce the foundational principles of quantum computing and quantum information theory.</li> <li>Understand quantum computational models, algorithms, and transformations such as QFT and phase estimation.</li> <li>Explore the role of quantum search algorithms and their efficiency over classical counterparts.</li> <li>Study quantum operations and the impact of noise in quantum systems.</li> <li>Learn quantum error correction mechanisms and fault-tolerant quantum computation.</li> </ul>								
Course Outcomes	<ul style="list-style-type: none"> <li>At the end of the course, the student should be able to,</li> </ul>							Knowledge Level	
	CO1: Explain the fundamental concepts of quantum mechanics, quantum bits and quantum circuits.							K2	
	CO2: Apply quantum computational models and perform simulations involving QFT, phase estimation, and basic quantum algorithms.							K3	
	CO3: Analyze the quantum search algorithm and evaluate its optimality in solving unstructured problems and NP-complete problems.							K4	
	CO4: Explain and assess the role of quantum operations and their limitations in noisy quantum systems.							K4	
CO5: Apply and construct basic quantum error correction techniques including the Shor code and stabilizer codes for fault-tolerant computation.							K3		
Pre-requisites	-								

CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak													CO/PSO Mapping			
COs	Programme Outcomes (POs)										PSOs					
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	
CO 1	3	2	2									2	3	3	2	
CO 2	3	2	3									2	3	3	2	
CO 3	2	2	2									2	3	3		
CO 4	2	2	2									2		2		
CO 5	2	2	2									2		2		

  
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<b>Course Assessment Methods</b>			
<b>Direct</b>			
1. Continuous Assessment Test I, II & III 2. Assignment 3. End-Semester examinations			
<b>Indirect</b>			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>FUNDAMENTAL CONCEPTS OF QUANTUM COMPUTING</b>	Periods	<b>9</b>
Global perspectives-Quantum bits- Quantum computation: single qubit gates, multiple qubit gates, qnaum circuits, qubit copying circuit- Quantum information- Linear algebra-The postulates of quantum mechanics- Application: Superdense coding-EPR and the Belline quality			
<b>Unit – II</b>	<b>QUANTUM COMPUTATION</b>	Periods	<b>9</b>
Quantum algorithms- Single qubit operations - Controlled operations – Measurement - Universal quantum gates -Quantum circuit model of computation - Simulation of quantum systems- Quantum fourier transform- Phase estimation-Order finding and factoring -General applications of the quantum Fourier transform			
<b>Unit – III</b>	<b>QUANTUM SEARCH ALGORITHMS</b>	Periods	<b>9</b>
The quantum search algorithm- Quantum search as a quantum simulation-Speeding up the solution of NP-complete problems- Quantum search of an unstructured database- Optimality of the search algorithm-Black box algorithm limits			
<b>Unit – IV</b>	<b>QUANTUM INFORMATION</b>	Periods	<b>9</b>
Classical noise and Markov processes -Quantum operations-Examples of quantum noise and quantum operations-Applications of quantum operations-Limitations of the quantum operations formalism-Distance measures for quantum information			
<b>Unit – V</b>	<b>QUANTUM ERROR-CORRECTION</b>	Periods	<b>9</b>
Introduction-The Shor code-Theory of quantum error correction-Constructing quantum codes-Stabilizer codes-Fault-tolerant quantum computation: Fault-tolerant quantum logic-Fault-tolerant measurement and Elements of resilient quantum computation			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	Himanshu Thapliyal, Travis Humble, “Quantum Computing: Circuits, Systems, Automation and Applications”, Springer International Publishing AG, 1 <sup>st</sup> Edition, 2023.		
2.	Michael A. Nielsen & Isaac L. Chuang, “Quantum Computation and Quantum Information”, 10 <sup>th</sup> Edition, Cambridge University Press, 2010.		
<b>References</b>			
1.	Eleanor G.Rieffel, Wolfgang H.Polak, “Quantum Computing: A Gentle Introduction”, MIT Press, 2014.		
2.	Scott Aaronson, “Quantum Computing since Democritus”, Cambridge University Press, 2013.		
3.	Jonathan A, Jones, Dieter Jaksch, “ Quantum information, Computation and communication” Cambridge University Press, 1 <sup>st</sup> Edition, 2012		
<b>E-Reference</b>			
1	<a href="https://profincruz.wordpress.com/wp-content/uploads/2017/08/quantum-computation-and-quantum-information-nielsen-chuang.pdf">https://profincruz.wordpress.com/wp-content/uploads/2017/08/quantum-computation-and-quantum-information-nielsen-chuang.pdf</a>		

  
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Programme	<b>B.E.</b>	Programme Code	<b>103</b>	Regulation	<b>2023</b>
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Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>			Semester	
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Course Code	Course Name	Periods Per Week			Credit	Maximum Marks		
		L	T	P		C	CA	ESE
<b>U23ECV21</b>	<b>DSP Architecture and Programming</b>	3	0	0	3	40	60	100


<b>Course Objective</b>	The main objective of the course is to
	<ul style="list-style-type: none"> <li>Understand the fundamental architectural features of programmable DSPs, including specialized processing elements and memory structures.</li> <li>Interpret the architecture, instruction set, and addressing modes of the TMS320C5X processor and its applications.</li> <li>Analyze the advanced features of the TMS320C6X processor including its VLIW architecture and on-chip peripherals for real-time signal processing.</li> <li>Explore the architecture and application programming techniques for ADSP family processors.</li> <li>Compare the features of advanced DSP processors from TI, ADSP, and NXP families to determine their suitability for various signal processing applications.</li> </ul>

<b>Course Outcome</b>	At the end of the course, the student should be able to,	Knowledge Level
	<b>CO1:</b> Explain the architectural features of programmable DSPs including pipelining, MAC, and memory systems.	K2
	<b>CO2:</b> Describe the instruction set, addressing modes, and peripheral interfaces of TMS320C5X DSP processor.	K2
	<b>CO3:</b> Develop simple assembly-level programs and real-time signal processing applications using TMS320C6X.	K3
	<b>CO4:</b> Implement signal processing algorithms like filters and FFTs using ADSP-21XX/210XX series processors.	K3
<b>CO5:</b> Compare and evaluate the capabilities of TI, ADSP, and NXP DSP families for various DSP applications.	K4	

<b>Pre-requisites</b>	-
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COs	CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak												CO/PSO Mapping		
	Programme Outcomes (POs)												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	2	1	2	2	2	-	-	-	-	1	-	-	1	1	-
CO2	2	1	2	2	2	-	-	-	-	2	-	-	2	2	-
CO3	3	1	2	2	2	-	-	-	-	2	-	-	2	2	-
CO4	2	2	2	2	2	-	-	-	-	2	-	-	2	2	-
CO5	2	1	2	2	2	-	-	-	-	2	-	-	2	2	-

<b>Course Assessment Methods</b>	<b>Direct</b>
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1. Continuous Assessment Test I, II & III			
2. Assignment: Simulation using tool			
3. End-Semester examinations			
<b>Indirect</b>			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>Fundamentals Of Programmable DSPs</b>	<b>Periods</b>	<b>9</b>
Introduction to Programmable DSPs, Architectural Features of PDSPs - Multiplier and Multiplier accumulator – Modified Bus Structures and Memory access – Multiple access memory – Multi-port memory – VLIW architecture- Pipelining – Special Addressing modes in P-DSPs – On chip Peripherals, Applications of Programmable DSPs.			
<b>Unit - II</b>	<b>TMS320C5X Processor</b>	<b>Periods</b>	<b>9</b>
Architecture of C5X Processor – Addressing modes – Assembly language Instructions - Pipeline structure, On-chip Peripherals – Block Diagram of DSP starter kit (DSK) – Software Tools, DSK on-board peripherals, Application Programs for processing real time signals.			
<b>Unit – III</b>	<b>TMS320C6X Processor</b>	<b>Periods</b>	<b>8</b>
Architecture of the C6x Processor - Instruction Set – Addressing modes, Assembler directives, On-chip peripherals, DSP Development System: DSP Starter Kit - Code Composer Studio - Support Files – Introduction to AIC23 codec and other on-board peripherals, Real-Time Programming Examples for Signals and Noise generation, Frequency analysis, Filter design			
<b>Unit - IV</b>	<b>ADSP Processors</b>	<b>Periods</b>	<b>9</b>
Architecture of ADSP-21XX and ADSP-210XX series of DSP processors- Addressing modes and assembly language instructions – Application programs –Filter design, FFT calculation.			
<b>Unit – V</b>	<b>TI's Advanced Processors</b>	<b>Periods</b>	<b>10</b>
Study of TI's advanced processors - TMS320C674x and TMS320C55x DSPs, ADSP's Blackfin and Sigma DSP Processors, NXP's DSP56Fxx Family of DSP Processors, Comparison of the features of TI, ADSP and NXP DSP family processors			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	B. Venkataramani and M. Bhaskar, Digital Signal Processors – Architecture, Programming and Applications– McGraw Hill Education, 2nd Edition, 2017.		
2.	Avtar Singh and S. Srinivasan, Digital Signal Processing – Implementations using DSP Microprocessors with Examples from TMS320C54xx, Cengage Learning India Private Limited, Delhi, 2004.		
<b>References</b>			
1.	Rulph Chassaing and Donald Reay, Digital Signal Processing and Applications with the C6713 and C6416 DSK, John Wiley & Sons, Inc., Publication, 2012 (Reprint).		
2.	User guides Texas Instruments, Analog Devices and NXP, 2012.		
<b>E-Resources</b>			
1.	<a href="https://www.analog.com/en/lp/001/beginners-guide-to-dsp.html">https://www.analog.com/en/lp/001/beginners-guide-to-dsp.html</a>		
2.	<a href="https://www.ti.com/lit/ug/spru056d/spru056d.pdf">https://www.ti.com/lit/ug/spru056d/spru056d.pdf</a>		
3.	<a href="https://www.analog.com/en/product-category/adsp-21xx-fixed-point-dsps.html">https://www.analog.com/en/product-category/adsp-21xx-fixed-point-dsps.html</a>		



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Programme	<b>B.E.</b>	Programme Code	<b>103</b>	Regulation	<b>2023</b>			
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>			Semester				
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks		
		L	T	P	C	CA	ESE	Total
<b>U23ECV22</b>	<b>Digital Image Processing</b>	3	0	0	3	40	60	100
<b>Course Objective</b>	The main objective of the course is to							
	<ul style="list-style-type: none"> <li>Understand the fundamental concepts and building blocks of digital image processing, including visual perception and mathematical tools.</li> <li>Explain the various image transforms used for spatial and frequency domain analysis.</li> <li>Apply enhancement and restoration techniques for improving image quality.</li> <li>Analyze image segmentation and representation methods for object detection and description.</li> <li>Compare and evaluate different image compression techniques and standards.</li> </ul>							
	At the end of the course, the student should be able to,							Knowledge level
	<b>CO1:</b> Explain the components of image processing systems and basic concepts such as brightness, contrast, and sampling.							K2
	<b>CO2:</b> Describe and differentiate various 2D image transforms including DFT, DCT, and wavelet transforms.							K2
<b>CO3:</b> Apply image enhancement and restoration techniques using spatial and frequency domain methods.							K3	
<b>CO4:</b> Analyze and implement segmentation techniques such as thresholding, region-based methods, and edge detection.							K4	
<b>CO5:</b> Evaluate and compare image compression algorithms and digital watermarking techniques.							K4	
<b>Pre-requisites</b>	Mathematical knowledge, signals and system							

COs	CO / PO Mapping											CO/PSO Mapping			
	(3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak											PSOs			
	Programme Outcomes (POs)														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	3	2					2					3	2	
CO2	3	3	2	2				2		2			3		2
CO3	3	3	2	2									3	2	
CO4	3	2	2	2				2		2			3		2
CO5	3	2	2							2			3	2	

**Course Assessment Methods**

**Direct**

- Continuous Assessment Test I, II & III
- Assignment: Simulation using tool

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3. End-Semester examinations			
<b>Indirect</b>			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>DIGITAL IMAGE FUNDAMENTALS</b>	Periods	<b>9</b>
Elements of digital image processing systems, steps in image processing, Elements of visual perception, brightness, contrast, hue, saturation, Mach band effect, image sampling and quantization, relationship between pixels, mathematical tools used in image processing. 2D sampling, sampling theorem, aliasing and Moire patterns.			
<b>Unit - II</b>	<b>IMAGE TRANSFORMS</b>	Periods	<b>9</b>
2D transforms - DFT, DCT, DST, Walsh, Hadamard, Slant and Haar wavelet transforms			
<b>Unit – III</b>	<b>IMAGE ENHANCEMENT AND RESTORATION</b>	Periods	<b>9</b>
Intensity transformations, histogram processing, smoothing spatial filters, sharpening spatial filters. Image restoration: Degradation/ restoration process, noise models, noise probability distributions, spatial filtering, mean filters, order statistics filters. Estimating the degradation function, Inverse filtering, Wiener filtering, constrained least squares filtering.			
<b>Unit - IV</b>	<b>IMAGE SEGMENTATION AND REPRESENTATION</b>	Periods	<b>9</b>
Point, line and edge detection, edge linking and boundary detection, thresholding – global, multiple and variable, multivariable thresholding, region growing, region splitting and merging. Image representation: Boundary following, chain codes, polygonal approximations, signatures, boundary segments and skeletons.			
<b>Unit – V</b>	<b>IMAGE COMPRESSION</b>	Periods	<b>9</b>
Fundamentals, basic compression methods – Huffman coding, arithmetic coding, LZW coding, run length coding, block transform coding and wavelet coding, Digital image watermarking, JPEG standard, MPEG.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, “Digital Image Processing”, Pearson Prentice Hall, 4 <sup>th</sup> Edition, 2018.		
2.	S. Annadurai and R. Shanmugalakshmi, “Fundamentals of Digital Image Processing”, Pearson Education, 2007.		
<b>References</b>			
1.	Anil K- Jain- ‘Fundamentals of Digital Image Processing’ - Pearson / Prentice Hall of India- 2012		
2.	William K. Pratt, “Digital Image Processing”, John Wiley, New York, 2002.		
3.	Digital Image Processing, S Jayaraman, S Esakirajan T Veerakumar, Mc Graw-Hill, 2017.		
4.	Digital Image Processing, K. William Pratt, John Wiley, 2006.		
5.	Image Processing Theory, Algorithm and Architectures, M.A.Sid Ahmed, McGraw-Hill, 1995.		
<b>E-Resources</b>			
1.	<a href="http://web.ipac.caltech.edu/staff/fmasci/home/astro_refs/Digital_Image_Processing_2ndEd.pdf">http://web.ipac.caltech.edu/staff/fmasci/home/astro_refs/Digital_Image_Processing_2ndEd.pdf</a>		
2.	<a href="https://www.cis.rit.edu/class/simg361/Notes_11222010.pdf">https://www.cis.rit.edu/class/simg361/Notes_11222010.pdf</a>		
3.	<a href="http://ultra.sdk.free.fr/docs/DxO/Fundamentals%20of%20Digital%20Image%20Processing.pdf">http://ultra.sdk.free.fr/docs/DxO/Fundamentals%20of%20Digital%20Image%20Processing.pdf</a>		



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Programme	B.E.	Programme Code	103	Regulation	2023			
Department	ELECTRONICS AND COMMUNICATION ENGINEERING			Semester				
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks		
		L	T	P	C	CA	ESE	Total
U23ECV23	Digital Video Processing	3	0	0	3	40	60	100

<b>Course Objective</b>	The main objective of the course is to
	<ul style="list-style-type: none"> <li>Understand the principles of digital video formation, standards, and acquisition systems.</li> <li>Explain and analyze motion detection and estimation methods used in video processing.</li> <li>Apply video enhancement techniques to reduce artifacts and improve visual quality.</li> <li>Examine advanced motion tracking and segmentation techniques for scene interpretation.</li> <li>Evaluate various video compression methods and standards for efficient storage and transmission.</li> </ul>

<b>Course Outcome</b>	At the end of the course, the student should be able to,	Knowledge level
	CO1: Explain the basics of digital video formation, acquisition, scanning techniques, and storage formats.	K2
	CO2: Analyze different motion detection, estimation, and compensation techniques in video sequences.	K3
	CO3: Apply spatio-temporal filtering and artifact removal techniques to enhance video quality.	K3
	CO4: Examine motion segmentation and video tracking algorithms for scene analysis and shot detection.	K4
	CO5: Compare and evaluate inter-frame coding and video compression standards like MPEG, H.261, and H.264.	K4

<b>Pre-requisites</b>	Digital Signal Processing
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COs	CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak											CO/PSO Mapping			
	Programme Outcomes (POs)											PSOs			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO 2	PSO 3
CO1	3	2	2									2	2		
CO2	2	3	2	2									2	2	
CO3	2		3	3									3	3	
CO4	2							2					2	2	
CO5	3	2	2									2	2		

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### Course Assessment Methods

#### Direct

1. Continuous Assessment Test I, II & III
2. Assignment: Simulation using tool
3. End-Semester examinations

#### Indirect

1. Course - end survey

### Content of the syllabus

Unit – I	DIGITAL VIDEO FORMATION	Periods	9
Introduction to digital video and digital video processing, Analog versus Digital, Analog to Digital, Digital Video Standards- Video acquisition, CCD and CMOS Sensors, Video sampling and interpolation- Interlaced and Progressive scanning- Video file formats- Storage devices, NVR, DVR, IP Camera			
Unit - II	MOTION ANALYSIS	Periods	9
Motion Detection – Hypothesis testing with Fixed/Adaptive thresholding Motion Estimation-Pixel based approaches- Block matching approaches- Motion compensation for videos			
Unit – III	VIDEO ENHANCEMENT	Periods	8
Video artifacts – Spatio-temporal noise filtering- Order statistics filtering, Blotch detection and Removal			
Unit - IV	GUARANTEED SERVICE MODEL	Periods	9
Scene change detection- Motion segmentation- Video shot boundary detection- Motion tracking-contour based tracking-Feature based tracking			
Unit – V	VIDEO COMPRESSION TECHNIQUES	Periods	9
Inter frame coding-MPEG-1,MPEG-2 and MPEG-4video compression standards – Low bit rate approaches-H.261 and H.264			
<b>Total Periods</b>			<b>45</b>

### Text Books

1. A. Murat Tekalp, “Digital Video Processing, Pearson Education”, Prentice Hall, 2015. (ISBN-10: 0-13-399100-8)
2. Yao.Wang, Jom Ostermann, & Ya-Oin Zhang, “Video Processing & Communications”, Prentice Hall, 2002. (ISBN 0-13-017547-1)

### References

1. Oge Marques, “Practical Image and Video Processing using MATLAB”, Wiley-IEEE Press. 2011.
2. H.264 and MPEG-4 Video Compression: Video Coding for Next Generation Multimedia – Iain E.G. Richardson, Wiley, 2003
3. Al Bovik, “Handbook of Image & Video Processing”, Academic Press, 2010. (ISBN: 0121197905)
4. J. W. Woods, “Multidimensional Signal, Image and Video Processing and Coding”, Academic Press, 2006. (ISBN 0-12-088516-6)

### E-Resources

1. <https://preetikale.files.wordpress.com/2018/07/handbook-of-image-and-video-processing-al-bovik1.pdf>
2. <https://yslaiseblog.files.wordpress.com/2013/10/gfx-multimedia-making-it-work-8th-edition.pdf>
3. <https://doc.lagout.org/network/H.264%20and%20MPEG4%20Video%20Compression.pdf>
4. <https://ptgmedia.pearsoncmg.com/images/9780133991000/samplepages/9780133991000.pdf>
5. [https://books.google.co.in/books/about/Digital\\_Image\\_Sequence\\_Processing\\_Compre.html?id=tXgmDwAAQBAJ&redir\\_esc=y](https://books.google.co.in/books/about/Digital_Image_Sequence_Processing_Compre.html?id=tXgmDwAAQBAJ&redir_esc=y)



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Programme	<b>B.E.</b>	Programme Code	<b>103</b>	Regulation	<b>2023</b>			
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>			Semester				
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks		
		L	T	P	C	CA	ESE	Total
<b>U23ECV24</b>	<b>Medical Image Processing</b>	3	0	0	3	40	60	100
<b>Course Objective</b>	The main objective of the course is to							
	<ul style="list-style-type: none"> <li>Understand the principles and functioning of various medical imaging systems including scintillation, solid-state cameras, and tomography.</li> <li>Describe and apply the mathematical foundations behind image reconstruction techniques using projection data.</li> <li>Explain the working of fluoroscopy, CT imaging systems, and assess image quality parameters.</li> <li>Analyze the principles of MRI and MR spectroscopy, including spatial encoding and contrast enhancement.</li> <li>Evaluate ultrasound imaging techniques, Doppler effects, and related artifacts and system limitations.</li> </ul>							
<b>Course Outcomes</b>	At the end of the course, the student should be able to,							Knowledge Level
	<b>CO1:</b> Explain the working principles of various image acquisition systems like scintillation cameras and tomography.							K2
	<b>CO2:</b> Apply mathematical concepts such as Radon transform and projection theorem for image reconstruction in 2D/3D.							K3
	<b>CO3:</b> Describe digital fluoroscopy and CT systems, and evaluate the effects of parameters influencing image quality.							K2
	<b>CO4:</b> Analyze the mechanisms of MRI, pulse sequences, tissue contrast, and MR spectroscopy techniques.							K4
	<b>CO5:</b> Evaluate ultrasound imaging modes, Doppler shift principles, and identify common image artifacts.							K4
<b>Pre-requisites</b>	Knowledge on Mathematics, Image Processing							

CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 – Weak													CO/PSO Mapping		
Cos	Programme Outcomes (Pos)												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	2					2				2	3	2	
CO 2	3	3	2	2				2		2		2	3		2
CO 3	3	3	2	2								2	3	2	
CO 4	3	2	2	2				2		2		2	3		2
CO 5	3	2	2							2		2	3	2	

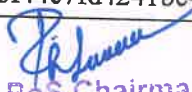
**Course Assessment Methods**



<b>Direct</b>
1.Continuous Assessment Test I, II & III
2.Assignment
3.End-Semester examinations
<b>Indirect</b>
1. Course – end survey

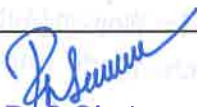
**Content of the syllabus**

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**BoS Chairman,**

<b>Unit – I</b>	<b>ACQUISITION OF IMAGES</b>	<b>Periods</b>	<b>9</b>
Introduction to Imaging Techniques – Single crystal scintillation camera – Principles of scintillation camera – multiple crystal scintillation camera – solid state camera – rectilinear scanner- Emission computed Tomography.			
<b>Unit – II</b>	<b>MATHEMATICAL PRELIMINARIES FOR IMAGE RECONSTRUCTION</b>	<b>Periods</b>	<b>9</b>
Image Reconstruction from Projections in Two dimensions- Mathematical Preliminaries for Two and Three dimensional Image Reconstructions – Radon Transform- Projection Theorem – central slice Theorem- Sinogram- Two Dimensional Projection Reconstruction- Three Dimensional Projection Reconstruction- Iterative Reconstruction Techniques.			
<b>Unit – III</b>	<b>IMAGING DIAGNOSTICS</b>	<b>Periods</b>	<b>9</b>
Digital fluoroscopy- Automatic Brightness control – cinefluorography- Principles of computed Tomographic Imaging – Reconstruction algorithms – Scan motions- X-ray sources. Influences of Images quality: Unsharpness- contrast – Image Noise- - Image Distortion And Artifacts			
<b>Unit – IV</b>	<b>MAGNETIC RESONANCE IMAGING AND SPECTROSCOPY</b>	<b>Periods</b>	<b>9</b>
Fundamentals of magnetic resonance- overview –Pulse techniques- spatial encoding of magnetic resonance imaging signal- motion suppression techniques- contrast agents- tissue contrast in MRI- Spectroscopy- Chemical Shift Imaging			
<b>Unit – V</b>	<b>ULTRASOUND IMAGING</b>	<b>Periods</b>	<b>9</b>
Ultrasound: Presentation modes- Time required to obtain Images- System components, signal processing dynamic Range- Ultrasound Image Artifacts- Quality control, Origin of Doppler shift- Limitations of Doppler systems.			
			<b>Total Periods</b>
			<b>45</b>
<b>Text Books</b>			
1.	William R. Hendee, E. Russell Ritenour, Medical Imaging Physics: A John Wiley & sons, Inc., Publication, Fourth Edition 2002.		
2.	Z.H. Cho., J-oie, P. Jones and Manbir Singh, Foundations of Medical Imaging: John Wiley and sons Inc.1993.		
3.	Isaac Bankman , “Handbook of Medical Image Processing and Analysis”, Academic Press Series in Biomedical Engineering, 2008.		
<b>References</b>			
1.	Webb, S. The Physics of Medical Imaging. New York, NY: Taylor & Francis, 2018.		
2.	Macovski, A. Medical Imaging Systems. Upper Saddle River, NJ: Prentice Hall, 2018		
3.	Avinash C. Kak, Malcolm Shaney, "Principles of Computerized Tomographic Imaging", IEEE Press, Newyork-1998.		
4.	Image Processing Theory, Algorithm and Architectures, M.A.Sid Ahmed,McGraw-Hill, 1995		
5.	Epstein, C. L. Mathematics of Medical Imaging. Upper Saddle River, NJ: Prentice Hall, 2003		
<b>E-Resources</b>			
1.	<a href="https://www.k-space.org/ymk/Hendee_Ultrasound_Imaging.pdf">https://www.k-space.org/ymk/Hendee_Ultrasound_Imaging.pdf</a>		
2.	<a href="https://cds.ismrm.org/ismrm-2001/PDF3/0758.pdf">https://cds.ismrm.org/ismrm-2001/PDF3/0758.pdf</a>		
3.	<a href="https://dl.icdst.org/pdfs/files3/eeec98f44e7fd4241be41facb31e38a7.pdf">https://dl.icdst.org/pdfs/files3/eeec98f44e7fd4241be41facb31e38a7.pdf</a>		

  
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Programme	B.E.	Programme Code			103	Regulation	2023								
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>				Semester										
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks									
		L	T	P		C	CA	ESE	Total						
U23ECV25	<b>Biomedical Signal Processing</b>	3	0	0	3	40	60	100							
<b>Course Objective</b>	The main objective of the course is to														
	<ul style="list-style-type: none"> <li>Understand the properties and challenges of biomedical signals and the need for artifact removal techniques.</li> <li>Describe and apply different modeling approaches for biomedical systems using parametric and spectral methods.</li> <li>Analyze neurological signals, especially EEG, using adaptive filtering and statistical techniques.</li> <li>Apply cardiological signal processing methods, including ECG feature extraction and multiscale analysis.</li> <li>Evaluate heart rate variability (HRV) using time and frequency domain methods for arrhythmia analysis.</li> </ul>														
<b>Course Outcomes</b>	At the end of the course, the student should be able to,							Knowledge Level							
	<b>CO1:</b> Explain the nature of biomedical signals, their sources, and techniques for noise/artifact removal.							K2							
	<b>CO2:</b> Apply modeling techniques like all-pole, pole-zero, and spectral modeling to represent biomedical systems.							K3							
	<b>CO3:</b> Analyze EEG signals using linear prediction, Wiener filtering, and adaptive filtering algorithms.							K4							
	<b>CO4:</b> Apply ECG processing techniques such as wavelet transform and multiscale analysis for parameter estimation.							K3							
	<b>CO5:</b> Evaluate time-domain and spectral-domain HRV parameters for short- and long-term arrhythmia analysis.							K4							
<b>Pre-requisites</b>	Signal Processing														
<b>CO / PO Mapping</b> (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak															
<b>COs</b>	Programme Outcomes (POs)											<b>CO/PSO Mapping</b> PSOs			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PSO 2	PS O 3
CO 1	3	2	2									2	2		
CO 2	2	3	2	2									2	2	
CO 3	2		3	3									3	3	
CO 4	2						2						2	2	
CO 5	3	2	2									2	2		
<b>Course Assessment Methods</b>															
<b>Direct</b>															
1.Continuous Assessment Test I, II & III 2.Assignment 3.End-Semester examinations															



  
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<b>Indirect</b>			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>INTRODUCTION</b>	Periods	<b>9</b>
Biomedical Signals – Sources, Properties, Objectives and Difficulties in Biomedical Signal Analysis, Filtering for removal of artifacts – Time domain filters, Frequency domain filters, Optimal filtering.			
<b>Unit – II</b>	<b>MODELLING BIOMEDICAL SYSTEMS</b>	Periods	<b>9</b>
Pontryagin process, Parametric System Modeling, All Pole Modeling, Pole-Zero Modeling, Spectral Modeling, Applications.			
<b>Unit – III</b>	<b>NEUROLOGICAL SIGNAL PROCESSING</b>	Periods	<b>9</b>
The Brain and its potentials; The Electrophysiology origin of brain waves; the EEG Signal and its characteristics; EEG analysis; EEG Rhythms, waves and Transients, Statistical parameter mapping of EEG signal; Linear prediction theory; The autoregressive (AR) method; Wiener filtering problem; Principle of an adaptive filter; Steepest – descent algorithm; Windrow-hoff least-mean-square adaptive algorithm.			
<b>Unit – IV</b>	<b>CARDIOLOGICAL SIGNAL PROCESSING</b>	Periods	<b>9</b>
Basic electrocardiography; ECG data acquisition; ECG lead system; ECG parameters and their estimation; Use of multi-scale analysis for parameters estimation of ECG waveforms, Adaptive noise canceller; Long term continuous ECG recording; The wavelet approximation – Discrete wavelet transform (DWT); Multi-resolution analysis; Pyramid algorithm.			
<b>Unit – V</b>	<b>HRV AND ARRHYTHMIA ANALYSIS</b>	Periods	<b>9</b>
Heart Rate variability; comparison of short-term and long term HRV analysis; Time domain and spectral domain parameters of short term recording.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	Rangaraj M.Rangayyan, “Biomedical Signal Analysis”, Wiley, 2024		
2.	Kayvan Najarian and Robert Splinter, “Biomedical Signal and Image Processing”, 2nd Edition, CRC Press, 2016		
<b>References</b>			
1.	D.C.Reddy, Biomedical Signal Processing Principles and Techniques, TATA McGraw-Hill Education, New Delhi, 2009.		
2.	Arnon Cohen “Biomedical Signal Processing” Crc Pr I Llc; 2nd Edition, May, 2019		
3.	W.J.Tompkins, Biomedical Digital signal processing, Prentice Hall, New Jersey-1993.		
4.	Tompkins W J “Biomedical Signal Processing”, Prentice hall of India, New Delhi, 2000.		
5.	IEEE Engineering Medicine and Biology Magazine.2002		
<b>E-Resources</b>			
1.	<a href="https://go-pdf.online/biomedical-signal-processing-by-d-c-reddy.pdf">https://go-pdf.online/biomedical-signal-processing-by-d-c-reddy.pdf</a>		
2.	<a href="https://www.intechopen.com/books/8851#:~:text=Neural%20signal%20processing%20is%20a,of%20neuroscience%20and%20neural%20engineering.">https://www.intechopen.com/books/8851#:~:text=Neural%20signal%20processing%20is%20a,of%20neuroscience%20and%20neural%20engineering.</a>		
3.	<a href="https://ocw.mit.edu/courses/hst-582j-biomedical-signal-and-image-processing-spring-2007/pages/lecture-notes/">https://ocw.mit.edu/courses/hst-582j-biomedical-signal-and-image-processing-spring-2007/pages/lecture-notes/</a>		



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Programme	B.E.		Programme Code				103	Regulation			2023				
Department	ELECTRONICS AND COMMUNICATION ENGINEERING						Semester								
Course Code	Course Name		Periods Per Week			Credit	Maximum Marks								
			L	T	P		C	CA	ESE	Total					
U23ECV26	Software Defined Radio		3	0	0	3	40	60	100						
Course Objective	The main objective of the course is to <ul style="list-style-type: none"> <li>Understand the fundamental concepts of multirate signal processing and its applications in communications.</li> <li>Apply various filter structures such as polyphase and recursive filters in baseband transceiver design.</li> <li>Analyze cascaded filtering systems and their integration with ADC/DAC converters for SDR applications.</li> <li>Explain multirate system techniques for carrier-related processes including DDC, timing and carrier recovery.</li> <li>Evaluate digital filtering methods and overall SDR architectures including current and future trends.</li> </ul>														
Course Outcomes	At the end of the course, the student should be able to,										Knowledge Level				
	CO1: Explain the principles of multirate signal processing, Nyquist filtering, and QMFs for efficient signal representation.										K2				
	CO2: Apply filter implementation techniques such as polyphase, half-band, and dyadic filters in signal resampling systems.										K3				
	CO3: Analyze cascaded filtering systems (e.g., CIC filters) and their role in signal conversion in SDR environments.										K4				
	CO4: Describe multirate systems in carrier recovery, digital down conversion, and demodulation processes in communication systems.										K3				
	CO5: Evaluate complete SDR systems with focus on digital filtering, signal recovery, and future SDR trends like RFNM										K4				
Pre-requisites	-														
CO / PO Mapping													CO/PSO Mapping		
(3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak															
COs	Programme Outcomes (POs)												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O 2	PS O 3
CO 1	3	3	2	2	1	-	-	-	-	-	-	2	3	2	-
CO 2	3	3	2	2	2	-	-	-	-	-	-	2	3	2	-
CO 3	3	3	2	3	2	-	-	-	-	-	-	2	3	2	-
CO 4	3	3	2	3	2	-	-	-	-	-	-	2	3	2	-
CO 5	3	3	2	2	3	-	-	-	-	-	-	2	3	2	-
Course Assessment Methods															
Direct															
1.Continuous Assessment Test I, II & III															
2.Assignment															



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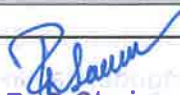
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3.End-Semester examinations			
<b>Indirect</b>			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>Multirate Signal Processing</b>	Periods	<b>9</b>
Fundamentals of Multirate Signal Processing – Nyquist and Square root Nyquist Filter –Systems using resampling filter – Quadrature Mirror Filters (QMF) – Theory and Application – Wavelet for multirate signal processing.			
<b>Unit – II</b>	<b>Filter implementations for baseband transceivers</b>	Periods	<b>9</b>
Polyphase FIR filter – Resampling Filter – Half-band Filters – Dyadic filter – Arbitrary Sampling Rate Conversion -Recursive polyphase filter			
<b>Unit – III</b>	<b>Cascaded Systems</b>	Periods	<b>9</b>
Cascade Integrator Comb Filter (CIC) – Cascade and multiple stage filters – Analog to Digital and Digital to Analog converters for SDR.			
<b>Unit – IV</b>	<b>Multirate systems for carrier</b>	Periods	<b>9</b>
Application in communication systems – Conventional Digital down converters (DDC) – Aliasing DDC – Timing recovery in digital demodulation – Carrier recovery and phase recovery – Introduction to software-defined radio – Review of telecommunication concepts and systems			
<b>Unit – V</b>	<b>Digital filtering</b>	Periods	<b>9</b>
Analog and Digital Communication System – Front-end RF system – Link Budgets – noise – C/N and S/N ratios – Digital filtering – Signal recovery – Baseband and Band pass Sampling – Complete SDR systems – Future trends in SDR-RFNM: a next generation SDR.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	Fredric J Harris, “Multirate Signal Processing for Communication Systems”, Pearson Education, 2007.		
2.	Behrouz Farhang- Boroujeny, “Signal Processing Techniques for Software Radios”, Lulu Publishing House, 2 <sup>nd</sup> Edition, 2010		
3	Jeffrey H Reed, “Software Radio: A Modern Approach to Radio Engineering”, Prentice Hall PTR, 2002.		
<b>References</b>			
1.	Vaidyanathan P P, “Multirate Systems and Filter Banks”, Prentice Hall Inc., 1993.		
2.	N. J. Fliege, “Multirate Digital Signal Processing – Multirate Systems”, Filter Banks and Wavelets, John Wiley, 1999.		
3.	Tony J. Roupheal, “RF and Digital Signal Processing for Software-Defined Radio: A Multi-Standard Multi-Mode Approach”, Elsevier Inc., 2009.		
4.	Walter Tuttlebee, “Software Defined Radio: Origins, Drivers and International Perspectives”, John Wiley and Sons Ltd, 2002.		
<b>E-Resources</b>			
1.	<a href="https://www.staff.ncl.ac.uk/oliver.hinton/eee305/Chapter9.pdf">https://www.staff.ncl.ac.uk/oliver.hinton/eee305/Chapter9.pdf</a>		
2.	<a href="https://courses.grainger.illinois.edu/ece401/fa2021/lectures/lec14.pdf">https://courses.grainger.illinois.edu/ece401/fa2021/lectures/lec14.pdf</a>		
3.	<a href="https://123.physics.ucdavis.edu/week_5_files/filters/digital_filter.pdf">https://123.physics.ucdavis.edu/week_5_files/filters/digital_filter.pdf</a>		

  
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Programme	B.E.		Programme Code			103	Regulation			2023					
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>						Semester								
Course Code	Course Name		Periods Per Week			Credit	Maximum Marks								
			L	T	P		C	CA	ESE	Total					
U23ECV27	<b>Radar Signal Processing</b>		3	0	0	3	40		60		100				
<b>Course Objective</b>	The main objective of the course is to														
	<ul style="list-style-type: none"> <li>Understand the fundamentals of radar systems, radar range equations, and matched filter receivers.</li> <li>Explain and analyze signal detection methods in noise using statistical criteria and detection algorithms.</li> <li>Understand and apply radar waveform design principles using ambiguity functions and waveform selection criteria.</li> <li>Analyze pulse compression techniques and their role in improving radar performance.</li> <li>Evaluate phase coding techniques and their application in CW radar systems for Doppler and clutter tolerance.</li> </ul>														
	At the end of the course, the student should be able to,											Knowledge Level			
	<b>CO1:</b> Explain the radar system fundamentals, radar equations, matched filters, and their use in signal detection.											K2			
	<b>CO2:</b> Apply detection criteria such as Neyman-Pearson and CFAR to identify radar signals in the presence of noise.											K3			
<b>CO3:</b> Describe and utilize the ambiguity function for selecting radar waveforms suitable for various detection environments.											K3				
<b>CO4:</b> Analyze pulse compression techniques including linear FM, SAW, and digital pulse compression to enhance radar resolution.											K4				
<b>CO5:</b> Evaluate and compare binary and polyphase coding techniques for Doppler-tolerant and clutter-resistant radar applications.											K4				
<b>Pre-requisites</b>	Analog and Digital Communication														
<b>CO / PO Mapping</b> (3/2/1 indicates strength of correlation) <b>3-Strong, 2 – Medium, 1 - Weak</b>												<b>CO/PSO Mapping</b>			
COs	Programme Outcomes (POs)											PSOs			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O 2	PS O 3
CO 1	3	3	2	2	2	2						1	3	2	
CO 2	3	3	2	2	2	2						1	3		2
CO 3	3	3	2	2	2	2						1	3	2	
CO 4	3	3	2	2	2	2						1	3		2
CO 5	3	3	2	2	2	2						1	3	2	
<b>Course Assessment Methods</b>															
<b>Direct</b>															
1.Continuous Assessment Test I, II & III															
2.Assignment															
3.End-Semester examinations															
<b>Indirect</b>															
1. Course - end survey															

  
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<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>INTRODUCTION</b>	Periods	<b>9</b>
Radar System -Fundamentals, Radar Equation, Information Available from Radar Echo. Review of Radar Range Performance– General Radar Range Equation, Radar Detection with Noise Jamming, Beacon and Repeater Equations, Bistatic Radar. Matched Filter Receiver – Impulse Response, Frequency Response Characteristic and its Derivation, Matched Filter and Correlation Function, Correlation Detection and Cross-Correlation Receiver, Efficiency of Non-Matched Filters, Matched Filter for Non-White Noise.			
<b>Unit – II</b>	<b>DETECTION OF RADAR SIGNALS IN NOISE</b>	Periods	<b>9</b>
Detection Criteria – Neyman-Pearson Observer, Likelihood-Ratio Receiver, Inverse Probability Receiver, Sequential Observer, Detectors – Envelope Detector, Logarithmic Detector, I/Q Detector. Automatic Detection- CFAR Receiver, Cell Averaging CFAR Receiver, CFAR Loss, CFAR Uses in Radar. Radar Signal Management – Schematics, Component Parts, Resources and Constraints.			
<b>Unit – III</b>	<b>WAVEFORM SELECTION</b>	Periods	<b>9</b>
Radar Ambiguity Function and Ambiguity Diagram – Principles and Properties; Specific Cases – Ideal Case, Single Pulse of Sine Wave, Periodic Pulse Train, Single Linear FM Pulse, Noise Like Waveforms, Waveform Design Requirements, Optimum Waveforms for Detection in Clutter, Family of Radar Waveforms.			
<b>Unit – IV</b>	<b>PULSE COMPRESSION IN RADAR SIGNALS</b>	Periods	<b>9</b>
Introduction, Significance, Types, Linear FM Pulse Compression – Block Diagram, Characteristics, Reduction of Time Side lobes, Stretch Techniques, Generation and Decoding of FM Waveforms – Block Schematic and Characteristics of Passive System, Digital Compression, SAW Pulse Compression.			
<b>Unit – V</b>	<b>PHASE CODING TECHNIQUES</b>	Periods	<b>9</b>
Principles, Binary Phase Coding, Barker Codes, Maximal Length Sequences (MLS/LRS/PN), Block Diagram of a Phase Coded CW Radar. Poly Phase Codes : Frank Codes, Costas Codes, Non-Linear FM Pulse Compression, Doppler Tolerant PC Waveforms – Short Pulse, Linear Period Modulation (LPM/HFM), Side lobe Reduction for Phase Coded PC Signals -Real time applications.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	G. Richard Curry, “Radar System Performance Modeling”, Volume 1, Artech House, 2 <sup>nd</sup> Edition, 2015.		
2.	M.I. Skolnik, “Introductions to Radar Systems”, TMH, 3 <sup>rd</sup> Edition, 2013.		
<b>References</b>			
1.	Peyton Z. Peebles, “Radar Principles”, John Wiley, 2014.		
2.	Peyton Z. Peebles, “Radar Design Principles: Signal Processing and The Environment”, PHI. 2 <sup>nd</sup> Edition, 2013.		
3.	R. Nitzberg, “Radar Signal Processing and Adaptive Systems”, Artech House, 2014.		
4.	M.I. Skolnik, “Radar Handbook”, McGraw Hil , 2 <sup>nd</sup> Edition, 2015.		
5.	F.E. Nathanson, “Radar Design Principles”, McGraw Hil ,2015.		
<b>E-Resources</b>			
1.	<a href="https://pdfcoffee.com/basic-radar-analysis-2015pdf-2-pdf-free.html">https://pdfcoffee.com/basic-radar-analysis-2015pdf-2-pdf-free.html</a>		
2.	<a href="https://soaneemrana.org/onewebmedia/INTRODUCTION%20TO%20RADAR%20SYSTEM%20BY%20MERRIL,%20I%20SKLOINK%20%284%29.pdf">https://soaneemrana.org/onewebmedia/INTRODUCTION%20TO%20RADAR%20SYSTEM%20BY%20MERRIL,%20I%20SKLOINK%20%284%29.pdf</a>		





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Programme	B.E.	Programme Code	103	Regulation	2023			
Department	ELECTRONICS AND COMMUNICATION ENGINEERING			Semester				
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks		
		L	T	P	C	CA	ESE	Total
U23ECV28	Robotics sensors and Signal Processing	3	0	0	3	40	60	100

<b>Course Objective</b>	The main objective of the course is
	<ul style="list-style-type: none"> <li>Understand various types and classifications of sensors used in robotic systems.</li> <li>Explain the working principles and applications of position, inertial, force, and range sensors.</li> <li>Apply concepts of signal acquisition, sampling, and analog-to-digital interface in robotic sensor systems.</li> <li>Design analog filters such as Butterworth, Chebyshev, Bessel, and RC active filters for signal conditioning.</li> <li>Analyze and design digital filters, including FIR, IIR, and adaptive filters, for processing sensor signals.</li> </ul>

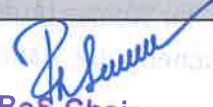
<b>Course Outcome</b>	At the end of the course, the student should be able to	Knowledge Level
	CO1: Explain sensor classification, characteristics, and their use in proximity, tactile, and interaction sensing.	K2
	CO2: Describe and compare position, inertial, force, and range sensors used in robotic applications.	K2
	CO3: Apply signal-processing concepts such as sampling, anti-aliasing, and filtering in sensor interfacing.	K3
	CO4: Design analog filters like Butterworth, Chebyshev, and RC filters for conditioning robotic sensor signals.	K3
	CO5: Analyze and design digital FIR, IIR, and adaptive filters for sensor signal processing and integration in robotic systems.	K4

**Pre-requisites** -

CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak													CO/PSO Mapping			
Cos	Programme Outcomes (POs)											PSOs				
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O 2	PS O 3	
CO 1	3	3	2	3										2		
CO 2	3	3	2	3								2		2		
CO 3	3	3	2	3						2		2	3	2		
CO 4	3	3	2	2						2			3			
CO 5	3	2	2	2						2			3			



**Course Assessment Methods**

Direct

  
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1. Continuous Assessment Test I, II & III 2. Assignment, Seminar and Quiz 3. End-Semester examinations			
<b>Indirect</b>			
1. Course – end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>INTRODUCTION AND CLASSIFICATION OF SENSORS</b>	Periods	<b>9</b>
Introduction, Sensor classification and characteristics, Touch and proximity sensors: IR, Photodiodes. Tactile sensors, collision sensors, interaction sensors – proximity/distance sensors.			
<b>Unit – II</b>	<b>POSITION MEASUREMENT, INERTIAL, FORCE AND RANGE SENSORS</b>	Periods	<b>9</b>
Position measurement: Optical encoder, Potentiometer, 2D and 3D cameras, Velocity measurement. Inertial sensors: Gyroscopes, Accelerometer. Force sensors, Torque sensors, Range sensors: IR, Ultrasonic sensors, laser ranger finder.			
<b>Unit – III</b>	<b>SIGNAL-PROCESSING CHAIN IN ROBOTICS APPLICATIONS</b>	Periods	<b>9</b>
The boundary between analog and digital blocks: The Nyquist–Shannon sampling theorem - Anti aliasing filters. General concepts about filter synthesis (frequency transforms, ideal and physical filters, adaptation)			
<b>Unit – IV</b>	<b>DESIGN OF ANALOG FILTERS</b>	Periods	<b>9</b>
Design of doubly-terminated passive filters: Butterworth, Chebyshev, Elliptic and Bessel filters - Design of RC active filters. Design of Analog Filters for Sensor Signal Conditioning in Robotics.			
<b>Unit – V</b>	<b>DESIGN OF DIGITAL FILTERS</b>	Periods	<b>9</b>
Digital Filter Design for Sensor Noise Reduction in Robotics —design of Adaptive filters for Robot Navigation -Design of integrated filters: Switched-capacitor filters.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	Sensors, Actuators, and Their Interfaces: A multidisciplinary introduction, 2 <sup>nd</sup> edition. Nathan Ida, 2020.		
2.	J.G. Proakis, D.G. Manolakis, "Digital signal processing: principles, algorithms, and applications," Prentice Hall, 2007.		
<b>Reference Book:</b>			
1.	Robert J Schilling: Fundamentals of Robotics, Analysis and Control. Prentice Hall of India, 2024.		
2.	L.B. Jackson, "Digital filters and signal processing," Kluwer Academic Publishers, 2016.		
<b>E-Resources</b>			
E1	<a href="http://www.sensorcentral.com/photoelectric/ultra_sonic01.php">http://www.sensorcentral.com/photoelectric/ultra_sonic01.php</a>		


  
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Programme	B.E.	Programme Code	103	Regulation	2023			
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>			Semester				
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks		
		L	T	P		C	CA	ESE
U23ECV31	<b>Mobile Communication</b>	3	0	0	3	40	60	100
<b>Course Objective</b>	The main objective of the course is to							
	<ul style="list-style-type: none"> <li>Understand the cellular concepts, frequency reuse, and propagation models relevant to wireless communication.</li> <li>Explore small-scale fading, multipath propagation models, and equalization techniques to improve communication reliability.</li> <li>Study and compare different multiple access techniques and their capacity in cellular systems.</li> <li>Understand the evolution of mobile systems from 2G to LTE and LTE-Advanced, with focus on system architecture and antenna techniques.</li> <li>Analyze the structure and advancements in 5G wireless networks, including cognitive radio and IoT integration.</li> </ul>							
<b>Course Outcomes</b>	At the end of the course, the student should be able to,						Knowledge Level	
	<b>CO1:</b> Explain the concepts of frequency reuse, channel assignment, handoff strategies, and propagation models used in cellular systems.						K2	
	<b>CO2:</b> Analyze the impact of small-scale multipath fading and evaluate the use of equalizers and diversity techniques in mobile communications.						K4	
	<b>CO3:</b> Compare different multiple access techniques like FDMA, TDMA, CDMA, WCDMA, and analyze their capacities.						K3	
	<b>CO4:</b> Understand the transition from UMTS to LTE and evaluate LTE system architecture and MIMO techniques.						K3	
	<b>CO5:</b> Analyze the key features of 5G networks including cognitive radio, vehicular communication, and future mobile applications.						K4	
<b>Pre-requisites</b>	Analog and Digital Communication							


COs	CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak											CO/PSO Mapping			
	Programme Outcomes (POs)											PSOs			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO 1	3	3	2				2						3	2	
CO 2	3	3	2	2			2		2				3		2
CO 3	3	3	2	2									3	2	
CO 4	3	2	2	2			2		2				3		2
CO 5	3	2	2						2				3	2	

#### Course Assessment Methods

<b>Direct</b>
1.Continuous Assessment Test I, II & III
2.Assignment
3.End-Semester examinations
<b>Indirect</b>

  
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1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>CELLULAR CONCEPT AND PROPAGATION MODEL</b>	Periods	<b>9</b>
Frequency reuse–Channel assignment strategies, Handoff strategies, Interference and system capacity, Co-channel interference and system capacity- Free space propagation model- Terrestrial propagation: Reflection- Two ray ground model- Scattering model- Indoor propagation model – Outdoor propagation model.			
<b>Unit – II</b>	<b>CHANNEL MODEL, EQUALIZERS AND DIVERSITY TECHNIQUES</b>	Periods	<b>9</b>
Small-scale multipath propagation and measurements - Mobile multipath channel parameters - Types of small scale fading- Rayleigh and Rician channel model- Equalizers: Linear and nonlinear equalizers- Equalizer algorithms - Selection diversity model - RAKE receiver.			
<b>Unit – III</b>	<b>MULTIPLE ACCESS TECHNIQUES</b>	Periods	<b>9</b>
FDMA-TDMA- Spread spectrum multiple access-Capacity of cellular CDMA – SDMA- WCDMA- Packet radio protocols- Capture effect in packet radio.			
<b>Unit – IV</b>	<b>INTRODUCTION TO LTE &amp; 4G NETWORKS</b>	Periods	<b>9</b>
History of Mobile Telecommunication Systems - The Need for LTE - From UMTS to LTE - From LTE to LTE-Advanced – System Architecture Evolution - Multiple Antenna Techniques- Diversity Processing, Spatial Multiplexing, Beamforming			
<b>Unit – V</b>	<b>5G WIRELESS NETWORKS</b>	Periods	<b>9</b>
5G objectives and usage scenarios - channel access method/air interface - Cognitive Radio Technology – Vehicular communications – Connected Devices - Mobile applications – The way forward: fast forward to the year 2040.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	Theodore S. Rappaport , "Wireless Communications", Pearson Education, 2017.		
2.	Christopher Cox, "An Introduction to LTE: LTE, LTE Advanced, SAE, VoLTE and 4G Mobile Communications", 2nd Edition, Wiley Publications, New Delhi, 2014.		
3.	Saad Z. Asif, "5G Mobile Communications Concepts and Technologies", 1st Edition, CRC Press Taylor & Francis Group, USA, 2019.		
<b>References</b>			
1.	Simon Haykin , Michael Moher, David Koilpillai, —Modern Wireless CommunicationsI, First Edition, Pearson Education, 2013		
2.	Erik Dahlman, Stefan Parkvall,Johan Sko” Id, “4G, LTE-Advanced Pro and The Road to 5G” ,Elsevier Ltd, 2016		
3.	R. Vannithamby and S. Talwar, Towards 5G: Applications, Requirements and Candidate Technologies., John Willey & Sons, West Sussex, 2017.		
<b>E-Resources</b>			
1.	<a href="https://web.uettaxila.edu.pk/CMS/SP2013/teMCTTms/tutorial%5CMobile-Communications-JochenSchiller.pdf">https://web.uettaxila.edu.pk/CMS/SP2013/teMCTTms/tutorial%5CMobile-Communications-JochenSchiller.pdf</a>		
2.	<a href="https://www.vssut.ac.in/lecture_notes/lecture1428730613.pdf">https://www.vssut.ac.in/lecture_notes/lecture1428730613.pdf</a>		
3.	<a href="https://www.researchgate.net/profile/A-Mitra/publication/327136258_Lecture_Notes_on_Mobile_Communication/links/5b7bc1a8458515fd123f138/Lecture-Notes-on-Mobile-Communication.pdf">https://www.researchgate.net/profile/A-Mitra/publication/327136258_Lecture_Notes_on_Mobile_Communication/links/5b7bc1a8458515fd123f138/Lecture-Notes-on-Mobile-Communication.pdf</a>		
4.	<a href="https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SECA3020.pdf">https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SECA3020.pdf</a>		

  
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Programme	B.E.	Programme Code	103	Regulation	2023			
Department	ELECTRONICS AND COMMUNICATION ENGINEERING			Semester				
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks		
		L	T	P	C	CA	ESE	Total
U23ECV32	Optical Communication	3	0	0	3	40	60	100
Course Objective	The main objective of the course is to							
	<ul style="list-style-type: none"> <li>Understand the principles and structure of optical fiber systems, including fiber types, fabrication, and passive components.</li> <li>Examine the transmission characteristics of optical fibers, including various dispersion and attenuation mechanisms.</li> <li>Explore the operating principles, materials, and characteristics of optical transmitters used in fiber communication systems.</li> <li>Learn about optical receivers, photodetectors, receiver noise analysis, and link budgeting methods.</li> <li>Analyze optical amplifiers and networking concepts used in modern high-speed fiber optic communication systems.</li> </ul>							
	At the end of the course, the student should be able to,							Knowledge Level
	CO1: Explain the fundamentals of optical fiber systems, modes of propagation, and passive optical components.							K2
	CO2: Analyze signal attenuation and dispersion mechanisms in optical fibers and their impact on signal quality.							K4
	CO3: Describe the materials, structures, and characteristics of optical transmitters including LEDs and laser diodes.							K3
CO4: Evaluate the performance of optical receivers using key metrics such as SNR, BER, and analyze link budgets.							K4	
CO5: Understand the working principles of optical amplifiers and explain optical networking concepts like SONET.							K2	
Pre-requisites	Analog and Digital Communication							

COs	CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak												CO/PSO Mapping		
	Programme Outcomes (POs)												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO 1	3	3	2	-	-	-	-	2	-	-	-	-	3	2	-
CO 2	3	3	2	2	-	-	-	2	-	2	-	-	3	-	2
CO 3	3	3	2	2	-	-	-	-	-	-	-	-	3	2	-
CO 4	3	2	2	2	-	-	-	2	-	2	-	-	3	-	2
CO 5	3	2	2	-	-	-	-	-	-	2	-	-	3	2	-

**Course Assessment Methods**

**Direct**

1. Continuous Assessment Test I, II & III
2. Assignment

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3. End-Semester examinations			
<b>Indirect</b>			
1. Course - End survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>INTRODUCTION TO OPTICAL FIBERS</b>	Periods	<b>9</b>
Elements of an Optical Fiber Systems, Optical fiber modes and configuration, Ray theory transmission, Mode theory of optical propagation, Parameters, fiber materials, Photonic crystal fiber, fiber fabrication techniques, Passive optical components - Optical couplers, Filters, Isolators.			
<b>Unit – II</b>	<b>TRANSMISSION CHARACTERISTICS</b>	Periods	<b>9</b>
Introduction, Optical signal attenuation mechanisms in guided and unguided optical signal transmissions, Optical signal Dispersion – Group delay, material dispersion, waveguide dispersion, polarization mode dispersion, Intermodal dispersion, profile dispersion, Modified single mode fibers- Dispersion Shifted Fibers, Dispersion Flattened Fibers, Polarization , Principles of fiber non linearity.			
<b>Unit – III</b>	<b>OPTICAL TRANSMITTERS</b>	Periods	<b>9</b>
Materials for optical sources, Light-Emitting Diodes - Power and Efficiency, Structure, Characteristics Semiconductor Laser Diodes - Basic Principles and emission, Temperature effects, External quantum efficiency, Structures, longitudinal modes, Gain and index-guiding, power-current characteristics, Injection Laser Characteristics, Laser sources and Transmitters for free space communication.			
<b>Unit – IV</b>	<b>OPTICAL RECEIVERS</b>	Periods	<b>9</b>
Performance and requirements for optical detectors, Principles of optical detection, spectral responsivity, PIN Photo diode , APD, Receiver noises, Signal to Noise Ratio (SNR) and Bit Error Rate (BER), Receiver structure, Preamplifier types, Principles of coherent detection, Link power and rise time budget, relevance of power and rise time budget in practical link/network planning.			
<b>Unit – V</b>	<b>OPTICAL AMPLIFIERS AND NETWORKS</b>	Periods	<b>9</b>
Optical amplifiers: Erbium doped fiber amplifiers, Semiconductor optical amplifiers, Optical switches, Optical MEMS components - Networking Concepts: SONET optical networks.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	Gerd Keiser, “Optical Fiber Communications”, Tata McGraw –Hill, New Delhi, 5 <sup>th</sup> Edition, 2017.		
2.	John M. Senior, “Optical Fiber Communications - Principles and Practice”, Pearson Education, 3 <sup>rd</sup> impression, 2014.		
<b>References</b>			
1.	Gerd Keiser, “ Optical communications Essentials”, Tata Mc Graw Hill, New Delhi, Special Indian Edition ,2008.		
2.	Govind P. Agrawal, “ Fiber-Optic Communication Systems”, John Wiley & Sons, 5 <sup>th</sup> Edition 2021.		
3.	Rajiv Ramasamy & Kumar N. Sivarajan, “Optical Networks – A Practical Perspective”, 3rd Edition, Morgan Kauffman , 2011.		
<b>E-Resources</b>			
1.	<a href="http://gsundar.weebly.com/uploads/5/4/5/6/54560163/optical_fiber_communication_by_gerd_keiser.pdf">http://gsundar.weebly.com/uploads/5/4/5/6/54560163/optical_fiber_communication_by_gerd_keiser.pdf</a>		

  
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Programme	B.E.	Program me Code	103	Regulation	2023			
Department	ELECTRONICS AND COMMUNICATION ENGINEERING			Semester				
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks		
		L	T	P	C	CA	ESE	Total
U23ECV33	Satellite Communication	3	0	0	3	40	60	100
Course Objective	The main objective of the course is to							
	<ul style="list-style-type: none"> <li>• Provide foundational understanding of satellite orbits, launching techniques, and related orbital parameters.</li> <li>• Explore the structure and functions of the space segment and analyze the design of satellite communication links.</li> <li>• Understand and compare multiple access techniques used in satellite communication.</li> <li>• Explain the operation of the earth segment and satellite networking with emphasis on transmission protocols.</li> <li>• Analyze modern satellite communication applications including DBS, VSAT, GPS, and mobile satellite systems.</li> </ul>							
Course Outcomes	At the end of the course, the student should be able to,							Knowledge Level
	CO1: Explain satellite orbital mechanics, look angle determination, and orbital positioning concepts.							K2
	CO2: Analyze the design aspects of the satellite space segment and perform link budget calculations for uplink/downlink.							K4
	CO3: Compare FDMA, TDMA, and CDMA access techniques and evaluate their uplink/downlink requirements.							K3
	CO4: Describe the components and roles of earth stations and explain networking concepts like ATM over satellite and TCP/IP.							K2
	CO5: Analyze key satellite applications including DBS, VSAT, GPS, and their technical parameters like bandwidth, bit rates, and compression standards.							K4
Pre-requisites	-							

COs	CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak											CO/PSO Mapping			
	Programme Outcomes (POs)											PSOs			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O 2	PS O 3
CO 1	3	3	2							2		2	3		2
CO 2	3	3	2	2			2					2	3		
CO 3	3	3	2	2						2		2	3	2	
CO 4	3	2	2	2	2		2					2		2	
CO 5	3	2	2		2							2		2	

**Course Assessment Methods**

Direct

I. Continuous Assessment Test I, II & III


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2.Assignment			
3.End-Semester examinations			
<b>Indirect</b>			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>SATELLITE ORBITS</b>	Periods	<b>9</b>
Kepler’s Laws, Orbital elements, Apogee and perigee heights, Orbital perturbations, inclined orbits, Sub satellite point, The geo stationary orbits- Look Angle Determination, Polar Mount Antenna, Limits of visibility , Earth eclipse, Sun transit outage, Launching orbits.			
<b>Unit – II</b>	<b>SPACE SEGMENT AND SATELLITE LINK DESIGN</b>	Periods	<b>9</b>
Introduction- Power supply, Attitude and Orbit control, Station keeping, Thermal control, Telemetry, Tracking and command, transponders, The antenna subsystems, Satellite uplink and downlink Analysis and Design, EIRP, Transmission Losses, link power budget equation, System noise, C/N calculation, inter modulation and interference, inter-satellite links.			
<b>Unit – III</b>	<b>SATELLITE ACCESS</b>	Periods	<b>9</b>
Introduction, single access, pre-assigned FDMA, demand assigned FDMA, spade system, FDMA downlink analysis, TDMA-basic equipment in TDMA system, pre-assigned and demand assigned TDMA, downlink analysis for digital transmission, comparison of uplink power requirements for FDMA and TDMA, satellite-switched TDMA. Overview of CDMA.			
<b>Unit – IV</b>	<b>EARTH SEGMENT AND SATELLITE IN NETWORKS</b>	Periods	<b>9</b>
Earth Station- Introduction, TVRO, MATV, CATV, Transmit and Receive earth stations. Satellite in networks- introduction, bandwidth, asynchronous transfer mode, ATM over satellite, satellite links and TCP.			
<b>Unit – V</b>	<b>SATELLITE APPLICATIONS</b>	Periods	<b>9</b>
DBS-Introduction, orbital spacing, power rating and number of transponders, frequency an polarization, transponders capacity, bit rates for digital television, MPEG compression standards, forward error correction, the home indoor and outdoor unit, HDTV, Video frequency bandwidth, Satellite mobile services, VSAT, Radarsat, GPS.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	Dennis Roddy, “Satellite Communication”, McGraw Hill International, 4 <sup>th</sup> Edition Reprint, 2017.		
2.	Timothy Pratt, Charles W. Bostian, “Satellite Communications”, John Wiley & Sons, 2 <sup>nd</sup> Edition, 2009.		
<b>References</b>			
1.	Wilbur L. Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, ‘Satellite Communication Systems Engineering’, Prentice Hall/Pearson, 3 <sup>rd</sup> Edition, 2007.		
2.	Bruce R. Elbert, “The Satellite Communication Applications”, Hand Book, Artech House Bostan London, 1997.		
3.	M. O. Kolawole, “Satellite Communication Engineering”, Marcel Dekker, Inc. NY, 2 <sup>nd</sup> Edition , 2017.		
4.	M. Richharia, "Satellite Systems for Personal Applications", John Wiley, 2010.		
<b>E-Resources</b>			
1.	<a href="https://www.scribd.com/doc/105119756/Solutions-Manual-for-Satellite-Communications-Second-edition-Timothy-Pratt-Charles-Bostian-Jeremy-Allnutt">https://www.scribd.com/doc/105119756/Solutions-Manual-for-Satellite-Communications-Second-edition-Timothy-Pratt-Charles-Bostian-Jeremy-Allnutt</a>		

  
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Course Code	Course Name	Periods Per Week			Credit	Maximum Marks									
		L	T	P		CA	ESE	Total							
U23ECV34	<b>5G and 6G Communication Networks</b>	3	0	0	3	40	60	100							
<b>Course Objectives</b>	The main objective of the course is to														
	<ul style="list-style-type: none"> <li>Understand the evolution of wireless networks from 2G to 5G, including changes in core and access network architectures.</li> <li>Examine the fundamental concepts, architecture, and challenges in deploying 5G networks and technologies.</li> <li>Analyze the structure and protocols of 5G network architecture including network slicing and multi-access edge computing (MEC).</li> <li>Explore enabling technologies and challenges associated with reconfigurable intelligent surfaces (RIS) in 6G systems.</li> <li>Study the mmWave and terahertz spectrum characteristics for high-speed wireless communication and understand ongoing standardization efforts.</li> </ul>														
	At the end of the course, the student should be able to,							Knowledge Level							
	<b>CO1:</b> Explain the evolution of wireless technologies from 2G to 5G and describe key differences between 4G and 5G.							K2							
	<b>CO2:</b> Understand the fundamental concepts and architectural components of 5G core networks and cloud-based technologies.							K2							
	<b>CO3:</b> Analyze the 5G system architecture and protocols including network slicing, MEC, and service continuity.							K4							
<b>CO4:</b> Explain the role and design challenges of reconfigurable intelligent surfaces in 6G wireless systems..							K3								
<b>CO5:</b> Analyze mmWave and THz communication systems and understand their propagation characteristics and standardization trends.							K4								
<b>Pre-requisites</b>	Mobile communication														
<b>CO / PO Mapping</b> (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak													<b>CO/PSO Mapping</b>		
<b>COs</b>	<b>Programme Outcomes (POs)</b>												<b>PSOs</b>		
	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PS O1</b>	<b>PS O2</b>	<b>PS O3</b>
<b>CO 1</b>	3	3	2	3	2								1	1	3
<b>CO 2</b>	3	3	3	2	2								1	1	2
<b>CO 3</b>	3	3	2	2	2								2	2	2
<b>CO 4</b>	3	3	3	3	2								3	2	2
<b>CO 5</b>	3	2	3	3	2								2	2	2
<b>Course Assessment Methods</b>															
<b>Direct</b>															
1.Continuous Assessment Test I, II & III															
2.Assignment															
3.End-Semester examinations															

  
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<b>Indirect</b>			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>EVOLUTION OF WIRELESS NETWORKS</b>	Periods	<b>9</b>
Networks evolution: 2G, 3G, 4G, evolution of radio access networks, need for 5G. 4G versus 5G, Next Generation core (NG-core), virtualized Evolved Packet core(vEPC).			
<b>Unit – II</b>	<b>5G CONCEPTS AND CHALLENGES</b>	Periods	<b>9</b>
Fundamentals of 5G technologies, overview of 5G core network architecture, 5G new radio and cloud technologies, Radio Access Technologies (RATs), EPC for 5G.			
<b>Unit – III</b>	<b>NETWORK ARCHITECTURE AND THE PROCESSES</b>	Periods	<b>9</b>
5G architecture and core, network slicing, multi access edge computing(MEC) visualization of 5G components, end-to-end system architecture, service continuity, relation to EPC, and edge computing. 5G protocols: 5G NAS, NGAP, GTP-U, IPSec and GRE.			
<b>Unit – IV</b>	<b>6G ENABLING TECHNOLOGIES</b>	Periods	<b>9</b>
Introduction, Role of Physical Layer in 6G, PHY-Layer Design Challenges in Reconfigurable Intelligent Surface Aided 6G Wireless Networks, System Model, Channel Estimation in RIS-Aided Single-User Systems, Channel Estimation in RIS-Aided Multi-User Systems			
<b>Unit – V</b>	<b>MILLIMETER WAVE AND TERAHERTZ SPECTRUM</b>	Periods	<b>9</b>
Background and Motivation, Introduction to mmWave and THz Spectrum, Propagation at the mmWave and THz Frequencies, The mmWave Communications Systems, The THz Communications Systems, Standardization Efforts			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	5G Core networks: Powering Digitalization , Stephen Rommer, Academic Press, 2019		
2.	An Introduction to 5G Wireless Networks: Technology, Concepts and Use cases, Saro Velrajan, First Edition, 2020.		
3.	6G Mobile Wireless Networks, Yulei_Wu, Sukhdeep_Singh, Tarik Taleb, Abhishek Roy, Harpreet S.Dhillon, Madhan Raj Kanagarathinam, Alok Nath De , Springer Nature Switzerland AG publisher, 2021.		
<b>References</b>			
1.	5G Simplified: ABCs of Advanced Mobile Communications Jyrki. T.J.Penttinen, Kindle Edition 2019.		
2.	5G system Design: An end to end Perspective, Wan Lee Anthony, Springer Publications, 2 <sup>nd</sup> Edition 2021.		
<b>E-Resources</b>			
1.	<a href="https://www.geeksforgeeks.org/generations-of-wireless-communication/">https://www.geeksforgeeks.org/generations-of-wireless-communication/</a>		
2.	<a href="https://decisiontele.com/news/perspectives-and-barriers-5g-implementation-and-its-impact-small-and-medium-businesses.html">https://decisiontele.com/news/perspectives-and-barriers-5g-implementation-and-its-impact-small-and-medium-businesses.html</a>		
3.	<a href="https://www.zscaler.com/zpedia/what-is-5g-security">https://www.zscaler.com/zpedia/what-is-5g-security</a>		

  
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Programme	B.E.	Program me Code	103	Regulation	2023										
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>			Semester											
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks									
		L	T	P	C	CA	ESE	Total							
U23ECV35	<b>MIMO Communications</b>	3	0	0	3	40	60	100							
<b>Course Objective</b>	The main objective of the course is to														
	<ul style="list-style-type: none"> <li>Understand the behavior of wireless fading channels and analyze diversity techniques to improve performance.</li> <li>Study the capacity and information rates of various MIMO communication systems including non-coherent and constrained signaling scenarios.</li> <li>Learn the principles and construction of space-time block codes and trellis codes, including their design and performance evaluation.</li> <li>Explore the development and decoding of concatenated codes, including turbo coded modulation schemes in MIMO systems.</li> <li>Analyze space-time coding for frequency-selective fading channels and investigate MIMO-OFDM systems for high-speed communication.</li> </ul>														
<b>Course Outcomes</b>	At the end of the course, the student should be able to,						Knowledge Level								
	CO1: Explain the effects of fading channels and describe various diversity and coding techniques used in wireless communication.						K2								
	CO2: Analyze the capacity and performance of MIMO communication systems in different channel conditions.						K4								
	CO3: Compare and evaluate space-time block and trellis coding techniques for different modulation schemes.						K3								
	CO4: Explain the structure and operation of concatenated codes and analyze their performance in MIMO systems.						K3								
	CO5: Analyze the application of space-time coding in frequency-selective fading channels and describe the architecture of MIMO-OFDM systems.						K4								
<b>Pre-requisites</b>	Analog and Digital Communication														
<b>CO / PO Mapping</b>													<b>CO/PSO Mapping</b>		
(3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak															
COs	Programme Outcomes (POs)											PSOs			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O 2	PS O 3
CO 1	3	3	2					2					3	2	
CO 2	3	2	2	2				2		2			3		2
CO 3	3	2	2	2									3	2	
CO 4	3	3	2	2				2		2			3		2
CO 5	3	3	2							2			3	2	
<b>Course Assessment Methods</b>															
<b>Direct</b>															
1.Continuous Assessment Test I, II & III															
2.Assignment															
3.End-Semester examinations															
<b>Indirect</b>															

*[Signature]*  
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1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>FADING CHANNELS AND DIVERSITY TECHNIQUES</b>	Periods	<b>9</b>
Wireless channels, Error/Outage probability over fading channels, Diversity techniques, Channel coding - Time Diversity, Multiple antennas in wireless communications.			
<b>Unit – II</b>	<b>CAPACITY AND INFORMATION RATES OF MIMO CHANNELS</b>	Periods	<b>9</b>
Capacity and Information rates of noisy, AWGN and fading channels, Capacity of non-coherent MIMO channels, Constrained signaling for MIMO communications.			
<b>Unit – III</b>	<b>SPACE TIME BLOCK AND TRELIS CODE</b>	Periods	<b>9</b>
Alamouti scheme, Orthogonal and Quasi- orthogonal space-time block codes, Linear dispersion codes, Generic space-time trellis codes, Basic space-time code design principles, Representation of space-time trellis codes for PSK constellation, Performance analysis for space-time trellis codes, Comparison of space-time block and trellis codes.			
<b>Unit – IV</b>	<b>CONCATENATED CODES AND ITERATIVE DECODING</b>	Periods	<b>9</b>
Development of concatenated codes, Concatenated codes for AWGN and MIMO channels, Turbo coded modulation for MIMO channels, Concatenated space-time block coding.			
<b>Unit – V</b>	<b>SPACE-TIME CODING FOR FREQUENCY SELECTIVE FADING CHANNELS</b>	Periods	<b>9</b>
MIMO frequency - Selective channels, Capacity and Information rates of MIMO FS fading channels, Space-time coding and Channel detection for MIMO FS channels, MIMO OFDM systems			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	Tolga M. Duman and Ali Ghrayeb, “Coding for MIMO Communication Systems”, John Wiley & Sons, West Sussex, England, 2008.		
2.	A.B. Gershman and N.D. Sidiropoulos, “Space-Time Processing for MIMO Communications”, Wiley, Hoboken, NJ, USA, 2005.		
<b>References</b>			
1.	E.G. Larsson and P.Stoica, “Space-time block coding for Wireless communications”, Cambridge University Press, 2008.		
2.	M. Janakiraman, “Space-Time Codes and MIMO systems”, Artech House, 2004.		
3.	H. Jafarkhani, “Space-Time Coding: Theory & Practice”, Cambridge University Press, 2005.		
<b>E-Resources</b>			
1.	<a href="http://acsp.ece.cornell.edu/papers/Sung2SadlerTong05book.pdf">http://acsp.ece.cornell.edu/papers/Sung2SadlerTong05book.pdf</a>		
2.	<a href="https://www.ursi.org/proceedings/procGA05/pdf/C08.1(01584).pdf">https://www.ursi.org/proceedings/procGA05/pdf/C08.1(01584).pdf</a>		



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Programme	B.E.	Program me Code	103	Regulation	2023			
Department	ELECTRONICS AND COMMUNICATION ENGINEERING			Semester				
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks		
		L	T	P	C	CA	ESE	Total
U23ECV36	Advanced Wireless Communication Techniques	3	0	0	3	40	60	100
Course Objective	<p>The main objective of the course is to</p> <ul style="list-style-type: none"> <li>Understand the modeling of wireless channels, including path loss, shadowing, and various fading models.</li> <li>Analyze the capacity of wireless channels under different conditions and channel knowledge scenarios.</li> <li>Evaluate the performance of digital modulation schemes over fading and frequency-selective channels.</li> <li>Examine diversity techniques to improve wireless system reliability in the presence of fading.</li> <li>Understand and compare different equalization techniques for mitigating inter-symbol interference in wireless systems.</li> </ul>							
	Course Outcomes	At the end of the course, the student should be able to,						Knowledge Level
CO1: Explain the behavior and statistical modeling of wireless channels including path loss, shadowing, and multipath fading.						K2		
CO2: Analyze the capacity of wireless channels for various fading conditions and levels of channel knowledge at the transmitter/receiver.						K4		
CO3: Evaluate the performance of various digital modulation techniques over wireless fading channels.						K3		
CO4: Describe and analyze diversity techniques such as selection combining, MRC, EGC, and Alamouti scheme.						K3		
CO5: Analyze and compare different equalization techniques including ZF, MMSE, MLSE, and adaptive equalizers.						K4		
Pre-requisites	Analog and Digital Communication							

COs	CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak												CO/PSO Mapping		
	Programme Outcomes (POs)												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O 2	PS O 3
CO 1	3	3	2				2						3	2	
CO 2	3	2	2	2			2		2				3		2
CO 3	3	2	2	2									3	2	
CO 4	3	3	2	2			2		2				3		2
CO 5	3	3	2						2				3	2	

Course Assessment Methods

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<b>Direct</b>			
1.Continuous Assessment Test I, II & III 2.Assignment 3.End-Semester examinations			
<b>Indirect</b>			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>WIRELESS CHANNELS</b>	Periods	<b>9</b>
Physical Modeling For Wireless Channels, Path loss and Shadowing: Radio wave propagation, Empirical Path – Loss Models, Outage Probability under Path Loss and Shadowing, Statistical Multipath Channel Models, Narrowband Fading Models, Wideband Fading Models, Discrete-Time Model, Space-Time Channel Models.			
<b>Unit – II</b>	<b>CAPACITY OF WIRELESS CHANNELS</b>	Periods	<b>9</b>
Capacity in AWGN , Capacity of Flat Fading Channels, Channel Distribution Information Known at Transmitter and Receiver ,Capacity Comparisons, Capacity of Frequency -Selective Fading Channels-Time Invariant Channels - Time variant Channels.			
<b>Unit – III</b>	<b>PERFORMANCE OF DIGITAL MODULATION OVER WIRELESS CHANNELS</b>	Periods	<b>9</b>
SNR and bit/symbol energy, error probability for BPSK, QPSK, MPSK, MPAM, MQAM, Index Modulation over fading channels. Error probability for FSK and CPFSK, error probability approximation for coherent modulations and differential modulation, Q-function representation, outage probability, average probability of error, inter symbol interference.			
<b>Unit – IV</b>	<b>DIVERSITY</b>	Periods	<b>9</b>
Receiver diversity, selection combining (sc), maximal ratio combining (mrc), equal gain combining (egc), transmitter diversity: channel known at the transmitter, channel unknown at the transmitter, alamouti scheme, diversity analysis for non-coherent and differentially coherent modulation.			
<b>Unit – V</b>	<b>EQUALIZATION</b>	Periods	<b>9</b>
Equalizer Noise Enhancement, Equalizer Types, Zero Forcing (ZF) Equalizer, MMSE Equalizer, Maximum Likelihood Sequence Estimation (MLSE), Decision Feedback Equalization, Adaptive Equalizers.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	Andrea goldsmith, Wireless Communication, Cambridge University Press, 2015, South Asia Edition.		
2.	Theodore S. Rappaport, Wireless Communications Principles and Practice, Pearson Education. 2010, Third Edition.		
<b>References</b>			
1.	David Tse, Pramod Viswanath, Fundamentals of Wireless Communication, Cambridge University Press, 2012.		
<b>E-Resources</b>			
1.	<a href="https://nptel.ac.in/courses/117102062">https://nptel.ac.in/courses/117102062</a>		
2.	<a href="https://onlinecourses.nptel.ac.in/noc24_ee10">https://onlinecourses.nptel.ac.in/noc24_ee10</a>		



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Programme	B.E.	Programme Code	103	Regulation	2023			
Department	ELECTRONICS AND COMMUNICATION ENGINEERING			Semester				
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks		
		L	T	P	C	CA	ESE	Total
U23ECV37	Quantum Communication	3	0	0	3	40	60	100
Course Objective	<p>The main objective of the course is to</p> <ul style="list-style-type: none"> <li>Understand the fundamental differences between classical and quantum communication and their applications.</li> <li>Study quantum entanglement, Bell's theorem, and their implications for secure communication protocols.</li> <li>Explore various quantum key distribution (QKD) protocols and quantum communication channels, including teleportation and superdense coding.</li> <li>Analyze the structure and scalability challenges of quantum communication networks and core concepts in quantum information theory.</li> <li>Examine real-world implementations and experimental platforms of quantum communication technologies.</li> </ul>							
Course Outcomes	At the end of the course, the student should be able to,							Knowledge Level
	CO1: Explain fundamental principles of quantum communication, including qubits, superposition, and entanglement.							K2
	CO2: Analyze quantum entanglement and evaluate cryptographic protocols such as BB84 and E91 for secure communication.							K4
	CO3: Compare advanced QKD protocols and assesses the effects of noise and decoherence in quantum communication channels.							K3
	CO4: Understand the architecture of quantum networks and analyze quantum information metrics such as entropy and Holevo bound.							K4
CO5: Describe experimental implementations of quantum communication systems and evaluate their integration with classical technologies.							K3	
Pre-requisites	-							

COs	CO/POMapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak										CO/PSO Mapping				
	Programme Outcomes (POs)										PSOs				
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	2	2	1		2	2						2	1	
CO2	3	2	2	1		2	2						2	1	
CO3	3	2	2	1		2	2						2	1	
CO4	3	2	2	1		2	2						2	1	
CO5	3	2	2	1		2	2						2	1	

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<b>Course Assessment Methods</b>			
<b>Direct</b>			
1.Continuous Assessment Test I, II & III			
2.Assignment			
3.End-Semester examinations			
<b>Indirect</b>			
1. Course-end survey			
<b>Content of the syllabus</b>			
<b>Unit –I</b>	<b>Introduction to Quantum Communication</b>	Periods	<b>9</b>
Introduction to quantum computation-Classical computation on a Quantum computer- - Applications: Cryptography, networks, and sensing. Foundations of Quantum Mechanics -Qubits and quantum states-Quantum superposition and entanglement-Measurement and the no-cloning theorem			
<b>Unit–II</b>	<b>Quantum Entanglement and Bell's Theorem</b>	Periods	<b>9</b>
Definition and properties of quantum entanglement- EPR paradox and Bell's inequality-Experimental demonstrations of entanglement. Principles of quantum cryptography- BB84 protocol: Concept, implementation, and security- E91 protocol based on entanglement.			
<b>Unit –III</b>	<b>Advanced Quantum Key Distribution Protocols and Quantum Communication Channels</b>	Periods	<b>9</b>
Continuous-variable QKD- Decoy-state QKD- Device-independent QKD. Quantum Communication Channels-Noise in quantum channels (decoherence, depolarizing channels)-Quantum teleportation-Superdense coding.			
<b>Unit –IV</b>	<b>Quantum Networks and Quantum Information Theory</b>	Periods	<b>9</b>
Quantum repeaters and entanglement swapping-Quantum internet architecture-Challenges in scaling quantum communication networks. Quantum Shannon entropy- Holevo bound and classical information over noisy quantum channels-Quantum error correction for communication			
<b>Unit –V</b>	<b>Experimental Implementations of Quantum Communication</b>	Periods	<b>9</b>
Overview of quantum hardware: Photonic systems, satellites, and fiber optics-Case studies: China's Micius satellite, fiber-based QKD experiments-Integrating quantum communication with existing technology			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	Quantum Computation and Quantum Information by Michael A. Nielsen and Isaac L. Chuang First edition ,Cambridge University Press.2010		
2.	Principles of Quantum Mechanics by R. Shankar, second edition by Springer, 2014.		
3	Quantum Cryptography and Secret-Key Distillation by Gilles Van Assche, First edition by Cambridge University Press., 2012		
<b>References</b>			
1.	Quantum Information Theory by Mark M. Wilde. Second edition ,Cambridge University Press 2017		
2.	Quantum Communications and Cryptography by Alexander V. Sergienko, First edition. CRC Press. 2019		
<b>E-Resources</b>			
1.	Quantum Network Explorer.		
2.	Qiskit Tutorials on Quantum Communication.		



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Programme	B.E.	Programme Code	103	Regulation	2023		
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>			Semester			
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks	
		L	T	P	C	CA	ESE
U23ECV38	<b>Green Communication and Technology</b>	3	0	0	3	40	60
Course Objective	<p>The main objectives of this course are to:</p> <ul style="list-style-type: none"> <li>• Understand the foundational principles of green chemistry and green engineering, and apply green metrics to assess sustainability.</li> <li>• Examine green reagents, green solvents, and environmentally benign synthesis techniques using energy-efficient methods and recycling.</li> <li>• Learn the principles of designing inherently safer and sustainable chemical processes</li> <li>• Understand the applications of nanotechnology in green chemistry, including environmental remediation and sustainable energy solutions.</li> <li>• Energy consumption trends in IoT Communication.</li> </ul>						
Course Outcomes	At the end of the course, the student should be able to,					Knowledge Level	
	CO1: Explain the principles of green chemistry and calculate sustainability using green chemistry metrics.					K2	
	CO2: Describe and evaluate green synthesis methods, including the use of alternative solvents and energy-efficient reaction techniques and recycling					K3	
	CO3: Analyze safe and sustainable design approaches for chemical processes including process intensification and real-time monitoring.					K4	
	CO4: Understand the role of nanotechnology in environmental applications and assess its potential and concerns in green chemistry.					K4	
	CO5: Evaluate low-power IoT communication protocols and sustainable smart systems.					K3	
Pre-requisites	-						

COs	CO / PO Mapping											CO/PSO Mapping			
	(3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak											PSOs			
	Programme Outcomes (POs)														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO 1	3	3	3									2			
CO 2	3	3	3	2			2					2			
CO 3	3	3	3	2								2			
CO 4	3	3	3	2	2		2					2			
CO 5	3	3	3		2							2			

**Course Assessment Methods**

**Direct**

1.Continuous Assessment Test I, II & III

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2.Assignment			
3.End-Semester examinations			
<b>Indirect</b>			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>PRINCIPLES OF GREEN CHEMISTRY</b>	Periods	<b>9</b>
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.			
<b>Unit – II</b>	<b>GREEN REAGENTS AND GREEN SYNTHESIS</b>	Periods	<b>9</b>
Environmentally benign processes- alternate solvents- supercritical solvents, ionic liquids, water as a reaction medium, energy-efficient design of processes, microwave-assisted reactions chemical, physical and biochemical methods of waste minimization and recycling.			
<b>Unit – III</b>	<b>DESIGNING GREEN PROCESSES</b>	Periods	<b>9</b>
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			
<b>Unit – IV</b>	<b>GREEN NANOTECHNOLOGY</b>	Periods	<b>9</b>
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			
<b>Unit – V</b>	<b>GREEN IoT AND SMART SUSTAINABLE TECHNOLOGIES</b>	Periods	<b>9</b>
Green IoT: principles, architecture, design challenges- Low-power protocols for IoT: LoRa, NB-IoT, ZigBee, 6LoWPAN, BLE- Energy-efficient sensor networks and wearable devices- Smart grids, smart cities, intelligent transportation, green buildings-Sustainable computing: green data centers, virtualization, thermal management			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	Green technology and design for the environment, SamirB. Billatos, NadiaA. Basaly, Taylor &Francis, Washington, DC,1997		
2.	Green Chemistry–An introductory text-M. Lancaster, RSC, 2016.		
3.	Green chemistry metrics-Alexi Lapkin and david Constable (Eds),Wiley publications,2008		
4.	Hossam Fattah & Karim Maali, Energy Efficient Internet of Things (IoT), Springer, 2021		
<b>References</b>			
1.	Environmental chemistry, Stanley E Manahan,Taylor and Francis, 2017		

  
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Programme	B.E.	Programme Code	103	Regulation	2023			
Department	ELECTRONICS AND COMMUNICATION ENGINEERING			Semester				
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks		
		L	T	P	C	CA	ESE	Total
U23ECV41	Embedded System Design and Real Time Applications	3	0	0	3	40	60	100
Course Objective	<p>The main objective of the course is to</p> <ul style="list-style-type: none"> <li>Understand the fundamentals of embedded systems, their architectures, and design philosophies.</li> <li>Explore the TIVA ARM Cortex-M4 microcontroller architecture and its programming techniques.</li> <li>Study the concepts of timers, PWM, ADC, and mixed signal processing in embedded applications.</li> <li>Learn how to integrate hardware and software components in embedded systems.</li> <li>Analyze real-time operating system concepts and apply them in embedded product development.</li> </ul>							
Course Outcome	At the end of the course, the student should be able to,							Knowledge level
	CO1: Explain the architectural features and design philosophies of embedded systems including CISC/RISC and Von Neumann/Harvard models.							K2
	CO2: Apply basic embedded programming techniques using TIVA ARM Cortex M4 microcontroller and its memory-mapped peripherals.							K3
	CO3: Demonstrate the usage of timers, PWM modules, ADCs, and other peripherals for signal processing and motion control applications.							K3
	CO4: Analyze the integration of hardware components like displays, motors, and relays with embedded software for real-world applications.							K4
	CO5: Examine the role of RTOS in embedded system design and evaluate different inter-process communication mechanisms and task management techniques.							K4
Pre-requisites	Microprocessors and Microcontrollers							

COs	CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak											CO/PSO Mapping			
	Programme Outcomes (POs)											PSOs			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3					3	2	2		2		1	2		
CO2	3	3			2							1	2	2	
CO3	3	3	2		2					3	1	1	3	3	
CO4	3	3				2	2	2		3		1	2	2	
CO5	3	3			3			2		3		1	2		

**Course Assessment Methods**

<b>Direct</b>
1. Continuous Assessment Test I, II & III

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2. Assignment: Simulation using tool			
3. End-Semester examinations			
<b>Indirect</b>			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>INTRODUCTION</b>	Periods	<b>9</b>
Embedded system overview and applications, features and architecture considerations-ROM, RAM, timers, data and address bus, Memory and I/O interfacing concepts, memory mapped I/O, CISC Vs RISC design philosophy, Von-Neumann Vs Harvard architecture, instruction set, instruction formats, and various addressing modes. Fixed point and floating point arithmetic operations.			
<b>Unit - II</b>	<b>BASIC EMBEDDED PROGRAMMING TECHNIQUES</b>	Periods	<b>9</b>
Introduction to TIVA ARM Cortex M4 – Key Features – Functional Block Diagram - Pin Configuration –I/O pin multiplexing, pull up/down registers, GPIO control, Memory Mapped Peripherals, programming System registers, Watchdog Timer, need of low power for embedded systems, System Clocks and control, Hibernation Module on Tiva, Active vs Standby current consumption.			
<b>Unit – III</b>	<b>TIMERS, PWM and MIXED SIGNAL PROCESSING</b>	Periods	<b>9</b>
Timer, Basic Timer, Real Time Clock (RTC), Timing generation and measurements, Analog interfacing and data acquisition: ADC, Analog Comparators, DMA, Motion Control Peripherals: PWM Module & Quadrature Encoder Interface (QEI).			
<b>Unit - IV</b>	<b>HARDWARE AND SOFTWARE INTEGRATION</b>	Periods	<b>9</b>
Host and Target Machines. In-System Programming (ISP)-In-Application Programming (IAP)-Getting Embedded Software into Target System: Programmers. Display, Keyboard, Relay, Stepper and DC Motor Interfacing.			
<b>Unit – V</b>	<b>REAL TIME OPERATING SYSTEMS</b>	Periods	<b>9</b>
Survey of Software Architectures, Tasks and Task States, Tasks and Data, Semaphores and Shared Data, Message Queues, Mailboxes and Pipes, Timer functions, Events, Memory Management and Interrupt Routines in RTOS Environment. Study of embedded product design with real time concepts using RTOS.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	Jonathan Valvano, “Embedded Systems: Real-Time Operating Systems for Arm Cortex-M Microcontrollers”, 2017.		
2.	David E Simon, “An Embedded Software Primer”, Pearson Education Asia, New Delhi, 2009.		
<b>References</b>			
1.	Rajkamal, ”Embedded Systems: Architecture, Programming and Design”; Tata McGraw-Hill, New Delhi, 2019.		
2.	Andrew Sloss & Dominic Symes & Chris Wright, “ARM System Developer’s Guide, 1st Edition, Elsevier, Morgan Kaufmann Publishers, 2004.		
3.	Lyla B Das, —Embedded Systems-An Integrated Approachl, Pearson, 2013		
<b>E-Resources</b>			
1.	<a href="https://www.scribd.com/document/328586500/embedded-systems-by-rajkamal-2nd-pdf">https://www.scribd.com/document/328586500/embedded-systems-by-rajkamal-2nd-pdf</a>		

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Programme	<b>B.E.</b>	Programme Code	<b>103</b>	Regulation	<b>2023</b>			
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>			Semester				
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks		
		L	T	P	C	CA	ESE	Total
<b>U23ECV42</b>	<b>Software for Embedded system</b>	3	0	0	3	40	60	100
<b>Course Objective</b>	<p>The main objective of the course is to</p> <ul style="list-style-type: none"> <li>• Understand the characteristics and components of embedded systems and application and design process</li> <li>• Learn embedded C programming concepts including memory access, I/O, and interrupts.</li> <li>• Understand real-time operating system concepts such as task scheduling, synchronization, and inter-task communication.</li> <li>• Familiarize with embedded software development tools and debugging techniques.</li> <li>• Apply embedded software design principles in real-world projects involving sensor data and communication protocols.</li> </ul>							
<b>Course Outcome</b>	At the end of the course, the student should be able to,							Knowledge level
	CO1: Explain the characteristics and application areas of embedded systems and differentiate them from general-purpose systems.							K2
	CO2: Apply embedded C programming techniques to develop software involving memory access, I/O operations, and interrupt handling.							K3
	CO3: Illustrate the functionality of RTOS features including task management, semaphores, and ISRs with examples such as FreeRTOS or CMSIS-RTOS.							K3
	CO4: Demonstrate the use of embedded development tools and debugging methods including version control and IDEs for software development.							K3
	CO5: Analyze embedded software design and development life cycles and implement mini projects involving device drivers and wireless communication.							K4
<b>Pre-requisites</b>	Processors and controllers							


COs	CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak											CO/PSO Mapping			
	Programme Outcomes (POs)											PSOs			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O 2	PS O 3
CO1	3											3	2		1
CO2	3		2		2								2	2	
CO3	3	3	2		2								3	3	
CO4	3	3	2		2							3	2	2	
CO5	3	3	2		2							3	2		

**Course Assessment Methods**

<b>Direct</b>
1.Continuous Assessment Test I, II & III
2.Assignment: Simulation using tool

  
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3.End-Semester examinations			
<b>Indirect</b>			
1.Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>INTRODUCTION TO EMBEDDED SYSTEMS</b>	Periods	<b>9</b>
Definition and characteristics, Embedded system vs general-purpose systems, Embedded system design process, Applications in consumer, automotive, medical, and industrial electronics, Embedded system components: hardware and software Role of software in embedded systems.			
<b>Unit - II</b>	<b>PROGRAMMING FOR EMBEDDED SYSTEMS</b>	Periods	<b>9</b>
Embedded C basics: data types, structures, pointers, Memory access: volatile, const, bit manipulation, Input/output programming, Interrupt handling, Writing and compiling embedded software.			
<b>Unit – III</b>	<b>REAL-TIME OPERATING SYSTEMS (RTOS)</b>	Periods	<b>9</b>
Introduction to RTOS, Task creation and scheduling, Preemptive and non preemptive scheduling, RMS Scheduling, Semaphores, mutexes, and inter-task communication, Interrupt service routines, Case study: FreeRTOS or CMSIS-RTOS.			
<b>Unit - IV</b>	<b>EMBEDDED SOFTWARE DEVELOPMENT TOOLS</b>	Periods	<b>9</b>
Toolchain overview: Editor, Compiler, Assembler, Linker, Debugger, Cross-compilation, Flashing, Simulation, IDEs: Keil uVision, MPLAB X, STM32CubeIDE, Arduino IDE, Debugging techniques (JTAG, SWD), Code version control using Git.			
<b>Unit – V</b>	<b>EMBEDDED SOFTWARE DESIGN FOR PROJECTS</b>	Periods	<b>9</b>
Software design and development life cycle for embedded projects, Device driver development (GPIO, ADC, UART, SPI, I2C), Case study: Using Arduino/Raspberry Pi/STM32 for real-world applications, Mini project: Sensor data acquisition and wireless transmission, Testing and documentation of embedded software.			
<b>Total Periods</b>			<b>45</b>
<b>Text Book</b>			
1.	Raj Kamal, Embedded Systems: Architecture, Programming and Design, 3rd Edition, McGraw-Hill Education, 2017.		
<b>References</b>			
1.	Michael J. Pont, Embedded C, Pearson Education, 2007.		
2.	Jonathan W. Valvano, Embedded Systems: Real-Time Interfacing to ARM Cortex-M Microcontrollers, 3rd Edition, Create Space, 2016.		
3.	Shibu K.V., Introduction to Embedded Systems, McGraw Hill Education, 2nd Edition, 2017.		
4.	Jack Ganssle, The Art of Designing Embedded Systems, 2nd Edition, Newnes, 2008.		
5.	Free RTOS Documentation and Tutorials ( <a href="http://www.freertos.org">www.freertos.org</a> )		

  
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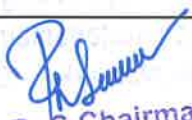
Programme	B.E.	Programme Code	103	Regulation	2023			
Department	ELECTRONICS AND COMMUNICATION ENGINEERING			Semester				
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks		
		L	T	P	C	CA	ESE	Total
U23ECV43	Sensor for Industrial Applications	3	0	0	3	40	60	100
Course Objective	<p>The main objective of the course is to</p> <ul style="list-style-type: none"> <li>• Understand the fundamental principles and classification of physical and chemical sensors.</li> <li>• Explore the working and characteristics of mechanical and electromechanical sensors.</li> <li>• Study the operating principles of magnetic and current sensors for measurement and control.</li> <li>• Analyze the behaviour and applications of thermal, radiation, and smart sensors.</li> <li>• Examine the real-world applications of sensors in various domains.</li> </ul>							
Course Outcome	At the end of the course, the student should be able to,						Knowledge Level	
	CO1: Explain the principles, classifications, & characteristics of physical and chemical sensors.						K2	
	CO2: Illustrate the operating principles and construction of mechanical and electromechanical sensors used for force and displacement measurements.						K3	
	CO3: Apply the principles of magnetic and current sensors for motion and position sensing.						K3	
	CO4: Analyze the functioning and applications of thermal, radiation, and smart sensors.						K4	
Pre-requisites	Electron Devices							

COs	CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak											CO/PSO Mapping			
	Programme Outcomes (POs)											PSOs			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	1	1									1	3		
CO2	3		3									1			
CO3	2	2	3				1						2		
CO4	2	2	3				1					1	2		
CO5	2	2	3				1					1	3		

**Course Assessment Methods**

**Direct**



- 1.Continuous Assessment Test I, II & III
- 2.Assignment: Simulation using tool

  
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3.End-Semester examinations			
<b>Indirect</b>			
1.Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>INTRODUCTION</b>	Periods	<b>9</b>
Principles of Physical and Chemical Sensors –Classification of sensors-Static and dynamic characteristics-Environmental Parameters – Characterization- Electrical, mechanical, thermal, Optical and Chemical/Biological.			
<b>Unit - II</b>	<b>MECHANICAL &amp; ELECTROMECHANICAL SENSORS</b>	Periods	<b>9</b>
Force Sensors -Potentiometers – Strain Gauge –Resistance type, Semiconductor type – Inductive sensors – Electromagnetic, Magneto-strictive – Capacitive sensors –Parallel plate, Serrated plate- Electrostatic Transducer – Ultrasonic Sensors.			
<b>Unit – III</b>	<b>MAGNETIC AND CURRENT SENSORS</b>	Periods	<b>9</b>
Magnetic Sensors –types & Principle behind- Magneto resistive – Hall Effect and sensors – Inductance and eddy Current sensor – Angular /rotary movement Transducers			
<b>Unit – IV</b>	<b>THERMAL , RADIATION AND OPTICAL SENSORS</b>	Periods	<b>9</b>
Thermometer,Thermistor, Thermo couple & RTD – Thermal Radiation sensors – Radiation Sensors - Photo conductive cell, photo voltaic, Photo resistive, LDR –Nuclear Radiation sensors- Fiber optic sensors –Smart Sensors - Film sensor, MEMS & Nano Sensors.			
<b>Unit – V</b>	<b>APPLICATIONS OF SENSORS</b>	Periods	<b>9</b>
Applications and case studies of Sensors in Automobile Engineering, Aeronautics, Manufacturing processes & Consumer Electronics			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	Patranabis D., “Sensor and Actuators”, Prentice Hall of India (Pvt) Ltd., second edition 2013(revised).		
2.	Ian R Sinclair, —Sensors and Transducers, Third Edition, Newnes publishers, 2011.		
3.	G.K.Anantha Suresh “Micro and smart systems”, Wiley Edition, 2010.		
<b>References</b>			
1.	Ernest O. Doebelin, “Measurement systems Application and Design”, International Student Edition, VI Edition, Tata McGraw-Hill Book Company, 2012.		
2.	Robert B.Northrop, “Introduction to Instrumentation and Measurement” ,3rd Edition” ,CRC–Press–Taylor and Francis Group,2014		
<b>E-Resources</b>			
1.	<a href="https://www.finoit.com/blog/top-15-sensor-types-used-iot/">https://www.finoit.com/blog/top-15-sensor-types-used-iot/</a>		
2.	<a href="https://www.sensorsportal.com/HTML/DIGEST/march_2015/Vol_186/ST_Vol_186_Issue_3_2015.pdf">https://www.sensorsportal.com/HTML/DIGEST/march_2015/Vol_186/ST_Vol_186_Issue_3_2015.pdf</a>		
3.	<a href="https://www.first-sensor.com/en/applications/industrial/">https://www.first-sensor.com/en/applications/industrial/</a>		
4.	<a href="https://nybsys.com/types-of-sensors/">https://nybsys.com/types-of-sensors/</a>		



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Programme	B.E.	Programme Code	103	Regulation	2023			
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>			Semester				
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks		
		L	T	P	C	CA	ESE	Total
U23ECV44	<b>IoT System Design and Processor</b>	3	0	0	3	40	60	100
Course Objective	The main objective of the course is							
	<ul style="list-style-type: none"> <li>Understand the fundamentals, architecture, and ecosystem of IoT.</li> <li>Explore the role of middleware, protocols, and interoperability in IoT systems.</li> <li>Analyze communication technologies, networking protocols, and security for IoT.</li> <li>Apply IoT concepts using programming tools and platforms like Python and Raspberry Pi.</li> <li>Examine real-world IoT applications and evaluate use cases in various sectors.</li> </ul>							
Course Outcomes	At the end of the course, the student should be able to,						Knowledge Level	
	CO1: Explain the architecture, enabling technologies, and functional components of an IoT ecosystem.						K2	
	CO2: Describe the middleware architecture and communication protocols used in IoT systems, including RFID, SCADA, WSN, and M2M.						K2	
	CO3: Apply networking and communication technologies such as 6LoWPAN, LoRaWAN, and MQTT for IoT system design.						K3	
	CO4: Develop basic IoT applications using Python, Raspberry Pi, and sensor-based embedded platforms.						K3	
Pre-requisites	Communication Systems							

CO / PO Mapping													CO/PSO Mapping		
(3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak															
COs	Programme Outcomes (POs)											PSOs			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO 1	3		2									3	2		
CO 2	3		2	2	3								2	2	
CO 3	3	2	3	3									3	3	
CO 4	3	2	3					2					2	2	
CO 5	3	2	3	3	2	2	2	2				3	3		3


#### Course Assessment Methods

##### Direct

1. Continuous Assessment Test I, II & III
2. Assignment
3. End-Semester examinations

##### Indirect

1. Course - end survey

  
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<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>Fundamentals of IoT</b>	<b>Periods</b>	<b>9</b>
Evolution of Internet of Things, Enabling Technologies, M2M Communication, IoT World Forum (IoTWF) standardized architecture, Simplified IoT Architecture, Core IoT Functional Stack, Fog, Edge and Cloud in IoT, Functional blocks of an IoT ecosystem, Sensors, Actuators, Smart Objects and Connecting Smart Objects.			
<b>Unit – II</b>	<b>MIDDLEWARE AND PROTOCOLS OF IOT</b>	<b>Periods</b>	<b>9</b>
IoT Ecosystem Overview – Horizontal Architecture Approach for IoT Systems – SOA based IoT Middleware - Middleware architecture of RFID,WSN,SCADA,M2M –Interoperability challenges of IoT- Protocols for RFID,WSN,SCADA,M2M- Zigbee, KNX, BACnet, MODBUS - Challenges Introduced by 5G in IoT Middleware (Technological Requirements of 5G Systems - Perspectives and a Middleware Approach Toward 5G (COMPaaS Middleware) – Resource management in IoT.			
<b>Unit – III</b>	<b>COMMUNICATION AND NETWORKING</b>	<b>Periods</b>	<b>9</b>
IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Low, Routing over Low Power and Lossy Networks – Application Transport Methods: Supervisory Control and Data Acquisition – Application Layer Protocols: CoAP and MQTT- Data aggregation and dissemination.			
<b>Unit – IV</b>	<b>IOT IMPLEMENTATION TOOLS</b>	<b>Periods</b>	<b>9</b>
Introduction to Python, Introduction to different IoT tools, Developing applications through IoT tools, Developing sensor based application through embedded system platform, Implementing IoT concepts with python, Implementation of IoT with Raspberry Pi..			
<b>Unit – V</b>	<b>APPLICATIONS AND CASE STUDIES</b>	<b>Periods</b>	<b>9</b>
Home automations - Smart cities – Environment – Energy – Retail – Logistics – Agriculture –Industry - Health and life style – Case study.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	Vlasios Tsiatsis, Jan Holler, Catherine Mulligan “Internet of Things Technologies and Applications for a New Age of Intelligence”, Elsevier Academic Press, Second Edition 2018.		
2.	Vijay Madiseti and Arshdeep Bahga, “Internet of Things (A Hands-onApproach)”, VPT, 1 <sup>st</sup> Edition, 2015.		
3.	Honbo Zhou, “Internet of Things in the cloud: A middleware perspective”, CRC press, 2012.		
<b>References</b>			
1.	Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, 2017		
2.	Constandinos X. Mavromoustakis, George Mastorakis, Jordi MongayBatalla, “Internet of Things (IoT) in 5G Mobile Technologies” Springer International Publishing Switzerland 2016.		
3.	Dieter Uckelmann, Mark Harrison, Florian Michahelles, “Architecting the Internet of Things” Springer-Verlag Berlin Heidelberg, 2011.		
<b>E-Resources</b>			
1.	<a href="http://docshare04.docshare.tips/files/23353/233530586.pdf">http://docshare04.docshare.tips/files/23353/233530586.pdf</a>		
2.	<a href="https://profile.iiita.ac.in/bibhas.ghoshal/teaching_iot.html">https://profile.iiita.ac.in/bibhas.ghoshal/teaching_iot.html</a>		
3.	<a href="https://beckassets.blob.core.windows.net/product/readingsample/8279126/9783642191565_excerpt_001.pdf">https://beckassets.blob.core.windows.net/product/readingsample/8279126/9783642191565_excerpt_001.pdf</a>		

  
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Programme	B.E.	Programme Code	103	Regulation	2023																																																																																																																																				
Department	ELECTRONICS AND COMMUNICATION ENGINEERING			Semester																																																																																																																																					
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks																																																																																																																																			
		L	T	P	C	CA	ESE	Total																																																																																																																																	
U23ECV45	Embedded System Interfacing and Testing	3	0	0	3	40	60	100																																																																																																																																	
Course Objective	The main objective of the course is to																																																																																																																																								
	<ul style="list-style-type: none"> <li>Understand the architecture, features, and memory interfacing techniques in embedded systems.</li> <li>Explore embedded programming using ARM Cortex-M4, focusing on GPIO, system registers, and power optimization.</li> <li>Develop the ability to interface various hardware peripherals and implement embedded software loading techniques.</li> <li>Gain knowledge of embedded software testing principles, models, tools, and life cycle methodologies.</li> <li>Analyze and apply various dynamic and static testing methods to ensure embedded software reliability.</li> </ul>																																																																																																																																								
	At the end of the course, the student should be able to,							Knowledge level																																																																																																																																	
	CO1: Explain the architectural concepts of embedded systems including memory interfacing, data buses, and processor architectures.							K2																																																																																																																																	
	CO2: Apply embedded C programming techniques for ARM Cortex-M4 including GPIO control, memory-mapped peripherals, and power management strategies.							K3																																																																																																																																	
	CO3: Demonstrate the interfacing and integration of hardware peripherals such as timers, ADCs, motors, and displays with embedded systems.							K3																																																																																																																																	
Course Outcome	CO4: Explain the principles and life cycle models used in embedded software testing, including test planning and commercial test tools.							K2																																																																																																																																	
	CO5: Analyze various testing methodologies such as dynamic, static, and model-based testing to evaluate embedded software quality and coverage.							K4																																																																																																																																	
	Pre-requisites: Microcontrollers and its interfacing																																																																																																																																								
<table border="1"> <thead> <tr> <th rowspan="3">COs</th> <th colspan="12">CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak</th> <th colspan="3">CO/PSO Mapping</th> </tr> <tr> <th colspan="12">Programme Outcomes (POs)</th> <th colspan="3">PSOs</th> </tr> <tr> <th>PO 1</th> <th>PO 2</th> <th>PO 3</th> <th>PO 4</th> <th>PO 5</th> <th>PO 6</th> <th>PO 7</th> <th>PO 8</th> <th>PO 9</th> <th>PO 10</th> <th>PO 11</th> <th>PO 12</th> <th>PSO 1</th> <th>PSO 2</th> <th>PSO 3</th> </tr> </thead> <tbody> <tr> <td>CO1</td> <td>3</td> <td></td> <td></td> <td></td> <td></td> <td>3</td> <td>2</td> <td>2</td> <td></td> <td>2</td> <td></td> <td>1</td> <td>2</td> <td>1</td> <td></td> </tr> <tr> <td>CO2</td> <td>3</td> <td>3</td> <td></td> <td></td> <td>2</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>1</td> <td>2</td> <td>2</td> <td></td> </tr> <tr> <td>CO3</td> <td>3</td> <td>3</td> <td>2</td> <td></td> <td>2</td> <td></td> <td></td> <td></td> <td></td> <td>3</td> <td>1</td> <td>1</td> <td>3</td> <td>3</td> <td></td> </tr> <tr> <td>CO4</td> <td>3</td> <td>3</td> <td>2</td> <td>2</td> <td></td> <td>2</td> <td>2</td> <td>2</td> <td></td> <td>3</td> <td></td> <td>1</td> <td>2</td> <td>2</td> <td></td> </tr> <tr> <td>CO5</td> <td>3</td> <td>3</td> <td>2</td> <td>2</td> <td>3</td> <td></td> <td>2</td> <td>2</td> <td></td> <td>3</td> <td></td> <td>1</td> <td>2</td> <td>3</td> <td></td> </tr> </tbody> </table>												COs	CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak												CO/PSO Mapping			Programme Outcomes (POs)												PSOs			PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	CO1	3					3	2	2		2		1	2	1		CO2	3	3			2							1	2	2		CO3	3	3	2		2					3	1	1	3	3		CO4	3	3	2	2		2	2	2		3		1	2	2		CO5	3	3	2	2	3		2	2		3		1	2	3	
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*[Signature]*

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<b>Indirect</b>			
1.Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>INTRODUCTION TO EMBEDDED SYSTEM</b>	Periods	<b>9</b>
Embedded system overview and applications, features and architecture considerations-ROM, RAM, timers, data and address bus, Memory and I/O interfacing concepts, memory mapped I/O, CISC Vs RISC design philosophy, Von-Neumann Vs Harvard architecture, instruction set, instruction formats, and various addressing modes. Fixed point and floating point arithmetic operations.			
<b>Unit - II</b>	<b>BASIC EMBEDDED PROGRAMMING TECHNIQUES</b>	Periods	<b>9</b>
Introduction to TIVA ARM Cortex M4 – Key Features – Functional Block Diagram - Pin Configuration –I/O pin multiplexing, pull up/down registers, GPIO control, Memory Mapped Peripherals, programming System registers, Watchdog Timer, need of low power for embedded systems, System Clocks and control, Hibernation Module on Tiva, Active vs Standby current consumption.			
<b>Unit – III</b>	<b>INTERFACING</b>	Periods	<b>9</b>
Timer, Basic Timer, Real Time Clock (RTC), Timing generation and measurements, Analog interfacing and data acquisition: ADC, Analog Comparators, DMA, Motion Control Peripherals: PWM Module & Quadrature Encoder Interface (QEI). Host and Target Machines. In-System Programming (ISP)-In-Application Programming (IAP)-Getting Embedded Software into Target System: Programmers. Display, Keyboard, Relay, Stepper and DC Motor Interfacing.			
<b>Unit - IV</b>	<b>FUNDAMENTALS OF EMBEDDED SOFTWARE TESTING</b>	Periods	<b>9</b>
Introduction, Concepts of Testing, TEmb method, Test cases and test procedures, Principles of embedded software testing, creating a test harness, Commercial test tools. Software testing life cycle: multiple V-model, nested multiple V-model, master test planning, activities, testing by developers, testing by independent test team.			
<b>Unit – V</b>	<b>TESTING METHODS</b>	Periods	<b>9</b>
Dynamic Testing: Structured basis testing, Equivalence Partitions, Boundary Value Analysis, Problems with polymorphic code Model-Based Testing: Synthesis- versus Analysis models, Generating tests from state diagrams Coverage Testing: White-box, grey and black box tests, Coverage measures – Statement, Branch, Condition, Path and others, Coverage testing tools. Static Analysis: Static analysis concepts, the use of the compiler for static analysis, Static analysis tools, coding standards			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1	Jonathan Valvano, “Embedded Systems: Real-Time Operating Systems for Arm Cortex-M Microcontrollers”, 2017.		
2	David E Simon, “An Embedded Software Primer”, Pearson Education Asia, New Delhi, 2009.		
3.	Testing Embedded Software by Bart Broekman, Edwin Notenboom, 2003		
<b>References</b>			
1.	Rajkamal, ”Embedded Systems: Architecture, Programming and Design”, Tata McGraw-Hill, New Delhi, 2008.		
2.	Andrew Sloss & Dominic Symes & Chris Wright, “ARM System Developer’s Guide, 1st Edition, Elsevier, Morgan Kaufmann Publishers, 2004.		
3.	Lyla B Das, —Embedded Systems-An Integrated Approach, Pearson, 2013		
4.	TIVA Series ARM Cortex M Data Sheet.		
<b>E-Resources</b>			
1.	<a href="https://learnengineering.in/introduction-to-arm-cortex-m-microcontrollers-by-jonathan-w-valvano/">https://learnengineering.in/introduction-to-arm-cortex-m-microcontrollers-by-jonathan-w-valvano/</a>		
2.	<a href="https://go-pdf.online/david-simon-embedded-systems.pdf">https://go-pdf.online/david-simon-embedded-systems.pdf</a>		
3.	<a href="https://www.scribd.com/document/328586500/embedded-systems-by-rajkamal-2nd-pdf">https://www.scribd.com/document/328586500/embedded-systems-by-rajkamal-2nd-pdf</a>		
4.	<a href="http://www.ti.com/tiva">www.ti.com/tiva</a>		

  
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Programme	B.E.	Programme Code	103	Regulation	2023			
Department	ELECTRONICS AND COMMUNICATION ENGINEERING			Semester				
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks		
		L	T	P	C	CA	ESE	Total
U23ECV46	Industrial IoT and Industry 5.0	3	0	0	3	40	60	100
Course Objective	<p>The main objective of the course is</p> <ul style="list-style-type: none"> <li>To provide foundational knowledge of Industrial Internet of Things (IIoT), including architectures, layers, and business models.</li> <li>To develop analytical capabilities in big data, SDN, machine learning, and data management relevant to industrial environments.</li> <li>To familiarize with IIoT communication protocols, networking standards, and cloud platforms.</li> <li>To impart understanding of security challenges, including fog and cloud integration, in Industry 5.0 ecosystems.</li> <li>To expose students to real-world IIoT applications through domain-specific case studies in manufacturing, chemical, pharmaceutical, and UAV-based industries.</li> </ul>							
Course Outcomes	At the end of the course, the student should be able to,						Knowledge Level	
	CO1: Explain the fundamentals and business models of Industrial IoT and describe the reference architecture and the functional layers of IIoT (sensing, processing, communication, and networking).						K2	
	CO2: Apply analytics and machine learning concepts, including Julia and Hadoop, for processing IIoT data.						K3	
	CO3: Demonstrate the use of IIoT communication protocols and cloud platforms for industrial system integration and data management.						K3	
	CO4: Identify security threats and mitigation strategies in industrial IoT systems and discuss challenges in Industry 5.0 and compare its factories with traditional industrial models.						K4	
Pre-requisites	Internet of Things							

COs	CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak											CO/PSO Mapping			
	Programme Outcomes (POs)											PSOs			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO 1	1	-	-	2	2	2	-	-	-	3	3	3	2	2	1

  
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CO 2	1	1	-	2	2	2	-	-	-	3	3	3	2	2	1
CO 3	1	-	-	2	2	1	-	-	-	2	3	1	1	1	1
CO 4	1	-	1	1	2	2	-	-	-	3	2	3	2	2	1
CO 5	1	-	-	2	2	1	-	-	-	2	3	1	1	2	1

#### Course Assessment Methods

##### Direct

1. Continuous Assessment Test I, II & III
2. Assignment
3. End-Semester examinations

##### Indirect

1. Course - end survey

#### Content of the syllabus

<b>Unit – I</b>	<b>INDUSTRIAL IoT</b>	Periods	<b>9</b>
IIoT-Introduction, Industrial IoT: Business Model and Reference Architecture: IIoT-Business Models, Industrial IoT- Layers: IIoT Sensing, IIoT Processing, IIoT Communication, IIoT Networking			
<b>Unit – II</b>	<b>IIOT ANALYTICS</b>	Periods	<b>9</b>
Big Data Analytics and Software Defined Networks, Machine Learning and Data Science, Julia Programming, Data Management with Hadoop			
<b>Unit – III</b>	<b>PROTOCOLS AND CLOUD</b>	Periods	<b>9</b>
Need of protocols; Types of Protocols, Wi-Fi, Wi-Fi direct, Zigbee, Z wave, BACnet, BLE, Modbus, SPI, I2C, IIoT protocols –COAP, MQTT, 6LoWPAN, LWM2M, AMPQ IIoT cloud platforms: Overview of COTS cloud platforms, Predix, PTC Thing Worx, Microsoft Azure etc. Data analytics, cloud services, Business models: SaaS, PaaS, IaaS.			
<b>Unit – IV</b>	<b>IoT SECURITY AND ROLE OF INDUSTRY 5.0</b>	Periods	<b>9</b>
Industrial IoT: Security and Fog Computing - Cloud Computing in IIoT, Fog Computing in IIoT, Security in IIoT. Challenges for Industry 5.0, Comparison of Industry 5.0 Factory and Today's Factory			
<b>Unit – V</b>	<b>CASE STUDY</b>	Periods	<b>9</b>
Industrial IOT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies: Milk Processing and Packaging Industries, Manufacturing Industries			
<b>Total Periods</b>			<b>45</b>

#### Text Books

1.	“Industrial Internet of Things: Cyber manufacturing Systems” by Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer), 2017
2.	Industry 4.0: The Industrial Internet of Things”, by Alasdair Gilchrist (Apress), 2017
3.	Internet of Things - A Hands-on Approach, – 1 January 2015, by Arsheep Bahga (Author), Vijay Madiseti (Author), Techno Series, 2015

#### References

1.	Hands-On Industrial Internet of Things: Create a powerful Industrial IoT by Giacomo Veneri, Antonio Capasso, Packt, 2018.
2.	The Internet of Things: Key Applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi, 2nd Edition, Willy Publications 2017

#### E-Resources

1.	<a href="https://download.e-bookshelf.de/download/0007/6832/86/L-G-0007683286-0014731014.pdf">https://download.e-bookshelf.de/download/0007/6832/86/L-G-0007683286-0014731014.pdf</a>
2.	<a href="https://www.ifm.eng.cam.ac.uk/uploads/DIAL/industrial-internet-of-things-report.pdf">https://www.ifm.eng.cam.ac.uk/uploads/DIAL/industrial-internet-of-things-report.pdf</a>



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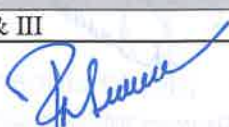
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Programme	B.E.	Programme Code	103	Regulation	2023										
Department	ELECTRONICS AND COMMUNICATION ENGINEERING			Semester											
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks									
		L	T	P	C	CA	ESE	Total							
U23ECV47	IoT SECURITY AND TRUST	3	0	0	3	40	60	100							
Course Objective	The main objective of the course is														
	<ul style="list-style-type: none"> <li>Understand the fundamentals of IoT ecosystem security, including cryptographic techniques and system vulnerabilities.</li> <li>Explore security and privacy challenges in IoT devices across domains like smart homes, vehicles, and healthcare.</li> <li>Examine threats, attacks, and corresponding countermeasures in virtualized and cloud-based IoT environments.</li> <li>Learn about trust establishment models and cryptosystem-based identity validation in IoT.</li> <li>Analyze cloud security, digital identity, and legal frameworks related to cybercrimes and data protection.</li> </ul>														
Course Outcomes	At the end of the course, the student should be able to,							Knowledge Level							
	CO1: Explain the principles of IoT system design and describe basic cryptographic techniques used to ensure confidentiality, integrity, and							K2							
	CO2: Apply security and privacy measures to IoT applications in domains like smart homes, vehicles, healthcare, and BYOD environments.							K3							
	CO3: Analyze IoT-specific threats such as VM-based attacks, guest hopping, and hyper jacking, and evaluate appropriate countermeasures.							K4							
	CO4: Explain and compare trust establishment models and cryptographic identity mechanisms within IoT ecosystems.							K2							
	CO5: Analyze cloud security risks, digital identity management solutions, and the legal implications of cybercrime in the context of IoT data management.							K4							
Pre-requisites	Internet of Things														
CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak												CO/PSO Mapping			
COs	Programme Outcomes (POs)											PSOs			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O 2	PS O 3
CO 1	1	1	1	1	-	1	1	-	2	1	3	1	2	3	2
CO 2	1	1	2	1	1	3	1	-	2	1	3	1	3	3	2
CO 3	2	2	1	1	-	3	1	1	2	1	3	1	3	3	3
CO 4	1	1	1	2	2	1	-	2	1	3	1	2	2	2	1
CO 5	2	1	1	1	1	3	1	-	2	1	3	1	2	3	2
<b>Course Assessment Methods</b>															
Direct															
I.Continuous Assessment Test I, II & III															

  
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2.Assignment			
3.End-Semester examinations			
<b>Indirect</b>			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>FUNDAMENTALS OF IOT ECOSYSTEM</b>	Periods	<b>9</b>
IoT security issues, how to design an IoT system, Hardware, software and network security related to IoT systems - Basics of cryptographic solutions to IoT systems – Applied Cryptography & Intrusion Detection, One Way Hash Function and Integrity, Encryption Algorithms and Confidentiality, Digital Signature and Authentication (DH, RSA, 2 class)			
<b>Unit – II</b>	<b>SECURITY CONCEPTS IN CONTEXT TO IOT DEVICES</b>	Periods	<b>9</b>
Internet of Things Security, Security and Privacy for IoT Case Study: Smart Home, Smart Grid Network, Modern Vehicle, Wearable Computing & BYOD, Mobile HealthCare.			
<b>Unit – III</b>	<b>IOT SECURITY THREATS AND COUNTERMEASURES</b>	Periods	<b>9</b>
System-Specific Attacks: Guest hopping, attacks on the VM (delete the VM, attack on the control of the VM, code or file injection into the virtualized file structure), VM migration attack, hyper jacking.			
<b>Unit – IV</b>	<b>TRUST ESTABLISHMENT</b>	Periods	<b>9</b>
Trust management lifecycle, Identity and Trust, Web of trust models. Establishment: cryptosystems – Mutual establishment phases – Comparison on security analysis.			
<b>Unit – V</b>	<b>SECURITY AND DIGITAL IDENTITY IN CLOUD COMPUTING CYBER CRIMES</b>	Periods	<b>9</b>
Cloud security , Digital identity management in cloud, Classical solutions, alternative solutions, Management of privacy and personal data in Cloud. Cyber Crimes and Laws – Hackers – Dealing with the rise tide of Cyber Crimes			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	John R. Vacca, “Computer and Information Security Handbook”, Elsevier, 2017.		
2.	Parikshit Narendra Mahalle, Poonam N. Railkar, “Identity Management for Internet of Things”, River Publishers, 2015.		
3.	William Stallings, “Cryptography and Network security: Principles and Practice”, 5th Edition, 2014, Pearson Education, India.		
4.	Brian Russell, Drew Van Duren, “Practical Internet of Things Security: Design a security framework for an Internet connected ecosystem”, 2nd Edition, 2018.		
<b>References</b>			
1.	Christo Paar and Jan Pelzl, “Understanding Cryptography – A Textbook for Students and Practitioners”, Springer, 2014.		
2.	Alasdair Gilchrist, “IoT security Issues”, Oreilly publications, 2017.		
3.	Maryline Laurent, Samia Bouzefrane, “Digital Identity Management”, Elsevier, 2015.		
<b>E-Resources</b>			
1.	<a href="https://phoenixnap.com/blog/best-network-security-tools">https://phoenixnap.com/blog/best-network-security-tools</a>		
2.	<a href="https://sucuri.net/guides/website-security/">https://sucuri.net/guides/website-security/</a>		
3.	<a href="https://nptel.ac.in/courses/106/105/106105162/">https://nptel.ac.in/courses/106/105/106105162/</a>		

  
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Programme	B.E.	Programme Code	103	Regulation	2023			
Department	ELECTRONICS AND COMMUNICATION ENGINEERING			Semester				
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks		
		L	T	P	C	CA	ESE	Total
U23ECV48	Cloud Technologies and its Applications	3	0	0	3	40	60	100
Course Objective	<p>The main objective of the course is</p> <ul style="list-style-type: none"> <li>Understand the evolution, models, and architecture of cloud computing and its services.</li> <li>Explore cloud-based information systems, privacy, security, and standardization practices.</li> <li>Study the infrastructure components and management standards of modern cloud data centers.</li> <li>Analyze cloud-based applications and architectures, including SaaS frameworks and development environments.</li> <li>Evaluate future trends, design considerations, and transformation strategies in cloud computing adoption.</li> </ul>							
Course Outcomes	At the end of the course, the student should be able to,						Knowledge Level	
	CO1: Explain the evolution, service models, and delivery mechanisms in cloud computing, including IaaS, PaaS, and SaaS.						K2	
	CO2: Describe privacy, security, federation, and access issues related to cloud-based information systems and services.						K2	
	CO3: Apply cloud infrastructure concepts including virtualization, provisioning, and policy-based automation in modern IT environments.						K3	
	CO4: Analyze SaaS application characteristics, development platforms (e.g., AWS, Azure, Google App Engine), and multitenant database systems.						K4	
CO5: Analyze future trends and design models in cloud computing with focus on application transformation, metering, and monitoring interfaces.						K4		
Pre-requisites	Networking							

COs	CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak											CO/PSO Mapping			
	Programme Outcomes (POs)											PSOs			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO 1	2	1	1	1	-	1	1	-	2	1	3	1	2	3	2
CO 2	1	1	2	1	1	3	1	-	2	1	3	1	3	3	2
CO 3	2	2	1	1	-	3	1	1	2	1	3	1	3	3	3
CO 4	1	1	1	2	2	1	-	2	1	3	1	2	2	2	1
CO 5	2	1	1	1	1	3	1	-	2	1	3	1	2	3	2

  
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<b>Course Assessment Methods</b>			
<b>Direct</b>			
1.Continuous Assessment Test I, II & III			
2.Assignment			
3.End-Semester examinations			
<b>Indirect</b>			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>INTRODUCTION</b>	Periods	<b>9</b>
Introduction to Cloud Computing- The Evolution of Cloud Computing – Hardware Evolution – Internet Software Evolution – Server Virtualization - Web Services Deliver from the Cloud – Communication-as-a-Service – Infrastructure-as-a-Service – Monitoring-as-a-Service – Platform-as-a-Service – Software-as-a-Service – Building Cloud Network.			
<b>Unit – II</b>	<b>CLOUD INFORMATION SYSTEMS</b>	Periods	<b>9</b>
Federation in the Cloud - Presence in the Cloud - Privacy and its Relation to Cloud-Based Information Systems – Security in the Cloud - Common Standards in the Cloud – End-User Access to the Cloud Computing.			
<b>Unit – III</b>	<b>CLOUD INFRASTRUCTURE</b>	Periods	<b>9</b>
Introduction– Evolving IT infrastructure – Evolving Software Applications –Service Oriented Architecture – Interoperability Standards for Data Center Management - Virtualization – Hyper Threading – Blade Servers - Automated Provisioning - Policy Based Automation – Application Management – Evaluating Utility Management Technology - Virtual Test and development Environment.			
<b>Unit – IV</b>	<b>CLOUD APPLICATIONS</b>	Periods	<b>9</b>
Software Utility Application Architecture - Characteristics of a SaaS - Software Utility Applications - Cost Versus Value - Software Application Services Framework - Implementing Database Systems for Multitenant Architecture - Service creation environments to develop cloud based applications.			
<b>Unit – V</b>	<b>FUTURE OF CLOUD</b>	Periods	<b>9</b>
Design of a Web Services Metering Interface - Application Monitoring Implementation - A Design for an Update and Notification Policy - Transforming to Software as a Service - Application Transformation Program - Business Model Scenarios - Virtual Services for Organizations.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	Sandeep Bhowmik, & quot; Cloud Computing & quot;,Cambridge University Press; First edition, 2017		
2.	“Cloud Computing: Concepts, Technology Architecture”, Pearson Education India, 1st edition, 2014.		
3.	Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, “Distributed and Cloud Computing, From Parallel Processing to the Internet of Things”, Morgan Kaufmann Publishers, 2013.		
<b>References</b>			
1.	Sanjiva Shankar Dubey ,“ Cloud Computing and Beyond”, Dreamtech Press 2edition,2019		
2.	John W. Rittinghouse and james F. Ransome, “Cloud Computing Implementation, Management and Security”, CRC Press, Taylor Francis Group, Boca Raton London New York, 2017.		
3.	George Reese, “Cloud Application Architectures”, O’reilly Publications, 2009.		
<b>E-Resources</b>			
1.	<a href="http://www.coltdatacentres.net/Cloud Technology">www.coltdatacentres.net/Cloud Technology</a> .		
2.	<a href="https://www.cloudbakers.com/blog/what-is-a-cloud-application">https://www.cloudbakers.com/blog/what-is-a-cloud-application</a>		
3.	<a href="http://www.zdnet.com">www.zdnet.com</a> .		

  
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Programme	<b>B.E.</b>	Programme Code	<b>103</b>	Regulation	<b>2023</b>			
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>			Semester				
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks		
		L	T	P	C	CA	ESE	Total
<b>U23ECV51</b>	<b>Mobile Adhoc Networks</b>	3	0	0	3	40	60	100
<b>Course Objective</b>	The main objective of the course is to							
	• Introduce the fundamentals of cellular and ad hoc wireless networks along with their key challenges and applications.							
	• Explain the design and classification of medium access control (MAC) protocols in ad hoc networks.							
	• Provide knowledge of various routing and multicasting protocols and their use in quality-sensitive and application-specific scenarios.							
	• Examine the security concerns, key management strategies, and QoS frameworks applicable to ad hoc and sensor networks.							
	• Explore energy management techniques and understand recent technological advances in wireless communication systems.							
<b>Course Outcomes</b>	At the end of the course, the student should be able to,						Knowledge Level	
	<b>CO1:</b> Explain the key issues in ad hoc wireless networks such as routing, addressing, and quality of service.						K2	
	<b>CO2:</b> Classify and compare various MAC protocols based on contention, scheduling, and power efficiency.						K3	
	<b>CO3:</b> Analyze different routing and multicasting protocols and identify suitable models for specific network requirements.						K4	
	<b>CO4:</b> Illustrate security challenges and evaluate different secure routing and QoS provisioning methods in wireless networks.						K3	
	<b>CO5:</b> Examine energy management schemes and recent advancements like UWB, Wi-Fi, and optical wireless systems.						K4	
<b>Pre-requisites</b>	Computer Networks							

COs	CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak											CO/PSO Mapping			
	Programme Outcomes (POs)											PSOs			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
<b>CO 1</b>	3	3	2	2	2	2						1	3	2	
<b>CO 2</b>	3	3	2	2	2	2						1	3		2
<b>CO 3</b>	3	3	2	2	2	2						1	3	2	
<b>CO 4</b>	3	3	2	2	2	2						1	3		2
<b>CO 5</b>	3	3	2	2	2	2						1	3	2	

**Course Assessment Methods**

**Direct**

- 1.Continuous Assessment Test I, II & III
- 2.Assignment
- 3.End-Semester examinations

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<b>Indirect</b>			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>INTRODUCTION</b>	Periods	<b>9</b>
Cellular and ad hoc wireless networks, Issues in adhoc wireless networks-medium access scheme, routing, multicasting, transport layer protocols, schemes, quality of service provisioning, self organization, addressing and service discovery, scalability.			
<b>Unit – II</b>	<b>MEDIUM ACCESS PROTOCOLS</b>	Periods	<b>9</b>
MAC Protocols: design issues, goals and classification. Contention based protocols- with reservation, scheduling algorithms, protocols using directional antennas. Multichannel MAC protocol, CSMA MAC protocols and power control MAC protocols			
<b>Unit – III</b>	<b>ROUTING AND MULTICASTING PROTOCOLS</b>	Periods	<b>9</b>
Routing Protocols: Design issues, goals and classification. Table driven routing protocols, On demand routing protocols, Hybrid routing protocols, Hierarchical routing protocol, power routing protocols, issues and classification of multicast routing protocols, Tree based and mesh based multicast routing protocols. multicasting with QoS and application dependent multicast routing.			
<b>Unit – IV</b>	<b>SECURITY PROTOCOLS, QoS AND WIRELESS SENSOR NETWORK</b>	Periods	<b>9</b>
Network security requirement-Issues and challenges, network security attacks, key management, secure routing protocols. Issues and challenges in providing QoS, classification of QoS solutions and QoS frameworks-QoS models, INSIGNIA, INORA, SWAN.			
<b>Unit – V</b>	<b>ENERGY MANAGEMENT AND RECENT ADVANCES IN WIRELESS NETWORKS</b>	Periods	<b>9</b>
Energy management schemes-Battery management, transmission power management, system power management schemes. RECENT ADVANCES- Ultra wide band radio communication, Wireless fidelity systems, optical wireless networks, The multimode 802.11-IEEE 802.11a/b/g, The Meghadoot architecture.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	C.Siva Ram Murthy and B.S.Manoj, “Ad hoc Wireless Networks Architectures and Protocols”, Pearson Education, 2 <sup>nd</sup> edition, 2015		
2.	Charles E. Perkins, “Ad hoc Networking”, Addison – Wesley, 2015		
<b>References</b>			
1.	Stefano Basagni, Marco Conti, Silvia Giordano and Ivan Stojmenovic, “Mobile ad hoc Networking”, Wiley-IEEE press, 2013.		
2.	Mohammad Ilyas, “The Handbook of adhoc Wireless Networks”, CRC press, 2003.		
3.	T.Camp, J. Boleng, and V. Davies, “A Survey of Mobility Models for Ad Hoc Network Research, Wireless Commun. and Mobile Comp.”, Special Issue on Mobile Ad Hoc Networking Research, Trends and Applications, vol. 2, no. 5, 2002, pp. 483–502.		
<b>E-Resources</b>			
1.	<a href="https://www.pdfdrive.com/ad-hoc-wireless-networks-architectures-and-protocols-c-siva-ram-murthy-bs-manoj-d77724424.html">https://www.pdfdrive.com/ad-hoc-wireless-networks-architectures-and-protocols-c-siva-ram-murthy-bs-manoj-d77724424.html</a>		
2.	<a href="https://doc.lagout.org/network/Mobile%20Ad%20Hoc%20Networking.pdf">https://doc.lagout.org/network/Mobile%20Ad%20Hoc%20Networking.pdf</a>		
3.	<a href="https://library.oapen.org/handle/20.500.12657/41721">https://library.oapen.org/handle/20.500.12657/41721</a>		



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Programme	B.E.	Programme Code	103	Regulation	2023			
Department	ELECTRONICS AND COMMUNICATION ENGINEERING			Semester				
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks		
		L	T	P	C	CA	ESE	Total
U23ECV52	WIRELESS BODY AREA NETWORK	3	0	0	3	40	60	100
Course Objective	The student should be made to:							
	<ul style="list-style-type: none"> <li>Introduce the fundamentals of Body Area Networks (BANs) and the key technical challenges in healthcare applications.</li> <li>Understand the hardware components required for BANs, including low-power processors, antennas, and power sources.</li> <li>Explain wireless communication techniques, RF propagation, and network technologies relevant to BANs.</li> <li>Examine coexistence issues such as interference, regulatory requirements and security measures in BAN environments.</li> <li>Explore real-world healthcare and biomedical applications of BANs and analyze their effectiveness.</li> </ul>							
	At the end of the course, the student should be able to,							Knowledge Level
	CO1: Explain the architecture and fundamental challenges of Body Area Networks in healthcare settings.							K2
	CO2: Identify and describe the hardware components and energy sources used in BAN systems.							K2
Course Outcomes	CO3: Apply knowledge of RF communication and network protocols to analyze BAN communication systems.							K3
	CO4: Evaluate the impact of interference and regulatory issues on BAN operation and propose mitigation techniques.							K4
	CO5: Analyze BAN applications in various medical and physiological monitoring scenarios.							K4
	Pre-requisites							
	Computer Network							

COs	CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak											CO/PSO Mapping			
	Programme Outcomes (POs)											PSOs			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PSO 2	PS O 3
CO 1	2	2	1	1	1	1	1					1	3	3	3
CO 2	3	3	3	3	1	2	2					1	3	3	3
CO 3	3	2	1	1	1	1	1					1	3	3	3
CO 4	2	2	1	1	1	1	1					1	3	3	3
CO 5	2	2	1	1	1	2	2					1	3	3	3

**Course Assessment Methods**

**Direct**

- 1.Continuous Assessment Test I, II & III
- 2.Assignment

*[Signature]*  
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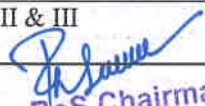
3.End-Semester examinations			
<b>Indirect</b>			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>INTRODUCTION</b>	<b>Periods</b>	<b>9</b>
Definition, BAN and Healthcare, Technical Challenges- Sensor design, biocompatibility, Energy Supply, optimal node placement, number of nodes, System security and reliability, BAN Architecture – Introduction.			
<b>Unit – II</b>	<b>HARDWARE FOR BAN</b>	<b>Periods</b>	<b>9</b>
Processor-Low Power MCUs, Mobile Computing MCUs, Integrated processor with radio transceiver, Memory, Antenna-PCB antenna, Wire antenna, Ceramic antenna, External antenna, Sensor Interface, Power sources- Batteries and fuel cells for sensor nodes.			
<b>Unit – III</b>	<b>WIRELESS COMMUNICATION AND NETWORK</b>	<b>Periods</b>	<b>9</b>
RF communication in Body, Antenna design and testing, Propagation, Base Station-Network topology-Stand – Alone BAN, Wireless personal Area Network Technologies-IEEE 802.15.1,IEEE P802.15.13, IEEE 802.15.14, Zigbee.			
<b>Unit – IV</b>	<b>CO-EXISTENCE ISSUES WITH BAN</b>	<b>Periods</b>	<b>9</b>
Interferences – Intrinsic - Extrinsic, Effect on transmission, Counter measures- on physical layer and data link layer, Regulatory issues-Medical Device regulation in USA and Asia, Security and Self-protection-Bacterial attacks, Virus infection, Secured protocols, Self-protection.			
<b>Unit – V</b>	<b>APPLICATIONS OF BAN</b>	<b>Periods</b>	<b>9</b>
Monitoring patients with chronic disease, Hospital patients, Elderly patients, Cardiac arrhythmias monitoring, Multi patient monitoring systems, Multichannel Neural recording, Gait analysis, Sports Medicine, Electronic pill.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	Sandeep K.S. Gupta, Tridib Mukherjee, Krishna Kumar Venkata Subramanian, “Body Area Networks Safety, Security, and Sustainability”, Cambridge University Press, 2013		
2.	Mehmet R. Yuce, Jamil Y.Khan, “Wireless Body Area Networks Technology, Implementation, and Applications”, Pan Stanford Publishing Pte. Ltd., Singapore, 2012		
<b>References</b>			
1.	Zhang, Yuan-Ting, “Wearable Medical Sensors and Systems”, Springer, 2013.		
2.	Guang-Zhong Yang(Ed.), “Body Sensor Networks”, Springer, 2014.		
3.	Annalisa Bonfiglio, Danilo De Rossi, “Wearable Monitoring Systems”, Springer, 2011.		



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Programme	B.E.	Programme Code				103	Regulation		2023						
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>					Semester									
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks									
		L	T	P		C	CA	ESE	Total						
U23ECV53	<b>Wireless Sensor Networks</b>	3	0	0	3	40		60	100						
<b>Course Objective</b>	The main objective of the course is to														
	<ul style="list-style-type: none"> <li>Understand the architecture, components, and energy constraints of sensor nodes and sensor networks.</li> <li>Explore MAC and routing protocols tailored for energy-efficient and low-latency WSN communication.</li> <li>Investigate the security threats in WSN and understand counter measures including secure routing and key management.</li> <li>Gain insight into the functional and structural differences between WSNs and other wireless networks, and their applications.</li> <li>Introduce WSN platforms, simulation tools and node-level programming environments for practical development and testing.</li> </ul>														
	At the end of the course, the student should be able to,											Knowledge level			
	<b>CO1:</b> Explain the single-node and network architecture of wireless sensor networks including hardware and energy considerations.											K2			
	<b>CO2:</b> Apply MAC and routing protocols to optimize communication efficiency in WSNs.											K3			
	<b>CO3:</b> Analyze security threats in WSNs and evaluate the effectiveness of existing secure routing protocols and key management techniques.											K4			
<b>CO4:</b> Distinguish between WSNs and mobile ad hoc networks and analyze WSN application-specific requirements like topology control and synchronization.											K4				
<b>CO5:</b> Describe the use of hardware platforms, operating systems, and simulation tools for developing and testing WSN applications.											K2				
<b>Pre-requisites</b>	-														
<b>CO / PO Mapping</b> (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak													<b>CO/PSO Mapping</b>		
COs	Programme Outcomes (POs)											PSOs			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	2	2									2	2		
CO2	2	3	2	2									2	2	
CO3	2		3	3									3	3	
CO4	2							2					2	2	
CO5	3	2	2									2	2		
<b>Course Assessment Methods</b>															
<b>Direct</b>															
1. Continuous Assessment Test I, II & III															
2. Assignment															


  
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3. End-Semester examinations			
<b>Indirect</b>			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>INTRODUCTION</b>	Periods	<b>9</b>
Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Network Architecture - Sensor Network Scenarios, Transceiver Design Considerations, Optimization Goals and Figures of Merit.			
<b>Unit - II</b>	<b>WSN NETWORKING CONCEPTS AND PROTOCOLS</b>	Periods	<b>9</b>
MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols and Wakeup Concepts - S-MAC, The Mediation Device Protocol, Contention based protocols - PAMAS, Schedule based protocols – LEACH, IEEE 802.15.4 MAC protocol, Routing Protocols- Energy Efficient Routing, Challenges and Issues in Transport layer protocol.			
<b>Unit – III</b>	<b>SENSOR NETWORK SECURITY</b>	Periods	<b>9</b>
Network Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks, Layer wise attacks in wireless sensor networks, possible solutions for jamming, tampering, black hole attack, flooding attack, Key Distribution and Management, Secure Routing – SPINS, reliability requirements in sensor networks.			
<b>Unit - IV</b>	<b>OVERVIEW OF WIRELES SENSOR NETWORKS</b>	Periods	<b>9</b>
Challenges for Wireless Sensor Networks-Characteristics requirements-required mechanisms, Difference between mobile ad-hoc and sensor networks, Applications of sensor networks, Topology Control, Clustering, Time Synchronization.			
<b>Unit – V</b>	<b>SENSOR NETWORK PLATFORMS AND TOOLS</b>	Periods	<b>9</b>
Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms – TinyOS, nesC, CONTIKIOS, Node-level Simulators – NS2 and its extension to sensor networks, COOJA, TOSSIM, Programming beyond individual nodes – State centric programming.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	Holger Karl, Andreas willing, —Protocol and Architecture for Wireless Sensor Networks, John wiley publication, Oct 2007.		
2.	FeiHu, Xiaojun Cao , “ Wireless Sensor Networks , Principles and Practice CRC Press ,2010		
<b>References</b>			
1.	Kazem Sohraby, Daniel Minoli, & Taieb Znati, “—Wireless Sensor Networks-Technology, Protocols, And Applications”, John Wiley, 2015.		
2.	Ian Akyildiz, Mehmet Can Vuran “Wireless Sensor Networks” John Wiley & Sons USA 2014.		
3.	Feng Zhao, Leonidas Guibas, —Wireless Sensor Networks: an information processing approach, Elsevier publication, 2004		
4.	Waltenegus Dargie, Christian Poellabauer ,”Fundamentals of Wireless Sensor Networks: Theory and Practice ‘(Wiley)July 2010		
<b>E-Resources</b>			
1.	<a href="http://profsite.um.ac.ir/~hyaghmae/ACN/WSNbook.pdf">http://profsite.um.ac.ir/~hyaghmae/ACN/WSNbook.pdf</a>		
2.	<a href="http://www.tfb.edu.mk/amarkoski/WSN/Kniga-w02">http://www.tfb.edu.mk/amarkoski/WSN/Kniga-w02</a>		



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Programme	<b>B.E.</b>	Programme Code				<b>103</b>	Regulation			<b>2023</b>					
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>						Semester								
Course Code	Course Name	Periods Per Week			Credit		Maximum Marks								
		L	T	P	C	CA	ESE	Total							
<b>U23ECV54</b>	<b>Wireless Sensor Networks for Robotics</b>	3	0	0	3	50	50	100							
<b>Course Objective</b>	The main objective of the course is to														
	<ul style="list-style-type: none"> <li>• Introduce the fundamentals of wireless sensor networks and their role in robotic systems.</li> <li>• Explain WSN communication protocols, topologies, and deployment strategies relevant to robotics.</li> <li>• Explore localization techniques and sensor fusion methods for enhancing robotic perception.</li> <li>• Analyze the integration of WSNs in mobile robotic platforms for cooperative navigation and control.</li> <li>• Study security issues and review real-world applications of WSNs in various robotic domains.</li> </ul>														
<b>Course Outcome</b>	At the end of the course, the student should be able to,											Knowledge level			
	<b>CO1:</b> Explain the architecture of wireless sensor nodes and the communication technologies (RF, BLE, ZigBee, LoRa, Wi-Fi) used in robotic applications.											K2			
	<b>CO2:</b> Compare various network topologies, MAC protocols, and routing techniques used for energy-efficient WSN design in robotics.											K3			
	<b>CO3:</b> Apply localization techniques such as RSSI, TOA, AOA, and multilateration for determining positions of mobile robots using WSNs.											K3			
	<b>CO4:</b> Analyze the integration of WSNs in mobile robot platforms and evaluate coordination strategies for swarm and cooperative robotics.											K4			
	<b>CO5:</b> Evaluate security challenges in WSNs and assess real-world case studies involving WSN-based robotic systems in environmental, rescue, and industrial applications.											K4			
<b>Pre-requisites</b>	-														
<b>CO / PO Mapping</b> (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak													<b>CO/PSO Mapping</b>		
<b>COs</b>	<b>Programme Outcomes (POs)</b>											<b>PSOs</b>			
	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PS O1</b>	<b>PS O 2</b>	<b>PS O 3</b>
CO1	3	2	2									2	2		
CO2	2	3	2	2									2	2	
CO3	2		3	3				2					3	3	
CO4	2							2					2	2	
CO5	3	2	2									2	2		
<b>Course Assessment Methods</b>															
<b>Direct</b>															

  
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1. Continuous Assessment Test I, II & III			
2. Assignment			
3. End-Semester examinations			
<b>Indirect</b>			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>OVERVIEW OF WIRELESS SENSOR NETWORKS</b>	Periods	<b>9</b>
Introduction to WSNs and their role in robotics, Wireless communication basics: RF, BLE, ZigBee, LoRa, Wi-Fi, Sensor node architecture: hardware, operating systems (TinyOS, Contiki).			
<b>Unit - II</b>	<b>TOPOLOGIES AND PROTOCOL</b>	Periods	<b>9</b>
Network topologies and deployment strategies, MAC protocols for low-power networks (TDMA, CSMA, etc.), Routing protocols: Directed Diffusion, LEACH, RPL.			
<b>Unit – III</b>	<b>LOCALIZATION IN WSN</b>	Periods	<b>9</b>
Localization in WSNs: RSSI, TOA, AOA, multilateration, Data aggregation and fusion for robotic perception, Energy-efficient communication and duty cycling.			
<b>Unit - IV</b>	<b>WSN IN MOBILE ROBOTIC PLATFORMS</b>	Periods	<b>9</b>
WSN integration in mobile robots (UAVs, UGVs, swarms), Cooperative robotics: consensus, coordination via WSNs, Robot navigation with WSN support (indoor/outdoor).			
<b>Unit – V</b>	<b>SECURITY CHALLENGES AND APPLICATIONS</b>	Periods	<b>9</b>
Security in WSNs for robotics: vulnerabilities and solutions, Case Studies: Environmental monitoring, Search and Rescue, Industrial robots applications.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	<b>Wireless Sensor Networks by Ian F. Akyildiz and Mehmet Can Vuran, John Wiley &amp; Sons, Ltd, 2011.</b>		
2.	<b>Wireless Sensor and Robot Networks by Nathalie Mitton, David Simplot-Ryl, World Scientific publishers, 2013</b>		
<b>References</b>			
1.	Kazem Sohraby, Daniel Minoli, & Taieb Znati, “—Wireless Sensor Networks-Technology, Protocols, And Applications”, John Wiley, 2015.		
2.	Kazem Sohraby, Daniel Minoli, & Taieb Znati, “Wireless Technology, Protocols, And Applications”, John Wiley, 2007.		
3.	Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003.		
4.	Waltenegus Dargie, Christian Poellabauer, “Fundamentals of Wireless Sensor Networks: Theory and Practice (Wiley) July 2010		
5.	Ian Akyildiz, Mehmet Can Vuran “Wireless Sensor Networks” John Wiley & Sons USA 2010.		
<b>E-Resources</b>			
1.	<a href="https://www.ece.iastate.edu/~kamal/Docs/kk04.pdf">https://www.ece.iastate.edu/~kamal/Docs/kk04.pdf</a>		
2.	<a href="http://www.tfb.edu.mk/amarkoski/WSN/Kniga-w02">http://www.tfb.edu.mk/amarkoski/WSN/Kniga-w02</a>		

  
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Programme	<b>B.E.</b>	Programme Code	<b>103</b>	Regulation	<b>2023</b>			
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>		Semester					
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks		
		L	T	P	C	CA	ESE	Total
<b>U23ECV55</b>	<b>Optical Networks</b>	3	0	0	3	40	60	100
<b>Course Objective</b>	<p>The main objective of the course is to</p> <ul style="list-style-type: none"> <li>Understand the fundamentals of optical network architectures including key standards such as FDDI, SONET/SDH, and their role in metropolitan area networks.</li> <li>Explore wavelength routing networks, analyze node design concepts, and evaluate cost trade-offs and routing techniques.</li> <li>Study network control and management functions essential for maintaining optical network performance, reliability, and safety.</li> <li>Examine photonic packet switching technologies, including OTDM multiplexing, synchronization, and broadcast networks.</li> <li>Analyze current and future optical access network architectures such as HFC, FTTC, and PON evolution to support high-speed connectivity.</li> </ul>							
<b>Course Outcomes</b>	At the end of the course, the student should be able to,							Knowledge Level
	<b>CO1:</b> Describe the architecture and components of optical networks, including FDDI, SONET/SDH, and their layered designs.							K2
	<b>CO2:</b> Explain broadcast and select network topologies and apply media-access control (MAC) protocols for efficient network communication.							K3
	<b>CO3:</b> Analyze wavelength routing network designs, including node structures, routing algorithms, and virtual topologies, to optimize optical layer performance.							K4
	<b>CO4:</b> Apply network management principles for configuration, performance monitoring, and fault management to maintain optical network integrity.							K3
<b>CO5:</b> Evaluate photonic packet switching methods and access network architectures, comparing their advantages and limitations for future optical communication systems.							K4	
<b>Pre-requisites</b>	-							

COs	CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak											CO/PSO Mapping			
	Programme Outcomes (POs)											PSOs			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O 2	PS O 3
CO 1	3	2	2	1		2	2						2	1	
CO 2	3	2	2	1		2	2						2	1	
CO 3	3	2	2	1		2	2						2	1	
CO 4	3	2	2	1		2	2						2	1	
CO 5	3	2	2	1		2	2						2	1	

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<b>Course Assessment Methods</b>			
<b>Direct</b>			
1.Continuous Assessment Test I, II & III			
2.Assignment			
3.End-Semester examinations			
<b>Indirect</b>			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>OPTICAL NETWORK ARCHITECTURE</b>	Periods	<b>9</b>
Introduction -FDDI - SONET/SDH - Computer Interconnects – Metropolitan Area Networks – Layered Architecture. Broadcast and Select Networks: Topologies for Broadcast Networks – Media-Access Control (MAC) Protocols – Test beds.			
<b>Unit – II</b>	<b>WAVELENGTH ROUTING NETWORKS</b>	Periods	<b>9</b>
The optical layer, Node Designs, Optical layer cost tradeoff, Routing and wavelength assignment, Virtual topology design, Architectural variations. Wavelength Routing Testbeds : ONE/Sea Me We-3 – AON – NTT Ring – MWTN – ONTC – Alcatel's-WDM Ring – MONET.			
<b>Unit – III</b>	<b>CONTROL AND MANAGEMENT</b>	Periods	<b>9</b>
Network Management functions – Configuration Management – Performance Management – Faulty Management – Optical Safety – Service Interface.			
<b>Unit – IV</b>	<b>PHOTONIC PACKET SWITCHING</b>	Periods	<b>9</b>
OTDM – Multiplexing and De-multiplexing – Synchronization – Broadcast OTDM Networks - Switch-Based Networks – OTDM Test beds.			
<b>Unit – V</b>	<b>ACCESS NETWORKS</b>	Periods	<b>9</b>
Network Architecture Overview –Enhanced HFC -Fiber to the Curb (FTTC) - PON Evolution- Today's Access Networks – Future Access Networks.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	Rajiv Ramasami Kumar and Sivarajan N, “Optical Networks: A Practical Perspective”, 4 <sup>th</sup> Edition Harcourt Asia PTE Ltd Singapore, 2011.		
<b>References</b>			
1.	Siva Ram Murthy and Mohan Gurusamy, “WDM Optical Networks”, Prentice-Hall of India Private Limited, New Delhi, 2004.		
2.	Debasish Datta,” Optical Networks”, Oxford University Press, USA,2021		
3.	Mrs. Pratibha D. Kulkarni Miss Sharvari D. Kulkarni,” Optical Network and satellite communication”,2020		
<b>E-Resources</b>			
1.	<a href="https://archive.nptel.ac.in/courses/108/106/108106167/">https://archive.nptel.ac.in/courses/108/106/108106167/</a>		
2.	<a href="https://www.coursera.org/specializations/optical-engineering">https://www.coursera.org/specializations/optical-engineering</a>		



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Programme	B.E.	Programme Code	103	Regulation	2023																																																																																																																			
Department	ELECTRONICS AND COMMUNICATION ENGINEERING			Semester																																																																																																																				
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks																																																																																																																		
		L	T	P	C	CA	ESE	Total																																																																																																																
U23ECV56	Cryptography and Network Security	3	0	0	3	40	60	100																																																																																																																
Course Objective	The main objective of the course is to																																																																																																																							
	<ul style="list-style-type: none"> <li>• Introduce fundamental concepts of security, including legal, ethical, and professional aspects, and the need for multi-level security policies and mechanisms.</li> <li>• Understand the mathematical foundations and design principles of symmetric key cryptography, including classical ciphers and modern algorithms like AES and DES.</li> <li>• Explore the mathematics behind asymmetric cryptography and key management techniques.</li> <li>• Analyze web and operating system security concepts</li> <li>• Examine security testing methodologies for web applications and understand cybercrime classifications, attack tools, and defences in network, cloud, and wireless environments.</li> </ul>																																																																																																																							
Course Outcomes	At the end of the course, the student should be able to,							Knowledge Level																																																																																																																
	CO1: Explain the concepts of network security, security policies, classical encryption techniques, and foundations of modern cryptography.							K2																																																																																																																
	CO2: Illustrate the mathematical principles underlying symmetric key cryptography and apply encryption standards like DES and AES in securing data.							K3																																																																																																																
	CO3: Analyze asymmetric cryptographic algorithms such as RSA and elliptic curve cryptography, including their key distribution and management methods.							K4																																																																																																																
	CO4: Identify and analyze common web application vulnerabilities and operating system security models, applying best practices for authentication and access control.							K3																																																																																																																
Pre-requisites	-							K4																																																																																																																
	<p align="center"><b>CO / PO Mapping</b>          (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak</p> <table border="1"> <thead> <tr> <th rowspan="2">COs</th> <th colspan="10">Programme Outcomes (POs)</th> <th colspan="3">CO/PSO Mapping</th> </tr> <tr> <th>PO 1</th> <th>PO 2</th> <th>PO 3</th> <th>PO 4</th> <th>PO 5</th> <th>PO 6</th> <th>PO 7</th> <th>PO 8</th> <th>PO 9</th> <th>PO 10</th> <th>PO 11</th> <th>PO 12</th> <th>PS O1</th> <th>PSO 2</th> <th>PS O 3</th> </tr> </thead> <tbody> <tr> <td>CO 1</td> <td>3</td> <td>3</td> <td>2</td> <td></td> <td></td> <td></td> <td></td> <td>2</td> <td></td> <td>2</td> <td></td> <td></td> <td>3</td> <td></td> <td></td> </tr> <tr> <td>CO 2</td> <td>3</td> <td>3</td> <td>2</td> <td>2</td> <td></td> <td></td> <td>2</td> <td></td> <td></td> <td></td> <td>2</td> <td></td> <td>3</td> <td></td> <td></td> </tr> <tr> <td>CO 3</td> <td>3</td> <td>3</td> <td>2</td> <td>2</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>3</td> <td>2</td> <td></td> </tr> <tr> <td>CO 4</td> <td>3</td> <td>2</td> <td>2</td> <td>2</td> <td></td> <td></td> <td></td> <td>2</td> <td>2</td> <td></td> <td>2</td> <td></td> <td>3</td> <td>2</td> <td></td> </tr> <tr> <td>CO 5</td> <td>3</td> <td>2</td> <td>2</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>2</td> <td></td> <td></td> </tr> </tbody> </table>												COs	Programme Outcomes (POs)										CO/PSO Mapping			PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PSO 2	PS O 3	CO 1	3	3	2					2		2			3			CO 2	3	3	2	2			2				2		3			CO 3	3	3	2	2									3	2		CO 4	3	2	2	2				2	2		2		3	2		CO 5	3	2	2										2	
COs	Programme Outcomes (POs)										CO/PSO Mapping																																																																																																													
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<b>Indirect</b>			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>INTRODUCTION</b>	Periods	<b>9</b>
Security trends - Legal, Ethical and Professional Aspects of Security, Need for Security at Multiple levels, Security Policies - Model of network security – Security attacks, services and mechanisms – OSI security architecture – Classical encryption techniques: substitution techniques, transposition techniques, steganography).- Foundations of modern cryptography: perfect security – information theory – product cryptosystem – cryptanalysis.			
<b>Unit – II</b>	<b>SYMMETRIC CRYPTOGRAPHY</b>	Periods	<b>9</b>
MATHEMATICS OF SYMMETRIC KEY CRYPTOGRAPHY: Algebraic structures – Modular arithmetic- Euclid’s algorithm- Congruence and matrices - Groups, Rings, Fields- Finite fields- SYMMETRIC KEY CIPHERS: SDES – Block cipher Principles of DES – Strength of DES – Differential and linear cryptanalysis - Block cipher design principles – Block cipher mode of operation – Evaluation criteria for AES – Advanced Encryption Standard - RC4 – Key distribution.			
<b>Unit – III</b>	<b>PUBLIC KEY CRYPTOGRAPHY</b>		<b>9</b>
MATHEMATICS OF ASYMMETRIC KEY CRYPTOGRAPHY: Primes – Primality Testing – Factorization – Euler’s totient function, Fermat’s and Euler’s Theorem - Chinese Remainder Theorem – Exponentiation and logarithm - ASYMMETRIC KEY CIPHERS: RSA cryptosystem – Key distribution – Key management – Diffie Hellman key exchange - ElGamal cryptosystem – Elliptic curve arithmetic-Elliptic curve cryptography.			
<b>Unit – IV</b>	<b>WEB SECURITY &amp; OS SECURITY</b>	Periods	<b>9</b>
Overview, various types of web application vulnerabilities, Reconnaissance, Authentication, Authorization (Fuzzing and Privilege Escalation), Session Management, Cross Site Scripting (XSS), Cross Site Request Forgery (CSRF), SQL Injection and Blind SQL Injection. Memory and Address protection – Access Control –file protection mechanisms –User authentication –models of security –Trusted OS design			
<b>Unit – V</b>	<b>SECURITY TESTING FOR WEB APPLICATIONS</b>	Periods	<b>9</b>
Cyber Crime and Information Security – classifications of Cyber Crimes – Tools and Methods – Password Cracking, Keyloggers, Spywares, SQL Injection – Network Access Control – Cloud Security – Web Security – Wireless Security			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	Atul Kahate, “Cryptography and Network Security”, 4th Edition, Tata McGraw-Hill Education Pvt. Ltd., New Delhi, 2019.		
2.	William Stallings, “Cryptography and Network Security: Principles and Practice”, 8th Edition, Pearson, 2022.		
3.	Nina Godbole, Sunit Belapure, Cyber Security: Understanding Cyber crimes, Computer Forensics and Legal Perspectives, First Edition, Wiley India, 2020.		
<b>References</b>			
1.	Niels Ferguson, Bruce Schneier, Tadayoshi Kohno, “Cryptography Engineering- Design Principles and Practical Applications”, Wiley Publishing, Inc, Indian, 2010.		
2.	Niels Ferguson and Bruce Schneier, “Practical Cryptography”, John Wiley and Sons, 2003.		
3.	BehrouzA. Foruzan, Cryptography and Network Security, Tata McGraw Hill 2007.		
4.	Brian Sullivan, Vincent Liu, “Web Application security: A beginners guide, Tata McGraw Hill, 2012.		
5.	Charles P Fleeger, Shari Lawrence P Fleeger, “Security in Computing”, Pearson Education, 2004.		
<b>E-Resources</b>			
1.	<a href="http://indexof.es/Cryptography/Cryptography%20and%20Network%20Security%20Principles%20and%20Practices,%204th%20Ed%20-%20William%20Stallings.pdf">http://indexof.es/Cryptography/Cryptography%20and%20Network%20Security%20Principles%20and%20Practices,%204th%20Ed%20-%20William%20Stallings.pdf</a>		
2.	<a href="https://bh.titichest.cyou/155.html">https://bh.titichest.cyou/155.html</a>		
3.	<a href="http://uru.ac.in/uruonlinelibrary/Cyber_Security/Cryptography_and_Network_Security.pdf">http://uru.ac.in/uruonlinelibrary/Cyber_Security/Cryptography_and_Network_Security.pdf</a>		

  
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Programme	B.E.		Programme Code				103		Regulation		2023				
Department	ELECTRONICS AND COMMUNICATION ENGINEERING							Semester							
Course Code	Course Name		Periods Per Week			Credit	Maximum Marks								
			L	T	P		C	CA	ESE	Total					
U23ECV57	Cyber Security		3	0	0	3	40	60	100						
Course Objective	The main objective of the course is to <ul style="list-style-type: none"> <li>• Introduce ethical considerations in cybersecurity, focusing on cyber warfare, information availability, and ethical challenges in healthcare cybersecurity.</li> <li>• Explain core principles of cybersecurity including threat types, vulnerabilities, risk assessment, and advanced persistent threats.</li> <li>• Explore public opinions and perspectives on cybersecurity across different sectors such as health, business, law enforcement, and national security.</li> <li>• Understand network security technologies and tools, including firewalls, wireless attacks, application inspection, and incident response strategies.</li> <li>• Analyze the role of artificial intelligence in cybersecurity, including neural networks, expert systems, and bio-inspired computing approaches.</li> </ul>														
Course Outcomes	At the end of the course, the student should be able to,										Knowledge Level				
	CO1: Describe ethical issues in cybersecurity with emphasis on cyber warfare, information availability, and challenges specific to health sector cybersecurity.										K2				
	CO2: Explain cybersecurity threats and vulnerabilities, and apply risk assessment techniques to evaluate security postures.										K3				
	CO3: Analyze citizen perspectives on cybersecurity issues across various sectors such as healthcare, business, and national security.										K4				
	CO4: Demonstrate knowledge of network security mechanisms including firewalls, intrusion detection, and digital forensics, and analyze cybercrime incident response processes.										K4				
	CO5: Evaluate the application of artificial intelligence techniques like neural networks and expert systems in enhancing cybersecurity defenses.										K4				
Pre-requisites	-														
CO / PO Mapping													CO/PSO Mapping		
(3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak															
COs	Programme Outcomes (POs)									PSOs					
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	3	2			3	2	3		2			2		2
CO 2	3	3	2	2					2				3	2	
CO 3	3	3	2	2			2						3		2
CO 4	3	2	2	2						2			3	3	
CO 5	3	2	2					2					3		

  
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<b>Course Assessment Methods</b>			
<b>Direct</b>			
1.Continuous Assessment Test I, II & III			
2.Assignment			
3.End-Semester examinations			
<b>Indirect</b>			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>ETHICS IN CYBER SECURITY</b>	Periods	<b>9</b>
Cyber security in Health- Information Availability in Cyber Security- Cyber Warfare- Observations in Cyber Ethics			
<b>Unit – II</b>	<b>PRINCIPLES IN CYBER SECURITY</b>	Periods	<b>9</b>
Cyber security Essentials- Threat and Vulnerabilities of Cyber Security- Risk Assessment in Cyber Security- Advance Persistent Threat and Cyber Kill Chain			
<b>Unit – III</b>	<b>OPINIONS IN CYBERSECURITY</b>	Periods	<b>9</b>
Citizens On Cybersecurity in General- Citizens on Cybersecurity in Health- Citizens on Cybersecurity in Business- Citizens on Cybersecurity in Police and National Security			
<b>Unit – IV</b>	<b>NETWORKS IN CYBER SECURITY</b>	Periods	<b>9</b>
Firewall and Packet Filters- Windows and Linux Firewall- Attacks on Wireless Networks- Application Inspection Tools- Password cracking and brute force tools- Web Attacks- Cyber Crime- Incident Response in Cyber Crime- Digital Forensics- Network Security			
<b>Unit – V</b>	<b>ARTIFICIAL INTELLIGENCE IN CYBER SECURITY</b>	Periods	<b>9</b>
AI in Cyber Security- Artificial Neural Networks (ANNs)- Cascade Correlation Neural Network (CCNN)- Case-based reasoning (CBR)- A rule-based cybersecurity expert system model- Bio-inspired computing in AI- Classification and regression			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	Cybersecurity in Engineering And Technology- Natarajan R,2022		
2.	Forouzan.B.A. and Mukho padhyay.D, Cryptography and Network Security, Tata McGraw Hill, 2nd Edition, 2012		
3.	Anand Shinde, "Introduction to Cyber Security Guide to the World of Cyber Security", Notion Press, 2021		
<b>References</b>			
1.	William Stallings, Cryptography and Network Security, Prentice Hall, 2017.		
2.	Roberta Bragg, MarkRhodes, Keith Strass BergJ, -Network Security-The Complete Reference, Tata McGraw Hill, 2017		
3.	Brian Sullivan, Vincent Liu,—Web Application security: A beginners guide, Tata McGraw Hill, 2012.		
4.	Charles P Fleegeer, Shari Lawrence P Fleegeer,—Security in Computing, Pearson Education, 2018.		
5.	Bruce Schneier, "Applied Cryptography: Protocols, Algorithms, and Source Code in C", Second Edition, Wiley, John & Sons, Incorporated, 2015.		
<b>E-Resources</b>			
1.	<a href="http://Cybersecurity%20in%20engineering%20and%20technology.Pdf">http://Cybersecurity%20in%20engineering%20and%20technology.Pdf</a>		
2.	<a href="http://www.nitjsr.ac.in/course_assignment/CS16CS4204CS4204%20Lecture%20Material.pdf">http://www.nitjsr.ac.in/course_assignment/CS16CS4204CS4204%20Lecture%20Material.pdf</a>		
3.	<a href="http://index-of.es/Hack/CyberSecurity.pdf">http://index-of.es/Hack/CyberSecurity.pdf</a>		

  
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Programme	<b>B.E.</b>		Programme Code				<b>103</b>		Regulation		<b>2023</b>				
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>								Semester		-				
Course Code	Course Name		Periods Per Week			Credit		Maximum Marks							
			L	T	P	C	CA	ESE	Total						
<b>U23ECV58</b>	<b>AI Enabled Next Generation Network</b>		3	0	0	3	40	60	100						
<b>Course Objective</b>	The main objective of the course is to														
	<ul style="list-style-type: none"> <li>Understand the role of AI in optimizing and automating network operations, including cognitive radio networks and self-organizing networks.</li> <li>Explore the architecture and management requirements of Next Generation Networks (NGN), focusing on transport and service strata.</li> <li>Analyze cooperation techniques for next-generation wireless networks, including cooperative diversity, relaying strategies, and their impact on PHY and MAC layers.</li> <li>Study security challenges in 5G communications and the role of self-organizing networks in enhancing network performance and management.</li> <li>Examine AI-enabled services and applications such as QoS/QoE management, IoT, autonomous vehicles, healthcare, smart cities, and Industry 4.0.</li> </ul>														
<b>Course Outcome</b>	At the end of the course, the student should be able to											Knowledge Level			
	<b>CO1:</b> Explain AI techniques applied to network design, operation, and management, and describe the ethical considerations in AI-driven networks.											K2			
	<b>CO2:</b> Illustrate the NGN functional architecture, including management requirements across customer, configuration, and performance domains.											K3			
	<b>CO3:</b> Analyze cooperative diversity and relaying strategies in wireless networks, assessing their effects on PHY and MAC layer performance for QoS guarantees.											K4			
	<b>CO4:</b> Evaluate security issues and self-organizing network approaches in 5G systems, highlighting their importance in evolving HetNets architectures.											K4			
	<b>CO5:</b> Assess AI-enabled applications in modern networks such as IoT, edge computing, autonomous vehicles, and smart city implementations, forecasting future trends.											K4			
<b>Pre-requisites</b>															
<b>CO / PO Mapping</b> (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak															
<b>Cos</b>	<b>Programme Outcomes (POs)</b>												<b>CO/PSO Mapping</b>		
	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>	<b>PSO 3</b>
<b>CO 1</b>	3	2	2	2	2					2	1	2	3	2	2
<b>CO 2</b>	3	2	2	2	2					2	1	2	3	2	2
<b>CO 3</b>	3	2	2	2	2					2	1	2	3	2	2
<b>CO 4</b>	3	2	2	2	2					2	1	2	3	2	2
<b>CO 5</b>	3	2	2	2	2					2	1	2	3	2	2
<b>Course Assessment Methods</b>															

  
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<b>Direct</b>			
1. Continuous Assessment Test I, II & III			
2. Assignment and Seminar			
3. End-Semester examinations			
<b>Indirect</b>			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>AI NETWORKS AND ARCHITECTURE</b>	Periods	<b>9</b>
Role of AI in optimizing and automating network operations, Importance of AI in next-gen networks, AI techniques used in network design, operation, and management, Cognitive radio networks, self-organizing networks (SON), AI for network slicing, virtualized networks (SDN, NFV), Ethics in AI.			
<b>Unit – II</b>	<b>NGN ARCHITECTURE AND MANAGEMENT</b>	Periods	<b>9</b>
Evolution towards NGN-Technology requirements – NGN functional architecture- Transport stratum, service stratum – NGN requirements on Management-Customer, third party, Configuration, Accounting, performance, device and information management – Service and control manage.			
<b>Unit – III</b>	<b>COOPERATION FOR NEXT GENERATION WIRELESS NETWORKS</b>	Periods	<b>9</b>
Introduction – Cooperative Diversity and Relaying Strategies: Cooperation and Network Coding, Cooperative ARQ MAC Protocols – PHY Layer Impact on MAC Protocol Analysis: Impact of Fast Fading and Shadowing on Packet Reception for QoS Guarantee, Impact of Shadowing Spatial Correlation– Study: NCCARQ, PHY Layer Impact.			
<b>Unit – IV</b>	<b>SECURITY AND SELF ORGANISING NETWORKS</b>	Periods	<b>9</b>
Overview of Potential 5G Communications System Architecture – Security Issues and Challenges in 5G Communications Systems - Self Organising Networks in UMTS and LTE, The Need for Self Organising Networks in 5G, Evolution towards Small Cell Dominant HetNets.			
<b>Unit – V</b>	<b>AI-Enabled Services and Applications</b>	Periods	<b>9</b>
AI for QoS (Quality of Service) and QoE (Quality of Experience), AI in Healthcare, AI for Autonomous Vehicles, Smart Cities, and Industry 4.0, Future of AI in Networking and Emerging Trends.			
<b>Total Periods</b>			<b>45</b>
<b>References</b>			
R1	"AI in 5G and Beyond: Fundamentals and Applications" by Latif U. Khan, Alagan Anpalagan, and Binoy Krishna Ghosh, Springer 2022.		
R2	"Artificial Intelligence in Wireless Networks: 5G and Beyond" by Chien-Ching Chen, Hongyu Wu, and Xiqi Gao, 2024.		
R3	"Artificial Intelligence for Next-Generation Networks: Advances in Machine Learning, Data Science, and Automation" by Y. Xiao, D. Lee, M. Shen, and L. Zhao, 2021.		
R4	Jonathan Rodriguez, "Fundamentals of 5G Mobile Networks", Wiley, 2015		
R5	Jingming Li Salina, Pascal Salina "Next Generation Networks-perspectives and potentials Wiley, January 2008.		
R6	Thomas Plavky, —Next generation Telecommunication Networks, Services and Management!, Wiley & IEEE Press Publications, 2010.		

  
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Programme	<b>B.E.</b>	Programme Code	<b>103</b>	Regulation	<b>2023</b>			
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>			Semester				
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks		
		L	T	P	C	CA	ESE	Total
<b>U23ECV61</b>	<b>Neural Networks and its Applications</b>	3	0	0	3	40	60	100
Course Objective	The main objective of the course is to							
	<ul style="list-style-type: none"> <li>Understand the biological basis and fundamental architecture of Artificial Neural Networks including Perceptron, Adaline, and Madaline models.</li> <li>Explore the principles of supervised learning through backpropagation, and associative memory networks such as Hopfield networks and their applications.</li> <li>Study neural networks based on competitive learning including Kohonen Self-Organizing Maps and Learning Vector Quantization.</li> <li>Examine unsupervised learning techniques and clustering analysis, applying neural network approaches to pattern recognition.</li> <li>Analyze supervised learning methods using parametric and non-parametric classifiers including Bayesian classifiers and k-nearest neighbour algorithms.</li> </ul>							
Course Outcome	At the end of the course, the student should be able to,						Knowledge Level	
	CO1: Describe the structure and functioning of biological neural networks and basic ANN models such as Perceptron and Hebb nets.						K2	
	CO2: Explain the backpropagation algorithm and implement associative memory networks like Hopfield networks for practical applications.						K3	
	CO3: Analyze competitive neural network models such as Kohonen maps and their role in pattern classification tasks..						K4	
	CO4: Apply unsupervised learning techniques and clustering algorithms in neural network-based pattern recognition problems.						K3	
	CO5: Evaluate supervised learning techniques including Bayesian classifiers and non-parametric methods for data classification and error estimation.						K4	
Pre-requisites	-							

COs	CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak											CO/PSO Mapping			
	Programme Outcomes (POs)											PSOs			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O 2	PS O 3
CO1	3	3	2				2						3	2	
CO2	3	3	2	2			2		2				3	2	2
CO3	3	3	2	2									3	2	
CO4	3	2	2	2			2		2				3		2
CO5	3	2	2						2				3	2	

**Course Assessment Methods**

**Direct**

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1. Continuous Assessment Test I, II & III			
2. Assignment			
3. End-Semester examinations			
<b>Indirect</b>			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>INTRODUCTION AND SIMPLE NEURALETWORK</b>	Periods	<b>9</b>
Elementary Neurophysiology and Biological Neural Network-Artificial Neural Network (ANN) – Architecture, Biases and Thresholds, Hebb net, Perceptron, Adaline and Madaline.			
<b>Unit-II</b>	<b>BACK PROPOGATION AND ASSOCIATIVE MEMORY</b>	Periods	<b>9</b>
Back propagation Network- generalized Delta rule, Bidirectional Associative Memory, Hopfield Network- Autonomous Vehicles Applications			
<b>Unit – III</b>	<b>NEURAL NETWORKS BASED ON COMPETITION</b>	Periods	<b>9</b>
Kohonen Self organizing Map, Learning Vector Quantization, Counter propagation Network- Clustering and Data Segmentation Applications.			
<b>Unit - IV</b>	<b>UNSUPERVISED LEARNING AND CLUSTERING ANALYSIS</b>	Periods	<b>9</b>
Patterns and Features, training and learning in pattern recognition, Discriminant functions, Different types of pattern recognition. Unsupervised learning- hierarchical clustering, partitional clustering. Neural pattern recognition approach – perceptron model- Social Network Analysis Applications.			
<b>Unit – V</b>	<b>SUPERVISED LEARNING USING PARAMETRIC AND NON PARAMETRIC APPROACH</b>	Periods	<b>9</b>
Bayesian classifier, Non Parametric Density Estimation, Histograms, kernels, window estimators, k-nearest neighbor classifier, estimation of error rates-Applications of Data Science and Network.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	Hagan, Demuth and Beale, —Neural Network Design, Vikas Publishing House Pvt.Ltd., New Delhi, 2014.		
2.	Freeman J.A., and Skapura B.M, — Neural Networks, Algorithms, Applications and Programming Techniques, Addison – Wesley, 2004.		
<b>References</b>			
1.	Robert Schalkoff, —Pattern Recognition, Statistical, Structural and Neural Approaches, John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2005.		
2.	Laurene Fausett , Fundamentals of Neural Networks – Architectures, Algorithms and Applications, Prentice Hall, 2004.		
3.	Duda R.O, Hart P.G, —Pattern classification and scene analysis, Wiley Edition, 2013.		
4.	Earl Gose, Richard Johnson baugh, Steve Jost, —Pattern Recognition and Image Analysis, Prentice Hall of India Pvt. Ltd., New Delhi, Reprint, 2017.		
<b>E-Resources</b>			
1.	<a href="https://hagan.okstate.edu/NNDesign.pdf">https://hagan.okstate.edu/NNDesign.pdf</a>		
2.	<a href="https://www.wiley.com/en-sg/exportProduct/pdf/9780471529743">https://www.wiley.com/en-sg/exportProduct/pdf/9780471529743</a>		
3.	<a href="https://e.pdfpremiumfree.com/download/pattern_recognition_statistical_structural_and_neural_approaches/">https://e.pdfpremiumfree.com/download/pattern_recognition_statistical_structural_and_neural_approaches/</a>		



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Programme	B.E.	Programme Code	103	Regulation	2023			
Department	ELECTRONICS AND COMMUNICATION ENGINEERING			Semester				
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks		
		L	T	P	C	CA	ESE	Total
U23ECV62	Deep Learning	3	0	0	3	40	60	100
Course Objective	The main objective of the course is to							
	<ul style="list-style-type: none"> <li>Introduce fundamental machine learning concepts including bias-variance tradeoff, overfitting, under fitting, and types of learning algorithms</li> <li>Understand deep feedforward networks, including architecture design, gradient-based learning, and backpropagation algorithms.</li> <li>Explore regularization techniques such as norm penalties, dropout, dataset augmentation, and ensemble methods to improve model generalization.</li> <li>Study optimization methods for training deep models, including adaptive learning rates and approximate second-order optimization techniques.</li> <li>Examine convolutional neural networks (CNNs), recurrent neural networks (RNNs), and their applications in computer vision, speech recognition, and natural language processing.</li> </ul>							
Course Outcomes	At the end of the course, the student should be able to,							Knowledge Level
	CO1: Explain the key concepts of machine learning including model capacity, bias-variance tradeoff, and supervised vs unsupervised learning techniques.							K2
	CO2: Illustrate the architecture and training of deep feedforward networks using backpropagation and gradient-based optimization.							K3
	CO3: Analyze the impact of various regularization techniques such as dropout and early stopping on the performance of deep learning models.							K4
	CO4: Apply and evaluate different optimization algorithms and strategies for effectively training deep neural networks.							K4
	CO5: Assess convolutional and recurrent neural network architectures and their applications in real-world problems like computer vision and natural language processing							K4
Pre-requisites	-							

CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak													CO/PSO Mapping		
COs	Programme Outcomes (POs)											PSOs			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO 1	3	3	2										3		
CO 2	3	3	2	2									3	2	
CO 3	3	3	2	2									3		
CO 4	3	2	2	2									3	2	2
CO 5	3	2	2										3		

**Course Assessment Methods**

<b>Direct</b>
1.Continuous Assessment Test I, II & III

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2. Assignment			
3. End-Semester examinations			
<b>Indirect</b>			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>Machine Learning Fundamentals</b>	Periods	<b>9</b>
Review of Machine Learning techniques – Capacity, Over fitting & Under fitting – Hyper parameters & Validation sets – Estimators, Bias and Variance - Supervised and Unsupervised learning algorithms, Stochastic Gradient Descent. Artificial Neural networks - Concepts.			
<b>Unit – II</b>	<b>Deep Feed forward Networks</b>	Periods	<b>9</b>
Learning XOR – Gradient Based learning – Hidden Units – Architecture Design - , Back propagation and other differentiation algorithms.			
<b>Unit – III</b>	<b>Regularization</b>	Periods	<b>9</b>
Norm penalties – Constrained & Under-constrained problems-Dataset augmentation- Early Stopping – Sparse representations-Ensemble methods – Dropout.			
<b>Unit – IV</b>	<b>Optimization for training deep models</b>	Periods	<b>9</b>
Learning & Optimization - Challenges in Optimization – Basic algorithms – Algorithms with adaptive learning rate - Approximate Second-Order Methods, Optimization Strategies and Meta Algorithms.			
<b>Unit – V</b>	<b>Convolutional Neural Networks &amp; Sequence Modelling, Applications</b>	Periods	<b>9</b>
Convolution operation – Pooling – Efficient convolution algorithms-Recurrent Neural Networks (RNN) – Bi-directional RNN – Long Short-term Memory (LSTM) - Gated Recurrent Unit (GRU) – Deep Recurrent Networks.			
<b>Applications : Computer vision – Speech recognition – Natural Language Processing</b>			
<b>Total Periods</b>			<b>45</b>
<b>Text Book</b>			
1.	Goodfellow, Ian, Yoshua Bengio, and Aaron Courville, “Deep Learning”, MIT press, 2016.		
<b>References</b>			
1.	Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani, An Introduction to Statistical Learning with Applications in R, Springer, New York, 2016.		
2.	S.N. Deepa, S.N. Sivanandam, “Principles of Soft Computing”, Wiley India Pvt. Ltd., 2018.		
3.	Buduma, Nikhil, and Nicholas Locascio. Fundamentals of deep learning: Designing next generation machine intelligence algorithms. “O’Reilly Media, Inc.”, 2017.		
4.	Josh Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017.		
<b>E-Resources</b>			
1.	<a href="https://www.cin.ufpe.br/~tfl2/artificial-intelligence-modern-approach.9780131038059.25368.pdf">https://www.cin.ufpe.br/~tfl2/artificial-intelligence-modern-approach.9780131038059.25368.pdf</a>		
2.	<a href="http://dwa-bis.xpl.io/cgi-bin/pdf.php?article=artificial%20intelligence%20third%20edition%20elaine%20rich%20pdf&amp;code=ff289aa336a33fec5fc4e5f50940e98b">http://dwa-bis.xpl.io/cgi-bin/pdf.php?article=artificial%20intelligence%20third%20edition%20elaine%20rich%20pdf&amp;code=ff289aa336a33fec5fc4e5f50940e98b</a>		
3.	<a href="http://users.isr.ist.utl.pt/~wurmd/Livros/school/Bishop%20-%20Pattern%20Recognition%20And%20Machine%20Learning%20-%20Springer%20%202006.pdf">http://users.isr.ist.utl.pt/~wurmd/Livros/school/Bishop%20-%20Pattern%20Recognition%20And%20Machine%20Learning%20-%20Springer%20%202006.pdf</a>		



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Programme	B.E.	Programme Code	103	Regulation	2023			
Department	ELECTRONICS AND COMMUNICATION ENGINEERING			Semester				
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks		
		L	T	P	C	CA	ESE	Total
U23ECV63	Artificial Intelligence and Machine Learning	3	0	0	3	40	60	100
Course Objective	The main objectives of this course are to:							
	<ul style="list-style-type: none"> <li>• Provide a strong foundation in the fundamental concepts of Artificial Intelligence (AI), including problem-solving and search strategies.</li> <li>• Introduce knowledge representation and probabilistic reasoning under uncertainty using Bayesian techniques.</li> <li>• Develop an understanding of supervised learning models and their applications in real-world scenarios.</li> <li>• Explore ensemble learning methods and unsupervised learning techniques for effective data analysis.</li> <li>• Understand the architecture, training, and tuning of neural networks from shallow to deep learning models.</li> </ul>							
Course Outcomes	At the end of the course, the student should be able to,							Knowledge Level
	CO1: Explain the concepts of AI and apply uninformed and informed search strategies to solve problems.							K2
	CO2: Apply probabilistic reasoning models like Bayesian networks and perform inference in uncertain domains.							K3
	CO3: Analyze and implement supervised learning algorithms such as SVM, Logistic Regression, and Decision Trees.							K4
	CO4: Evaluate ensemble and unsupervised learning techniques such as bagging, boosting, K-means, and GMM.							K4
	CO5: Design, train, and optimize neural networks using gradient descent, backpropagation, and regularization techniques.							K3
Pre-requisites	-							

COs	CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak											CO/PSO Mapping			
	Programme Outcomes (POs)											PSOs			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO 1	3	2	2	2	1	1	2	-	-	-	-	1	3	2	2
CO 2	3	2	2	2	1	1	2	-	-	-	-	1	3	2	2
CO 3	3	2	1	2	2	1	2	-	-	-	-	1	3	2	2
CO 4	3	2	2	1	3	1	2	-	-	-	-	1	3	2	2
CO 5	3	2	2	1	3	1	2	-	-	-	-	1	3	2	2

**Course Assessment Methods**

<b>Direct</b>
1.Continuous Assessment Test I, II & III
2.Assignment

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3.End-Semester examinations			
<b>Indirect</b>			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>PROBLEMSOLVING</b>	Periods	<b>9</b>
Introduction to AI - AI Applications -Problem solving agents – searching for solutions– uninformed search strategies–Heuristic search strategies–Local search and optimization problems–adversarial search– constraint satisfaction problems(CSP)			
<b>Unit – II</b>	<b>KNOWLEDGE AND PROBABILISTIC REASONING</b>	Periods	<b>9</b>
Acting under uncertainty – Bayesian inference – naïve bayes models. Probabilistic reasoning –Bayesian networks –exact inference in BN–approximate inference in BN– causal networks.			
<b>Unit – III</b>	<b>SUPERVISED LEARNING</b>	Periods	<b>9</b>
Introduction to machine learning – Linear Regression Models: Least squares, single & multiple variables, Bayesian linear regression, gradient descent, Linear Classification Models: Discriminant function – Probabilistic discriminative model - Logistic regression, Probabilistic generative model –Naïve Bayes, Maximum margin classifier–Support vector machine, Decision Tree, Random forests			
<b>Unit – IV</b>	<b>ENSEMBLE TECHNIQUES AND UNSUPERVISED LEARNING</b>	Periods	<b>9</b>
Combining multiple learners: Model combination schemes, Voting, Ensemble Learning - bagging, boosting, stacking, Unsupervised learning: K-means, Instance Based Learning: KNN, Gaussian mixture models and Expectation maximization.			
<b>Unit – V</b>	<b>NEURAL NETWORKS</b>	Periods	<b>9</b>
Perceptron–Multilayer perceptron, activation functions, network training–gradient descent optimization – stochastic gradient descent, error back propagation, from shallow networks to deep networks –Unit saturation (aka the vanishing gradient problem) – ReLU, hyper parameter tuning, batch normalization, regularization, dropout.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	Stuart Russell and Peter Norvig, “Artificial Intelligence–Modern Approach”, Fourth Edition, Pearson Education, 2021.		
2.	EthemAlpaydin,“Introduction to Machine Learning”,MIT Press,Fourth Edition,2020		
<b>References</b>			
1.	Dan W.Patterson,“Introduction to AI and ES”, Pearson Education, 2007		
2.	KevinNight,ElaineRich,andNairB.,“Artificial Intelligence”,McGraw Hill,2008		
3.	Patrick H.Winston,"Artificial Intelligence",Third Edition, Pearson Education, 2006		
4.	Deepak Khemani, “Artificial Intelligence”,Tata McGraw Hill Education, 2013 ( <a href="http://nptel.ac.in/">http://nptel.ac.in/</a> )		
5.	Christopher M. Bishop, “Pattern Recognition and Machine Learning”,Springer,2006		
6.	TomMitchell, “Machine Learning”, Mc Graw Hill,3 <sup>rd</sup> Edition, 1997.		
7.	CharuC.Aggarwal,“Data Classification Algorithms and Applications”,CRC Press, 2014		
8.	Mehryar Mohri, Afshin Rostamizadeh,AmeetTalwalkar,“Foundations of Machine Learning”, MIT Press, 2012.		
9.	IanGood fellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press,2016		

  
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Programme	<b>B.E.</b>	Programme Code	<b>103</b>	Regulation	<b>2023</b>			
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>			Semester				
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks		
		L	T	P		C	CA	ESE
<b>U23ECV64</b>	<b>Computer Vision</b>	3	0	0	3	40	60	100
<b>Course Objective</b>	The main objectives of this course are to							
	<ul style="list-style-type: none"> <li>Introduce the fundamentals of image formation and basic image processing techniques including filtering, transformation, and enhancement.</li> <li>Explore techniques for detecting and matching features such as points, edges, lines, and patches, and to understand image segmentation methods.</li> <li>Understand motion estimation and feature-based alignment methods in 2D and 3D, including pose estimation and optical flow.</li> <li>Explain 3D reconstruction methods from image data, focusing on representations, shape recovery, and texture mapping.</li> <li>Study image-based rendering and object recognition techniques, including interpolation, recognition models, and use of recognition datasets.</li> </ul>							
<b>Course Outcomes</b>	At the end of the course, the student should be able to ,						Knowledge Level	
	<b>CO1:</b> Explain the principles of image formation, filtering, and transformations used in computer vision.						K2	
	<b>CO2:</b> Apply feature detection, matching, and segmentation techniques to extract meaningful patterns from images.						K3	
	<b>CO3:</b> Analyze motion estimation techniques including optical flow, structure from motion, and motion alignment.						K4	
	<b>CO4:</b> Construct basic 3D models using shape-from-X and other reconstruction techniques.						K3	
	<b>CO5:</b> Evaluate recognition techniques for object and scene identification using real-world datasets.						K4	
<b>3Pre-requisites</b>	Basic knowledge on image and pixels							

COs	CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak												CO/PSO Mapping		
	Programme Outcomes (POs)												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O 2	PS O 3
<b>CO 1</b>	3	1	1	1	1				2	1	3	2	2	1	1
<b>CO 2</b>	3	3	3	2	3		1		2	1	2	2	3	1	2
<b>CO 3</b>	3	3	2	2	3				1	1	2	2	3	2	2
<b>CO 4</b>	2	3	3	2	2				3	1	2	3	2	2	3
<b>CO 5</b>	2	3	3	2	2	2			2	1	2	3	3	3	3

**Course Assessment Methods**

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<b>Direct</b>			
1.Continuous Assessment Test I, II & III			
2.Assignment			
3.End-Semester examinations			
<b>Indirect</b>			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>INTRODUCTION TO IMAGE FORMATION AND PROCESSING</b>	<b>Periods</b>	<b>9</b>
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.			
<b>Unit – II</b>	<b>FEATURE DETECTION, MATCHING AND SEGMENTATION</b>	<b>Periods</b>	<b>9</b>
Points and patches - Edges - Lines - Segmentation - Active contours - Split and merge - Mean shift and mode finding - Normalized cuts - Graph cuts and energy-based methods.			
<b>Unit – III</b>	<b>FEATURE-BASED ALIGNMENT &amp; MOTION ESTIMATION</b>	<b>Periods</b>	<b>9</b>
2D and 3D feature-based alignment - Pose estimation - Geometric intrinsic calibration - Triangulation - Two-frame structure from motion - Factorization - Bundle adjustment - Constrained structure and motion - Translational alignment - Parametric motion - Spline-based motion - Optical flow - Layered motion.			
<b>Unit – IV</b>	<b>3D RECONSTRUCTION</b>	<b>Periods</b>	<b>9</b>
Shape from X - Active range finding - Surface representations - Point-based representations- Volumetric representations - Model-based reconstruction - Recovering texture maps and albedosos.			
<b>Unit – V</b>	<b>IMAGE-BASED RENDERING AND RECOGNITION</b>	<b>Periods</b>	<b>9</b>
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.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
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.		
<b>References</b>			
1.	Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.		
2.	Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2007		
3.	E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press, 2012.		



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Programme	B.E.	Programme Code	103	Regulation	2023										
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>			Semester											
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks									
		L	T	P	C	CA	ESE	Total							
U23ECV65	<b>AUGMENTED REALITY/ VIRTUAL REALITY</b>	3	0	0	3	40	60	100							
<b>Course Objective</b>	The main objectives of this course are to														
	<ul style="list-style-type: none"> <li>• Introduce the basic concepts and components of Virtual Reality (VR) and Augmented Reality (AR) systems, including hardware and input/output devices.</li> <li>• Understand different modeling techniques including geometric, physical, and behavior modeling used in VR environments.</li> <li>• Gain knowledge of VR programming tools and platforms, and to compare VR development toolkits like World Tool Kit and Java 3D.</li> <li>• Explore various VR and AR applications across domains like medicine, education, defense, business, and entertainment.</li> <li>• Study the fundamentals of AR, including computer vision, user interaction models, and wearable technology.</li> </ul>														
<b>Course Outcomes</b>	At the end of the course, the student should be able to,							Knowledge Level							
	CO1: Explain the components and working principles of Virtual and Augmented Reality systems.							K2							
	CO2: Apply geometric, kinematic, and physical modeling techniques to represent virtual objects and interactions.							K3							
	CO3: Compare different VR programming toolkits and demonstrate scene development using VR platforms.							K4							
	CO4: Identify and analyze the impact of VR on human factors and real-world applications in various fields.							K4							
	CO5: Describe AR systems, including interaction methods and wearable technologies for real-time augmentation.							K2							
<b>Pre-requisites</b>	Fundamentals of image processing														
<b>CO / PO Mapping</b>													<b>CO/PSO Mapping</b>		
(3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak															
COs	Programme Outcomes (POs)											PSOs			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O 2	PS O 3
CO 1	3	2	2	-	3	-	-	-	2	2	1	2	2	1	2
CO 2	3	2	2	1	3	-	-	-	3	2	2	3	3	1	2
CO 3	3	3	2	2	3	-	-	-	3	2	1	2	3	2	2
CO 4	3	3	3	2	3	-	-	-	3	2	2	3	3	2	2
CO 5	3	3	3	3	3	-	-	-	3	3	3	3	3	3	3
<b>Course Assessment Methods</b>															
<b>Direct</b>															
1.Continuous Assessment Test I, II & III															
2.Assignment															

  
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3.End-Semester examinations			
<b>Indirect</b>			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>INTRODUCTION</b>	Periods	<b>9</b>
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 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.			
<b>Unit – II</b>	<b>VR MODELING</b>	Periods	<b>9</b>
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.			
<b>Unit – III</b>	<b>VR PROGRAMMING</b>	Periods	<b>9</b>
VR Programming – Toolkits and Scene Graphs – World Tool Kit – Java 3D – Comparison of World Tool Kit and Java 3D			
<b>Unit – IV</b>	<b>APPLICATIONS</b>	Periods	<b>10</b>
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.			
<b>Unit – V</b>	<b>AUGMENTED REALITY</b>	Periods	<b>9</b>
Introduction to Augmented Reality-Computer vision for AR-Interaction-Modelling and Annotation- Navigation-Wearable devices			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
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 & Practice”, Addison Wesley, 2016		
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		



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Programme	<b>B.E.</b>	Programme Code	<b>103</b>	Regulation	<b>2023</b>				
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>			Semester					
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks			
		L	T	P	C	CA	ESE	Total	
<b>U23ECV66</b>	<b>Generative AI</b>	3	0	0	3	40	60	100	
<b>Course Objective</b>	The main objective of the course is to								
	<ul style="list-style-type: none"> <li>• Provide foundational knowledge of Artificial Intelligence and Neural Networks, including training processes and key concepts like backpropagation and hyperparameters.</li> <li>• Introduce and explain advanced neural network architectures, focusing on models such as GANs, VAEs, Transformers, Attention, and LSTMs.</li> <li>• Impart understanding of essential data preprocessing and training techniques, enabling reliable AI model performance.</li> <li>• Explore real-world applications of Generative AI across domains such as healthcare, finance, arts, and more.</li> <li>• Study GPT architectures and their practical applications, including chatbot development and text generation systems.</li> </ul>								
<b>Course Outcome</b>	At the end of the course, the student should be able to,						Knowledge level		
	CO1: Explain the fundamentals of neural networks, training steps, and historical evolution of AI/ML and NLP.						K2		
	CO2: Apply knowledge of advanced neural architectures like GANs, VAEs, Transformers, and LSTMs in building generative models.						K3		
	CO3: Apply statistical and preprocessing techniques to prepare data and train generative models effectively.						K3		
	CO4: Analyze the practical applications and deployment challenges of generative AI models in various industries.						K4		
	CO5: Analyze the structure and use of GPT models for developing intelligent systems such as chatbots and dialogue agents.						K4		
<b>Pre-requisites</b>	Fundamentals of AI								

COs	CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak											CO/PSO Mapping			
	Programme Outcomes (POs)											PSOs			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	3	3	3	2	2						2	3	3	3
CO2	3	3	2	2	1	2						2	3	2	3
CO3	3	3	2	2	2	2						2	3	2	3
CO4	3	3	3	2	2	1						2	1	2	2
CO5	3	3	3	2	2	2						3	2	1	2

**Course Assessment Methods**

Direct

*[Signature]*  
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for Women (Autonomous),  
Tiruchengode

1. Continuous Assessment Test I, II & III 2. Assignment 3. End-Semester examinations			
Indirect			
2. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>Foundations of AI and Neural Networks</b>	<b>Periods</b>	<b>9</b>
History and evolution of AI/ML, Deep learning revolution, Transfer learning, History of Neural Natural Language Processing, Structure of Artificial Neural Networks, Steps in Training an Artificial Neural Network, Parameters and Hyper parameters, Backpropagation.			
<b>Unit - II</b>	<b>Advanced Neural Network Architectures</b>	<b>Periods</b>	<b>9</b>
Introduction to advanced architectures, Introduction to Generative AI Models: Generative Adversarial Networks (GANs), Variation Auto encoders (VAEs), Transformers, Attention Mechanism in detail Long Short-Term Memory Networks (LSTMs).			
<b>Unit – III</b>	<b>Data Preprocessing</b>	<b>Periods</b>	<b>9</b>
Probability and Statistics, Data Preprocessing Techniques, Model Training Techniques			
<b>Unit - IV</b>	<b>Generative AI Applications</b>	<b>Periods</b>	<b>9</b>
Applications in Various Fields: Art and Creativity, Image and Video Generation, Text Generation, Music Composition, Healthcare Finance. Real-world use cases and challenges in deploying generative AI models			
<b>Unit – V</b>	<b>GPT Models and Applications</b>	<b>Periods</b>	<b>9</b>
Study of GPT architecture and variants. Applications of GPT models in text generation and dialogue systems. Case study based implementation of GPT-based tasks. GPT-based chat bot enhances E-Shop's customer support service			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	"Introduction to Generative AI", Numa Dhamani, Kindle Edition, 2024.		
2.	"Generative AI for everyone: Understanding the essentials and applications of this breakthrough technology, Altaf Rehmani, 2024.		
3.	"Neural Networks and Deep Learning: A Textbook" by Charu C. Aggarwal, 2018.		
<b>References</b>			
1.	"Generative Adversarial Networks Cookbook: Over 100 recipes to build generative models using Python, TensorFlow, and Keras" by Josh Kalin, 2018.		
2.	"Generative AI in Software Development: Beyond the Limitations of Traditional Coding" Jesse Sprinter, 2024		
<b>E-Resources</b>			
1.	<a href="https://elearn.nptel.ac.in/shop/iit-workshops/completed/leveraging-generative-ai-for-teaching-programming-courses/?v=c86ee0d9d7ed">https://elearn.nptel.ac.in/shop/iit-workshops/completed/leveraging-generative-ai-for-teaching-programming-courses/?v=c86ee0d9d7ed</a>		

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Elayampalayam, Tiruchengode – 637 205



Programme	<b>B.E.</b>	Programme Code	<b>103</b>	Regulation	<b>2023</b>				
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>			Semester					
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks			
		L	T	P	C	CA	ESE	Total	
<b>U23ECV67</b>	<b>AI BASED ROBOTICS AUTOMATION</b>	3	0	0	3	40	60	100	
<b>Course Objective</b>	The main objective of the course is to								
	<ul style="list-style-type: none"> <li>• Introduce the historical development and fundamental concepts of Artificial Intelligence (AI), including intelligent agents and rationality.</li> <li>• Explain the principles and varieties of machine learning, focusing on input-output learning, supervised learning models, and evaluation metrics.</li> <li>• Explore advanced supervised learning techniques, including gradient descent, SVMs, Naive Bayes, and regularization.</li> <li>• Understand the integration of AI in robotics, covering robotic perception, planning, movement control, and ethical concerns.</li> <li>• Analyze the role of AI in industrial automation and real-world robotic applications, including Industry 4.0 and emerging robotic technologies.</li> </ul>								
<b>Course Outcome</b>	At the end of the course, the student should be able to,						Knowledge level		
	<b>CO1:</b> Explain the historical evolution and key principles of AI, intelligent agents, and rational behavior.						K2		
	<b>CO2:</b> Apply machine learning techniques such as decision trees, logistic regression, and nearest neighbors to solve classification problems.						K3		
	<b>CO3:</b> Analyze and compare advanced supervised learning models, including linear models, SVMs, and probabilistic methods.						K4		
	<b>CO4:</b> Apply AI concepts in robotic perception, planning, and movement control, recognizing ethical implications.						K3		
<b>Pre-requisites</b>	Introduction to Robotics								

COs	CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak												CO/PSO Mapping		
	Programme Outcomes (POs)												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
<b>CO1</b>	3	3	2					2				2	3	3	
<b>CO2</b>	3	3	2	2									2	2	
<b>CO3</b>	3	3	2	2								2	3	2	2
<b>CO4</b>	3	3	2	2				2				1		2	
<b>CO5</b>	3	2	2					2		2		1	3	2	

**Course Assessment Methods**

**Direct**

1. Continuous Assessment Test I, II & III

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2. Assignment			
3. End-Semester examinations			
Indirect			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>HISTORY OF AI</b>	Periods	<b>9</b>
Introduction – History, Definition of AI, Emulation of human cognitive process, Intelligent agents – The concept of rationality, the nature of environments, the structure of agents.			
<b>Unit - II</b>	<b>MACHINE LEARNING</b>	Periods	<b>9</b>
Machine learning – Varieties of Machine learning – Learning Input- Output functions: Types of learning – Input Vectors – Outputs – Training regimes – Noise – Performance Evaluation. Foundations of Supervised Learning: Decision trees and Inductive bias – Geometry and nearest neighbors – Logistic regression – Perceptron – Binary classification.			
<b>Unit – III</b>	<b>ADVANCED SUPERVISED LEARNING</b>	Periods	<b>9</b>
Linear models and gradient descent – Support Vector machines – Naive Bayes models and probabilistic modeling – Model selection and feature selection – Model Complexity and Regularization.			
<b>Unit - IV</b>	<b>AI IN ROBOTICS</b>	Periods	<b>9</b>
Robotic perception, localization, mapping- configuring space, planning uncertain movements, dynamics and control of movement, Ethics and risks of artificial intelligence in robotics.			
<b>Unit – V</b>	<b>ROBOT AUTOMATION &amp; APPLICATIONS</b>	Periods	<b>9</b>
Goals and Issues in Automation, Industry 4.0, Components of an automatic system, Trends in Automation – PLC, DCS, SCADA, AI based Automation. <b>Emerging Applications:</b> Mobile Robots, Medical Robots, Soft Robots, Collaborative Robots, Cloud Robots, Micro robots, Tele Robots, AGVs, Underwater Robots, Robotics and AI, RPA, Economic and Social Aspects of Robots.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	Artificial Intelligence for Robotics Build intelligent robots that perform human tasks using AI Techniques, Francis X. Govers, August 2018.		
2.	Gupta. A.K, Arora. S. K., Industrial Automation and Robotics, Mercury Learning and Information, 2017.		
<b>References</b>			
1.	Russell Stuart, Norvig Peter, “Artificial Intelligence Modern Approach”, Pearson Education series in AI, 3rd Edition, 2010.		
2.	Peter Flach, Machine Learning: The Art and Science of Algorithms that make sense of data, Tom Mitchell, Machine Learning ‘, McGraw Hill, 2015		
3.	Ethem Alpaydin, ‘Introduction to Machine Learning’, The MIT Press, 2004		
4.	Mikell P Groover, “Industrial Robotics”, Mc GrawHill, 2012		
5.	Thomas. K. Rufuss, “Robotics and Automation Handbook”, CRC Press, 2018		
<b>E-Resources</b>			
1.	<a href="https://waverleysoftware.com/blog/ai-in-robotics/">https://waverleysoftware.com/blog/ai-in-robotics/</a>		
2.	<a href="https://www.sciencedirect.com/science/article/pii/S2667241323000113">https://www.sciencedirect.com/science/article/pii/S2667241323000113</a>		
3.	<a href="https://www.nobledesktop.com/learn/python/exploring-the-power-of-ai-in-robotics-and-automation">https://www.nobledesktop.com/learn/python/exploring-the-power-of-ai-in-robotics-and-automation</a>		

  
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Programme	B.E.	Programme Code	103	Regulation	2023			
Department	ELECTRONICS AND COMMUNICATION ENGINEERING			Semester				
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks		
		L	T	P	C	CA	ESE	Total
U19ECV68	ETHICS OF ARTIFICIAL INTELLIGENCE	3	0	0	3	40	60	100

**Course Objective**

The student should be made to

- Understand foundational concepts of morality and ethics in AI and their multifaceted impacts on society, psychology, law, environment, and trust.
- Explore global ethical initiatives and analyze real-world case studies involving AI technologies such as autonomous vehicles, healthcare robots, and surveillance systems.
- Examine standards and regulatory frameworks for ethical AI system design, including transparency, data privacy, and algorithmic bias mitigation.
- Investigate ethical concerns in data usage and algorithmic decision-making across sectors like finance, criminal justice, and employment.
- Evaluate challenges and future directions in AI governance, emphasizing interdisciplinary collaboration and the development of ethical standards.

**Course Outcomes**

At the end of the course, the student should be able to,	Knowledge Level
CO1: Explain the ethical principles and societal implications of AI technologies.	K2
CO2: Analyze international ethical initiatives and assess ethical risks in various AI applications.	K3
CO3: Apply ethical frameworks and standards to evaluate AI system design and regulatory compliance.	K3
CO4: Critically assess data ethics and algorithmic fairness in predictive AI systems.	K4
CO5: Evaluate global governance strategies and propose ethically sound approaches for emerging AI tech.	K4

**Pre-requisites** -

COs	CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak												CO/PSO Mapping		
	Programme Outcomes (POs)												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	3	3	1	-	-	-	1	2	1	1	3	1	1
CO 2	2	1	1	2	1	-	-	-	1	2	1	1	3	3	1
CO 3	2	3	1	1	3	-	-	-	2	1	1	2	3	2	2
CO 4	3	1	3	3	2	-	-	-	2	2	3	1	2	1	3
CO 5	3	1	1	3	3	-	-	-	2	3	3	3	1	3	3


**Course Assessment Methods**

**Direct**


- Continuous Assessment Test I, II & III
- Assignment
- End-Semester examinations

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<b>Indirect</b>			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>INTRODUCTION</b>	Periods	<b>9</b>
Definition of morality and ethics in AI-Impact on society-Impact on human psychology-Impact on the legal system-Impact on the environment and the planet-Impact on trust			
<b>Unit – II</b>	<b>ETHICAL INITIATIVES IN AI</b>	Periods	<b>9</b>
International ethical initiatives-Ethical harms and concerns-Case study: healthcare robots, Autonomous Vehicles, drones, the trolley problem, surveillance technologies, Warfare and weaponization			
<b>Unit – III</b>	<b>AI STANDARDS AND REGULATION</b>	Periods	<b>9</b>
Model Process for Addressing Ethical Concerns During System Design - Transparency of Autonomous Systems-Data Privacy Process- Algorithmic Bias Considerations - Ontological Standard for Ethically Driven Robotics and Automation Systems			
<b>Unit – IV</b>	<b>ETHICS OF DATA IN AI AND ALGORITHMIC DECISION-MAKING</b>	Periods	<b>9</b>
Privacy issues, data ownership, consent in data usage, differential privacy, transparency in data collection, ethical data handling. Ethics of predictive AI in areas like finance, criminal justice, and employment, analysing fairness, transparency, and the accountability of algorithmic decisions.			
<b>Unit – V</b>	<b>CHALLENGES, OPPORTUNITIES, FUTURE DIRECTIONS AND GOVERNANCE OF AI</b>	Periods	<b>9</b>
Challenges – Opportunities- ethical issues in artificial intelligence- National and International Strategies on AI. Ethical implications of emerging AI technologies, the role of global governance in AI regulation, transparency, and the need for ethical AI standards, interdisciplinary collaboration in AI ethics.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	y. Eleanor Bird, Jasmin Fox-Skelly, Nicola Jenner, Ruth Larbey, Emma Weitkamp and Alan Winfield ,”The ethics of artificial intelligence: Issues and initiatives”, EPRS   European Parliamentary Research Service Scientific Foresight Unit (STOA) PE 634.452 – March 2020		
2.	Patrick Lin, Keith Abney, George A Bekey,” Robot Ethics: The Ethical and Social Implications of Robotics”, The MIT Press- January 2014		
3.	Paula Boddington, “AI Ethics” Springer publication, 2023.		
4.	Luciano Floridi. OUP , “The Ethics of Artificial Intelligence: Principles, Challenges, and Opportunities” 2023.		
<b>REFERENCES:</b>			
1.	Towards a Code of Ethics for Artificial Intelligence (Artificial Intelligence: Foundations, Theory, and Algorithms) by Paula Boddington, November 2017		
2.	Mark Coeckelbergh,” AI Ethics”, The MIT Press Essential Knowledge series, April 2020		
<b>E-Resources</b>			
1.	<a href="https://sci-hub.mkxa.top/10.1007/978-3-540-30301-5_65">https://sci-hub.mkxa.top/10.1007/978-3-540-30301-5_65</a>		
2.	<a href="https://www.scu.edu/ethics/all-about-ethics/artificial-intelligence-and-ethics-sixteen-challenges-and-opportunities">https://www.scu.edu/ethics/all-about-ethics/artificial-intelligence-and-ethics-sixteen-challenges-and-opportunities</a>		
3.	<a href="https://www.weforum.org/agenda/2016/10/top-10-ethical-issues-in-artificial-intelligence/">https://www.weforum.org/agenda/2016/10/top-10-ethical-issues-in-artificial-intelligence/</a>		
4.	<a href="https://sci-hub.mkxa.top/10.1159/000492428">https://sci-hub.mkxa.top/10.1159/000492428</a>		

  
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U23ECV71	Medical Electronics	3	0	0	3	40	60	100																																																																																																																																																		
Course Objective	The main objective of the course is to																																																																																																																																																									
	<ul style="list-style-type: none"> <li>Introduce the fundamental concepts of bioelectric signals and their recording methods, including electrodes and biomedical recorders.</li> <li>Explain the techniques and instruments used in patient monitoring, including measurement of vital physiological parameters.</li> <li>Study assistive biomedical devices and bio-telemetry systems, focusing on cardiac output, pacemakers, and telemedicine.</li> <li>Understand the principles and operation of modern medical imaging systems such as X-rays, MRI, ultrasound, and thermal imaging.</li> <li>Explore recent trends in medical instrumentation, including patient safety, laser applications, cryogenics, and radiotherapy equipment.</li> </ul>																																																																																																																																																									
	At the end of the course, the student should be able to											<b>Knowledge level</b>																																																																																																																																														
	CO1: Explain the origin of bioelectric signals and describe the types of electrodes and recording systems used in ECG, EEG, and EMG.											K2																																																																																																																																														
	CO2: Apply techniques to measure physiological parameters like heart rate, blood pressure, and blood gas levels using appropriate instruments.											K3																																																																																																																																														
	CO3: Analyze the function and applications of assistive devices such as pacemakers, defibrillators, and telemedicine systems.											K4																																																																																																																																														
Course Outcome	CO4: Explain the working principles of various modern imaging techniques including MRI, ultrasound, and thermal imaging.											K2																																																																																																																																														
	CO5: Analyze recent technological advancements and safety protocols in medical instrumentation, including lasers and cryogenic applications.											K4																																																																																																																																														
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<table border="1"> <thead> <tr> <th colspan="13">CO / PO Mapping</th> <th colspan="3">CO/PSO Mapping</th> </tr> <tr> <th colspan="13">(3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak</th> <th colspan="3"></th> </tr> <tr> <th rowspan="2">COs</th> <th colspan="11">Programme Outcomes (POs)</th> <th colspan="3">PSOs</th> </tr> <tr> <th>PO 1</th> <th>PO 2</th> <th>PO 3</th> <th>PO 4</th> <th>PO 5</th> <th>PO 6</th> <th>PO 7</th> <th>PO 8</th> <th>PO 9</th> <th>PO 10</th> <th>PO 11</th> <th>PO 12</th> <th>PS O1</th> <th>PSO 2</th> <th>PS O 3</th> </tr> </thead> <tbody> <tr> <td>CO 1</td> <td>3</td> <td>3</td> <td>2</td> <td></td> <td></td> <td></td> <td></td> <td>2</td> <td></td> <td>2</td> <td></td> <td></td> <td>3</td> <td></td> <td>2</td> </tr> <tr> <td>CO 2</td> <td>3</td> <td>3</td> <td>2</td> <td>2</td> <td></td> <td></td> <td></td> <td>2</td> <td></td> <td></td> <td></td> <td>2</td> <td>3</td> <td>2</td> <td></td> </tr> <tr> <td>CO 3</td> <td>3</td> <td>3</td> <td>2</td> <td>2</td> <td></td> <td></td> <td></td> <td>2</td> <td></td> <td>2</td> <td></td> <td></td> <td>3</td> <td>2</td> <td></td> </tr> <tr> <td>CO 4</td> <td>3</td> <td>2</td> <td>2</td> <td>2</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>2</td> <td></td> <td>2</td> <td>3</td> <td>3</td> <td></td> </tr> <tr> <td>CO 5</td> <td>3</td> <td>2</td> <td>2</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>3</td> <td></td> <td></td> </tr> </tbody> </table>													CO / PO Mapping													CO/PSO Mapping			(3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak																COs	Programme Outcomes (POs)											PSOs			PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PSO 2	PS O 3	CO 1	3	3	2					2		2			3		2	CO 2	3	3	2	2				2				2	3	2		CO 3	3	3	2	2				2		2			3	2		CO 4	3	2	2	2						2		2	3	3		CO 5	3	2	2										3		
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1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>ELECTRO-PHYSIOLOGY AND BIO-POTENTIAL RECORDING</b>	Periods	<b>9</b>
The origin of Bioelectric signals, recording electrodes, electrodes for ECG,EEG,EMG, Microelectrodes, basic recording system, preamplifiers and biomedical recorders for ECG,EEG & EMG.			
<b>Unit - II</b>	<b>PATIENT MONITORING SYSTEM</b>	Periods	<b>9</b>
Measurement of Heart rate-Measurement of pulse rate-Blood Pressure Measurement-colorimeter, Auto analyzer -Blood PH measurement-Blood cell counters-Measurement of Blood PCO <sub>2</sub> -Blood pO <sub>2</sub> Measurement.			
<b>Unit – III</b>	<b>ASSIST DEVICES AND BIO-TELEMETRY</b>	Periods	<b>9</b>
Bio-Telemetry-Cardiac Output Measurements-Cardiac Pacemakers and DC Defibrillators-Telemedicine System-Heart lung machine.			
<b>Unit - IV</b>	<b>MODERN IMAGING SYSTEM</b>	Periods	<b>9</b>
Visualization of X-rays-basic principles of MRI, diagnostic ultrasound, medical ultrasound, Thermal Imaging Systems.			
<b>Unit – V</b>	<b>RECENT TRENDS IN MEDICAL INSTRUMENTATION</b>	Periods	<b>9</b>
Patient Safety- Laser applications in Bio-medical field- Cryogenic application – Radiotherapy equipment.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	Khandpur, R.S., “Handbook of Biomedical Instrumentation”, Tata McGraw Hill Education (India) Private Limited, 3 <sup>rd</sup> Edition, 2016.		
2.	Leislle Cromwell, Fred J.Weibell, Erich A. Pfeiffer, “Biomedical Instrumentation and Measurement”, Prentice Hall of India, New Delhi, 2 <sup>nd</sup> Edition, 2015.		
<b>References</b>			
1.	John G.Webster, “Medical Instrumentation Application and Design” Wiley India, 4 <sup>th</sup> Edition, 2015.		
2.	Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Education, 4th Edition, 2014.		
3.	Digital Image Processing , S Jayaraman, S Esakkirajan T Veerakumar, Mc Graw-Hill, 2010.		
4.	Digital Image Processing, K.William Pratt, John Wiley, 1997.		
5.	Image Processing Theory, Algorithm and Architectures, M.A.Sid Ahmed,McGraw-Hill, 1995.		
<b>E-Resources</b>			
1.	<a href="http://fa.bme.sut.ac.ir/Downloads/AcademicStaff/3/Courses/4/Medical%20instrumentation%20application%20and%20design%204th.pdf">http://fa.bme.sut.ac.ir/Downloads/AcademicStaff/3/Courses/4/Medical%20instrumentation%20application%20and%20design%204th.pdf</a>		
2.	Leislle Cromwell, Fred J.Weibell, Erich A. Pfeiffer, “Biomedical Instrumentation and Measurement”,Prentice Hall of India, New Delhi, 2 <sup>nd</sup> Edition, 2015.		
3.	<a href="https://scilab.in/textbook_companion/generate_book/125">https://scilab.in/textbook_companion/generate_book/125</a>		



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Programme	B.E.	Programme Code				103	Regulation			2023					
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>						Semester								
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks									
		L	T	P	C	CA	ESE	Total							
U23ECV72	<b>Management Quality and Ethical Values</b>	3	0	0	3	40	60	100							
<b>Course Objective</b>	The student should be made to														
	<ul style="list-style-type: none"> <li>Understand the fundamentals of management, types of managers, and organizational structures, including contemporary trends.</li> <li>Explain planning, organizing, human resource management, and decision-making concepts.</li> <li>Examine motivation theories, leadership styles, communication processes, and organizational control techniques.</li> <li>Develop awareness of human values, professional ethics, stress-management methods such as yoga and meditation.</li> <li>Analyze safety aspects, professional responsibilities, intellectual property rights, and global ethical issues relevant to engineers and managers.</li> </ul>														
<b>Course Outcomes</b>	At the end of the course, the student should be able to,											Knowledge Level			
	CO1: Describe management concepts, organizational forms, types of managers, and emerging trends.											K2			
	CO2: Apply planning and organizing techniques such as decision-making, departmentalization, and HRM.											K3			
	CO3: Analyze motivation theories, leadership styles, communication barriers, and control strategies.											K4			
	CO4: Explain the significance of human values, ethics, professional behavior, and stress-management techniques.											K2			
	CO5: Evaluate professional responsibilities, safety issues, IPR, and ethical challenges in global engineering contexts.											K4			
<b>Pre-requisites</b>	-														
<b>CO / PO Mapping</b> (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 – Weak													<b>CO/PSO Mapping</b>		
COs	Programme Outcomes (POs)											PSOs			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO 1	3	2	2	1	1	1		1	1	2	1	2	2	1	2
CO 2	3	3	2	2	1	1		1	2	2	1	2	2	2	1
CO 3	2	2	2	2	1	1	1	2	3	2	1	3	2	2	3
CO 4	1	1	1	0	0	2	1	3	2	2	1	2	1	1	3
CO 5	1	1	1	1	1	2	2	3	2	2	1	3	1	1	3
<b>Course Assessment Methods</b>															

  
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<b>Direct</b>			
1.Continuous Assessment Test I, II & III			
2.Assignment			
3.End-Semester examinations			
<b>Indirect</b>			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>Introduction to Management and Organizations</b>	Periods	<b>9</b>
Definition Management and Evolution of Management thought – Science or Art – Manager Vs Entrepreneur - Types of managers - Managerial roles and skills – Types of Business organization - Sole proprietorship, partnership, company- public and private sector enterprises – Current Trends and Issues in Management.			
<b>Unit – II</b>	<b>Planning and Organizing</b>	Periods	<b>9</b>
Planning Introduction and Planning Process – Types of planning – Planning Tools and Techniques – Decision making steps and process – Formal and informal organization – Departmentalization – Centralization and Decentralization – Human Resource Management – Recruitment, Selection, Training, Performance Appraisal and Job Evaluation.			
<b>Unit – III</b>	<b>Motivation By Leadership and Controlling</b>	Periods	<b>9</b>
Motivation Theories – Types and Theories of Leadership – Communication – Purpose and Process of Communication – Communication(flow and channel) in Organization – Barrier in Communication – Electronic Media in Communication – Budgetary and Non-budgetary Control Techniques – Inventory Controls – Break Even Analysis – Productivity – Quality Controls.			
<b>Unit – IV</b>	<b>Human Values and Engineering Ethics</b>	Periods	<b>9</b>
Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and Meditation for Professional Excellence and Stress Management. Types of inquiry – Kohlberg’s Theory – Gilligan’s Theory – Consensus and Controversy – Models of professional roles.			
<b>Unit – V</b>	<b>Safety, Responsibilities, Rights and Global Issues</b>	Periods	<b>9</b>
Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk – Respect for Authority – Professional Rights – Employee Rights –Engineers as Managers – Intellectual Property Rights (IPR) – Multinational Corporations – Occupational Crime – Computer Ethics – Weapons Development – Consulting Engineers – Engineers as Expert Witnesses and Advisors.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	Stephen P. Robbins & Mary Coulter, “Management”, Prentice Hall (India) Pvt. Ltd., 13 <sup>th</sup> Edition, 2017.		
2.	JAF Stoner, Freeman R.E and Daniel R Gilbert ,“Management”, Pearson Education, 6 <sup>th</sup> Edition 2018.		
3.	Jayshree Suresh, B.S. Raghavan, “Human Values and Professional Ethics”, Scand & Company Ltd, New Delhi, 2 <sup>nd</sup> Edition, 2015.		
4.	Mike W. Martin and Roland Schinzinger, “Ethics in Engineering”, Tata Mc Graw Hill, New Delhi,4 <sup>th</sup> Edition 2004.		
<b>References</b>			
1.	Stephen A. Robbins & David A. Decenzo & Mary Coulter, “Fundamentals of Management”, Pearson Education, 7 <sup>th</sup> Edition, 2016.		
2.	Robert Kreitner & Mamata Mohapatra, “Management”, Biztantra, 2008.		
3.	Harold Koontz & Heinz Weihrich, “Essentials of management”,Tata Mc Graw Hill,2010.		
4.	P.C.Tripathi,P N Reddy &Ashish Bajpai, “Principles of Management”,Mc Graw Hill,7th Edition,2021		

  
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5.	Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2011.
6.	Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009
7.	John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2017.
8.	Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001
9.	Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility", Mc Graw Hill education, India Pvt. Ltd., New Delhi 2013.
<b>E-Resources</b>	
1.	<a href="https://www.pearsonhighered.com/assets/preface/0/1/3/6/0136715303.pdf">https://www.pearsonhighered.com/assets/preface/0/1/3/6/0136715303.pdf</a>
2.	<a href="https://hostnezt.com/cssfiles/businessadmin/Management%20by%20Robins%2011th%20ed.pdf">https://hostnezt.com/cssfiles/businessadmin/Management%20by%20Robins%2011th%20ed.pdf</a>
3.	<a href="https://content.kopykitab.com/ebooks/2019/01/24287/sample/sample_24287.pdf">https://content.kopykitab.com/ebooks/2019/01/24287/sample/sample_24287.pdf</a>



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Programme	B.E.	Programme Code	103	Regulation	2023			
Department	ELECTRONICS AND COMMUNICATION ENGINEERING			Semester				
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks		
		L	T	P	C	CA	ESE	Total
U23ECV73	Remote Sensing	3	0	0	3	40	60	100
Course Objective	The main objective of the course is to							
	<ul style="list-style-type: none"> <li>Introduce the fundamental concepts, energy sources, and radiation principles of remote sensing, along with Geographic Information Systems (GIS).</li> <li>Explain various Earth Observation Systems (EOS) and sensor types, including optical, microwave, and radar systems, as well as satellite motion principles.</li> <li>Understand data reception, preprocessing, and quality assessment techniques used in remote sensing data handling and analysis.</li> <li>Explore the applications of EOS in managing earth resources such as agriculture, forestry, geology, water resources, and urban studies.</li> <li>Study image classification methods, change detection, and spatial data modeling and management using GIS.</li> </ul>							
Course Outcomes	At the end of the course, the student should be able to,						Knowledge Level	
	CO1: Explain the principles of remote sensing, energy interactions, and the role of GIS in earth observation.						K2	
	CO2: Identify and describe different Earth Observation Systems, sensor technologies, and satellite orbit characteristics.						K2	
	CO3: Apply data acquisition, preprocessing, and quality assessment methods for remote sensing data.						K3	
	CO4: Analyze the applications of Earth Observation Systems in various earth resource management domains.						K4	
CO5: Analyze image classification techniques, change detection, and spatial data modeling using GIS frameworks.						K4		
Pre-requisites	Satellite Communication & Analog to Digital Communication.							

COs	CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 - Medium, 1 - Weak											CO/PSO Mapping			
	Programme Outcomes (POs)											PSOs			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PSO 2	PS O 3
CO 1	3	2	1										3	2	
CO 2	3	2	1										3		2
CO 3	3	3	2	2	1								3	2	
CO 4	3	3	3	2	2								3		2
CO 5	3	3	2	3	1		1						3	2	

**Course Assessment Methods**

**Direct**

- 1.Continuous Assessment Test I, II & III
- 2.Assignment
- 3.End-Semester examinations

*[Signature]*



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<b>Indirect</b>			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>Concepts and Foundations of Remote Sensing</b>	Periods	<b>9</b>
Introduction, Energy Sources and Radiation Principles, Energy Interactions in the Atmosphere, Physical basis of Signatures of Earth features, Characteristics of Remote Sensing Systems, Global Navigation Satellite Systems (GNSS), An overview of Data Reception and Data products, Geographic Information Systems (GIS).			
<b>Unit – II</b>	<b>Earth Observation Systems (EOS) and Platforms</b>	Periods	<b>9</b>
Introduction, Classification of EOS-Infrared-Visible optical sensors (IVOS): Photographic cameras, Television Cameras, Opto-mechanical Scanners, Push-broom Cameras, Multispectral and Hyperspectral imagers-Microwave EOS: Passive microwave sensors, Active microwave sensors, Synthetic Aperture Radars, Ground Penetrating Radars- Principles of Satellite Motion: Types of orbits, Orbit perturbations, Space craft Elements and GNSS.			
<b>Unit – III</b>	<b>Data Reception and Processing</b>	Periods	<b>9</b>
Introduction, Data formats, Data acquisition and onboard data handling, Data reception system, Data pre-processing – Radiometric and Geometric rectifications, Referencing Scheme, Data products generation, Data products Output media, Data Analysis and Quality Assessment, Special processing, digital and visual interpretation.			
<b>Unit – IV</b>	<b>Applications of EOS in Earth Resources Management</b>	Periods	<b>9</b>
Agriculture and Soils, Forestry, Geology, Land Cover – Land use Mapping, Water resources, Snow and Glaciers, Urban studies, Coastal zone management and marine fisheries, Desertification, Archaeology.			
<b>Unit – V</b>	<b>EOS Image Classification and Spatial Data Modeling and Management</b>	Periods	<b>9</b>
Introduction, Supervised and unsupervised classification concepts and methods, Change detection applications, Geographic information systems – Spatial data types, Data preparation and management, GIS working environment, Spatial data infrastructure.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	George Joseph & Jeganathan C., "Fundamentals of Remote Sensing", 3rd Edition, Universities Press (India) Pvt. Ltd., Hyderabad, 2018.		
2.	Thomas M. Lillesand, Ralph W. Kiefer, "Remote Sensing And Image Interpretation", 7th Edition, John Wiley, New Delhi, 2015		
<b>References</b>			
1.	Campbell J.B. & Randolph H. Wayne, "Introduction to Remote sensing", 5th Edition, Guilford Press, USA, 2011.		
<b>E-Resources</b>			
1.	<a href="http://www.geoservis.ftn.uns.ac.rs/downloads/ISP/1999-fundamentals-of-remote-sensing.pdf">http://www.geoservis.ftn.uns.ac.rs/downloads/ISP/1999-fundamentals-of-remote-sensing.pdf</a>		
2.	<a href="https://www.geokniga.org/bookfiles/geokniga-remote-sensing-and-image-interpretation.pdf">https://www.geokniga.org/bookfiles/geokniga-remote-sensing-and-image-interpretation.pdf</a>		
3.	<a href="https://ncert.nic.in/textbook/pdf/kegy307.pdf">https://ncert.nic.in/textbook/pdf/kegy307.pdf</a>		



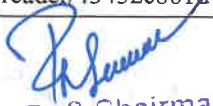
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Programme	B.E.	Programme Code			103	Regulation			2023						
Department	ELECTRONICS AND COMMUNICATION ENGINEERING					Semester									
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks									
		L	T	P	C	CA	ESE	Total							
U23ECV74	Industry 4.0 and 5.0	3	0	0	3	40	60	100							
Course Objective	The main objective of the course is to <ul style="list-style-type: none"> <li>• Provide a foundational understanding of the evolution from Industry 1.0 to Industry 5.0 and its socio-technical impacts.</li> <li>• Introduce and explain the enabling technologies behind Industry 4.0 such as IoT, CPS, cloud computing, and digital twins.</li> <li>• Understand industrial data acquisition systems, sensor and actuator types, and industrial communication protocols like Fieldbus, Profibus, and LoRA.</li> <li>• Explore the role and drivers of Industry 5.0, including digitalization, networked economy, and smart business automation trends.</li> <li>• Study industrial IoT analytics techniques and their applications through case studies in manufacturing, quality control, and inventory management.</li> </ul>														
	Course Outcomes	At the end of the course, the student should be able to,											Knowledge Level		
CO1: Explain the evolution from Industry 1.0 to Industry 5.0 and identify the key drivers and impacts of Industry 4.0.											K2				
CO2: Illustrate the working principles and applications of enabling technologies such as IoT, CPS, and digital twins.											K3				
CO3: Apply knowledge of sensors, actuators, and industrial communication protocols in designing data acquisition systems.											K3				
CO4: Analyze the drivers, challenges, and enablers of Industry 5.0 and its influence on smart manufacturing processes.											K4				
CO5: Analyze industrial IoT analytics approaches and evaluate case studies involving quality control, inventory management, and automation.											K4				
Pre-requisites	Basics of Internet of Things and Instrumentation control														
<b>CO / PO Mapping</b> (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak															
COs	Programme Outcomes (POs)											CO/PSO Mapping			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O 2	PS O 3
CO 1	1	-	-	2	2	2	-	-	-	3	3	3	2	2	1
CO 2	1	1	-	2	2	2	-	-	-	3	3	3	2	2	1
CO 3	1	-	-	2	2	1	-	-	-	2	3	1	1	1	1
CO 4	1	-	1	1	2	2	-	-	-	3	2	3	2	2	1
CO 5	1	-	-	2	2	1	-	-	-	2	3	1	1	2	1
Course Assessment Methods															



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<b>Direct</b>			
1.Continuous Assessment Test I, II & III 2.Assignment 3.End-Semester examinations			
<b>Indirect</b>			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>INTRODUCTION TO INDUSTRY 4.0</b>	Periods	<b>9</b>
Overview of Industry 1.0 to 5.0- Drivers of Industry 4.0 (automation, data exchange) - Transition to Industry 5.0 (human-centric, sustainable, resilient) - Impacts of Industry 4.0.			
<b>Unit – II</b>	<b>ENABLING TECHNOLOGIES OF INDUSTRY 4.0</b>	Periods	<b>9</b>
Internet of Things (IoT) and Industrial IoT-Cyber-Physical Systems (CPS)-Cloud Computing & Edge Computing-Big Data Analytics-Additive Manufacturing (3D Printing)-Digital Twins-Augmented Reality (AR) & Virtual Reality (VR) in industry			
<b>Unit – III</b>	<b>INDUSTRIAL DATA ACQUISITION SYSTEMS</b>	Periods	<b>9</b>
Sensors: Introduction – characteristics – categories. Actuators: Thermal, Hydraulic, Pneumatic, Electromechanical actuators - Industrial data transmission: Fieldbus – Profibus –HART – Modbus – CAN – DeviceNet – LoRA – NB-IoT - Distributed control system – PLC - SCADA.			
<b>Unit – IV</b>	<b>ROLE OF INDUSTRY 5.0</b>	Periods	<b>8</b>
Introduction of Various Industrial Revolutions, Digitalisation and the Networked Economy, Drivers, Enablers, Compelling Forces and Challenges for Industry 5.0, Comparison of Industry 5.0 Factory and Today's Factory, Trends of Industrial Big Data and Predictive Analytics for Smart Business Automation and Transformation Processes			
<b>Unit – V</b>	<b>INDUSTRIAL IOT ANALYTICS AND CASE STUDY</b>	Periods	<b>10</b>
Necessity of analytics - Categorization of analytics – Usefulness and challenges of analytics - Mapping and deployment of analytics -Artificial intelligence- Applications of analytics across value chain -Plant security - Intelligent NextG Wireless Networks. Case study: Inventory management and quality control - Manufacturing industry - Milk Processing and Packaging Industries, CNC/NC automation			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	“Industrial Internet of Things: Cyber manufacturing Systems” by Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer), 2017		
2.	Industry 4.0: The Industrial Internet of Things”, by Alasdair Gilchrist (Apress), 2017		
3.	“Machine Learning and IoT for Intelligent Systems and Smart Applications” by Madhumathy P, M Vinoth Kumar, R. Umamaheswari, CRC Press 2021		
4.	“Industry 5.0: A New Revolution Through Human-Centric Solution (De Gruyter Frontiers in Computational Intelligence)– Import”by Ali Kashif Bashir, Harry Haoxiang Wang, Manoj Kumar, N. Pradeep, Vinod Kumar Shukla, Yousaf Bin Zikria, 2022		
<b>References</b>			
1.	Hands-On Industrial Internet of Things: Create a powerful Industrial IoT by Giacomo Veneri, Antonio Capasso, Packt, 2018.		
2.	The Internet of Things: Key Applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi, 2nd Edition, Wiley Publications 2017		
3.	“Hands-On Industrial Internet of Things: Create a powerful Industrial IoT” by Giacomo Veneri, Antonio Capasso, Packt, 2018.		
<b>E-Resources</b>			
1.	<a href="https://download.e-bookshelf.de/download/0007/6832/86/L-G-0007683286-0014731014.pdf">https://download.e-bookshelf.de/download/0007/6832/86/L-G-0007683286-0014731014.pdf</a>		
2.	<a href="https://www.ifm.eng.cam.ac.uk/uploads/DIAL/industrial-internet-of-things-report.pdf">https://www.ifm.eng.cam.ac.uk/uploads/DIAL/industrial-internet-of-things-report.pdf</a>		
3.	<a href="https://www.semanticscholar.org/reader/43432c861d7529f19e2302b178823aeb16cfl157">https://www.semanticscholar.org/reader/43432c861d7529f19e2302b178823aeb16cfl157</a>		

  
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Programme	B.E.	Programme Code	103	Regulation	2023			
Department	ELECTRONICS AND COMMUNICATION ENGINEERING			Semester				
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks		
		L	T	P	C	CA	ESE	Total
U23ECV75	Automotive Electronics	3	0	0	3	40	60	100
Course Objective	The main objective of the course is to							
	<ul style="list-style-type: none"> <li>• Introduce the role and evolution of electronics in automotive systems and subsystems.</li> <li>• Provide foundational knowledge of analog and digital electronics used in automotive applications.</li> <li>• Familiarize students with microcomputer and microprocessor architecture used in vehicle control.</li> <li>• Explain the principles of electronic engine management systems for emission and fuel control.</li> <li>• Explore various sensors and advanced automotive technologies including navigation, telematics, and safety systems.</li> </ul>							
Course Outcome	At the end of the course, the student should be able to,						Knowledge level	
	CO1: Describe the role and evolution of electronics in automobiles and identify major automotive electronic systems.						K2	
	CO2: Explain semiconductor devices, analog and digital circuits used in automotive electronics.						K2	
	CO3: Apply knowledge of microcomputer architecture and interfaces in automotive electronic system design.						K3	
	CO4: Analyze electronic engine control systems focusing on fuel economy, emission control, and ignition systems.						K4	
	CO5: Analyze different automotive sensors and advanced electronic systems for safety and navigation applications.						K4	
Pre-requisites	Basics of Electronic devices and Instrumentation							

COs	CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak												CO/PSO Mapping		
	Programme Outcomes (POs)												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PSO 2	PS O 3
CO1	3	3	3	3	2	2						2	3	3	3
CO2	3	3	2	2	1	2						2	3	2	3
CO3	3	3	2	2	2	2						2	3	2	3
CO4	3	3	3	2	2	1						2	1	2	2
CO5	3	3	3	2	2	2						3	2	1	2

**Course Assessment Methods**



<b>Direct</b>
1.Continuous Assessment Test I, II & III
2.Assignment
3.End-Semester examinations
<b>Indirect</b>


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1.Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>INTRODUCTION AUTOMOTIVE FUNDAMENTALS</b>	<b>Periods</b>	<b>9</b>
Use of electronics in the automobile, evolution of automotive electronics, the automobile physical configuration, evolution of electronics in the automobile, survey of major automotive systems, engine control or electronic control unit, ignition system.			
<b>Unit - II</b>	<b>ELECTRONICS FUNDAMENTALS</b>	<b>Periods</b>	<b>9</b>
Semiconductor devices- diodes, rectifier circuit, transistors, field effect transistors; transistor amplifiers, use of feedback in op amps, summing mode amplifier, analog computers, digital circuits- binary number system, combinational- Basic logic gates, multiplexer (IC 74151), 3 to 8 decoder (IC74138) , sequential- flip flops, decade counters (IC 7490).			
<b>Unit – III</b>	<b>AUTOMOTIVE MICRO-COMPUTER SYSTEM</b>	<b>Periods</b>	<b>9</b>
Microcomputer fundamentals-digital versus analog computers, basic computer block diagram, microcomputer operations, CPU registers, accumulator registers, condition code register-branching; microprocessor architecture, memory ROM, RAM; I/O parallel interface, digital to analog converter and analog to digital converters with block diagram, microcomputer application in automotive systems.			
<b>Unit - IV</b>	<b>BASICS OF ELECTRONICS ENGINE CONTROL</b>	<b>Periods</b>	<b>9</b>
Motivation for electronic engine control, exhaust emissions, fuel economy, concept of an electronic engine control system, engine functions and control, electronic fuel control configuration, electronic ignition with sensors.			
<b>Unit – V</b>	<b>SENSORS AND FUTURE AUTOMOTIVE ELECTRONIC SYSTEMS</b>	<b>Periods</b>	<b>9</b>
Introduction; Basic sensor arrangement; Types of Sensors such as oxygen sensors, Crank angle position sensors, fuel Metering/vehicle speed sensors and detonation sensors, altitude sensors, flow Sensors, throttle position sensors, Telematics, Safety: Collision Avoidance Radar warning System with block diagram, automotive internal navigation system, GPS navigation system, voice recognition cell phone dialing, advanced cruise control system.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	William B. Ribbens, "Understanding Automotive Electronics", 8th Edition, 2017, Elsevier Publishing.		
2.	Robert Bosch Gambh, "Automotive Electrics Automotive Electronics Systems and Components", 5th Edition, John Wiley & Sons Ltd., 2013.		
<b>References</b>			
1.	Ronald K Jurgen, "Automotive Electronics Handbook", 2nd Edition, McGraw Hill, 1999.		
2.	G. Meyer, J. Valldorf and W. Gessner, "Advanced Microsystems for Automotive Applications", Springer, 2010		
<b>E-Resources</b>			
1.	<a href="https://onlinecourses.nptel.ac.in/noc20_de06/preview">https://onlinecourses.nptel.ac.in/noc20_de06/preview</a>		

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Programme	<b>B.E.</b>		Programme Code		<b>103</b>	Regulation		<b>2023</b>																																																																																																																																																
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<b>U23ECV76</b>	<b>Soft Computing</b>		3	0	0	3	40	60	100																																																																																																																																															
<b>Course Objective</b>	The main objective of the course is to																																																																																																																																																							
	<ul style="list-style-type: none"> <li>Introduce the foundational concepts of fuzzy set theory, fuzzy reasoning, and inference systems.</li> <li>Explore both derivative-based and derivative-free optimization methods applicable in soft computing.</li> <li>Explain principles of artificial intelligence with emphasis on reasoning, knowledge representation, and heuristic search.</li> <li>Understand the architecture and learning algorithms used in neuro-fuzzy modeling systems.</li> <li>Apply computational intelligence techniques to real-world problems such as pattern recognition and predictive modeling.</li> </ul>																																																																																																																																																							
	At the end of the course, the student should be able to,										Knowledge level																																																																																																																																													
	<b>CO1:</b> Understand the concepts of fuzzy set theory, fuzzy inference models, and fuzzy reasoning techniques.										K2																																																																																																																																													
	<b>CO2:</b> Apply various optimization techniques including genetic algorithms and simulated annealing for solving soft computing problems.										K3																																																																																																																																													
	<b>CO3:</b> Illustrate knowledge representation and perform symbolic reasoning and heuristic search in AI systems.										K3																																																																																																																																													
<b>CO4:</b> Analyze the structure and learning mechanisms of adaptive neuro-fuzzy inference systems (ANFIS) and related models.										K4																																																																																																																																														
<b>CO5:</b> Apply fuzzy logic and neural network techniques to real-world problems like character recognition, kinematics, and efficiency prediction.										K3																																																																																																																																														
<b>Pre-requisites</b>	A strong mathematical background, Programming skill in C, C++, Proficiency with algorithm																																																																																																																																																							
<table border="1"> <thead> <tr> <th colspan="12">CO / PO Mapping</th> <th colspan="3">CO/PSO Mapping</th> </tr> <tr> <th colspan="15">(3/2/1 indicates strength of correlation) 3-Strong, 2 - Medium, 1 - Weak</th> </tr> <tr> <th rowspan="2">Cos</th> <th colspan="11">Programme Outcomes (POs)</th> <th colspan="3">PSOs</th> </tr> <tr> <th>PO 1</th> <th>PO 2</th> <th>PO 3</th> <th>PO 4</th> <th>PO 5</th> <th>PO 6</th> <th>PO 7</th> <th>PO 8</th> <th>PO 9</th> <th>PO 10</th> <th>PO 11</th> <th>PO 12</th> <th>PS O1</th> <th>PSO 2</th> <th>PS O 3</th> </tr> </thead> <tbody> <tr> <td>CO 1</td> <td>3</td> <td>3</td> <td>2</td> <td></td> <td></td> <td></td> <td></td> <td>2</td> <td></td> <td>2</td> <td></td> <td></td> <td>3</td> <td>2</td> <td></td> </tr> <tr> <td>CO 2</td> <td>3</td> <td>3</td> <td>2</td> <td>2</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>2</td> <td></td> <td>3</td> <td></td> <td>2</td> </tr> <tr> <td>CO 3</td> <td>3</td> <td>3</td> <td>2</td> <td>2</td> <td></td> <td></td> <td></td> <td>2</td> <td></td> <td>2</td> <td></td> <td></td> <td>3</td> <td></td> <td></td> </tr> <tr> <td>CO 4</td> <td>3</td> <td>2</td> <td>2</td> <td>2</td> <td></td> <td></td> <td></td> <td>2</td> <td></td> <td></td> <td></td> <td></td> <td>3</td> <td>2</td> <td></td> </tr> <tr> <td>CO 5</td> <td>3</td> <td>2</td> <td>2</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>2</td> <td></td> <td></td> <td>3</td> <td></td> <td></td> </tr> </tbody> </table>													CO / PO Mapping												CO/PSO Mapping			(3/2/1 indicates strength of correlation) 3-Strong, 2 - Medium, 1 - Weak															Cos	Programme Outcomes (POs)											PSOs			PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PSO 2	PS O 3	CO 1	3	3	2					2		2			3	2		CO 2	3	3	2	2							2		3		2	CO 3	3	3	2	2				2		2			3			CO 4	3	2	2	2				2					3	2		CO 5	3	2	2							2			3		
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<b>Indirect</b>			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>FUZZY SET THEORY</b>	<b>Periods</b>	<b>9</b>
Introduction to Neuro, Fuzzy and Soft Computing, Fuzzy Sets, Basic Definition and Terminology, Set-theoretic Operations, Member Function Formulation and Parameterization, Fuzzy Rules and Fuzzy Reasoning, Extension Principle and Fuzzy Relations, Fuzzy If-Then Rules, Fuzzy Reasoning, Fuzzy Inference Systems, Mamdani Fuzzy Models, Sugeno Fuzzy Models, Tsukamoto Fuzzy Models, Input Space Partitioning and Fuzzy Modeling.			
<b>Unit - II</b>	<b>OPTIMIZATION</b>	<b>Periods</b>	<b>9</b>
Derivative-based Optimization, Descent Methods, The Method of Steepest Descent, Classical Newton's Method, Step Size Determination, Derivative-free Optimization, Genetic Algorithms, Simulated Annealing, Random Search, Downhill Simplex Search.			
<b>Unit – III</b>	<b>ARTIFICIAL INTELLIGENCE</b>	<b>Periods</b>	<b>9</b>
Introduction, Knowledge Representation – Reasoning, Issues and Acquisition: Propositional and Predicate Calculus Rule Based knowledge Representation Symbolic Reasoning Under Uncertainty, Basic knowledge Representation Issues Knowledge acquisition – Heuristic Search: Techniques for Heuristic search Heuristic Classification.			
<b>Unit - IV</b>	<b>NEURO FUZZY MODELING</b>	<b>Periods</b>	<b>9</b>
Adaptive Neuro-Fuzzy Inference Systems, Architecture, Hybrid Learning Algorithm, Learning Methods that Cross-fertilize ANFIS and RBFN, Coactive Neuro Fuzzy Modeling, Framework Neuron Functions for Adaptive Network, Neuro Fuzzy Spectrum.			
<b>Unit – V</b>	<b>APPLICATIONS OF COMPUTATIONAL INTELLIGENCE</b>	<b>Periods</b>	<b>9</b>
Printed Character Recognition, Inverse Kinematics Problems, Automobile Fuel Efficiency Prediction, Soft Computing for Color Recipe Prediction.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	S.R. Jang, C. T. Sun and E. Mizutani, "Neuro-Fuzzy and Soft Computing", Pearson Education, 1 <sup>st</sup> Edition 2015.		
2.	N.P.Padhy, "Artificial Intelligence and Intelligent Systems", Oxford University Press, 2011.		
<b>References</b>			
1.	Elaine Rich & Kevin Knight, "Artificial Intelligence, Second Edition", Tata Mcgraw Hill Publishing Comp., New Delhi, 2006		
2.	Timothy J.Ross, "Fuzzy Logic with Engineering Applications", McGraw-Hill, 2011.		
3.	S. Rajasekaran and G.A.V.Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI, 2003.		
4.	R.Eberhart, P. Simpson and R. Dobbins, "Computational Intelligence - PC Tools", AP, Professional, Boston, 1996.		
5.	Dr.S.N.Sivanandam and S.N.Deepa, "Principles of Soft Computing", Wiley India, 2007.		
<b>E-Resources</b>			
1.	<a href="http://www.soukalfi.edu.sk/01_NeuroFuzzyApproach.pdf">http://www.soukalfi.edu.sk/01_NeuroFuzzyApproach.pdf</a>		
2.	<a href="https://www.worldcat.org/title/artificial-intelligence-and-intelligent-systems/oclc/60836856">https://www.worldcat.org/title/artificial-intelligence-and-intelligent-systems/oclc/60836856</a>		
3.	<a href="http://iauctb.ac.ir/Files/%D9%88%D8%A8%20%D8%B3%D8%A7%DB%8C%D8%AA%20%D8%A7%D8%B3%D8%A7%D8%AA%DB%8C%D8%AF/fuzzy%20logic%20with%20engineering%20application-3rdEdition.pdf">http://iauctb.ac.ir/Files/%D9%88%D8%A8%20%D8%B3%D8%A7%DB%8C%D8%AA%20%D8%A7%D8%B3%D8%A7%D8%AA%DB%8C%D8%AF/fuzzy%20logic%20with%20engineering%20application-3rdEdition.pdf</a>		

  
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Programme	B.E.	Programme Code	103	Regulation	2023			
Department	ELECTRONICS AND COMMUNICATION ENGINEERING			Semester				
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks		
		L	T	P	C	CA	ESE	Total
U23ECV77	PCB Design and Fabrication	3	0	0	3	40	60	100
Course Objective	<p>The main objective of the course is to</p> <ul style="list-style-type: none"> <li>Understand the fundamental concepts of electronic components and PCB design processes.</li> <li>Learn the use of Electronic Design Automation (EDA) tools for circuit design, layout, and simulation.</li> <li>Apply hands-on skills in PCB fabrication, including soldering, drilling, and component placement.</li> <li>Understand enclosure design, IPC standards, and circuit packaging techniques.</li> <li>Explore and analyze the role of additive manufacturing in modern PCB prototyping and fabrication.</li> </ul>							
Course Outcomes	At the end of the course, the student should be able to,							Knowledge Level
	CO1: Understand PCB materials, types, and layout rules for designing single and multi-layer PCBs.							K2
	CO2: Apply EDA tools to design PCB schematics, footprints, netlists, and Gerber files.							K3
	CO3: Demonstrate PCB fabrication skills including etching, drilling, soldering, and quality inspection.							K3
	CO4: Analyze the significance of IPC standards, component footprints, and packaging techniques for PCB quality.							K4
	CO5: Evaluate the application of additive manufacturing techniques (FDM, SL, 3DP) and emerging prototyping tools for PCB production.							K4
Pre-requisites	-							

COs	CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak												CO/PSO Mapping		
	Programme Outcomes (POs)												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO 1	3	3	2					2					3	2	
CO 2	3	3	2	2				2		2			3		2
CO 3	3	3	2	2									3	2	
CO 4	3	2	2	2				2		2			3		2
CO 5	3	2	2							2			3	2	

**Course Assessment Methods**

Direct
I.Continuous Assessment Test I, II & III

*[Signature]*  
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2. Assignment			
3. End-Semester examinations			
<b>Indirect</b>			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>INTRODUCTION TO PRINTED CIRCUIT BOARD</b>	Periods	<b>9</b>
Fundamental of electronic components, Basic electronic circuits, Basics of printed circuit board designing: PCB Materials, types of PCBs, Single Sided (Single Layer), Multi-Layer (Double Layer), Layout planning, general rules and parameters, ground conductor considerations, Thermal issues, Photo printing, film-master production, Screen printing process, plating, check and inspection of the designed product.			
<b>Unit – II</b>	<b>INTRODUCTION TO ELECTRONIC DESIGN AUTOMATION (EDA) TOOLS</b>	Periods	<b>9</b>
Overview of Electronic design automation (EDA) tools for PCB designing: Brief Introduction of various simulators, EasyEDA, Ki-CAD, Altium Designer, Selecting the Component Footprints as per design, through hole and SMD components, Form Factors, Padstack design, Hole-to-lead ratio, PTH land dimension (annular ring width), PCB Layout Designing, Assigning specific text to design, creating fabrication data (Gerber) files.			
<b>Unit – III</b>	<b>STEPS INVOLVED IN FABRICATION OF SIMPLE ELECTRONIC CIRCUITS</b>	Periods	<b>9</b>
Fabrication of Astable multivibrator Circuit using 555 timer, Different file formats required for PCB fabrication - Bit Map File, Png, Vector file & gerber file, Ezcad software, LASER (IPG or RAYCUS LASER Source) cum Chemical Etching, Different Etchant Solutions, Manual Drilling using WEN Drilling Machine, PCB tinning, component placement and soldering (Flux, Lead and solder paste for SMD Components), Quality Inspection.			
<b>Unit – IV</b>	<b>MAKING OF ENCLOSURES AND PCB IPC STANDARDS</b>	Periods	<b>9</b>
Overview about different non-metal LASERS, Acrylic casing-cutting done by CO2 LASERS, Foam Board Cutting, Printed circuit boards Recycling techniques, Introduction to Integrated Circuit Packaging and footprints, NEMA and Different IPC standards for PCBs.			
<b>Unit – V</b>	<b>EMERGING ADDITIVE PROCESSES FOR PCB MANUFACTURING</b>	Periods	<b>9</b>
Fundamentals of additive manufacturing, classification, advantages and standards on Additive manufacturing. Stereo lithography (SL), Stereo lithography (SL), Fused Deposition Modelling (FDM), Three Dimensional Printing (3DP), Materials, Applications. Voltera-V-one PCB double side Printer, Bot Factory-SV2-multi layer PCB printer, LPKF circuit board plotter and LDS Prototyping.			
<b>Total Periods</b>			<b>45</b>
<b>References</b>			
1.	Simon Monk, "Make Your Own PCBs with EAGLE: From Schematic Designs to Finished Boards", McGraw-Hill Education TAB; 2nd Edition, 2017.		
2.	Kraig Mitzner, "Complete PCB Design Using OrCad Capture and Layout", Newness, 1st Edition, 2009.		
3.	Douglas Brooks, "Signal Integrity Issues and Printed Circuit Board Design", Prentice Hall PTR, 2003.		
4.	Lee W. Ritchey, John Zasio, Kella J. Knack, "Right the First Time: a Practical Handbook on High Speed PCB and System Design", Speeding Edge, 2003.		

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Programme	B.E.	Programme Code	103	Regulation	2023			
Department	ELECTRONICS AND COMMUNICATION ENGINEERING			Semester				
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks		
		L	T	P	C	CA	ESE	Total
U23ECV78	ROCKETRY AND SPACE MECHANICS	3	0	0	3	40	60	100
Course Objective	<p>The main objective of the course is to</p> <ul style="list-style-type: none"> <li>• Provide foundational knowledge of space mechanics, reference frames, Kepler's laws, and orbital parameters.</li> <li>• Study the dynamics of satellite motion, including perturbations, orbit transfers, and orbital coordinate calculations.</li> <li>• Understand the principles of rocket propulsion, motion trajectories, and related performance metrics.</li> <li>• Analyze the dynamics and forces acting on rocket vehicles, including motion through various frames of reference.</li> <li>• Explore the need and control mechanisms for multistage rockets, including staging techniques and control systems.</li> </ul>							
Course Outcomes	At the end of the course, the student should be able to,							Knowledge Level
	CO1: Explain Kepler's and Newton's laws, coordinate systems, and orbital concepts.							K2
	CO2: Apply concepts of satellite dynamics to calculate orbit parameters, Hohmann transfers, and satellite positions from orbital elements.							K3
	CO3: Determine rocket thrust, burnout velocity, range, and altitude for different types of rocket trajectories in gravitational fields.							K3
	CO4: Analyze the forces and dynamics acting on launch vehicles, considering propulsion, aerodynamic forces, and coordinate transformations.							K4
	CO5: Analyze the need for staging, stage separation dynamics, and control mechanisms such as aerodynamic and jet control including SITVC in rocket systems.							K4
Pre-requisites	-							

COs	CO / PO Mapping											CO/PSO Mapping			
	(3/2/1 indicates strength of correlation) 3-Strong, 2 - Medium, 1 - Weak											PSOs			
	Programme Outcomes (POs)														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PSO 2	PS O 3
CO 1	3	3	2	2	2	2						3	3	2	2
CO 2	3	3	3	2	2	2						2	3	2	3
CO 3	3	3	3	2	2	2						2	3	2	2
CO 4	3	3	3	2	2	2						2	2	2	2
CO 5	3	3	3	3	2	2						2	2	2	2

Course Assessment Methods

*[Signature]*  
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<b>Direct</b>
1.Continuous Assessment Test I, II & III 2.Assignment 3.End-Semester examinations
<b>Indirect</b>
1. Course - end survey

### Content of the syllabus

Unit – I	BASIC CONCEPTS OF SPACE MECHANICS	Periods	9
The solar system – reference frames and coordinate systems – terminology related to the celestial sphere and its associated concepts – Kepler’s laws of planetary motion and proof of the laws – Newton’s Law of Universal gravitation – Two body and Three-body problems – Jacobi’s Integral, Librations points – Estimation of orbital and escape velocities..			
Unit – II	SATELLITE DYNAMICS	Periods	9
Geosynchronous and geostationary satellites- factors determining life time of satellites – satellite perturbations – orbit transfer and examples –Hohmann orbits – calculation of orbit parameters– Determination of satellite rectangular coordinates from orbital elements.			
Unit – III	ROCKET MOTION	Periods	9
Principle of operation of rocket motor – thrust equation – one dimensional and two dimensional rocket motions in free space and homogeneous gravitational fields – Description of vertical, inclined and gravity turn trajectories – determinations of range and altitude – simple approximations to burnout velocity..			
Unit – IV	ROCKET DYNAMICS	Periods	9
Classification of launch vehicles and missiles – Rocket systems – Airframe components – Forces and moments acting on a rocket – Propulsion, aerodynamics, gravity – inertial and non-inertial frames – coordinate transformation – Equations of motion for three-dimensional motion through atmosphere and vacuum – numerical problems.			
Unit – V	STAGING AND CONTROL OF ROCKET VEHICLES	Periods	9
Need for multi staging of rocket vehicles – multistage vehicle optimization – stage separation dynamics and separation techniques- aerodynamic and jet control methods of rocket vehicles – SITVC.			
<b>Total Periods</b>			<b>45</b>

### Text Books

1. Suresh. B N & Sivan. K, —Integrated Design for Space Transportation Systeml, Springer India, 2015.
2. Cornelisse,JW, —Rocket Propulsion and Space Dynamicsl, J.W. Freeman & Co., Ltd., London, 1982.

### References



1. Sutton,GP, —Rocket Propulsion Elementsl, John Wiley & Sons Inc., New York, 8th Edition, 2010.
2. Joseph Jimmerson, —The Rocket Filesl, Lulu.com, 2nd Ed., 2013
3. Parker,ER, —Materials for Missiles and Spacecraftl, McGraw-Hill Book Co., Inc., 1982.
4. Analysis And Design Of Analog Integrated Circuits 4/E, Paul R. Gray, Paul J. Hurst, Robert G Meyer, 2001, Wiley Publications


### E-Resources

1. <https://archive.nptel.ac.in/noc/courses/noc16/SEM2/noc16-ae04/>
2. <https://archive.nptel.ac.in/courses/101/101/101101079/>

  
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Programme	B.E.	Programme Code			103	Regulation	2023								
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>				Semester		V								
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks									
		L	T	P	C	CA	ESE	Total							
U23ECO1	<b>Principles of Communication</b>	3	0	0	3	40	60	100							
Course Objective	The main objective of the course is to <ul style="list-style-type: none"> <li>Understand the fundamentals of analog communication, including amplitude and angle modulation and their spectral characteristics. Explore various digital modulation techniques used in modern communication systems.</li> <li>Learn the principles of data communication and error detection/correction methods.</li> <li>Analyze pulse communication techniques such as PAM, PWM, PPM, and PCM.</li> <li>Examine multi-user radio communication systems, including cellular technologies and satellite communication.</li> </ul>														
Course Outcomes	At the end of the course, the student should be able to,										Knowledge Level				
	CO1: Explain the principles, parameters, and bandwidth requirements of amplitude and angle modulation techniques in analog communication.										K2				
	CO2: Apply various digital modulation schemes such as ASK, FSK, PSK, QPSK, QAM, and DPSK in the context of digital communication systems.										K3				
	CO3: Demonstrate knowledge of data communication systems including interfaces, coding schemes, and error detection and correction techniques.										K3				
	CO4: Analyze and compare different pulse communication techniques (PAM, PWM, PPM, PCM) based on their principles, efficiency, and applications.										K4				
	CO5: Analyze the working principles and architecture of multi-user radio communication systems like GSM, AMPS, and satellite communication, and evaluate different multiple access techniques (TDMA, FDMA, CDMA).										K4				
Pre-requisites	<b>Engineering Physics and Statistics</b>														
CO / PO Mapping													CO/PSO Mapping		
(3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak															
COs	Programme Outcomes (POs)											PSOs			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO 1	3	2	2					2					3	3	
CO 2	3	2	2	2				2		2			3		2
CO 3	3	3	2	2									3	2	
CO 4	3	2	2					2		2			3		2
CO 5	3	2	2							2			3	2	
Course Assessment Methods															
Direct															
1.Continuous Assessment Test I, II & III 2.Assignment 3.End-Semester examinations															


  
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<b>Indirect</b>			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>ANALOG COMMUNICATION</b>	Periods	<b>9</b>
Principles of amplitude modulation – frequency spectrum and bandwidth – modulation index and percentage of Modulation – Angle modulation –Phase Modulation - FM Modulation –frequency deviation, modulation index, Deviation ratio ,Percentage of modulation			
<b>Unit – II</b>	<b>DIGITAL MODULATION TECHNIQUES</b>	Periods	<b>9</b>
Amplitude shift keying – frequency shift keying – Phase shift keying – Quadrature Phase shift keying – Minimum Shift keying – 8-PSK -16-PSK - Quadrature Amplitude Modulation, Differential Phase shift keying.			
<b>Unit – III</b>	<b>DATA COMMUNICATION</b>	Periods	<b>9</b>
History of Data Communication – Standards Organizations for Data Communication – Data Communication Codes – Error Detection and Correction Techniques- serial and parallel interfaces.			
<b>Unit – IV</b>	<b>PULSE MODULATION</b>	Periods	<b>9</b>
Pulse Amplitude Modulation– Quantization process- Pulse Width Modulation - Delta Modulation - Adaptive Delta Modulation – Pulse code Modulation– Pulse Position modulation.			
<b>Unit – V</b>	<b>MULTI-USER RADIO COMMUNICATION</b>	Periods	<b>9</b>
Multiple access techniques – TDMA, FDMA, CDMA, satellite communication, wireless communication Advanced Mobile Phone System (AMPS) – Global System for Mobile Communications (GSM).			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	Wayne Tomasi, “Advanced Electronic Communication Systems”, Pearson Education, 6 <sup>th</sup> Edition 2015.		
2.	Simon Haykin, “Communication Systems”, John Wiley & Sons, 5 <sup>th</sup> Edition, 2022.		
<b>References</b>			
1.	Rappaport T.S, "Wireless Communications: Principles and Practice", Pearson Education, 2 <sup>nd</sup> Edition ,2010.		
2.	Martin S.Roden, “Analog and Digital Communication System”, Prentice Hall of India, 3 <sup>rd</sup> Edition ,2009.		
3.	B.Sklar, “Digital Communication Fundamentals and Applications”, Pearson Education, 2 <sup>nd</sup> Edition, Reprint2018.		
<b>E-Resources</b>			
1.	<a href="https://www.geeksforgeeks.org/introduction-to-analog-communication/">https://www.geeksforgeeks.org/introduction-to-analog-communication/</a>		
2.	<a href="https://www.geeksforgeeks.org/digital-modulation-techniques/">https://www.geeksforgeeks.org/digital-modulation-techniques/</a>		
3.	<a href="https://www.spiceworks.com/tech/networking/articles/what-is-gsm/">https://www.spiceworks.com/tech/networking/articles/what-is-gsm/</a>		




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	<b>VIVEKANANDHA COLLEGE OF ENGINEERING FOR WOMEN</b> (Autonomous Institution, Affiliated to Anna University, Chennai) Elayampalayam, Tiruchengode – 637 205														
Programme	B.E.	Programme Code			103	Regulation	2023								
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>				Semester		V								
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks									
		L	T	P	C	CA	ESE	Total							
U23ECO2	Basics of VLSI	3	0	0	3	40	60	100							
<b>Course Objective</b>	The main objective of the course is to														
	<ul style="list-style-type: none"> <li>Understand the evolution of VLSI, characteristics of MOS transistors and VLSI design methodologies.</li> <li>Learn the CMOS fabrication processes, layout rules, and their impact on circuit performance and manufacturing.</li> <li>Explore various CMOS and BiCMOS logic circuit families for combinational circuit design.</li> <li>Examine implementation strategies using ASICs, PLDs, and FPGAs, including design tools and architecture.</li> <li>Develop proficiency in modeling digital circuits using Verilog HDL at various abstraction levels.</li> </ul>														
	At the end of the course, the student should be able to							Knowledge Level							
	<b>CO1:</b> Describe the evolution of VLSI systems, MOS transistor characteristics, and apply layout rules to draw stick and layout diagrams for CMOS circuits.							K2							
	<b>CO2:</b> Apply knowledge of CMOS fabrication techniques such as N-well, P-well, SOI, and layout design rules in realizing CMOS logic circuits.							K3							
<b>Course Outcome</b>	<b>CO3:</b> Analyze different logic circuit families like static CMOS, dynamic logic, pass transistor logic, and BiCMOS in terms of performance and power.							K4							
	<b>CO4:</b> Demonstrate the implementation of digital systems using ASIC and FPGA architectures such as Xilinx and Altera, along with routing and interconnect strategies.							K3							
	<b>CO5:</b> Analyze and model combinational and sequential logic circuits using Verilog HDL across behavioral, gate-level, and dataflow modeling paradigms.							K4							
	<b>Pre-requisites</b> -														
	<b>CO / PO Mapping</b> (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1- Weak												<b>CO/PSO Mapping</b>		
Cos	Programme Outcomes (Pos)											PSOs			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	P O 11	PO 12	PS O1	PS O 2	PS O 3
CO 1	3	3	3	2					2				3		
CO 2	3	3	3	2					2	2			3	2	
CO 3	3	3	3	2				2		2			3	2	
CO 4	3	3	3	2				2					3	2	
CO 5	3	3	3	2										2	

  
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<b>Course Assessment Methods</b>			
<b>Direct</b>			
1. Continuous Assessment Test I, II & III			
2. Assignment and Seminar			
3. End-Semester examinations			
<b>Indirect</b>			
1. Course – end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>MOS DEVICES AND CIRCUITS</b>	Periods	<b>9</b>
Evolution of Ics– Moore’s law- VLSI design flow – MOS transistors - Ideal I-V and C-V characteristics, non-ideal I-V effects, DC transfer characteristics– Stick diagram and Layout diagram- Layout design rules- Realization of circuit using CMOS			
<b>Unit – II</b>	<b>FABRICATION OF CMOSs</b>	Periods	<b>9</b>
NMOS and CMOS fabrication – N-well, P-well and twin tub processes and SOI, Layout design Rules, CMOS Logic. Technology related CAD issues, manufacturing issues.			
<b>Unit – III</b>	<b>COMBINATIONAL CIRCUIT DESIGN</b>	Periods	<b>9</b>
Circuit Families- Static CMOS, Ratioed circuits, Cascode voltage switch logic, Dynamic circuits, Pass transistor circuits, BiCMOS, Realization of circuits using Circuit families			
<b>Unit – IV</b>	<b>IMPLEMENTATION STRATEGIES</b>	Periods	<b>9</b>
PLDs – PAL, PLA, CPLD, Full custom and Semi custom ASIC design- Standard cell design, FPGA building block architectures, FPGA interconnect – Routing – FPGA, Xilinx 4000 series –Altera Cyclone III			
<b>Unit – V</b>	<b>VERILOG HARDWARE DESCRIPTION LANGUAGE</b>	Periods	<b>9</b>
Introduction to Verilog HDL –Basic Concepts-Identifiers-Gate primitives, gate delays, operators, timing controls, procedural assignments, conditional assignments, Tasks and functions - Behavior modeling —Gate level modeling – Dataflow modeling- switch level modeling. Design examples - Combinational and sequential circuits using Verilog			
<b>Total Periods</b>			<b>45</b>
<b>References</b>			
1.	M.MorrisMano, Digital Design, 5th Edition, Prentice Hall of India Pvt.Ltd.,2003/ Pearson Education (Singapore) Pvt.Ltd., NewDelhi, 2018.		
2.	Neil Weste& David Harris , "CMOS VLSI Design-A circuits & System Perspective", 4th Edition, Pearson education, New Delhi, 2017		
3.	Palnitkar Samir, "Verilog HDL: Guide to Digital Design and synthesis", 2nd Edition, Pearson Education , New Delhi, 2017.		
4.	Pucknell D.A and Eshraghian K , “Basic VLSI Design”, PHI publication, Second Edition,2011		
5.	Charles H. Roth, “Digital Systems Design Using VHDL”, CL Engineering/CengageLearning India, 2012.		
6.	M.J. Smith, “Application specific integrated circuits”, Addison Wesley, 2008.		
7.	JohnF.Wakerly, Digital Design,Fourth Edition,Pearson /PHI,2016		
<b>E-Resources</b>			
E1	<a href="http://www.electronicsforu.com">www.electronicsforu.com</a>		
E2	<a href="http://www.vlsi-expert.com">www.vlsi-expert.com</a>		
E3	<a href="https://nptel.ac.in/courses/117106086/">https://nptel.ac.in/courses/117106086/</a>		
E4	<a href="https://nptel.ac.in/content/syllabus_pdf/108105113.pdf">https://nptel.ac.in/content/syllabus_pdf/108105113.pdf</a>		

  
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Programme	<b>B.E.</b>	Programme Code	<b>103</b>	Regulation	<b>2023</b>			
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>			Semester	<b>V</b>			
Course Code	Course Name	Periods Per Week		Credit	Maximum Marks			
<b>U23ECO3</b>	<b>Industry 4.0 and 5.0</b>	L	T	P	C	CA	ESE	Total
		3	0	0	3	40	60	100

**Course Objective**

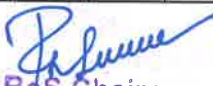
The main objective of the course is to

- Understand the architecture, layers, and business models of Industrial IoT and its impact on sustainable smart industries.
- Explore key enabling technologies for IIoT security, including cloud, fog computing, big data, and machine learning.
- Learn about industrial data acquisition systems, sensors, actuators, industrial protocols, and automation platforms like PLC and SCADA.
- Examine the emergence and vision of Industry 5.0, its drivers, and the role of predictive analytics in industrial transformation.
- Apply AI and analytics in IIoT applications and analyze real-world case studies in smart manufacturing and automation.

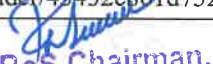
<b>Course Outcomes</b>	At the end of the course, the student should be able to,	Knowledge Level
	<b>CO1:</b> Explain the architecture, layers, business models, and cybersecurity considerations of Industrial IoT, including its relevance to Industry 4.0 and sustainability.	K2
	<b>CO2:</b> Apply knowledge of cloud/fog computing, big data, SDN, and machine learning in addressing IIoT security challenges and data processing.	K3
	<b>CO3:</b> Use industrial sensors, actuators, and communication protocols to understand data acquisition and control in automated systems..	K3
	<b>CO4:</b> Analyze the technological shift from Industry 4.0 to Industry 5.0 and evaluate the challenges and trends driving the digital transformation in industrial environments.	K4
	<b>CO5:</b> Analyze the role of AI and analytics in industrial operations through real-world case studies involving inventory, quality control, and smart manufacturing.	K4



**Pre-requisites** -

COs	CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak												CO/PSO Mapping		
	Programme Outcomes (POs)												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
<b>CO 1</b>	1	-	-	2	2	2	-	-	-	3	3	3	2	2	1
<b>CO 2</b>	1	1	-	2	2	2	-	-	-	3	3	3	2	2	1
<b>CO 3</b>	1	-	-	2	2	1	-	-	-	2	3	1	1	1	1
<b>CO 4</b>	1	-	1	1	2	2	-	-	-	3	2	3	2	2	1
<b>CO 5</b>	1	-	-	2	2	1	-	-	-	2	3	1	1	2	1

  
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<b>Course Assessment Methods</b>			
<b>Direct</b>			
1.Continuous Assessment Test I, II & III 2.Assignment 3.End-Semester examinations			
<b>Indirect</b>			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>INDUSTRIAL IoT</b>	Periods	<b>9</b>
IIoT-Introduction, Industrial IoT: Business Model and Reference Architecture: IIoT-Business Models, Industrial IoT- Layers: IIoT Sensing, IIoT Processing, IIoT Communication, IIoT Networking. Sustainability assessment of industries - Smart business perspective – Cyber security - Impacts of Industry 4.0.			
<b>Unit – II</b>	<b>IOT SECURITY KEY TECHNOLOGIES</b>	Periods	<b>9</b>
Industrial IoT: Security and Fog Computing - Cloud Computing in IIoT, Fog Computing in IIoT, Security in IIoT.Big Data Analytics and Software Defined Networks, Machine Learning and Data Science, Julia Programming, Data Management with Hadoop.			
<b>Unit – III</b>	<b>INDUSTRIAL DATA ACQUISITION SYSTEMS</b>	Periods	<b>9</b>
Sensors: Introduction – characteristics – categories. Actuators: Thermal, Hydraulic, Pneumatic, Electromechanical actuators - Industrial data transmission: Fieldbus – Profibus –HART – Modbus – CAN – DeviceNet – LoRA – NB-IoT - Distributed control system – PLC - SCADA.			
<b>Unit – IV</b>	<b>ROLE OF INDUSTRY 5.0</b>	Periods	<b>8</b>
Introduction of Various Industrial Revolutions, Digitalization and the Networked Economy, Drivers, Enablers, Compelling Forces and Challenges for Industry 5.0, Comparison of Industry 5.0 Factory and Today's Factory, Trends of Industrial Big Data and Predictive Analytics for Smart Business Automation and Transformation Processes			
<b>Unit – V</b>	<b>INDUSTRIAL IOT ANALYTICS AND CASE STUDY</b>	Periods	<b>10</b>
Necessity of analytics - Categorization of analytics – Usefulness and challenges of analytics - Mapping and deployment of analytics -Artificial intelligence- Applications of analytics across value chain -Plant security - Intelligent NextG Wireless Networks. Case study: Inventory management and quality control - Manufacturing industry - Milk Processing and Packaging Industries, CNC/NC automation			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	“Industrial Internet of Things: Cyber manufacturing Systems” by Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer), 2017		
2.	Industry 4.0: The Industrial Internet of Things”, by Alasdair Gilchrist (Apress), 2017		
3.	“Machine Learning and IoT for Intelligent Systems and Smart Applications” by Madhumathy P, M Vinoth Kumar, R. Umamaheswari, CRC Press 2021		
4.	“Industry 5.0: A New Revolution Through Human-Centric Solution (De Gruyter Frontiers in Computational Intelligence)– Import”by Ali Kashif Bashir, Harry Haoxiang Wang, Manoj Kumar, N. Pradeep, Vinod Kumar Shukla, Yousaf Bin Zikria, 2022		
<b>References</b>			
1.	Hands-On Industrial Internet of Things: Create a powerful Industrial IoT by Giacomo Veneri, Antonio Capasso, Packt, 2018.		
2.	The Internet of Things: Key Applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi,2ndEdition, Willy Publications 2017		
3.	“Hands-On Industrial Internet of Things: Create a powerful Industrial IoT” by Giacomo Veneri, Antonio Capasso, Packt, 2018.		
<b>E-Resources</b>			
1.	<a href="https://download.e-bookshelf.de/download/0007/6832/86/L-G-0007683286-0014731014.pdf">https://download.e-bookshelf.de/download/0007/6832/86/L-G-0007683286-0014731014.pdf</a>		
2.	<a href="https://www.ifm.eng.cam.ac.uk/uploads/DIAL/industrial-internet-of-things-report.pdf">https://www.ifm.eng.cam.ac.uk/uploads/DIAL/industrial-internet-of-things-report.pdf</a>		
3.	<a href="https://www.semanticscholar.org/reader/43432c861d7529f19e2302b178823aeb16cf1157">https://www.semanticscholar.org/reader/43432c861d7529f19e2302b178823aeb16cf1157</a>		

  
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Programme	B.E.	Programme Code		103	Regulation		2023		
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>				Semester		VI		
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks			
		L	T	P		C	CA	ESE	Total
U23ECO4	<b>Satellite Communication</b>	3	0	0	3	40	60	100	
<b>Course Objective</b>	The main objective of the course is to								
	<ul style="list-style-type: none"> <li>Understand the orbital mechanics and characteristics of satellite orbits, including station keeping and orbit perturbations.</li> <li>Learn the design and components of the space segment, and perform satellite uplink/downlink link budget analysis.</li> <li>Explore multiple access techniques such as FDMA, TDMA, and CDMA used in satellite communication.</li> <li>Study the earth segment architecture, and examine how satellites integrate into terrestrial and TCP/IP-based networks.</li> <li>Understand various satellite communication applications, including DTH, GPS, VSAT, and remote sensing systems.</li> </ul>								
<b>Course Outcomes</b>	At the end of the course, the student should be able to,							Knowledge Level	
	CO1: Explain Kepler's laws, satellite orbital parameters, and phenomena such as eclipse, sun transit outage, and visibility limits in satellite orbits.							K2	
	CO2: Apply satellite link design principles including EIRP, transmission losses, C/N ratio, and intermodulation interference to perform basic link budget calculations.							K3	
	CO3: Analyze and compare multiple access techniques (FDMA, TDMA, CDMA) in terms of bandwidth usage, uplink power requirements, and throughput efficiency.							K4	
	CO4: Demonstrate the functionality and design of earth stations and evaluate how satellite links support modern data networks such as ATM and TCP/IP over satellite.							K2	
	CO5: Analyze the structure and operational features of key satellite applications and remote sensing satellites, including MPEG standards and FEC techniques.							K4	
<b>Pre-requisites</b>	-								

COs	CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 - Medium, 1 - Weak												CO/PSO Mapping		
	Programme Outcomes (POs)												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO 1	3	3	2							2			3		2
CO 2	3	3	2	2			2						3		
CO 3	3	3	2	2					2				3	2	
CO 4	3	2	2	2			2							2	
CO 5	3	2	2											2	

  
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<b>Course Assessment Methods</b>			
<b>Direct</b>			
1.Continuous Assessment Test I, II & III			
2.Assignment			
3.End-Semester examinations			
<b>Indirect</b>			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>SATELLITE ORBITS</b>	Periods	<b>9</b>
Kepler’s Laws, orbital elements, orbital perturbations, station keeping –apogee and perigee heights, inclined orbits. The geo stationary orbits- Look Angle Determination- Limits of visibility – eclipse -Sub satellite point – Sun transit outage-Launching vehicles and propulsion			
<b>Unit – II</b>	<b>SPACE SEGMENT</b>	Periods	<b>9</b>
Introduction- Spacecraft Technology-Structure-Power supply, Attitude and Orbit control, Station Keeping, Thermal control and Propulsion sub system, transponders, the antenna subsystems. Telemetry, Tracking and command.			
<b>Unit – III</b>	<b>SATELLITE ACCESS</b>	Periods	<b>9</b>
Introduction, Types of Multiple access, Modulation and Multiplexing, Preassigned FDMA, Demand assigned FDMA, Spade system, TDMA-basic equipment in TDMA system, Preassigned and demand assigned TDMA, Satellite switched TDMA, CDMA			
<b>Unit – IV</b>	<b>EARTH SEGMENT</b>	Periods	<b>9</b>
Introduction, Receive-Only Home TV Systems, Outdoor unit, Indoor unit - Master Antenna TV System , Community Antenna TV System , Transmit and Receive earth stations.			
<b>Unit – V</b>	<b>SATELLITE APPLICATIONS</b>	Periods	<b>9</b>
INTELSAT, INSAT, VSAT, Global system for mobile communication(GSM),Global Positioning System(GPS),INMARSAT, LEO, MEO, Geo synchronous orbit satellites – DBS,DTH-DAB, Polar orbiting satellites.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	Dennis Roddy, “Satellite Communication”, McGraw Hill International, 4 <sup>th</sup> Edition, 2010.		
2.	Timothy Pratt, Charles W. Bostian, “Satellite Communications”, John Wiley & Sons, 2 <sup>nd</sup> Edition, 2009.		
<b>References</b>			
1.	Wilbur L. Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, ‘Satellite Communication Systems Engineering’, Prentice Hall/Pearson, 3 <sup>rd</sup> Edition, 2007.		
2.	N. Agarwal, “Design of Geosynchronous Space Craft”, Prentice Hall, 1986.		
3.	Bruce R. Elbert, “The Satellite Communication Applications”, Hand Book, Artech House Bostan London, 1997.		
4.	M. O. Kolawole, “Satellite Communication Engineering”, Marcel Dekker, Inc. NY,2 <sup>nd</sup> Edition ,2013.		
5.	M. Richharia, "Satellite Systems for Personal Applications", John Wiley, 2010.		
<b>E-Resources</b>			
1.	Satellite communications by Dennis Roddy   Open Library		
2.	<a href="https://www.scribd.com/doc/105119756/Solutions-Manual-for-Satellite-Communications-Second-edition-Timothy-Pratt-Charles-Bostian-Jeremy-Allnutt">https://www.scribd.com/doc/105119756/Solutions-Manual-for-Satellite-Communications-Second-edition-Timothy-Pratt-Charles-Bostian-Jeremy-Allnutt</a>		
3.	<a href="https://www.gettextbooks.com/author/M_Richharia">https://www.gettextbooks.com/author/M_Richharia</a>		



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Programme	B.E.	Programme Code	103	Regulation	2023				
Department	ELECTRONICS AND COMMUNICATION ENGINEERING			Semester	VI				
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks			
		L	T	P	C	CA	ESE	Total	
U23ECO5	4G and 5G Network	3	0	0	3	40	60	100	
Course Objective	The main objective of the course is to								
	<ul style="list-style-type: none"> <li>Understand the evolution of wireless networks from 2G to 5G and the transition in core network architectures.</li> <li>Explore the key concepts, architecture, and enabling technologies of 5G, including New Radio and cloud integration.</li> <li>Examine the 5G system architecture, protocols, and processes such as network slicing and edge computing.</li> <li>Study dynamic spectrum management techniques and the role of millimeter waves in 5G. Understand security challenges and solutions specific to 5G networks.</li> </ul>								
Course Outcomes	At the end of the course, the student should be able to,						Knowledge Level		
	CO1: Explain the evolution of wireless networks and distinguish between different generations (2G to 5G) and their core architectures.						K2		
	CO2: Apply knowledge of 5G technologies, Radio Access Technologies (RATs), and cloud-based architectures to understand how next-gen networks operate.						K3		
	CO3: Analyze the architecture of 5G networks including concepts like network slicing, MEC, and 5G protocol stacks.						K4		
	CO4: Demonstrate the use of dynamic spectrum management techniques and explain the impact of millimeter wave technology in high-speed mobile communication.						K3		
	CO5: Evaluate the security mechanisms in 5G networks, including network domain and user domain security, and how threats are mitigated using flow-based QoS frameworks.						K4		
Pre-requisites	-								

CO / PO Mapping													CO/PSO Mapping		
(3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak															
COs	Programme Outcomes (POs)												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O 2	PS O 3
CO 1	3	3	2	3	2								1	1	3
CO 2	3	3	3	2	2								1	1	2
CO 3	3	3	2	2	2								2	2	2
CO 4	3	3	3	3	2								3	2	2
CO 5	3	2	3	3	2								2	2	2

**Course Assessment Methods**


**Direct**

- 1.Continuous Assessment Test I, II & III
- 2.Assignment
- 3.End-Semester examinations

*[Signature]*

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<b>Indirect</b>			
1. Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>EVOLUTION OF WIRELESS NETWORKS</b>	Periods	<b>9</b>
Networks evolution: 2G, 3G, 4G, evolution of radio access networks, need for 5G. 4G versus 5G, Next Generation core (NG-core), visualized Evolved Packet core(vEPC).			
<b>Unit – II</b>	<b>5G CONCEPTS AND CHALLENGES</b>	Periods	<b>9</b>
Fundamentals of 5G technologies, overview of 5G core network architecture, 5G new radio and cloud technologies, Radio Access Technologies (RATs), EPC for 5G.			
<b>Unit – III</b>	<b>NETWORK ARCHITECTURE AND THE PROCESSES</b>	Periods	<b>9</b>
5G architecture and core, network slicing, multi access edge computing(MEC) visualization of 5G components, end-to-end system architecture, service continuity, relation to EPC, and edge computing. 5G protocols: 5G NAS, NGAP, GTP-U, IPsec and GRE.			
<b>Unit – IV</b>	<b>DYNAMIC SPECTRUM MANAGEMENT AND WAVES</b>	Periods	<b>9</b>
Mobility management, Command and control, spectrum sharing and spectrum trading, cognitive radio based on 5G, millimeter waves.			
<b>Unit – V</b>	<b>SECURITY IN 5G NETWORKS</b>	Periods	<b>9</b>
Security features in 5G networks, network domain security, user domain security, flow based QoS framework, mitigating the threats in 5G.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	5G Core networks: Powering Digitalization , Stephen Rommer, Academic Press,2019		
2.	An Introduction to 5G Wireless Networks : Technology, Concepts and Use cases, Saro Velrajan, First Edition, 2020.		
<b>References</b>			
1.	5G Simplified: ABCs of Advanced Mobile Communications Jyrki.J.Penttinen, Copyrighted Material.		
2.	5G system Design: An end to end Perspective , Wan Lee Anthony, Springer Publications,2019.		
<b>E-Resources</b>			
1.	<a href="https://www.geeksforgeeks.org/generations-of-wireless-communication/">https://www.geeksforgeeks.org/generations-of-wireless-communication/</a>		
2.	<a href="https://decisiontele.com/news/perspectives-and-barriers-5g-implementation-and-its-impact-small-and-medium-businesses.html">https://decisiontele.com/news/perspectives-and-barriers-5g-implementation-and-its-impact-small-and-medium-businesses.html</a>		
3.	<a href="https://www.zscaler.com/zpedia/what-is-5g-security">https://www.zscaler.com/zpedia/what-is-5g-security</a>		

  
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	<b>VIVEKANANDHA COLLEGE OF ENGINEERING FOR WOMEN</b> (Autonomous Institution, Affiliated to Anna University ,Chennai) Elayampalayam, Tiruchengode – 637 205														
Programme	<b>B.E.</b>	Programme Code			<b>205</b>	Regulation	<b>2023</b>								
Department	<b>ELECTRONICS AND COMMUNICATION ENGINEERING</b>					Semester	<b>VI</b>								
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks									
		L	T	P	C	CA	ESE	Total							
<b>U23ECO6</b>	<b>ROBOTICS SYSTEM AND CONTROL</b>	3	0	0	3	40	60	100							
<b>Course Objective</b>	The main objective of the course is to														
	<ul style="list-style-type: none"> <li>• Introduce the foundational concepts, classifications, and industrial applications of robots.</li> <li>• Develop analytical skills in robot kinematics and dynamics using standard modeling techniques.</li> <li>• Provide knowledge of control systems and their application in robotic motion and trajectory planning.</li> <li>• Explore sensing, perception, and localization techniques essential for robotic autonomy.</li> <li>• Analyze the use of robotics in real-world applications and explore emerging trends including AI integration and soft robotics.</li> </ul>														
<b>Course Outcome</b>	At the end of the course, the student should be able to										Knowledge Level				
	<b>CO1:</b> Describe the components, classifications, and industrial applications of robots, including types of arms, sensors, and actuators.										K2				
	<b>CO2:</b> Apply kinematic and dynamic models using Denavit–Hartenberg notation and transformation matrices to determine the position and motion of robotic manipulators.										K3				
	<b>CO3:</b> Implement control strategies such as PID, feedforward, and computed torque control to ensure accurate trajectory tracking in robotic systems.										K3				
	<b>CO4:</b> Analyze sensor data using fusion techniques and apply SLAM algorithms for robotic navigation and environment mapping.										K4				
	<b>CO5:</b> Evaluate the design and implementation of robotic systems including collaborative robots and soft robotics, with consideration for AI integration, safety, and ethics.										K4				
<b>Pre-requisites</b>	-														
<b>CO / PO Mapping</b> (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak													<b>CO/PSO Mapping</b>		
<b>Cos</b>	<b>Programme Outcomes (POs)</b>												<b>PSOs</b>		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
<b>CO 1</b>	3	2	2									2	3	2	2
<b>CO 2</b>	3	2	2									2	3	2	2
<b>CO 3</b>	3	2	2									2	3	2	2
<b>CO 4</b>	3	2	2									2	3	2	2
<b>CO 5</b>	3	2	2									2	3	2	2
<b>Course Assessment Methods</b>															

  
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<b>Direct</b>
1.Continuous Assessment Test I, II & III 2.Assignment and Seminar 3.End-Semester examinations
<b>Indirect</b>
1.Course - end survey

**Content of the syllabus**

<b>Unit – I</b>	<b>INTRODUCTION TO ROBOTICS</b>	Periods	<b>9</b>
Definition of robots and their components, Classification of robots: industrial robots, service robots, mobile robots, humanoid robots, Kinematic chains, degrees of freedom (DoF), end-effectors, sensors, and actuators, Types of robot arms (serial, parallel, and hybrid robots), Applications of robotics in various industries (manufacturing, healthcare, agriculture, etc			
<b>Unit – II</b>	<b>KINEMATICS AND DYNAMICS OF ROBOTS</b>	Periods	<b>9</b>
Denavit- Hartenberg (DH) notation, Transformation matrices and homogenous transformations, Calculating end-effector position and orientation, Analytical vs. numerical methods, Inverse kinematics for simple robotic arms (planar and spatial), Newton-Euler and Lagrangian formulations, Equations of motion for robotic manipulators.			
<b>Unit – III</b>	<b>ROBOT CONTROL SYSTEMS AND TECHNIQUES</b>	Periods	<b>9</b>
Overview of control theory and its applications to robotics, Open-loop vs. closed-loop control, Stability analysis and error dynamics, PID control in robotics, Feedforward and feedback control for trajectory tracking, Inverse dynamics control, Computed torque control, Real-time adaptation in robotic systems, Applications in force control and compliant motion.			
<b>Unit – IV</b>	<b>SENSING AND PERCEPTION IN ROBOTICS</b>	Periods	<b>9</b>
Types of sensors used in robotics: encoders, vision systems, lidar, force sensors, Sensor fusion and integration for reliable data interpretation, Image processing fundamentals: edge detection, feature extraction, object recognition, Applications in robotic navigation and manipulation, Principles of SLAM in mobile robotics, Algorithms (EKF-SLAM, Fast SLAM, Graph-based SLAM).			
<b>Unit – V</b>	<b>ROBOTIC APPLICATIONS AND FUTURE TRENDS</b>	Periods	<b>9</b>
Industrial robot arms, robotic arms for assembly, welding, and pick-and-place tasks, Human-robot interaction and collaborative robots (cobots), Design and control of soft robots, Bioinspired soft actuators and their applications, Integration of AI for task planning, autonomous decision-making, and reinforcement learning, Ethical concerns in autonomous robots, Safety protocols and standards in robotic systems.			
<b>Total Periods</b>			<b>45</b>


**References**

R1	"Introduction to Robotics: Mechanics and Control" by John J. Craig
R2	Robotics: Control, Sensing, Vision, and Intelligence" by K.S. Fu, R.C. Gonzalez, and C.S.G. Lee
R3	"Robotics: Modelling, Planning, and Control" by Bruno Siciliano, Lorenzo Sciavicco, and Giuseppe Villani
R4	"Modern Robotics: Mechanics, Planning, and Control" by Kevin M. Lynch and Frank C. Park
R5	"Robotics: Principles and Practice" by B.S. Soni
R6	"Springer Handbook of Robotics" edited by Bruno Siciliano and Oussama Khatib

  
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				L	T	P		C	CA	ESE	Total																																																																																																																																														
U23ECO7	Industrial Electronics			3	0	0	3	40	60	100																																																																																																																																															
Course Objective	The main objective of the course is to																																																																																																																																																								
	<ul style="list-style-type: none"> <li>Introduce the fundamentals and scope of industrial and power electronics.</li> <li>Familiarize students with industrial control systems including PLCs, SCADA, and automation technologies.</li> <li>Impart knowledge of various industrial instrumentation methods and data acquisition systems.</li> <li>Provide an understanding of power quality issues, industrial safety standards, and maintenance procedures.</li> <li>Explore renewable energy technologies and their integration with modern industrial applications, including IoT and AI-based automation.</li> </ul>																																																																																																																																																								
	At the end of the course, the student should be,										Knowledge Level																																																																																																																																														
	CO1: Explain the working principles and differences between industrial and consumer electronics, as well as the role of power semiconductor devices in industrial circuits.										K2																																																																																																																																														
	CO2: Apply the knowledge of PLCs, sensors, and SCADA systems to design basic industrial control and automation processes.										K3																																																																																																																																														
	CO3: Demonstrate the use of industrial instrumentation systems, including analog/digital meters and data acquisition methods, for monitoring and control.										K3																																																																																																																																														
CO4: Analyze power quality issues such as harmonics and poor power factor in industrial systems, and suggest suitable correction techniques.										K4																																																																																																																																															
CO5: Evaluate the integration of renewable energy sources, battery management, and IoT in smart factories and Industry 4.0 systems through case studies.										K4																																																																																																																																															
Pre-requisites	-																																																																																																																																																								
<table border="1"> <thead> <tr> <th colspan="12">CO / PO Mapping</th> <th colspan="3">CO/PSO Mapping</th> </tr> <tr> <th colspan="15">(3/2/1 indicates strength of correlation) 3-Strong, 2 - Medium, 1 - Weak</th> </tr> <tr> <th rowspan="2">Cos</th> <th colspan="12">Programme Outcomes (POs)</th> <th colspan="3">PSOs</th> </tr> <tr> <th>PO 1</th> <th>PO 2</th> <th>PO 3</th> <th>PO 4</th> <th>PO 5</th> <th>PO 6</th> <th>PO 7</th> <th>PO 8</th> <th>PO 9</th> <th>PO 10</th> <th>PO 11</th> <th>PO 12</th> <th>PSO 1</th> <th>PSO 2</th> <th>PSO 3</th> </tr> </thead> <tbody> <tr> <td>CO 1</td> <td>3</td> <td>1</td> <td>1</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>1</td> <td>3</td> <td>2</td> <td>2</td> </tr> <tr> <td>CO 2</td> <td>3</td> <td></td> <td>3</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>1</td> <td>3</td> <td>2</td> <td>2</td> </tr> <tr> <td>CO 3</td> <td>2</td> <td>2</td> <td>3</td> <td></td> <td></td> <td></td> <td>1</td> <td></td> <td></td> <td></td> <td></td> <td>1</td> <td>3</td> <td>2</td> <td>2</td> </tr> <tr> <td>CO 4</td> <td>2</td> <td>2</td> <td>3</td> <td></td> <td></td> <td></td> <td>1</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>3</td> <td>2</td> <td>2</td> </tr> <tr> <td>CO 5</td> <td>2</td> <td>2</td> <td>3</td> <td></td> <td></td> <td></td> <td>1</td> <td></td> <td></td> <td></td> <td></td> <td>1</td> <td>3</td> <td>2</td> <td>2</td> </tr> </tbody> </table>													CO / PO Mapping												CO/PSO Mapping			(3/2/1 indicates strength of correlation) 3-Strong, 2 - Medium, 1 - Weak															Cos	Programme Outcomes (POs)												PSOs			PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	CO 1	3	1	1									1	3	2	2	CO 2	3		3									1	3	2	2	CO 3	2	2	3				1					1	3	2	2	CO 4	2	2	3				1						3	2	2	CO 5	2	2	3				1					1	3	2	2
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Content of the syllabus			
<b>Unit – I</b>	<b>INTRODUCTION TO INDUSTRIAL ELECTRONICS AND POWER ELECTRONICS FUNDAMENTALS</b>	Periods	<b>9</b>
Overview of industrial electronics and its applications-Difference between industrial and consumer electronics-Basic electronic components and circuits - Introduction to power semiconductors: Diodes, SCRs, TRIACs, MOSFETs, IGBTs, Rectifiers: Single-phase and three-phase rectifiers- AC/DC converters and switching power supplies- Inverters: Types and applications			
<b>Unit-II</b>	<b>INDUSTRIAL CONTROL SYSTEMS</b>	Periods	<b>9</b>
Basics of automation and control- controllers and PLCs. Rotary encoders, digipots. Automation: Transfer machines, robotics basics, Application of PLCs, Industrial heating: Arc furnace, high frequency heating, High frequency source for induction heating, dielectric heating and microwave heating, Ultrasonic- Generation and applications-SCADA (Supervisory Control and Data Acquisition) systems-Distributed Control Systems (DCS)			
<b>Unit – III</b>	<b>INDUSTRIAL INSTRUMENTATION</b>	Periods	<b>9</b>
High voltage equipments: voltage multipliers, electrostatic charging, precipitation, and painting. Plasma torches, particle accelerators electron beam welding, ion implantation, thrusters and gas lasers. Case studies of industrial applications- Measurement techniques-Analog and digital meters-Data acquisition systems (DAQ)- Industrial data communication (RS232, RS485, Modbus, Profibus)			
<b>Unit - IV</b>	<b>POWER QUALITY &amp; INDUSTRIAL SAFETY</b>	Periods	<b>9</b>
Harmonics and power factor correction-Grounding and earthing in industrial setups-Electrical safety standards (IEC, IEEE, NEC)-Industrial maintenance and troubleshooting.			
<b>Unit – V</b>	<b>RENEWABLE ENERGY AND INDUSTRIAL APPLICATIONS</b>	Periods	<b>9</b>
Solar power electronics: MPPT controllers, inverters-Wind energy conversion systems-Battery storage and management systems-Industrial robots and robotic arms-Actuators and motion control-IoT and AI in industrial automation-Case studies on industrial automation projects-Smart factories and Industry 4.0-Emerging trends in industrial electronics			
<b>Total Periods</b>			<b>4 5</b>
<b>Text Books</b>			
1.	"Industrial Electronics" – James A. Rehg, Glenn J. Sartori, Pearson Prentice Hall, 2005.		
2.	Power Electronics: Circuits, Devices, and Applications" – Muhammad H. Rashid, Fourth Edition, published by Pearson Education, 2014.		
3.	Programmable Logic Controllers" – Frank D. Petruzella, By Frank D. Petruzella, 2024,  Published, 6th Edition, McGraw Hill		
4.	"Modern Control Engineering" – Katsuhiko Ogata, 3 <sup>rd</sup> edition, Prentice Hall, 2020		
<b>References</b>			
1.	"Introduction to Industrial Robotics" – S.K. Saha, Tata McGraw Hill –2th Edition, 2017		
3.	Thomas. E. Kissell, " Industrial Electronics", Pearson Education-3 <sup>rd</sup> edition 2002.		
<b>E-Resources</b>			
1.	<a href="http://www.inohv8.info/industrial%20tronics.pdf">https:// http://www.inohv8.info/industrial%20tronics.pdf</a>		
2.	<a href="https://www.mdpi.com/books/reprint/3785?utm_source">https://www.mdpi.com/books/reprint/3785?utm_source</a>		



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Programme	B.E.	Programme Code	103	Regulation	2023			
Department	ELECTRONICS AND COMMUNICATION ENGINEERING			Semester	VII			
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks		
		L	T	P	C	CA	ESE	Total
U23ECOES	Sensor and its Applications	3	0	0	3	40	60	100
Course Objective	The main objective of the course is to							
	<ul style="list-style-type: none"> <li>Understand the basic principles and classifications of sensors.</li> <li>Learn the working and applications of motion &amp; ranging sensors.</li> <li>Explore the characteristics and types of optical &amp; thermal sensors.</li> <li>Study real-world applications of sensor technologies across engineering domains.</li> </ul>							
Course Outcome	At the end of the course, the student should be able to,							Knowledge Level
	CO1: Explore the basic concept of sensors, it types & working principles.							K2
	CO2: Apply knowledge of motion and range sensors in positioning and distance measurement in engineering systems.							K3
	CO3: Analyze the operation and use of orientation sensors in measurement systems.							K4
	CO4: Demonstrate the application of optical & thermal sensors in industrial monitoring and control.							K3
Pre-requisites	-							K4

CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak												CO/PSO Mapping			
COs	Programme Outcomes (POs)											PSOs			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	1	1									1	3		
CO2	3		3									1			
CO3	2	2	3				1						2		
CO4	2	2	3				1					1	2		
CO5	2	2	3				1					1	3		

**Course Assessment Methods**

<b>Direct</b>
1.Continuous Assessment Test I, II & III 2.Assignment 3.End-Semester examinations



*[Signature]*  
BoS Chairman,

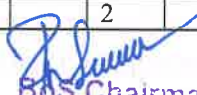
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for Women (Autonomous),  
Elayampalayam, Tiruchengode - 637 205.

<b>Indirect</b>			
1.Course - end survey			
<b>Content of the syllabus</b>			
<b>Unit – I</b>	<b>BASIC INTRODUCTION</b>	Periods	<b>9</b>
Basics of Sensors- Classification of sensors -Principles of Physical and Chemical Sensors –Static and dynamic characteristics-			
<b>Unit - II</b>	<b>MOTION AND RANGE SENSORS</b>	Periods	<b>9</b>
Motion Sensors–types of motion sensors, Position sensors, Other sensors : Accelerometer– GPS, Bluetooth, Range Sensors: Ultrasonic Ranging sensors,Laser Range Sensor (LIDAR).			
<b>Unit – III</b>	<b>ORIENTATION SENSORS</b>	Periods	<b>9</b>
Magnetic Sensors : types, principles- Magneto resistive sensors-Heading Sensors – Compass, Gyroscope, Inclinometers			
<b>Unit - IV</b>	<b>OPTICAL AND THERMAL SENSOR</b>	Periods	<b>9</b>
Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors –Thermistor, RTD, Thermo couple. Radiation Sensors - Smart Sensors - Film sensor			
<b>Unit – V</b>	<b>APPLICATIONS OF SENSORS</b>	Periods	<b>9</b>
Industrial Applications,Healthcare Applications,Automotive applications,Applications in consumer Electronics.			
<b>Total Periods</b>			<b>45</b>
<b>Text Books</b>			
1.	Patranabis D., “ Sensor and Actuators”, Prentice Hall of India (Pvt) Ltd., second edition 2013(revised).		
2.	Ian R Sinclair, —Sensors and Transducers, Third Edition, Newnes publishers, 2011.		
3.	Ernest O. Doebelin, “Measurement systems Application and Design”, International Student Edition, VI Edition, Tata McGraw-Hill Book Company, 2012.		
<b>References</b>			
1.	Ernest O. Doebelin, “Measurement systems Application and Design”, International Student Edition, VI Edition, Tata McGraw-Hill Book Company, 2012.		
2.	Robert B.Northrop, “Introduction to Instrumentation and Measurement” ,3rd Edition” ,CRC–Press–Taylor and Francis Group,2014		
<b>E-Resources</b>			
1.	<a href="https://www.finoit.com/blog/top-15-sensor-types-used-iot/">https://www.finoit.com/blog/top-15-sensor-types-used-iot/</a>		
2.	<a href="https://www.sensorsportal.com/HTML/DIGEST/march_2015/Vol_186/ST_Vol_186_Issue_3_2015.pdf">https://www.sensorsportal.com/HTML/DIGEST/march_2015/Vol_186/ST_Vol_186_Issue_3_2015.pdf</a>		
3.	<a href="https://www.first-sensor.com/en/applications/industrial/">https://www.first-sensor.com/en/applications/industrial/</a>		
4.	<a href="https://nybsys.com/types-of-sensors/">https://nybsys.com/types-of-sensors/</a>		

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	<b>VIVEKANANDHA COLLEGE OF ENGINEERING FOR WOMEN</b> (Autonomous Institution, Affiliated to Anna University ,Chennai) Elayampalayam, Tiruchengode – 637 205														
Programme	B.E.		Programme Code				205		Regulation		2023				
Department	ELECTRONICS AND COMMUNICATION ENGINEERING							Semester		VII					
Course Code	Course Name	Periods Per Week			Credit	Maximum Marks									
		L	T	P		C	CA	ESE	Total						
U23ECO9	Nano Electronics	3	0	0	3	40	60	100							
Course Objective	The main objective of the course is to <ul style="list-style-type: none"> <li>Understand the principles and techniques involved in the deposition, etching, and polishing of materials used in nano-fabrication and thin-film technologies.</li> <li>Explore the properties and applications of carbon nanostructures, focusing on carbon nanotubes and their fabrication methods.</li> <li>Examine the working and potential of logic devices such as MOSFETs, Ferroelectric FETs, and superconducting electronics, with a focus on alternative materials and nano-devices.</li> <li>Investigate various random access memory and storage technologies, understanding their properties, operation, and emerging alternatives in mass storage.</li> <li>Analyze data transmission systems, display technologies, and interfaces, including the use of photonics and organic materials in modern communication and display devices.</li> </ul>														
	Course Outcome	At the end of the course, the student should be able to										Knowledge Level			
CO1: Understand and describe the various film deposition methods and material removal techniques, including lithography, etching, and chemical-mechanical polishing, and their significance in nanotechnology and semiconductor manufacturing										K2					
CO2: Explain the fabrication methods and the electrical, mechanical, and vibrational properties of carbon nanotubes, and discuss their real-world applications.										K3					
CO3: Analyze the working principles of silicon MOSFETs, Ferroelectric FETs, and superconducting digital electronics, and compare them with emerging technologies like carbon nanotube-based data processing.										K4					
CO4: Evaluate the various types of random access memory technologies, including DRAM, FeRAM, MRAM, and emerging mass storage devices like holographic storage and rewriteable DVDs based on phase-change materials.										K4					
CO5: Compare and contrast data transmission systems, such as photonic networks and microwave communication, and analyze the principles of LCDs and OLEDs.										K3					
Pre-requisites	VLSI design and circuits, Semiconductor materials														
CO / PO Mapping													CO/PSO Mapping		
(3/2/1 indicates strength of correlation) 3-Strong, 2 – Medium, 1 - Weak															
Cos	Programme Outcomes (POs)										PSOs				
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	P O 11	PO 12	PS O1	PS O 2	PS O 3
CO 1	3	3	2	2									3		
CO 2	3	3	2	2			2						3		
CO 3	3	3	3	2			2						3		

  
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CO 4	3	3	3	2				2					3	2		
CO 5	3	3	3	2										2		
<b>Course Assessment Methods</b>																
<b>Direct</b>																
1. Continuous Assessment Test I, II & III																
2. Assignment and Seminar																
3. End-Semester examinations																
<b>Indirect</b>																
1. Course – end survey																
<b>Content of the syllabus</b>																
<b>Unit – I</b>	<b>TECHNOLOGY AND ANALYSIS</b>										Periods	<b>9</b>				
Film Deposition Methods – Lithography- Material removing techniques – Etching and Chemical-Mechanical Polishing – Scanning Probe Techniques.																
<b>Unit – II</b>	<b>CARBON NANO STRUCTURES</b>										Periods	<b>9</b>				
Carbon Clusters – Carbon Nano tubes – Fabrication – Electrical, Mechanical and Vibrational Properties – Applications of Carbon Nano tubes.																
<b>Unit – III</b>	<b>LOGIC DEVICES</b>										Periods	<b>9</b>				
Silicon MOSFET's – Novel materials and alternative concepts – Ferroelectric Field Effect Transistors – Super conductor digital electronics – Carbon Nano tubes for data processing.																
<b>Unit – IV</b>	<b>RANDOM ACCESS MEMORIES AND MASS STORAGE DEVICES</b>										Periods	<b>9</b>				
High Permittivity material for DRAM's – Ferro electric Random Access memories – Magneto- resistive RAM- Hard Disk Drives – Magneto Optical Disks – Rewritable DVDs based on Phase Change Materials –Holographic Data Storage.																
<b>Unit – V</b>	<b>DATA TRANSMISSION AND INTERFACES AND DISPLAYS</b>										Periods	<b>9</b>				
Photonic Networks – Microwave Communication System – Liquid Crystal Displays – Organic Light Emitting diodes.																
												<b>Total Periods</b>	<b>45</b>			
<b>References</b>																
1.	Rainer Waser, “Nano Electronics and Technology”, Wiley VCH, 2003.															
2.	Charles Poole, “Introduction to Nano Technology”, Wiley Inter science, 2003.															
3.	C.Wasshuber, Simon , “Simulation of Nano Structures Computational Single-Electronics”, Springer- Velag, 2001.															
4.	Rainer Waser, “Nano Electronics and information technology advanced electronic materials and novel devices”, Wiley –Germany, 2005.															
5.	M. Mark Reed and Takhee Lee, “Molecular Nano Electronics”, American Scientific Publisher, California, 2003.															
<b>E-Resources</b>																
E1	<a href="https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-701-introduction-to-nanoelectronics">https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-701-introduction-to-nanoelectronics</a>															
E2	<a href="https://nptel.ac.in/courses/117108047/">https://nptel.ac.in/courses/117108047/</a> , Course Co-ordinated By : IISC Bangalore															



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