Estd. 1962
"A++" Accredited by NAAC (2021)
With CGPA 3.52

SHIVAJI UNIVERSITY, KOLHAPUR
416 004, MAHARASHTRA
PHONE : EPABX – 2609000, BOS Section – 0231-2609094, 2609487
Web : www.unishivaji.ac.in Email: bos@unishivaji.ac.in
शिवाजी विद्यापीठ, कोल्हापूर ४१६ ००४, महाराष्ट्र
दूरध्वनी - इपीबीएक्स - २०६०९०००, अभ्यासमंडळे विभाग : ०२३१- २६०९०९४. २६०९४८७
वेबसाईट : www.unishivaji.ac.in ईमेल : bos@unishivaji.ac.in

जा.क्र./शि.वि/अं.म./ 608 दिनांक:— ०७/१०/२०२५

प्रति,

१. मा. संचालक / प्राचार्य,
सर्व संलग्नीत अभियांत्रीकी महाविद्यालये,
शिवाजी विद्यापीठ, कोल्हापूर

२.प्र. संचालक,
स्कुल ऑफ इंजिनिअरींग ॲण्ड टेक्नॉलॉजी,
शिवाजी विद्यापीठ, कोल्हापूर

३.प्र. संचालक,
यशवंतराव चव्हाण स्कुल ऑफ रुरल डेव्हलपमेंट,
शिवाजी विद्यापीठ, कोल्हापूर

विषय:— एम. टेक अभ्यासक्रमातील किरकोळ दुरुस्तीबाबत.

संदर्भ:— १.एसयु/बीओएस/सायन्स&टेक/३१७ व ५३४ दि.२३/५/२०२५ व दि.४/९/२०२५
२.एसयु/बीओएस/सायन्स&टेक/५३९ दि.०८/०९/२०२५

महोदय,

उपरोक्त संदर्भिय विषयास अनुसररुन आपणास आदेशान्वये कळविण्यात येते की, शैक्षणिक वर्ष २०२५—२६ पासून लागू करण्यात आलेल्या खालील **एम.टेक** अभ्यासक्रमामध्ये किरकोळ दुरुस्ती करण्यात आलेली आहे.

Sr.	Course/Syllabus	Sr.	Course/Syllabus
1	Enargy Technology (ON)	6	Rural Technology (ON)
2	Computer Science and Technology (ON)	7	Computer Science and Engineering (OFF)
3	Electronics and Telecommunication (ON)	8	Mechanical (CAD/CAM/CAE) (OFF)
4	Environmental Science and Technology (ON)	9	Electronics and Telecommunication Engineering (OFF)
5	Food Technology (ON)		

सोबत सदर अभ्यासक्रमाची प्रत जोडली आहे. तसेच विद्यापीठाच्या https://www.unishivaji.ac.in (NEP-2020@suk/ Online syllabus) या संकेस्थळावर ठेवण्यात आला आहे. सदर दुरुस्ती ही शैक्षणिक वर्ष २०२५—२६ पासून लागू राहील.

सदर अभ्यासक्रम सर्व संबधित विद्यार्थी व शिक्षकांच्या निदर्शनास आणून द्यावेत ही विनंती.

कळावे.

आपला विश्वासू,

डॉ. एस. एम. कुबल
उपकुलसचिव

सोबत — अभ्यासक्रमाची प्रत,

प्रत :— **माहितीसाठी व पुढील योग्यत्या कार्यवाहीसाठी**

मा. संचालक, परीक्षा व मुल्यमापन मंडळ	प्र. अधिष्ठाता, विज्ञान व तंत्रज्ञान विद्याशाखा
अध्यक्ष, संबंधित अभ्यास /अस्थायी मंडळ	इतर परिक्षा ४ विभागास.
परीक्षक नियुक्ती ए व बी विभागास.	संलग्नता टी. १ व टी. २ विभागास
पीजी प्रवेश विभागास	पीजी सेमिनार विभागास
संगणक केंद्र / आयटी सेल	पात्रता विभागास

Shivaji University

Kolhapur

Revised Syllabus

M. Tech.

Electronics and Telecommunication Engineering

To be implemented from

Academic Year 2025-26



Program Outcomes (POs):

PO1: Demonstrates in-depth knowledge and understanding of the chosen engineering discipline.

PO2: Analyzes complex engineering problems, evaluates information, and forms well-reasoned conclusions.

PO3: Identifies, formulates, and solves complex engineering problems using appropriate methods and tools.

PO4: Conducts research, analyzes data, and interprets findings to contribute to the advancement of knowledge.

PO5: Effectively utilizes modern engineering tools, software, and technologies.

PO6: Works effectively as a team member and leader in multidisciplinary environments.

PO7: Demonstrates knowledge of project management principles and applies them to engineering projects.

PO8: Effectively communicates technical information both orally and in writing.

PO9: Recognizes the need for continuous learning and professional development.

PO10: Applies ethical principles and understands the societal impact of engineering solutions.

Shivaji University, Kolhapur
Department of Electronics and Telecommunication Engineering

M. Tech. Electronics & Telecommunication Engineering Course Structure
Semester-I
Applicable From Academic Year 2025-26

Course Category	Subject Code	Course	Teaching Scheme				Examination Scheme			
			L	T	P	Credits	Theory		Practical	
							Scheme	Max. marks	Scheme	Max. marks
PCC	ETC C111	Random Process	3		-	3	IE	40		
							ESE	60		
PCC	ETCC112	Advanced Mobile Security	3	-	-	3	IE	40		
							ESE	60		
PCC	ETCC113	Advanced Embedded System	3	-	-	3	IE	40		
							ESE	60		
PSE	ETCE111	Elective-I	3	-	-	3	IE	40		
							ESE	60		
OE	ETCOE111	Elective – II (Open Elective)	3	-	-	3	IE	40		
							ESE	60		
All	ETCA111	Research Methodology	2		-	2	-	-	IE	50
PCC	ETCC114	Seminar I	-	-	2	1			IE	50
PCC	ETCC115	Random Process Laboratory	-	-	2	1	-	-	IE	50
PCC	ETCC116	Advanced Embedded System Laboratory	-	-	2	1	-	-	IE	50
		Total	**17**	**-**	**6**	**20**		**500**		**200**
Total Contact hours per week =23*										

Course Code	Elective – I (Program Specific)
ETCE111-1	Computer Organization and Architecture
ETCE111-2	RF and Microwave Circuit Design
ETCE111-3	AI and Machine Learning
ETCE111-4	Application Specific Integrated Circuit

Course Code	Elective – II (Open Elective)	Branch
MECADOE11	Design of Hydraulic and Pneumatic Systems	CAD/CAM/CAE
MECADOE12	Mechatronics System Design	
MECADOE13	Advanced Finite Element Analysis	
CSEOE11	Advanced Operating System	Computer Science Engineering
CSEOE12	Internet of Things	
CSEOE13	Data Analytics	

Shivaji University, Kolhapur
Department of Electronics and Telecommunication Engineering

M. Tech. Electronics & Telecommunication Engineering Course Structure
Semester-II
Applicable From Academic Year 2025-26

Course Category	Subject Code	Subject Title	Teaching Scheme (Hours/week)				Examination Scheme			
							Theory		Practical	
			L	T	P	Credits	Scheme	Max. marks	Scheme	Max. marks
PCC	ETCC121	System On Chip	3	-	-	3	IE	40	-	-
							ESE	60		
PCC	ETCC122	Computer Vision	3	-	-	3	IE	40	-	-
							ESE	60	-	-
PCC	ETCC123	Wireless Sensor Networks	3	-	-	3	IE	40	-	-
							ESE	60	-	-
PSE	ETCE121	Elective-III	3	-	-	3	IE	40	-	-
							ESE	60	-	-
OE	ETCOE121	Elective – IV (Open Elective)	3	-	-	3	IE	40	-	-
							ESE	60	-	-
ALL	ETCA121	Intellectual Property Rights	2	-	-	2	----	---	IE	50
PCC	ETCC124	Seminar-II	-	-	2	1	--------	-------	IE	50
PCC	ETCC125	Wireless Sensor Networks Laboratory	-	-	2	1	--------	-------	IE	50
PCC	ETCC126	Computer Vision Laboratory	-	-	2	1	--------	-------	IE	50
		Total	**17**	**-**	**6**	**20**		**500**		**200**
Total Contact hours per week =23*										

Course Code	Elective–III (Program Specific)
ETCE121-1	Cryptography and Network Security
ETCE121-2	Antenna and Radiation System
ETCE121-3	Industrial IoT
ETCE121-4	CMOS VLSI

Course Code	Elective-IV (Open Elective)	Branch
MECADOE21	Product Life Cycle Management	CAD/CAM/CAE
MECADOE22	Rapid Manufacturing	
MECADOE23	Industrial Automation and Robotics	
CSEOE21	Geographical Information System	Computer Science and Engineering
CSEOE22	Natural Language Processing	
CSEOE23	Blockchain Technology	

Shivaji University, Kolhapur
Department of Electronics and Telecommunication Engineering
M. Tech. Electronics & Telecommunication Engineering Course Structure

Semester- III

Sr. No.	Subject Code	Subject Title	Teaching Scheme (Hours/week)				Examination Scheme			
							Theory		Practical	
			L	T	P	Credits	Scheme	Max. marks	Scheme	Max. marks
1	ETCC231	Internship	-	-	2*	5**	--------	-------	IE	50
									EOE	50
2	ETCC232	Dissertation Phase-I	-	-	2*	15	--------	-------	IE	100
									EOE	100
		Total	-	-	4	20				300
Total Contact hours per week =4*										

*Students are expected to do self-study for two hours as per the guidance given by the Project Guide and report to the department once a week. Hence, contact hours are to be taken as two for the calculation of contact hours.

** Internship of eight weeks at the end of the First Year

OR

Industrial training will be split in two slots of four weeks during semester III

Evaluation at the end of III semester on the basis given report and Presentation to the concerned Guide.

Shivaji University, Kolhapur
Department of Electronics and Telecommunication Engineering
M. Tech. Electronics & Telecommunication Engineering Course Structure

Semester- IV

Sr. No.	Subject Code	Subject Title	Teaching Scheme (Hours/week)				Examination Scheme			
							Theory		Practical	
			L	T	P	Credits	Scheme	Max. marks	Scheme	Max. marks
1	ETCC241	Dissertation Phase-II	-	-	4*	20	---	---	IE	150
									EOE	150
		Total	-	-	4	20	----	--		300
Total Contact hours per week =4*										

*Students are expected to do self-study for two hours as per the guidance given by the project Guide and report to the department once in a week. Hence, contact hours are to be taken as two for the calculation of contact hours.
Note: $: Minimum 40% marks required in ESE as passing head.

• Tutorials and Practicals shall be conducted in batches with batch strength not exceeding 18 students.
IE – Internal Evaluation, ESE –End Semester Examination,
IPE – Internal Practical Evaluation, EPE–External Practical Examination,
IOE– Internal Oral Evaluation, EOE–External Oral Examination

SEMESTER-I

Class, Part & Semester	**:**	**First Year M. Tech (E&TC), Part I, Sem-I**					
Course Title	**:**	Random Process			***Course Code*:**	**:**	ETCC111
Teaching Scheme (Hours)	**:**	Lecture:	3 Hrs/week		***Total Credits***	**:**	3
Evaluation Scheme (Marks)	**:**	IE= 40	ESE = 60	Grand Total=100	***Duration of ESE***	**:**	2 hrs
Pre-requisites *(if any)*	**:**	probability and statistics, signals and systems, and fundamental mathematical concepts					
Course Domain	**:**	Electronics & Communication Engineering					

Course Rationale: The course on Random Processes builds fundamental skills to model and analyze uncertainty in signals and systems, essential for applications in communications, signal processing, and modern data-driven technologies.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	To develop an understanding of basic probability concepts and their applications.	1.	Students will be able to solve probability problems using conditional probability and Bayes' theorem.
2.	To study the behavior and statistical properties of discrete and continuous random variables.	2.	Students will be able to classify random variables and compute their statistical measures.
3.	To understand joint distributions and statistical relationships among multiple random variables.	3.	Students will be able to analyze and apply the central limit theorem, covariance, and correlation in practical cases.
4.	To introduce classification, correlation, and spectral analysis of random processes.	4.	Students will be able to estimate autocorrelation and spectral density for random processes.
5.	To study the fundamentals and state behavior of Markov chains.	5.	Students will be able to apply Chapman-Kolmogorov equations and analyze stability of Markov systems.
6.	To understand the principles and models of queuing systems.	6.	Students will be able to analyze and solve M/M/1 and multi-server queuing problems.

Curriculum Content	**Hours**
Unit 1 Probability Theory: The concept of Probability; the axioms of Probability; sample space and events; Conditional probability and Baye‟s theorem, Independence of events, Bernoulli trails	**6**
Unit 2 Random variables: Introduction to Random Variables, Discrete Random Variable, Continuous Random Variable, Expectation of Random Variable, Moments of Random Variable (mean, mode variance, skewness, Kurtosis)	**6**
Unit 3 Multiple Random Variables: Cumulative distribution function and probability density function of single and multiple Random Variables, statistical properties, jointly distributed Gaussian random variables, Conditional probability density, properties of	**6**

sum of random variables, Central limit theorem, estimate of population means, Expected value and variance and covariance.	
Unit 4 Random Processes: Classification of Processes; Properties, Auto correlation and cross correlation function; Estimate of auto correlation function. Spectral Density: Definition, Properties, white noise, Estimation of auto- correlation function using frequency domain technique, Estimate of spectral density, cross spectral density and its estimation, coherence.	**6**
Unit 5 Markov Chains: Chapman Kolmogorov equation, Classification of states, Limiting probabilities, Stability of Markov system, Reducible chains, Markov chains with continuous state space.	**6**
Unit 6 Queuing Theory: Elements of Queuing System Little's Formula, M/M/1 Queue, Multi server system	6
Suggested list of Tutorials and Assignments: As suggested by the course teacher	
Suggested Text Books:	
1.	Introduction to probability Models, Sheldon M. Ross, Academic Press, 9thedition 2009
2.	Random Signal Processing, Prof. G. V. Kumbhojkar, C. Jamanadas & Company, 2nd edition 2009
Suggested Reference Books:	
1.	Probability and Random Processes for Electrical Engg., Alberto Lean, Pearson, 2nd edition 2009
2.	Probability, Random Variables and Stochastic Processes, Athanasios Papoulis, S. Unnikrishna Pillai, PHI, 4thb edition 2010
3.	Stochastic Processes, J. Medhi, New Age International, 3rd edition, 2009

Course Outcome and Program Outcome Mapping

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	2	-	-	-	1	-
CO2	3	3	3	2	2	-	-	-	1	-
CO3	3	3	3	3	2	-	-	1	2	-
CO4	3	3	3	3	3	-	-	1	2	-
CO5	3	3	3	3	3	-	1	-	2	1
CO6	3	3	3	3	3	1	1	1	2	1

Level of Mapping as: Low1, Moderate2, High3

Class, Part & Semester	**:**	**First Year M. Tech (E&TC), Part I, Sem-I**					
Course Title	**:**	**Advanced Mobile Security**			***Course Code*:**	**:**	ETCC112
Teaching Scheme (Hours)	**:**	Lecture :	3 Hrs/week		***Total Credits***	**:**	3
		Tutorial :	-- Hrs/week				
Evaluation Scheme (Marks)	**:**	IE= 40	ESE = 60	Grand Total=100	***Duration of ESE***	**:**	2 hrs
Pre-requisites *(if any)*	**:**	Students are expected to have prior knowledge of Network Concept, Mobile Communication, OS, Security Fundamentals					
Course Domain	**:**	**Electronics and Telecommunication Engineering (E&TC)** and **Computer Engineering**					

Course Rationale: To develop core understanding of mobile systems, 5G, and security challenges in modern wireless networks.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Learn mobile cellular systems	1.	Describe the basics of Mobile cellular systems
2.	Learn the Operating system	2.	Classify the different mobile security and OS
3.	Learn security issues of the mobile network	3.	Apply the basic knowledge of security.
4.	Discuss IOS security	4.	Establishing infrastructure, simulations and programming the in WSN environment
5.	Study the 5G network.	5.	Compare the various Mobile Networks
6.	Understand Emerging Trends in Mobile Security	6.	Explore emerging trends and future directions in mobile security.

Curriculum Content	**Hours**
Unit 1 Introduction: History of mobile cellular systems, First Generation, Second Generation, Generation 2.5, Overview of 3G & 4G, 3GPP and 3GPP2 standards, 3G Networks: Evolution from GSM, 3G Services & Applications, 4G Networks: Evolution, Services & Applications,	**6**
Unit 2 Android **and Operating System:** Introduction to Smartphones and Operating Systems, Smartphone Applications, Android System Architecture and Development, Android Inter-Process Communication (IPC), Android Security Model, Permissions and Security in Android, Key Android Components	**7**
Unit 3 Security of Mobile Networks: Wi-Fi security, Telecom Network Security, Personal Area Network Security, Near Field Communications Security. Android Application development, Development Tools & Debugging, Application Runtime, Application. Basics, Mobile HTML Sites and Security, Authentication on Mobile Web Apps, Encryption & Secure Communication in Mobile Networks, Mobile Application Security Attacks and Mitigation	**7**
Unit 4 Apple **IOS security:**Breaking out, Breaking In, Security testing, Application format, Permissions and user control, Local data storage, Networking, Push notification,	**7**

copy/paste and other IPC	
Unit 5 – 5G NETWORKS: 5G Vision, 5G features and challenges, Applications of 5G, Difference between 4G & 5G, 5G Technologies – Millimeter Wave (mmWave) Communications, Massive MIMO (Multiple Input, Multiple Output), Software-Defined Networking (SDN) and Network Function Virtualization (NFV).	**6**
Unit 6 – Emerging Trends in Mobile Security:5G Security: Security implications of 5G networks on mobile devices. IoT and Mobile Security: Challenges in securing IoT devices and their integration with mobile platforms. Artificial Intelligence in Mobile Security: Use of AI for threat detection and response. Future Directions: Anticipated developments in mobile security technologies.	**7**

Suggested Text Books:	
1.	John M Senior, Optical Fiber Communications, Principles and Practice, 3 Edition, Pearson Education, 20i0, ISBN:978-8i-3i7-3266-3.
2.	Rajeev Rama swamy and Kumar N Sivarajan, "Optical Networks: A Practical Perspective", 2nd Ed., 2004, Elsevier Morgan Kaufmann Publishers (An imprint of Elsevier).
3.	Pallapa Venkataram, Satish Babu, Wireless and Mobile Network Security, First Edition, Tata McGraw Hill, 2010..
Suggested Reference Books:	
1.	Harold Kolimbris, "Fiber Optic Communication", 2nd Ed, 2004, PEI
2.	Uyless Black, "Optical Networks: Third Generation Transport Systems", 2nd Ed, 2009, PEI
3.	Govind Agarwal, "Optical Fiber Communications", 2nd Ed, 2004, TMH.
4.	Hakima Chaouchi, Maryline Laurent-Maknavicius, Wireless and Mobile Network Security Basics, Security in On-the-shelf and Emerging Technologies, Wiley, 2009.

Course Outcome and Program Outcome Mapping

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	-	1	-	-	1	1	1
CO2	2	3	2	-	2	-	-	1	1	2
CO3	2	3	3	1	2	-	-	1	1	2
CO4	2	2	3	2	3	1	1	1	1	1
CO5	2	3	2	1	1	-	-	1	1	2
CO6	2	3	2	1	1	-	-	1	3	2

Level of Mapping as: Low1, Moderate2, High3

Class, Part & Semester	**:**	**First Year M. Tech (E&TC), Part I, Sem-I**					
Course Title	**:**	**Advanced Embedded System**			***Course Code*:**	**:**	ETCC113
Teaching Scheme (Hours)	**:**	Lecture:	3 Hrs/week		***Total Credits***	**:**	3
		Tutorial:	- Hrs/week				
Evaluation Scheme (Marks)	**:**	IE= 40	ESE = 60	Grand Total=100	***Duration of ESE***	**:**	2 hrs
Pre-requisites *(if any)*	**:**	Embedded System					
Course Domain	**:**	Integrated Circuits					

Course Rationale: An advanced embedded system course is designed to build upon foundational knowledge, equipping students with in-depth skills in hardware, software and advanced programming techniques, preparing them for specialized roles in the industry.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Introduce the fundamentals, evolution, and categories of embedded systems	1.	Explain the definition, evolution, characteristics, and design challenges of embedded systems.
2.	Develop knowledge and practical skills in using popular embedded platforms such as Arduino, MSP430, and ESP32 for real-world applications.	2.	Demonstrate the ability to use embedded platforms such as Arduino, MSP430, and ESP32 for specific applications.
3.	Impart an understanding of embedded communication protocols including serial, parallel, wired, and wireless interfaces for system integration.	3.	Analyze and implement various embedded communication protocols including SPI, I2C, CAN, Zigbee, BLE, and LoRa.
4.	Explore advanced embedded architectures, especially ARM Cortex-M3, covering processor architecture, instruction sets, and interrupt handling mechanisms.	4.	Illustrate the ARM Cortex-M3 architecture, including its registers, pipeline, stack operations, and its programming.
5.	Apply embedded system design principles through case studies relevant to modern engineering challenges.	5.	Design and evaluate embedded system solutions using case studies, integrating hardware, firmware, and communication protocols for real-world scenarios.

Curriculum Content	**Hours**
Unit 1 Introduction To Embedded System: Definition, Evolution of embedded systems, Categories of embedded systems Applications in telecom, IoT, automotive, medical devices. Embedded system architecture – hardware, firmware, software layers. Characteristics & design challenges of advanced embedded systems, Real-time constraints & performance requirements.	**5**
Unit 2 Embedded Platforms: Arduino Platform: ATmega328P microcontroller features, Board description, Arduino IDE and programming model, Digital/analog I/O, serial	**7**

communication, Simple sensor interfacing examples, MSP430 Platform: Features, Ultra-low-power architecture, GPIO, ESP32 Platform: Built-in Wi-Fi and Bluetooth (BLE), TCP/IP Networking stack , MQTT basics.	
Unit 3 Embedded Communication Protocols : Introduction–Serial / Parallel Communication–Serial communication protocols -RS232 standard – RS485 – Synchronous Serial Protocols - Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) - USB -ISA/PCI Bus protocols – Fire wire, CAN, Wireless protocols: Zigbee, BLE, LoRa, Embedded TCP/IP	**6**
Unit 4 Advanced Embedded Architecture: Introduction to ARM Cortex-M3 Processor,Cortex-M3 Architecture, Cortex-M3 Pipeline, Operation Modes, Registers: General-Purpose Registers, Stack Pointer, Link Register, Program Counter, Special Registers, Stack Memory Operations: Basic Operations of the Stack, Cortex-M3 Stack Implementation, Exceptions and Interrupts.	**7**
Unit 5 Advanced Embedded Programming: Instruction Sets: Assembly Basics, Instruction List, Instruction Descriptions - Cortex-M3 Implementation Overview: Pipeline, Block Diagram, Bus Interfaces on Cortex-M3, I-Code Bus, D-Code Bus, System Bus, External PPB and DAP Bus, Introduction to ARM Cortex-M3 C program (LPC1768).	**6**
Unit 6 Embedded System Design Case Studies: Wearable Health Monitoring System, Industrial IoT Vibration Analysis System, Smart Agriculture Irrigation System, Automotive ECU for Adaptive Headlights, Secure Smart Lock System.	**5**

Suggested Text Books:	
1.	The Definitive Guide to the ARM Cortex-M3, Joseph Yiu, Second Edition, Elsevier Inc. 2010.
2.	Frank Vahid/Tony Givargis, "Embedded System Design- A unified Hardware/software Introduction".
3.	David E. Simon, ―An Embedded Software Primer,Perason Education,2003.
4.	John H. Davies "MSP430 Microcontroller Basics",Elsevier Ltd Publications, Copyright 2008
Suggested Reference Books:	
1.	Embedded systems by Raj Kamal, McGraw Hill
2.	Cortex-M series-ARM Reference Manual
3.	Cortex-M3 Technical Reference Manual (TRM)
4.	ATmega328P Datasheet
5.	ESP32 Datasheet

Course Outcome and Program Outcome Mapping

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	1	2	–	–	–	–	–
CO2	3	2	3	1	3	–	–	–	2	–
CO3	3	3	3	2	3	–	–	–	2	–
CO4	3	2	2	2	3	–	–	–	2	–
CO5	3	3	3	3	3	1	1	2	3	2

Level of Mapping as: Low1, Moderate2, High3

Class, Part & Semester	**:**	**First Year M. Tech (E&TC), Part I, Sem-I**					
Course Title	**:**	**Computer Organization and Architecture (PSE-I)**			***Course Code*:**	**:**	ETCE111-1
Teaching Scheme (Hours)	**:**	Lecture:	3 Hrs/week		***Total Credits***	**:**	3
		Tutorial:	-- Hrs/week				
Evaluation Scheme (Marks)	**:**	IE= 40	ESE = 60	Grand Total=100	***Duration of ESE***	**:**	2 hrs
Pre-requisites (if any)	**:**	Operating system, Microcontroller					
Course Domain	**:**	Computer Engineering					

***Course Rationale**:* This course provides the knowledge and skills required to understand, design, and analyze advanced computer architectures and parallel processing systems. It prepares students for solving complex problems in high-performance computing, distributed systems, and emerging computing technologies.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Introduce the fundamental principles and organization of modern computer system	1.	Demonstrate understanding of computer architecture fundamentals, instruction sets, and performance metrics.
2.	Provide an understanding of processor structure, instruction execution, and control design.	2.	Analyze processor organization, instruction execution, and control unit design including pipelining.
3.	Familiarize students with memory hierarchy, cache, and virtual memory systems.	3.	Compare different memory technologies, cache mapping techniques, and virtual memory management approaches.
4.	Explain the concepts of I/O organization, system buses, and interfacing mechanisms.	4.	Explain I/O mechanisms, DMA, bus architectures, and storage devices.
5.	Explore multiprocessor architectures, interconnection networks, and cache coherence issues.	5.	Evaluate multiprocessor systems, interconnection networks, and cache coherence protocols.
6.	Introduce advanced architectural features, multicore processors, and emerging computing trend	6.	Relate advanced processor architectures (RISC, CISC, VLIW, multicore) and emerging trends (clusters, GPUs) to modern computing applications

Curriculum Content	**Hours**
Unit 1 Fundamentals of Computer Architecture: Basic structure of computers: CPU, memory, I/O, Evolution of computer architecture, Performance metrics: throughput, latency, speedup, efficiency. Flynn's Taxonomy (SISD, SIMD, MISD, MIMD), Overview of instruction set architecture (ISA)	**6**
Unit 2 Processor Organization and Control: CPU organization and data path, Micro-operations and control unit design, Hardwired vs. microprogrammed control,	**6**

Instruction cycle, instruction pipelining, Hazards: structural, data, control hazard	
Unit 3 Memory Organization: Memory hierarchy design, Cache memory: mapping techniques, replacement policies, write policies, Virtual memory: paging, segmentation, Main memory organization (RAM, DRAM, SRAM),Performance considerations.	**6**
Unit 4 Input/Output and Interfacing: I/O organization, programmed I/O, interrupt-driven I/Direct Memory Access (DMA),I/O interfaces and controllers, Buses: structure and function, bus arbitration, External storage: magnetic disks, RAID, SSDs.	**6**
Unit 5 Multiprocessors and Parallel Processing :Introduction to multiprocessor systems, Symmetric multiprocessors (SMPs)Interconnection networks: bus, crossbar, mesh, hypercube, Cache coherence and memory consistency models, Shared-memory vs. distributed-memory models.	**6**
Unit 6 Advanced Architectures and Trends: RISC vs. CISC architectures, Superscalar and VLIW processors, Multicore, processors and parallelism, Cluster computing and GPU computing, Emerging trends in computer architecture	**6**
Suggested list of Tutorials and Assignments: As suggested by the course teacher	
Suggested Text Books:	
1.	"Computer Organization and Architecture: Designing for Performance" William Stallings
2.	"Computer System Architecture" M. Morris Mano
Suggested Reference Books:	
1.	"Computer Organization and Design: The Hardware/Software Interface" David A. Patterson & John L. Hennessy
2.	"Computer Architecture: A Quantitative Approach" John L. Hennessy & David A. Patterson
3.	"Advanced Computer Architecture: Parallelism, Scalability, Programmability" Kai Hwang
4.	"Parallel Computers: Architecture and Programming" V. Rajaraman & C. Siva Ram Murthy

Course Outcome and Program Outcome Mapping

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	1	2	1	-	-	-	1
CO2	3	3	3	2	3	1	1	-	-	1
CO3	3	3	3	2	3	-	1	-	-	-
CO4	2	2	2	1	3	-	1	1	1	-
CO5	3	3	3	2	3	1	1	1	-	-
CO6	3	3	2	2	3	-	-	-	1	1

Level of Mapping as: Low1, Moderate2, High3

Class, Part & Semester	**:**	**First Year M. Tech (E&TC), Part I, Sem-I**					
Course Title	**:**	**RF and Microwave Circuit Design (PSE-I)**			***Course Code*:**	**:**	ETCE111-2
Teaching Scheme (Hours)	**:**	Lecture:	3 Hrs/week		***Total Credits***	**:**	3
		Tutorial:	- Hrs/week				
Evaluation Scheme (Marks)	**:**	IE= 40	ESE = 60	Grand Total=100	***Duration of ESE***	**:**	2 hrs
Pre-requisites *(if any)*	**:**	Microwave Engineering					
Course Domain	**:**	Electronics and Telecommunication Engineering					

Course Rationale: This course equips students with fundamental knowledge and practical design skills in RF and microwave circuits, enabling them to analyze, model, and implement high-frequency components for modern communication, radar, and satellite systems.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	To develop a fundamental understanding of RF and microwave engineering concepts.	1.	Explain and apply fundamental RF and microwave engineering concepts for high-frequency systems.
2.	To analyze the behaviour of RF passive components and model active components.	2.	Analyze the behavior of RF passive components and model active components using appropriate circuit parameters.
3.	To perform transmission line analysis for various high-frequency applications.	3.	Perform transmission line analysis to determine impedance, reflection coefficients, and standing wave ratio for various applications.
4.	To utilize the Smith Chart effectively for RF circuit design and impedance matching.	4.	Utilize the Smith Chart effectively for impedance matching and RF circuit design.
5.	To evaluate and justify the selection of components based on design requirements.	5.	Evaluate and justify the selection of RF/microwave components based on design specifications and performance trade-offs.
6.	To apply theoretical knowledge in the design and development of RF circuits for practical applications.	6.	Apply theoretical knowledge to design, simulate, and develop RF circuits for practical communication and microwave applications.

Curriculum Content	**Hours**
Unit 1: Transmission Line Theory: Lumped element circuit model for transmission line, field analysis, Smith chart, quarter wave transformer, generator and load mismatch, impedance matching and tuning.	**6**
Unit 2: Microwave Network Analysis: Impedance and equivalent voltage and	**6**

current, Impedance and admittance matrix, The scattering matrix, transmission matrix, Signal flow graph.	
Unit 3: Microwave Components: Microwave resonators, Microwave filters, power dividers and directional couplers, Ferromagnetic devices and components.	**6**
Unit 4: Nonlinearity And Time Variance Inter-symbol interference, random process & noise, definition of sensitivity and dynamic range, conversion gain and distortion.	**6**
Unit 5: Microwave Semiconductor Devices and Modeling: PIN diode, Tunnel diodes, Varactor diode, Schottky diode, IMPATT and TRAPATT devices, transferred electron devices, Microwave BJTs, GaAs FETs, low noise and power GaAs FETs, MESFET, MOSFET, HEMT.	**6**
Unit 6: Amplifiers Design: Power gain equations, stability, impedance matching, constant gain and noise figure circles, small signal, low noise, high power and broadband amplifier, oscillators, Mixers design.	**6**

Suggested Text Books:	
1.	D.M. Pozar, *Microwave Engineering*, 4th Edition, Wiley, 2011.
2.	R. Ludwig and P. Bretchko**,** *RF Circuit Design: Theory and Applications*, Pearson Education, 2009.
3.	Matthew M. Radmanesh, *Advanced RF & Microwave Circuit Design: The Ultimate Guide to Superior Design*, AuthorHouse, 2009.
Suggested Reference Books:	
1.	G.D. Vendelin, A.M. Pavio, U.L. Rohde, *Microwave Circuit Design Using Linear and Nonlinear Techniques, Wiley, 1990.*
2.	S.Y. Liao, *Microwave Circuit Analysis and Amplifier Design*, Prentice Hall, 1987.
3.	Radmanesh, *RF and Microwave Electronics Illustrated*, Pearson Education, 2004.
4.	Gupta, Amarjit Singh, *Foundations of Microwave Engineering*, Wiley-IEEE, 2006.
5.	Bahl, I.J.**,** *Fundamentals of RF and Microwave Transistor Amplifiers*, Wiley, 2009.

Course Outcome and Program Outcome Mapping

Course Outcomes (Cos)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	1	2	–	–	–	1	1
CO2	3	3	2	2	3	–	–	–	1	–
CO3	3	3	2	2	3	–	–	–	1	–
CO4	3	2	3	2	3	–	–	–	–	–
CO5	3	3	3	2	3	1	1	–	–	2
CO6	3	2	3	2	3	1	1	1	2	2

Level of Mapping as: Low1, Moderate2, High3

Class, Part & Semester	**:**	**First Year M. Tech (E&TC), Part I, Sem-I**					
Course Title	**:**	**AI and Machine Learning (PSE-I)**			***Course Code*:**	**:**	ETC111-3
Teaching Scheme (Hours)	**:**	Lecture :	3 Hrs/week		***Total Credits***	**:**	3
		Tutorial :	-- Hrs/week				
Evaluation Scheme (Marks)	**:**	IE= 40	ESE = 60	Grand Total=100	***Duration of ESE***	**:**	2 hrs
Pre-requisites *(if any)*	**:**	Image processing					
Course Domain	**:**	Computer Science and Engineering					

Course Rationale: This course introduces students to the **theories, algorithms, and methodologies** that enable machines to simulate intelligent behavior and learn from data.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Introduce the fundamentals, history, and applications of Artificial Intelligence and Machine Learning.	1.	Describe the fundamentals, scope, and applications of AI and ML.
2.	Develop problem-solving abilities using AI search algorithms.	2.	Apply search algorithms and problem-solving strategies to AI problems.
3.	Familiarize students with knowledge representation and reasoning techniques.	3.	Use knowledge representation and reasoning techniques to solve problems.
4.	Provide a comprehensive understanding of Machine Learning algorithms and their applications.	4.	Implement and evaluate supervised ML algorithms.
5.	Develop skills for implementing supervised, unsupervised, and reinforcement learning approaches.	5.	Apply unsupervised and reinforcement learning methods for data analysis.
6.	Explore real-world applications, ethical concerns, and future trends in AI/ML.	6.	Analyze the societal, ethical, and research issues related to AI and ML applications.

Curriculum Content	**Hours**
Unit 1 Introduction to AI & ML: Definition and history of AI, Applications of AI and ML,AI vs ML vs Deep Learning, Intelligent agents and environments	**7**
Unit 2 Introduction to Machine Learning basics and types pipeline: data preprocessing, feature extraction, model evaluation, Overfitting and underfitting, Cross-validation	**6**
Unit 3 Supervised Learning: Linear regression, logistic regression, Decision trees, random forests, SVM, Basics of neural networks and backpropagation, Evaluation metrics	**7**
Unit 4 Unsupervised Learning: means clustering, Hierarchical clustering,	**7**

Dimensionality reduction: PCA, t-SNE, Association rule mining		
Unit 5 Reinforcement Learning: Fundamentals of RL; Markov Decision Processes (MDPs); Q-learning; SARSA; Applications in robotics and games		**7**
Unit 6 Applications, Ethics & Trends: AI in healthcare, finance, and robotics; Societal and ethical implications; Issues of bias, accountability, transparency; Emerging trends: Deep learning, Explainable AI, Generative AI		**6**
Suggested Text Books:		
1.	Elaine Rich & Kevin Knight**,** *Artificial Intelligence*, Tata McGraw Hill.	
2.	George F. Luger**,** *Artificial Intelligence: Structures and Strategies for Complex Problem Solving*, Pearson Education.	
3.	Michael Negnevitsky**,** *Artificial Intelligence: A Guide to Intelligent Systems*, Pearson Education.	
4.	Tom M. Mitchell, *Machine Learning*, McGraw-Hill. *(or equivalent ML textbook: Alpaydin / Bishop depending on availability)*	
Suggested Reference Books:		
1.	Stuart Russell and Peter Norvig, *Artificial Intelligence: A Modern Approach*, Pearson.	
2.	Ethem Alpaydin**,** *Introduction to Machine Learning*, MIT Press.	

Course Outcome and Program Outcome Mapping

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	1	1	1	-	-	2	2	-
CO2	2	3	3	2	2	-	-	1	2	-
CO3	3	3	3	2	2	-	-	2	1	-
CO4	3	3	3	2	3	-	-	2	2	-
CO5	3	3	3	2	3	-	-	2	2	-
CO6	2	2	2	3	2	1	1	1	1	-

Level of Mapping as: Low1, Moderate2, High3

Semester	**:**						
Course Title	**:**	**Application Specific Integrated Circuits (PSE-I)**			***Course Code*:**	**:**	ETCE111-4
Teaching Scheme (Hours)	**:**	Lecture :	3 Hrs/week		***Total Credits***	**:**	3
		Tutorial :	-- Hr/week				
Evaluation Scheme (Marks)	**:**	IE=40	ESE = 60	Grand Total=100	***Duration of ESE***	**:**	2 hrs
Pre-requisites *(if any)*	**:**	VLSI design					
Course Domain	**:**	Embedded					

Course Rationale: ASICs are built for specific applications, which allow them to offer high performance and efficiency. On the other hand, FPGAs are reprogrammable and flexible, making them ideal for prototypes and applications where adaptability is needed.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Provide an understanding of the fundamentals of ASIC technology, its types, and applications in various domains.	**1.**	Explain the fundamentals of ASICs, including types, structures, and applications, and differentiate between ASICs, FPGAs, and microcontrollers.
2.	Familiarize students with different ASIC design methodologies and complete design flows from concept to fabrication.	**2.**	Demonstrate understanding of ASIC design methodologies, including top–down and bottom–up approaches, and describe complete design flows from specification to fabrication.
3.	Introduce physical design concepts including partitioning, floor planning, placement, and routing.	**3.**	Apply concepts of physical design such as partitioning, floor planning, placement, and routing, and perform basic design rule and verification checks.
		4.	Analyze design considerations related to performance, area, power consumption, and signal integrity, and propose optimization techniques.
		5.	Evaluate timing parameters, perform basic static timing analysis, and suggest solutions for clock and timing violations.
		6.	Identify and utilize appropriate EDA tools, including open-source alternatives, and discuss recent trends and challenges in ASIC design.

Curriculum Content	**Hours**
Unit 1 – Basics of ASIC Introduction to VLSI and role of ASICs in electronics, Categories of ASICs: Full-custom, Semi-custom, and Programmable, ASIC vs FPGA vs Microcontroller – key differences, Overview of programmable logic devices (PLD, CPLD, FPGA), Real-life examples of ASIC applications in mobile, automotive, and IoT, Basic structure of an	**8**

ASIC: logic cells, I/O blocks, interconnects	
Unit 2 – Design Flow Steps in ASIC design: Specification → Design Entry → Simulation → Synthesis → Fabrication → Testing, Top–Down design method: advantages and when to use, Bottom–Up design method: advantages and limitations, Design entry using HDL (VHDL/Verilog) basics, FPGA and PLD-based design flows, RTL-to-GDSII overview	**7**
Unit 3 – Physical Design Concept of partitioning in large systems, Floor planning – arranging blocks for performance and area efficiency, Placement – automatic vs manual methods, Routing – difference between global and detailed routing, Design Rule Checking (DRC) and Layout vs Schematic (LVS) verification, Circuit extraction and parasitic estimation	**6**
Unit 4 – Design Considerations Performance metrics: speed, throughput, and latency, Area optimization techniques, Power consumption types: dynamic, static, and leakage, Low-power design techniques (clock gating, power gating), Signal integrity problems: crosstalk, delay, IR drop, Reliability and thermal considerations in ASIC design	**6**
Unit 5 – Timing Analysis Digital timing parameters: setup time, hold time, propagation delay, Understanding timing paths in a circuit, Static Timing Analysis (STA) basics, Clock skew, clock jitter, and their effects, Slack – positive and negative, and timing violations, Techniques to fix timing violations	**7**
Unit 6 – Tools and Trends Overview of common EDA tools (Cadence, Synopsys, Mentor Graphics), Open-source EDA tools (e.g., Yosys, Magic VLSI, OpenROAD), Verification tools and simulation environments, Trends in ASIC design: SoC, AI accelerators, 3D ICs, Case study of an ASIC design (e.g., smartphone processor), Challenges in future ASIC designs – power, performance, cost	**8**
Suggested list of Tutorials and Assignments: As suggested by the course teacher	
Suggested Text Books:	
1	M.J.S. Smith,―Application Specific Integrated Circuits‖, Pearson, 2003
2	Weste, Neil HE, and Kamran Eshraghian. "Principles of CMOS VLSI design: a systems perspective.", Wesley Pub.Co.1985
Suggested Reference Books:	
1	Douglas A. Pucknell & Kamran Eshraghian, Basic VLSI Design :Systems and Circuits, Prentice Hall of India Private Ltd. , New Delhi , 1989.
2	Mead C, Conway L. Introduction to VLSI systems. Reading, MA: Addison-Wesley; 1980.
3	Mukherjee A. Introduction to n MOS & VLSI systems design. Prentice-Hall, Inc.; 1986.
4	L. A. Glassey & D. W. Dobbepahl, The Design & Analysis of VLSI Circuits, Addison Wesley Pub Co. 1985.
5	Rabaey JM, Chandrakasan AP, Nikolić B. Digital integrated circuits: a design perspective. Upper Saddle River, NJ: Pearson Education; 2003.

Course Outcome and Program Outcome Mapping

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	1	2	1	1	2	2	2
CO2	3	3	2	2	2	1	2	2	2	2
CO3	3	2	3	2	3	1	2	2	1	2
CO4	3	3	3	2	2	1	2	2	2	2
CO5	3	3	3	2	2	1	2	2	1	2
CO6	2	2	2	2	3	1	1	2	2	2

Level of Mapping as: Low1, Moderate2, High3

Elective -II

Class, Part & Semester	**:**	**First Year M. Tech (E&TC), Part I, Sem-I**					
Course Title	**:**	**Advanced Communication System (Elective-II)**			***Course Code*:**	**:**	ETCOE11
Teaching Scheme (Hours)	**:**	Lecture :	3 Hrs/week		***Total Credits***	**:**	3
		Tutorial :	-- Hrs/week				
Evaluation Scheme (Marks)	**:**	IE=40	ESE = 60	Grand Total=100	***Duration of ESE***	**:**	2 hrs
Pre-requisites *(if any)*	**:**	Analog and Digital Communication					
Course Domain	**:**	Communication					

Course Rationale*:* Advanced Communication refers to the utilization of sophisticated technologies to enable seamless connectivity and interaction between various devices and systems, leading towards a more interconnected global community.

Course Objectives: The Course teacher will		*Course Outcomes:* Students will be able to	
1.	Provide understanding of advanced concepts of data communication.	1.	Understand the concepts and technologies used in the data communication domain.
2.	Along with basics it also covers the protocols like USART, USB, I2C , CAN etc.	2.	Understand the various protocols used in the various data communication applications.
3.	Provide student with theoretical background and applied knowledge so that they can design an optimum Single and multi-carrier communication system under given power, spectral and error performance constraints.	3.	Get knowledge about latest trends in the data communication field
4.	Analyze the error performance of digital modulation techniques.	4.	Analyze the design parameters of a single and multi-carrier communication system.
5.		5.	Use mathematical tools to analyze the performance of communication systems.
6.		6.	Use probability theory and stochastic processes in communication system applications.

Curriculum Content	**Hours**
Unit I Digital Modulation Schemes: BPSK, QPSK, 8PSK, 16PSK, 8QAM, 16QAM, DPSK – Methods, Bandwidth Efficiency, Carrier Recovery, Clock Recovery.	**6**
Unit II Multiplexing: Frequency Division Multiplexing (FDM), Time Division Multiplexing (TDM), Multiplexing Application, SMDS Switching: Circuit Switching, Packet Switching, Message Switching. Networking and Interfacing Devices: Repeaters, Bridges, Routers, Gateway, Other Devices.	**7**
Unit III	**7**

Basic Concepts of Data Communications, Interfaces and Modems: Data Communication Networks, Protocols and Standards, CAN, UART, USB, I2C, I2S, Line Configuration, Topology, Transmission Modes, Digital Data Transmission, DTE-DCE interface, Categories of Networks – TCP/IP Protocol suite and Comparison with OSI model.	
Unit IV Error Correction: Types of Errors, Vertical Redundancy Check (VRC), LRC, CRC, Checksum, Error Correction using Hamming code Data Link Control: Line Discipline, Flow Control, Error Control Data Link Protocols: Asynchronous Protocols, Synchronous Protocols, Character Oriented Protocols, Bit-Oriented Protocol, Link Access Procedures.	**7**
Unit V Random Access, Aloha- Carrier Sense Multiple Access (CSMA)- Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA), Controlled Access- Reservation Polling- Token Passing.	**6**
Unit VI Channelization, Frequency- Division Multiple Access (FDMA), Time - Division Multiple Access (TDMA), Code - Division Multiple Access (CDMA), Orthogonal Frequency-Division Multiplexing (OFDM) and Orthogonal Frequency-Division Multiple Access (OFDMA).	**7**

Suggested list of Tutorials and Assignments: As suggested by the course teacher

Suggested Text Books:

1.	Data Communication and Computer Networking - B. A.Forouzan, 2nd Ed., 2003, TMH.
2.	Advanced Electronic Communication Systems - W. Tomasi, 5th Ed., 2008, PEI

Suggested Reference Books:

1.	Data and Computer Communications - William Stallings, 8th Ed., 2007, PHI.
2.	Data Communication and TeleProcessing Systems -T. Housely, 2nd Ed, 2008, BSP.
3.	Data Communications and Computer Networks- Brijendra Singh, 2nd Ed., 2005, PHI.
4.	Computer Networks; By: Tanenbaum, Andrew S; Pearson Education Pte. Ltd., Delhi, 4th Edition
5.	Manufacturers Device data sheets

Course Outcome and Program Outcome Mapping

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	3									
CO 2	2	3							2	
CO 3				2						2
CO 4			2			3				3
CO 5	2	2							3	
CO6		2				2				

Level of Mapping as: Low 1, Moderate 2, High 3

Class, Part & Semester	**:**	**First Year M. Tech (E&TC), Part I, Sem-I**					
Course Title	**:**	**Reconfigurable Computing (Elective-II)**			***Course Code*:**	**:**	ETCOE12
Teaching Scheme (Hours)	**:**	Lecture :	3 Hrs/week		***Total Credits***	**:**	3
		Tutorial :	-- Hrs/week				
Evaluation Scheme (Marks)	**:**	IE=40	ESE = 60	Grand Total=100	***Duration of ESE***	**:**	2 hrs
Pre-requisites *(if any)*	**:**	FPGA Basics					
Course Domain	**:**	**Design and Computing**					

Course Rationale: Reconfigurable (adaptive) computing is a novel yet important research field investigating the capability of hardware to adapt to changing computational requirements such as emerging standards, late design changes, and even to changing processing requirements arising at run-time. Reconfigurable computing thus benefits from a) the programmability of software similar to the Von Neumann computer and b) the speed and efficiency of parallel hardware execution.

Course Objectives: The Course teacher will able to		***Course Outcomes:*** Students will be able to	
1.	Make students to understand various computing architectures	1.	Understand the concept of reconfigurable computing and its integration on computing platforms.
2.	Provide students the concept of handling issues of reconfigure computing	2.	Design, implement and analyze reconfigurable systems in the recent application domains using HDL.
3.	Provide students implementation approaches of FPGA design in view of reconfiguration	3.	Use advanced EDA tools to simulate and synthesize HDL codes for reconfigurable architectures.
4.		4.	get familiar with the possibilities and rapidly growing interest in adaptive hardware and corresponding design techniques
5.		5.	Analyze the existing Reconfigurable Processing Fabric (RPF) Architectures

Curriculum Content	**Hours**
Unit I Domain of RC: General Purpose Computing, Domain-Specific Processors, Application-Specific Processors, Reconfigurable Computing, Fields of Application. Architecture of Field Programmable Gate Arrays	**6**
Unit II Reconfigurable Processing Fabric (RPF) Architectures: Fine grained, Coarse-Grained, Integration of RPF into Traditional Computing Systems. Early systems of Reconfigurable computing: PAM, VCC, Splash, PRISM, Teramac, Cray, SRC, non-FPGA research, other issues.	**7**
Unit III Contexts, Context switching; Area calculations for PE Efficiency, ISP, Hot Reconfiguration; Case study. Architectures for existing multi FPGA systems, Arrays for fast computations, CPLDs, FPGAs,	**7**

Multi context, Partial Reconfigurable Devices; TSFPGA, DPGA, Mattrix; Best suitable approach for RD; Case study Reconfiguration Management: Reconfiguration, Configuration architectures, managing reconfiguration process, reducing reconfiguration time, configuration security.	
Unit IV RC Applications: Implementing applications with FPGAs, various applications and use of reconfiguration: Video Streaming, , Distributed arithmetic, Adaptive Controller, Adaptive cryptographic systems, Software Defined Radio, High-Performance Computing, Automatic target recognition systems.	**7**
Unit V Implementation: Integration, FPGA Design Flow, System On A Programmable Chip: Introduction to SoPC, Adaptive Multiprocessing on Chip. Reconfiguration Project Design Approaches: J-Bit, Modular, Early Access, Vivad.	**7**
Unit VI Software challenges in System on chip; Testability challenges; Case studies. Modeling, Temporal partitioning algorithms, Online temporal placement, Device space management.	**6**

Suggested list of Tutorials and Assignments: As suggested by the course teacher	
Suggested Text Books:	
1.	Wolf Wayne, FPGA Based System Design, Pearson Edu, 2004.
2.	Hauck Scott, Dehon A, "Reconfigurable Computing: The Theory and Practice of FPGA- Based Computation", Elsevier.
Suggested Reference Books:	
1.	Vivado Partial Reconfiguration.pdf: user guide 909 by Xilinx Revision: 04/06/2016
2.	Maya Gokhale, Paul Ghaham, "Reconfigurable Computing", Springer Publication.
3.	Bobda Christophe, "Introduction to Reconfigurable Computing: Architectures, Algorithms, and Applications", Springer.

Course Outcome and Program Outcome Mapping

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	3			2				2		
CO 2		3				2			2	
CO 3				2						
CO 4			2					3		
CO 5		3			2					2

Level of Mapping as: Low 1, Moderate 2, High 3

Class, Part & Semester	**:**	**First Year M. Tech (E&TC), Part I, Sem-I**					
Course Title	**:**	**VLSI Testing & Testability (Elective -II)**			***Course Code*:**	**:**	ETCOE13
Teaching Scheme (Hours)	**:**	Lecture :	3 Hrs/week		***Total Credits***	**:**	3
		Tutorial :	-- Hrs/week				
Evaluation Scheme (Marks)	**:**	IE=40	ESE = 60	Grand Total=100	***Duration of ESE***	**:**	2 hrs
Pre-requisites *(if any)*	**:**	Basic knowledge in the following areas: digital design, optimization algorithms, and computer architecture.					
Course Domain	**:**	**VLSI**					

Course Rationale: VLSI testing verifies the functionality and detects defects in integrated circuits, while testability focuses on making designs easier to test, improving efficiency and reducing costs.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1	Introduce design process in VLSI	1.	Accept challenges in VLSI Testing at different abstraction levels
2	Teach the logical and Fault simulation models	2.	Understand fault models for generation of test vectors
3	Make students to learn techniques for design of testability	3.	Calculate observability and controllability parameters of circuit
4	Make students to study hardware and software verification issues for testing	4.	Enhance testability of a circuit. Use simulation techniques for designing and testing of VLSI circuits

Curriculum Content	**Hours**
Unit I Introduction to the concepts and techniques of VLSI (Very Large Scale Integration) design verification and testing, VLSI testing process and test equipment, test economics and product quality	**7**
Unit II Fault modeling, testing and verification in VLSI design process, test methods, logic and fault simulation, modeling circuits for simulation, algorithms for true- value simulation and algorithms for fault simulation.	**7**
Unit III Statistical methods for fault simulation, testability measures, combinational circuit test generation, sequential circuit test generation, memory test.	**6**
Unit IV Fault Simulation Application and Methods: Fault Simulation, Fault Simulation Applications, Fault Simulation Technologies. Test pattern Generation Methods and Algorithm: Test Generation Basics, Controllability and Observability, Random Test Generation.	**6**
Unit V Design for testability, Scan and Boundary scan architectures, Built-in Self-test (BIST) and current-based testing, analog test bus standard, System test and core-based design, ATPG, Embedded core test fundamentals.	**7**
Unit VI	**7**

Design verification techniques based on simulation, analytical and formal approaches. Functional verification. Timing verification. Formal verification. Basics of equivalence checking and model checking. Hardware emulation.	
Suggested list of Tutorials and Assignments: As suggested by the course teacher	
Suggested Text Books:	
1.	Bushnell M L, Agrawal V D, "Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", Kluwer Academic Publishers.
2.	Abramovici M, Breuer M A and FriedmanA D, "Digital systems and Testable Design", JaicoPublications.
Suggested Reference Books:	
1.	Crouch A L, "Design Test for Digital IC's and Embedded Core Systems", Prentice Hall.
2.	Kropf T, "Introduction to Formal Hardware Verification," Springer Publications
3.	Niraj K. Jha, Sandeep Gupta, Testing of Digital Systems, 1st edition, Cambridge University Press, 2003. ISBN: 0521-77356-3
4.	M. Abramovici, M. A. Breuer and A. D. Figriieta, Digital Systems Testing and Testable Design, Wiley-IEEE Press, 1994, ISBN: 978-0-7803-1062-9.

Course Outcome and Program Outcome Mapping

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	3					2				
CO 2		3		2					1	
CO 3				2		3				
CO 4	3		2						2	
CO 5						2				
CO6										

Level of Mapping as: Low 1, Moderate 2, High 3

Class, Part & Semester	**:**	**First Year M. Tech (E&TC), Part I, Sem-I**					
Course Title	**:**	Research Methodology			***Course Code*:**	**:**	ETCA111
Teaching Scheme (Hours)	**:**	Lecture :	2 Hrs/week		***Total Credits***	**:**	2
		Tutorial :	-- Hrs/week				
Evaluation Scheme (Marks)	**:**	IE= 50	ESE = NIL	Grand Total=50	***Duration of ESE***	**:**	—
Pre-requisites *(if any)*	**:**	Not required					
Course Domain	**:**	Research Theory					

Course Rationale: This course aims to lay a foundation for your research. The goal is to help you to design and develop your future research projects.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	This course aims to lay a foundation for your research. The goal is to help you to design and develop your future research projects.	1.	To understand basic concepts of research and its methodologies
2.	Familiarize Research Design.	2.	To select and define appropriate research problem and parameters
3.	Introduce measurement and scaling techniques in research.	3.	To apply Measurement and Scaling Techniques
4.	Familiarize methods of data collection and analysis	4.	To use Methods of Data Collection and Analysis
5.	Introduce techniques of hypotheses, parametric or standard tests	5.	To apply techniques of hypotheses, parametric or standard tests
6.	Help to analyze variance and co-variance	6.	Present and defend research ideas using Analysis of Variance and Co-variance

Curriculum Content	**Hours**
Unit I Research Methodology: An Introduction, Objectives of Research, Types of Research, Research Methods and Methodology, Defining a Research Problem, Techniques involved in Defining a Problem	**5**
Unit II Research Methodology: An Introduction Objectives of Research, Types of Research, Research Methods and Methodology, Defining a Research Problem, Techniques involved in Defining a Problem	**5**
Unit III Measurement and Scalin Techniques Measurement in Research, Measurement Scales, Sources in Error, Techniques of Developing Measurement Tools, Scaling, Meaning of Scale, Scale Construction Techniques.	**4**

Unit IV Methods of Data Collection and Analysis Collection of Primary and Secondary Data, Selection of appropriate method, Data Processing Operations, Elements of Analysis, Statistics in Research, Measures of Dispersion, Measures of Skewness, Regression Analysis, Correlation	**4**
Unit V Techniques of Hypotheses, Parametric or Standard Tests Basic concepts, Tests for Hypotheses I and II, Important parameters, Limitations of the tests of Hypotheses,. Chi-square Test, Comparing Variance, As a non-parameteric Test, Conversion of Chi to Phi, Caution in using Chi-square test	**4**
Unit VI Analysis of Variance and Co-variance ANOVA, One way ANOVA, Two Way ANOVA, ANOCOVA, Assumptions in ANOCOVA, Multivariate Analysis Technique, Classification of Multivariate Analysis, factor Analysis, R-type Q Type factor Analysis, Path Analysis	**5**
Suggested list of Tutorials and Assignments: As suggested by the course teacher	
Suggested Text Books:	
1.	"Research Methodology", C.R. Kothari, Wiley Eastern.
Suggested Reference Books:	
1.	"Formulation of Hypothesis", Willkinson K.P, L Bhandarkar, Hymalaya Publication, Bombay.
2.	"Research in Education", John W Best and V. Kahn, PHI Publication.
3.	"Research Methodology- A step by step guide for beginners", Ranjit Kumar, Pearson Education
4.	"Management Research Methodology-Integration of principles, methods and Techniques", K.N. Krishnaswami and others, Pearson Education

Course Outcome and Program Outcome Mapping

Course Outcome CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1		2								
CO2				3						
CO3				2						
CO4				3						
CO5				3						
CO6				3						

Level of Mapping as: Low1, Moderate2, High3

Class, Part & Semester	**:**	**First Year M. Tech (E&TC), Part I, Sem-I**					
Course Title	**:**	**Seminar-I**			***Course Code*:**	**:**	ETCC114
Teaching Scheme (Hours)	**:**	Practical:	2 Hrs/week		***Total Credits***	**:**	1
Evaluation Scheme (Marks)	**:**	IE= 50 Marks	EOE= ---	Total= 50 marks	***Duration of EPE***	**:**	----
Pre-requisites *(if any)*	**:**	**Advance Technology Studies**					
Course Domain	**:**	**Technology Exchange**					

Course Rationale: Students should get acquainted with the advance topics in the field of Electronic, IT , E&TC and Computer Engineering

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	*To encourage students for research development*	1	*Demonstrate and explore New Technology*
2.		2	*Inculcate ability to make presentation*
3.		3.	*Explore the research*
4.		4	*Inculcate innovations*

Outcome and Program Outcome Mapping

Course outcome CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1							3			
CO2							3			
CO3							3			3
CO4							3			

Level of Mapping as: Low1, Moderate2, High3

Class, Part & Semester	**:**	**First Year M. Tech (E&TC), Part I, Sem-I**					
Course Title	**:**	**Lab-1: Random Process**			***Course Code*:**	**:**	ETCC115
Teaching Scheme (Hours)	**:**	Practical:	2 Hrs/week		***Total Credits***	**:**	1
Evaluation Scheme (Marks)	**:**	IE=50 marks	EOE= -----	Total=50	***Duration of EPE***	**:**	----
Pre-requisites *(if any)*	**:**	probability and statistics, signals and systems, and fundamental mathematical concepts					
Course Domain	**:**	Electronics & Communication Engineering					

Course Rationale*: The course on Random Processes builds fundamental skills to model and analyze uncertainty in signals and systems, essential for applications in communications, signal processing, and modern data-driven technologies.*

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	This Lab course will provide in-depth knowledge about Probability theory	1.	Understand the concept of probability theory practically
		2.	Understand different types of correlation.
		3.	Study Probability density function
		4.	Study different types of statistical parameters

List of Experiments

Sr. No.	**Experiments**
1.	Study of Bernoulli Trials (Binomial Distribution)
2.	Study of the Rayleigh Probability Density Function
3.	Probability density function of a Gaussian-distributed random variable
4.	Effect of changing the Mean and Standard deviation in the Gaussian PDF
5.	Study of autocorrelation
6.	Study of cross-correlation
7.	Study of a Markov chain
8.	Study of power spectral density (PSD)
9.	Study of various statistical parameters for a random signal

Suggested Text Books/ Reference Books/Manual

1.	Probability and Random Processes for Electrical Engg., Alberto Lean, Pearson, 2nd edition 2009
2.	Probability, Random Variables and Stochastic Processes, Athanasios Papoulis, S. Unnikrishna Pillai, PHI, 4thb edition 2010
3.	Stochastic Processes, J. Medhi, New Age International 3rdedition, 2009
4.	Introduction to probability Models, Sheldon M. Ross, Academic Press, 9thedition 2009

Course Outcome and Program Outcome Mapping

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	2	2	-	-	-	1	-
CO2	3	3	3	2	2	-	-	-	1	-
CO3	3	3	3	2	2	-	-	-	1	-
CO4	3	3	3	2	2	-	-	1	2	1

Level of Mapping as: Low1, Moderate2, High3

Class, Part & Semester	**:**	**First Year M. Tech (E&TC), Part I, Sem-I**					
Course Title	**:**	**Lab-1: Advanced Embedded System**			***Course Code*:**	**:**	ETCC116
Teaching Scheme (Hours)	**:**	Practical:	2 Hrs/week		***Total Credits***	**:**	1
Evaluation Scheme (Marks)	**:**	IE=50 marks	EOE= -----	Total=50	***Duration of EPE***	**:**	----
Pre-requisites *(if any)*	**:**	Embedded System					
Course Domain	**:**	Electronics and Telecommunication Engineering					

Course Rationale:

An advanced embedded system course is designed to build upon foundational knowledge, equipping students with in-depth skills in hardware, software and advanced programming techniques, preparing them for specialized roles in the industry.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	To develop basic programming skills in Arduino, ESP32 etc microcontrollers for interfacing and embedded applications.	1.	Implement and test microcontroller programs in Arduino using Embedded C Language.
2.	To gain practical knowledge of Assembly Language Programming (ALP) for arithmetic, logical, and array-based operations using Keil µVision.	2.	Implement and simulate programs in ESP32 using Embedded C Language.
3.	To understand Embedded C concepts and apply them for microcontroller-based system design.	3.	Analyze and execute assembly-level operations like arithmetic, array manipulation, and searching using Keil µVision.
4.	To build problem-solving	4.	Demonstrate the ability to design, debug, and document embedded system applications

List of Experiments

Sr. No.	**Experiments**
1.	Write Arduino program to blink the built-in LED on Arduino board
2.	Write Arduino program for temperature monitoring system that displays temperature values on the Serial Monitor
3.	Write Arduino program to interface Bluetooth module.
4.	Write ESP32 program to connect the ESP32 to a Wi-Fi network and fetch IP details.
5.	Write an ALP to Multiply Two 16-Bit Numbers using Keil µVision4/5.
6.	Write an ALP to Add Two 64-Bit Numbers using Keil µVision4/5.
7.	Write an ALP to Find The Sum Of First 10 Integer Numbers using Keil µVision4/5.
8.	Write an ALP to Add An Array Of 16-Bit Numbers And Store The 32-Bit Result In Internal

	Ram using Keil µVision4/5.
9.	Write an ALP to Find The Square Of A Number (1 To 10) using Keil µVision4/5.
10.	Write an ALP to Find The Largest/Smallest Number In An Array Of 32 Numbers using Keil µVision4/5
11.	Introduction to Embedded C Programming using Keil µVision4/5.
12.	Study of MSP430G2553 board
General Instructions: if any regarding course delivery and assessment	
Suggested Text Books/ Reference Books/Manual	
1.	The Definitive Guide to the ARM Cortex-M3, Joseph Yiu, Second Edition, Elsevier Inc. 2010.
2.	Frank Vahid/Tony Givargis, "Embedded System Design- A unified Hardware/software Introduction".
3.	David E. Simon, ―An Embedded Software Primer,Perason Education,2003.
4.	John H. Davies "MSP430 Microcontroller Basics",Elsevier Ltd Publications, Copyright 2008

Course Outcome and Program Outcome Mapping

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	1	3				2	1
CO2	3	2	3	1	3				2	1
CO3	3	3	3	2	3				2	1
CO4	3	3	3	2	3				3	2

Level of Mapping as: Low1, Moderate2, High3

Semester-II

Class, Part & Semester	**:**	**First Year M. Tech (E&TC), Part I, Sem-II**					
Course Title	**:**	**System On Chip**			***Course Code*:**	**:**	ETCC121
Teaching Scheme (Hours)	**:**	Lecture :	3 Hrs/week		***Total Credits***	**:**	3
		Tutorial :	-- Hrs/week				
Evaluation Scheme (Marks)	**:**	IE= 40	ESE = 60	Grand Total=100	***Duration of ESE***	**:**	2 hrs
Pre-requisites *(if any)*	**:**	Students are expected to have prior knowledge of Digital Electronics, Computer Architecture, Embedded Systems, and basic VLSI Design.					
Course Domain	**:**	**Electronics and Telecommunication Engineering (E&TC)** and **Computer Engineering**					

Course Rationale: System-on-Chip (SoC) technology has become the foundation of modern embedded and high-performance computing systems, integrating processors, memories, communication interfaces, and peripherals onto a single chip.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Introduce the fundamentals of System-on-Chip design and its relevance in modern embedded systems.	1.	Explain the fundamentals and challenges of SoC design.
2.	Familiarize students with SoC design methodologies, hardware-software co-design, and IP integration.	2.	Apply hardware-software co-design methodologies for SoC development.
3.	Provide knowledge of processor architectures, memory subsystems, and interconnect structures.	3.	Analyze processor cores, memory architectures, and interconnects in SoC.
4.	Develop an understanding of peripheral interfacing, bus standards, and NoC design.	4.	Integrate IP cores and peripherals into a functional SoC.
5.	Explain low-power design strategies and performance trade-offs in SoC.	5.	Evaluate SoC performance, power, and area trade-offs.
6.	Expose learners to real-world SoC applications and case studies.	6.	Demonstrate understanding of SoC applications through case studies and project design.

Curriculum Content	**Hours**
Unit 1 – Introduction to SoC Evolution from VLSI to SoC, characteristics and applications, SoC design challenges, role in IoT, mobile, and automotive systems	**7**
Unit 2 – SoC Design Methodologies Design flows (specification → RTL → verification → synthesis), hardware-software co-design, IP-based design, reuse methodology	**6**
Unit 3 – Processor Architectures RISC vs. CISC, ARM architecture, RISC-V cores, DSP processors, custom processor	**7**

design for applications	
Unit 4 – Memory and Interconnects On-chip memory, cache hierarchy, DRAM/SRAM, memory controllers, bus architectures (AMBA, AXI, AHB, APB), Network-on-Chip (NoC)	**7**
Unit 5 – Peripheral and IP Integration UART, SPI, I²C, GPIO, timers, ADC/DAC integration, IP core interfacing, verification techniques	**7**
Unit 6 – Optimization and Case Studies Low-power SoC design (DVFS, clock gating, power gating), performance metrics, FPGA-based SoC prototyping, case studies: ARM Cortex-M, RISC-V SoC, smartphone SoCs	**6**

Suggested Text Books:	
1.	Steve Furber, *ARM System-on-Chip Architecture*, Addison Wesley.
2.	Wayne Wolf**,** *Computers as Components: Principles of Embedded Computing System Design*, Morgan Kaufmann.
Suggested Reference Books:	
1.	Michael Keating & Pierre Bricaud**,** *Reuse Methodology Manual for System-on-a-Chip Designs*, Springer
2.	Raj Kamal**,** *Embedded Systems: Architecture, Programming and Design*, Tata McGraw Hill.
3.	Ashok K. Sharma**,** *Advanced Computer Architecture*, Tata McGraw Hill.
4.	Sudeep Pasricha, Nikil Dutt**,** *On-Chip Communication Architectures: System on Chip Interconnect*, Morgan Kaufmann.

Course Outcome and Program Outcome Mapping

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	1	2	1	1	2	-	2
CO2	2	2	2	2	3	2	-	1	-	2
CO3	3	3	3	2	2	1	-	2	-	2
CO4	2	2	1	2	3	2	2	2	1	1
CO5	3	3	3	2	3	1	2	1	1	2
CO6	2	1	2	-	-	-	-	-	-	-

Level of Mapping as: Low1, Moderate2, High3

Class, Part & Semester	**:**	**First Year M. Tech (E&TC), Part I, Sem-II**					
Course Title	**:**	**Computer Vision**			***Course Code*:**	**:**	ETCC122
Teaching Scheme (Hours)	**:**	Lecture:	3 Hrs/week		***Total Credits***	**:**	3
Evaluation Scheme (Marks)	**:**	IE= 40	ESE = 60	Grand Total=100	***Duration of ESE***	**:**	2 hrs
Pre-requisites *(if any)*	**:**	Image Processing					
Course Domain	**:**	Electronics & Telecommunication					

Course Rationale: This course equips students with the knowledge and tools to analyze, interpret, and understand visual information from images and videos, enabling applications in automation, robotics, medical imaging, and intelligent systems.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1	Introduce multiresolution analysis techniques (pyramids, wavelets) for image processing and feature extraction.	1	Apply multiresolution techniques such as pyramids, sub band coding, and wavelet transforms for image analysis.
2	Provide knowledge of image representation, boundary descriptors, and region-based descriptors.	2	Demonstrate the ability to represent and describe images using boundaries, chain codes, skeletons, and region descriptors.
3	Familiarize students with pattern recognition fundamentals and various classification techniques.	3	Explain fundamental concepts of pattern recognition and identify different types of patterns.
4	Explore statistical and structural methods for image classification and recognition.	4	Implement and analyze classification techniques such as minimum distance, correlation, Bayes classifier, and nearest neighbour classifier.
5	Develop understanding of image mining, content-based image retrieval (CBIR), and feature-based indexing.	5	Apply image mining and content-based image retrieval techniques using color, texture, and shape features with indexing methods.
6	Introduce the role of artificial neural networks in image analysis, recognition, and decision-making.	6	Employ artificial neural network models for image recognition and learning-based applications.

Curriculum Content	**Hours**
Unit 1 Wavelets and Multi resolution Processing Background: Image Pyramids, Sub band Coding, Haar Transform, Multi resolution Expansion: Series Expansion, Scaling Function, Wavelet Function Discrete Wavelet Transform in one Dimension, and DWT in 2 Dimensions. Fast wavelet Transform, wavelet packets	**8**
Unit 2 Representation and Description: Representation: Boundary Following	**8**

Algorithm, Chain Codes, Polygonal Approximation, Signatures, Boundary segments, Skeletons. Descriptors: Boundary descriptors; Regional descriptors;; Relational descriptors.	
Unit 3 Pattern Recognition: Overview of pattern recognition; Patterns and pattern Classes	**2**
Unit 4 Classifier: Matching: Minimum distance classifier, Matching by Correlation, Matching shape numbers, String matching statistical classifier: Bayes classifier, Nearest Neighbor classifier	**6**
Unit 5 Image Mining and Content-Based Image Retrieval: Introduction, Image Mining, Image Features for Retrieval and Mining: Color Features, Texture Features, Shape features, Topology, Multidimensional Indexing Simple CBIR System, Video mining	**7**
Unit 6 Artificial neural networks: Human Recognition system; Artificial neural networks; Different models of Artificial neural networks; Perception and learning;	**5**
Suggested list of Tutorials and Assignments: As suggested by the course teacher	
Suggested Text Books:	
1.	Digital Image processing and Pattern Recognition by Malay K. Pakhira PHI
2.	Digital Image processing Education by Rafael C. Gonzalez and Richard E. Woods Pearson
3.	Image Processing Principles and Applications, Tinku Acharya , Ajoy K. Ray,, Wiley, 2005
Suggested Reference Books:	
1.	Fundamentals of Digital Image processing, by A.K.Jain PHI
2.	Digital image processing and analysis by B. Chanda , D. Dutta Mujumdar PHI
3.	processing, analysis and machine vision by Milan sonka , V. Hlavac , R. Boyle Thomson learning

Course Outcome and Program Outcome Mapping

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	3	-	-	-	1	-
CO2	3	3	3	2	2	-	-	1	1	-
CO3	3	3	3	2	2	-	-	1	2	1
CO4	3	3	3	3	3	-	-	1	2	1
CO5	3	3	3	3	3	1	1	2	2	1
CO6	3	3	3	3	3	1	1	2	3	2

Level of Mapping as: Low1, Moderate2, High3

Class, Part & Semester	**:**	**First Year M. Tech (E&TC), Part I, Sem-II**					
Course Title	**:**	**Wireless Sensor Networks**			***Course Code*:**	**:**	ETCC123
Teaching Scheme (Hours)	**:**	Lecture :	3 Hrs/week		***Total Credits***	**:**	3
		Tutorial :	-- Hrs/week				
Evaluation Scheme (Marks)	**:**	IE= 40	ESE = 60	Grand Total=100	***Duration of ESE***	**:**	2 hrs
Pre-requisites *(if any)*	**:**	Students are expected to have prior knowledge of GSM, Mobile frequency, Handoff					
Course Domain	**:**	**Electronics and Telecommunication Engineering (E&TC)** and **Computer Engineering**					

Course Rationale: This course provides a comprehensive introduction to Wireless Sensor Networks (WSNs), covering their architecture, protocols, hardware, and applications, while addressing key challenges, enabling technologies, and future trends.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Understand the basics, applications, and hardware components of Wireless Sensor Networks	1.	Understand challenges and technologies for wireless networks
2.	Analyze WSN architectures, physical layer design, operating systems, and Internet integration.	2.	Understand architecture of network and wireless sensors
3.	Evaluate MAC protocols, standards, addressing, and routing in wireless sensor networks.	3.	Describe the communication, energy efficiency, computing, storage and transmission
4.	Design topology control, clustering, synchronization, localization, and sensor tasking methods.	4.	Establishing infrastructure, simulations and programming the in WSN environment
5.	Apply knowledge of sensor node hardware, programming platforms, and simulation tools.	5.	Demonstrate proficiency with sensor network platforms, hardware components, and simulation tools.
6.	Examine mobility challenges and solutions in mobile wireless sensor networks.	6.	Assess the impact of mobility in WSNs and design solutions for dynamic, mobile sensor network applications.

Curriculum Content	**Hours**
Unit 1 Introduction to Wireless Sensor Networks: Definition and Purpose of WSNs, Applications and Use Cases, Node Architecture and Hardware Components, Unique Constraints and Challenges, Enabling Technologies for WSNs, Types of Wireless Sensor Networks, Recent Advances and Future Directions.	**6**

Unit 2 Architectures: Network Architecture, Sensor Networks, Physical Layer and Transceiver Design Optimization Goals and Performance Metrics, Gateway Concepts, Operating Systems and Execution Environments, Internet Integration of WSNs	**7**
Unit 3 Networking Sensors: MAC Protocols for Wireless Sensor Networks, Standards and Protocols, Addressing and Naming in WSNs, Routing Protocols in WSNs.	**7**
Unit 4 Infrastructure Establishment: Topology Control, Clustering, Time Synchronization and its need, Localization and Positioning, Sensor Tasking and Control.	**7**
Unit 5 Sensor Network Platforms and Tools: Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node level software platforms, Node level Simulators, State centric programming.	**6**
Unit 6 Mobility in Wireless Sensor Networks: Mobile Sensor Nodes and Mobile Sinks, Challenges of Mobility on Network Performance, Routing and Data Dissemination in Mobile WSNs, Applications Involving Mobile WSNs (e.g., Wildlife Tracking, Disaster Recovery), Dynamic Topology Management	**7**

Suggested Text Books:	
1.	Holger Karl & Andreas Willing, "Protocols And Architectures for Wireless Sensor Networks", John Wiley, 2005.
2.	Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks An Information Processing Approach", Elsevier, 2007.
3.	Waltenegus Dargie , Christian Poellabauer, "Fundamentals of Wireless Sensor Networks Theory and Practice", John Wiley & Sons Publications, 2011
Suggested Reference Books:	
1.	Kazem Sohraby, Daniel Minoli, & Taieb Znati, "Wireless Sensor Networks Technology, Protocols,and Applications", John Wiley, 2007.
2.	Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003

Course Outcome and Program Outcome Mapping

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	1	1	-	-	1	2	2
CO2	3	2	2	1	1	-	-	1	2	2
CO3	2	3	3	2	2	1	-	1	2	2
CO4	2	2	3	2	3	1	1	1	2	1
CO5	2	2	3	2	3	1	1	2	2	1
CO6	3	3	3	2	2	2	1	1	2	2

Level of Mapping as: Low1, Moderate2, High3

Class, Part & Semester	**:**	**First Year M. Tech (E&TC), Part I, Sem-II**					
Course Title	**:**	**Cryptography and Network Security (PSE-II)**			***Course Code*:**	**:**	ETCE121-1
Teaching Scheme (Hours)	**:**	Lecture:	3 Hrs/week		***Total Credits***	**:**	3
		Tutorial:	-- Hrs/week				
Evaluation Scheme (Marks)	**:**	IE= 40	ESE = 60	Grand Total=100	***Duration of ESE***	**:**	2 hrs
Pre-requisites *(if any)*	**:**	Computer Networks, Discrete Mathematics, Data Structures					
Course Domain	**:**	Computer Engineering					

Course Rationale: This course provides the foundational principles and practical techniques of cryptography and network security to protect data and communication in modern computing systems. It equips students with skills to analyze threats, apply encryption and authentication mechanisms, and design secure systems for real-world applications.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1	To introduce the fundamentals of cryptography, classical and modern encryption techniques.	1.	Demonstrate understanding of classical and modern cryptographic techniques.
2	To provide knowledge of symmetric key and asymmetric key cryptographic algorithms.	2.	Apply symmetric key and public key algorithms for encryption, decryption, and key exchange.
3	To explain key distribution, digital signatures, and authentication mechanisms.	3.	Analyze authentication, integrity, and digital signature mechanisms in securing communication.
4	To introduce security at the network and transport layers using protocols such as SSL, TLS, IPSec, and Kerberos.	4.	Evaluate security protocols (IPSec, SSL/TLS, Kerberos) for network security.
5	To study system security issues including intrusion detection, malicious software, and firewalls.	5.	Assess threats like intrusions, viruses, and malware, and apply security solutions such as IDS and firewalls.
6	To enable students to apply cryptographic techniques to solve real-world information security problems.	6.	Relate cryptographic algorithms and security protocols to practical applications in modern computing and networking environments.

Curriculum Content	**Hours**
Unit 1 Introduction to Cryptography: Principles of security: confidentiality, integrity, availability, authentication, non-repudiation, Attacks: passive vs. active attacks, threats, vulnerabilities, Classical cryptography: Caesar cipher, monoalphabetic and polyalphabetic ciphers, Playfair, Vigenère cipher, Cryptanalysis of classical ciphers.	**6**

Unit 2 Symmetric Key Cryptography: Block ciphers: Feistel structure, DES, triple DES, AES, Stream ciphers: RC4, Modes of operation: ECB, CBC, CFB, OFB, CTR, Security issues in symmetric encryption.	**6**
Unit 3 Asymmetric Key Cryptography: Principles of public key cryptography, RSA algorithm, mathematical foundations (modular arithmetic, prime numbers, Euler's theorem), Key management and distribution, Diffie–Hellman key exchange, ElGamal cryptosystem.	**6**
Unit 4 Message Authentication and Digital Signatures: Message authentication codes (MAC), hash functions (MD5, SHA family),Digital signatures: RSA-based, DSS, Authentication protocols: Kerberos, X.509 certificates, PKI.	**6**
Unit 5 Network Security Protocols: IP Security (IPSec): AH, ESP, Security Associations, Transport layer security: SSL, TLS, Electronic mail security: PGP, S/MIME ,Web security protocols: HTTPS.	**6**
Unit 6 System Security: Intruders and intrusion detection systems, Viruses, worms, malware, and countermeasures, Firewalls: types and design principles, Virtual Private Networks (VPNs),Emerging trends: cloud security, IoT security, blockchain basics.	**6**

Suggested list of Tutorials and Assignments: As suggested by the course teacher	
Suggested Text Books:	
1.	William Stallings – Cryptography and Network Security: Principles and Practice (Pearson)
2.	Behrouz A. Forouzan – Cryptography and Network Security (McGraw-Hill)
Suggested Reference Books:	
1.	Cryptography: Theory and Practice (CRC Press) Douglas R. Stinson
2.	Modern Cryptography: Theory and Practice (Pearson) Mao, Wenbo
3.	Applied Cryptography: Protocols, Algorithms, and Source Code in C (Wiley) Bruce Schneier
4.	Handbook of Applied Cryptography (CRC Press) Alfred J. Menezes, Paul C. van Oorschot, Scott A. Vanstone

Course Outcome and Program Outcome Mapping

Course Outcomes COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	1	1	2	1	-	–	–	–
CO2	3	3	2	2	3	–	–	–	–	–
CO3	3	2	2	2	2	–	1	–	1	–
CO4	3	3	3	2	3	2	–	–	–	1
CO5	3	3	3	3	2	3	-	–	–	–
CO6	3	2	2	3	1	2	–	-	-	-

Level of Mapping as: Low1, Moderate2, High3

Class, Part & Semester	**:**	**First Year M. Tech (E&TC), Part I, Sem-II**					
Course Title	**:**	**Antennas and Radiating Systems (PSE-II)**			***Course Code*:**	**:**	ETCE121-2
Teaching Scheme (Hours)	**:**	Lecture:	3 Hrs/week		***Total Credits***	**:**	3
		Tutorial:	-- Hrs/week				
Evaluation Scheme (Marks)	**:**	IE= 40	ESE = 60	Grand Total=100	***Duration of ESE***	**:**	2 hrs
Pre-requisites *(if any)*	**:**	Antenna and Wave Propagation					
Course Domain	**:**	Electronics and Telecommunication Engineering					

Course Rationale: This course provides fundamental knowledge and design skills in antenna theory, radiation mechanisms, and array systems, preparing students to apply electromagnetic principles for modern wireless communication, radar, and satellite applications.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	To introduce the fundamental principles of antenna theory and radiation mechanisms.	1.	Compute the far field distance, radiation pattern, and gain of an antenna for a given current distribution.
2.	To enable students to analyze and evaluate key antenna parameters such as far-field distance, radiation pattern, gain, impedance, and efficiency.	2.	Estimate the input impedance, efficiency, and ease of match for antennas.
3.	To develop the ability to compute and interpret array factors for antenna arrays.	3.	Compute the array factor for an array of identical antennas.
4.	To equip students with the skills to design antennas and antenna arrays that meet specified radiation pattern requirements.	4.	Design antennas and antenna arrays for various desired radiation pattern characteristics.

Curriculum Content	**Hours**
Unit 1: Types of Antennas: Wire antennas, Aperture antennas, Microstrip antennas, Array antennas, Reflector antennas, Lens antennas, Radiation Mechanism, Current distribution on thin wire antenna. **Fundamental Parameters of Antennas:** Radiation Pattern, Radiation Power Density, Radiation Intensity, Directivity, Gain, Antenna efficiency, Beam efficiency, Bandwidth, Polarization, Input Impedance, radiation efficiency, Antenna Vector effective length, Friis Transmission equation, Antenna Temperature.	**6**
Unit 2: Linear Wire Antennas: Infinitesimal dipole, small dipole, Region separation, Finite length dipole, half-wave dipole, Ground effects. **Loop Antennas:** Small Circular loop, Circular Loop of constant current, Circular loop with non-uniform current.	**6**
Unit 3: Linear Arrays: Two-element array, N-element array: Uniform Amplitude and spacing, Broadside and End-fire array, Super directivity, Planar array, Design consideration.	**6**

Unit 4: Aperture Antennas: Huygen's Field Equivalence principle, radiation equations, Rectangular Aperture, Circular Aperture. Horn Antennas: E-Plane, H-plane Sectoral horns, Pyramidal and Conical horns	**6**
Unit 5: Microstrip Antennas: Basic Characteristics, Feeding Mechanisms, Method of Analysis, Rectangular Patch, Circular Patch	**6**
Unit 6: Reflector Antennas: Plane reflector, parabolic reflector, Cassegrain reflectors, Introduction to MIMO.	**6**

Suggested Text Books:	
1.	Constantine A. Balanis, *Antenna Theory: Analysis and Design*, 4th Edition, Wiley, 2016.
2.	John D. Kraus, Ronald J. Marhefka, Ahmad S. Khan, *Antennas for All Applications*, 3rd Edition, McGraw-Hill, 2002.
3.	R.C. Johnson and H. Jasik**,** *Antenna Engineering Handbook*, McGraw-Hill, 1984.
4.	I.J. Bahl and P. Bhartia**,** *Microstrip Antennas*, Artech House, 1980.
Suggested Reference Books:	
1.	R. S. Elliott, *Antenna Theory and Design*, Revised Edition, Wiley-IEEE Press, 2003.
2.	W.L. Stutzman and G.A. Thiele, *Antenna Theory and Design*, 3rd Edition, Wiley, 2012.
3.	Robert E. Collin, *Antennas and Radiowave Propagation*, McGraw-Hill, 1985.
4.	D. K. Cheng, *Field and Wave Electromagnetics*, 2nd Edition, Pearson, 2014.
5.	Thales D. Correia and Jorge R. Costa, *Microstrip Antennas: Design and Applications*, Springer, 2019.
6.	Debatosh Guha and Yahia M.M. Antar, *Microstrip and Printed Antennas: New Trends, Techniques and Applications*, Wiley, 2011.

Course Outcome and Program Outcome Mapping

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	2	2	-	-	-	1	-
CO2	3	3	3	2	2	-	-	-	1	1
CO3	3	3	2	2	3	-	-	1	1	-
CO4	3	3	3	2	3	1	1	2	2	1

Level of Mapping as: Low1, Moderate2, High3

Class, Part & Semester	**:**	**First Year M. Tech (E&TC), Part I, Sem-II**					
Course Title	**:**	**Industrial IoT (PSE-II)**			***Course Code*:**	**:**	ETCE121-3
Teaching Scheme (Hours)	**:**	Lecture :	3 Hrs/week		***Total Credits***	**:**	3
		Tutorial :	-- Hrs/week				
Evaluation Scheme (Marks)	**:**	IE= 40	ESE = 60	Grand Total=100	***Duration of ESE***	**:**	2 hrs
Pre-requisites *(if any)*	**:**	Students are expected to have prior knowledge of Computer Networks, Embedded Systems, Digital Electronics, and basic Control Systems.					
Course Domain	**:**	Electronics and Telecommunication Engineering (E&TC) and Computer Engineering					

Course Rationale: The Industrial Internet of Things (IIoT) represents the convergence of industrial automation, communication technologies, cloud/edge computing, and artificial intelligence**.**

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Introduce the concepts of Industrial IoT 5.0 and its role in the transition from Industry 4.0 to Industry 5.0.	1.	Explain the fundamentals, principles, and applications of IIoT 5.0.
2.	Familiarize students with IIoT 5.0 architectures, human–machine collaboration, and enabling technologies.	2.	Analyze IIoT 5.0 architectures, protocols, and human–machine integration models.
3.	Provide knowledge of industrial sensors, actuators, robotics, and edge/cloud integration.	3.	Demonstrate knowledge of industrial sensors, robotics, cobots, and edge/cloud platforms in IIoT 5.0.
4.	Develop understanding of advanced analytics, AI, digital twins, and sustainable manufacturing in IIoT 5.0.	4.	Apply AI, ML, and digital twin technologies for predictive and prescriptive analytics.
5.	Explain IIoT 5.0 cybersecurity, ethics, and resilience strategies.	5.	Evaluate IIoT 5.0 security, privacy, and sustainability challenges.
6.	Expose learners to real-world applications, case studies, and emerging research trends in IIoT 5.0.	6.	Design and analyze IIoT 5.0-based case studies and applications in smart factories, energy, and healthcare.

Curriculum Content	**Hours**
Unit 1 – Introduction to IIoT 5.0 Evolution from IIoT 4.0 to IIoT 5.0; Human-centric Industry 5.0; Role of AI, big data, and robotics; Applications in smart manufacturing, healthcare, energy, and logistics	**6**
Unit 2 – IIoT 5.0 Architectures and Technologies IIoT 5.0 reference architectures (Edge–Fog–Cloud–Human layer); Human–Machine collaboration; Interoperability; Standards and frameworks (RAMI 4.0 → IIoT 5.0 extensions)	**7**
Unit 3 – Devices, Robotics, and Edge Systems	**7**

Industrial sensors, actuators, cobots (collaborative robots), digital controllers; PLCs, SCADA in IIoT 5.0; Edge gateways, cloud integration	
Unit 4 – AI, Digital Twins, and Analytics Predictive and prescriptive analytics; Digital twin design and simulation; AI/ML in IIoT 5.0; Data pipelines and cloud platforms (AWS, Azure, Siemens MindSphere)	**7**
Unit 5 – IIoT 5.0 Security, Ethics, and Sustainability Cybersecurity in IIoT 5.0; Data privacy; Resilience strategies; Green and sustainable manufacturing; Ethical implications of human–AI collaboration	**6**
Unit 6 – Applications and Case Studies Smart factories, healthcare 5.0, energy systems, intelligent transportation, agriculture 5.0; Case studies of Industry 5.0 platforms (GE Predix, Bosch IoT Suite, Siemens Digital Twin)	**7**

Suggested Text Books:	
1.	Alasdair Gilchrist**,** *Industry 5.0: The Industrial Internet of Things and Human–Machine Collaboration*, Apress.
2.	Dimitrios Serpanos & Marilyn Wolf**,** *Internet-of-Things (IoT) Systems: Architectures, Algorithms, Methodologies*, Springer.
Suggested Reference Books:	
1.	Ovidiu Vermesan & Peter Friess (Eds.)**,** *Industrial IoT: Cybermanufacturing Systems*, Springer.
2.	Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat, *Industrial Internet of Things: Cybermanufacturing Systems*, Springer.
3.	Jay Lee, Behrad Bagheri, Hung-An Kao**,** *Industry 5.0 and Cyber-Physical Systems for Manufacturing*, Elsevier.
4.	Hakima Chaouchi**,** *The Internet of Things: Connecting Objects to the Web*, Wiley.

Course Outcome and Program Outcome Mapping

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	1	1	-	-	1	1	2
CO2	3	3	3	2	2	-	-	2	2	2
CO3	2	2	2	2	1	1	-	2	1	2
CO4	3	3	3	3	3	-	-	2	-	2
CO5	2	2	2	2	2	1	1	2	1	1
CO6	3	3	3	2	1	2	2	1	1	2

Level of Mapping as: Low1, Moderate2, High3

Class, Part & Semester	**:**	**First Year M. Tech (E&TC), Part I, Sem-I**					
Course Title	**:**	**CMOS VLSI (PSE-II)**			***Course Code*:**	**:**	ETCE121-4
Teaching Scheme (Hours)	**:**	Lecture :	3 Hrs/week		***Total Credits***	**:**	3
		Tutorial :	-- Hrs/week				
Evaluation Scheme (Marks)	**:**	IE= 40	ESE = 60	Grand Total=100	***Duration of ESE***	**:**	2 hrs
Pre-requisites *(if any)*	**:**	Digital Electronics					
Course Domain	**:**	Electronics Engineering					

Course Rationale: The CMOS VLSI Design course is integral to developing expertise in the design and implementation of modern digital integrated circuits using Complementary Metal-Oxide-Semiconductor (CMOS) technology. This course provides foundational knowledge and practical skills essential for tackling complex engineering problems in the field of Very-Large-Scale Integration (VLSI)

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	To understand MOS transistor physics, CMOS fabrication technologies, and the VLSI design abstraction hierarchy	1.	Understand CMOS transistor behaviour and fabrication technology.
2.	To analyze and design CMOS logic circuits including static and dynamic styles	2.	Analyze and design CMOS logic circuits and layout.
3.	To learn layout design rules, stick diagram conventions, and interconnect modelling to create manufacturable integrated circuits	3.	Evaluate circuit performance in terms of delay, power, and process variation.
4.	Utilize delay estimation techniques and power analysis to optimize circuit speed, area,	4.	Apply CMOS design styles including combinational, sequential, and dynamic logic.
5.	Design and analyze combinational and sequential circuits at the transistor level	5.	Create memory and datapath components in CMOS.
6.	Understand Emerging Trends and Challenges	**6.**	Able to understand CMOS VLSI design, including nanoscale effects

Curriculum Content	**Hours**
Unit 1 CMOS Technology & Device Fundamentals :CMOS process flow and fabrication, MOSFET structure, operation modes, non-ideal effects (channel-length modulation, body effect)	**6**
Unit 2 CMOS Logic Circuits & Layout :CMOS inverter characteristics (DC, transient, noise margins),Logic families (static CMOS, transmission gate, dynamic, domino),Stick diagrams, layout rules, and hierarchical layout design	**6**
Unit 3 Delay, Logical Effort & Power Optimization delay models, Elmore delay, Logical effort methodology for optimizing speed, Power dissipation sources and	**6**

reduction techniques.	
Unit 4 Combinational & Sequential Logic Design : Design of combinational logic—adders, multiplexers, comparators, ALUs, Sequential elements: latches, flip-flops, clocking strategies	**6**
Unit 5 Memories & Datapath Components :CMOS memory architectures: SRAM (6T), DRAM, ROMs, Datapath blocks: shifters, multipliers, PLAs, ROMs, BIST basics, Design for Testability concepts (scan, IDDQ test)	**6**
Unit 6 Emerging Trends and Challenges: Challenges of modern CMOS VLSI design, including nanoscale effects, variability, reliability, and emerging device technologies.	**6**
Suggested list of Tutorials and Assignments: As suggested by the course teacher	
Suggested Text Books:	
1.	Fundamentals of Modern VLSI Devices by Yuan Taur & Tak Ning
2.	CMOS VLSI Design: A Circuits and Systems Perspective by Weste & Harris (4th Edition)
Suggested Reference Books:	
1.	CMOS VLSI Design by Weste & Harris
2.	Fundamentals of Modern VLSI Devices by Taur & Ning
3.	Fundamentals of Logic Design — Charles H. Roth Jr.
4.	CMOS Circuit Design, Layout, and Simulation by Christopher J. Myers

Course Outcome and Program Outcome Mapping

Course Outcomes (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	1	2	1	-	-	-	1	1
CO2	3	3	3	2	3	-	-	1	1	1
CO3	2	3	3	2	2	-	-	-	1	1
CO4	3	3	3	2	3	1	-	1	1	1
CO5	3	3	3	2	3	1	1	2	1	1
CO6	3	3	3	2	3	-	-	1	2	2

Level of Mapping as: Low1, Moderate2, High3

Elective -IV

Class, Part & Semester	**:**	**First Year M. Tech (E&TC), Part I, Sem-II**					
Course Title	**:**	**MIMO System (Elective -IV)**			***Course Code*:**	**:**	METCOE21
Teaching Scheme (Hours)	**:**	Lecture :	3 Hrs/week		***Total Credits***	**:**	3
		Tutorial :	-- Hrs/week				
Evaluation Scheme (Marks)	**:**	IE=40	ESE = 60	Grand Total=100	***Duration of ESE***	**:**	3 hrs
Pre-requisites *(if any)*	**:**	**Digital Communications, Signals and Systems, Wireless communications**					
Course Domain	**:**	**Communication**					

Course Rationale: To learn about MIMO communication systems, capacity of MIMO, space time coding scheme and MIMO in 4G/5G wireless communications with available technology and schemes

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1	Impart in depth knowledge about MIMO	1	Understand SIMO, MISO, MIMO in-depth
2	Impart in depth knowledge about MIMO channel capacity	2	Understand random MIMO channels, Capacity of i.i.d., Rayleigh fading MIMO channels capacity.
3	Impart in depth knowledge about *Space-Time codes*	3	Understand Alamouti space-time codes, Space-time block codes, Space-time trellis codes, Space-time turbo codes.
4	Impart in depth knowledge about *MIMO detection, Advances in MIMO wireless communication*	4	Understand *MIMO detection, Advances in MIMO wireless communication,* Spatial modulation, cognitive radio, multiuser MIMO, MIMO systems for 5G wireless.

Curriculum Content	**Hours**
Unit I *Introduction*: Diversity-multiplexing trade-off, transmit diversity schemes, advantages and applications of MIMO systems	**6**
Unit II *Analytical MIMO channel models*: Uncorrelated, fully correlated, separately correlated and keyhole MIMO fading models, parallel decomposition of MIMO channel. *Power allocation in MIMO systems*: Uniform, adaptive and near optimal power allocation.	**7**
Unit III *MIMO channel capacity*: Capacity for deterministic and random MIMO channels, Capacity of i.i.d., separately correlated and keyhole Rayleigh fading MIMO channels.	**6**
Unit IV *Space-Time codes*: Advantages, code design criteria, Alamouti space-time codes, SER analysis of Alamouti space-time code over fading channels, Space-time block codes, Space-time trellis codes, Performance analysis of Space-time codes over separately correlated MIMO channel, Space-time turbo codes.	**7**
Unit V *MIMO detection*: ML, ZF, MMSE, ZF-SIC, MMSE-SIC, LR based detection	**7**

Unit VI *Advances in MIMO wireless communications*: Spatial modulation, MIMO based cooperative communication and cognitive radio, multiuser MIMO, cognitive-femtocells and large MIMO systems for 5G wireless.	**6**
Suggested list of Tutorials and Assignments: As suggested by the course teacher	
Suggested Text Books:	
1.	
2.	
Suggested Reference Books:	
1.	B. Clerckx and C. Oestges, MIMO wireless networks, Elsevier Academic Press, 2nd ed., 2013.
2.	T. M. Duman and A. Ghrayeb, Coding for MIMO communication systems, John Wiley and Sons, 2007.
3.	N. Costa and S. Haykin, Multiple-input multiple-output channel models, John Wiley & Sons, 2010.
4.	J. Choi, Optimal Combining & Detection, Cambridge University Press, 2010.
5.	A. Chokhalingam and B. S. Rajan, Large MIMO systems, Cambridge University Press, 2014.

Course Outcome and Program Outcome Mapping

Course Outcomes (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	3	1	1	1				1		
CO 2	2	1	1	1				1		
CO 3	2	1	1	1				1		
CO 4	3	1	1	1				1		

Level of Mapping as: Low 1, Moderate 2, High 3

Class, Part & Semester	**:**	**First Year M. Tech (E&TC), Part I, Sem-II**					
Course Title	**:**	**Satellite Communication (Elective -IV)**			***Course Code*:**	**:**	METCOE22
Teaching Scheme (Hours)	**:**	Lecture :	3 Hrs/week		***Total Credits***	**:**	3
		Tutorial :	-- Hrs/week				
Evaluation Scheme (Marks)	**:**	IE=40	ESE = 60	Grand Total=100	***Duration of ESE***	**:**	3 hrs
Pre-requisites *(if any)*	**:**	Satellite communication					
Course Domain	**:**	Communication					

Course Rationale: This course provides an introduction to the fundamentals of orbital mechanics and launchers, link budgets, modulation, coding, multiple access techniques, propagation effects, and earth terminals. This course provides an understanding how analog and digital technologies are used for satellite communications networks. They will gain skills for performance improvement for different available satellites by calculating power Budgets

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1	Impart in depth knowledge of orbital mechanism.	1	Visualize the architecture of satellite systems as a means of high speed, high range communication system.
2	Impart in depth knowledge of link budgets, modulation, coding, multiple access techniques, propagation effects, and earth terminals.	2	State various aspects related to satellite systems such as orbital equations, sub-systems in a satellite, link budget, modulation and multiple access schemes.
3	Impart in depth knowledge power budget.	3	Solve numerical problems related to orbital motion and design of link budget for the given parameters and conditions.

Curriculum Content	**Hours**
Unit I Architecture of Satellite Communication System: Principles and architecture of satellite Communication, Brief history of Satellite systems, advantages, disadvantages, applications, and frequency bands used for satellite communication and their advantages/drawbacks	**6**
Unit II Orbital Analysis: Orbital equations, Kepler's laws of planetary motion, Apogee and Perigee for an elliptical orbit, evaluation of velocity, orbital period, angular velocity etc of a satellite, concepts of Solar day and Sidereal day.	**7**
Unit III Satellite sub-systems: Architecture and Roles of various sub-systems of a satellite system such as Telemetry, tracking, command and monitoring (TTC & M), Attitude and orbit control system (AOCS), Communication sub-system, power sub-systems, antenna sub-system.	**7**
Unit IV Typical Phenomena in Satellite Communication: Solar Eclipse on satellite, its effects, remedies for Eclipse, Sun Transit Outage phenomena, its effects and remedies, Doppler frequency shift phenomena and expression for Doppler shift.	**7**
Unit V Satellite link budget: Flux density and received signal power equations, Calculation of System noise temperature for satellite receiver, noise power calculation, Drafting of satellite link budget and C/N ratio calculations in clear air and rainy conditions, Case study of Personal Communication system	**7**

(satellite telephony) using LEO.	
Unit VI Modulation and Multiple Access Schemes used in satellite communication.Typical case studies of VSAT, DBS-TV satellites and few recent communication satellites launched by NASA/ ISRO. GPS.	**6**
Suggested list of Tutorials and Assignments: As suggested by course teacher	
Suggested Text Books:	
1.	
Suggested Reference Books:	
1.	Timothy Pratt and Others, "Satellite Communications", Wiley India, 2nd ¬ edition,2010.
2.	S. K. Raman, "Fundamentals of Satellite Communication", PearsonEducation India, 2011.
3.	Tri T. Ha, "Digital Satellite Communications", Tata McGraw Hill, 2009
4.	Dennis Roddy, "Satellite Communication", McGraw Hill, 4th Edition, 2008

Course Outcome and Program Outcome Mapping

Course Outcomes (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	3	2	1					1		
CO 2	3	2	1					1		
CO 3	3	2	1					1		

Level of Mapping as: Low 1, Moderate 2, High 3

	:						
Course Title	:	**Smart and Phase Array Antenna Design (Elective -IV)**			***Course Code*:**	:	METCOE 23
Teaching Scheme (Hours)	:	Lecture :	3 Hrs/week		***Total Credits***	:	3
		Tutorial :	-- Hrs/week				
Evaluation Scheme (Marks)	:	IE=40	ESE = 60	Grand Total=100	***Duration of ESE***	:	3 hrs
Pre-requisites *(if any)*	:	Antenna theory					
Course Domain	:	Communication					

Course Rationale*:* In this course students shall learn basics as well as advanced phase are antennas. they shall learn radiation pattern of two point sources, Dolf Tchebyschef array, Pattern Synthesis for Linear and Planar Arrays, Methods of Pattern Optimization/Adaptive Arrays, various antennas and their feed mechanism,

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1	Teach radiation pattern of two point sources for various distances and phases.	1	Shall understand how to obtain radiation pattern of two point sources for various cases.
2	Teach Pattern Synthesis for Linear and Planar Arrays	2	understand Pattern Synthesis for Linear and Planar Arrays
3	Teach Adaptive antennas	3	Understand Adaptive antennas.
4	Teach various antennas and their feed mechanism for array antenna design	4	Understand various antennas and their feed mechanism for array antenna design

Curriculum Content	**Hours**
Unit I Array of two point sources, Linear broadside array with nonuniform amplitude distributions, Dolf Tchebyscheff distribution	**6**
Unit II Pattern Synthesis for Linear and Planar Arrays Linear Arrays and Planar Arrays with Separable Distributions, Fourier Transform Method, Schelkunov's (Schelkunoff's) Form, Woodward Synthesis, Dolph-Chebyshev Synthesis, Taylor Line Source Synthesis, Modified sin pz/pz Patterns, Bayliss Line Source Difference Patterns.	**7**
Unit III Methods of Pattern Optimization/Adaptive Arrays Pattern Optimization, Adaptive Arrays, Generalized S/N Optimization for Sidelobe Cancelers, Phased and Multiple-Beam Arrays, Operation as Sidelobe Canceler, Fully Adaptive Phased or Multiple-Beam Arrays, Wideband Adaptive Control	**6**
Unit IV Elements for Phased Arrays, Array Elements, Polarization Characteristics of Infinitesimal Elements in Free Space, Electric Current (Wire) Antenna Elements, Effective Radius of Wire Structures with Noncircular Cross Section, The Dipole and the Monopole, Special Feeds for Dipoles and Monopoles, Dipoles Fed Off-Center, The Sleeve Dipole and Monopole, The Bowtie and Other Wideband Dipoles, The Folded Dipole , Microstrip Dipoles, Other Wire Antenna Structures, Broadband Flared-Notch, Vivaldi, and Cavity-Backed Antennas, Aperture Antenna Elements, Slot Elements, Waveguide Radiators, Ridged Waveguide Elements, Horn Elements, Microstrip Patch Elements, Microstrip Patch, The Balanced Fed Radiator of Collings Elements for Alternative Transmission Lines, Elements and Row (Column) Arrays for One-Dimensional Scan, Waveguide Slot Array Line Source Elements, Printed Circuit Series-Fed Arrays, Elements and Polarizers for Polarization Diversity	**7**
Unit V Special Array Feeds for Limited Field-of-View and Wideband Arrays Multiple-Beam Systems, Beam Crossover Loss, Orthogonality Loss and the Stein Limit, Multiple-	**7**

Beam Matrices and Optical Beamformers, Antenna Techniques for Limited Field-of-View Systems, Minimum Number of Controls, Periodic and Aperiodic Arrays for Limited Field of View,	
Unit VI Constrained Network for Completely Overlapped Subarrays, Reflectors and Lenses with Array Feeds, Practical Design of a Dual-Transform System, Wideband Scanning Systems, Broadband Arrays with Time-Delayed Offset Beams, Contiguous Time-Delayed Subarrays for Wideband Systems, Overlapped Time-Delayed Subarrays for Wideband Systems	**7**
Suggested list of Tutorials and Assignments: As suggested by the course teacher	
Suggested Text Books:	
1.	Phased Array Antennas (2nd Edition) by Robert C. Hansen
2.	Array and Phased Array Antenna Basics by Alan J. Fenn (Wiley)
3.	
Suggested Reference Books:	
1.	Phased array antenna hand book by Robbert J. Mailbox
2.	Ultrawideband Phased Array Antenna Technology for Sensing and Communications Systems by Alan J. Fenn & Peter T. Hurst
3.	

Course Outcome and Program Outcome Mapping

Course Outcomes (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	3	1	1	1	1					
CO 2	3	1	1	1	1	1				
CO 3	3	1	1	1	1	1				
CO 4	3	1	1	1	1	1				

Level of Mapping as: Low 1, Moderate 2, High 3

Class, Part & Semester	**:**	**First Year M. Tech (E&TC), Part I, Sem-II**					
Course Title	**:**	**Intellectual Property Rights**			***Course Code*:**	**:**	ETCA121
Teaching Scheme (Hours)	**:**	Lecture :	2 Hrs/week		***Total Credits***	**:**	2
		Tutorial :	-- Hrs/week				
Evaluation Scheme (Marks)	**:**	IE=nil	IE = 50	Grand Total=50	***Duration of ESE***	**:**	—-
Revision:	**:**	Fourth			***Month***	**:**	July 2025
Pre-requisites *(if any)*	**:**	Basic Legal Awareness, Digital Literacy					
Course Domain	**:**	Audit Course					

Course Rationale: The course on Intellectual Property Rights (IPR) is designed to provide students with an in-depth understanding of the importance of intellectual property in fostering innovation, creativity, and economic development. As the global economy becomes increasingly knowledge-driven, protecting and managing intellectual property is critical for individuals, organizations, and nations.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Provide a comprehensive understanding of the concept, origin, and types of Intellectual Property Rights (IPR) and their significance in the global context.	1.	Explain the fundamental concepts, origin, and significance of various types of Intellectual Property Rights (IPRs) in protecting innovations and creations.
2.	Introduce the legal framework of IPR, including the TRIPS agreement and its relationship with the WTO	2.	Apply the knowledge of patent laws, registration procedures, and infringement remedies in the protection of inventions and technologies
3.	Familiarize students with the processes and laws related to patents, copyrights, and trademarks, along with their infringements and remedies	3.	Demonstrate an understanding of copyright laws, including software copyrights, piracy issues, and the remedies for infringement.
4.	Understand the significance of designs, geographical indications, and layout designs, as well as their protection under international and national laws.	4.	Analyze and manage issues related to trademarks, including registration, infringement, and offenses in cyberspace, such as domain name disputes.
5.	Explore the legal provisions and ethical considerations related to the Information Technology Act, 2000, including cybercrime, e-commerce, and digital signatures.	5.	Evaluate the legal framework for design protection, including the Semiconductor Integrated Circuits Layout Design Act and international conventions.
6.	Develop the ability to identify, register, and manage intellectual property rights in various domains, including traditional knowledge and modern technologies.	6.	Assess the implications of the Information Technology Act, 2000, particularly in the areas of e-governance, e-commerce, and combating cybercrime.

Curriculum Content	**Hours**
Unit I Introduction to IPR: Meaning of property, Origin, Nature, Meaning of Intellectual Property Rights, Introduction to TRIPS and WTO, Kinds of Intellectual property rights—Copy Right, Patent,	**5**

Trade Mark, Trade; Secret and trade dress, Design, Layout Design, Geographical Indication, Plant. Varieties and Traditional Knowledge	
Unit II Patent Rights and Copy Rights: Origin, Meaning of Patent, Types, Inventions which are not patentable, Registration Procedure, Rights and Duties of Patentee, Assignment and license, Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties	**5**
Unit III Copy Right:Origin, Definition &Types of Copy Right, Registration procedure, Assignment & license, Terms of Copy Right, Piracy, Infringement, Remedies, Copy rights with special reference to software	**4**
Unit IV Trade Marks: Origin, Meaning & Nature of Trade Marks, Types, Registration of Trade Marks, Infringement & Remedies, Offences relating to Trade Marks, Passing Off, Penalties. Domain Names on cyber space	**4**
Unit V Design: Meaning, Definition, Object, Registration of Design, Cancellation of Registration, International convention on design, functions of Design. Semiconductor Integrated circuits and layout design Act-2000**.**	**4**
Unit VI Basic Tenents Of Information Technology Act-2000, IT Act - Introduction, E-Commerce and legal provisions, E- Governance and legal provisions, Digital signature and Electronic Signature. Cybercrimes.	**5**

Suggested list of Tutorials and Assignments: As suggested by the course teacher	
Suggested Text Books/Reference Books	
1.	Intellectual Property Rights and the Law, Gogia Law Agency, by Dr. G.B. Reddy
2.	Law relating to Intellectual Property, Universal Law Publishing Co, by Dr. B.L.Wadehra
3.	IPR by P. Narayanan
Suggested:	
1.	Law of Intellectual Property, Asian Law House, Dr. S. R. Myneni.

Outcome and Program Outcome Mapping

Course Outcome CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1		2								
CO2				3						
CO3				2						
CO4				3						
CO5				3						
CO6				3						

Level of Mapping as: Low1, Moderate2, High3

Class, Part & Semester	**:**	**First Year M. Tech (E&TC), Part I, Sem-II**					
Course Title	**:**	**Seminar-II**			***Course Code*:**	**:**	ETCC124
Teaching Scheme (Hours)	**:**	Practical :	2 Hrs/week		***Total Credits***	**:**	1
Evaluation Scheme (Marks)	**:**	IE= 50 Marks	EOE= ---	Total= 50 marks	***Duration of EPE***	**:**	----
Pre-requisites *(if any)*	**:**	**Advance Technology Studies**					
Course Domain	**:**	**Technology Exchange**					

Course Rationale: Students should get acquainted with the advance topics in the field of Electronic, IT , E&TC and Computer Engineering

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	*To encourage students for research development*	1	*Demonstrate and explore New Technology*
2.		2	*Inculcate ability to make presentation*
3.		3.	*Explore the research*
4.		4	*Inculcate innovations*

Course Outcome and Program Outcome Mapping

Course outcome CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1							3			
CO2							3			
CO3							3			3
CO4							3			

Level of Mapping as: Low1, Moderate2, High3

Class, Part & Semester	**:**	**First Year M. Tech (E&TC), Part I, Sem-II**					
Course Title	**:**	**Laboratory-I: Wireless Sensor Network**			***Course Code*:**	**:**	ETCC125
Teaching Scheme (Hours)	**:**	Practical :	2 Hrs/week		***Total Credits***	**:**	1
Evaluation Scheme (Marks)	**:**	IE=50 marks	EOE= ---	Total=50 marks	***Duration of EPE***	**:**	----
Pre-requisites *(if any)*	**:**	Wireless Communication, Computer Network					
Course Domain	:	Electronics and Telecommunication Engineering					

Course Rationale:

Course Objectives:		***Course Outcomes:*** Students will be able to	
1.	To Introduce concept of WSN	1.	Understood practical implementation of WSN
2.	To teach the students about simulation of WSN	2.	Learn about the types of architecture of WSN
3.	To Introduce sensor network architecture	3.	Acquire knowledge about simulation of WSN

List of Experiments

Sr. No.	**Title of Experiment**
1.	NS Simulation: Node Deployment and Clustering
2.	MAC Protocol Simulation—TSCH Behavior
3.	Implement a WSN time sync protocol (e.g., Flooding Time Synchronization Protocol) and evaluate synchronization precision across nodes.
4.	Implement wireless data transmission between sensor nodes
5.	Dynamic Routing with Mobile Nodes
6.	Mobility in WSNs Mobile Sink Simulation
7.	Implement and analyze routing via AODV in a simulated WSN
8.	Measure packet loss rates across varied distances in indoor/outdoor setups to understand wireless propagation and performance constraints

General Instructions: if any regarding course delivery and assessment

Suggested Text Books/ Reference Books/Manual

1.	Holger Karl & Andreas Willing, Protocols And Architectures for Wireless Sensor Networks, John Wiley, 2005.
2.	Feng Zhao & Leonidas J. Guibas, Wireless Sensor Networks An Information Processing Approach, Elsevier, 2007.
3.	Waltenegus Dargie, Christian Poellabauer, Fundamentals of Wireless Sensor Networks: Theory and Practice John Wiley & Sons Publications, 2011

Course Outcome and Program Outcome Mapping

Course Outcome CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	2	3	2	1	-	-	-
CO2	3	3	2	2	2	1	1	-	-	-
CO3	2	3	3	2	3	2	1	-	-	-

Level of Mapping as: Low1, Moderate2, High3

Class, Part & Semester	**:**	**First Year M. Tech (E&TC), Part I, Sem-II**					
Course Title	**:**	**Laboratory-I: Computer Vision**			***Course Code*:**	**:**	ETCC126
Teaching Scheme (Hours)	**:**	Practical:	2 Hrs/week		***Total Credits***	**:**	1
Evaluation Scheme (Marks)	**:**	IE=50 marks	EOE= ---	Total=50 marks	***Duration of EPE***	**:**	---
Pre-requisites *(if any)*	**:**	Image Processing					
Course Domain	**:**	Electronics & Telecommunication					

Course Rationale: *: This course equips students with the knowledge and tools to analyze, interpret, and understand visual information from images and videos, enabling applications in automation, robotics, medical imaging, and intelligent systems.*

Course Objectives:		***Course Outcomes:*** Students will be able to	
1.	To Introduce the students practical approach of computer vision	1.	Comprehend the basic concept of Computer Vision
2.	To teach the students about basics of computer vision	2.	Learn about the different transforms in image processing
3.	To Introduce concept of ANN	3.	Acquire knowledge about different image retrievals techniques
4.		4.	To be able to explain ANN

List of Experiments

Sr. No.	**Title of Experiment**
1.	Implementation of Discrete wavelet transform for Image processing (2DWT)
2.	Implementation of Harr wavelet for Image processing
3.	Representation of boundary using Chain codes.
4.	To study the Nearest neighbor classifier
5.	To study the Statistical decision matching
6.	Implementation of Image Retrieval using Color Features
7.	Implementation of Image Retrieval using Texture Features
8.	Implementation of Image Retrieval using Shape features
9.	To study Artificial Neural Networks

General Instructions: If any regarding course delivery and assessment

Suggested Text Books/ Reference Books/Manual

1.	Digital Image processing and Pattern Recognition by Malay K. Pakhira PHI

2.	Digital Image processing Education by Rafael C. Gonzalez and Richard E. Woods Pearson
3.	Image Processing Principles and Applications, Tinku Acharya , Ajoy K. Ray,, Wiley, 2005

Course Outcome and Program Outcome Mapping

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	2	2	-	-	-	1	1
CO2	3	3	3	2	3	-	-	-	1	-
CO3	3	3	3	2	3	1	1	2	2	1
CO4	3	3	3	3	3	1	1	2	3	2

Level of Mapping as: Low1, Moderate2, High3

Semester- III

Class, Part & Semester	**:**	**Second Year M. Tech (E&TC), Part II, Sem-III**					
Course Title	**:**	**Industrial Training**			***Course Code*:**	**:**	ETCC231
Teaching Scheme (Hours)	**:**	Practical:	2 Hrs./week		***Total Credits***	**:**	5
Evaluation Scheme (Marks)	**:**	IE= 50	EOE= 50	Total= 100	***Duration of EPE***	**:**	----
Pre-requisites *(if any)*	**:**	Technical Knowledge and Skills, Communication and Interpersonal Skills					
Course Domain	**:**	Core					

Course Rationale: By including industrial training in the curriculum, students can gain practical experience, industry exposure, and relevant skills that prepare them for successful careers in their chosen field. Industrial training enhances their employability, facilitates networking, and cultivates the necessary attributes for professional growth and development.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Provide students with an opportunity to apply the theoretical knowledge gained during their coursework to a real-world software development project	1.	Apply the theoretical concepts and skills learned during their training to develop a software project
2.	Offer students hands-on experience in various aspects of software development, including requirements gathering, system design, coding, testing, and documentation.	2.	Gain hands-on experience in various aspects of software development
3.	Develop students' collaborative and professional skills	3.	Learn to collaborate effectively with team members, communicate their ideas, and participate in project discussions
4.	Enhance students' problem-solving abilities by exposing them to complex real-world problems	4.	Analyze complex problems, break them down into manageable tasks, and develop innovative solutions
5	Develop students' project management skills by engaging in a software development project	5.	Practice project management skills, including task planning, time management, and resource allocation
6.	Enhance students' technical writing and presentation skills	6.	Submit a comprehensive report of their development work

Curriculum Content

- The student shall undertake software development project at any of the industry/research organization/software company under the guidance of an internal guide and a suitable Co-guide from that industry/research organization/ company for a duration of eight weeks at the end of the first year (during summer). The report of the development work is to be submitted to the University in the first week of semester III.

(Student is expected to submit Industrial Training report in Latex/Microsoft Word in the standard format

style file available in the department)

- Industrial Training of eight weeks at the end of the First Year

OR

Industrial training will be split into two slots of four weeks during semester III

- Evaluation at end of III semester on the basis given report and Presentation to the concerned Guide.

Course Outcome and Program Outcome Mapping

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3						3			
CO2						2			2	
CO3						3		3	3	
CO4									2	
CO5						3		2	2	
CO6						3		2	2	

Level of Mapping as: Low1, Moderate2, High3

Class, Part & Semester	**:**	**Second Year M. Tech (E&TC), Part II, Sem-III**					
Course Title	**:**	**Dissertation Phase-I**			***Course Code*:**	**:**	ETCC232
Teaching Scheme (Hours)	**:**	Practical:	2 Hrs./week		***Total Credits***	**:**	15
Evaluation Scheme (Marks)	**:**	IE= 100	EOE= 100	Total= 200	***Duration of EPE***	**:**	----
Pre-requisites *(if any)*	**:**	Research Skills and Methodology, Domain-Specific Knowledge					
Course Domain	**:**	Core					

Course Rationale: This course develops essential research skills, demonstrates their ability to formulate research questions and proposals, and gains a comprehensive understanding of the research process. The rationale behind this course is to prepare students for the subsequent stages of their dissertation, ensuring they have the necessary knowledge, skills, and tools to undertake rigorous and meaningful research.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Develop students' research competence by providing them with the opportunity to engage in independent research.	1.	Develop research skills through conducting a literature survey, critically analyzing existing literature, identifying research gaps, and proposing a dissertation topic.
2.	Enable students to prepare and deliver effective research proposals.	2.	Gain proficiency in preparing and delivering a presentation to propose a dissertation title.
3.	Equip students with project planning and execution skills.	3.	Demonstrate the ability to plan and execute a research project by preparing a synopsis, outlining research objectives, methodology, and expected outcomes
4.	Foster students' ability to monitor and report their research progress effectively.	4.	Develop skills in monitoring and documenting their research progress by submitting monthly progress reports
5	Enhance students' research presentation and communication skills.	5.	Develop effective presentation and communication skills by delivering an end-of-semester presentation summarizing the progress of their dissertation work
6.	Assess students' research work and their ability to defend their findings.	6.	Gain valuable research experience, contribute to their chosen field of study, and develop essential skills for future academic and professional pursuits.

Curriculum Content
• The dissertation title should be identified based on the literature survey, and a presentation should be delivered. The synopsis of the dissertation should be prepared and submitted to the University for its Approval. • The student shall carry out work related to the dissertation with the consent of the guide. This work shall include related hardware/software assignments, field work (if required), as decided by the guide. • The student shall be allowed to submit the dissertation phase I report only after the completion of a minimum of 50% work of the total project, with intermediate /partial results of the dissertation project to the concerned guide. The student shall deliver a presentation at the end of Semester III, submitting the progress of the work done. The work is to be jointly assessed for oral examinations by internal (guide) and external examiners appointed by the University. (Student is expected to submit the dissertation report in LaTeX/Microsoft Word in the standard format style file available in the department) • Students are expected to do self-study for two hours as per the guidance given by the Project Guide and report to the department once a week. Hence, contact hours are to be taken as two for the calculation of contact hours.

Course Outcome and Program Outcome Mapping

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	3		2		2	2			
CO2		3		3						
CO3	2					2		2	2	
CO4			2			2		2	3	
CO5						3	3		3	
CO6			3			3		3	3	

Level of Mapping as: Low1, Moderate2, High3

Semester- IV

Class, Part & Semester	**:**	**Second Year M. Tech (ETC), Part II, Sem-IV**					
Course Title	**:**	**Dissertation Phase-II**			***Course Code*:**	**:**	ETCC241
Teaching Scheme (Hours)	**:**	Practical:	4 Hrs./week		***Total Credits***	**:**	20
Evaluation Scheme (Marks)	**:**	IE= 150	EOE= 150	Total= 300	***Duration of EPE***	**:**	----
Pre-requisites *(if any)*	**:**	Research Skills and Methodology, Domain-Specific Knowledge Research Ethics, Research Methods or Analysis					
Course Domain	**:**	Core					

Course Rationale: The course rationale is to provide students with a comprehensive learning experience that combines theoretical knowledge with practical application, enabling them to become proficient researchers capable of conducting rigorous research, producing high-quality academic writing, delivering effective presentations, and publishing their work in reputable outlets.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Enable students to acquire the necessary skills and knowledge to conduct high-quality research in their chosen field of study.	1.	Develop research skills by conducting a comprehensive study, collecting relevant data, and analyzing findings to contribute to the field of study.
2.	Foster the ability to produce well-structured and coherent written reports, including monthly progress reports.	2.	Enhance presentation skills by delivering a comprehensive presentation of the dissertation work at the end of Semester IV
3.	Help to develop effective oral communication and presentation skills.	3.	Gain experience in publishing research work by submitting a paper on the thesis work to either the National or International Conference
4.	Encourage students to contribute to the academic community by publishing their thesis work in conference proceedings.	4.	Develop proficiency in using LaTeX or Microsoft Word to create dissertation reports in the standard format style file provided by the department.
5	Help to develop proficiency in using LaTeX or Microsoft Word for the creation of seminar reports	5.	Cultivate effective time management skills by submitting monthly progress reports
6.	Help to cultivate effective time management skills by submitting monthly progress reports	6.	Acquire proficiency in technical writing by preparing monthly progress reports,

Curriculum Content
• The student shall submit a monthly progress report to the department and shall deliver a presentation of the work at the end of Semester IV, submitting the report on the dissertation work. • A publication of a paper on the thesis work in a National/International Conference proceedings with a presentation certificate, OR a paper on the thesis work be communicated to a National/International Journal & accepted for publication for the submission of thesis at the end of IVth semester is mandatory. • The student shall be allowed to submit the dissertation phase II report only after the full-fledged demonstration of his /her work to the concerned guide. A pair of referees, as appointed by the University, one of which will be the guide and the other – external examiner, will assess the dissertation work during the oral examination. • (Student is expected to submit the dissertation phase-II report in Latex/Microsoft Word in the standard format style file available in the department) • Students are expected to do self-study for four hours as per the guidance given by the Project Guide and report to the department once a week. Hence, contact hours are to be taken as four for the calculation of contact hours.

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO1	2	3		2		2	2			
CO2		3		3						
CO3	2					2		2	2	
CO4			2			2		2	3	
CO5						3	3		3	
CO6			3			3		3	3	

Level of Mapping as: Low1, Moderate2, High3

Applicable From Academic Year 2025-26

Sr. No.	Subject Code	Subject Title	Teaching Scheme (Hours/week)				Examination Scheme			
							Theory		Practical	
			L	T	P	Credits	Scheme	Max. marks	Scheme	Max. marks
1	METCC41	Dissertation Phase-II	-	-	4*	20	---	---	IE	100
									EOE	200
		Total	-	-	4	20	--	---		300
Total Contact hours per week =4*										

*Students are expected to do self-study for two hours as per the guidance given by the dissertation guide and report to the department as per the schedule in the disseminated time table.

During Dissertation Phase –II students are expected to complete their respective dissertation in all respect and submit it to the University for the Further Procedures.

Note:
** For dissertation guiding 2 hrs./week load will be considered for the designated dissertation guide (faculty member) of the program/department

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	3		2		2	2			
CO2		3		3						
CO3	2					2		2	2	
CO4			2			2		2	3	
CO5						3	3		3	
CO6			3			3		3	3	

Level of Mapping as: Low1, Moderate2, High3