Shree Warana Vibhag Shikshan Mandal's

WARANA UNIVERSITY,
WARANANAGAR

(A State Public University established under Section 3 (6) of MPUA, 2016)

॥ विद्या सर्वस्य भूषणम् ॥

Warana University

Established: 2025

Structure &Syllabus

of

First Year Master of Technology (M.Tech.)

Department of Electronics & Telecommunication Engineering

Under

Faculty of Science & Technology

Structure and Syllabus in Accordance With

National Education Policy - 2020

With Effective from Academic Year 2025-26

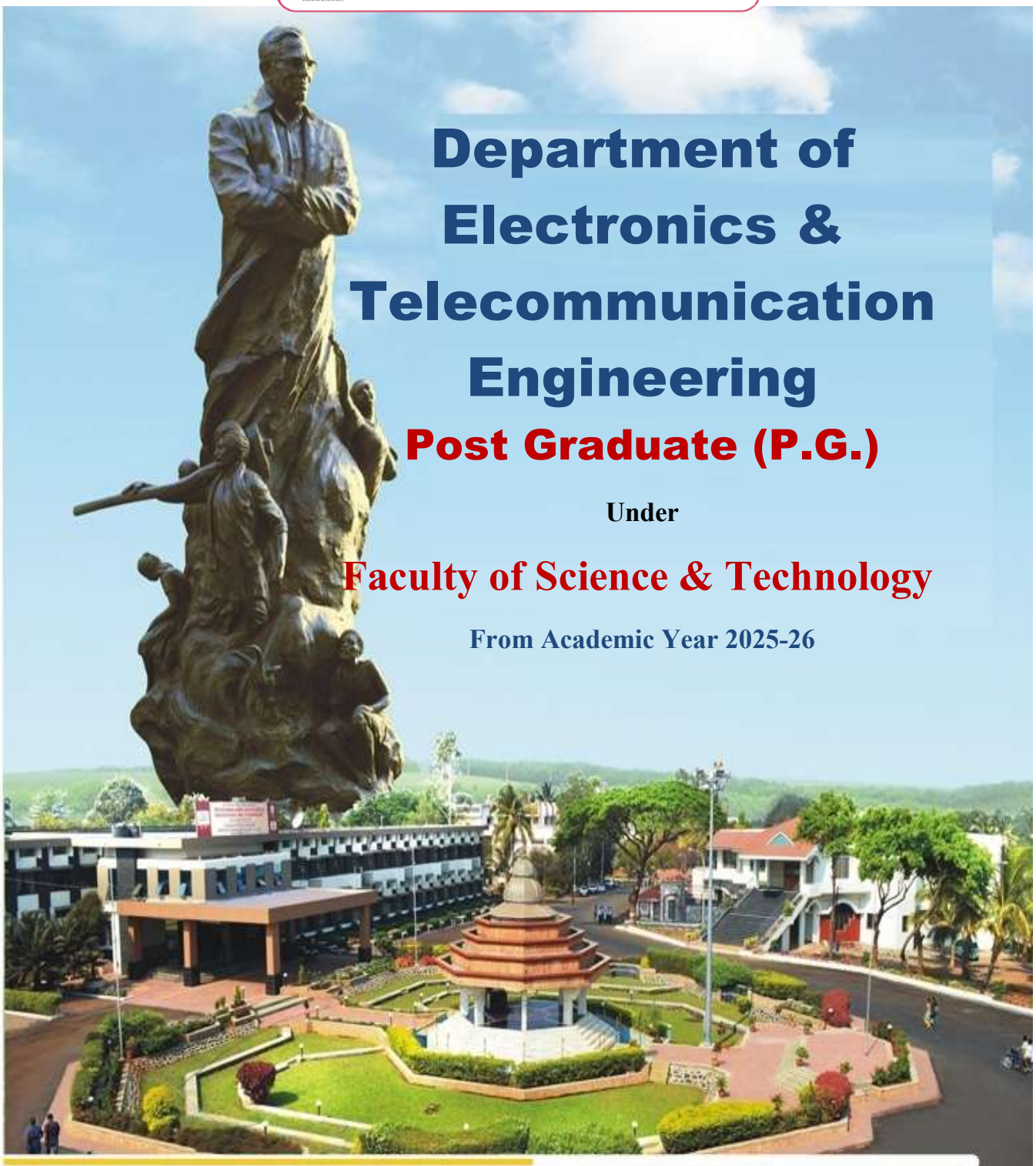
Shree Warana Vibhag Shikshan Mandal's

TATYASAHEB KORE INSTITUTE OF ENGINEERING AND TECHNOLOGY
(AUTONOMOUS), WARANANAGAR, KOLHAPUR

Estd. 1983

Lead Institute of

WARANA UNIVERSITY, WARANANAGAR
(A State Public University)



Department of Electronics & Telecommunication Engineering

Post Graduate (P.G.)

Under

Faculty of Science & Technology

From Academic Year 2025-26

M.Tech.in Electronics &Telecommunication Engineering

Structure and Syllabus under Autonomy as per NEP Policy 2020

Abbreviations

Sr. No.	Acronym	Definition
1	ISE	In-Semester Examination
2	ISE -I	In-Semester Examination I
3	ISE-II	In-Semester Examination II
4	ESE	End Semester Examination
5	TH	Theory Lecture
6	Tut	Tutorial
7	PH	Practical Hours
8	P	Practical
9	O	Oral
10	TW	Term Work
11	CH	Contact Hours
12	C	Credit

Course/ Subjects Categories

Sr. No	Acronym	Definition
1	PCC	Professional Core Course
2	PE	Program Elective
3	OE	Open Elective Course
4	LC	Laboratory Course
5	MC	Mandatory Course
6	SW	Seminar work
7	II	Industrial Internship
8	PC	Dissertation
9	SLC/AC	Self Learning Course/Audit course

First Year M. Tech. Electronics and Telecommunication Engineering

Curriculum Structure and Evaluation Scheme

Semester-I

(To be implemented from 2025-26)

Sr. No.	Category	Course Category	Course Code	Course Title	Teaching and Credit Scheme					Examination and Evaluation Scheme			
					L	T	P	C	CH	Component	Marks	Min. for Passing	
1	Programme Course	PCC	2501PETC PCC101	Advanced Embedded System	3	-	-	3	3	ESE	60	24	40
										ISE	40	16	
			2501PETC PCC101T	Advanced Embedded System	-	1	-	1	1	ISA	25	10	10
			2501PETC PCC102	Error control Coding Techniques	3	-	-	3	3	ESE	60	24	40
										ISE	40	16	
			2501PETC PCC102T	Error control Coding Techniques	-	1	-	1	1	ISA	25	10	10
2	Program Elective	PE	2501PETC PE103X	Program Elective-I	3	-	-	3	3	ESE	60	24	40
										ISE	40	16	
			2501PETC PE104X	Program Elective-II	3	-	-	3	3	ESE	60	24	40
										ISE	40	16	
			2501PETC PE105X	Program Elective-III	3	-	-	3	3	ESE	60	24	40
										ISE	40	16	
3	Laboratory Course	LC	2501PETC LC106P	Laboratory Practice	-	-	4	2	4	OE	25	10	20
										ISA	25	10	
4	Seminar Work	SW	2501PETC SW107T	Seminar-I	-	-	2	1	2	ISA	50	20	20
					15	**2**	**6**	**20**	**23**	**--**	**650**	**260**	**260**

Note: 'X' indicates the sequence number of Program Elective (PE) offered by E & Tc Engineering Program.

First Year M. Tech. Electronics and Telecommunication Engineering

Curriculum Structure and Evaluation Scheme

Semester-II

(To be implemented from 2025-26)

Sr. No.	Category	Course Category	Course Code	Course Title	Teaching and Credit Scheme					Examination and Evaluation Scheme			
					L	T	P	C	CH	Component	Marks	Min. for Passing	
1	Programme Course	PCC	2501PETCPCC201	Computer Vision	3	--	--	3	3	ESE	60	24	40
										ISE	40	16	
		PCC	2501PETCPCC201T	Computer Vision	--	1	--	1	1	ISA	25	10	10
		PCC	2501PETCPCC202	Adhoc & wireless Sensor networks	3	--	--	3	3	ESE	60	24	40
										ISE	40	16	
		PCC	2501PETCPCC202T	Adhoc & wireless Sensor networks	--	1	---	1	1	ISA	25	10	10
2	Program Elective	PE	2501PETCPE203X	Program Elective-IV	3	--	--	3	3	ESE	60	24	40
										ISE	40	16	
		PE	2501PETCPE204X	Program Elective-V	3	--	--	3	3	ESE	60	24	40
										ISE	40	16	
3	Open Elective Course	OE	2501PETCOE205X	Open Elective Course	3	--	--	3	3	ESE	60	24	40
										ISE	40	16	
4	Laboratory Course	LC	**2501PETCLC206T**	Laboratory Practice	--	--	2	1	2	ISA	25	10	10
5	Seminar Work	SW	**2501PETCSW207T**	Seminar-II	--	--	2	1	2	ISA	50	20	20
6	Comprehensive Viva	CV	2501PETCCV208P	Comprehensive Viva	--	--	2	1	2	OE	25	10	10
					15	**2**	**6**	**20**	**23**	**--**	**650**	**260**	**260**

Note:

- 'X' indicates the sequence number of Program Elective (PE) offered by E & Tc Engineering Program.
- Students should opt for the Open Elective (OE) course from other departments. The list of OE courses offered by other departments is available in the structure. Although the OE course code is defined by the respective program in the structure, the actual opted OE course will appear on the mark card.

First Year M. Tech. Electronics and Telecommunication Engineering

List of Program Elective (PE)

Semester-I

	Course Code	Course Title
Program Elective-I	2501PETCPE1031	Advanced Wireless Communication
	2501PETCPE1032	Optimization Techniques
	2501PETCPE1033	Internet Traffic Engineering
Program Elective-II	2501PETCPE1041	Random Process
	2501PETCPE1042	Digital Data Compression
	2501PETCPE1043	Advanced Biomedical Signal Processing
Program Elective-III	2501PETCPE1051	Mobile Computing
	2501PETCPE1052	Design of VLSI Systems
	2501PETCPE1053	Advanced Antenna Theory

Semester-II

	Course Code	Course Title
Program Elective-IV	2501PETCPE2031	Cryptography and Network Security
	2501PETCPE2032	Multi Rate System
	2501PETCPE2033	Advanced Light Wave Communication
Program Elective-V	2501PETCPE2041	Advanced Microwave circuit Design
	2501PETCPE2042	SDR & Cognitive Radio Technology
	2501PETCPE2043	Industry Automation & Process Control

First Year M. Tech. Electronics and Telecommunication Engineering

List of Open Electives (OE) Courses

Semester-II

Sr. No.	OE Offered by Program	Course Code	Open Elective Course
1	Chemical Engineering	2501PCHEOE2051	Project Management
2		2501PCHEOE2052	Operations Research
3		2501PCHEOE2053	Energy Technology
4	Electronics &Telecommunication Engineering	2501PETCOE2051	Advanced Operating Systems
5		2501PETCOE2052	Cyber Security
6		2501PETCOE2053	Artificial Intelligence and Machine Learning
7	Construction Management (Civil Engineering)	2501PCCMOE2051	Water Power Engineering
8		2501PCCMOE2052	Waste to Energy
9		2501PCCMOE2053	Contracts & Tenders
10	Mechanical Design (Mechanical Engineering)	2501PMDEOE2051	Cryogenics
11		2501PMDEOE2052	Design for Manufacture & Assembly
12		2501PMDEOE2053	Enterprise Resource Planning
13	Structural Engineering (Civil Engineering)	2501PCSTOE2051	Cost Management of Engineering Projects
14		2501PCSTOE2052	Optimization Techniques in Civil Engineering
15		2501PCSTOE2053	Industrial Safety
16	Computer Science and Engineering	2501PCSEOE2051	Ethical AI & Explainability
17		2501PCSEOE2052	Computer Vision
18		2501PCSEOE2053	High Performance Computing for Multidisciplinary Research

First Year M. Tech. Electronics and Telecommunication Engineering

Curriculum Structure and Evaluation Scheme

Semester-III

(To be implemented from 2025-26)

Sr. No.	Category	Course Category	Course Code	Course Title	Teaching and Credit Scheme					Examination and Evaluation Scheme			
					L	T	P	C	CH	Component	Marks	Min. for Passing	
1	Mandatory Course	MC	2501PETC MC301	Research Methodology	3	-	-	3	3	ESE	60	24	40
										ISE	40	16	
2	Mandatory Course	MC	2501PETC MC302	Intellectual Property Rights	3	-	-	3	3	ESE	60	24	40
										ISE	40	16	
3	Industrial Internship	II	2501PETC II303	**Industrial Training**	-	-	4	4	8	ISA	75	30	30
4	Self Learning Course/ Audit course	**SLC/AC**	**2501PETCS L304**	**One Course from MOOC/SWAYAM**	-	-	2	-	-	ISA	25	10	10
5	Dissertation	**PC**	**2501PETCP C305**	**Dissertation Phase-I**	-	-	8	10	16	ISA	50	20	40
										OE	50	20	
					6	**-**	**14**	**20**	**30**	**--**	**400**	**150**	**150**

First Year M. Tech. Electronics and Telecommunication Engineering

Curriculum Structure and Evaluation Scheme

Semester-IV

(To be implemented from 2025-26)

Sr. No.	Category	Course Category	Course Code	Course Title	Teaching and Credit Scheme					Examination and Evaluation Scheme			
					L	T	P	C	CH	Component	Marks	Min. for Passing	
1	Dissertation	PC	2501PETCPC401	Dissertation Phase-II	-	-	15	20	30	OE	100	404	80
										ISA	100	40	
					6	-	15	20	30	--	200	80	80

Tatyasaheb Kore Institute of Engineering & Technology,Warananagar

First Year M.Tech Electronics and Telecommunication Engineering Semester- I

2501PETCPCC101: Advanced Embedded System

Teaching Scheme			**Examination Scheme**	
Lectures	03Hrs./Week		ISE	40Marks
Tutorials	01Hrs./Week		ESE	60Marks
Total Credits	04		TW	25Marks
			Duration of ESE	02 Hrs.

Prerequisites, if any:

Students should have basic knowledge of **microprocessors/microcontrollers**, **C programming for embedded systems**, and **computer organization**. Familiarity with **digital electronics** and **operating system fundamentals** will help in understanding ARM architecture and RTOS concepts.

Course Objectives (CO):

1. Understand the architecture of ARM family.
2. Understand On chip peripherals of ARM controller.
3. Understand basic concepts of RTOS and µCOS.

Course Outcomes (CO):At the end of course, students will

1. Explain the **ARM9 architecture**, memory organization, programmer's model, instruction set, and develop basic **ARM assembly programs**.
2. Analyze and configure **ARM cache architecture, MPU, and MMU**, including cache policies, page tables, TLB, and Coprocessor-15 operations for efficient memory management.
3. Develop and debug **Embedded C programs** to interface and control **ARM on-chip peripherals** such as GPIO, timers, UART, I2C, CAN, and interrupts using LPC29xx series controllers.
4. Describe and apply **RTOS concepts** including task management, scheduling algorithms, synchronization mechanisms, inter-task communication, and interrupt handling.
5. Implement and manage **µC/OS-II kernel services**, including task creation, scheduling, context switching, and system initialization in real-time embedded applications.
6. Apply **time management and event control mechanisms** in µC/OS-II to design reliable real-time systems using delays, event control blocks, message queues, and inter-task communication.

Course Description

This course provides an in-depth understanding of **ARM9 microprocessor architecture, memory organization, and assembly-level programming**, enabling students to develop efficient embedded applications. Students will learn about **ARM caches, Memory Protection Unit (MPU), and Memory Management Unit (MMU)**, including cache policies, virtual memory, and system-level configuration using Coprocessor15. The course covers **on-chip peripherals** such as GPIO, timers, UART, I2C, CAN, and LIN, along with practical **embedded C programming** on LPC29xx series microcontrollers. An introduction to **Real-Time Operating Systems (RTOS)** is included, focusing on multitasking, task management, context switching, semaphores, message queues, and event handling. The course also emphasizes the **µC/OS-II kernel structure**, task scheduling, time management, event control blocks, and inter-task communication, preparing students to design and implement **real-time embedded systems** efficiently.

	Course Contents	**Hours**
Unit 1	**ARM9 Architecture & programming:** ARM9 architecture, Memory organization, Programmers model, instructions and assembly programming.	(06)
Unit 2	**ARM caches MPU and MMU:** Cache architecture, Cache policy, Coprocessor15 and caches, protected region, Initializing MPUs, caches and write buffer, virtual memory, ARM MMU, page tables, TLB, Coprocessor15 and MMU Configuration	(08)
Unit 3	**ARM Peripherals and Programming:** On chip peripherals, GPIO, Event router, Interrupts, vectored interrupt controller (VIC), timers, RTC, Watchdog, UART, I2C, CAN, LIN	(08)

Unit 4	**Introduction to RTOS:** RTOS basics, RTOS architecture, share data problem, critical section, shared resources, Task states multitasking, context switching, Kernels, pre-emptive & non-pre-emptive schedulers, mutual exclusion, semaphores, Interrupt Latency, pipes & mails boxes. Message queues, timer functions, events.	(05)
Unit 5	**µCOS:** Kernel Structure: Tasks, Task State, Task Level Context Switching, Locking and unlocking of scheduler, Idle Task, Statistics Task, Interrupts, Clock Tick, Initialization, Starting the OS, Task Management: Creating/deleting and suspending/ Resuming Task, Task S t a c k s and checking, Changing Task's	(06)
Unit 6	**Time Management and Event Control Blocks:** Time Management: Delaying/Resuming Task, System Time, Event Control Blocks: Initialization of ECB, Placing/Removing Task from ECB waitlist, Finding Highest Priority Task, List of Free ECB, Task State Management. Communication in µCOS-II.	(03)

Term Work:
Minimum Six assignments based on above topics

Reference Books

1	ARM System Developers Guide , Designing & Optimizing System Software, Andrew sloss, Dominic symes, Chris Wright, 1st Edition 2004.
2	Micro C/OSII the Real Time Kernel, Jean Labarosse, CMP Books, PIC C Manual, CCS Inc, 2ndEdition.
3	Embedded software primer, David Simon, Pearson Education, 1stEdition 2005.
4	ARM LPC 29xx series data sheet, ARM Datasheet

Tatyasaheb Kore Institute of Engineering & Technology, Warananagar

First Year M.Tech Electronics and Telecommunication Engineering Semester- I

2501PETCPCC102: Error Control Coding Techniques

Teaching Scheme			**Examination Scheme**	
Lectures	03Hrs./Week		ISE	40Marks
Tutorials	01Hrs./Week		ESE	60Marks
Total Credits	04		TW	25Marks
			Duration of ESE	02 Hrs.

Prerequisites, if any:

Students should have basic knowledge of **digital communication systems**, **probability and random processes**, and **linear algebra**. Familiarity with **signals and systems** and **binary arithmetic** is desirable for understanding error control coding techniques.

Course Objectives (CO):

1. Understand basic concept & need of Error Control Coding
2. Study of various encoding & decoding techniques through block codes
3. Study of various encoding & decoding techniques through Convolution Codes.

Course Outcomes (CO):At the end of course, students will

1. Explain the need, objectives, and fundamental principles of **error control coding**, including parameters and distance properties of linear block codes.
2. Analyze and design **linear block codes** such as Hamming, Reed–Muller, product, repetition, and extended/shortened codes for error detection and correction.
3. Apply algebraic principles to construct and decode **cyclic codes**, including CRC, cyclic Hamming, Golay, and quasi-cyclic codes.
4. Develop and implement **BCH codes** using Galois field arithmetic and perform decoding using algebraic decoding algorithms.
5. Explain the construction and decoding of **Reed–Solomon codes**, and apply Euclidean and Berlekamp algorithms for nonbinary error correction.
6. Analyze **convolutional, Turbo, and LDPC codes**, and implement decoding techniques such as Viterbi, MAP, and iterative decoding for modern communication systems.

Course Description

This course introduces the principles and techniques of **error control coding**, covering both linear block codes and cyclic codes, including Hamming, Reed-Muller, Golay, and Bose-Chaudhuri-Hocquenghem (BCH) codes. Students will learn **code construction, encoding and decoding techniques**, syndrome computation, distance properties, and error detection and correction capabilities. The course further explores **Reed-Solomon codes, convolutional codes, and iterative decoding schemes** such as Turbo codes and Low-Density Parity-Check (LDPC) codes, emphasizing algebraic structures, polynomial representations, and practical decoding algorithms including Viterbi, Euclidean, and Berlekamp methods. Through this course, students develop the ability to design, analyze, and implement robust coding schemes for **reliable digital communication systems**.

	Course Contents	**Hours**
Unit 1	**Linear block codes:** Need, Objective &Approaches of Error Control Coding, Introduction, Structure, Parameters, Generator& Parity Check Matrix, Encoding circuit for (n-k) Linear Block Code, Syndrome & Error detection, Syndrome circuit, Distance Properties, Error detecting & Correction Capabilities, Standard Array & Syndrome decoding for (n, k) linear Block Code. Hamming Codes, Product codes, Repetition code, Hada mard codes (Wash Code), Dual Code, Shortened and Extended linear Codes, Reed Muller (RM) Codes.	(07)
Unit 2	**Cyclic codes:** Algebraic structure, Polynomial representation of codeword, Generator polynomial, Non-systematic & Systematic Cyclic Codes, Generator & Parity Check Matrices, Structure of Cyclic Encoder & Syndrome Calculator, Encoding	(07)

	Redundancy Check Code, Cyclic Hamming Codes, Golay Code, Shortened Cyclic Codes, Cyclic Product Code, Quasi Cyclic Code.	
Unit 3	**Bose Chaudhuri Hocquenghem CODE (BCH):** Groups, Rings & its properties, Fields: Binary Field Arithmetic, Primitive element and primitive polynomial, Primitive BCH Code, Construction of Galois Field GF(2m), Properties of Galois Field GF(2m), Minimal & Generator Polynomial for BCH Code. Decoding of BCH Code, Peterson-Gorenstein-Zierler decoder, Error location and Error Evaluation Polynomials, Implementation Correction of Galois Field Arithmetic, Implementation of Error	(8)
Unit 4	**Reed-Solomon codes & decoding algorithms:** Introduction, Error correction capability of RS code, RS code in Nonsystematic &Systematic form, Syndrome decoding, The Euclidean Algorithm: Error location & Error Evaluation Polynomials, Decoding of RS using the Euclidean Algorithm, Decoding of RS & Nonbinary BCH codes using the Berlekamp Algorithm	(07)
Unit 5	**Convolutional Codes:** Introduction, Convolutional Encoder, Generation of Output code sequence using Time domain & Transform domain approach, Convolutioanal code representation: Code Tree, State diagram & Trellis diagram, Structural & Distance properties of Convolutional codes, Transfer Function of Convolution Code. Optimum decoding of Convolutional Codes: Maximum Likelihood decoding, The Viterbi Algorithm, Suboptimal Decoding: Sequential Decoding, Majority Logic Decoding.	(06)
Unit 6	**Iteratively decoded codes:** TURBO CODE: Introduction, Basic Turbo Encoding Structure, Decoding Algorithms, The Maximum Posterior Decoding Algorithm. Low Density Parity CheckCodes (LDPC): Introduction, Construction, Tanner Graph, Decoding LDPC Code: Hard & Soft decoding, Vertical Step updating, Horizontal Step Updating, Terminating & Initializing the decoderalgorithm.	(07)

Term Work:
Minimum Six assignments based on above topics

Reference Books

1	Shu Lin, Daniel J. Costello, Jr., "Error Control Coding", IInd Edition, Pearson Education
2	Todd K Moon," Error Correction Coding", Wiley student, Edition 2006
3	Salvatore Gravano, "Introduction to Error Control Codes", South Asia Edition, Oxford University Press.
4	Jorge Castineira Moreira, Patrick Guy Farrell," Essentials of Error Control
5	W. Cary Huffman and Vera Press," Fundamentals of Error correcting Codes", First Edition, Cambridge University Press.

Tatyasaheb Kore Institute of Engineering & Technology, Warananagar

First Year M.Tech Electronics and Telecommunication Engineering Semester- I

2501PETCPE1031: Advanced Wireless Communication

Teaching Scheme			**Examination Scheme**	
Lectures	03Hrs./Week		ISE	40Marks
Tutorials	---		ESE	60Marks
Total Credits	03		TW	-----
			Duration of ESE	02 Hrs.

Prerequisites, if any:

Students should have prior knowledge of **signals and systems**, **probability and random processes**, and **basic digital communication concepts**. Familiarity with **linear algebra** and **electromagnetic wave propagation** is desirable for understanding wireless channel and MIMO systems.

Course Objectives (CO):

1. Acquire fundamental knowledge of Wireless Communications
2. Study the wireless channel capacities and different channel models
3. Understand the basic concepts of OFDM

Course Outcomes (CO):At the end of course, students will

1. Explain the **physical and statistical modeling of wireless channels**, including time- and frequency-domain characteristics.
2. Analyze **point-to-point wireless communication** over fading channels and evaluate the impact of time, frequency, and antenna diversity.
3. Describe and analyze **OFDM-based multicarrier modulation**, including orthogonality principles, system design, and parameter selection.
4. Evaluate the **capacity of wireless channels**, including AWGN, LTI Gaussian, and fading channels under different resource constraints.
5. Analyze **MIMO systems** for capacity enhancement and diversity gain, including space–time modulation and coding techniques.
6. Explain and compare **multiuser MIMO uplink and downlink communication**, focusing on multiple-antenna transmission and reception strategies.

Course Description

This course provides a comprehensive study of **wireless communication systems**, covering the physical modeling of wireless channels, statistical channel behavior, and input/output channel models. Students will explore **point-to-point communication in fading environments**, including diversity techniques and channel uncertainty impacts, as well as **wideband modulation schemes** such as OFDM and multicarrier systems. The course also focuses on **channel capacity analysis** for AWGN and fading channels, and advanced **MIMO techniques**, including space-time coding, MIMO diversity, and multiuser communication for both uplink and downlink scenarios, enabling students to design and analyze high-performance wireless systems.

	Course Contents	**Hours**
Unit 1	**Wireless channel:** Physical modeling for wireless channels, input/output model of wireless channel, time and frequency response, statistical models.	(07)
Unit 2	**Point to point communication:** Detection in rayleigh fading channel, time diversity, Antenna diversity, frequency diversity, impact of channel uncertainty.	(07)
Unit 3	**Wideband Modulation Techniques: OFDM (Multicarrier Modulation):** Basic Principles of orthogonality, single vs multicarrier systems, OFDM block diagram and ITS Explanation, OFDM signal mathematical representation, selection parameters for modulation	(06)
	Capacity of wireless channels:	

Unit 5	**MIMO and multicarrier modulation:** Narrowband MIMO model-parallel decomposition of MIMO channel-MIMO channel capacity-MIMO diversity gain Space-Time modulation and coding, Smart	(06)
Unit 6	**MIMO IV –multiuser communication:** Uplink with multiple receive antennas, MIMO uplink, Downlink with multiple receive antennas, MIMO downlink	(07)

ReferenceBooks

1	Fundamentals of wireless communication, David Tse, P. Viswanath, Cambridge, 5th Edition 2005
2	Andreas Molisch, Andreas Molisch, Wiley, 2nd Edition 2012
3	Wireless communications, Principles and Practice, Theodore S. Rappaport, Pearson, 2nd Edition 2010
4	Wireless communication, Upen Dalal, Oxford, 1st Edition, 2009
5	Wireless communications, Mark Ciampa, Jorge Olenwa, Cengage, 3rd Edition, 2013

Tatyasaheb Kore Institute of Engineering & Technology, Warananagar

First Year M.Tech Electronics and Telecommunication Engineering Semester-I

2501PETCPE1032:Optimization Techniques

Teaching Scheme			**Examination Scheme**	
Lectures	03Hrs./Week		ISE	40Marks
Tutorials	--		ESE	60Marks
Total Credits	03		TW	--
			Duration of ESE	02 Hrs.

Prerequisites, if any:

Students should have basic knowledge of **engineering mathematics**, including **calculus, linear algebra, and probability**. Familiarity with **numerical methods** and **fundamentals of operations research** will be helpful for understanding optimization techniques.

Course Objectives (CO):

1. Students should understand the concept of Optimization Techniques.
2. Students should understand the concept of linear programming, Nonlinear programming, Geometric programming, Dynamic programming.
3. Students should understand the method for formulation of problem and assignment of models.

Course Outcomes (CO):At the end of course, students will

1. Explain the **fundamental concepts of optimization**, including problem formulation, classification, and multivariable optimization with and without constraints.
2. Formulate and solve **linear programming problems** using graphical, simplex, revised simplex, and duality methods, including transportation models.
3. Apply **nonlinear programming techniques** for single- and multi-variable optimization using analytical and numerical search methods.
4. Analyze and solve **convex optimization problems** using geometric programming and Kuhn–Tucker optimality conditions.
5. Apply **dynamic programming and assignment models** to solve multistage decision-making and resource allocation problems.
6. Explain and implement **genetic algorithms** for solving complex engineering optimization problems and analyze their performance.

Course Description

This course introduces the principles and methods of **optimization in engineering problems**, starting from the historical development and classification of optimization problems to multivariable optimization with and without constraints. Students will learn **linear programming** including formulation, graphical and simplex solutions, duality, and transportation problems, as well as **nonlinear programming** techniques such as uni-dimensional search methods, steepest descent, and Kuhn-Tucker conditions. The course further explores **geometric and dynamic programming**, **assignment models**, and **genetic algorithms**, emphasizing both theoretical concepts and practical applications through case studies and computational procedures.

	Course Contents	**Hours**
Unit 1	**Introduction:** Historical development, Application to Engineering Problems, Statement Of Optimization problems, Classification of Optimization, Multivariable optimization with and without constraints.	(5)
Unit 2	**Linear Programming:** Formulation, Geometry, Graphical solution, standard and matrix form of linear programming problems, Simplex programming and its flow chart, revised simplex algorithm, Two-phase Simplex method, Degeneracy. Duality in linear programming: Definition of Dual Problem, General Rules for converting any Primal into its Dual Simplex method and its flow chart. Decomposition principle, Transportation problem.	(7)

Unit 3	**Nonlinear programming:** Unimodal functions, single dimensional minimization methods, Exhaustive search, Fibonnaci method, Golden section, Comparison of Elimination method, Quadrature interpolation, Cubic interpolation, Direct root method, Randomsearch method, Steepest decent method, Fletcher-Reeves method, David- Fletcher- Powell Method, Convex sets and convex functions, Kuhn-Tucker conditions.	(6)
Unit 4	**Geometric programming:** **P**roblems with coefficients up to one degree of difficulty, Generalized for the positive and negative coefficients dynamic programming: Discrete & continuous dynamic programming (simple illustrations). Multistage decision problems, computation procedure and casestudies	(6)
Unit 5	**Assignment Models:** Formulation of problem, Hungarian Method for Assignment Problem, Unbalanced Assignment Problems	(6)
Unit 6	**Genetic Algorithms:** Introduction, Representation of design variables, Representation of objective function and constraints, Genetic operators, Application procedure and casestudies.	(6)

Reference Books	
1	Linear Programming and Network Flows- Mokhtar S. Bazaraa, John J. Jarvis,
2	Chong, E. P. & Zak S. H. An introduction to optimization, John Wiley
3	Peressimi A.L., Sullivan F.E., Vhi, J.J..Mathematics of Non-linear Programming, Springer– Verlag
4	Optimization: Theory and Practices, S.S Rao, New Age Int. P Ltd. Publishers, New Delhi
5	Optimization concepts & application in Engg. -A. D. Belegundu, Tirupati R. Chandrupatla Pearson Edn.

Tatyasaheb Kore Institute of Engineering & Technology, Warananagar

First Year M. Tech Electronics and Telecommunication Engineering Semester- I

2501PETCPE1033:Internet Traffic Engineering

Teaching Scheme			**Examination Scheme**	
Lectures	03Hrs./Week		ISE	40Marks
Tutorials	---		ESE	60Marks
Total Credits	03		TW	-----
			Duration of ESE	02 Hrs.

Prerequisites, if any:

Students should have prior knowledge of **computer networks**, including **IP addressing, routing protocols, and TCP/IP architecture**. Familiarity with **data communication concepts** and **basic algorithms** will help in understanding traffic engineering and QoS routing.

Course Objectives (CO):

1. Determine link weights for IP traffic engineering for an interior gateway protocol (IGP) such as OSPF or IS-IS
2. To discuss traffic engineering for intra domain networks
3. Develop the platform for understanding the basics of routers and types of routers, and as the background material to understand more details about a router's critical functions, such as address lookup and packet class classification

Course Outcomes (CO):At the end of course, students will

1. Explain the **evolution, architecture, and performance metrics of IP traffic engineering**, including traffic models and link weight determination.
2. Analyze **Internet routing principles and router architectures**, including policy-based routing, routing instability, and packet processing mechanisms.
3. Evaluate and implement **IP address lookup algorithms**, focusing on longest prefix matching and trie-based techniques for high-speed networks.
4. Analyze **IP packet filtering and classification algorithms**, including multidimensional and hardware-based approaches for high-performance routing.
5. Design and evaluate **Quality of Service (QoS) routing mechanisms**, including source-based routing, QoS-aware protocols, and routing under dynamic network conditions.
6. Apply **MPLS-based traffic engineering techniques** for IP and VPN networks, including constrained shortest path and network flow modeling approaches.

Course Description

This course covers the principles and practices of **IP traffic engineering** and advanced routing techniques in modern networks. It begins with the evolution, taxonomy, performance measures, and architectural framework of Internet traffic engineering, including link weight determination and MCNF problem duality. Students will study **Internet routing and router architectures**, IP address lookup algorithms, and packet filtering/classification techniques. The course further explores **Quality of Service (QoS) routing** and **MPLS-based traffic engineering**, including VPN traffic management, constrained path determination, and network flow modeling, emphasizing both theoretical foundations and practical design considerations for high-performance networks.

	Course Contents	**Hours**
Unit 1	**IP traffic engineering**: Evolution of Traffic engineering in internet domain, Taxonomy and recommendation for internet traffic engineering, Performance Measures and characteristics, applications view and traffic models, Architectural frame work, link weight determination, Duality of the MCNF Problem	(05)
Unit 2	**Internet Routing and Router Architectures**: Architectural View of the Internet, Allocation of IP Prefixes and AS Number, Policy-Based Routing, Point of Presence, Traffic Engineering Implications, Internet Routing Instability. Router Architectures: Functions, Types, Elements of a Router, Packet Flow, Packet Processing: FastPath versus Slow Path, Router Architectures	(07)

Unit 3	**Analysis of IP address lookup Algorithms**: Network Bottleneck, Network Algorithmics, Strawman solutions, Thinking Algorithmically, Refining the Algorithm, Cleaningup, Characteristics of Network Algorithms. IP Address Lookup Algorithms : Impact, Address Aggregation, Longest Prefix Matching, Naïve Algorithms, Binary , Multibit and Compressing Multibit Tries.	(05)
Unit 4	**IP Packet Filtering and Classification** Search by Length Algorithms, Search by Value Approaches, Hardware Algorithms, Comparing Different Approaches IP Packet Filtering and Classification: Classification, Classification Algorithms, Naïve Solutions, Two-Dimensional Solutions, Approaches for d Dimensions.	(06)
Unit 5	**Quality of Service Routing**: QoS Attributes, Adapting Routing: A Basic Framework. Update Frequency, Information Inaccuracy, and Impact on Routing, Dynamic Call Routing in the PSTN, Heterogeneous Service, Single Link Case, A General Framework for Source-Based QoS Routing with Path Caching, Routing Protocols for QoS Routing, QOSPF: Extension to OSPF for QoS Routing, ATM PNNI.	(06)
Unit 6	**Routing and Traffic Engineering with MPLS**: Traffic Engineering of IP/MPLS Networks, VPN Traffic Engineering, Problem Illustration: Layer 3 VPN, LSP Path Determination:ConstrainedShortestPathApproach,LSPPathDeterminati on:Network Flow Modeling Approach, Layer2 VPN Traffic Engineering, Observations and	(08)

Reference Books

1	Network Routing: Algorithms, Protocols, and Architectures
2	Network Algorithmic: An Interdisciplinary Approach to Designing Fast Networked Devices George Varghese (Morgan Kaufmann Series in Networking
3	Network Analysis, Architecture, and Design, James D. McCabe, Morgan Kaufmann

Tatyasaheb Kore Institute of Engineering & Technology, Warananagar

First Year M.Tech Electronics and Telecommunication Engineering Semester- I

2501PETCPE1041: Random Process

Teaching Scheme			**Examination Scheme**	
Lectures	03Hrs./Week		ISE	40Marks
Tutorials	--		ESE	60Marks
Total Credits	03		TW	--
			Duration of ESE	02 Hrs.

Prerequisites, if any:

Students should have basic knowledge of **engineering mathematics**, including **calculus and elementary statistics**. Familiarity with **set theory** and **basic probability concepts** will help in understanding random variables and stochastic processes.

Course Objectives (CO):

1. Develop the logical concepts of probability theory
2. Understand basic concepts of Random variables & Random Processes
3. Study concept of Markov Chain and Queuing Theory

Course Outcomes (CO):At the end of course, students will

1. Explain the **fundamental concepts of probability**, including axioms, conditional probability, Bayes' theorem, and Bernoulli trials.
2. Analyze **discrete and continuous random variables** and compute expectation, moments, and statistical measures.
3. Apply concepts of **multiple random variables**, including joint distributions, correlation, covariance, and the central limit theorem.
4. Analyze **random processes** using autocorrelation, cross-correlation, and spectral density in time and frequency domains.
5. Model and analyze **Markov chains**, including state classification, stability, and limiting probabilities.
6. Apply **queuing theory models** such as M/M/1 and multiserver systems to evaluate system performance using Little's law.

Course Description:

This course provides a comprehensive foundation in **probability theory, random variables, and stochastic processes**, essential for modeling and analyzing engineering systems under uncertainty. It covers the fundamental concepts of probability, conditional probability, Bayes' theorem, and Bernoulli trials, extending to **random variables** and their statistical properties, including expectation, moments, and distributions. Students will learn **multiple random variable analysis**, cumulative distribution functions, Gaussian distributions, and the Central Limit Theorem. The course also introduces **random processes**, including autocorrelation, cross-correlation, spectral density estimation, and coherence analysis, alongside **Markov chains** and their applications in system modeling. Finally, it covers **queuing theory**, including Little's formula, M/M/1 queues, and multi-server systems, enabling the design and performance evaluation of service-oriented and communication systems.

	Course Contents	**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.	(07)
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)	(06)

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 sum of random variables, Central limit heorem, estimate of population means, Expected value and variance and covariance.	(07)
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.	(06)
Unit 5	**Markov Chains:** Chapman Kolmogorov equation, Classification of states, Limiting probabilities, Stability of Markov system, Reducible chains, Markov chains with continuous state space.	(07)
Unit 6	**Queuing Theory:** Elements of Queuing System Little's Formula, M/M/1 Queue, Multi server system	(07)

Course Outcomes (CO):At the end of course, students will

1. Solve Probability Problems
2. Classify Random Variables
3. Apply statistical measures in Practical problems
4. Apply Markov Chain & Queuing Theory to solve Problems

Text Books

1	Introduction to probability Models, Sheldon M. Ross, Academic Press, 9th edition2009
2	Random Signal Processing, Prof. G. V. Kumbhojkar, C. Jamanadas & Company, 2nd edition 2009
3	Probability and Random Processes for Electrical Engg., Alberto Lean, Pearson, 2nd edition 2009
4	Probability, Random Variables and Stochastic Processes, Athanasios Papoulis, S. Unnikrishnan Pillai, PHI, 4thb edition 2010

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First Year M.Tech Electronics and Telecommunication Engineering Semester-I

2501PETCPE1042:Digital Data Compression

Teaching Scheme			**Examination Scheme**	
Lectures	03Hrs./Week		ISE	40Marks
Tutorials	--		ESE	60Marks
Total Credits	03		TW	--
			Duration of ESE	02Hrs.

Prerequisites, if any:

Students should have basic knowledge of **signals and systems**, **digital signal processing fundamentals**, and **probability concepts**. Familiarity with **digital communication** and **linear algebra** will be helpful for understanding compression techniques.

Course Objectives (CO):

1. Provide students with contemporary knowledge in Data Compression and Coding.
2. Equip students with skills to analyze and evaluate different Data Compression and Coding methods
3. **To study and apply** image, video, and audio compression techniques using **transform-based, predictive, and perceptual coding methods** for multimedia applications.

Course Outcomes (CO):At the end of course, students will

1. Explain the **fundamental concepts, taxonomy, and applications of data compression**, including intuitive and run-length encoding techniques.
2. Analyze and implement **statistical compression methods** based on information theory, including Huffman, adaptive Huffman, and arithmetic coding.
3. Apply **dictionary-based compression algorithms** such as LZ77, LZ78, LZW, and their variants for efficient lossless compression.
4. Analyze **image compression techniques**, including transform-based, vector quantization, wavelet-based, and context-based methods such as JPEG and JPEG-LS.
5. Explain the principles and standards of **video compression**, including MPEG, MPEG-4, and H.261, for digital video applications.
6. Describe and evaluate **audio and speech compression techniques**, including companding, ADPCM, MPEG audio layers, and speech coding methods.

Course Description:

This course introduces the fundamental concepts and techniques of **data compression** for text, image, audio, and video applications. It begins with an overview of compression principles, including run-length encoding, move-to-front coding, and scalar quantization, and then explores **statistical methods** such as variable-length codes, Huffman coding, Golomb codes, and arithmetic coding. Students learn **dictionary-based compression algorithms**, including LZ77, LZ78, LZW, and their variants. The course covers **image compression techniques**, from transform-based approaches like Discrete Cosine Transform (DCT) and wavelet methods to vector quantization and progressive coding standards like JPEG, JPEG-LS, JBIG, and JBIG2. For multimedia applications, it addresses **video compression** standards (MPEG, MPEG-4, H.261) and **audio compression** techniques, including ADPCM, μ-Law/A-Law companding, MLP, and speech coding, with emphasis on the underlying theory, human perception, and practical implementation considerations.

	Course Contents	**Hours**
Unit 1	**Introduction:** Definitions, Historical background, Applications, Taxonomy, Intuitive Compression. Run-Length Encoding, RLE Text Compression, RLE Image Compression, Move- to Front Coding, Scalar Quantization.	(6)

Unit 2	**Statistical methods:** Information Theory Concepts, Variable-Size Codes, Prefix Codes, Golomb Codes,The Kraft-MacMillan Inequality, The Counting Argument, Shannon-Fano Coding, Huffman Coding, Adaptive Huffman Coding, MNP5, MNP7, Arithmetic	(7)
Unit 3	**Dictionary Methods** String Compression, Simple Dictionary Compression, LZ77 (Sliding Window), LZSS, Repetition Times, QIC-122, LZX, File Differencing: VCDIFF, LZ78, LZFG, LZRW1, LZRW 4, LZW, LZMW, LZAP, LZY, LZP	(7)
Unit 4	**Image Compression Approaches to Image Compression**; Image Transforms, Orthogonal Transforms. The Discrete Cosine Transform JPEG, JPEG-LS. Progressive Image Compression, JBIG, JBIG2, Vector Quantization, Adaptive Vector Quantization, Block Matching, Block Truncation Coding,Context- Based Methods, Wavelet Methods.	(6)
Unit 5	**Video Compression:** Analog Video,Composite and Components Video,Digital Video,Video Compression, MPEG, MPEG-4, H.261	(6)
Unit 6	**Audio Compression:** Sound, Digital Audio, The Human Auditory System, μ-Law and A-Law Companding, ADPCM Audio Compression, MLP Audio, Speech Compression, Shorten MPEG-1 Audio Layers	(6)

Reference Books	
1	The Data Compression- Mark Nelson, Jean-Ioup Gailly, 2nd edition, M&T pub.
2	Introduction to Data Compression-Khalid Sayood, 2nd edition, Academic press ltd.
3	Introduction to Information Theory and Data Compression- Darrel Hankerson, 2nd ed, Chapman and Hall/CRC publications.
4	Handbook of Image and video Processing-Al Bovik Academic press ltd. Publication.
5	Compression Algorithms for Real Programmers- Peter Wayner Academic press ltd.
6	Data compression: the complete reference- David Salomen D, Springer Publication

Tatyasaheb Kore Institute of Engineering & Technology, Warananagar

First Year M.Tech Electronics and Telecommunication Engineering Semester-I

2501PETCPE1043: Advanced Biomedical Signal Processing

Teaching Scheme			**Examination Scheme**	
Lectures	03Hrs./Week		ISE	40Marks
Tutorials	--		ESE	60Marks
Total Credits	03		TW	--
			Duration of ESE	02Hrs.

Prerequisites, if any:

Students should have basic knowledge of **signals and systems**, **digital signal processing**, and **probability & random processes**. Familiarity with **linear algebra** and **human physiology fundamentals** is desirable for understanding biomedical signal analysis.

Course Objectives(CO):

1. Introduce students to the principles of signal processing techniques and its application to biomedical signals
2. Understanding methods and tools for extracting information from biomedical signals.
3. Understand analysis of biomedical signals

Course Outcomes (CO):At the end of course, students will

1. Explain the **characteristics and clinical significance of biomedical signals** such as ECG, EEG, and EMG, and their role in computer-aided diagnosis.
2. Apply **linear systems, Fourier, wavelet, and spectral estimation techniques** for analysis of deterministic, random, and stochastic biomedical signals.
3. Analyze and design **adaptive and optimal filtering methods** to detect biomedical signals in noise and remove artifacts, including maternal–fetal ECG and muscle interference.
4. Process and interpret **cardiological signals**, including ECG acquisition, parameter estimation, QRS detection, and arrhythmia analysis using multiscale methods.
5. Apply **data compression and heart rate variability analysis** techniques for efficient representation and interaction of physiological signals.
6. Model and analyze **EEG signals** using linear, stochastic, and nonlinear techniques, and evaluate brain connectivity through time–frequency, correlation, and coherence analysis.

Course Description:

This course provides a comprehensive introduction to **biomedical signal processing**, focusing on signals such as ECG, EEG, and EMG, and their applications in **computer-aided diagnosis**. Students learn foundational concepts in linear systems, Fourier and wavelet transforms, and processing of random and stochastic signals, including spectral estimation and noise filtering in biomedical instruments. The course explores **concurrent, coupled, and correlated processes**, with adaptive and optimal filtering, event detection, and artifact removal, supported by case studies on ECG and EEG. Emphasis is placed on **cardiological signal processing**, including ECG acquisition, QRS detection, arrhythmia analysis, heart rate variability, and both lossless and lossy data compression techniques. In addition, **EEG processing and modeling** is covered, including linear and nonlinear models, spectral analysis, time-frequency methods, channel correlation, and coherence analysis, with applications in epilepsy diagnosis, sleep disorder monitoring, and brain-computer interfaces.

	Course Contents	**Hours**
Unit1	**Introduction To Biomedical Signals:** Examples of Biomedical signals - ECG, EEG, EMG etc. - Tasks in Biomedical Signal Processing - Computer Aided Diagnosis. - Review of linear systems- Fourier Transform and Time Frequency Analysis (Wavelet) of biomedical signals- Processing of Random & Stochastic signals – spectral estimation– Properties and effects o f noise in biomedical instruments	(7)

Unit2	**Concurrent, Coupled and Correlated Processes:** Illustration with case studies − Adaptive and optimal filtering - Modeling of Biomedical signals - Detection of biomedical signals in noise -removal of artifacts of one signal embedded in another -Maternal-Fetal ECG – Muscle contraction interference. Event detection - case studies with ECG & EEG – Independent component Analysis	(6)
Unit3	**Cardio logical Signal Processing and Applications:** Basic Electrocardiography (ECG) - Electrical Activity of the heart- ECG data acquisition− ECG Lead System- ECG parameters & their estimation - Use of Multi-Scale analysis for parameters estimation of ECG Waveforms - Noise & Artifacts- ECG Signal Processing: Baseline Wandering, Power line interference, Muscle noise filtering – QRS detection - Arrhythmia analysis	(5)
Unit4	**Data Compression:** Lossless &Lossy- Heart Rate Variability − Time Domain measures -Heart Rhythm representation - Spectral analysis of heart rate variability interaction without her physiological signals.	(4)
Unit5	**Introduction to EEG:** The Electroencephalogram - EEG rhythms & waveform-categorization of EEG activity - recording techniques - EEG applications- Epilepsy, sleep disorders, Brain ComputerInterface.	(7)
Unit6	**EEG Modeling:** Linear, stochastic models – Nonlinear modeling of EEG - artifacts in EEG& their characteristics and processing – Model based spectral analysis - EEG segmentation -Joint Time-Frequency analysis – correlation analysis of EEG channels - coherence analysis of EEG channels.	(7)

Course Outcomes (CO):After the completion of course, students will be able to
1. Understand different types of biomedical signals and their properties.
2. Understand different artifacts in biomedical signals and the process to remove it.
3. Understand ECG signal and its analysis.
4. Systematically apply advanced methods to extract relevant Information from biomedical signal measurements..
5. Understand EEG signal and its analysis.

Reference Books

1	Biomedical Signal Processing: Principles and techniques, D.C.Reddy, Tata McGraw-Hill, New Delhi,
2	Biomedical Signal Processing, Willis J Tompkins, ED, Prentice Hall, 1993
3	Compression Algorithms for Real Programmers- Peter Wayner Academic press ltd.
4	Biomedical Signal Analysis, R. Rangayan, Wiley, 2002
5	Biomedical Signal Processing and Signal Modeling, Eugene N. Bruce, Wiley, 2001
6	Introduction to Biomedical Engineering, John D. Enderle, Elsevier, 2005
7	Advanced Bio signal Processing, Amine Nait-Ali, Springer, 2009

Tatyasaheb Kore Institute of Engineering & Technology, Warananagar

First Year M.Tech Electronics and Telecommunication Engineering Semester-I

2501PETCPE1051: Mobile Computing

Teaching Scheme			**Examination Scheme**	
Lectures	03Hrs./Week		ISE	40Marks
Tutorials	--		ESE	60Marks
Total Credits	03		TW	--
			Duration of ESE	02 Hrs

Prerequisites, if any:

Students should have basic knowledge of **analog and digital communication systems**, **signals and systems**, and **computer networks fundamentals**. Familiarity with **modulation techniques** and **TCP/IP concepts** will help in understanding wireless communication technologies.

Course Objectives(CO):

1.Define Mobile Computing study its applications and look at current trends

2. Distinguish between different types of Mobility.

3. Analyze the performance of MAC protocols used for wired network and wireless networks.

4. Explore Theory and Research areas related to Mobile Computing

Course Outcomes (CO):At the end of course, students will

1. Explain the **need, applications, and market evolution of wireless communication systems** and wireless data technologies.
2. Describe **wireless transmission principles**, including antennas, signal propagation, modulation, multiplexing, spread spectrum, and cellular concepts.
3. Analyze **medium access control techniques** such as SDMA, FDMA, TDMA, and CDMA for efficient wireless resource sharing.
4. Explain the **architecture, protocols, and services of GSM and UMTS/IMT-2000 systems**, including mobility management and security.
5. Analyze **wireless LAN and personal area network technologies**, including IEEE 802.11 and Bluetooth, and compare infrastructure and ad-hoc networks.
6. Explain **mobile networking and wireless application protocols**, including Mobile IP, TCP over wireless networks, and WAP architecture and services.

Course Description:

This course introduces the principles, technologies, and applications of **wireless communication**. It covers fundamental concepts of wireless transmission, signal propagation, antennas, multiplexing, modulation, and cellular systems, along with medium access control techniques including SDMA, FDMA, TDMA, and CDMA. Students explore **telecommunication systems** such as GSM, UMTS, and IMT-2000, including system architecture, protocols, handover, localization, security, and emerging data services. The course also addresses **wireless LAN technologies**, comparing infrared and radio transmission, infrastructure versus ad-hoc networks, and standards like IEEE 802.11 and Bluetooth. Additionally, it examines **mobile network and transport layers**, including Mobile IP, DHCP, TCP enhancements over 2.5G/3G networks, and **wireless application protocols**, WAP architecture, security, session management, and push/pull services, preparing students to design and analyze modern mobile communication systems.

	Course Contents	**Hours**
Unit 1	**Introduction to wireless communication**: Need and Application of wireless communication. Wireless Data Technologies Market for mobile.	(07)
Unit 2	**Wireless transmission and medium access Control:** Frequency for radio transmission signal antennas, signal propagation Multiplexing, Modulation, Spread and Cellular systems, Medium access	(06)

Unit 3	**Telecommunications systems:** GSM: Mobile services, System architecture, Radio interface, Protocols, Localization and calling, Handover, Security, New data services. UMTS and IMT-2000: UMTS releases and standardization, UMTS	(07)
Unit 4	**Wireless LAN:** Introduction, Infrared v/s Radio transmission, Infrastructure and ad-hoc Network, IEEE 802.11, Blue Tooth.	(07)
Unit 5	Mobile Network Layer and Transport Layer: Mobile IP, DHCP, Mobile ad-hoc networks, Traditional TCP, Classical TCP improvements, TCP over 2.5/3G wireless networks.	(07)
Unit 6	**Wireless application protocol:** Architecture, Wireless datagram protocol, Wireless transport layer, security Wireless transaction protocol, Wireless session protocol, Wireless application environment , Wireless markup language, WML Script, Mobile communications, Wireless telephony application, Pusharchitecture, Push/pull services, Example stacks with WAP 1.x 429	(06)

Text Books

1	Mobile Communications - Jochen Schiller - 2nd edition, Publication-Pearson Education.
2	Introduction to Wireless Telecommunications systems and Networks - Gary J. Mulett. Publications- Cengage Learning India Edition.
3	Mobile Computing − Ashok K Talukdar, Roopa R Yavagal, Publication-TATA MGH

Tatyasaheb Kore Institute of Engineering & Technology, Warananagar

First Year M. Tech Electronics and Telecommunication Engineering Semester- I

2501PETCPE1052: Design of VLSI Systems

Teaching Scheme			**Examination Scheme**	
Lectures	03Hrs./Week		ISE	40Marks
Tutorials	---		ESE	60Marks
Total Credits	03		TW	-----
			Duration of ESE	02 Hrs.

Prerequisites, if any:

Students should have basic knowledge of **digital electronics**, including logic gates, combinational circuits, and flip-flops. Familiarity with **Boolean algebra** and **introductory hardware description language concepts** is desirable.

Course Objectives (CO):

1. Understand the design of logic circuits
2. Provide exposure to ASIC, CPLD & FPGA
3. Provide exposure to VHDL Programming.

Course Outcomes (CO):At the end of course, students will

1. Explain the **fundamentals of sequential logic design**, including FSM concepts, state diagrams, ASM charts, and flip-flop behavior.
2. Analyze and design **synchronous finite state machines** (Moore, Mealy, and mixed types) using systematic synchronous design procedures.
3. Analyze **asynchronous sequential circuits**, including race conditions, hazards, and race-free state assignment techniques
4. Explain the **architecture and applications of ASICs, CPLDs, and FPGAs**, and select appropriate programmable devices for given design requirements.
5. Develop **VHDL models** using concurrent and sequential constructs, entities, architectures, and component instantiation.
6. Perform **simulation and synthesis of digital designs**, including test bench development, timing analysis, and application of synthesis guidelines.

Course Description:

This course provides a comprehensive understanding of **sequential logic design**, covering both synchronous and asynchronous circuits. Students learn **finite state machines (FSMs)**, state diagrams, ASM charts, latches, flip-flops, and design procedures, including metastability and timing analysis. The course introduces **ASIC, FPGA, and CPLD architectures**, device selection, and practical design considerations. It also covers **VHDL programming**, including entities, architectures, concurrency, sequential statements, processes, loops, and test benches for simulation. Key topics include **simulation methodologies, test bench design, and synthesis**, enabling students to model, simulate, and implement complex digital systems efficiently.

	Course Contents	**Hours**
Unit1	**Fundamentals of Sequential Logic Design:** Concept of FSM and use of state diagrams, use of ASM charts, S- R Latch, D Latch J-K flip-flop, Master Slave Flip-flops and their characteristic equations, excitation tables and timing diagrams, metastability. Moore, Melay and mixed type synchronous state machines, synchronous design procedure, sync. using programmable devices.	(05)
Unit2	**Asynchronous Sequential logic Circuit Design:** Asynchronous design fundamentals, differences with synchronous design, Timing diagram specification, mergerdiagrams, making race- free state assignment using transition diagram,essential	(07)

Unit3	**ASIC, FPGA and CPLD:** Concept of ASIC, architecture of Xilinx 95XX series CPLD, 4XXX series FPGA, specifications and noise considerations, Typical applications, choice of target devices, speed grade, I/O pins & various resources..	(08)
Unit4	**Introduction to VHDL and Elements of VHDL:** Features o f VHDL, concurrency, sequential behavior, used as test language, design hierarchies, levels of abstraction. Basic building blocks like entity, architecture, language elements, concurrent statements, sequential statements, signals and variables, configuration, operators, operator overloading, data types, component instantiation. Generate statement, process,loop statements, case statements, next statements, exit statements.	(07)
Unit5	**Simulation Issues and Test Benches:** Steps in simulation, simulation process, simulation delta, types of delays,types of simulation. Function of test bench, design methodologies for test benches, interpreting the test bench reports.	(07)
Unit6	**Synthesis Issues:** Introduction to synthesis, synthesis tools and their features, hardware modeling examples, synthesis guidelines.	(06)

Course Outcomes (CO):At the end of course, students will

1. Design the sequential logic circuits
2. Differentiate between synchronous & asynchronous logic circuit design
3. Design VLSI based systems using CPLD/FPGA
4. Design logic circuits using VHDL programming
5. Use test benches for updating the design.

Reference Books

1	Digital Design- principles and practices J. F. Wakerly PHI 3rd edition
2	Digital Principles and Design, Donald Givone, TMH
3	Digital Logic Design Principles, Bradley Carlson, Wiley
4	Introductory VHDL from Simulation to Synthesis, Sudhakar Yalamanchil, Pearson
5	Digital System Design using VHDL, Charles Roth, TMH

Tatyasaheb Kore Institute of Engineering & Technology, Warananagar

First Year M. Tech Electronics and Telecommunication Engineering Semester- I

2501PETCPE1053: Advanced Antenna Theory

Teaching Scheme			**Examination Scheme**	
Lectures	03Hrs./Week		ISE	40Marks
Tutorials	---		ESE	60Marks
Total Credits	03		TW	-----
			Duration of ESE	02 Hrs.

Prerequisites, if any:

Students should have basic knowledge of **electromagnetic field theory**, **antenna fundamentals**, and **RF/microwave engineering concepts**. Familiarity with **vector calculus** and **wireless communication systems** will be helpful for understanding advanced antenna designs.

Course Objectives (CO):

1. Get an idea regarding various types of arrays
2. Achieve the knowledge regarding aperture antenna with ground plane effects
3. Get the brief knowledge. of smart antenna concept

Course Outcomes (CO):At the end of course, students will

1. Analyze **linear antenna arrays**, including array factor, pattern multiplication, directivity, nonuniform excitation, and mutual coupling effects.
2. Explain the principles and design of **aperture antennas** using field equivalence, radiation integrals, Fourier transform methods, and diffraction theory.
3. Describe the concepts and performance benefits of **smart antennas**, including beamforming, diversity techniques, and applications in cellular and MANET systems.
4. Design and analyze **compact microstrip antennas** for single-band, dual-band, broadband, and circularly polarized applications.
5. Evaluate techniques for **compact broadband microstrip antennas**, including stacked patches, slot loading, and reactive loading methods.
6. Analyze and design **compact dual-frequency and dual-polarized microstrip antennas** for modern wireless communication systems.

Course Description:

This course provides an in-depth study of **antenna theory and design** for modern wireless communication systems. Students learn **array antennas**, including linear arrays, pattern multiplication, directivity, and mutual impedance. **Aperture antennas** are covered through Huygens' principle, radiation equations, Babinet's principle, Fourier analysis, and diffraction effects. The course explores **smart antennas**, beamforming, diversity combining, and applications in MANETs and Rayleigh-fading channels. Detailed coverage of **compact microstrip antennas** includes broadband, dual-frequency, dual-polarized, circularly polarized designs, and techniques such as shorted patches, meandered patches, planar inverted-L, slot-loading, and chip-based enhancements. Emphasis is placed on **design, simulation, and practical performance evaluation** of antennas for high-frequency applications.

	Course Contents	**Hours**
Unit 1	**Array Antenna:** Array factor for linear array, uniformly equally spaced linear array, Pattern multiplication, directivity of uniformly excited equally spaced linear array, Nonuniformly excited equally spaced linear array, mutualimpedance.	(04)
Unit 2	**Aperture Antenna:** Field equivalence Principle: Huygens Principle, radiation equations, directivity, rectangular apertures, circular apertures, design considerations, Babinet"s Principle, fourier transforms in aperture	(07)

Unit 3	**Smart Antenna:** Smart antenna analogy, cellular Radio system evolution, signal propagation, smart antenna benefits, smart antenna drawbacks, antenna, antenna beamforming, mobile Ad hoc Networks (MANETs), smart antenna system: design, simulation and Results, Beamforming, diversity combining, Rayleigh-fading and Trellis-coded modulation, other geometries.	(08)
Unit 4	**Compact Microstrip Antenna:** Compact Microstrip Antennas ,Compact Broadband Microstrip Antennas ,Compact Dual-Frequency Microstrip Antennas ,Compact Dual-Polarized Microstrip Antennas ,Compact Circularly Polarized Microstrip Antennas ,Compact Microstrip Antennas with Enhanced Gain ,Broadband Microstrip Antennas , Broadband Dual- Frequency and Dual-Polarized Microstrip Antennas , Broadband and Dual- Band Circularly Polarized Microstrip Antennas Use of a Shorted Patch with a Thin Dielectric Substrate , Use of a Meandered Patch ,Use of a Meandered Ground Plane ,Use of a Planar Inverted-L Patch ,Use of an InvertedU Shaped or FoldedPatch	(07)
Unit 5	**Compact Broadband Microstrip Antennas:** Use of a Shorted Patch with a Thick Air Substrate, Use of Stacked Shorted Patches, Use of Chip-Resistor and Chip-Capacitor Loading Technique, Use of a Slot-Loading Technique, Use of a Slotted Ground.	(06)
Unit 6	**Compact Dual-Frequency and Dual-Polarized Microstrip Antennas:** Some Recent Advances in Regular-Size Dual-Frequency Designs, Compact Dual-Frequency Operation with Same Polarization Planes, Compact Dual-Frequency Operation, Dual-Band or Triple-Band PIFA, Compact Dual-Polarized Designs.	(08)

Reference Books

1	Antenna Theory and design, Stutzmen, warren L, wiley, 3rd edition,1981
2	Broad band Microstrip Antenna by Girishkumar, K.P. Ray Artech House, Inc. 2003
3	Compact And broadband microstrip Antennas by kin-Lu Wong A Wiley-Interscience Publication John Wiley & Sons, Inc. 2002
4	Antenna Theory analysis And Design by constantine A. Balanis 3rd Edition. A John Wiley & Sons, Inc., Publication 2005.
5	Microstrip antenna design handbook, Ramesh garg, prakash Bhatia, Inderbahl, Artech house, boston, london
6	Antenna engineering handbook, Richard c. johnson, MGH

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First Year M. Tech Electronics and Telecommunication Engineering Semester- I

2501PETCLC106P: Lab Course

Teaching Scheme			**Examination Scheme**	
Lectures	----		ISE	----
Tutorials	----		ESE(Oral)	25
Practical	04Hrs./Week		TW	25
Total Credits	02		Duration of ESE	------.

Prerequisites, if any:

The prerequisite for the **Probability and Random Processes** course includes a solid foundation in mathematics, particularly calculus, linear algebra, and basic statistics. Students should also understand signals and systems, including linear system behavior and Fourier analysis. Additionally, a basic knowledge of engineering fundamentals, especially in electronics or communication systems, is helpful to apply probability concepts to real-world signal processing problems.

Course Objectives (CO):

1.To acquire basic understanding of MATLAB implantation.

2.To acquire complete knowledge of probability.

3.To make students understand and learn about Experimental design of processes.

Course Outcomes (CO):At the end of course, students will

1. Understand and apply the basic concepts of probability, including conditional probability, Bayes' theorem, and independence of events.
2. Analyze and compute probabilities using standard distributions such as Gaussian, Poisson, and uniform distributions.
3. Formulate and evaluate **joint, marginal, and conditional probability density functions** for multiple random variables.
4. Understand the properties of random processes and compute **autocorrelation and cross-correlation functions** for stationary and non-stationary signals.
5. Apply the concepts of **power spectral density** to characterize random signals in the frequency domain.
6. Develop practical skills in **modeling random phenomena** using experiments such as dice experiments, Bernoulli trials, and simulations, relevant for engineering applications in communications and signal processing.

Course Description:

This course introduces the **fundamentals of probability theory and random processes** for engineering applications. Students study probability calculations, classical distributions such as **Gaussian, Poisson, and uniform**, as well as joint probability density functions. Practical experiments include **dice experiments, Bernoulli trials, and relative frequency approaches**. The course also covers **random process analysis**, including **autocorrelation, cross-correlation functions, and power spectral density**, providing essential tools for signal processing, communications, and statistical modeling in engineering systems.

	Course Contents	**Hours**
1	Probability Calculation	(04)
2	Gaussian Distribution Function	(04)
3	Dice Experiment..Relative Frequency Approach	(04)
4	Uniform Probability Density Function...	(04)
5	Gaussian Joint Probability Density Function...	(04)

6	Poisson Probability Density Function...	(04)
7	Power Spectral Density. . . .	(04)
8	Autocorrelation Function	(04)
9	Cross correlation Function...	(04)
10	Bernoulli Trials	(04)

Course Outcomes(CO):At the end of course, students will

1. Able to design the mathematical functions.
2. Able to calculate the distribution functions.
3. Design the processes.
4. Analyze the random processes.

Reference Books

1	Kandaswamy- Queing Theory

Tatyasaheb Kore Institute of Engineering & Technology, Warananagar

First Year M. Tech Electronics and Telecommunication Engineering Semester- I

2501PETCSW107T: Seminar-1

Teaching Scheme			**Examination Scheme**	
Lectures	-----		ISE	-----
Tutorials	-----		ESE(Oral)	-----
Practical	02Hrs./Week		TW	50
Total Credits	01		Duration of ESE	-----.

Course Objectives (CO):

1.To Identify, understand and discuss current, real-world issues.

2. To Distinguish and integrate differing forms of knowledge and academic disciplinary approaches (e.g., humanities and sciences) with that of the student ‘s own academic discipline (e.g., in agriculture, architecture, art, business, economics, education, engineering, natural resources, etc.).And apply a multidisciplinary strategy to address current, real-world issues.

3.To Improve oral and written communication skills.

4.ToImprovepresentationskills

	Course Contents	**Hours**
1	Seminar-I should be based on the literature survey on any topic relevant to Design Engineering (should be helpful for selecting a probable title of the dissertation). Each student has to prepare awriteupofabout25-30pagesof –A4 size sheets and submit it in IEEE format in duplicate as the term work. Thestudenthastodeliveraseminartalkinfrontofthefacultyofthedepartmentandhis classmates.Theconcernedfacultyshouldassessthestudentsbasedonthequalityof workcarriedout,preparationandunderstandingofthecandidates. Some marks should be reserved for the Attendance of a student in the seminars of other students.	(--)

Tatyasaheb Kore Institute of Engineering & Technology, Warananagar

First Year M. Tech Electronics and Telecommunication Engineering Semester- II

2501PETCPCC201: Computer Vision

Teaching Scheme			**Examination Scheme**	
Lectures	03Hrs./Week		ISE	40Marks
Tutorials	01Hrs./Week		ESE	60Marks
Total Credits	04		TW	25Marks
			Duration of ESE	02 Hrs.

Prerequisites, if any:

Students should have basic knowledge of **signals and systems**, **digital image processing fundamentals**, and **linear algebra**. Familiarity with **probability concepts** and **programming basics** will be helpful for understanding pattern recognition and neural networks.

Course Objectives (CO):

1. Study wavelets for image processing.
2. Provide basics for CBIR systems.
3. Provide logical base for Feature Extraction

Course Outcomes (CO):At the end of course, students will

1. Explain the principles of **wavelets and multiresolution analysis**, including image pyramids, subband coding, and discrete wavelet transforms.
2. Apply **1D and 2D discrete wavelet transforms** and wavelet packet techniques for efficient image representation and analysis.
3. Represent and describe **image shapes and regions** using boundary- and region-based representation and descriptor techniques.
4. Analyze and apply **pattern recognition techniques**, including minimum distance, correlation-based, Bayesian, and nearest neighbor classifiers.
5. Explain and implement **image mining and content-based image retrieval (CBIR)** systems using color, texture, and shape features.
6. Describe the fundamentals and models of **artificial neural networks**, including learning mechanisms inspired by human recognition systems.

Course Discription:

This course provides a comprehensive study of **wavelets and multi-resolution processing**, introducing key concepts such as image pyramids, sub-band coding, Haar transforms, and both 1D and 2D discrete wavelet transforms (DWT), along with fast wavelet transforms and wavelet packets. It covers **image representation and description** techniques including boundary following algorithms, chain codes, polygonal approximation, skeletonization, and regional/relational descriptors for effective feature extraction. The course also explores **pattern recognition and classification methods**, including minimum distance classifiers, correlation-based matching, Bayes classifiers, and nearest neighbor classifiers. Students will learn **image mining and content-based image retrieval (CBIR)**, focusing on color, texture, and shape features, multidimensional indexing, and video mining techniques. Finally, the course introduces **artificial neural networks** for human recognition systems, covering different ANN models, learning, and perception methods for practical applications in image analysis, recognition, and intelligent systems.

	Course Contents	**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	(07)
	Representation and Description:	

	Descriptors: Boundary descriptors; Regional descriptors; Relational descriptors	
Unit 3	**Pattern Recognition:** Overview of pattern recognition; Patterns and pattern Classes	(06)
Unit 4	**Classifier:** Matching: Minimum distance classifier, Matching by Correlation, Matching shape numbers, String matching statistical classifier: Bayes classifier, Nearest Neighbor classifier	(07)
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	(06)
Unit 6	**Artificial neural networks:** Human Recognition system; Artificial neural networks; Different models of Artificial neural networks; Perception and learning;	(07)

Term Work:
Minimum Seven assignments based on above topics

Course Outcomes(CO):At the end of course, students will

1. Apply wavelets for image processing
2. Develop content-based image retrieval systems
3. Extract the features from objects/Image
4. Apply classifier technique.

Reference Books

1	Digital Image processing and Pattern Recognition by Malay K. Pakhira PHI
2	Digital Image processing by Rafael C. Gonzalez and Richard E. Woods Pearson Education
3	Image Processing Principles and Applications, Tinku Acharya, Ajoy K. Ray, Wiley, 2005
4	Fundamentals of Digital Image processing, by A. K. Jain PHI
5	Digital image processing and analysis by B. Chanda, D. Dutta Mujumdar PHI
6	processing, analysis and machine vision by Milan sonka , V. Hlavac , R. Boyle Thomson learning

Tatyasaheb Kore Institute of Engineering & Technology, Warananagar

First Year M. Tech Electronics and Telecommunication Engineering Semester- II

2501PETCPCC202: Adhoc & Wireless Sensor Networks

Teaching Scheme			**Examination Scheme**	
Lectures	03Hrs./Week		ISE	40Marks
Tutorials	01Hrs./Week		ESE	60Marks
Total Credits	04		TW	25Marks
			Duration o fESE	02 Hrs.

Prerequisites, if any:

Students should have basic knowledge of **computer networks**, **wireless communication fundamentals**, and **data communication protocols**. Familiarity with **TCP/IP concepts** and **basic probability and mobility models** will help in understanding ad hoc and sensor networks.

Course Objectives (CO):

1. Explain the constraints of physical layer that affect the design and performance of Adhoc network
2. Discuss the operations and performance of various MAC layer protocols proposed for Adhoc networks.
3. Discuss the operations and performance of various routing protocols proposed for ad hoc networks.

Course Outcomes (CO):At the end of course, students will

1. Explain the **fundamentals, characteristics, mobility models, and applications of ad hoc networks** in indoor and outdoor wireless environments
2. Analyze **medium access control protocols** for ad hoc networks, including contention-based schemes and IEEE 802.11/802.15 standards.
3. Compare and evaluate **routing protocols for ad hoc networks**, including proactive, reactive, hybrid, multicast, energy-aware, and QoS-aware routing.
4. Describe the **architecture, components, and operational challenges of wireless sensor networks**, including node hardware and energy consumption.
5. Analyze **cross-layer design approaches** and integration of ad hoc networks with Mobile IP and 4G wireless systems.
6. Explain **sensor network platforms and development tools**, including sensor node hardware, operating systems, simulators, and programming models.

Course Description:

This course introduces the fundamentals of **ad hoc networks**, including their definition, characteristics, applications, and the modeling of wireless channels and mobility for both indoor and outdoor environments. It covers **medium access control (MAC) protocols** with design issues, contention-based and reservation-based mechanisms, scheduling algorithms, and relevant IEEE standards such as 802.11, 802.15, and HIPERLAN. The course also explores **network protocols**, including routing strategies (proactive, reactive, hybrid, energy-aware, and QoS-aware), unicast and multicast algorithms, and hierarchical routing. Students will study **wireless sensor networks (WSNs)**, focusing on challenges, enabling technologies, single-node architecture, energy consumption, operating systems, and execution environments. Additionally, the course emphasizes **cross-layer design and integration** of ad hoc networks with 4G systems, parameter optimization, and practical integration with Mobile IP networks. Finally, it introduces **sensor network platforms and tools**, including Berkeley motes, node-level programming, simulators, and state-centric programming for effective WSN deployment and experimentation.

	Course Contents	**Hours**
Unit 1	**Introduction to Adhoc networks** – definition, characteristics features, applications. Characteristics of Wireless channel, Adhoc Mobility Models, Indoor and outdoor models	(07)
Unit 2	**Medium Access Protocols:**	(07)

	antennas, IEEE standards: 802.11a, 802.11b, 802.1g, 802.15, HIPERLAN	
Unit 3	**Network Protocols:** Routing Protocols: Design issues, goals and classification. Proactive Vs reactive routing, Unicast routing algorithms, Multicast routing algorithms, hybrid routing algorithm, Energy aware routing algorithm, Hierarchical Routing, QoS aware routing	(06)
Unit 4	**Overview of Wireless Sensor Networks:** Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks, Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Operating Systems and Execution Environments	(07)
Unit 5	**Cross Layer Design and Integration of Adhoc for 4G:** Cross layer Design: Need for cross layer design, cross layer optimization, parameter optimization techniques, Cross layer cautionary perspective, Integration of Adhoc with Mobile IP networks.	(06)
Unit 6	**Sensor Network Platforms and Tools:** Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators, State-centric programming.	(07)

Term Work:
Minimum Seven assignments based on above topics

Reference Books

1	Ad hoc Wireless Networks Architectures and protocols, Da C. Siva Ram Murthy and B.S. Manoj, 2nd edition, Pearson Education. 2007
2	Adhoc Networking, Charles E. Perkins, Addison − Wesley, 2nd edition, 2000
3	Mobile Adhoc networking, Stefano Basagni, Marco Conti, Silvia Giordano and Ivan, 2nd edition, 2000
4	The handbook of Adhoc wireless networks, Mohammad Ilyas, CRC press,2002
5	ÉCLAIR; An Efficient Cross-Layer Architecture for wireless protocol stacks, V. T. Raisinhani and S. Iyer, World Wireless cong., San Francisco, CA, 3rd edition,

Tatyasaheb Kore Institute of Engineering & Technology, Warananagar

First Year M. Tech Electronics and Telecommunication Engineering Semester- II

2501PETCPE2031: Cryptography & Network Security

Teaching Scheme			**Examination Scheme**	
Lectures	03Hrs./Week		ISE	40Marks
Total Credits	03		ESE	60Marks
			Duration of ESE	02 Hrs.

Prerequisites, if any:

Students should have basic knowledge of **computer networks**, **data communication protocols**, and **discrete mathematics**. Familiarity with **number theory**, **operating systems fundamentals**, and **programming basics** will help in understanding cryptography and network security concepts.

Course Objectives (CO):

1. Understand Block Cipher and DES principles
2. Understand Symmetric Encryption Methods
3. Identify network security threat

Course Outcomes (CO):At the end of course, students will

1. Explain the **fundamental concepts of network security**, including security services, mechanisms, attack models, and the OSI security architecture.
2. Analyze **classical and modern symmetric encryption techniques**, including DES, block cipher principles, modes of operation, and cryptanalysis methods.
3. Evaluate **contemporary symmetric ciphers** and key management techniques to ensure confidentiality, secure key distribution, and random number generation.
4. Explain the principles of **public key cryptography**, including RSA and Diffie–Hellman key exchange, and their role in secure communication.
5. Apply **message authentication and hash functions**, including MACs, digital signatures, and authentication protocols, to ensure data integrity and non-repudiation.
6. Analyze **security applications and system-level security mechanisms**, including Kerberos, IPsec, SSL/TLS, firewalls, intrusion detection systems, and malware protection.

Course Description:

This course provides a comprehensive understanding of **network security principles, mechanisms, and potential attacks**, including the OSI security architecture and classical encryption methods such as symmetric ciphers, substitution, transposition techniques, rotor machines, and steganography. It explores **block ciphers and modern symmetric encryption** including DES, Triple DES, Blowfish, and RC5, along with key management, traffic confidentiality, and secure encryption practices. Students also learn **public key cryptography** concepts, RSA, Diffie-Hellman key exchange, and message authentication using hash functions, digital signatures, and MACs. The course covers practical **authentication and security applications**, including Kerberos, X.509, email security protocols (PGP, S/MIME), IP security, and secure web communications through SSL/TLS. Finally, it addresses **system security concerns**, such as intrusion detection, malware, viruses, firewall design, and trusted systems, equipping students to design, analyze, and implement robust security solutions in modern networked environments.

	Course Contents	**Hours**
Unit 1	**Overview:** Services, Mechanisms, and attacks, The OSI Security Architecture, A model for network security, Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Rotor Machines, and Steganography	(07)
Unit 2	**Block Ciphers and the Data Encryption Standard**: Simplified DES, Block Cipher Principles, The Data Encryption Standard, The Strength of DES, Differential Linear Cryptanalysis, Block Cipher Design Principles, Block Cipher Modes of Operation.	(07)

Unit 3	**Contemporary symmetric Ciphers:** Triple DES, Blowfish, RC5, Characteristics of Advanced Symmetric Block Ciphers, confidentially using symmetric Encryption: Placement of Encryption Function, Traffic Confidentiality, Key Distribution, and Random Number Generation	(06)
Unit 4	**Public Key Cryptography and RSA:** Principles of Public Key cryptosystems, The RSA Algorithm, Key Management, other Public Key Cryptosystems key Management, Diffle-Hellman Key exchange	(07)
Unit 5	**Message Authentication and hash functions:** Authentication Requirements, Authentication Function, Message Authentication Codes, Hash Functions, Security of Hash Functions and MACs. **Hash Algorithms:** MD5 Message Digest Algorithm, Secure Hash Algorithm. Digital signatures and Authentication protocols: Digital signatures, Authentication protocols and Digital signature Standard	(06)
Unit 6	**Authentication Applications:** Kerberos, X. 509 Authentication Service. Electronic Mail Security: Pretty Good Privacy, S/MIME, IP Security Overview, IP Security Architecture, Authentications, Header, Encapsulating Security Payload, Combining Security Associations, Key Management. **Web Security:** Web Security Considerations, Secure socket layer and Transport layer security. Secure electronic transaction. System Security: Intruders, Intrusion detection, password management. Malicious Software, Viruses, Viruses and Related Threats, Firewalls: Firewall Design Principles, Trusted systems.	(07)

Reference Books

1	Willam Stallings, Cryptography and Network Security, Third Edition, Pearson Education
2	Network Algorithmic: An Interdisciplinary Approach to Designing Fast Networked Devices George Varghese (Morgan Kaufmann Series in Networking
3	Atul Kahate, Cryptography and Network Security, Tata McGraw-Hill, 2003

Tatyasaheb Kore Institute of Engineering & Technology, Warananagar

First Year M. Tech Electronics and Telecommunication Engineering Semester- II

2501PETCPE2032:Multirate Systems

Teaching Scheme			**Examination Scheme**	
Lectures	03Hrs./Week		ISE	40Marks
			ESE	60Marks
Total Credits	03			
			Duration of ESE	02 Hrs.

Prerequisites, if any:

Students should have a solid foundation in **signals and systems** and **digital signal processing**, including **Fourier and Z-transform techniques**. Familiarity with **linear algebra** and **basic probability concepts** will be helpful for understanding multirate and filter bank designs.

Course Objectives (CO):

1. To provide basic concepts of Multirate systems
2. To give inputs regarding details of Multirate filter banks and their types.
3. To provide concepts of Multidimensional Multirate Systems

Course Outcomes (CO):At the end of course, students will

1. Explain the **fundamentals of multirate signal processing**, including interpolation, decimation, polyphase representation, and multistage implementations.
2. Analyze and design **maximally decimated and perfect reconstruction filter banks**, including QMF banks, aliasing effects, and transmultiplexers.
3. Apply **para-unitary filter bank concepts** to design lossless and perfect reconstruction systems for transform coding applications.
4. Design and analyze **linear-phase and cosine-modulated perfect reconstruction filter banks** using lattice and polyphase structures.
5. Explain the principles of **multidimensional multirate systems**, including sampling, alias-free decimation, and multirate filter design.
6. Apply **multirate signal processing techniques** to real-world applications such as speech and audio coding, image and video coding, communication systems, and sensor signal processing.

Course Description:

This course introduces the fundamentals of **multirate signal processing**, including basic multirate operations, interconnection of building blocks, polyphase representations, and multistage implementations. Students study **multirate filter banks** such as maximally decimated QMF banks, M-channel filter banks, and perfect reconstruction systems, including para-unitary and linear phase FIR filter banks, as well as cosine-modulated filter banks and their efficient polyphase structures. The course also covers **multidimensional multirate systems**, addressing sampling, alias-free decimation, cascade connections, and multirate filter design. Practical **applications** include FSK modems, DAB, ADSL, asynchronous sampling rate conversion, speech and audio coding, image and video coding, wavelet-based room acoustics simulation, and sensor signal processing, equipping students to design and implement advanced multirate systems across communication and signal processing applications.

	Course Contents	**Hours**
Unit 1	**Fundamentals of Multi-rate Systems:** Basic multi-rate operations, interconnection of building blocks, polyphase representation, multistage implementation.	(07)
Unit 2	**Multirate Filter Banks:** Maximally decimated filter banks: Errors created in the QMF bank, alias-free QMF system, power symmetric QMF banks, M-channel filter banks, poly-phase representation, perfect reconstruction systems, alias-free filter banks, tree structured filter banks, transmultiplexers.	(07)
Unit 3	**Para-unitary Perfect Reconstruction Filter Banks**: Lossless transfer matrices, filter bank properties induced by paraunitariness, two channel Para-unitary lattices, M- channel FIR Para-unitary QMF banks	(06)

Unit 4	**Linear Phase Perfect Reconstruction QMF Banks**: Necessary conditions, lattice structures for linear phase FIR PR QMF banks, formal synthesis of linear phase FIR PR QMF lattice. Cosine Modulated Filter Banks: Pseudo-QMF bank and its design, efficient polyphase structures, properties of cosine matrices, cosine modulated perfect reconstruction systems	(07)
Unit 5	**Multidimensional Multirate Systems:** Introduction, Multidimensional signals and their sampling, minimum sampling density, Multirate fundamentals, Alias free decimation. Cascade connections, Multirate filter design. Special filters and filterbanks.	(06)
Unit 6	**Applications:** FSK Modems, OMC data transmission, DAB and ADSL, Asynchronous conversion of sampling rates, Speech and audio coding, Image and video coding, Simulation of room acoustics using Wavelets, Multirate techniques with sensors	(07)

Reference Books

1	P. Vaidyanathan, "Multirate Systems and Filter Banks,"Pearson Education (Asia) Third impression,2010.
2	N. J. Fliege, "Multirate Digital Signal Processing," John Wiley & Sons,USA, 2000.engineeringand network design, oliver heckmann john wiley & sonsltd,
3	.Ljiljana Milic, "Multirate Filtering for Digital Signal Processing: MATLAB Applications (Premier Reference Source)"..
4	R. E. Crochiere, L.R. Rabiner, "Multirate Digital Signal Processing," Prentice Hall..
5	3. Gilbert Strang and Truong Nguyen, "Wavelets and Filter Banks," Wellesley-Cambridge Press,

Tatyasaheb Kore Institute of Engineering & Technology, Warananagar

First Year M. Tech Electronics and Telecommunication Engineering Semester- II

2501PETCPE2033:Advanced Light Wave Communication

Teaching Scheme			**Examination Scheme**	
Lectures	03Hrs./Week		ISE	40Marks
			ESE	60Marks
Total Credits	03			
			Duration of ESE	02 Hrs.

Prerequisites, if any:

Students should have basic knowledge of **optical physics**, **electromagnetic theory**, and **analog/digital communication systems**. Familiarity with **semiconductor devices** and **signals and systems** will help in understanding optical communication system design.

Course Objectives (CO):

1. To expose the students to the basics of signal propagation through optical fiber impairments, components and devices and system design. fibers,
2. To provide an in-depth understanding needed to perform fiber-optic communication system engineering calculations, identify system tradeoffs, and apply this knowledge to modern fiber optic systems.
3. **To design and evaluate WDM/DWDM-based long-haul optical communication systems**, considering system performance parameters such as BER, regeneration, and reliability.

Course Outcomes (CO):At the end of course, students will

1. Explain the **fundamentals of guided optical communication**, including optical fiber types, cable structures, transmission losses, and fiber selection for high-speed systems.
2. Analyze **attenuation mechanisms** such as absorption and scattering, and apply loss considerations in the design of high-bandwidth optical links.
3. Describe the **construction, operating principles, and performance characteristics of optical sources**, including LEDs, lasers, EDFAs, and soliton-based systems.
4. Evaluate **optical detectors and receiver design**, including detector sensitivity calculations and suitability for 980 nm, 1.3 µm, and 1.55 µm wavelength systems.
5. Explain and analyze **optical multiplexing techniques**, including WDM and DWDM systems, and the design of optical multiplexers and demultiplexers.
6. Design and evaluate **long-haul high-bandwidth optical transmission systems**, considering power budget, BER, regeneration, interfacing, and system reliability.

Course Description:

This course provides a comprehensive introduction to **guided optical communication systems**, starting with the fundamentals of optical fibers, types of fibers and cables, and transmission losses due to absorption and scattering. It covers **optical sources** including LEDs and lasers, their working principles, optical amplifiers like EDFA, and system design considerations for LAN and WAN applications, including power budget calculations. The course also addresses **optical detectors**, their characteristics, spectral response, and receiver design for different wavelength systems. Students learn **multiplexing techniques** such as WDM and DWDM, including the design of multiplexers and demultiplexers using angular dispersive devices, thin-film filters, and planar waveguides. Finally, the course explores the design of **long-haul high-bandwidth transmission systems**, focusing on outage, bit error rate, cross-connects, interface considerations, regenerator spacing, and practical deployment challenges, equipping students to design and analyze high-speed optical communication networks.

	Course Contents	**Hours**
Unit 1	**Introduction to guided optical communication:** Optical Fibers, types of fibers & optical Cables, Study of losses during transmission through viz. Attenuation by Absorption & Scattering, Consideration of losses in designing of High Speed / High bandwidth optical communication systems, Selection of fiber for such systems.	(07)
Unit 2	**Optical Sources:** Types of LEDs used in optical communication, their construction & operating principle, Types of Lasers. Principle of working of Lasers, solid state & injection Lasers, Optical amplifiers, EDFA, Soliton Systems & design of	(07)

Unit 3	**Optical Detectors:** Introduction & study of type of detectors characteristics. Spectral spread and availability of detectors for 980 nm, 1.3 μm & 1.55 μm λ systems. Calculation of detector sensitivity and design considerations of suitable receivers for LAN, WAN applications.	(06)
Unit 4	**Multiplexing Components & Techniques:** Concepts of WDM, DWDM system design parameters, Optical multiplex / Demultiplex design considerations- Angular dispersive devices, Dielectric thin film filter type devices, Hybrid & planer wave guide devices, Active WDM devices, Wavelength non selective devices, System application.	(07)
Unit 5	**Long Haul High Band Width Tx System:** Designing systems for long haul high band width consideration-Outage, Bit error rate, Cross connect, Low & high-speed interphases, Multiplex / Demultiplex consideration, Regenerator spacing, Degeneration & Allowances, Application consideration.	(06)

Reference Books

1	Optical Communication Systems by John Gowar (PHI)
2	Optical Fiber Communication by Gerd Keiser (MGH)
3	Optical Fiber Communication Principles & Practice by John M. Senior (PHI pub.1996.)

Tatyasaheb Kore Institute of Engineering & Technology, Warananagar

First Year M. Tech Electronics and Telecommunication Engineering Semester- II

2501PETCPE2041: Advanced Microwave Circuit Design

Teaching Scheme			**Examination Scheme**	
Lectures	03Hrs./Week		ISE	40Marks
Total Credits	03		ESE	60Marks
			Duration of ESE	02 Hrs.

Prerequisites, if any:

Students should have basic knowledge of **electromagnetic theory**, **analog electronics**, and **signals and systems**. Familiarity with **transmission lines**, **network theory**, and **semiconductor devices** is desirable for understanding RF and microwave circuit design.

Course Objectives (CO):

1. Analyze transmission line circuits at RF and microwave frequencies.
2. Design impedance matching in transmission line networks
3. Perform Scattering parameter analysis of RF networks

Course Outcomes (CO):At the end of course, students will

1. Explain the **importance of RF design** and analyze RF behavior of passive components, transmission lines, and impedance matching using the Smith chart.
2. Apply **microwave network analysis techniques**, including scattering parameters and interconnecting networks, for RF circuit characterization.
3. Design and analyze **RF filters**, including resonator-based and coupled filter configurations, to meet given frequency specifications.
4. Design and evaluate **RF transistor amplifiers**, including biasing, matching, stability, gain, noise figure, and broadband multistage performance
5. Explain the **principles and design of RF oscillators and mixers**, including high-frequency oscillator configurations and mixer characteristics.
6. Describe the **materials, fabrication technologies, and applications of microwave integrated circuits (MICs and MMICs)** used in modern RF systems.

Course Description:

This course provides a detailed study of **radio frequency (RF) and microwave engineering**, emphasizing the design and analysis of RF components and circuits. Students learn the fundamentals of **RF behavior of passive components**, chip components, and circuit board considerations, along with **transmission line analysis** using stripline, microstrip line, and Smith Chart techniques. The course covers **microwave network analysis**, including interconnecting networks, scattering parameters, and impedance matching with discrete and microstrip components. Key topics include **RF filter design** with resonators, coupled filters, and special filter configurations, as well as **RF transistor amplifier design**, focusing on active component modeling, matching, biasing, stability, noise, and multistage high-power amplifiers. The curriculum also addresses **oscillator and mixer design**, exploring high-frequency configurations, and concludes with **microwave integrated circuits (MICs)**, covering hybrid and monolithic IC fabrication, amplifiers, oscillators, mixers, frequency dividers, modulators, switches, phase shifters, multipliers, and up-converters, providing a strong foundation for practical RF and microwave system design.

	Course Contents	**Hours**
Unit 1	**Introduction:** Importance of Radio frequency design, RF behavior of passive components, Chip components and circuit board consideration. Transmission line Analysis: Strip line & micro strip line, Smith Chart	(07)
Unit 2	**Microwave Network Analysis:** Interconnecting Networks, Network properties & applications, scattering parameters, impedance matching using discrete components, micro strip line matching networks, biasing networks.	(07)
Unit 3	**RF Filter Design:** Basic resonator &Filter configurations, special filter realizations,Filter implementation, Coupled filters.	(06)
	RF Transistor Amplifier Design:	

	Stability considerations, Constant gain, Noise figure circles, Constant VSWR circles, Broadband High power & Multistage Amplifiers.	
Unit 5	**Oscillator and Mixture Design:** Basic Oscillator Model, High frequency Oscillator configuration, Basic characteristics of Mixers & mixer design.	(06)
Unit 6	**Microwave Integrated Circuits:** Materials &basic fabrications technologies of Hybrid ICs & monolithic ICs, Examples of IC Fabrication flow, MICs- amplifiers, Oscillators, Mixers, Frequency dividers, Digital modulators, Switches, Phase shifters, Multipliers & Up-converters.	(07)

Reference Books

1	Reinhold Ludwig and Pavel Bretshko Circuit Design Theory & Applications", Pearson Education.
2	D. M. Pozar, "Microwave Engineering", John Wiley & sons
3	Yoshihiro Konishi, "Microwave Integrated Circuits" BSP Books Pvt. Ltd
4	Samuel Y Liao, "Microwave Devices & Circuits", Prentice Hall of India, 2006
5	Robert E.Colin,2 "Foundations for Microwave Engineering", Mc Graw Hill.

Tatyasaheb Kore Institute of Engineering & Technology, Warananagar

First Year M. Tech Electronics and Telecommunication Engineering Semester- II

2501PETCPE2042: SDR & Cognitive Radio Technology

Teaching Scheme			**Examination Scheme**	
Lectures	03Hrs./Week		ISE	40Marks
Total Credits	04		ESE	60Marks
			Duration of ESE	02 Hrs.

Prerequisites, if any:

Students should have basic knowledge of **wireless communication systems**, **digital signal processing**, and **RF/microwave fundamentals**. Familiarity with **computer networks**, **embedded systems**, and **antenna basics** will help in understanding SDR and cognitive radio concepts.

Course Objectives (CO):

1. Understand concept of SDR and Cognitive radios.
2. Know COBRA, SCA, JTRS
3. Understand concept of smart antenna

Course Outcomes (CO):At the end of course, students will

1. Explain the **concepts, evolution, and benefits of Software Defined Radio (SDR)**, including ideal SDR architecture, end-to-end communication, and global frequency band plans.
2. Describe the **Software Communications Architecture (SCA)**, including functional view, core framework, real-time operating systems, CORBA, and JTRS compliance.
3. Analyze **RF front-end and baseband signal processing architectures** used in SDR systems, including intelligent radios and adaptive techniques.
4. Explain the integration of **smart antennas, phased array antennas, and adaptive beamforming** in SDR-based wireless systems.
5. Evaluate **low-cost SDR platforms**, their system requirements, architectures, and convergence of military and commercial communication systems.
6. Explain the **principles and architecture of Cognitive Radio**, including spectrum awareness, adaptive transmission, smart antenna integration, and future trends in cognitive wireless systems.

Course Description:

This course introduces the fundamental concepts, architectures, and applications of **Software Defined Radio (SDR)** and **Cognitive Radio (CR)** systems. Students study the **history, evolution, and benefits of SDR**, exploring the SDR Forum standards, ideal SDR architecture, end-to-end SDR communication, and global frequency band plans. The curriculum covers **SDR system design**, including RF design, baseband signal processing, smart and adaptive antennas, phased array antennas, and the integration of SDR principles with antenna systems. Emphasis is given to **low-cost SDR platforms**, their system architecture, and convergence between military and commercial applications, as well as emerging trends in SDR.The course also introduces **Cognitive Radio concepts**, including its history, advantages, forums, and ideal architectures for dynamic spectrum management and end-to-end communication. Students learn the design and implementation of **CR-based platforms**, cognitive RF systems, adaptive signal processing, and smart antenna architectures, highlighting the application of cognitive principles in modern wireless communication systems. Practical aspects of SDR and CR integration into intelligent radio systems are emphasized to prepare students for research and industry applications in next-generation wireless networks.

	Course Contents	**Hours**
Unit 1	SDR concepts & history, Benefits of SDR, SDR Forum, Ideal SDR architecture, SDR Based End-to-End Communication, Worldwide frequency band plans, Aim and requirements of the SCA.	(07)
Unit 2	Architecture Overview, Functional View, Networking Overview, Core Framework, Real Time Operating Systems, Common Object Request Broker Architecture (CORBA), SCA and JTRS compliance..	(07)

Unit 3	Radio Frequency design, Baseband Signal Processing, Radios with intelligence, Smart antennas, Adaptive techniques, Phased array antennas, Applying SDR principles to antenna systems, Smart antenna architectures.	(06)
Unit 4	Low Cost SDR Platform, Requirements and system architecture, Convergence between military and commercial systems, The Future For Software Defined Radio .	(07)
Unit 5	Cognitive radio concepts & history, Benefits of Cognitive radio, Cognitive radio Forum. Ideal Cognitive radio architecture, Cognitive radio Based End-to-End Communication, Worldwide frequency band plans. Low Cost Cognitive radio Platform, Requirements and system architecture, Convergence between military and commercial	(06)
Unit 6	Radio Frequency design, Baseband Signal Processing, Radios with intelligence, Smart antennas, Adaptive techniques, Phased array antennas, Applying Cognitive radio principles to antenna systems, Smart antennaarchitectures.	(07)

Reference Books

1	Dillinger, Madani, Alonistioti (Eds.): Software Defined Radio, Architectures, Systems and Functions, Wiley 2003
2	Software Defined Radio for 3G, 2002, by Paul Burns.
3	Tafazolli (Ed.): Technologies for the Wireless Future, Wiley 2005
4	Bard,Kovarik:SoftwareDefinedRadio,TheSoftwareCommunicationsArchitecture,Wiley2007

Tatyasaheb Kore Institute of Engineering & Technology, Warananagar

First Year M. Tech Electronics and Telecommunication Engineering Semester- II

2501PETCPE2043:Industry Automation & Process Control

Teaching Scheme			**Examination Scheme**	
Lectures	03Hrs./Week		ISE	40Marks
Total Credits	03		ESE	60Marks
			Duration of ESE	02 Hrs.

Prerequisites, if any:

Students should have prior knowledge of engineering mathematics, including differential equations and Laplace transforms, along with fundamentals of control systems. A basic understanding of electrical and electronics engineering concepts such as sensors, actuators, signal conditioning, and digital logic is required. Familiarity with industrial processes and introductory instrumentation concepts will help in understanding automation strategies and advanced control techniques.

Course Objectives (CO):

1. Explain the General function of Industrial Automation, List basic Devices in Automated Systems, Distinguish Different Controllers Employed In Automated Systems.
2. Identify Practical Programmable Logic Controller Applications, Know the History of the PLC, Demonstrate Basic PLC Skills
3. To study basics fuzzy logic and control for industrial atomization

Course Outcomes (CO):At the end of course, students will

1. Explain the characteristics of industrial processes by analyzing process variables, degrees of freedom, dynamic behavior, and classification of processes such as self/non-self regulating, interacting/non-interacting, and linear/nonlinear systems.
2. Analyze liquid, gas, flow, and thermal processes using concepts of resistance, capacitance, dead time, oscillation, and damping for appropriate selection of control actions.
3. Describe the evolution of instrumentation and control systems and evaluate automation strategies using PLC, DCS, SCADA, and hybrid systems with respect to performance, safety, and industrial benefits.
4. Apply intelligent control techniques including model-based controllers, predictive controllers, fuzzy logic, neuro-fuzzy systems, and ANN controllers to improve dynamic performance of industrial processes.
5. Explain the architecture, configuration, programming, and database functions of Distributed Control Systems (DCS) and assess their role in enterprise-level automation and ERP integration.
6. Design and implement automation solutions using PLCs for discrete process control and evaluate automation practices in industries such as power, water treatment, food processing, pharmaceuticals, cement, sugar, automobile, and building automation.

Course Description:

This course provides a comprehensive understanding of **process dynamics, control strategies, and industrial automation systems**. Students learn about process characteristics, types of processes, control actions, and process variables, along with the evolution and application of automation tools like **PLC, DCS, and SCADA**. The course also covers **intelligent controllers** (fuzzy logic, model predictive control, and neural network-based controllers), distributed control systems, PLC design and programming, and their application across industries such as power, water treatment, food, pharmaceuticals, and manufacturing. Emphasis is placed on both theoretical concepts and practical implementation in real-world industrial automation.

	Course Contents	**Hours**
Unit 1	**Process characteristics:** Incentives or process control, Process Variables types and selection criteria, process degree of freedom, The period of Oscillation and Damping, Characteristics of physical System: Resistance, Capacitive and Combination of both. Elements of Process Dynamics, Types of processes- Dead time, Single/multi-capacity, self- Regulating/non-self-regulating, Interacting/non-interacting, Linear/nonlinear, and Selection of control action for them. Study	(07)

Unit 2	**Control Systems and Automation Strategy:** Evolution of instrumentation and control, Role of automation in industries, Benefits of automation, Introduction to automation tools PLC, DCS, SCADA, Hybrid DCS/PLC, Automation strategy evolution, Control system audit, performance criteria, Safety Systems	(07)
Unit 3	**Intelligent Controllers:** Stepan analysis method for finding first, second and multiple time constant sanddead time**.** Model Based controllers: Internal Model control, Smith predictor, optimal controller, Model Predictive controller, Dynamic matrix controller (DMC). Self-Tunning Controller. Fuzzy logic systems and Fuzzy controllers, Introduction, Basic Concepts of Fuzzy Logic, Fuzzy Sets, Fuzzy Relation, Fuzzy Graphs, and Fuzzy Arithmetic, Fuzzy If- Then Rules, Fuzzy Logic Applications, Neuro-Fuzzy Artificial Neural networks and ANN controller	(06)
Unit 4	**Distributed Control Systems:** DCS introduction, functions, advantages and limitations, DC Susanautomation Tool to support Enterprise Resources Planning, DCS Architecture of different makes, specific at ions, configuration and programming, functions includingdatabase	(07)
Unit 5	**Programmable logic controllers (PLC):** Introduction, architecture, definition of discrete state process control, PLCVs PC, PLCVs DCS, relay diagram, ladder diagram, ladder diagram examples, relay sequencers, timers/counters, PLC design, Study of at least one industrial PLC	(06)
Unit 6	Automation for following industries− Power, Water and Waste Water Treatment, Food and Beverages, Cement, Pharmaceuticals, Sugar, Automobile and Building Automation.	(07)

Reference Books

1	Donald Eckman−Automatic Process Control, Wiley Eastern Limited
2	Thomas E Marlin-Process Control- Design in processes and Control Systems for Dynamic Performance, McGraw- Hill International Editions
3	Process control Systems-F. G. Shinskey, TMH
4	Programmable Logic Controllers: Principles and Applications- Webb & Reis PHI
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Tatyasaheb Kore Institute of Engineering & Technology, Warananagar

First Year M. Tech Electronics and Telecommunication Engineering Semester- II

2501PETCOE2051:Advanced Operating Systems

Teaching Scheme			**Examination Scheme**	
Lectures	03Hrs./Week		ISE	40Marks
Total Credits	03		ESE	60Marks
			Duration of ESE	02 Hrs.

Prerequisites, if any:

Students should have a basic understanding of computer organization and architecture, including CPU operation, memory hierarchy, and I/O concepts. Prior knowledge of data structures, algorithms, and programming in a high-level language such as C/C++ or Java is essential. Familiarity with basic concepts of digital logic and computer networks will be helpful for understanding process management, scheduling, and security aspects of operating systems.

Course Objectives (CO):

1. Understand the Concept of hardware interface and OS Interface
2. Understand parallel System along with Multiprocessor
3. Understand IPC patterns

Course Outcomes (CO):At the end of course, students will

1. Explain the fundamental concepts, objectives, and classifications of operating systems, including batch, multiprogramming, time-sharing, real-time, and distributed systems.
2. Describe the internal structure and design approaches of operating systems such as monolithic, layered, virtual machine, and kernel-based architectures.
3. Analyze process management concepts including process states, process control blocks, inter-process relationships, and thread implementation using POSIX threads.
4. Apply process synchronization techniques to solve concurrency problems using critical sections, semaphores, monitors, and classical synchronization problems.
5. Evaluate uniprocessor, multiprocessor, and real-time CPU scheduling algorithms and assess their performance characteristics.
6. Identify computer security threats and attacks, and explain protection mechanisms including authentication, access control, intrusion detection, and malware defense techniques.

Course Description:

This course introduces the **fundamentals of operating systems**, covering their classification, structure, and core functions. Topics include **process and thread management, synchronization techniques, scheduling algorithms for uniprocessor and multiprocessor systems, and real-time scheduling**. Additionally, the course addresses **computer security principles**, exploring threats, attacks, authentication, access control, intrusion detection, and malware defense, providing students with both theoretical knowledge and practical understanding of OS operation and secure computing.

	Course Contents	**Hours**
Unit 1	**Overview of Operating Systems:** Classes of operating systems, Efficiency systems performance, and User service, Batch Processing system, Multiprogramming systems, Time sharing systems, Real-time operating systems, Distributed operating systems.	(06)
Unit 2	**Structure of Operating Systems:** Operations of an OS, Structure of an operating systems, Operating systems with monolithic structure, Layered design of operating systems, Virtual machine operating systems, Kernel-Based operating systems.	(06)
Unit 3	**Process Management and Threads:** Processes and programs, Relationship between processes and programs, Child Processes, Implementing Processes Process context and the process control block, Threads, POSIX Threads.	(06)
Unit 4	**Process Synchronization:** Race conditions, Critical Sections, Synchronization Approaches, Looping versus blocking, Classic Process synchronization, Semaphores, Monitors.	(06)

Unit 5	**Uniprocessor Scheduling and Multiprocessor & Real Time Scheduling:** Type of scheduling, Scheduling Algorithms, Multiprocessor Scheduling, Real time scheduling.	(06)
Unit 6	**Computer security Threats and Techniques:** Computer security Concepts, Threats Attacks & Assets, Intruders, Malicious Software Overview, Viruses Worms &Bots, Root kits, Authentication , Access Control , Intrusion Detection, Malware Defence , Dealing with Buffer overflow Attacks.	(06)

Course Outcomes(CO):At the end of course, students will

1. Implement hardware interface along with addressing and interrupts
2. Implement System calls and OS Interface
3. Implement Parallel System for two process system.
4. Implement I/O devices and System on OS

-ReferenceBooks

1	Operating Systems Internals and design principles – William Stallings.
2	Operating Systems- Dhananjay M. Dhamdhere.
3	Operating System by John Crowley
4	Operating System by William Stallings
5	Operating System by Achyut S Godbole

Tatyasaheb Kore Institute of Engineering & Technology, Warananagar

First Year M. Tech Electronics and Telecommunication Engineering Semester- II

2501PETCOE2052:Cyber Security

Teaching Scheme			**Examination Scheme**	
Lectures	03Hrs./Week		ISE	40Marks
Total Credits	03		ESE	60Marks
			Duration of ESE	02 Hrs.

Prerequisites, if any:

Students should have a basic understanding of **computer networks, operating systems, and internet technologies**. Familiarity with **programming fundamentals**, **data communication concepts**, and basic knowledge of **information security principles** will help in understanding cybercrime mechanisms, risk assessment, and legal perspectives in cybersecurity.

Course Objectives (CO):

1. Understand the Concept of Cyber security.
2. Understand Cyber offenses & Cybercrimes.
3. Understand Tools and Methods Used in Cybercrime

Course Outcomes (CO):At the end of course, students will

1. Understand the fundamentals of cyber security, cybercrime evolution, classifications, and the global and Indian legal perspectives including the IT Act 2000.
2. Identify various cyber offenses and attack methodologies such as social engineering, cyber stalking, botnets, mobile and wireless security threats, and credit card frauds.
3. Analyze common tools and techniques used in cybercrime including phishing, malware, network attacks, web application attacks, and identity theft mechanisms.
4. Apply security risk assessment and risk analysis techniques by understanding risk terminology, regulations, and qualitative and quantitative assessment methods.
5. Explain the concepts and methodologies of Vulnerability Assessment and Penetration Testing (VAPT) for networks and web applications, including discovery, exploitation, and reporting phases.
6. Interpret cyber security laws and legal frameworks related to cyberspace, e-commerce, cybercrime, digital evidence, intellectual property, and emerging global cyber law trends.

Course Description:

This course provides a comprehensive overview of **cybersecurity fundamentals**, including the definition, origins, and classification of cybercrimes, with a focus on both **global perspectives and Indian regulations (ITA 2000)**. It explores **cyber offenses, attack planning, social engineering, mobile and cloud security challenges**, and the tools and methods used by cybercriminals, such as phishing, malware, SQL injection, and DDoS attacks. Students also learn about **security risk assessment, vulnerability assessment, penetration testing (VAPT)**, and gain an understanding of **cyber laws, legal frameworks, and regulatory aspects** related to e-commerce, intellectual property, electronic banking, and cybercrime mitigation.

	Course Contents	**Hours**
Unit 1	**Introduction to Cyber Security:** Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, Cybercrime and the Indian ITA 2000, A global Perspective on cybercrimes.	(07)
Unit 2	**Cyber offenses & Cybercrimes:** How criminal plan the attacks, Social Engg, Cyber stalking, Cybercafé and Cybercrimes, Botnets, Attack vector, Cloud computing, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile	(07)

Unit 3	**Tools and Methods Used in Cybercrime:** Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Identity Theft (ID Theft)	(06)
Unit 4	**Security Risk Assessment and Risk Analysis:** Risk Terminology, Laws, Mandates, and Regulations, Risk Assessment Best Practices, The Goals and Objectives of a Risk Assessment, Best Practices for Quantitative and Qualitative Risk Assessment.	(07)
Unit 5	**Vulnerability Assessment and Penetration Testing (VAPT):** VAPT An Overview, Goals and Objectives of a Risk and Vulnerability Assessment, Vulnerability Assessment Phases-Discovery, Exploitation/Analysis, Reporting Penetration Testing Phases-Discover/Map, Penetrate Perimeter, Attack Resources, Network and Web VAPT	(06)
Unit 6	**Cyber Security Laws and Legal Perspectives:** The Concept of Cyber space E-Commerce, The Contract Aspects in Cyber Law, The Security Aspect of Cyber Law, The Intellectual Property Aspect in Cyber Law, The Evidence Aspect in Cyber Law, The Criminal Aspect in Cyber Law, Global Trends in Cyber Law, Legal Framework for Electronic Data Interchange Law Relating toElectronic Banking, The Need for an Indian Cyber Law	(07)

Reference Books

1	Nina Godbole, Sunit Belapure, Cyber Security, Wiley India, New Delhi.
2	The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
3	The Information technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
4	Cyber Law & Cyber Crimes By Advocate Prashant Mali; Snow White Publications, Mumbai
5	Nina Godbole, Information Systems Security, Wiley India, New Delhi

Tatyasaheb Kore Institute of Engineering & Technology, Warananagar

First Year M. Tech Electronics and Telecommunication Engineering Semester- II

2501PETCOE2053:Artificial Intelligence-Machine Learning

Teaching Scheme			**Examination Scheme**	
Lectures	03Hrs./Week		ISE	40Marks
Total Credits	03		ESE	60Marks
			Duration of ESE	02 Hrs.

Prerequisites, if any:

Students should have a solid understanding of **basic programming (Python preferred)**, **linear algebra, probability, and statistics**, and **fundamentals of data structures and algorithms**. Familiarity with **basic concepts of computer science and data analysis** will help in implementing and understanding AI and ML models effectively.

Course Objectives (CO):

1. To introduce the fundamental concepts and principles of Artificial Intelligence (AI) and Machine Learning (ML)
2. To develop competency in data preprocessing and feature engineering techniques
3. To enable learners to understand and apply various machine learning algorithms

Course Outcomes (CO):At the end of course, students will

1. Understand the fundamentals of Artificial Intelligence (AI) and Machine Learning (ML), including supervised, unsupervised, and reinforcement learning, and their real-world applications.
2. Preprocess and analyze data using techniques such as feature selection, scaling, normalization, and dimensionality reduction methods like PCA, Sparse PCA, and Kernel PCA.
3. Apply regression techniques including linear, polynomial, and logistic regression for prediction and classification problems, and implement optimization algorithms like stochastic gradient descent.
4. Design and implement classification models using Naïve Bayes and Support Vector Machines (SVM), including linear, kernel-based, and support vector regression approaches.
5. Design and implement classification models using Naïve Bayes and Support Vector Machines (SVM), including linear, kernel-based, and support vector regression approaches.
6. Develop and evaluate decision tree models and ensemble learning methods such as Random Forest, AdaBoost, and Gradient Boosting for supervised learning tasks.
7. Perform clustering and recommendation system tasks using methods like K-Means, DBSCAN, hierarchical and expectation-maximization clustering, and implement collaborative and content-based recommendation systems.

Course Description:

This course introduces students to the fundamentals of **Artificial Intelligence (AI) and Machine Learning (ML)**, covering supervised, unsupervised, and reinforcement learning along with statistical and information-theoretic foundations. It emphasizes **data preprocessing, feature selection, dimensionality reduction (PCA, Kernel PCA, Sparse PCA), and regression techniques**, including linear, polynomial, and logistic regression with optimization methods like stochastic gradient descent. Students also explore **classification algorithms (Naïve Bayes, SVM), decision trees, ensemble methods, clustering techniques (K-means, DBSCAN, hierarchical), and recommendation systems**, with practical implementation using **Scikit-learn** and hands-on applications for predictive modeling and pattern recognition.

	Course Contents	**Hours**
Unit 1	**Introduction to Artificial Intelligence and Machine learning: Introduction:** What Is Al and ML? Examples of AI and ML, Applications, Supervised Learning, Un-Supervised Learning and Reinforcement Learning, Important Elements of Machine Learning- Data formats, Learnability, Statistical learning approaches, Elements of information theory	(07)
Unit 2	**Feature Selection:** Scikit- Learn Dataset, creating training and test sets, managing categorical data, Managing missing features, Data scaling and normalization, Feature selection and Filtering, Principle Component Analysis(PCA)- non-negative matrix factorization, Sparse PCA, Kernel PCA. Atom Extraction and Dictionary Learning.	(07)

Unit 3	**Regression:** Linear regression- Linear models, A bi-dimensional example, Linear Regression and higher dimensionality, Polynomial regression, Logistic regression-Linear classification, Logistic regression, Implementation and Optimizations, Stochastic gradient descendent algorithms	(06)
Unit 4	**Naïve Bayes and Support Vector Machine:** Bayes Theorem, Naïve Bayes Classifiers, Naïve Bayes in Scikit-learn- Bernoulli Naïve Bayes, Multinomial Naïve Bayes, and Gaussian Naïve Bayes. Support Vector Machine (SVM)- Linear Support Vector Machines. Scikit- 06. learn implementation, Linear Classification, Kernel based classification, Non- linear Examples. Controlled Support Vector Machines, Support Vector Regression.	(07)
Unit 5	**Decision Trees and Ensemble Learning:** Decision Trees- Impurity measures, Feature Importance. Decision Tree Classification with Scikit learn, Ensemble Learning-Random Forest, AdaBoost, Gradient Tree Boosting, Voting Classifier. Clustering Fundamentals-Basics, K-means: Finding optimal number of clusters, DBSCAN, Spectral Clustering. Evaluation methods based on Ground Truth- Homogeneity, Completeness, Adjusted Rand Index.	(06)
Unit 6	**Clustering Techniques:** Hierarchical Clustering, Expectation maximization clustering. Agglomerative Clustering Dendrograms, Agglomerative clustering in Scikit- learn, Connectivity Constraints. Introduction to Recommendation Systems- Naïve User based systems. Content based Systems, Model free collaborative filtering-singular value decomposition, alternating least squares.	(07)

Reference Books

1	Giuseppe Bonaccorso, "Machine Learning Algorithms", Packt Publishing Limited.
2	Josh Patterson, Adam Gibson, "Deep Learning: A Practitioners Approach", O"REILLY
3	Ethem Alpaydin, "Introduction to Machine Learning", PRENTICE HALL INDIA Publication.
4	Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", Cambridge University Press.

Tatyasaheb Kore Institute of Engineering & Technology, Warananagar

First Year M. Tech Electronics and Telecommunication Engineering Semester- II

2501PETCLC206T: Lab Course

Teaching Scheme			**Examination Scheme**	
Lectures	----		ISE	----
Tutorials	----		ESE(Oral)	25
Practical	04Hrs./Week		TW	25
TotalCredits	02		DurationofESE	------.

Prerequisites, if any:

Students should have a basic understanding of **discrete mathematics**, including modular arithmetic, number theory, and matrix operations. Familiarity with **programming fundamentals** (preferably in Python, C, or Java) and basic concepts of **data structures** will help in implementing classical cryptographic algorithms.

Course Objectives (CO):

1.To acquire basic understanding of MATLAB coding for Ciphers.

2.Toacquirecompleteknowledgeof Security.

3.To make students understand and learn about algorithms of Cryptography.

4.Toacquireknowledge Transportation technique.

Course Outcomes (CO):At the end of course, students will

1. Understand the principles of classical cryptography, including substitution and transposition techniques, and their role in securing information.
2. Implement and analyze basic ciphers such as **Caesar**, **Affine**, and **Polyalphabetic ciphers**, understanding encryption and decryption procedures.
3. Develop skills to implement **digraph and key-based ciphers** like **Playfair** and **Auto Key ciphers** for secure communication.
4. Apply matrix-based encryption techniques such as the **Hill cipher** and implement **rail fence** and **columnar transposition** methods for data confidentiality.
5. Design and execute advanced **columnar transposition techniques** to enhance cryptographic security and analyze their strengths and weaknesses.
6. Use the **Euclidean Algorithm** for computing greatest common divisors, modular inverses, and its application in classical and modern encryption schemes.

Course Description:

This course provides hands-on understanding of **classical cryptographic techniques and fundamental algorithms** for secure communication. Students will implement and analyze various ciphers including **Caesar Cipher, Affine Cipher, Playfair Cipher, Polyalphabetic and Auto Key Ciphers, Hill Cipher, Rail Fence Cipher, and Columnar Transposition techniques**. Emphasis is also given to **mathematical foundations like the Euclidean Algorithm** for key generation and modular arithmetic. The course combines theory with practical programming exercises to strengthen skills in encryption, decryption, and cryptanalysis.

	Course Contents	**Hours**
1	Implement Ceaser Cipher	(04)
2	Implement Affine Cipher with equation c=3x+12	(04)
3	Implement Playfair Cipher with key l drp	(04)
4	Implement polyalphabetic Cipher	(04)
5	Implement Auto Key Cipher	(04)
6	Implement Hill Cipher	(04)
7	Implement Rail fence technique	(04)
8	Implement Simple Columnar Transposition Technique	(04)

9	Implement Advanced Columnar Transposition technique	(04)
10	Implement Euclidean Algorithm	(04)

Course Outcomes(CO):At the end of course, students will

1. Implement Cryptography methods on Network Security concepts and Application
2. Implement Symmetric methods
3. Implement Message authentication and Hash Functions
4. Identify the attacks and methods of web security

Reference Books

1	Willam Stallings, Cryptography and Network Security, Third Edition, Pearson Education
2	Network Algorithmic: An Interdisciplinary Approach to Designing Fast Networked Devices George Varghese (Morgan Kaufmann Series in Networking
3	Atul Kahate, Cryptography and Network Security, Tata McGraw-Hill, 2003

Tatyasaheb Kore Institute of Engineering & Technology, Warananagar

First Year M. Tech Electronics and Telecommunication Engineering Semester- II

2501PETCSW207T:Seminar-II

Teaching Scheme			**Examination Scheme**	
Lectures	-----		TW	50
Practical	02Hrs./Week			
Total Credits	01			

Prerequisites, if any:

Students should have a basic understanding of **engineering design concepts**, **research methodology**, and **technical writing**. Familiarity with **literature survey techniques**, **IEEE formatting**, and **presentation skills** will help in preparing the seminar report and delivering the talk effectively.

Course Objectives (CO):

1. ToIdentify, understand and discuss current, real-world issues.
2. To Distinguish and integrate differing forms of knowledge and academic disciplinary approaches (e.g., humanities and sciences) with that of the student ‘s own academic discipline (e.g., in agriculture, architecture, art, business, economics, education, engineering, natural resources, etc.).And apply multidisciplinary strategy to address current, real-world issues.
3. To Improve oral and written communication skills.

Course Outcomes (CO):At the end of course, students will

1. Conduct a comprehensive **literature survey** on a topic relevant to design engineering to identify research gaps and formulate objectives for a potential dissertation.
2. Develop skills to **organize and present technical information** effectively in a written report using the **IEEE format**.
3. Demonstrate the ability to **synthesize information** from multiple sources, critically analyze prior work, and draw meaningful conclusions.
4. Enhance **oral communication skills** by delivering a seminar presentation to peers and faculty with clarity and technical accuracy.
5. Apply proper **documentation and referencing techniques** to avoid plagiarism and maintain academic integrity in technical writing.
6. Develop **professional and collaborative skills** through participation in peer seminars, including evaluating others’ work and learning from feedback.

Course Description:

This course focuses on **developing research, presentation, and technical writing skills** through a literature survey on a topic relevant to Design Engineering. Students are required to prepare a **25–30 page report in IEEE format**, demonstrating in-depth study, critical analysis, and synthesis of current research. The course emphasizes **oral communication and professional presentation**, as students deliver a seminar in front of faculty and peers, while assessment also considers participation in evaluating other seminars.

	Course Contents	**Hours**
1	Seminar-I should be based on the literature survey on any topic relevant to Design Engineering (should be helpful for selecting a probable title of thedissertation). Each student has to prepare awriteupofabout25-30pagesof –A4 size sheets and submit it in IEEE format in duplicate as the erm work. Thestudenthastodeliveraseminartalkinfrontofthefacultyofthedepartmentandhis classmates.Theconcernedfacultyshouldassessthestudentsbasedonthequalityof workcarriedout,preparationandunderstandingofthecandidates. Some marks should be reserved for the Attendance of a student in the seminars of other students.	(--)

Course Outcomes(CO):At the end of course, students will

1.Apply principles of ethical leadership, collaborative engagement, socially responsible behavior, respect for diversity in an interdependent world, and a service-oriented commitment to advance and sustain local and global communities.
2. Learn and integrate. Through independent learning and collaborative study, attain, use, and develop Knowledge in the arts, humanities, sciences, and social sciences, with Disciplinary specialization and the ability to integrate information across disciplines.
3.Thinkandcreate.Use multiple thinking strategies to examine real-world issues, explore creative avenues of expression, solve problems, and make consequential ecisions
4. Communicate. Acquire, articulate, create and convey intended meaning using verbal andnon-verbalmethodofcommunicationthatdemonstratesrespectandunderstandingin a complex society.

Tatyasaheb Kore Institute of Engineering & Technology, Warananagar

Second Year M.Tech Electronics & Telecommunication Semester- III

2501PETCMC301: Research Methodology

Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/Week		ISE	40 Marks
Tutorials	--		ESE	60 Marks
Total Credits	04		TW	--
			Duration of ESE	02 Hrs.00 Min.

Prerequisites, if any:

Students should have a basic understanding of **college-level statistics, mathematics, and analytical reasoning**. Familiarity with **fundamentals of scientific methods, technical writing, and problem-solving** will help in understanding research processes, designing studies, and analyzing data effectively.

Course Objectives (CO):

1. To acquire basic understanding of research problem formulation.
2. To acquire complete knowledge of ethical practices.
3. To make students understand and learn about intellectual property right.

Course Outcomes (CO):At the end of course, students will

1. Understand the fundamental concepts of research, including its meaning, objectives, types, approaches, and ethical considerations in scientific inquiry.
2. Identify, define, and formulate research problems effectively by analyzing gaps in knowledge and establishing research objectives.
3. Design appropriate research methodologies, including exploratory, descriptive, diagnostic, and experimental study designs, for addressing research questions.
4. Conduct a comprehensive **literature survey**, evaluate sources critically, and synthesize information to support research objectives.
5. Select and apply suitable methods for **data collection**, including primary and secondary data, to ensure accuracy and reliability of research findings.
6. Formulate and test **hypotheses** using statistical methods, understand null and alternative hypotheses, and interpret results to support research conclusions.

Course Description:

This course provides a comprehensive introduction to **research principles, processes, and methodologies** for postgraduate students. It covers the **concept and significance of research**, types of research, and the scientific approach to problem-solving. Students learn to **formulate research problems, design appropriate studies, conduct literature surveys, and collect and analyze data**, including both qualitative and quantitative methods. Emphasis is placed on **hypothesis formulation and testing, ethical considerations, and effective strategies for conducting systematic and creative research** across engineering and technological domains.

	Course Contents	**Hours**
Unit 1	**Introduction to Research:** Meaning of research, Concepts of Research, Research as a Scientific Method, Types of Research, Motivational Research, Research Approach, Significance of Research, Characteristics of Good Research, Problems Encountered by Researchers, Research Process, Creativity in Research, Ethics in Research,	(07)

Unit 2	**Research Problem:** Concept of Research Problem, Need of research problem, Defining research Problem, Identifying research problem, Formulating research problem, Conditions and Components of research problem,	(07)
Unit 3	**Research Design:** Concept of research Design, Need and Features of Research Design, Components of Research design, Types of Research Design, Research design for Exploratory Studies, Research Design for Descriptive and Diagnostic Studies, Research Design for Experimental Studies.,	(06)
Unit 4	**Literature survey:** Definition of literature and literature survey, need of literature survey, sources of literature, elements and objectives of literature survey, styles of literature survey, and strategies of literature survey.	(06)
Unit 5	**Methods of Data Collections:** Concept of Data collection, Types of data, Methods of Primary Data Collection, Methods of Secondary Data Collection, Selecting an Appropriate Method of Data Collection.	(06)
Unit 6	**Concept of Hypothesis:** Defining Hypothesis, Characteristics of Hypothesis, Types of Hypothesis, Hypothesis testing, Null Hypothesis and Alternative Hypothesis, Decision Rule, Two-tailed Test, One –tailed Test, Procedure of Hypothesis Testing.	(07)

Text Books	
1	Research Methodology-G. C. Ramamurthy (Deramtech Press)
2	Aswani Kumar Bansal : Law of Trademarks in India.
3	C. R. Kothari: Research Methodology: Methods & Techniques.
4	B L Wadehra : Law Relating to Patents, Trademarks, Copyright, Designs and Geographical Indications.
5	Satyawrat Ponkse: The Management of Intellectual Property.
6	Intellectual Property Rights under WTO by T. Ramappa, S. Chand.
7	Applied Statistics and Probability for Engineers
8	Probability and Statistics for Engineers –Miller, Freund
9	Applied Mathematics for Engineers and Physiscists
Reference Books	
1	Research Methodology: concepts and cases—Deepak Chawla and Neena Sondhi.
2	Research Methods for Business—Sekaran—Wiley.
3	Research Methodology: Methods and Trends’
4	Research Methods in Education---Louis Cohen
5	Principles of Engineering Economy by Grant Ireson/Leavenworth.
6	Resisting Intellectual Property by Halbert ,Taylor & Francis.
7	Intellectual Property in New Technological Age by Robert P. Merges, Peter S. Menell, Mark A. Lemley
Useful Links	
1	freevideolectures.com
2	http://www.youtube.com/

Tatyasaheb Kore Institute of Engineering & Technology, Warananagar

Second Year M.Tech Electronics & Telecommunication Semester- III

2501PETCMC302: Intellectual Property Rights

Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/Week		ISE	40 Marks
Tutorials	---		ESE	60 Marks
Total Credits	03		TW	--
			Duration of ESE	02 Hrs.00 Min.

Prerequisites, if any:

Students should have a basic understanding of **engineering, technology, or management concepts**, along with familiarity with **research, innovation, and legal frameworks**. Knowledge of **patents, copyrights, and general business or industrial processes** will help in understanding and applying Intellectual Property Rights effectively.

Course Objectives (CO):

1. To acquire basic understanding of research problem formulation.
2. To acquire complete knowledge of ethical practices.
3. To make students understand and learn about intellectual property right.

Course Outcomes (CO):At the end of course, students will

1. Understand the fundamental concepts of intellectual property, including its nature, objectives, and importance in protecting innovations and creative works.
2. Explain the administration of patents in India, including the functioning of the Indian Patent Office and procedures under the Indian Patent Act.
3. Analyze patent rights, licensing, technology transfer, and the preparation of provisional and non-provisional patent applications, including specialized patents like plant and idea patents.
4. Describe the concepts of trademarks, copyrights, trade secrets, geographical indications, and traditional knowledge, along with case studies for practical understanding.
5. Explore innovations in IPR, including recent developments, patenting processes, and the role of technological research and innovation in intellectual property.
6. 6. Understand the international framework of IPR, including WIPO, TRIPS, and patents under the Patent Cooperation Treaty (PCT).

Course Description:

	Course Contents	Hours
Unit 1	**Introduction to Intellectual Property Rights:** Concepts o f Property and Intellectual Property ,Nature, Objectives and Importance of understanding Intellectual Property Rights.	(06)
Unit 2	**Administration in Intellectual Property:** -Patents-Indian Patent Office and its Administration, Administration of Patent System–Patenting under Indian Patent Act.	(06)
Unit 3	**Rights in Patent:** Patent Rights and its Scope, Licensing and transfer of technology, Patent information and database. Provisional and Non Provisional Patent Application and Specification, Plant Patenting, Idea Patenting, Integrated Circuits, Industrial Designs.	(06)
Unit 4	**Trademarks, Copyrights & Trade Secrets:** Trademarks, Registered and unregistered trademarks, Copyrights, Traditional Knowledge, Geographical Indications, Trade Secrets, Case Studies.	(06)
Unit 5	**Innovations in IPR**: New development sin IPR, Process of patenting and development, technological research, innovation.	(06)

Unit 6	**International Scenario in IPR:** WIPO, TRIPs, Patent in gunder PCT.	(06)

Text Books	
1	Research Methodology-G. C. Ramamurthy (Deramtech Press)
2	Aswani Kumar Bansal : Law of Trademarks in India.
3	C. R. Kothari: Research Methodology: Methods & Techniques.
4	B L Wadehra : Law Relating to Patents, Trademarks, Copyright, Designs and Geographical Indications.
5	Satyawrat Ponkse: The Management of Intellectual Property.
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4	Research Methods in Education---Louis Cohen
5	Principles of Engineering Economy by Grant Ireson/Leavenworth.
6	Resisting Intellectual Property by Halbert ,Taylor & Francis.
7	Intellectual Property in New Technological Age by Robert P. Merges, Peter S. Menell, Mark A. Lemley
Useful Links	
1	freevideolectures.com
2	http://www.youtube.com/

Tatyasaheb Kore Institute of Engineering & Technology, Warananagar

First Year M. Tech Electronics and Telecommunication Engineering Semester- II

2501PETCII303: Industrial Training

Teaching Scheme			**Examination Scheme**	
Lectures	--=--		ISE	----
Tutorials	--		ESE	------
Practical	08Hrs/Week		TW	75
Total Credits	04		Duration of ESE	-----.

Prerequisites, if any:

Students should have a fundamental understanding of **core engineering concepts**, **basic technical skills**, and familiarity with **their branch-specific tools and processes**. Prior knowledge of **report writing, documentation, and presentation skills** will help in preparing the industrial training report and delivering an effective seminar.

Course Objectives (CO):

To provide students with **practical exposure** to industrial processes, tools, and work environments, bridging the gap between theory and real-world applications.

To develop the ability to **analyze, document, and report industrial assignments** systematically, enhancing technical writing and professional communication skills.

To strengthen **presentation, observation, and professional skills** through structured reporting and delivering seminars before faculty and industry experts.

Course Outcomes (CO):At the end of course, students will

1. Demonstrate the ability to **document industrial training experience** comprehensively, including assignments completed, observations, and analysis in a professional report.
2. Develop skills to **analyze practical industrial processes** and relate them to theoretical knowledge gained during academic studies.
3. Enhance **technical writing and documentation skills** by preparing a structured report suitable for departmental and professional review.
4. Demonstrate **oral communication and presentation skills** by delivering a clear and effective presentation before a panel of experts.
5. Evaluate and reflect on **learning outcomes and professional exposure** gained during the industrial training, including workplace practices and technologies.
6. Apply **professional ethics, discipline, and industry standards** observed during the training to future academic and professional projects.

Course Description:

This course provides students with **practical exposure to real-world industrial environments** by undergoing a minimum of **two weeks of training** in reputed industries. Students are required to **prepare a detailed report** documenting the assignments completed, observations, and analyses of processes and practices encountered. The course emphasizes **professional communication and presentation skills**, as students present their work before a departmental panel of experts. The term work includes **submission of the training report, certification from the industry, and performance in the departmental oral examination**, bridging academic learning with hands-on industrial experience.

	Course Contents	**Hours**
Unit 1	The student has to prepare the report of training undergone in the industry. It shall include the brief details of assignment completed by the candidate and general observation and analysis. The student has to make a presentation in front of panel of experts as decided by departmental head.The term work should be based on report and	---

	departmental oral examination. The training should be of minimum two weeks from reputed industries and certificate of the same should be a part of the report.	

Tatyasaheb Kore Institute of Engineering & Technology, Warananagar

Second Year M.Tech Electronics & Telecommunication Semester- III

2501PETCSL304: MOOC/Swayam / Center of Excellence

Teaching Scheme			**Examination Scheme**	
Lectures	----		ISE	----
Tutorials	--		ESE	------
Total Credits	--		TW	25
			Duration of ESE	----

Prerequisites, if any:

Students should have a solid understanding of **core Electronics and Telecommunication Engineering subjects** and basic knowledge of **circuit analysis, communication systems, and digital electronics**. Familiarity with **online learning platforms and technical report writing** will help in completing the course and presenting the work effectively.

Course Objectives (CO):

1. To provide students with **exposure to advanced and emerging topics** in Electronics and Telecommunication Engineering beyond the regular syllabus.
2. To develop the ability to **learn independently through online platforms** and apply new knowledge to modern engineering challenges.
3. To enhance **technical communication and presentation skills** by documenting course learnings and delivering seminars before faculty and experts.

Course Outcomes (CO):At the end of course, students will

1. Identify and select advanced online courses in **Electronics and Telecommunication Engineering** from MOOC, SWAYAM, or Centers of Excellence to explore topics beyond the regular syllabus.
2. Demonstrate the ability to **learn independently** using online platforms and acquire knowledge on **recent developments, emerging technologies, and trends** in E&TC engineering.
3. Apply the knowledge gained from the course to **analyze, understand, and evaluate modern electronic and telecommunication systems**
4. Develop **documentation skills** by submitting certificates, course summaries, and technical reports as part of the term work.
5. Enhance **presentation and communication skills** by delivering a seminar before a panel of experts, effectively conveying course learnings and insights.
6. Integrate **new knowledge with practical applications** in Electronics and Telecommunication Engineering, fostering innovation, problem-solving, and lifelong learning.

Course Description:

This course enables students to **pursue advanced learning beyond the regular curriculum** by selecting a **relevant MOOC/SWAYAM course or training from a Center of Excellence**, in consultation with their faculty guide. The course focuses on **recent developments and emerging trends in Electronics and Telecommunication Engineering**. Students are required to **submit the certificate of completion** from the chosen course and **deliver a presentation** in front of a departmental expert panel, demonstrating their understanding and application of the learned concepts. This approach fosters **self-directed learning, industry awareness, and professional presentation skills**.

	Course Contents	**Hours**
Unit 1	Students should select the course in consultation with the guide from MOOC/Swayam/ Center of Excellence and course should be in acquaintance with recent developments in Electronics and Telecommunication Engineering beyond the syllabus **The term work under this course submitted by the student shall include.** 1) Certificate issued by MOOC/Swayam/ Center of Excellence authorities. 2) The student has to make a presentation in front of panel of experts as decided by departmental head.	--

Tatyasaheb Kore Institute of Engineering & Technology, Warananagar

Second Year M.Tech Electronics & Telecommunication Semester- III

2501PETCPC305: Dissertation Phase-I

Teaching Scheme			**Examination Scheme**	
Lectures	-----		ISE	----
Tutorials	----		ESE (Oral)	50
Practical	16Hrs/Week		TW	50
Total Credits	10		Duration of ESE	-----.

Prerequisites, if any:

Students should have a strong foundation in their **core engineering subjects** and prior experience with **research methods, project work, and technical writing**. Familiarity with **data analysis, literature review, and presentation skills** is also essential to successfully complete the dissertation and defend it before a panel.

Course Objectives (CO):

1. To enable students to **independently conduct research or project work** and compile findings into a structured dissertation report following standard guidelines.
2. To develop **technical writing and documentation skills**, ensuring clarity, accuracy, and adherence to academic formatting standards like IEEE/ASME/Elsevier.
3. To enhance **oral communication and presentation skills** by effectively presenting the dissertation work before a panel of internal and external examiners.

Course Outcomes (CO):At the end of course, students will

1. Demonstrate the ability to **plan, execute, and complete a research or design project** independently.
2. Develop proficiency in **technical writing** by preparing a well-structured dissertation report adhering to professional standards and formatting guidelines.
3. Apply **research methodology and analytical skills** to investigate problems, collect data, and derive meaningful conclusions.
4. Enhance **visual communication skills** through effective use of figures, tables, graphs, and illustrations in the report.
5. Demonstrate **oral communication and presentation skills** by presenting work confidently before a panel of internal and external examiners.
6. Integrate **theoretical knowledge with practical insights**, fostering innovation, critical thinking, and readiness for professional or academic pursuits.

Course Description:

At the end of the semester, the student is required to prepare and submit a **dissertation report** strictly as per the prescribed guidelines. The report must be typed on **A4-size bond paper**, with a minimum length of **35 pages**, and should include figures, graphs, tables, and annexures wherever necessary. The dissertation must follow a **standard structure**, consisting of the title sheet, certificate, acknowledgement, list of figures/photographs/graphs/tables, abbreviations, abstract, contents, and the main text organized into appropriate chapters, followed by a bibliography. All references and sources of illustrative material must be properly cited in **IEEE / ASME / Elsevier format**. The student is also required to **present and defend the dissertation** before a panel comprising an internal and an external examiner.

	Course Contents	**Hours**
Unit 1	At the end of semester, student has to prepare the report as per the guidelines provided below. **Format of dissertation report:** The dissertation work report shall be typed on A4 size bond paper. The total number of pages shall not be less than 35. Figures, graphs, annexure etc be as per the requirement. **The report should be written in the standard format.** 1. Title sheet 2. Certificate 3. Acknowledgement 4. List of figures, Photographs/Graphs/Tables	---

	5. Abbreviations. 6. Abstract 7. Content. 8. Text with usual scheme of chapters. Bibliography (the source of illustrative matter be acknowledged clearly at appropriate place as per IEEE/ASME/Elsevier Format) Student should present his work in front of a panel having internal examiner and external examiner.	

Tatyasaheb Kore Institute of Engineering & Technology, Warananagar

Second Year M.Tech Electronics & Telecommunication Semester- IV

2501PETCPC401: Dissertation Phase-II

Teaching Scheme			**Examination Scheme**	
Lectures	-----		ISE	----
Tutorials	----		ESE (Oral)	100
Practical	30Hrs/Week		TW	100
Total Credits	20		Duration of ESE	-----.

Prerequisites, if any:

Students should have **advanced knowledge in their core discipline** and prior experience with **research methodology, project execution, and technical writing**. They must be familiar with **literature review, data analysis, research ethics, plagiarism checks, and scholarly publication standards**, as well as possess **presentation and viva voce skills** to defend their dissertation effectively.

Course Objectives (CO):

1. To enable students to **independently conduct advanced research** on an approved topic and systematically document their findings in a structured dissertation.
2. To develop **scholarly writing, data analysis, and publication skills**, ensuring adherence to professional standards and journal requirements.
3. To enhance **critical thinking, presentation, and defense skills** by incorporating feedback from the Departmental Post Graduate Committee and presenting the work before a panel of experts.

Course Outcomes (CO):At the end of course, students will

1. Demonstrate the ability to **plan, execute, and complete advanced research projects** independently in the chosen field of study.
2. Prepare a **well-structured dissertation report** with clear presentation of objectives, methodology, results, and conclusions following professional formatting standards.
3. Apply **research methodology, data analysis, and problem-solving skills** to generate meaningful and original contributions to the field.
4. Publish research findings in **reputed journals or conferences**, demonstrating understanding of scholarly communication and academic integrity.
5. Effectively **present and defend the research work** before academic panels, incorporating feedback for report refinement.
6. Develop **critical thinking, innovation, and lifelong learning skills**, preparing for professional practice or further research in the field.

Course Description:

The **dissertation submitted by the student**, on a topic already approved by the **Departmental Post Graduate Committee (DPGC)**, shall strictly adhere to the prescribed guidelines. The dissertation report must be typed on **A4-size bond paper** and should contain **not less than 60 pages**, with figures, graphs, tables, and annexures included as required. The report shall follow a **standard format**, comprising the **Title Sheet, Certificate, Acknowledgement, List of Figures/Photographs/Graphs/Tables, Abbreviations, Abstract, Contents, Main Text organized into chapters, and a separate section on Discussion of Results and Conclusions**, followed by a **Bibliography**. All references and illustrative materials must be properly cited in **IEEE / ASME / Elsevier format**.

In addition, the student is required to **publish at least one research paper** in a reputed journal (such as **UGC-approved or SCOPUS-indexed journals**). The student must make a **presentation before the DPGC** and incorporate the suggestions provided by the committee into the final report. The dissertation shall undergo a **plagiarism check** as per institutional norms, and finally, the student must **appear for the final viva voce examination** before a panel of experts appointed by the examination section.

	Course Contents	**Hours**

Unit 1	**The dissertation submitted by the student on the topic, already approved by the Departmental Post Graduate Committee (DPGC) shallbe according to following guidelines.** The dissertation work report shall be typed on A4 size bond paper. The total number of pages shall not be less than 60. Figures, graphs, annexure etc be as per the requirement. **The report should be written in the standard format.** 1. Title sheet 2. Certificate 3. Acknowledgement 4. List of figures, Photographs/Graphs/Tables 5. Abbreviations. 6. Abstract 7. Contents. 8. Text with usual scheme of chapters. 9. Discussion of the results and conclusions Bibliography (the source of illustrative matter be acknowledged clearly at appropriate place as per IEEE/ASME/Elsevier Format) The students should publish at least one paper in a reputed journal (UGC approved/ SCOPUS Indexed etc.) The student should make presentation in front of Departmental Post Graduate Committee (DPGC) and incorporate the suggestions in the report provided by the committee. The student should undergo plagiarism process of his report. The student has to appear for final viva voce examination in front of panel of experts as appointed by examination section.	---

BOS Secretary

Chairman BOS
Dept. of E & Tc

PG Coordinator
TKIET Warananagar

Academic Dean
T.K.I.E.T. Warananagar
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Principal
T.K.I.E.T. Warananagar