JSPM's
RAJARSHI SHAHU COLLEGE OF ENGINEERING
TATHAWADE, PUNE-33
(An Autonomous Institute Affiliated to Savitribai Phule Pune University,Pune)

Department of Electronics and Telecommunication Engineering

Syllabus Structure

(2023 Pattern)

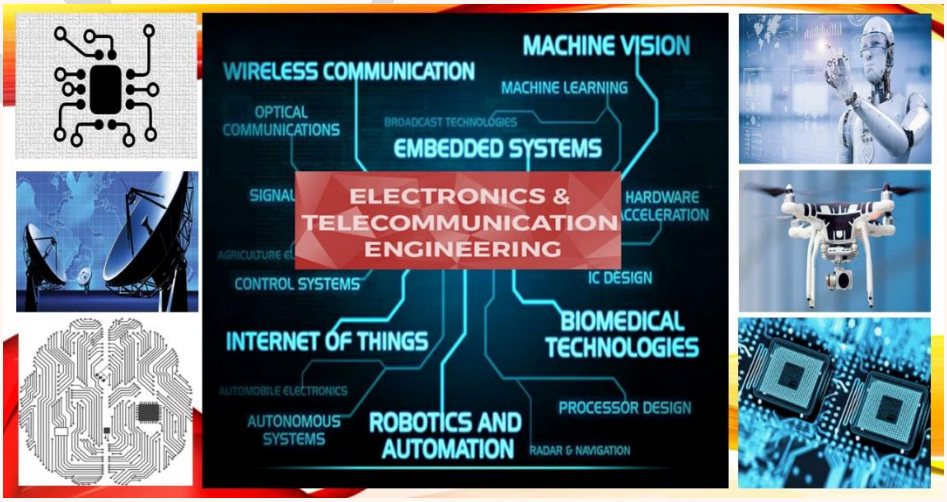
Department of Electronics and Telecommunication Engineering

Vision

"To create an educational environment to meet the challenges of modern Electronics and Telecommunication engineering industry through state of art technical knowledge and innovative approach".

Mission

- To entrust the students with fundamentals of Electronics and Telecommunication Engineering for successful carrier
- To enable students to pursue higher education, research and promote Entrepreneurship
- To serve the nation through techno-social development.



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Dean Academics

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Highlights of the Syllabus

Curriculum of Electronics and Telecommunication Engineering course is designed in consultation with

Academic Experts

Industry/Corporate Experts

Distinguished Alumni

The salient features of curriculum designed in association with **KPIT, Nayan Electronics.**

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Program Outcomes (POs)

Engineering Graduates will be able to:

1. Engineering knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

2. Problem analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4).

3. Design/development of solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5).

4. Conduct investigations of complex problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

5. Modern tool usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6).

6. The engineer and The world: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

7. Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9).

8. Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

9. Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences.

10.Project management and finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

11.Life-long learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8).

Department of Electronics and Telecommunication Engineering

Program Specific Outcomes (PSOs)

Upon successful completion of UG course in Information Technology, the students will attain following Program Specific Outcomes:

1. Graduate will demonstrate the ability to apply knowledge of Electronics and Telecommunication to identify, formulate and solve Engineering problems useful to society.
2. Graduate will demonstrate an ability to design, implement and analyze various functional elements of Electronics and Telecommunication domain, interpret data and work with multidisciplinary approach.
3. Graduate will demonstrate the analytical and managerial skills with a virtue of continued learning; carry out the professional and entrepreneurial responsibilities in Electronics and Telecommunication Engineering field considering environmental issues

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T. Y. B. Tech (Electronics & Telecommunication Engineering)
(2023 Pattern) Semester -V

Course	Course code	Course Title	Teaching Scheme				Credit	Examination Scheme			Total	Ownership
			L	T	P	Hr	C	ISE	MSE	ESE		
PCC	EC3201T	Advanced Embedded & RTOS	3	-	-	3	3	20	30	50	100	E&TC
PCC	EC3202T	Electromagnetic Waves & Radiating Systems	2	-	-	2	2	20	30	50	100	E&TC
PCC	EC3203T	Control Systems	3	-	-	3	3	20	30	50	100	E&TC
PEC	EC3204T	Program elective-I	3	-	-	3	3	20	30	50	100	E&TC
OE	ECO3201T	Open elective-I	3	-	-	3	3	20	30	50	100	Other department
MDM	ECM3201T	Multidisciplinary Minor-II	3	-	-	3	3	20	30	50	100	Other department
PCC	EC3201L	Advanced Embedded & RTOS Lab	-	-	2	2	1	ISCE: 30		20	50	E&TC
PCC	EC3202L	Electromagnetic Waves & Radiating Systems Lab	-	-	2	2	1	ISCE: 30		20	50	E&TC
PEC	EC3204L	Program elective-I Lab	-	-	2	2	1	ISCE: 30		20	50	E&TC
MDM	ECM3201L	Multidisciplinary Minor-II Lab	-	-	2	2	1	ISCE: 30		20	50	Other department
CC	EC3205L	Co-curricular course-III	-	-	2	2	1	ISCE: 30		20	50	E&TC
	Total		**17**	**-**	**10**	**27**	**22**				**850**	

Program Elective-I (Sem 5th)

Course Code	Course
EC3204TA	Digital Signal Processing
EC3204TB	Information Theory & Coding Techniques
EC3204TC	NPTEL - Programming in JAVA
EC3204TD	NPTEL - VLSI Design flow : RTL & GDS

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T. Y. B. Tech (Electronics & Telecommunication Engineering)
(2023 Pattern) Semester -VI

Course	Course code	Course Title	Teaching Scheme				Credit	Examination Scheme			Total	Ownership
			L	T	P	Hr	C	ISE	MSE	ESE		
PCC	EC3206T	VLSI Design & Technology	3	-	-	3	3	20	30	50	100	E&TC
PCC	EC3207T	Internet of Things	2	-	-	2	2	20	30	50	100	E&TC
MDM	ECM3202T	Multidisciplinary Minor-III	3	-	-	3	3	20	30	50	100	Other department
OE	EC3208T	Program Elective-II	3	-	-	3	3	20	30	50	100	E&TC
PEC	EC3209T	Program Elective-III	3	-	-	3	3	20	30	50	100	E&TC
OE	ECO3202T	Open elective-II	3	-	-	3	3	20	30	50	100	Other department
PCC	EC3206L	VLSI Design & Technology Lab	-	-	2	2	1	ISCE: 30		20	50	E&TC
PCC	EC3207L	Internet of Things Lab	-	-	2	2	1	ISCE: 30		20	50	E&TC
PCC	EC3209L	Program Elective-III Lab	-	-	2	2	1	ISCE: 30		20	50	E&TC
Project	EC3210L	Project Phase-I	-	-	4	4	2	ISCE: 100		50	150	E&TC
	Total		**17**	**-**	**10**	**27**	**22**				**900**	

Program Elective-II (Sem 6th)

Course Code	Course
EC3208TA	Biomedical Instrumentation
EC3208TB	Electronics Product Design
EC3208TC	NPTEL
EC3208TD	NPTEL

Program Elective -III (Sem 6th)

Course Code	Course
EC3209TA	Industrial Automation
EC3209TB	Computer Networks & Security
EC3209TC	NPTEL
EC3209TD	NPTEL

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List of Exit Courses after completion of Semester V and VI

1. Exit option is available for students those who have earned the total 132 credits at the End of Six Semester.
2. Student who wants to avail the exit option after Third year have to earn additional 8 credits from the list of courses shown below.
3. These courses student have to complete within summer vacation after 3rd Year.
4. After fulfilment as mentioned in 1 to 3 above, Students can earn **Bachelor's Degree in Vocation (B.Voc) E&TC Engineering** and same will be issued by the Institute.

Sr. No.	Course code	Name	Credits	
1.	EX-EC3201	Principles of Modern CDMA/MIMO/OFDM wireless communication	2	Three Years Bachelor's Degree in Vocation (B.Voc) E&TC Engineering
2.	EX-EC3202	Analysis and design principles of Microwave Antennas	2	
3.	EX-EC3203	Digital VLSI Testing	2	
4.	EX-EC3204	Simulation of communication Network using MATLAB	2	
5.	EX-EC3205	System Design using Verilog	2	
6.	EX-EC3206	Industry Automation	2	

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SEM-V

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T. Y. B. Tech (E & TC Engineering)

Academic Year – 2025-2026 Semester –V

[EC3201T]: Advanced Embedded and Real Time Operating Systems

Teaching Scheme:	Credit	Examination Scheme:
TH: - 03 Hours/Week	TH:03	In Sem. Evaluation :20 Marks Mid Sem. Exam:30 Marks End Sem. Exam:50 Marks

Course Prerequisites: Microprocessor & Microcontroller concepts and applications, Assembly language concepts, C programming, Computer architecture and operating system.

Course Objective:
This Course will give the insights of architecture, instruction set and programming aspects of ARM Processor. It also provides basics of operating systems, terms related to real time operating systems, features and its applications.

Course Outcome:
After successful completion of the course, students will able to:
CO1: Outline the Key Concepts and Components of ARM series Microcontrollers, RTOS, and Embedded Systems.
CO2. Describe the Functional structure of Embedded and Real-Time Operating Systems (RTOS)
CO3: Implement Embedded Systems for given tasks.
CO4: Analyze performance of designed system.

Course Contents

UNIT-I	Introduction to ARM Series and Architecture	08 Hours

Introduction to ARM Cortex-M series processors, ARM Cortex-M architecture overview and RISC design philosophy, architecture features, interrupt management, Hardware Architecture: Memory Organization, I/O Configuration and Port mapping, Power Management and Low-Power Modes, Development Tools.

UNIT-II	Introduction to Real Time Operating System	08 Hours

Characteristics and requirements of real-time systems, task scheduling and kernel architecture, Multitasking vs. Multithreading in embedded systems, RTOS Kernel Types: Preemptive vs non-preemptive , Types of ERTOS, RTOS Services and Concepts: Task creation, scheduling, and termination, Task states and transitions, Task synchronization mechanisms, Inter-task communication: Message Queues, Mailboxes, Pipes, Events, Real-Time Clock (RTC) and Timers, RTOS Memory Management: Static vs dynamic memory allocation, Memory pools and heap management, Memory protection and handling fragmentation.

UNIT-III	Real-Time Control and Communication with ARM Series Controller	08 Hours

Real-Time Control Systems: Designing real-time control systems (e.g., PID control, motor control),

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Interrupt handling and real-time data processing, Using DMA (Direct Memory Access) for real-time data transfer, Communication Protocols in Embedded Systems: UART, SPI, I2C protocols, CAN bus communication for real-time embedded systems (automotive, industrial), Setting up and using Ethernet, USB, and other communication interfaces, Peripherals in Real-Time Applications: ADC/DAC interface for real-time sensor data acquisition, PWM generation for motor and actuator control, Timer-based control in real-time applications.

UNIT-IV	**FreeRTOS**	**06 Hours**

Overview of FreeRTOS kernel, Installing and configuring FreeRTOS, Task management, queues, semaphores, and message buffers, FreeRTOS Services and Functions: Task creation and scheduling, Task priorities and preemptive scheduling, Task communication using queues, mailboxes, and semaphores, FreeRTOS Memory Management: Heap memory management and dynamic memory allocation, Memory protection techniques (stack overflows, memory leaks), FreeRTOS with ARM Cortex M series Processor: Configuring FreeRTOS , Running multiple tasks with FreeRTOS, Interfacing FreeRTOS with Processor's peripherals.

UNIT-V	**Embedded Systems Development: ARM-Based Approaches and Practices**	**06 Hours**

Peripheral Interfacing, Project Development: Blinking LED using FreeRTOS and (task-based LED control), UART communication between ARM series controller and a PC or another microcontroller, Simple real-time control system (e.g., temperature control using a sensors, Debugging Embedded Applications.

UNIT-VI	**Embedded Applications and Case Studies**	**06 Hours**

Real time health monitoring system of automobiles, Flight control systems, Patient monitoring systems, Portable diagnostic devices, Smart lighting and thermostat systems, Process control systems, Industrial Robot, Structural Health Monitoring Systems

Text Books:

T1 Jean J.Labrosse, ―MicroC OS II, The Real-Time Kernel‖, 2nd edition, CMP Books.
T2 Jim Cooling – Real time operating system Book 2
T3 Beginning STM32: Developing with FreeRTOS, libopencm3 and GCC

Reference Books:

R1. E-book: ARM System Developer's Guide by Andrew N. SLoss, Dominic Symes, Chris Wright.
R2. Embedded Systems: Architecture, Programming and design, Raj Kamal, Second Edition Tata McGraw Hill publisher, 2010.
R3. "STM32 Arm Programming for Embedded Systems" by Muhammad Ali Mazidi, Shujen Wang.
R4. "Embedded Systems: Real-Time Operating Systems for ARM Cortex-M Microcontrollers" by Jonathan W. Valvano.
R5. "Embedded Systems Design with the STM32" by Valerio Di Sante

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T. Y. B. Tech (E&TC Engineering)
Academic Year – 2025-2026 Semester -V
[EC3202T]: Electromagnetic Waves and Radiating Systems

Teaching Scheme:	Credit	Examination Scheme:
TH: - 2 Hours/Week	TH:2	In Sem. Evaluation:20 Marks Mid Sem. Exam:30 Marks End Sem. Exam:50 Marks

Course Prerequisites: Basic mathematical concepts related to electromagnetic vector fields.

Course Objective:
To introduce the basic mathematical concepts related to electromagnetic fields. To impart knowledge on the concepts of Faraday 's law, induced e.m.f. and Maxwell 's equations. To analyze and understand the Uniform plane wave propagation in various media and transmission lines. To identify and analyze various antennas according to radiation characteristics and applications.

Course Outcome:
After successful completion of the course, students will able to:
CO1: Discuss the basic principles of electrostatics and magneto-statics.
CO2: Illustrate Maxwell's equations for Static and time-varying field.
CO3: Discuss various wave propogation techniques.
CO4: Evaluate antennas parameters for different types of antenna.

Course Contents

UNIT-I	ELECTROSTATICS	08 Hours

Sources and effects of electromagnetic fields, Coordinate Systems, Vector fields Gradient, Divergence, Curl theorems and applications, Coulomb's Law, Electric field intensity, Gauss's law and applications. Electric potential, Concept of Uniform and Non-Uniform field. Electric field in free space, conductors, dielectrics, Dielectric polarization, Dielectric strength, Electric field in multiple dielectrics, Boundary conditions (dielectric-dielectric, conductor – dielectric), significance of Poisson 's and Laplace's equations, Capacitance, Energy density, Applications.

UNIT-II	MAGNETOSTATICS	08 Hours

Lorentz force, magnetic field intensity (H) , Biot–Savart's Law, Ampere's Circuit Law, H due to straight conductors, circular loop, infinite sheet of current, Magnetic flux density (B), B in free space, conductor, magnetic materials, Boundary conditions, scalar and vector potential, Poisson's Equation.

UNIT-III	WAVE PROPAGATION	08 Hours

Maxwell's Equations: Faraday's Law, Stationary Loop in a Time-Varying Magnetic Field, Displacement Current. Wave Polarization: Linear, Elliptical and Circular. Radio Wave Propagation: Ground Wave, Sky Wave and Line of Sight Propagation, Critical Frequency, MUF, LUF, Virtual Height and Skip Distance, Relation between MUF and Skip Distance, Multi hop Propagation.

UNIT-IV	BASIC ANTENNA CONCEPTS AND PARAMETERS	08 Hours

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Radiation Patterns, Beam solid angle, radiation intensity, Directivity, effective aperture, Antenna field zones, Polarization. Friis Transmission formula, Duality of Antennas, Antenna and Transmission line, Antenna temperature. Hertz and Marconi antannas, Concept of resonant and non-resonant antennas. Halfwave dipole antenna radiated fields of short dipole, Design and implementation of HW dipole antenna using necessary parameters.		
UNIT-V	**SMALL AND SPECIAL ANTENNAS**	**08 Hours**
Array antennas: Yagi uda Antenna, Log periodic. Pattern Multiplication. Structural details, radiation pattern, features and applications of following antennas: TW antenna, Turnstile antenna, Helical antenna, Rhombic antenna, Whip antenna, Horn antenna, Parabolic Reflector antennas, Micro strip antenna.		

Text Books:

T1 John D Kraus, Ronald J Marhefka, Ahmad S Khan, "Antenna and Wave Propagation",TataMcGraw Hill, 4th Edition, 2010.

T2 K. D. Prasad, "Antenna & Wave Propagation",Satya Prakashan, New Delh

Reference Books:

R1. R.L.Yadava, "Antennas and Wave Propagation", PHI,2011.

R2. ConstantineA.Balanis, "Antenna Theory: Analysis and Design", Third Edition, John Wiley and Sons, 2012.

R3. G.S.N. Raju, "Antennas and wave propagation", 1st Edition Pearson Education, 2012.

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T. Y. B. Tech (E&TC Engineering)
Academic Year – 2025-2026 Semester -V
[EC3203T]: Control Systems

Teaching Scheme:	Credit	Examination Scheme:
TH: - 03 Hours/Week	TH:3	In Sem. Evaluation :20 Marks Mid Sem. Exam:30 Marks End Sem. Exam:50 Marks

Course Prerequisites: Basic electrical systems and basic transforms such as Laplace and Z transforms.

Course Objective:
This course introduces the basics of control systems and their modeling using a variety of methodologies. This course aims to examine systems in the time and frequency domains and predict their stability.

Course Outcome:
After successful completion of the course, students will able to:

CO1. Obtain the transfer function of control systems using Block Diagram and signal Flow Graph.
CO2. Analyze the control system in time and frequency domain.
CO3. Analyze the control system using state space analysis.
CO4. Describe the concept of PID controllers and PLC.

Course Contents

UNIT-I	Basics of Control System and Mathematical Modeling:	06 Hours

Basic Elements of Control System, Open loop and Closed loop systems, Basics of Transfer function, Modeling of Electrical systems, Block diagram reduction techniques, Signal flow graph representation.

UNIT-II	Time Domain Analysis:	06 Hours

Basic terminologies of time domain analysis, types of standard inputs, steady state analysis: static error coefficient method and TYPE of systems, Time response analysis of First and second order systems, Transient specifications of second order systems.

UNIT-III	Stability Analysis:	06 Hours

Concept of Stability, types of stability, Routh-Hurwitz Criterion, Root Locus technique, Construction of Root Locus, stability determination using root locus techniques.

UNIT-IV	Frequency Domain Analysis:	06 Hours

Need of Frequency domain analysis, correlation between time domain and frequency domain analysis, Frequency Domain specifications, Bode Plot, Nyquist Plot, stability analysis using Bode plot and Nyquist plot.

UNIT-V	State Space Analysis:	06 Hours

State space advantages and representation, Transfer function from State space model, physical variable form, phase variable forms: controllable canonical form, observable canonical form, Solution of

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homogeneous state equations, state transition matrix and its properties, computation of state transition matrix by Laplace transform method, Concepts of Controllability and Observability.		
UNIT-VI	**PID Controller and PLC:**	**06 Hours**
Introduction to P, PI, PD and PID controllers, Characteristics and step response. Introduction to Programmable Logic Controller, architecture of PLC, Ladder programming for logical GATES.		

Text Books:

T1 Nagrath, M. Gopal "Control System Engineering", 6th Edition. New Age International Publishers.

T2 Benjamin C. Kuo, "Automatic Control Engineering", 7th Edition Prentice Hall of India Pvt. Ltd.

Reference Books:

R1. K. Ogata, "Modern Control Engineering", 5thEdition ,Prentice Hall of India Pvt. Ltd.

R2. M. Gopal, "Digital Control and State Variable Methods", Tata McGraw-Hill.

R3. M. N. Bandyopadhyay, "Control Engineering – Theory and Practice", Prentice Hall of India Ltd. Delhi.

R4. Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", Addison – Wesley, 1999.

R5. John J. D'Azzo& Constantine H. Houpis, "Linear Control System Analysis and Design", Tata McGraw-Hill, Inc., 1995.

NPTEL Video Links

Topic Title	NPTEL video Link
Introduction to control system	http://nptel.ac.in/courses/108103007/1
Types ofcontrol system	http://nptel.ac.in/courses/108103007/3
Signal flow graph	http://nptel.ac.in/courses/108103007/14
Time response analysis of First Order Systems	https://www.youtube.com/watch?v=r8LUG7p8QXo
Time response analysis of Second Order Systems	https://www.youtube.com/watch?v=KwUlz5MZuXM
Steady State Errors	https://www.youtube.com/watch?v=c5Rmoxt9-kM
rise time, peak time, peak overshoot, settling time and steady state error	https://www.youtube.com/watch?v=FU8bzKweMQg
Numericals on Root Locus	http://lpsa.swarthmore.edu/Root_Locus/RLocusExamples.html
Bode Plot	http://nptel.ac.in/courses/108101037/41
Nyquist Plot	http://nptel.ac.in/courses/108101037/39
State Space Analysis	https://www.youtube.com/watch?v=xajgSUci9zs
PID controllers	https://youtu.be/-To4nPh-N2A?list=PL874F91C0180417C3
Programmable Logic Controller	https://nptel.ac.in/courses/108105088

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T. Y. B. Tech (E&TC Engineering)
Academic Year – 2025-2026 Semester -V
[EC3204TA]: Program Elective I-Digital Signal Processing

Teaching Scheme:	Credit	Examination Scheme:
TH: - 03 Hours/Week	TH:03	In Sem. Evaluation:20 Marks Mid Sem. Exam:30 Marks End Sem. Exam:50 Marks

Course Prerequisites : Signals and Systems/ Basic signals, classification of signals and systems, time domain to frequency domain Transformation.

Course Objective:
This course introduces students with transforms for analysis of Discrete time signals and systems. It aims to understand the digital signal processing, sampling and aliasing. It gives insights of use and implementation of digital filters.

Course Outcome:
After successful completion of the course, students will able to:
CO1: Describe the fundamental concepts and properties of Z-transform, FIR/IIR filter design, and multirate signal processing.
CO2: Explain the significance of different transforms and filter design techniques in DSP applications.
CO3: Apply Z-transform, filter design methods, and sampling techniques to analyze discrete-time signals and systems.
CO4: Analyze the performance of digital filters, DSP processors, and multirate systems for real-time signal processing **tasks.**

Course Contents

UNIT-I	Z-Transform and Discrete System Analysis	08 Hours

Z-Transform, Properties of the Z-Transform, Inversion of the Z-Transforms (by Power Series Expansion, by Partial-Fraction Expansion), Analysis of Linear Time-Invariant Systems in the z-Domain, Response of Systems with rational System Functions, Transient and Steady-State Responses, Causality and Stability.

UNIT-II	IIR Filter Design	08 Hours

Concept of analog filter design, IIR filter design by approximation of derivatives, IIR filter design by impulse invariance method, Bilinear transformation method, warping effect. Butterworth filter design, Characteristics of Butterworth filters, IIR filter realization using direct form, cascade form and parallel form

UNIT-III	FIR Filter Design	08 Hours

Ideal filter requirements, Gibbs phenomenon, windowing techniques, characteristics and comparison of different window functions, Design of linear phase FIR filter using windows and frequency Magnitude

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and Phase response of Digital filters, FIR filters realization using direct form, cascade form.		
UNIT-IV	**Introduction to Multirate signal processing**	**06 Hours**
Introduction, Down Sampling, Decimation, Up sampling, Interpolation, Sampling Rate Conversion, Concept of Multirate, Basics of Digital Filter Banks. Adaptive filters: Introduction, Basic principles of Forward Linear Predictive filter and applications such as system identification, echo cancellation, equalization of channels, Image processing		
UNIT-V	**Introduction to DSP Processors**	**06 Hours**
Introduction to programmable DSPs: Multiplier and Multiplier Accumulator (MAC), Architectures, Pipelining, Special addressing modes, On-Chip Peripherals. Architecture of TMS 320C5X: Introduction, Bus Structure, Central Arithmetic Logic Unit, Parallel Logic Unit, Memory mapped registers, on- chip registers, On-chip peripherals.		
UNIT-VI	**Introduction to Artificial Intelligence Techniques in Signal Processing**	**06 Hours**
Introduction to AI/ML in DSP, Feature Extraction Techniques: Time-domain features(Mean, RMS, Zero-Crossing Rate), Frequency-domain features(FFT, Power Spectral Density), Introduction to Machine Learning Models (Supervised & Un Supervised), AI-based Signal Classification, ECG Signal Classification using k-NN, Audio Signal Classification (Speech vs Music)		
Note: Minor Project /Case study: Implementation of any one idea of signal processing in real time application open source software. (ISA)		

Text Books:

T1 John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing: Principles, algorithms and applications", Fourth edition, Pearson Prentice Hall.

T2 S. Salivahanan, C. Gnanpriya, "Digital Signal processing", McGraw Hill

T3 Digital Signal Processing – A computer-based Approach, S.K.Mitra, Tata McGraw Hill,3rd edition,2006

T4 Digital Signal Processors, Architecture, programming, and applications by B. Venkatramani, M Bhaskar, Mc-Graw Hill

Reference Books:

R1. Ifaeachor E.C,Jervis B. W., "Digital Signal processing : Practical approach", Pearson publication.

R2. Li Tan, Jean Jiang, "Digital Signal Processing : Fundamentals and applications", Academic press.

R3. Dr. Shaila Apte, "Digital Signal Processing", Wiley India Publication, second edition.

R4. K.A. Navas, R. Jayadevan, Lab Primer through MATLAB, PHI.

R5. For Lab http://vlabs.iitkgp.ac.in/dsp/ and https://sakshat.ac.in/

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T.Y.B. Tech (E&TC Engineering)

Academic Year – 2025-2026 Semester -V

[EC3204TB]: Information Theory & Coding Techniques

Teaching Scheme:	Credit	Examination Scheme:
TH: - 03Hours/Week	TH:03	In Sem. Evaluation :20 Marks Mid Sem. Exam:30 Marks End Sem. Exam:50 Marks

Course Prerequisites: Probability theory, field theory and random signal probability distribution

Course Objective:

Introduce the principles and applications of information theory. To teach study how information is measured in terms of probability and entropy, and the relationships among conditional and joint entropies. To teach coding schemes, including error correcting codes. To develop an understanding of different components of computer networks, various protocols, modern technologies, and their applications.

Course Outcome:

After successful completion of the course, students will able to:

CO1: Illustrate the concept of information using strong mathematical reasoning

CO2: Interpret the need & use of different coding techniques for data compression & reliable transmission.

CO3: Relate the fundamental principles of data communication for source coding & channel coding techniques.

CO4: Analyze the different lossless /lossy source codes & error correcting codes

Course Contents

UNIT-I	Information Theory & Source Coding	07 Hours

Introduction to information theory, Entropy and its properties, Source coding theorem, Huffman coding, Shannon-Fano coding, The Lempel Ziv algorithm, Run Length Encoding, Discrete memory less channel, Mutual information, Examples of Source coding- (Audio and Video Compression).

UNIT-II	Information Capacity & Channel Coding	06 Hours

Channel capacity, Channel coding theorem, Mutual Information for continuous ensembles, Information Capacity theorem, Binary Symmetric Channel, Shannon Hartley Theorem.

UNIT-III	Linear Block Code	07 Hours

Systematic linear codes and optimum decoding for the binary symmetric channel; Generator and Parity Check matrices, Syndrome decoding on symmetric channels; Hamming codes; Weight enumerators and the MacWilliams identities; Perfect codes. Encoding and decoding circuit, Single parity check codes, Repetition codes and dual codes, Interleaved code.

UNIT-IV	Cyclic Code	07 Hours

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Systematic cyclic codes and optimum decoding for the binary symmetric channel; Generator and Parity Check matrices, Syndrome decoding on symmetric channels; Fire code, Justeen Code, MIDS Code.		
UNIT-V	**BCH and RS Codes**	**08 Hours**
Binary BCH code, Generator polynomial for BCH code, Decoding of BCH code, RS codes, generator polynomial for RS code, Decoding of RS codes, Cyclic Hamming code and Golay code.		
UNIT-VI	**Convolution Code**	**07 Hours**
Introduction of convolution code, Polynomial description of convolution code, Generator Matrix of convolution code, State diagram, Tree diagram, Trellis diagram, Sequential decoding and Viterbi decoding,Known good convolution code, Trellis Coded Modulation, Turbo code.		

Text Books:

T1 Simon Haykin, "Communication Systems", John Wiley & Sons, Fourth Edition

T2 Ranjan Bose," Information Theory coding and Cryptography", Mc Graw-Hill. 2nd Ed

Reference Books:

R1. Murlidhar Kulkarni, K.S. Shivaprakasha," Information Theory & Coding", Wiley Publications

R2. Shu Lin and Daniel J. Costello Jr., "Error control Coding" Pearson, 2nd Edition.

R3. Todd Moon, "Error Correction Coding: Mathematical Methods and Algorithms", Wiley Publication

R4. Arijit Saha, "Information Theory, Coding & Cryptography", 1st edition, Pearson Education, 2013.

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T. Y. B. Tech (E & TC Engineering)

Academic Year – 2025-2026 Semester –V

[EC3201L]: Advanced Embedded and Real Time Operating Systems Lab

Teaching Scheme: PR: - 02 Hours/Week	Credit PR:01	Examination Scheme: Practical Exam :50 Marks

Course Prerequisites: Microprocessor & Microcontroller concepts and applications, Assembly language concepts, C programming, Computer architecture and operating system.

Course Objective:
This Course will give the insights of architecture, instruction set and programming aspects of ARM Processor. It also provides basics of operating systems, terms related to real time operating systems, features and its applications.

Lab Outcome:
After successful completion of the course, students will able to:
LO1. Define the HAL library and explain peripheral configuration along with the architecture and development tools of ARM Cortex-M series microcontrollers.
LO2. Describe interfacing techniques of various peripheral devices with the ARM Cortex-M microcontroller family.
LO3. Develop and implement real-time embedded systems using IDEs such as MATLAB and CUBEMX on ARM Cortex-M series controllers.
LO4. Evaluate and analyse the performance of various implemented system.

Lab Contents

Guidelines for Assessment

- Total marks assigned are 50.
- Continuous assessment will be carried out based on attendance, lab performance, and timely submission of lab file for 20 Marks, Mid semester examination 10 Marks on Viva Voce or Viva Voce + Micro project or Viva Voce + any one practical performance on the practical up to mid semester.
- Final practical examination for specific practical and oral examination will be conducted for 20 Marks.

List of Laboratory Assignments/Experiments (minimum 8 to be covered)

1	Understanding of HAL library concept and familiarization of STM32 cube.
2	Set up and configure an ARM Cortex M series microcontroller. Write a program to toggle an LED using GPIO pins.
3	Design a four-digit binary counter that increments continuously while the switch is pressed and pauses when the button is released. Display the count using LEDs (4Nos).
4	Use ADC to read sensor data and output it through a DAC or UART.
5	Design an analog temperature range indicator using LM35s with different colour

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	indicator.
6	Create priority structure for multiple task (e.g., one for LED blinking and another for UART communication).
7	Develop Bluetooth (UART)-based home automation system for one real time event.
8	Implement a PID-based motor control system using ARM Cortex M series processor and FreeRTOS, where the task adjusts motor speed using PWM based on a sensor input (e.g., temperature sensor, potentiometer).
9	Simulate and execute a given real-time system, generate C code, and test the code on the ARM Cortex M series controller platform.
10	Design and implement camera interfacing with ARM Cortex M series controller.
11	Simulate and execute LED Blinking using MATLAB Simulink and Hardware.
12	Develop Model Based Design for temperature control, generate code, and deploy it on ARM Cortex M series controller.
13	Design a temperature control system using MBD, generate code, and deploy it on ARM Cortex M series controller.

Text Books:

T1 Jean J.Labrosse, ―MicroC OS II, The Real-Time Kernel‖, 2nd edition, CMP Books.

T2 Christopher Hallinan, "Embedded Linux Primer -A Practical, Real-World Approach "2ndedition, Prentice Hall.

Reference Books:

R1. E-book: ARM System Developer's Guide by Andrew N. SLoss, Dominic Symes, Chris Wright.

R2. Embedded Systems: Architecture, Programming and design, Raj Kamal, Second Edition

a. Tata McGraw Hill publisher, 2010

R3. STM 32 ARM Programming for embedded systems, Muhammad Ali Mazidi

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T. Y. B. Tech (E & TC Engineering)

Academic Year – 2025-2026 Semester –V

[EC3202L]: Electromagnetic Waves and Radiating Systems Lab

Teaching Scheme: PR: - 02 Hours/Week	Credit PR:01	Examination Scheme: Practical Exam :50 Marks

Course Prerequisites: Basic mathematical concepts related to electromagnetic vector fields.

Course Objective:

To introduce the basic mathematical concepts related to electromagnetic fields. To impart knowledge on the concepts of Faraday's law, induced e.m.f. and Maxwell's equations. To analyze and understand the Uniform plane wave propagation in various media and transmission lines. To identify and analyze various antennas according to radiation characteristics and applications.

Lab Outcome:

After successful completion of the course, students will able to:

LO1: To analyse antenna pattern
LO2: To analyse antenna parameters
LO3: To simulate various antennas

Lab Contents

Guidelines for Assessment

- Total marks assigned are 50.
- Continuous assessment will be carried out based on attendance, lab performance, and timely submission of lab file for 20 Marks, Mid semester examination 10 Marks on Viva Voce or Viva Voce + Micro project or Viva Voce + any one practical performance on the practical up to mid semester.
- Final practical examination for specific practical and oral examination will be conducted for 20 Marks.

List of Laboratory Assignments/Experiments (minimum 8 to be covered)

1	To study Dipole Antenna and analyze its performance parameters
2	To Analyze Directivity pattern of Folded dipole antenna.
3	To Analyze Yagi-Uda antenna directivity pattern
4	To study and Analyze Microstrip antenna
5	To Analyze parameters of Parabolic Reflector antenna
6	To Simulate halfwave dipole antenna
7	To Analyze and Simulate Folded dipole antenna
8	To Simulate parabolic reflector antenna
9	To Analyze and Simulate Yagi-Uda antenna array (3 or 5 elements)

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Text Books:

T1 John D Kraus, Ronald J Marhefka, Ahmad S Khan, "Antenna and Wave Propagation",TataMcGraw Hill, 4th Edition, 2010.

T2 K. D. Prasad, "Antenna & Wave Propagation",SatyaPrakashan, New Delh

Reference Books:

R1. R.L.Yadava, "Antennas and Wave Propagation", PHI,2011.

R2. ConstantineA.Balanis, "Antenna Theory: Analysis and Design", Third Edition, John Wiley and Sons, 2012.

R3. G.S.N. Raju, "Antennas and wave propagation", 1st Edition Pearson Education, 2012.

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Academic Year – 2025-2026 Semester -V

[EC3204LA]: Program Elective I-Digital Signal Processing Lab

Teaching Scheme: PR: - 02 Hours/Week	Credit PR:01	Examination Scheme: Lab Evaluation:50 Marks

Course Prerequisites: Signals and Systems/ Basic signals, classification of signals and systems, time domain to frequency domain Transformation

Course Objective:

This course introduces students with transforms for analysis of Discrete time signals and systems. It aims to understand the digital signal processing, sampling and aliasing. It gives insights of use and implementation of digital filters.

Course Outcome:

After successful completion of the lab, students will able to:

LO1: Apply discrete-time signal processing techniques such as convolution, DFT, and system realization using MATLAB or equivalent tools.

LO2: Analyze the properties of LTI systems using pole-zero plots, system functions, and multirate signal operations to assess system behavior.

LO3: Design and implement digital filters (IIR and FIR) using methods such as bilinear transformation and windowing techniques.

LO4: Evaluate and compare the performance of various filter design methods and system implementations based on frequency response and computational efficiency.

LO5: Create and simulate DSP-based applications or hardware interfaces using processors or virtual labs to demonstrate real-time signal processing.

Lab Contents

Guidelines for Assessment

- Total marks assigned are 50.
- Continuous assessment will be carried out based on attendance, lab performance, and timely submission of lab file for 20 Marks, Mid semester examination 10 Marks on Viva Voce or Viva Voce + Micro project or Viva Voce + any one practical performance on the practical up to mid semester.
- Final practical examination for specific practical and oral examination will be conducted for 20 Marks.

List of Laboratory Assignments/Experiments (minimum 8 to be covered)

1	Write a program to find 4 point circular convolution using both traditional method and properties.
2	Write a program to study and verify DFT properties
3	Plot pole-zero diagram and determine ROC, causality, and stability of a system.

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4	Design and implement a Butterworth IIR filter using the bilinear transformation method
5	Compare the performance of different window functions in FIR filter design
6	Write a program for Direct form – I, II form realization of the given IIR system function.
7	To design a second-order digital Butterworth bandpass filter in MATLAB and plot its magnitude and phase response, follow the step-by-step guide below.
8	Analyze a multirate system by executing downsampling and upsampling operations on a discrete-time signal using MATLAB.
9	Simulate a DSP-based real-time audio application, e.g., simple noise removal or echo cancellation
10	Study assignment to interface DSP processor like TMS320C6748 0R STM DSP Processor with GLCD
11	Simulate one experiment from website: http://vlabs.iitkgp.ac.in/dsp/ .

Text Books:

T1 John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing: Principles, algorithms and applications", Fourth edition, Pearson Prentice Hall.

T2 S. Salivahanan, C. Gnanpriya, "Digital Signal processing", McGraw Hill.

Reference Books:

R1. IfaeachorE.C,Jervis B. W., "Digital Signal processing : Practical approach", Pearson publication.

R2. Li Tan, Jean Jiang, "Digital Signal Processing : Fundamentals and applications", Academic press.

R3. Dr. Shaila Apte, "Digital Signal Processing", Wiley India Publication, second edition.

R4. K.A. Navas, R. Jayadevan, Lab Primer through MATLAB, PHI.

R5. For Lab **http://vlabs.iitkgp.ac.in/dsp/ and https://sakshat.ac.in/**

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T. Y. B. Tech (E&TC Engineering)
Academic Year – 2025-2026 Semester –V
[EC3204LB]: Program Elective I- Information Theory & Coding Techniques Lab

Teaching Scheme: PR: - 02 Hours/Week	Credit PR:01	Examination Scheme: Lab Evaluation:50 Marks

Course Prerequisites: Probability theory, field theory and random signal probability distribution

Course Objective:
Introduce the principles and applications of information theory. To teach study how information is measured in terms of probability and entropy, and the relationships among conditional and joint entropies. To teach coding schemes, including error correcting codes. To develop an understanding of different components of computer networks, various protocols, modern technologies, and their applications.

Course Outcome:
After successful completion of the lab, students will able to:
LO1: Illustrate the concept of information using strong mathematical reasoning
LO2: Interpret the need & use of different coding techniques for data compression & reliable transmission.
LO3: Relate the fundamental principles of data communication for source coding & channel coding techniques.
LO4: Analyze the different lossless /lossy source codes & error correcting codes

Lab Contents

Guidelines for Assessment

- Total marks assigned are 50.
- Continuous assessment will be carried out based on attendance, lab performance, and timely submission of lab file for 20 Marks, Mid semester examination 10 Marks on Viva Voce or Viva Voce + Micro project or Viva Voce + any one practical performance on the practical up to mid semester.
- Final practical examination for specific practical and oral examination will be conducted for 20 Marks.

List of Laboratory Assignments/Experiments (minimum 8 to be covered)

1	Write program for Information Rate and Entropy calculation for Discrete Memoryless Source.
2	Write a program for generation and evaluation of variable length source coding using C/MATLAB for Shannon fano algorithm and Huffman algorithm
3	Write a program for determination of various entropies and mutual information of a

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	given channel. Test various types of channel such as a) Lossless Channel b) Deterministic Channel c) Binary symmetric channel d) Noiseless channel Compare channel capacity of above channels.
4	Write a Program for coding & decoding of Linear block codes.
5	Write a Program for coding & decoding of Cyclic codes.
6	Write a program for coding and decoding of convolution codes
7	Write a program for coding and decoding of BCH codes.
8	Write a program for coding and decoding of RS codes.
9	Implementation of any compression algorithm for either audio, image or video data.

Text Books:

T1 Simon Haykin, "Communication Systems", John Wiley & Sons, Fourth Edition

T2 Ranjan Bose," Information Theory coding and Cryptography", Mc Graw-Hill. 2nd Ed

Reference Books:

R1. Murlidhar Kulkarni, K.S.Shivaprakasha," Information Theory & Coding", Wiley Publications

R2. Shu Lin and Daniel J. Costello Jr., "Error control Coding" Pearson, 2nd Edition.

R3. Todd Moon, "Error Correction Coding: Mathematical Methods and Algorithms", Wiley Publication

R4. Arijit Saha, "Information Theory, Coding & Cryptography", 1st edition, Pearson Education, 2013.

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T. Y. B. Tech (E&TC Engineering)
Academic Year – 2025-2026 Semester -V
[EC3205L]: Co-curricular Course-III

Teaching Scheme:	Credit	Examination Scheme:
PR: - 02 Hours/Week	PR:01	Lab Evaluation:50 Marks

Course Objective:
To provide students the opportunity to better explore their interests and to groom overall personality, apart from academic ability.

Course Outcome:
Students will be able to
CO1: Broaden students' breadth of knowledge and horizons.
CO2: Stimulate out of the box thinking, self-reflection, and self-understanding to promote their individual growth.
CO3: Build solid foundation for "Whole Person Education" which will nurture and foster the holistic development

Course Contents

List of Extra curricular activities:
Leadership Work and Positions
Sports and Athletic Participation
Academic Clubs and Teams/ Professional student chapters
Artistic and Creative Pursuits
Volunteering and Community Service
Internships

Rules & Regulations:

- All the first year students should enroll in one of the Extra-Curricular Activities
- Students opting for Sports / Games / Yoga / Martial Arts / Dance can continue the same activity in the I/II/III/IV/V/VI/VII/VIII semester or can choose another activity
- Every week, any day last 2 hours are given for Cocurricular activity.
- Minimum of 50% attendance is required for these activities.
- In-charge faculty coordinator monitor the students and take the attendance.
- At the end of the year the attendance is submitted to the Attendance Committee and finally to the Exam Section.
- Students are given grades credits in the final memorandum.
-

Guideline for grading Co/Extra-Curricular Activity

- RSCOE shall organized various competitions through its various clubs (governed by either by Student

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Affairs pr Department) during the semester and academic year.

- All UG students shall choose at least ONE activity/event from the group of Co-curricular and Extra-curricular activities happening on campus or off campus during the semester. The student shall take active part in the activity, take part in competitions, and earn grade points.
- On registering for a particular activity, the performance of a student shall be continuously monitored by the Faculty-in-charge.

RSCOE plans club activities into three categories.

1. Art Club
2. Technical Club
3. Sports and Games
4. SWAYAM

- Art club include various clubs related to liberal arts, music, performing arts etc.
- Technical club include chapters of professional societies like SAE,ASRAE,ISHRAE,CSI,RSI,IEEE, ISTE, IET, Department Associations, Shashwat (socio-technical club),Rotaract, ASCE,ICI etc.
- National Service Scheme (NSS) and Similar activities such as Unnat Bharat, Social Work, Blood donation etc.
- SWAYAM portal offers some self-paced courses related with YOGA such as Physical Activity (YOGA) (योग) or approved by Dean concern.
- Participation in competitions, winning prizes, representing institute on state, national and international level etc shall get weightage as mentioned in the Annexure I and rubrics for same ids designed
- All competition to which Academic credit is concerned, shall have set of guidelines and rubrics defined by the department or Student Affair or concern faculty in charges.
- Few examples of Competition/Activity and is given in Annexure II

Annexure I: Assessment Rubrics:

Table A Rubrics for Assessment for Clubs Sports and cultural events(@UG Level)

		Clubs/Activity				Marks*	Grade point	Letter Grade
	• **Art clubs** • **Technical Clubs** • **Sports** • **Any other competition/activity defined by institute/ department.**	**NSS/NCC/Unnat Bharat Abhiyan**	**Participation in events outside of the institutes**	**SWAYAM Courses(only4 week course approved Dean concern)**	**Leadership & Management of clubs/activities/ Student Professional Societies/Institute Festival & Technical Events etc**			
	I Prize winner, II Prize Winner, III winner	Best NSS/NCC Volunteer Awardee (State/National level) / Participation in Republic Day Parade Camp/International	I Prize winner, II Prize Winner, III Prize Winner	As reflected in grade sheet	Top level management	50-45	10	O

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	Youth Exchange Programme, Supported by certification							
Active Participation (High)	Active Participation (High)	Selection in such events supported By certification		Middle level management	40-35	9	A+
					35-30	8	A
Active Participation (Medium)	Active Participation (Medium)			Lower-level management	30-25	7	B+
					25-20	6	B
Active Participation (low)	Active Participation (low)				20-15	5	C
					12	4	P
Not participate	Not participate	-		-	0	0	F

*Various clubs different marking system, however, it can be scaled down to 50 and assign credit accordingly.

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SEM-VI

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T. Y. B. Tech (E&TC Engineering)
Academic Year – 2025-2026 Semester -VI
[EC3206T]: VLSI Design & Technology

Teaching Scheme:	Credit	Examination Scheme:
TH: - 03 Hours/Week	TH:03	In Sem. Evaluation:20 Marks Mid Sem. Exam:30 Marks End Sem. Exam:50 Marks

Course Prerequisites: Digital system, MOSFET characteristics, Bipolar junction transistor and diode.

Course Objective:
To bring both Circuits and System views on design together. It offers a profound understanding of the design of complex digital VLSI circuits, computer aided simulation and synthesis tool for hardware design.

Course Outcome:
After successful completion of the course, students will able to:
CO1: Describe the fundamental concepts of MOSFET and processes involved in the fabrication of CMOS circuits.
CO2: Apply knowledge of real-time issues in digital design
CO3: Develop effective HDL codes for digital design.
CO4: Design CMOS circuits for specified applications.

Course Contents

UNIT-I	Design with HDL	08 Hours

Design Flow, Language constructs, Data objects, Data types, Entity, Architecture & types of modeling, Sequential statements, Concurrent statements, Packages, Sub programs, Attributes, HDL modeling of Combinational, Sequential circuits and FSM. Simulations, Synthesis, Efficient coding styles, Hierarchical and flat designs, Partitioning for synthesis, Pipelining, Resource sharing.

UNIT-II	Digital Design and Issues	07 Hours

Sequential synchronous machine design, Moore and Mealy machines, HDL code for Machines, FIFO. Meta-stability and solutions. Noise margin, Fan-out, Skew, Timing considerations, Hazards, Clock distribution, Clock jitter, Supply and ground bounce, Power distribution techniques, Power optimization. Interconnect routing techniques, Wire parasitic, Signal integrity issues. I/O architecture.

UNIT-III	Digital CMOS Circuits	07 Hours

N-MOS, P-MOS and CMOS. MOSFET parasitic, Technology scaling, Channel length modulation, Hot electron effect, Velocity saturation. CMOS Inverter, Device sizing, CMOS combinational logic design, Power dissipations, Power delay product, Body Effect, Rise and fall times, Latch Up effect, Transmission gates.

UNIT-IV	MOSFET Layout	08 Hours

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CMOS fabrication and layout: inverter cross-section, fabrication process, Layout design rule, gate layout, stick diagram, circuit extraction, Electrical rule check, Layout v/s schematic, post layout simulation and parasitic extraction, SRAM, and D Flip flop CMOS circuit. Transmission gate.		
UNIT-V	**Performance Parameters**	**06 Hours**
Propagation delay, Power delay product, Fan in, fan out and dependencies. Delay Estimation: RC Delay Models, Linear Delay Model, Logical Effort, Parasitic Delay. Logical Effort and Transistor Sizing: Delay in a Logic Gate, Delay in Multistage Logic Networks, Interconnect: Resistance, Capacitance, Delay, Crosstalk. Design Margin.		
UNIT-VI	**VLSI Testing and Analysis**	**06 Hours**
Types of fault, Need of Design for Testability (DFT), DFT Guideline, Testability, Fault models, Path sensitizing, Test pattern generation, Sequential circuit test, Built In Self Test, JTAG & Boundary scan, TAP Controller.		

Text Books:

T1. Charles H. Roth, ―Digital systems design using VHDL‖, PWS.

T2. E. Weste, David Money Harris, ―CMOS VLSI Design: A Circuit &System Perspective‖, Pearson Publication.

Reference Books:

R1. Kang, Sung-Mo, and Yusuf Leblebici. *CMOS digital integrated circuits*. Tata McGraw - Hill Education, 2003.

R2. R. Jacob Baker, ―CMOS Circuit Design, Layout, and Simulation‖, 3E, Wiley-IEEE Press.

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T. Y. B. Tech (E&TC Engineering)
Academic Year – 2025-2026 Semester -VI
[EC3207T]: Internet of Things

Teaching Scheme:	Credit	Examination Scheme:
TH: - 02 Hours/Week	TH:02	In Sem. Evaluation:20 Marks Mid Sem. Exam:30 Marks End Sem. Exam:50 Marks

Course Prerequisites: Object oriented Programing and Big data.

Course Objective:
This course provides the strong foundation of fundamentals of IOT with different sensors. Get acquainted with communication protocols on different applications of IOT Ecosystems.

Course Outcome:
After successful completion of the course, students will able to:
CO1: Summarize fundamental concepts of internet of things.
CO2: Describe various sensors, actuators, and protocols to meet requirements of an industrial applications.
CO3: Design different Realtime IoT based application systems.
CO4: Analyze performance parameters of IoT based systems.

Course Contents

UNIT-I	Overview of IOT	06 Hours

Internet of Things: Need, Definition and characteristics, Architecture: client-server architecture, P2P, M2M, Physical and Logical design, Frameworks, IOT levels, IOT vs M2M, Different software and hardware platforms for development.

UNIT-II	Wireless Sensors Networks and Actuators	07 Hours

Introduction to Wireless Sensor Network, Classification, Architecture of WSN. WSN Vs. IOT, Types of Sensors: - Definition, characteristics, types and their working- Soil moisture sensor, DHT11, Ultrasonic sensor, PIR sensor, sound sensor, color sensor, accelerometer, Gyroscope, magnetometer etc. Actuator- Definition, characteristics, types and their working- LED, Relay, DC motor, LCD etc

UNIT-III	Embedded Suite for IoT	08 Hours

Introduction to Arduino, ESP32 and Raspberry Pi, NodeMCU, - Their versions, models, physical design, specifications, GPIO pin structure, OS requirement, capabilities, reading datasheet, Interfacing with different sensors and actuators, Programming's, APIs/Packages, Web Services etc.

UNIT-IV	Wireless Technologies and IP based protocols supporting IoT	08 Hours

IEEE 802.15.4, Zigbee, Wireless HART, Z-Wave, Bluetooth, Low Energy, RFID, ZigBee Connecting Protocols: IPv4, IPv6, 6LoWPAN, RPL, REST, AMPQ, CoAP, MQTT, comparison of Bluetooth and BLE CoAP and MQTT.

UNIT-V	Data Handling& Analytics	07 Hours

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Bigdata, Types of data, Characteristics of Big data, Data handling Technologies, Introduction to Hadoop and cloud computing, Role of Cloud Computing in IoT, Introduction to data Analytics, Types of Data analytics.		
UNIT-VI	**Domain Specific Applications of IOT**	**04 Hours**
Home automation, smart cities, smart grid, Agriculture, Health & Lifestyle, Various Real time applications of IOT- Connecting IOT to cloud.		

Text Books:

T1 W. Boltan ―Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering‖ 6th Edition, Pearson Education, 2016.

T2 David Alciatore and MaichaelB Histand, ―Introduction to Mechatronics and Measurement Systems‖,4th Edition, Tata McGraw Hill 2013.

T3 Arshdeep Bahga, Vijay Madisetti, Internet of Things: A Hands-On Approach, Universities Press, 2015. ISBN: 978-8173719547

T4 Olivier Hersent, David Boswarthick, and Omar Elloumi, ―The Internet of Things: Key

Reference Books:

R1. Nitaigour P. Mahalik ,‖ Mechatronics-Principles, Concepts and Applications‖, Tata McGraw Hill, Eleventh reprint 2011.

R2. Devdas Shetty and Richard A.Kolk, ―Mechatronics System Design‖, Thomson India Edition 2007.

R3. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", (CRC Press)

R4. Hakima Chaouchi, ― The Internet of Things Connecting Objects to the Web‖ ISBN: 978-1-84821- 140-7, Wiley Publications Platforms, and Use Cases", (CRC Press).

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T. Y. B. Tech (E&TC Engineering)

Academic Year – 2025-2026 Semester -VI

[EC3208TA]: Program Elective-II-Biomedical Instrumentation

Teaching Scheme:	Credit	Examination Scheme:
TH: -3 Hours/Week	TH:3	In Sem. Evaluation:20 Marks Mid Sem. Exam:30 Marks End Sem. Exam:50 Marks

Prerequisites Courses: Knowledge of basic electronics, analog & digital electronics

Course Objective:

To familiarize students with various aspects of measuring electrical parameters from living body. To introduce students with the characteristics of medical instruments and related errors. To illustrate various types of amplifiers used in biomedical instruments. To familiarize students with biomedical recording devices. To introduce students with patient monitoring systems & their characteristics

Course Outcome: At the end of this course, students will be able to

CO1: Describe the origin of bio-potentials and common biomedical signals by their characteristics.
CO2: Discuss PC based medical instrumentation system and various patient monitoring healthcare systems.
CO3: Illustrate the medical instruments with their specifications, static-dynamic characteristics and errors.
CO4: Design pre-amplifiers and bioelectric amplifiers of biomedical instrumentation system.

Course Contents

UNIT-I	Medical Instrumentation	06 Hours

Sources of Biomedical Signals, Basic medical Instrumentation system, Performance requirements of medical Instrumentation system, Microprocessors in medical instruments, PC based medical Instruments, General constraints in design of medical Instrumentation system, Regulation of Medical devices.

UNIT-II	Measurement systems:	06 Hours

Specifications of instruments, Static & Dynamic characteristics of medical instruments, Classification of errors, Statistical analysis, Reliability, Accuracy, Fidelity, Speed of response, Linearization of technique, Data Acquisition System.

UNIT-III	Bioelectric signals and Bioelectric amplifiers	08 Hours

Origin of bioelectric signals, Electrodes, Electrode-tissue interface, Galvanic Skin Response, BSR, Motion artifacts, Instrumentation amplifiers, Special features of bioelectric amplifiers, Carrier amplifiers, Chopper amplifiers, Phase sensitive detector.

UNIT-IV	Biomedical recording systems-I	07 Hours

Basic Recording systems, General consideration for signal conditioners, Preamplifiers, Differential Amplifier, Isolation Amplifier, Electrocardiograph, Phonocardiograph, Electroencephalograph, and

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Electromyography.		
UNIT-V	**Biomedical recording systems-II**	**07 Hours**
Digital stethoscope Other biomedical recorders, Biofeedback instrumentation, Electrostatic and Electromagnetic coupling to AC signals, Proper grounding, Patient isolation and accident prevention.		
UNIT-VI	**Patient Monitoring Systems**	**08 Hours**
System concepts, Cardiac monitor, selection of system parameters, Bedside monitors, Central monitors, Heart rate meter, Pulse rate meter, Measurement of respiration rate, Holter monitor and Cardiac stress test, Catheterization Laboratory Instrumentation , Organization and equipments used in ICCU & ITU.		

Text:

T1 R. S. Khandpur "Handbook of Bio-Medical Instrumentation", 2nd Edition, Tata McGraw Hill.
T2 J.J.Carr & J.M.Brown, "Introduction to Biomedical Equipment Technology" Pearson Education, Asia.
T3 Cromwell, Weibell& Pfeiffer, "Biomedical Instrumentation & Measurement", Prentice Hall, India

References:

R1. Joseph Bronzino, "Biomedical Engineering and Instrumentation", PWS Engg . , Boston.
R2. J.Webster, "Bioinstrumentation", Wiley & Sons.
R3. Joseph D.Bronzino, "The Biomedical Engineering handbook", CRC Press.

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T. Y. B. Tech (E&TC Engineering)

Academic Year – 2025-2026 Semester -VI

[EC3208TB]: Program Elective-II Electronics Product Design

Teaching Scheme:	Credit	Examination Scheme:
TH: - 3 Hours/Week	TH: 3	In Sem. Evaluation:20 Marks Mid Sem. Exam:30 Marks End Sem. Exam:50 Marks

Course Prerequisites:

Course Objective:

This course will give the insight of product (hardware/ software) design and development cycle. It will give the design aspects of analog and digital as well as mixed circuit. The different design tools, design cycle and importance of documentation of documents are covered in this course.

Course Outcome:

After successful completion of the course, students will able to:

CO-1: Explain various stages of hardware, software and PCB design.
CO2: Discuss the design Process and testing Methods.
CO3: Summarise software development model and their metrics.
CO4: Test and debug the designed product with different methodologies.

Course Contents

UNIT-I	Introduction to Electronic Product Design	06 Hours

Man machine dialog and Industrial design, user-centered design, five elements of successful design, cognition, and ergonomics. Packaging and factors, design for manufacture, assembly and disassembly, wiring, temperature, vibration and shock. Safety, noise, energy coupling, grounding, filtering and shielding.

UNIT-II	Hardware Design & testing methods	06 Hours

Design process. Identifying the requirements, formulating specifications, design specifications, Specifications verses requirements, System partitioning, Functional design, architectural design, Functional model verses architectural model. Prototyping. Performance and Efficiency measures. Formulating a test plan, writing specifications, Test procedure and test cases, Egoless design, design reviews. Module debug and test: black box test, white box test, grey box test.

UNIT-III	Software Design and Testing methods	06 Hours

Types of Software. Waterfall model of software development. Models, metrics and software limitations. Risk abatement and failure preventions. Software bugs and testing. Good programming practice. User interface. Embedded, Real time software.

UNIT-IV	PCB design	06 Hours

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Fundamental Definitions, Standards. Routing Topology Configurations, Layer Stack up assignment, Grounding Methodologies, Aspect Ratio, Image Planes, Functional Partitioning, Critical frequencies, Bypassing and decoupling. Design techniques for ESD Protection, Guard Band implementation.		
UNIT-V	**Product Debugging and testing**	**06 Hours**
Steps of Debugging, Techniques for troubleshooting, characterization, Electromechanical components, passive components, active components, active devices, operational amplifier, Analog-Digital Conversion, Digital Components, Inspection and test of components, Simulation, Prototyping and testing, Integration, validation and verification. EMI & EMC issues.		
UNIT-VI	**Documentation**	**06 Hours**
Definition, need, and types of documentation. Records, Accountability, and Liability. Audience. Preparation, Presentation, and Preservation of documents. Methods of documentation, Visual techniques, Layout of documentation, Bill of material.		

Text Books:

T1 Kim Fowler," Electronic Instrument Design" Oxford university press.

T2 Robert J. Herrick, "Printed Circuit board design Techniques for EMC Compliance", Second edition, IEEE press.

Reference Books:

R1. James K. Peckol, "Embedded Systems – A Contemporary Design Tool", Wiley Publication

R2. J C Whitakar," The Electronics Handbook", CRC press.

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T.Y.B. Tech (E&TC Engineering)
Academic Year – 2025-2026 Semester -VI
[EC3209TA]: Program Elective III – Industrial Automation

Teaching Scheme:	Credit	Examination Scheme:
TH: - 03Hours/Week	TH:03	In Sem. Evaluation:20 Marks Mid Sem. Exam:30 Marks End Sem. Exam:50 Marks

Course Prerequisites: Control systems types, Mechatronics, Sensors, and Actuators

Course Objective:
Student will get the ability to recognize industrial control problems suitable for PLC control. The learners will get an over view of technology of advanced topics such as SCADA and DCS Systems. Student will gain the ability to select the essential elements and practices needed to develop and implement the Engineering Automation using PLC approach

Course Outcome:
After successful completion of the course, students will able to:
CO1: Describe the basic concepts and applications of process control systems and automation engineering in industrial contexts.
CO2: Apply suitable signal conditioning techniques, controllers, and actuators to ensure accurate data acquisition in industrial applications.
CO3: Design ladder logic programming for PLC based systems to ensure reliable automation control in industrial applications.
CO4: Apply SCADA, DCS, and industrial communication protocols to develop automation solutions for industrial applications.

Course Contents

UNIT-I	Process Control & Automation	06 Hours

Process control principles, Servomechanisms, Control System Evaluation, Analog control, Digital control, Supervisory control, Direct Digital control, Types of Automation; Architecture of Industrial Automation Systems, Advantages and limitations of Automation.

UNIT-II	Transmitters and Signal Conditioning	06 Hours

Standardization of signals, Current, Voltage and Pneumatic signal standards, Need of transmitters, 2-Wire & 3-Wire transmitters, Analog and Digital signal conditioning for RTD, Thermocouple, DPT etc , Smart and Intelligent transmitters.

UNIT-III	Controllers and Actuators	06 Hours

Types of continuous controllers, P,I,D and PID Controller principle and working, PAC (Programmable automation controller), Mechanical switches, Solid state switches, Electrical actuators: Solenoids, Relays and Contactors, AC Motor, VFD, DC Motor, BLDC Motor, Stepper Motor, Servo Motor, Pneumatic and hydraulic actuators.

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UNIT-IV	Introduction to PLC	07 Hours
PLC: Characteristics, Architecture Of PLC, Applications of PLC, PC v/s PLC, PLC programming, Ladder diagram: of logic gates, multiplexer, Ladder diagram for different logical conditions or logical equations or truth table. Timers: types of timer, Characteristics, Function of timer in PLC, Classification of a PLC timer, Ladder diagram using timer, PLC counter, Ladder diagram using counter.		
UNIT-V	**Industrial Automation**	**07 Hours**
Basic Concept, History and Hierarchy of DCS, Functions of each level, Advantages and Disadvantages, Architecture of SCADA , MTU- functions of MTU, RTU- Functions of RTU, working of SCADA, Comparison, suitability of PLC, DCS and SCADA, Applications: Thermal power plant, Irrigation and Cement factory		
UNIT-VI	**Industrial Communication**	**07 Hours**
Basic Concept, Communication protocols: Device-net, Inter-bus , Device network: Foundation Field bus -H 1, HART, CAN, PROFIBUS-PA, Control network: Control-Net, FF-HSE, PROFIBUSDP, Ethernet, TCP/IP. Panel Engineering for Automation		

Text Books:

T1 Curtis Johnson, "Process Control Instrumentation Technology"; 8th Edition, Pearson Education.

T2 Madhuchhanda Mitra, Samarjit Sen Gupta, "Programmable Logic controllers and Industrial Automation"; Penram International Publishing India Pvt. Ltd.

T3 Stuart A. Boyer, SCADA supervisory control and data acquisition, ISA Publication

Reference Books:

R1. John W. Webb, Ronold A Reis, "Programmable Logic Controllers, Principles and Applications"; 5th Edition, Prentice Hall of India Pvt. Ltd

R2. Kilian, "Modern control technology: components & systems, Delmar 2nd edition

R3. Bela G Liptak, Process software and digital networks, 3rd edition, 2002.

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T. Y. B. Tech (E&TC Engineering)
Academic Year – 2025-2026 Semester -VI
[EC3209TB]: Program Elective III -Cloud Computing

Teaching Scheme:	Credit	Examination Scheme:
TH: - 03 Hours/Week	TH:03	In Sem. Evaluation:20 Marks Mid Sem. Exam :30 Marks End Sem. Exam :50 Marks

Course Prerequisites: Object oriented Programing and Big data

Course Objective:

To Study, understand the concepts and various platforms for cloud computing, to explore the applications based on cloud computing also to explore the knowledge regarding AWS cloud platform, then how to design applications for cloud and develop applications using various services, to deploy applications on cloud by using cloud native services.

Course Outcome:

After successful completion of the course, students will able to:

CO1: Summarize fundamental concepts of cloud computing.
CO2: Describe applications and future trends of cloud computing.
CO3: Construct different AWS services of clouds.
CO4: Deploy applications on cloud using cloud native services.

Course Contents

UNIT-I	Basics of Cloud Computing	06 Hours

Introduction, Benefits and Limitations, Cloud computing architecture, cloud delivery models (SAAS, PAAS and IAAS), cloud deployment models, Benefits and challenges, cloud Quality of Service (QoS) and Service Level Agreements (SLAs), Understanding SOA, overview of virtualization, challenges in X86, virtualization advantages, hypervisor / Virtual Machine Monitor, Hypervisors types, Full virtualization, Para virtualization, Hardware assist virtualization ESXi, Xen, KVM.

UNIT-II	Data Storage and Security in Cloud	06 Hours

Cloud file systems: GFS and HDFS, BigTable, HBase and Dynamo Cloud data stores: Data store and Simple DB Gautam Shrauf, Cloud Storage-Overview, Cloud Storage Providers Securing the Cloud-General Security Advantages of Cloud-Based Solutions, Introducing Business Continuity and Disaster Recovery. Disaster Recovery-Understanding the Threats.

UNIT-III	Virtualization	06 Hours

Implementation Levels of Virtualization, Virtualization Structures/Tools and Mechanisms, Types of Hypervisors, Virtualization of CPU, Memory, and I/O Devices, Virtual Clusters and Resource Management, Virtualization for Data-Centre Automation. Common Standards:The Open Cloud Consortium, Open Virtualization Format, Standards for Application Developers: Browsers (Ajax), Data (XML, JSON), Solution Stacks (LAMP and LAPP), Syndication (Atom, Atom

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Publishing Protocol, And RSS), Standards for Security.

UNIT-IV	AWS	06 Hours

Services offered by Amazon Hands-on Amazon, EC2 - Configuring a server, Virtual Amazon Cloud, AWS Storage and Content Delivery Identify key AWS storage options Describe Amazon EBS Creating anElastic Block Store Volume Adding an EBS Volume to an Instance Snap shotting an EBS Volume andIncreasing Performance Create an Amazon S3 bucket and manage associated objects. AWS Load Balancing Service Introduction Elastic Load Balancer Creating and Verifying Elastic Load Balancer.

UNIT-V	Devops fundamentals	06 Hours

Devops Tools and their usage in cloud application development. Docker and Containerization Process. Tools and Applications, Containerization Process and application. Test 3.

UNIT-VI	Cloud Application development	06 Hours

Cloud Application development/Deployment/Execution steps. Design and developing solution steps using containers-containerization of application and deployment using Kubernetes, Projects use cases covering this.

Text Books:

T1 Anthony T. Velte TobyJ. Velte, Robert Elsenpeter, "Cloud Computing: APracticalApproach",2010, McGraw-Hill.

T2 Thomas Erl "Cloud Computing Technology and Architecture" Pearson publication 2nd edition.

T3 Dr. KrisJamsa, "Cloud Computing: SaaS, PaaS, IaaS, Virtualization andmore",WileyPublications, ISBN:978-0-470-97389-9

Reference Books:

R1. R1. Dr. Kumar Saurabh, "Cloud Computing",WileyPublication, ISBN10:8126536039.

R2. BarrieSosinsky,"Cloud Computing",WileyIndia, ISBN:978-0-470-90356-8

R3. L. Wang, R. Ranjan, J. Chen, and B. Benatallah, "Cloud Computing: Methodology, Systems, and Applications", CRC Press, Boca Raton, FL, USA, ISBN: 978-143-9856-413

R4. Buyya R., Broberg J., Goscinski A., "Cloud Computing: Principles and Paradigms", John Wiley & Sons Inc., ISBN: 978-0-470-88799-8

R5. V.K. Pachghare, "Cloud Computing", PHI Publication, ISBN: 978-81-203-5213-1R6. James Turnbull, "The Docker Book: Containerization is the new virtualization", ISBN: 978-L. Wang,

R6. Ranjan, J. Chen, and B. Benatallah, "Cloud Computing: Methodology, Systems, and Applications", CRC Press, Boca Raton, FL,USA, ISBN: 978-143-9856-413.

R7. Bernard Marr, "Big Data in Practice: How 45 Successful Companies Used Big Data Analytics to Deliver Extraordinary Results", Wiley, ISBN: 978-111-9231-387.

R8. http://docs.openstack.org/

R9. http://mininet.org/

R10. **https://www.opennetworking.org/**

R11. R11. http://pubs.vmware.com/vsphere-50/index.jsp

R12. R12. https://developers.google.com/appengine/

R13. R13. http://www.windowsazure.com/en-us/

R14. R14. http://www.cloudfoundry.com/

R15. R15. http://aws.amazon.com/developers/getting-started

R16. R16. https://docs.aws.amazon.com/AWSEC2/latest/UserGuide/concepts.html

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R17.	R17. https://docs.aws.amazon.com/directoryservice/latest/adminguide/gsg_create_vpc.h

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T. Y. B. Tech (E&TC Engineering)
Academic Year – 2025-2026 Semester -VI
[EC3206L]: VLSI Design & Technology Lab

Teaching Scheme:	Credit	Examination Scheme:
PR: - 02 Hours/Week	PR:01	Lab Evaluation:50 Marks

Course Prerequisites: Digital system, MOSFET characteristics, Bipolar junction transistor and diode.

Course Objective:
To bring both Circuits and System views on design together. It offers a profound understandingof the design of complex digital VLSI circuits, computer aided simulation and synthesis tool for hardware design.

Course Outcome:
After successful completion of the course, students will able to:
LO1: Demonstrate proficiency in writing effective HDL codes for designing and simulating digital circuits.
LO2: Design, simulate, and analyze the performance of CMOS circuits CO4: Explain fabrication process of CMOS circuit.

Lab Contents

Guidelines for Assessment

- Total marks assigned are 50.
- Continuous assessment will be carried out based on attendance, lab performance, and timely submission of lab file for 20 Marks, Mid semester examination 10 Marks on Viva Voce or Viva Voce + Micro project or Viva Voce + any one practical performance on the practical up to mid semester.
- Final practical examination for specific practical and oral examination will be conducted for 20 Marks.

List of Laboratory Assignments/Experiments

1	To write VHDL code, simulate with test bench, synthesis, implement on PLD 4 bit ALU for add, subtract, AND, NAND, XOR, XNOR, OR
2	To write VHDL code, simulate with test bench, synthesis, implement on PLD sequence detector
3	To write VHDL code, simulate with test bench, synthesis, implement on PLD Traffic Light Controller
4	To write VHDL code, simulate with test bench, synthesis, implement on PLD keyboard interface.
5	To prepare CMOS layout in selected technology, simulate with and without capacitive load, comment on rise, and fall times Inverter, NAND, NOR gates.
6	To prepare CMOS layout in selected technology, simulate with and without capacitive load,

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	comment on rise, and fall times 2:1 multiplexer using logic gates and transmission gates.
7	To prepare CMOS layout in selected technology, simulate with and without capacitive load, comment on rise, and fall times Single bit SRAM cell.
8	To prepare CMOS layout in selected technology, simulate with and without capacitive load, comment on rise, and fall times D flip-flop.

Text Books:

T1 Charles H. Roth, ―Digital systems design using VHDL‖, PWS.

T2 E. Weste, David Money Harris, ―CMOS VLSI Design: A Circuit &System Perspective‖, Pearson Publication.

Reference Books:

R1. Kang, Sung-Mo, and Yusuf Leblebici. *CMOS digital integrated circuits*. Tata McGraw - Hill Education, 2003.

R2. R. Jacob Baker, ―CMOS Circuit Design, Layout, and Simulation‖, 3E, Wiley-IEEE Press.

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T. Y. B. Tech (E&TC Engineering)
Academic Year – 2025-2026 Semester -VI
[EC3207L]: Internet of Things Lab

Teaching Scheme: PR: -02 Hours/Week	Credit PR:01	Examination Scheme: Lab Evaluation :50 Marks

Course Prerequisites: Object oriented Programing and Big data

Course Objective:
This course provides the strong foundation of fundamentals of IOT with different sensors. Get acquainted with communication protocols on different applications of IOT Ecosystems.

Course Outcome:
After successful completion of the course, students will able to:
LO1: To understand basic concepts development boards and cloud platforms.
LO2: Classify the different sensors and actuators as per the functionality and application.
LO3: Design IoT system with cloud interfacing for given application.
LO4: Construct IoT systems for given case study.

Lab Contents

Guidelines for Assessment

- Total marks assigned are 50.
- Continuous assessment will be carried out based on attendance, lab performance, and timely submission of lab file for 20 Marks, Mid semester examination 10 Marks on Viva Voce or Viva Voce + Micro project or Viva Voce + any one practical performance on the practical up to mid semester.
- Final practical examination for specific practical and oral examination will be conducted for 20 Marks.

List of Experiments

1	To study all development boards and different cloud platforms.
2	Interfacing of LED and LCD with Raspberry Pi/ESP32/Arduino.
3	Interfacing of Raspberry Pi/ESP32/Arduino with DHT11.
4	Interfacing sensors to Raspberry Pi/ ESP32/Arduino board (PIR, Ultrasonic and IR).
5	IoT based Stepper Motor/DC Motor Control with Arduino/Raspberry Pi.
6	Interfacing of Raspberry Pi/ESP32/Arduino to demonstrate the Traffic Signal Control.
7	Interfacing of Rasberrypi/Arduino to Bluetooth Module.
8	Access the data pushed from sensor to cloud and apply any data analytics or visualization services.
9	Demonstrate the cloud interface with Raspberry pi/ESP32, Upload data from Environmental Sensors to Cloud Server.

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10	Mini project: - 1. Develop Case study –Garden Automation with Arduino/Raspberry-pi. 2. Develop Case study –Home Automation with Arduino/Raspberry-pi. 3. Develop Case study –Door Opener with Arduino/Raspberry-pi

Text Books:

T1 W. Boltan ―Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering‖ 6th Edition, Pearson Education, 2016.

T2 David Alciatore and MaichaelB Histand, ―Introduction to Mechatronics and Measurement Systems‖,4th Edition, Tata McGraw Hill 2013.

T3 ArshdeepBahga, Vijay Madisetti, Internet of Things: A Hands-On Approach, Universities Press, 2015. ISBN: 978-8173719547

T4 Olivier Hersent, David Boswarthick, and Omar Elloumi, ―The Internet of Things: Key

Reference Books:

R1. Nitaigour P. Mahalik,‖ Mechatronics-Principles, Concepts and Applications‖, Tata McGraw Hill, Eleventh reprint 2011.

R2. DevdasShetty and Richard A.Kolk, ―Mechatronics System Design‖, Thomson India Edition 2007.

R3. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", (CRC Press)

R4. HakimaChaouchi, ― The Internet of Things Connecting Objects to the Web‖ ISBN: 978-1-84821- 140-7, Wiley Publications

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Academic Year – 2025-2026 Semester -VI

[EC3209LA]: Program Elective III - Industrial Automation Lab

Teaching Scheme:	Credit	Examination Scheme:
PR: - 02 Hours/Week	PR:01	Lab Evaluation :50 Marks

Course Prerequisites: Control systems types, Mechatronics , Sensors and Actuators

Course Objective:

1. Student will get the ability to recognize industrial control problems suitable for PLC control.
2. The learners will get an over view of technology of advanced topics such as SCADA and DCS Systems.
3. Student will gain the ability to select the essential elements and practices needed to develop and implement the Engineering Automation using PLC approach

Course Outcome:

After successful completion of the course, students will able to:

LO1: Design and implement basic logic gate operations using PLC programming and interface Human-Machine Interface (HMI) with PLC for real-time monitoring and control.

LO2: Demonstrate the ability to measure and control parameters, such as water temperature using RTD and shaft angle using encoders, by interfacing sensors with PLC systems.

LO3: Develop and execute control strategies for industrial equipment, including controlling the speed of a 3-phase AC induction motor using a Variable Frequency Drive (VFD) and simulating a pneumatic piston pump with PLC.

LO4: Interface RFID and SCADA systems with PLCs to enable automated identification, data acquisition, and centralized control for enhanced system functionality and management.

Lab Contents

Guidelines for Assessment

- Total marks assigned are 50.
- Continuous assessment will be carried out based on attendance, lab performance, and timely submission of lab file for 20 Marks, Mid semester examination 10 Marks on Viva Voce or Viva Voce + Micro project or Viva Voce + any one practical performance on the practical up to mid semester.
- Final practical examination for specific practical and oral examination will be conducted for 20 Marks.

List of Laboratory Assignments/Experiments

1	Implementation of Logic GATEs using PLC Programming and HMI
2	Interfacing HMI to PLC Controller.
3	Water Temperature detection and controlling using RTD
4	Detection of shaft angle using encoder and PLC

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5	Controlling the speed of AC 3 phase induction motor using VFD
6	Simulation of piston pump using pneumatic kit and PLC
7	Interfacing RFID with PLC
8	Interfacing SCADA system to PLC controller.

Text Books:

T1 Curtis Johnson, "Process Control Instrumentation Technology"; 8th Edition, Pearson Education.

T2 Madhuchhanda Mitra, Samarjit Sen Gupta, "Programmable Logic controllers and Industrial Automation"; Penram International Publishing India Pvt. Ltd.

T3 Stuart A. Boyer, SCADA supervisory control and data acquisition, ISA Publication

Reference Books:

R1. John W. Webb, Ronold A Reis, "Programmable Logic Controllers, Principles and Applications"; 5th Edition, Prentice Hall of India Pvt. Ltd

R2. Kilian, "Modern control technology: components & systems, Delmar 2nd edition

R3. Bela G Liptak, Process software and digital networks, 3rd edition, 2002.

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T. Y. B. Tech (E&TC Engineering)

Academic Year – 2025-2026 Semester -VI

[EC3209LB]: Program Elective III -Cloud Computing Lab

Teaching Scheme:	Credit	Examination Scheme:
PR: - 02 Hours/Week	PR:01	Lab Evaluation :50 Marks

Course Prerequisites: Object oriented Programing and Big data

Course Objective:

To Study, understand the concepts and various platforms for cloud computing, to explore the applications based on cloud computing also to explore the knowledge regarding AWS cloud platform, then how to design applications for cloud and develop applications using various services, to deploy applications on cloud by using cloud native services.

Course Outcome:

After successful completion of the course, students will able to:

LO1: To understand basic concepts and Various platforms of cloud Computing.
LO2: To explore the knowledge regarding different cloud platform.
LO3: Create an application using various AWS services.
LO4: Deploy applications on cloud by using cloud native services.

Lab Contents

Guidelines for Assessment

- Total marks assigned are 50.
- Continuous assessment will be carried out based on attendance, lab performance, and timely submission of lab file for 20 Marks, Mid semester examination 10 Marks on Viva Voce or Viva Voce + Micro project or Viva Voce + any one practical performance on the practical up to mid semester.
- Final practical examination for specific practical and oral examination will be conducted for 20 Marks.

List of Laboratory Assignments/Experiments

1	To create and run virtual machines on open-source [VirtualBox, VMWare]. 1. To install an operating system in the virtual machine from template 2. Add storage to create the new virtual disk.
2	To install hypervisor such as KVM, ESXi. 1. Deploy VM on hypervisor 2. Back up or migrate VM.
3	Launch different EC2 Instance and connect to remote machine using AWS console platform. Launch different EC2 Instance and connect to remote machine using AWS command line interface.
4	To study difference between EBS and S3 storage. Create Buckets on AWS and explore

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Dean Academics

Dr. S. P. Bhosle
Director RSCOE, Pune

	versioning option on AWS console.
5	Create application Load Balancer
6	To install docker on window/Linux. 1. To build docker image from docker hub.
7	To install docker on window/linux. 1. To build docker image from docker hub.
8	Deploy a stateless/stateful application on Kubernetes cluster.
9	Mini project: 1. Deploy any web application on cloud with auto scaling features. 2. Develop an application on Raspberry-Pi to upload the temperature and humidity data on cloud.

Text Books:

T1 Anthony T. Velte TobyJ. Velte, Robert Elsenpeter, "Cloud Computing: APracticalApproach",2010, McGraw-Hill.

T2 Thomas Erl "Cloud Computing Technology and Architecture" Pearson publication 2nd edition.

T3 Dr. KrisJamsa, "Cloud Computing: SaaS, PaaS, IaaS, Virtualization andmore",WileyPublications, ISBN:978-0-470-97389-9

Reference Books:

R1. Dr. Kumar Saurabh, "Cloud Computing", Wiley Publication, ISBN10:8126536039.

R2. Barrie Sosinsky,"Cloud Computing", Wiley India, ISBN:978-0-470-90356-8

R3. L. Wang, R. Ranjan, J. Chen, and B. Benatallah, "Cloud Computing: Methodology, Systems, and Applications", CRC Press, Boca Raton, FL, USA, ISBN: 978-143-9856-413

R4. Buyya R., Broberg J., Goscinski A., "Cloud Computing: Principles and Paradigms", John Wiley & Sons Inc., ISBN: 978-0-470-88799-8

R5. V.K. Pachghare, "Cloud Computing", PHI Publication, ISBN: 978-81-203-5213-1R6. James Turnbull, "The Docker Book: Containerization is the new virtualization", ISBN: 978-L. Wang,

R6. Ranjan, J. Chen, and B. Benatallah, "Cloud Computing: Methodology, Systems, and Applications", CRC Press, Boca Raton, FL,USA, ISBN: 978-143-9856-413.

R7. Bernard Marr, "Big Data in Practice: How 45 Successful Companies Used Big Data Analytics to Deliver Extraordinary Results", Wiley, ISBN: 978-111-9231-387.

R8. http://docs.openstack.org/

R9. http://mininet.org/

R10. **https://www.opennetworking.org/**

R11. **http://pubs.vmware.com/vsphere-50/index.jsp**

R12. https://developers.google.com/appengine/

R13. **http://www.windowsazure.com/en-us/**

R14. **http://www.cloudfoundry.com/**

R15. **http://aws.amazon.com/developers/getting-started**

R16. **https://docs.aws.amazon.com/AWSEC2/latest/UserGuide/concepts.html**

R17. **https://docs.aws.amazon.com/directoryservice/latest/adminguide/gsg_create_vpc.h**

Dr. S. C. Wagaj **B.O.S. Chairman**	**Dr. A. M. Badadhe** **Dean Academics**	**Dr. S. P. Bhosle** **Director RSCOE, Pune**

T. Y. B. Tech (E & TC Engineering)
Academic Year – 2025-2026 Semester -VI
[EC3210L]: Project Phase-I

Teaching Scheme:	Credit	Examination Scheme:
TH: - 4 Hours/Week	PR:2	Term Work: 100Marks Oral : 50 Marks

Course Contents

Guide lines for Project Phase –I

- Identify the domain and finalize the tile of the Project.
- The student will carry the project work individually or by a group of students. Optimum group size is in 3 students. However, if project complexity demands a maximum group size of 4 students, the committee should be convinced about such complexity and scope of the work.
- Project coordinator will allocate the project guide.
- Students may contact different industries and finalize the sponsor project with the help of guide.
- For title and Project finalization department will form a committee and conduct the presentations.
- **Selection and approval of topic :**
  Topic should be related to real life application in the field of Electronics and Telecommunication OR Investigation of the latest development in a specific field of Electronics or Communication or Signal Processing OR The investigation of practical problem in manufacture and / or testing of electronics or communication equipment OR The Microprocessor / Microcontroller based applications project ispreferable. OR Software development project related to VHDL, Communication, Instrumentation, Signal Processing and Agriculture Engineering with the justification for techniques used / implemented is accepted. OR Interdisciplinary projects should be encouraged. The examination will be conducted independently in respective departments.
- Term work assessment is based on the project topic. It consists of Literature Survey and basic project work. The abstract of the project should be submitted before Term work assessment.
- The report consists of the Literature Survey, basic project work and the size of the report should be maximum of 40 pages.
- The examination is conducted by two examiners (internal and external) appointed by the university.
- The examiners appointed must have minimum 5 years of experience with UG qualification or 2 years with PG qualification.
- The assessment is based on Innovative Idea, Depth of understanding, Applications, Individual

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Contributions, presentation, and the grade given by the internal guide based on the work carried out in a semester. • A log book of Work carried out during the semester will be maintained with monthly review remarks by the guide and HoD. • A certified copy of report is required to be presented to external examiner at the time of final Examination.
Guidelines for Assessment
• Total marks assigned are 150. • Continuous assessment will be carried for 100 marks based on performance, and timely submission of lab file. • Final oral examination will be conducted 50 marks with external examiners.

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