Government College of Engineering Chh. Sambhajinagar

(An Autonomous Institute of Govt. of Maharashtra)

Third Year B Tech Curriculum Structure & Detailed Syllabus (UG Program)

(For Electronics and Telecommunication)

Effective from: A.Y. 2026-27

Dr. Sunil Hirekhan
Head E&TC

Dr. Anil Karwankar
Dean Academics

TY B.Tech. Electronics & Telecommunication Engineering Curriculum
With effect from Academic Year 2026-2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

Government College of Engineering Chhatrapati Sambhajinagar

Vision

To be globally recognized leader in technical education through industry integration and societal wellbeing

Mission

1. To build career-ready graduates through multidisciplinary learning and industry-sync curricula

2. To promote ecosystem for cutting-edge research, patents, publications, IPR, innovation, technology transfer and entrepreneurship

3. To be a premier trusted partner of government allied bodies, industries, and society

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Government College of Engineering Chhatrapati Sambhajinagar

Electronics & Telecommunication Engineering Department

Departmental Vision

Globally competent professionals in Electronics & Telecommunication Engineering with future-ready technologies

Departmental Mission

1. To provide a strong foundation in Electronics & Telecommunication Engineering, enabling students to develop globally relevant technical and professional competencies
2. To promote innovation, research and hands-on learning
3. To establish strong industry-institute collaborations that enhance practical exposure
4. To cultivate ethical values, leadership qualities and lifelong learning habits that empowers graduates to excel as responsible global engineering professionals

Electronics & Telecommunication Engineering Department

Program Educational Objective(s)	
PEO 1	**Domain proficiency:** Graduates will provide solutions to the challenging problems in Electronics & allied fields
PEO 2	**Career Growth:** Graduates will exhibit professional perfectionism
PEO 3	**Technical leadership**: Graduates will acquire entrepreneurship skills and innovative mindset
PEO 4	**Managerial Skills**: Graduates will perform cohesively in groups using moral, ethical practice, managerial, entrepreneurial skills for welfare of society with global outlook

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Electronics & Telecommunication Engineering Department

Programme Outcomes Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program specific outcomes

1. Graduates will be able to apply subject domain knowledge to design and develop Electronics Circuits and Systems for Industrial Solutions
2. Graduates will be able to design and analyses various types of Communication Systems
3. Graduates will be able to apply concepts of Signal Processing and algorithm to develop diversified application

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Government College of Engineering Aurangabad, Chh. Sambhajinagar

(An Autonomous Institute of Maharashtra State)

Teaching and Evaluation Scheme from year 2026-2027

B. Tech. Program in Electronics & Telecommunication Engineering with Minor

Semester – V

Course				Teaching Scheme			Continuous Evaluation in terms of Marks					
Sr No	**Category**	**Course Code**	**Course Name**	**TH**	**T**	**PR**	**Credits**	**ISE I**	**ISEII**	**ISEIII**	**ESE**	**Total (100)**
1	PCC	ETPCC3001	Microprocessor & Microcontroller	3	-	-	3	15	15	10	60	100
2	PCC	ETPCC3002	Lab- Microprocessor & Microcontroller	-	-	2	1	-	-	25	25	50
3	PCC	ETPCC3003	Digital Signal Processing	3	-		3	15	15	10	60	100
4	PCC	ETPCC3004	Lab-Digital Signal Processing		-	2	1	-	-	25	25	50
5	PCC	ETPCC3105	Electromagnetic Theory	3	-	-	3	15	15	10	60	100
6	PCC	ETPCC3006	Thinking System Applications	3	-	-	3	15	15	10	60	100
7	PCC	ETPCC3007	Lab- Thinking System Applications	-	-	2	1	-	-	25	25	50
8	PEC	ETPEC3001	Lab – Professional Skill Development	-	-	2	1	-	-	25	25	50
9	PEC	ETPECXXXX[$]	PEC I[$]	3	-	-	3	--	--	--	100	100
10	MDM		MDM 03	3	-	-	3	15	15	10	60	100
11	MDM		Lab MDM 03	-	-	2	1	-	-	25	-	25
12	OE	XXOECXXXX	OE III	2	-	-	2	10	10	-	30	50
	Total for B. Tech with one minor			**20**	**-**	**10**	**25**	**85**	**85**	**175**	**530**	**875**

[$]This is a MOOC/NPTEL/Online course. Students have to register and appear for the assignments and examinations conducted by MOOC /NPTEL/ Online course only. After submitting the Passing certificate of such a course, students will be awarded the 3 credits by virtue of 'Transfer of Credits'.

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Teaching and Evaluation Scheme from year 2026-2027

B. Tech. Program in Electronics & Telecommunication Engineering with Minor

Semester VI

Course				Teaching Scheme			Continuous Evaluation in terms of Marks					
Sr No	**Category**	**Course Code**	**Course Name**	**TH**	**T**	**PR**	**Credits**	**ISE I**	**ISEII**	**ISEIII**	**ESE**	**Total**
1	PCC	ETPCC3008	Control Systems	3	-	-	3	15	15	10	60	100
2	PCC	ETPCC3009	Lab-Control Systems	-	-	2	1	-	-	25	25	50
3	PCC	ETPCC3010	Embedded Systems	3	-	-	3	15	15	10	60	100
4	PCC	ETPCC3011	Computer Network	3	-	-	3	15	15	10	60	100
5	PCC	ETPCC3012	Lab-Computer Networks	-	-	2	1	-	-	25	-	25
6	PEC	ETPECxxxx	PEC II	2	-	-	2	15	15	10	60	100
7	PEC	ETPECxxxx	Lab PEC II	-	-	2	1	-	-	25	-	25
8	PEC	ETPECxxxx	PEC III	2	-	-	2	15	15	10	60	100
9	PEC	ETPECxxxx	Lab-PEC III	-	-	2	1	-	-	25	-	25
10	MDM		MDM 04	3	-	-	3	15	15	10	60	100
11	VSEC-05	ETVSE3002	Lab-Embedded Systems	-	-	2	1	-	-	25	25	50
12	Experiential Learning Courses	ETPRJ3001	Project Phase I	-	-	4	2	-	-	50	50	100
	Total for B. Tech with one minor			**16**		**14**	**23**	**90**	**90**	**235**	**460**	**875**

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Following courses will be offered as Professional Electives:

Professional Elective I – Following are the MOOC courses suggested:

Sr. No.	Course Code	Course Name
1.	ETPEC3002	Computer Architecture
2.	ETPEC3003	Operating System Fundamentals
3.	ETPEC3004	Quantum Computing
4.	ETPEC3005	Ethical Hacking
5.	ETPEC3006	Natural Language Processing
6.	ETPEC3007	Artificial Intelligence Search Methods For Problem Solving
7.	ETPEC3008	Data Science for Engineers
8.	ETPEC3009	Introduction to Machine Learning
9.	ETPEC3010	Introduction to Cyber Security
10.	ETPEC3031	Switching Circuits and Logic Design
11.	ETPEC3032	Neural Networks for Signal Processing
12.	ETPEC3033	Introduction to Internet of Things
13.	ETPEC3034	Programming in Java
14.	ETPEC3035	Hardware Modelling using Verilog
15.	ETPEC3036	Low Voltage CMOS Circuit Operation
16.	ETPEC3037	Programming with Generative AI
17.	ETPEC3038	Data Science for Engineers
18.	ETPEC3039	Electronic Modules for Application using Op-Amp
Students may opt for any other MOOC/NPTEL/Online course on current technology with the permission of BoS Chairman as PEC I course.		

Professional Elective II

(Each of the following course is of 2 + 0 + 1 = 3 Credits)

Sr. No.	Course Code	Course Name
01	ETPEC3011	Information Theory & Coding
	ETPEC3012	Lab Information Theory & Coding
02	ETPEC3013	Advanced Digital Signal Processing
	ETPEC3014	Lab Advanced Digital Signal Processing
03	ETPEC3015	Object Oriented Programming
	ETPEC3016	Lab Object Oriented Programming
04	ETPEC3017	Industrial Automation
	ETPEC3018	Lab Industrial Automation
05	ETPEC3019	Power Electronics
	ETPEC3020	Lab Power Electronics

Professional Elective III

(Each of the following courses is of 2 + 0 + 1 = 3 Credits)

Sr. No.	Course Code	Course Name
01	ETPEC3021	Digital Image Processing
	ETPEC3022	Lab Digital Image Processing
02	ETPEC3023	Deep Learning
	ETPEC3024	Lab Deep Learning
03	ETPEC3025	Digital System Design
	ETPEC3026	Lab Digital System Design
04	ETPEC3027	Cloud Computing
	ETPEC3028	Lab Cloud Computing
05	ETPEC3029	Digital Communication using GNU Radio
	ETPEC3030	Lab Digital Communication using GNU Radio

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ETPCC3001: Microprocessor & Microcontroller		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 hrs/week	**ISE I**	**15 Marks**
Credits: 03	**ISE II**	**15 Marks**
	ISE III	**10 Marks**
	End Semester Examination	**60 Marks**

Prerequisites: Knowledge of Digital Electronics

Course Description: This course deals with the basics of 8086 processor, 8051 microcontroller, architectures, internal organization and their functions. It also caters to the interfacing of peripherals to 8051. Study of open-source hardware like Arduino boards and Raspberry Pi will also be discussed. Class should be divided preferably into groups consisting of 3-5 students per team to build a microcontroller-based system.

Course Objectives:

- To get acquainted with the architecture of microprocessors and microcontrollers.
- To understand the addressing modes & instruction set of 8085 & 8051 and concepts of Assembly and 'C' Language Programming.
- To develop understanding of interrupt structure and serial I/O section.
- To understand the interfacing of different peripherals and develop systems using the same
- To study various open-source microcontroller hardware such as Raspberry Pi, Arduino or similar

Course Outcomes: After completing the course, students will be able to:

CO1	State functions of microprocessors, microcontrollers, allied blocks.
CO2	Describe the architecture, instruction sets of microprocessors and microcontrollers.
CO3	Write programs in assembly language and embedded 'C'.
CO4	Understand timers, interrupts and serial communication.
CO5	Implement interfacing applications with microcontrollers and peripherals.
CO6	Design systems using microcontrollers.

Detailed Syllabus:

Unit 1	**8086 Microprocessor** Programmers Model, Memory segmentation, Addressing Modes, Instruction Set, Assembly Programming.
Unit 2	**Introduction to 8051** Differentiation between Microprocessors and Microcontrollers, Functional block diagram, architecture, pin configuration, SFRs special function registers, stack and stack pointer, Internal memory organization, I/O ports, addressing modes, instruction set and simple programs using Assembly Language.
Unit 3	**Peripherals of 8051** Counters and Timers, Serial data input and output, Interrupts, Power saving modes, Interfacing LED, 7-segment LED, LCD, relay, optocoupler, ADC, DAC, Applications of 8051.

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Unit 4	**Introduction to Open-Source Microcontroller Hardware** Introduction to Arduino family, features, architecture and to Open-Source hardware boards like Raspberry Pi.
Unit 5	**Design of microcontroller-based systems** Design of industrial projects based on real time problems using microcontroller from 8051 family, Raspberry Pi, Arduino or suitable controllers

Textbooks, Reference Books and web resources

1. Ramesh Gaonkar, *Microprocessor Architecture, Programming and Applications with 8085/8085A*, 6th ed., Penram International Publishing
2. A.K. Ray and K.M. Bhurchandi, *Advanced Microprocessors and Peripherals*, 3rd ed, McGraw Hill Education.
3. D. V. Hall, SSSP Rao, *Microprocessor and Interfacing*, 3rd ed, McGraw Hill Education
4. Y.C. Liu and A. Gibson, *Microcomputer systems-The 8086/8088Family: Architecture, Programming and Design*, 2nd ed, Prentice Hall India Learning Private Limited
5. B. B. Brey, *The Intel Microprocessor, Architecture, Programming and Interfacing*, 6th ed, Pearson Education
6. M.A. Mazidi, J. G. Mazidi and R. D. McKinlay, "T*he Microcontroller and Embedded Systems*", 2nd ed, Prentice Hall India Learning Private Limited
7. K. J. Ayala, "*8051 Microcontroller: Architecture, Programming and applications*", 2nd ed, Delmar Cengage Learning
8. M.Predko, *Programming and customizing the 8051 Microcontroller*, McGraw Hill Education
9. M. Margolis, *Arduino Cookbook*, O'Reilly Media Inc, 2nd ed (ebook), https://juniorfall.files.wordpress.com/2011/11/arduino-cookbook.pdf
10. J. Purdum, *Beginning C for Arduino* (ebook), 1st Apress https://www.mica.edu.vn/perso/Vu-Hai/EE3490/Ref/Beginning.C.for.Arduino.Dec.2012.pdf
11. E. Upton and G. Halfacreene, *Raspberry Pi user guide*, 4th ed, Wiley, (ebook), https://dn.odroid.com/IoT/other_doc.pdf

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1							1	1	1		3		
CO2	2	2	1						1	1	1	1	3	1	1
CO3	2	2	1	1	1				1	1	1	1	3	1	1
CO4	2	2	1	1	1				1	1	1	1	3	1	1
CO5	2	2	2	2	2				1	1	2	1	3	1	1
CO6	2	2	2	2	2				2	2	3	2	3	2	2

3– High **2 – Medium** **1 - Low**

Assessment:

ISE I: Shall be based on Class Tests/ Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects

ISE II: Shall be based on class test

ISE III: Shall be based on Class Tests/ Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects

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Assessment table

Assessment Tool	K1	K2	K2	K2	K3	K3
	CO1	**CO2**	**CO3**	**CO4**	**CO5**	**CO6**
ISE I (15 Marks)	05	05	05	00	00	00
ISE II (15 Marks)	00	05	10	00	00	00
ISE III (10 Marks)	00	00	00	00	00	10
ESE (60 Marks)	06	18	12	12	12	00
Total Marks 100	**11**	**28**	**27**	**12**	**12**	**10**

ETPCC3002: Lab Microprocessor and Microcontroller	
Teaching Scheme **Practical: 2 Hrs/Week** **Credits: 1**	**Examination Scheme** **ISE III : 25 Marks** **End Semester Examination : 25 Marks**

Laboratory Course Outcomes

As an outcome of completing the Laboratory course, students will be able to:

CO1	Write algorithms and assembly language programs.
CO2	Write programs with DOS and BIOS function calls and embedded C.
CO3	Design and implement 8051 based systems with simple I/O devices.
CO4	Design systems with Stepper motor, DAC, LCD to 8051.

List of Experiments (Any 10)

Sr. No.	Title of the Experiments
1	Study of 8086 microprocessor trainer/ debug tool to enter, edit and execute program with simple programs
2	Write and execute ALP for (any three) like addition, subtraction, 16-bit addition
3	Write and execute ALP for (any three) like Logical operations, Multiplication, Division
4	Write and execute ALP for- ● Block transfer of N bytes of data ● Smallest/Largest number from an array ● Count '0s', 1s' in a byte
5	Identification and displaying the activated key, output char/string on display using DOS and BIOS function calls.
6	Practice IDE software and universal programmer to program 8051.
7	Write and execute ALP for addition, subtraction, block transfer ● Addition of two 8-bit no's stored in internal RAM ● Subtraction of two 8-bit no's stored in external RAM ● Block transfer of N bytes of data ● Bit manipulation programs
8	Write an embedded 'C' program to interface LED, keys. Generate various patterns on LEDs (flash, alternate flash, n-bit counter, ring counter). Display status of keys on LEDs
9	Write an embedded 'C' program to interface relay, buzzer, optocoupler
10	Write a program to Interface 7 segment display
11	Write a program to Interface LCD and display messages
12	Write programs and execute to interface stepper motor and rotate it in clockwise, anticlockwise directions, rotate motor by 'N' steps
13	Write program and execute to interface DAC to generate various waveforms like square, ramp, staircase, triangular waveforms

Mapping of Course Outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO 4	PO 5	PO6	PO7	PO8	PO9	PO10	PO1 1	PO12	PSO1	PSO2	PSO3
CO1	1	1		1	2					1			2		
CO2	1	1		1	2					1			3		
CO3	2	2		2	2					2			3	1	1
CO4	2	2		2	2					2			3	1	1

3 – High 2 – Medium 1- Low

Assessment:

ISE III: Shall be based on the assessment of submission work and interaction with students till the end of the term.

Assessment Table

Assessment Tool	S1	S2	S2	S3
	CO1	CO2	CO3	CO4
ISE III (25 Marks)	05	06	07	07
ESE (25 Marks)	07	06	06	06

ETPCC3003: Digital Signal Processing	
Teaching Scheme	**Examination Scheme**
Lectures: 3Hrs/Week	**ISEI:15 Marks**
Credits: 03	**ISEII:15Marks**
	ISEIII: 10 Marks
	End Semester Exam: 60 Marks

Course description:

The course covers theory and methods for digital signal processing including basic principles governing the analysis and design of discrete time systems as signal processing devices.

- The primary objective of this course is to provide a thorough understanding and working knowledge of design, implementation, and analysis of DSP systems.
- This course in digital signal processing develops essential analysis and design techniques required for a broad range of disciplines.
- Students are familiar with most important methods in DSP, including digital filter design, transform domain processing and importance of signal processors.
- After completion of the subject, the student should be able to understand the design principles and the implementation of digital filters and DFT/FFT and be able to make use of signal processing concepts and wavelets to perform some simple applications.

Course Outcomes

After completing the course, students will be able to:

CO1	Interpret, represent and process discrete/digital signals and systems.
CO2	Apply transforms for frequency domain analysis of discrete time signals.
CO3	Design digital filters for discrete time signals.
CO4	Demonstrate multirate signal processing.
CO5	Understand the DSP processors with programming skills.
CO6	Illustrate applications of digital signal processing.

Detailed Syllabus

Unit 1	**Introduction to digital signal processing** Review of Signals and systems, Time domain and frequency domain response of a digital system. Relationship between discrete time Fourier transform, discrete Fourier Transform & Z-transform. Fast Fourier Transform (FFT) - Decimation in time (DIT) and decimation in frequency (DIF) radix 2 algorithms. Finding DFT and inverse DFT using FFT
Unit 2	**Design of Infinite Impulse Response Filters** Revision of analog systems, Butterworth filters and Chebyshev filters. Types of digital filters: IIR and FIR. IIR filter design, bilinear transformation, frequency scaling, transformation from prototype low-pass filter to high-pass filter and band-pass fil Impulse-invariant and/or step-invariant approaches, Applicatio

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Unit 3	**Design of Finite Impulse Response Filters** FIR filter analysis, Fourier series approach, windowing, Gibbs phenomenon, commonly Used windows, concept of linear phase, frequency transformation, low-pass, band-pass, high-pass filters and filter band design. Applications
Unit 4	**Multirate signal processing** Multirate sampling, Decimation, Interpolation, Various applications of multirate sampling. Introduction to Wavelet Transforms & its application.
Unit 5	**Digital Signal Processors and Applications** Architecture and important instruction sets of TMS320C 5416/6713 FPGA: Architecture, different subsystems, DSP system design flow, mapping DSP algorithm into FPGA.

TEXT AND REFERENCE BOOKS

1. A.V.Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall, 1989.
2. L.R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall, 1992.
3. J.R.Johnson, Introduction to Digital Signal Processing, Prentice Hall, 1992.
4. D. J. DeFatta, J. G. Lucas and W. S. Hodgkis, Digital Signal Processing Wiley and Sons, Singapore, 1988.
5. G.Proakis and D.G.Manolakis, 'Digital Signal Processing Principles, Algorithms and Applications', Pearson Education, New Delhi, 2003 .
6. S.K.Mitra, 'Digital Signal Processing –A Computer Based Approach,Tata McGraw Hill, New Delhi, 2001

Mapping of Course outcomes with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	2	2	-	-	2	2	2	-	-	-	-	3
CO2	2	1	1	2	2	1	1	2	2	2	-	-	-	1	3
CO3	2	1	1	1	-	-	1	2	2	1	-	-	-	1	3
CO4	1	1	1	1	1	1	-	1	1	1	-	1	-	1	3
CO5	1	2	3	2	1	2	2	1	-	1	1	1	1	1	3
CO6	2	2	2	1	-	2	1	1	-	1	1	3	1	1	3

3–High2–Medium1–Low

Assessment table

Assessment Tool	K1	K3	K3	K2	K2	K2
	C01	C02	C03	CO4	CO5	CO6
ISE I (15Marks)	05	10	00	00	00	00
ISE II (15 Marks)	00	00	05	10	00	00
ISE III (10Marks)	00	05	05	00	00	00
ESE Assessment (60 Marks)	06	12	16	12	08	06

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ETPCC3004: Lab-Digital Signal Processing	
Teaching Scheme	**Examination Scheme**
Practical:2 Hrs/Week	**ISEIII: 25 Marks**
Credits:01	**ESE: 25 Marks**

Laboratory Course Outcomes

After completing the Laboratory course using MATLAB/CCS/IDE, students will be able to:

CO1	Perform frequency domain analysis of discrete time signals using transforms.
CO2	Sketch frequency response of FIR and IIR filters.
CO3	Demonstrate multi rate signal processing.
CO4	Implement signal processing algorithms on DSP processor

List of Experiments

Sr. No.	Details
1	To observe the output of an LTI system with given impulse function and observe amplitude and delay.
2	Frequency Analysis using DFT
3	Find the FFT of given 1-D signal and plot.
4	Determination of Power Spectrum of a given signal.
5	Obtain the convolution of two signals using frequency transform techniques.
6	Plot the Fequency Response of the IIR filter for the given pole-zero pair.
7	Design of Butterworth LPF for the given specification
8	Design of Butterworth HPF for the given specification
9	Design of Butterworth BPF for the given specification
10	Design of Butterworth BSF for the given specification
11	Design of FIR LPF using frequency sampling method
12	Design of FIR LPF using Rectangular window
13	Design of FIR LPF using different window.
14	Filter design using filter design analysis tool (FDAtool).
15	Demonstrate the effect of up sampling and down sampling on DTFT.
16	Implementation of Interpolation process in multi-rate digital signal processing.
17	Implementation of decimation process in multi-rate digital signal processing.
18	Study of Architecture of fixed point and floating point DSP processor.
19	Perform MAC operation using various addressing modes.
20	Generating different waveforms using the Hardware and Software Tools for the TI TMS320C6713 DSP Processor

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3		3											3
CO2		3		2										1	3
CO3	2	2		1										1	3
CO4				1		1					1			1	3

3–High 2–Medium 1–Low

Assessment Table

Assessment Pattern

Level No.	SkillLevel	TermWork	PracticalExamination&viva voce
S1	Imitation	08	08
S2	Manipulation	05	05
S3	Precision	10	10
S4	Articulation	02	02
S5	Naturalization	00	00
Total		25	25

ETPCC3105: Electromagnetic Theory	
Teaching Scheme **Lectures: 3 Hrs/Week** **Total Credits: 03**	**Examination Scheme** **ISE I : 15Marks** **ISE II : 15Marks** **ISE III : 10 Marks** **End Semester Exam : 60 Marks**

Course Objectives:

- To understand the three-dimensional representation of vector fields and vector calculus.
- To understand the fundamental principle of electrostatic and magnetic fields and their nature and understand the principles behind the practical laws.
- To understand Maxwell's equations as applied to static and time varying fields.

Course Outcomes: After completing the course, students will be able to:

CO1	Gain knowledge of coordinate systems and will be effective use it to three-dimensional field problems
CO2	Understand the fundamentals of electrostatic and steady magnetic fields
CO3	Understand the Maxwell's equations
CO4	Model static and time varying electromagnetic field problems and analyze
CO5	Understand the phenomenon of wave propagation and electromagnetic radiation.
CO6	Understand Antenna fundamentals.

Detailed Syllabus:

Unit 1	**Electrostatics** Brief overview of coordinate systems and vector calculus, Coulomb's law and electric field intensity, Experimental law of Coulomb, Electric field intensity, Field due to a continuous volume charge distribution, Field of a line charge, Field of a sheet of charge, Streamlines and sketches of fields, Electric flux density, Gauss's law, and Divergence, Electric flux density, Gauss's law, Application of Gauss's Law: Some symmetrical charge distributions., Differential volume element, Divergence, Maxwell's first equation (Electrostatics), Vector operator V and the Divergence theorem.
Unit 2	**Energy and Potential** Energy expended in moving a point charge in an electric field, Line integral, Definition of potential difference and potential, Potential field of a system of charges: Conservative property, Potential gradient, Dipole, Energy density in the electrostatic field, Conductors, Dielectrics and Capacitance, Current and current density, Continuity of current, Metallic of current, Conductor properties and boundary conditions.
Unit 3	**Magneto statics** Steady magnetic field, Biot-Savart law, Ampere's Circuital law, Curl, Stokes' Theorem, Magnetic flux and magnetic potentials, Derivation of steady-magnetic-field laws, Magnetic forces, Materials, and inductance. Force on a moving charge, Force on a differential current element, Force between differential current elements, Force and Torque on a closed circuit, Nature of magnetic materials, Magnetization and Permeability, Magnetic boundary conditions, Magnetic Circuit, Potential energy and forces on magnetic materials, Inductance and Mutual inductance.
Unit 4	**Time Varying Fields and Maxwell's Equations** Faraday's law, Displacement current, Maxwell's equations in point form, Maxwell's equations in integral form, Retarded potentials. Uniform Plane Wave: Wave motion in free space, Wave motion in perfect dielectrics, Plane waves in lossy dielectrics, Poynting vector and Power considerations, Propagation in Good Conductors: Skin effect, Reflection of uniform plane waves, Standing wave ratio.
Unit 5	**Antenna Fundamentals** Antenna parameters, Isotropic radiators, Radiation powe Directivity (D), Directive Gain, Radiation resistance, I bandwidth and Antenna beam width.

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Text and Reference Books

1. W.H. Hayt, J.A. Buck, "Electromagnetic Engineering", 6th editionTMH.
2. Jordon & Balmain, Mortise, "Electromagnetic Waves & Radiating System",PHI.
3. Kraus & Fleisch, "Electromagnetic with Applications", McgrawHill.
4. M.A. WazedMIAH, "Fundamentals of Electromagnetic", McGrawHill.
5. K.D. Prasad, "Electromagnetic Fields and Waves", SatyaPrakashan.
6. D. N. Vasudeva, "Fundamentals of Magnetism & Electricity", S & CPublication.
7. J. D. Kraus, R J Marhefka, "Antennas for All Applications",TMH.

Mapping of Course outcome with Program Outcomes and Program Specific Outcome

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	2											1	1	2
CO2	1	3											1	1	1
CO3	1												1	1	2
CO4	2	2											1	1	2
CO5	2		1										1	1	1
CO6	2		2										1	1	1

3 –High **2– Medium** **1 - Low**

Assessment:

ISE I, II, III	Shall be based on Class Tests/ Assignments/ Quizzes / Field Visits/ Presentations / Course Projects

Assessment table

Assessment Tool	K1	K1	K1	K3	K2	K2
	CO1	CO2	CO3	CO4	CO5	CO6
ISE I (15 Marks)	03	03	04	00	05	00
ISE II (15 Marks)	00	00	00	05	05	05
ISE III (10 Marks)	00	00	00	00	10	00
ESE Assessment (60 Marks)	10	10	12	13	10	05

ETPCC3006: Thinking Systems Applications

Teaching Scheme		Evaluation Scheme	
Lectures	03Hrs/Week	ISE I	15Marks
Total Credits	03	ISE II	15Marks
		ISE III	10Marks
		ESE	60Marks

Course description:

This course introduces students with the emerging field of artificial intelligence (AI) with a practical based approach. Here the meaning of the word 'thinking system' is a system which may include both hardware and software. It can be trained to make it think about the incoming data and do the necessary decision making. The thinking system normally categorizes the problems as searching problems or reasoning problems. The reasoning may be based on knowledge representation or probabilistic.
After introducing the different search techniques, logic and reasoning, the course enters the introduction of machine learning algorithms. It provides a concise introduction to the fundamental concepts in machine learning and popular machine learning algorithms. It covers standard and most popular supervised learning algorithms including linear regression, logistic regression, decision trees, k-nearest neighbor, naïve Bayes algorithm, support vector machines and kernels. It also covers the basic clustering algorithms and introduces the field of artificial neural network. At the end the course provides an introductory remark on Deep Learning and Generative AI.
The course prepares students to take a variety of focused, advanced courses related to AI.

Course Objectives:

1. To understand various concepts & models related to thinking systems.
2. To understand various supervised & unsupervised learning algorithms in ML.
3. To apply the model of AI and algorithms in ML to real world problems.

Course Outcomes

After completing the course, students will able to:

CO1	Learn various concepts in artificial intelligence.
CO2	Represent the given problem as searching or reasoning (logic & probabilistic)
CO3	Understand various supervised and unsupervised machine learning algorithms.
CO4	Understand how to evaluate models generated from data.
CO5	Apply the machine learning models to a real-world problem.
CO6	Apply the concepts learned to understand the modular Application building.

Detailed Syllabus:

Unit1	**Introduction to Thinking Systems** Thinking system Definition, Modeling a Problem as Search Problem, Uninformed Search: Depth First Search, Breadth First Search, Heuristic Search: Best First Search, Hill Climbing, Stochastic Local Search, Finding Optimal Paths: Branch & Bound, A*
Unit2	**Evolution of Thinking Systems** Game Theory, Game Trees, Algorithm Minimax, Alpha Beta pruning. Introduction to Constraint Satisfaction problem. Application-Graph coloring Problem, Genetic Algorithms. Application to get the multiple solutions for the given problem, Propositional ts application in building "Model based diagnosis"

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Unit3	**Introduction to Machine learning** Probabilistic reasoning, Bayesian Networks, Decision Theory, Markov Decision Processes (MDP), and Application of MDP in determining optimum policy for charging a solar panel unit mounted on Rover. Basic definitions, types of learning, hypothesis space and inductive bias, evaluation, cross-validation.
Unit4	**Supervised learning Methods** Linear regression, Decision trees, over-fitting & under-fitting, Logistic Regression, k-nearest neighbor, naïve Bayes algorithm, Support Vector Machine, Kernel function and Kernel SVM Application: Character recognition system [and converting to multiple language character]
Unit5	**Unsupervised & semi supervised learning Methods** Clustering: k-means, hierarchical clustering, Neural network: Perceptron, multilayer network, feed forward & back propagation algorithm, introduction to deep neural network & Generative AI. Application: Object detection, Face detection system, Face recognition system, Object tracking system.

Mapping of Course outcomes with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO 3
CO1	1	1	1	-	3	2	-	-	-	1	-		-	-	1
CO2	2	3	2	2	1	1	-	-	-	-	-	-	1	-	1
CO3	2	3		2	1		1	-	-	-	-	-	-	-	1
CO4	1	2	1	2	3		2	-	2	1	1	1	-	-	1
CO5	1	3	2	2	3	-	-	-	3	2	2	1	-	-	1
CO6	1	2	2	2	2	1	1	-	2	-	-	1	1	-	1

3 – High 2 – Medium 1–Low

Assessment table:

Assessment Tool	**K1**	**K3**	**K2**	**K2**	**K3**	**K3**
	CO1	**CO2**	**CO3**	**CO4**	**CO5**	**CO6**
ISEI (15Marks)	05	05	05	00	00	00
ISE II (15 Marks)	00	00	05	05	05	00
ISEIII (10Marks)	00	00	00	00	05	05
ESE Assessment (60 Marks)	00	12	06	18	12	12

ETPCC3007: Lab Thinking Systems Applications

Teaching Scheme		Evaluation Scheme	
Lectures	02Hrs/Week	ISE III	25Marks
Total Credits	01	ESE	25Marks

Course Outcomes:

Student will be able to

CO1	Implement different AI algorithms.
CO2	Apply AI algorithms on different types of data.
CO3	Understand different classifiers in machine learning.
CO4	Apply classifiers in Machine learning on different dataset.

List of Experiments (Any 10)

01	Implementation of different uninformed search strategies: i) Depth First Search Algorithm , ii) Breadth First Search Algorithm
02	Implementation of local search algorithm.
03	Obtaining Multiple solutions to the problem using different crossover techniques in Genetic algorithm.
07	Implementation of constraint satisfaction problem through Map coloring algorithm.
08	Predicting the optimum policy for the Solar panel mounted on rover using Markov decision process.
09	Application to Predict the root cause of the effect using Bayesian network model.
10	Fit the given set of data points using Linear regression algorithm. Plot the graph and estimate the value for unknown input.
11	Application to predict the performance of a stock based on its past data.
12	Classify the Given dataset using Logistic regression algorithm. Find out the accuracy of the algorithm. (Dataset: Iris data set or any other datasetwith2to4 features)
13	Implement Naïve Bayes Classifier (Dataset: with2to 4features).Comment on accuracy, precision and recall rate obtained.
14	Using K-nearest neighbour classifier, classify the mnist dataset (Datasetof10 numbers). Comment on the misclassified data.
15	Classify the data using SVM classifier.
16	Classify the data using kernel SVM classifier.
17	Evaluate and Compare different Classifiers Experimentally on given dataset (Dataset: 1) Iris dataset or any other dataset with 2 to 4 features 2. Digit 0 to 9).
18	Building a modular system to recognize handwritten Character in both i) online mode & ii) offline mode

19	Face detection system
20	Face recognition system.
21	Study of Large Language Model in AI.
22	Study of Generative Model in AI.

Mapping of Course outcomes with Program Outcomes:

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2	1	3	1	1	-	1	-	-	-	1	1	1	-	1
CO2	2	1	3	1	3	-	2	-	-	-	1	2	1	-	1
CO3	2	3	2	1	2	-	1	-	-	-	1	1	1	-	1
CO4	2	3	2	2	2	-	2	-	-	-	1	2	1	-	1

3 –High 2–Medium 1-Low

Assessment Table:

Assessment Tool	S1	S2	S3	S3
	CO1	CO2	CO3	CO4
ISEIII (25 Marks)	05	05	10	05
ESE (25 Marks)	05	10	-	10

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ETPEC3001: Lab – Professional Skill Development

Teaching Scheme		Evaluation Scheme	
Lectures	02Hrs/Week	ISE III	25Marks
Total Credits	01	ESE	25 Marks

Course Outcomes: This curriculum aims to provide a strong foundation in practical electronics and telecommunication skills, preparing students for real-world engineering challenges.

Students will be able to

CO1	Identify and formulate the problem statement
CO2	Acquire skills to develop the prototype
CO3	Apply Knowledge to develop electronics systems
CO4	Test and analyze the modules developed

Students must choose any one track of the following:

Track 1: Obtain a professional skill certificate in following areas of minimum duration at least 30 Hours. Credits will be transferred after submission of professional skill certificate

Areas:

1. **FPGA/CPLD Programming:** Introduction to Hardware Description Languages (HDL) like VHDL/Verilog and implementation of digital logic on FPGAs.
2. **IoT (Internet of Things) Applications:** Connecting embedded systems to the internet, cloud platforms, and mobile applications.
3. **Wireless Communication Protocols:** Deeper dive into Wi-Fi, Bluetooth, Zigbee, LoRa, and their practical implementation.
4. **Digital Signal Processing (DSP) Applications:** Implementing basic DSP algorithms on microcontrollers or dedicated DSP processors (e.g., filtering, FFT).
5. **RF Circuit Design Fundamentals:** Introduction to high-frequency circuit design, impedance matching, and S-parameters.
6. **Power Electronics:** Design and analysis of DC-DC converters, inverters, and power management circuits.
7. **Robotics & Automation:** Integrating sensors, actuators, and control algorithms for robotic applications.
8. **Certification on Network and Cyber security**
9. **Certification on Cloud Computing**
10. **Certification on Full stack development**
11. **Certification from Cisco**
12. **Certification from MATLAB**

Track – II : Complete an open ended project on following ideas or finalized by department as community projects

Open-Ended Project Ideas:

1. **Smart Home Automation System:** Design and implement a system that controls lights, fans, and appliances using a microcontroller, sensors (e.g., PIR, temperature), and a mobile app interface.
2. **Environmental Monitoring Station:** Build a device that measures environmental parameters (temperature, humidity, air quality) and transmits data wirelessly to a cloud platform for visualization.
3. **Gesture-Controlled Robot / Drone:** Develop a system where a robot or drone can be controlled using hand gestures detected by a sensor (e.g., accelerometer, IR sensor).
4. **Software Defined Radio (SDR) Receiver / Transmitter:** Explore basic SDR concepts by building a simple receiver or transmitter using a low-cost SDR dongle and open-source software (e.g., GNU Radio).
5. **Biomedical Sensor Interface:** Design a circuit to acquire and process signals from basic biomedical sensors (e.g., ECG, PPG) and display them.
6. **Energy Harvesting System:** Develop a small-scale system that harvests energy from ambient sources (e.g., solar, vibration) to power low-power electronic devices.
7. **Customizable LED Display / Matrix:** Design and build a programmable LED matrix display for animations, text scrolling, or simple games, controlled via a microcontroller.
8. **Wireless Power Transfer System:** Explore the principles of wireless power transfer by building a small-scale inductive coupling system to charge a low-power device.
9. **Automated Plant Watering System:** Create an embedded system that monitors soil moisture and automatically waters plants when needed, with options for manual override and notifications.
10. **Object Tracking System:** Implement a system using a camera module and a microcontroller to detect and track objects, potentially controlling a pan-tilt mechanism.
11. **Machine Learning at the Edge Device:** Implement a simple machine learning model (e.g., for anomaly detection or classification) on a microcontroller or a low-power embedded device.
12. **Li-Fi Communication System:** Design and build a basic visible light communication (VLC) system to transmit data wirelessly using LEDs and photodiodes.
13. **Smart Grid Monitoring Node:** Develop a prototype for a smart grid monitoring node that measures power consumption, voltage, and current, and transmits data for analysis.
14. **Wearable Health Monitor:** Design a wearable device that integrates multiple sensors (e.g., heart rate, SPO2, temperature) to monitor vital signs and provide alerts.
15. **Autonomous Navigation Robot (SLAM):** Build a small robot capable of basic autonomous navigation using sensors (e.g., ultrasonic, LiDAR), incorporating concepts of Simultaneous Localization anc

16. **5G/Next-Gen Communication Simulation:** Use simulation tools (e.g., MATLAB, NS-3) to model and analyze aspects of 5G or future wireless communication systems.
17. **Cyber-Physical System Security:** Explore vulnerabilities in a simple IoT or embedded system and implement basic security measures (e.g., encryption, secure boot).
18. **Augmented Reality (AR) Assisted Maintenance:** Develop a proof-of-concept AR application (e.g., using a smartphone) that overlays technical information or instructions onto physical electronic components for maintenance tasks.
19. **Industry need based project**
20. **Any other project recommended by the department**

Recommended Software & Tools:

- **Circuit Simulation:** LTSpice, Multisim, Proteus, TinkerCAD Circuits
- **PCB Design:** KiCad, Eagle, Altium Designer (for advanced exposure)
- **Microcontroller IDEs:** Arduino IDE, Platform IO, MPLAB IDE
- **Programming Languages:** C/C++ (for microcontrollers), Python (for data analysis/automation)
- **Measurement Equipment:** Digital Multi-meters, Oscilloscopes, Function Generators, DC Power Supplies, Spectrum Analyzers (if available).
- **Prototyping:** Breadboards, Soldering Stations, Desoldering tools, Component kits
- **Any other similar tools**

Mapping of Course outcome with Program Outcomes:

PO→ CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2	1	3	1	1	1	1	1	1	1	1	1	2	2	1
CO2	2	1	3	1	3	-	2	-	-	-	1	2	2	2	1
CO3	2	3	2	1	2	-	1	-	-	-	1	1	2	2	1
CO4	2	3	2	2	2	1	2	1	1	1	1	2	2	2	1

3 –High 2–Medium 1-Low

Assessment Table:

Assessment Tool	S1	S2	S3	S3
	CO1	CO2	CO3	CO4
ISE III (25 Marks)	05	05	05	10
ESE (25 Marks)	05	05	05	10

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ETPCC3008: Control Systems	
Teaching Scheme	**Examination Scheme**
Lectures: 3 Hrs/Week	**ISE I :15 Marks**
Total Credits: 03	**ISE II :15 Marks**
	ISE III : 10 Marks
	End Semester Exam : 60Marks

Course description: After completing this course, students will have a broad and fundamental understanding of Control System. Topics range from an overview of Basics of Control System, State Space Analysis, Overview of Stability analysis, Frequency and Time Response of System.

Course Outcomes

After completing the course, students will be able to:

CO1	Find types of systems, transfer function and stability.
CO2	Obtain transfer function and mathematical modeling of systems.
CO3	Illustrate steady state error constants, compensation networks and state space representation of a system.
CO4	Describe different techniques to find stability of systems.
CO5	Understand controllers and its applications.
CO6	Apply time domain analysis and frequency domain analysis to systems

Detailed Syllabus:

Unit 1	Introduction History of control system, Laplace transform review, open loop and closed loop systems, introduction of linear and nonlinear control systems, regenerative feedback, transfer function, block diagrams and reduction techniques including signal flow graphs, deriving transfer function of physical system like electrical networks, Mechanical system.
Unit 2	Time response analysis Standard test signals, time response of first order and second order system, steady state Error constants, design specifications of second order system, control system compensators: lead compensations, lag compensation, lag-lead compensation. Basic concept of state, state variable, and state models, state models for linear continuous time function, transfer matrix, diagonalization of transfer function, controllability, observe ability.
Unit 3	Stability Analysis Concept of stability, condition of stability, characteristic equation, relative stability, Routh-Hurwitz criterion, Nyquist stability criterion, Basic Concept of Root Locus, rules of root locus, application of root locus technique for control system.
Unit 4	Frequency response Analysis Bode plots, gain margin, phase margin, effect of addition of poles and zeros on bode plots, performance specifications in frequency domain, compensation and their realization in time and frequency domain.
Unit 5	Industrial controllers P,PI,PD,PID, Introduction to PLC,PLC programming and its application development.

Text Books:

1. I.J. Nagrath and M. Gopal, Control Systems Engineering, Third Edition, New age International Publishers, India,2001
2. Norman S. Nise, Control systems Engineering, Third Edition, John W

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Singapore,2001
3. K. Ogata, Modern Control Engineering, Fourth edition, Pearson Education India,2002.

Reference Books:

1. M Gopal, Control System Principle & Design, T.M.H., Fourth Edition,2012
2. B.C. Kuo, Automatic Control Systems, Seventh Edition, Prentice–Hall of India,2000
3. R.C. Dorf and R.H. Bishop, Modern Control Systems, Eighth edition, Addison-Wesley,1999.
4. Smarajit Ghosh, "Control Systems-Theory and Applications", Second Edition, Pearson

Mapping of Course outcome with Program Outcomes and Program Specific Outcomes

Program Outcome	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO1	3	2	3	2	2				1	1			1		2
CO2	3	3	2	2	1				1	1			2		2
CO3	3	2	2	1	2				1	1			3		2
CO4	2	2	2	1	1				1	1			1		2
CO5	2	2	2	2	1				1	1			1		2
CO6	3	2	1	2	1				1	1	1		2		2

1 –Low 2 – Medium 3 -High

Assessment:

ISE I, II, III	Shall be based on Class Tests/ Assignments / Quizzes /Field visits/ Presentations/ Course Projects

Assessment Table

Assessment Tool	**K1**	**K2**	**K2**	**K2**	**K2**	**K3**
	CO1	**CO2**	**CO3**	**CO4**	**CO5**	**CO6**
ISE I	03	06	06	00	00	00
ISE II	03	00	00	06	00	06
ISE III	00	00	00	05	00	05
ESE	4	12	12	10	10	12

ETPCC3009: Lab Control Systems	
Teaching Scheme	**Examination Scheme**
Practical: 2Hrs/Week	**ISE I: 25 Marks**
Total Credits : 01	**ESE : 25 Marks**

Course Outcomes

As an outcome of completing the Laboratory course, students will be able to:

CO1	Create transfer function, state space model and implement compensation networks.
CO2	Perform transient and steady state analysis of control systems.
CO3	Formula testability of closed-loop control systems.
CO4	Build simple systems using PLC and controller.

List of Experiments

(Any 10 of below experiments are to be conducted which will cover all four course outcomes)

Sr. No.	Details
01	Obtain transfer function and mathematical modelling of a system.
02	Determine Transient response of first order and second order systems.
03	Determine a)step and impulse response for a type '0', type '1', type '2' systems b)Steady state Errors for a type '0', type '1', type '2' systems
04	Find the effect of addition of zeros and poles to the forward path transfer function of a closed loop system
05	Determine a) state space representation, b) controllability c)observability of a system
06	Analyze stability using a)Routh-Hurwitz criteria b)Root Locus
07	Analyze stability using a)Bode Plot, b) Nyquist plot
08	Obtain magnitude and phase plot of compensation networks.
09	Determine effect of P, PD, PI, PID controller on second order systems.
10	Use PLC for solving Boolean equations.
11	Design of PID controller for speed control of DC Motor/ Temperature Controller/ Level

	Control System.
12	Design a PLC-controlled water pump system that maintains the water level in a tank between high and low limits.
13	Plot characteristics DC Motor Speed Control System.
14	Plot Synchro transmitter-receiver characteristics

Mapping of Course outcome with Program Outcomes and Program Specific Outcomes

PO	**01**	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**12**	**PSO1**	**2**	**3**
CO1	3	2	2	2	3					1			1		1
CO2	3	2	2	2	3					1			2		1
CO3	3	2	2	2	3				3	1		3	1		1
CO4	3	2	2	2	2					1			1		1

3 – High, 2 – Medium, 1- Low

Assessment Table

Assessment Tool	S2	S2	S2	S2
	CO1	CO2	CO3	CO4
ISE-II (25 Marks)	06	08	06	04
ESE (25 Marks)	06	08	06	04

ETPCC3010: Embedded Systems

Teaching Scheme		**Evaluation Scheme**	
Lectures	03Hrs/Week	ISE I	15 Marks
Total Credits	03	ISE II	15 Marks
		ISE III	10 Marks
		ESE	60 Marks

Pre-requisite: Knowledge of Digital Electronics, Microprocessor & Microcontroller

Course description: This course is an introduction to Embedded Systems with a focus on ARM processors, peripherals, interrupts and exceptions handing along with C/ Assembly Programming. Emphasis is placed on understanding and applying ARM-based processor concepts in real-world embedded applications. An overview of hardware platforms with System-on-Chip architecture is discussed.

Course Outcomes:
After completing the course, students will be able to:

CO1	Understand classification, design issues &design metrics of embedded systems including processor technologies.
CO2	Comprehend ARM processor fundamentals, ARM & Thumb modes and Zynq processor architectures
CO3	Know serial communication protocols and on-board peripheral devices
CO4	Program ARM processor using assembly and C language programming
CO5	Understand System-on chip concepts, embedded and Zynq SoC
CO6	Design and develop Embedded Systems for various applications

Detailed Syllabus:

Unit 1	**Introduction to Embedded Systems** Definition of Embedded System, Components of a typical Embedded System, Classification, Characteristics, Design Metrics, Embedded Processor technology, IC Technology, Design Technology, Hardware platforms like Microcontroller, GPP, ASSP, ASIP, SoC
Unit 2	**ARM as Embedded Processor** ARM and RISC Design Philosophy, Introduction to ARM processors and its versions, ARM7/ARM9/ARM11 features, advantages & suitability in embedded application, ARM7 Architecture, differentiation in Cortex Series (A, M, R), data flow model, programmers model, Register, Stack, processor modes, System Control Block, Interrupt and Exception Handling, ARM Memory map, GPIO and ARM Assembly Language, Introduction to Thumb mode

Unit 3	**Communication Interfaces** Serial and Parallel Communication, SPI, I2C, RS232, CAN, Interfacing of sensors and actuators using these communication protocols
Unit 4	**LPC2148 on-chip devices and System on Chip** LPC2148/STM32F401(ARMCortex M4):Timer/Counter, Watchdog Timer, PWM, ADC, DAC and Introduction to Zynq SoC, Anatomy of Embedded SoC, Overview of Zynq SoC architecture
Unit 5	**Embedded System Development** ARM Assembly Language Programming using Keil IDE, Peripherals Interfacing and programming, Embedded C programming Embedded system applications: Home Automation Systems, Vending Machine, Smart Irrigation System, Soil Health Monitoring, Greenhouse Monitoring and Control or any other such applications

Textbooks:

1. Raj Kamal, *"Embedded Systems: Architecture, Programming and Design"*, McGraw Hill Education, 3rd Edition
2. Andrew N. Sloss, Dominic Symes, Chris Wright, *"ARM System Developer's Guide: Designing and Optimizing System Software"*, Morgan Kaufmann, 1st Edition.
3. Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi, *"ARM Assembly Language Programming & Architecture"*, MicroDigitalEd, 1st Edition.
4. Embedded System Design with ARM an NPTEL course
5. The Zynq Book ebook.pdf

Reference Books:

1. Steve Furber, *"ARM System-on-Chip Architecture"*, Addison-Wesley, 2nd Edition
2. Joseph Yiu, *"The Definitive Guide to ARM® Cortex®-M3 and Cortex®-M4 Processors"*, Newnes (Elsevier), 3rd Edition.
3. Wayne Wolf, *"Computers as Components: Principles of Embedded Computing System Design"*, Morgan Kaufmann, 3rd Edition.
4. https://www.youtube.com/playlist?list=PLgIjRMdFBe6uhhko53nOU30T0u-wvoDG9
5. https://deepbluembedded.com/
6. https://armkeil.blob.core.windows.net/developer/Files/pdf/ebook/arm-designing-embedded-system-application-cortex-m.pdf

Mapping of Course Outcome with Program Outcomes, Program Specific Outcomes:

PO	01	02	03	04	05	06	07	08	09	10	11	12	PSO1	2	3
CO1	1	1							1	1	1		1		
CO2	2	2	1						1	1	1	1		2	
CO3	3	2	1	1	1				1	1	1	1	2		
CO4	2	2	2	2	2				1	1	1	2			2
CO5	2	2	1	1	1				1	1	2	1	2		
CO6	2	2	2	2	2				2	2	3	2	2		2

3 – High, 2 – Medium, 1- Low

Assessment:

ISE I, II, III	Shall be based on Class Tests/ Assignments / Quizzes /Field visits/ Presentations/ Course Projects

Assessment Table:

Assessment Tools	**K2**	**K2**	**K2**	**K3**	**K2**	**K3**
	CO1	**CO2**	**CO3**	**CO4**	**CO5**	**CO6**
ISE I (15 Marks)	10	05	00	00	00	00
ISE II (15 Marks)	00	05	10	00	00	00
ISE III (10 Marks)	00	00	00	05	00	05
ESE (60 Marks)	12	12	12	12	06	06

ETVSE3001: Lab Embedded Systems

Teaching Scheme		Evaluation Scheme	
Practicals	02 Hrs/Week	ISE III	25 Marks
Total Credits	01	ESE	25 Marks

Course Outcomes

As an outcome of completing the Laboratory course, students will be able to:

CO1	Use modern engineering tools necessary for integrating software and hardware components in Embedded system designs.
CO2	Program the basic interfacing of ARM processor with peripherals using Embedded C
CO3	Assembly Language Programming for ARM processor
CO4	Demonstrate data communication using communication and program on-board devices

List of Experiments (Any 8)

Sr. No.	List of Experiments
1	Introduction to IDE software and to program microcontroller
2	Write embedded 'C' program to display various patterns on LED 2.1 Flashing LEDs2.2 Alternate Flashing LEDs 2.3 N-bit counters2.4 Ring counter
3	Write an embedded 'C' program 3.1 To display 0 to 9 on seven segment display 3.2 to display 0 to 9 on seven segment display using an array 3.3 To interface seven segment display with Proteus software
4	Write an embedded 'C' program for LED, Buzzer and Switches 4.1 Buzzer ON/OFF with delay 4.2 Use switch status to turn either Buzzer or LED 4.3 Implement the same using Proteus software
5	Write an embedded 'C' program 5.1 To display status of switches on LEDs 5.2 Perform logical operations on switch inputs before displaying on LEDs
6	Write and execute assembly language program for 6.1 Addition of 2 32-bit numbers stored in register. 6.2 Addition of 2 32-bit numbers stored in memory. 6.3 Addition of 2 64-bit numbers stored in memory. 6.4 Addition of n 32-bit numbers stored in memory.
7	Write and execute assembly language program for 7.1 Multiplication of two 32-bit numbers stored in memory 7.2 Logical AND, OR and XOR of two 32-bit numbers stored in memory 7.3 Count number of zeros and ones in a number.
8	Write a program to read keys from keys/ key matrix and display on LCD display
9	Write a program to use on-board ADC in ARM LPC2148
10	Write a program to use on-board DAC in ARM LPC2148
11	Write a program to LCD / Graphics LCD Interfaced to LPC2148
12	Write a program to Interface Stepper motor Interfaced to LPC2148
13	Write a program to use external interrupt to carry out ISR

Mapping of Course Outcome with Program Outcomes, Program Specific Outcomes:

PO	01	02	03	04	05	06	07	08	09	10	11	12	PSO1	2	3
CO1	1	2		1	1				1	1			2		
CO2	1	2		1	2				2	1			3		
CO3	1	2		2	2				2	1			3	2	2
CO4	2	2		2	2				1	2			3	2	2

3 – High, 2 – Medium, 1- Low

Assessment Table

Assessment Tool	S1	S2	S2	S2
	CO1	CO2	CO3	CO4
Term Work (25 Marks)	03	14	04	04
Practical Examination & Viva Voce (25 Marks)	05	12	04	04

ETPCC3011: Computer Network

Teaching Scheme		Evaluation Scheme	
Lectures	03 Hrs/Week	ISEI	15 Marks
Total Credits	03	ISEII	15 Marks
		ISEIII	10 Marks
		ESE	60 Marks

Course Outcomes:

As an outcome of completing the Laboratory course, students will be able to:

CO1	Explain the fundamentals of data communication and networking, including protocols, Standards, and network categories, and identify security challenges in network architecture.
CO 2	Enumerate and Explain the function(s) of the layers of the OSI model and TCP/IP Model
CO 3	Demonstrate the configuration and operation of network devices (switches, routers, servers) and analyze physical and data link layer technologies.
CO 4	Design and evaluate network architectures for organizational requirements, applying concepts of IP addressing, sub-netting, and routing protocols.
CO 5	Implement and analyze transport and application layer protocols, including TCP, UDP, DNS, DHCP, HTTP, and security mechanisms like IPSec and cryptography.
CO 6	Apply modern tools and simulation techniques to model, configure, and troubleshoot networks, and correlate practical protocols with theoretical concepts

Detailed Syllabus:

Unit 1	Introduction to Data Communication: Networks, Protocols and Standards, Categories of Networks, OSI & TCP/IP Protocol suites Physical layer: Topology, Guided media, Unguided media, Network Devices.
Unit 2	Data Link Layer Design Issues: Framing, Error control, Flow control, Elementary data link protocols (ARQs: Stop and Wait, go back N, Sliding window), HDLC, PPP. Medium Access Technique: Wired LANs: Ethernet, Wireless LANs, CSMA /CD, CSMA/CA, channel allocation, Random Access, Channelization. High speed LANs like FDDI.
Unit 3	Network Layer & Design Issues:, IP addressing,IPV4, ARP,RARP, Error reporting protocolICMPRouting&congestioncontrolalgorithms:OSPF&BGP,CIDR&IPV6
Unit 4	Transport Layer: Transport Protocols, Addressing, Establishing & releasing a connection Transport protocol for Internet TCP & UDP Application Layer: Application Layer Protocols DHCP, DNS, TELNET, FTP, SMTP, HTTP, WWW, VoIP, Introduction to Network security: Goals of Security Basic Cryptography
Unit 5	A simple client-server implementation, A simple web server implementation, Networking Simulation and modeling techniques. Practical Network Simulators Case studies: Networking using Windows and Linux Operating systems

Text Books:

1. Behrouz A. Forouzan, Data Communications And Networking,5th Edition, Tata McGraw Hill 2017
2. Andrew S. Tanenbaum, Computer Networks,4th Edition, Prentice Hall 2003

Reference Books:

1. William Stallings Data And ComputerCommunication,8th Edition, Prentice Hall Of India, New Delhi, 2007.
2. Douglas E Comer, Computer Networks And Internet, Pearson Education Asia,4thEdition 2008
3. Larry L. Peterson, Bruce S.Davie, Computer Networks: A Systems Approach,3rd Edition 2003 Morgan Kaufmann Publishers

Useful Links:

1. http://www.rfceditor.org/rfcsearch.html
2. http://www.cisco.com.

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CO-PO Mapping Table

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	2	3
CO1	2	3	2	-	1	-	-	-	-	-	-	1	-	1	-
CO2	2	3	2	-	1	-	-	-	-	-	-	1	-	1	-
CO3	2	3	2	2	1	-	-	-	-	-	-	1	-	2	-
CO4	2	3	2	2	2	-	-	-	-	-	-	1	-	3	-
CO5	2	3	2	2	2	-	-	-	-	-	1	1	-	3	-
CO6	2	3	2	2	2	-	-	-	-	-	1	1	-	3	-

3 –High 2–Medium1–Low

Assessment:

ISE I, II, III	Shall be based on Class Tests/ Assignments / Quizzes /Field visits/ Presentations/ Course Projects

Assessment Table:

Assessment Tool	**K1**	**K2**	**K3**	**K3**	**K3**	**K4**
	CO1	**CO2**	**CO3**	**CO4**	**CO5**	**CO6**
ISEI	05	05	05	00	00	00
ISE II	05	05	05	00	00	00
ISE III	00	05	00	05	00	00
ESE	10	20	10	10	05	05

ETPCC3012: Lab Computer Networks

Teaching Scheme		Evaluation Scheme	
Practicals	02 Hrs/Week	ISE III	25
Total Credits	1	ESE	-

Course Outcomes:

As an outcome of completing the Laboratory course, students will be able to:

CO1	Implementprinciplesofcomputernetworking
CO2	Analyze performance of various computer network
CO3	Configure, Model and simulate Data Networks for LAN
CO4	Implement, analyze and evaluate networking protocols using Modern tools

List of Experiments:

01	Ethernet Cabling & Basic Configuration • Construct CAT6/CAT7 Ethernet cables (straight-through and cross-over). • Configure Layer 2 & Layer 3 switches and basic TCP/IP settings on PCs.
02	Execution of Windows Networking Commands such as Ping, NetstatARP, Netstat, Hostname, Tracert, Ip config, NSLookup, Route, Path Ping, Net Diag, Telnet, FTP, Netsh Execution of Linux Networking Commands such as ifconfig, ip, trace route, trace path, ping, netstat, ss, dig, nslookup, route, host, arp, iwconfig, hostname, curl or wget, mtr, whois, ifplugstatus, iftop, tcpdump
03	Error Detection & Correction Techniques Implement bit stuffing, character stuffing, and CRC code in software.
04	Data Link Layer Protocols Implement Stop-and-Wait and Sliding Window protocols in software.
05	ARQ Protocols Implement Go-Back-N and Selective Repeat protocols in software.
06	Create scenario and study IPIV and IPVI addressing scheme
07	Implementation of simple client server architecture
08	Web Server Configuration Configure WAMP and IIS servers for hosting web applications
09	Utilization of Wire shark network analyser, Network Simulation tools NS2/NS3
10	Network Modeling & Modern Tools Model and simulate networks using tools like Cisco Packet Tracer, GNS3, or Mininet.

Mapping of Course outcomes with Program Outcomes:

Program Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	2	3
CO1	1	2	3	1	2	-	-	-	-	-	-	-	-	2	-
CO2	2	1	3	1	1	-	-	-	-	-	-	-	-	2	-
CO3	1	1	3	1	2	-	-	-	-	-	-	-	-	2	-
CO4	2	1	3	1	3	-	-	-	-	-	-	-	-	2	-

3–High 2–Medium 1 –Low

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ETPRJ3001:Project – I

Teaching Scheme		Evaluation Scheme	
Practical	04 Hrs/Week	ISE III	50 Marks
Total Credits	02	ESE	50 Marks

Course Description: The project work will be carried out by a batch of at the most 4 students (Preferably 3 students) working on topic related to the Electronics, Telecommunications and allied fields. It is recommended to have a multi-disciplinary work by forming a project group of students from different programmes. The project group shall select the topic in consultation with the guide. They shall design and fabricate the system, and shall submit at the end of second term of current academic year.

Students shall carry field survey and review of literature on selected topic. They shall finalize the methodology and plan implementation stages of project.

ISE III: The evaluation is done through project reviews (2 to 3). The project batch has to prepare typed report of not less than 25 pages, in format, prescribed which shall include:

- Summary of field survey
- Literature review
- Technical details
- Design
- Related data

Every candidate has to give a talk on the selected topic in presence of faculty members and students. The Head of the department will appoint two internal examiners to assess the term work; guide shall be one of the examiners.

Course Outcomes:

As an outcome of completing the Laboratory course, students will be able to:

CO1	Identify, formulate and review the literature and frame problem statement.
CO2	Plan methodologies and implementation stages.
CO3	Write technical report and deliver presentation.

Mapping of Course outcome with Program Outcomes:

Program Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	2	3
CO1	3	3	2	1	2	3	1	1	2	1	2	3	2	2	2
CO2	3	2	2	1	2	1	1	2	1	2	1	2	2	2	2
CO3	3	2	2	1	2	1	1	1	1	3	1	2	2	2	2

3 -High2 –Medium 1 –Low

Assessment Table:

Assessment Tool	K4	K2	A3
	CO1	CO2	CO3
ISE III (50 Marks)	20	20	10
ESE (50 Marks)	20	20	10

Electronics & Telecommunication Engineering Department

Curriculum: Professional Electives

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Approved in the 32nd Academic Council Meeting, dated 26th July 2026

List of Professional Elective Courses

Professional Elective	Sr. No.	Course Code	Course Title
II (2+0+1)	01	ETPEC3011& 3012	Information Theory and Coding & Lab
	02	ETPEC3013 & 3014	Advanced Digital Signal Processing & Lab
	03	ETPEC3015 & 3016	Object Oriented Programming & Lab
	04	ETPEC3017 & 3018	Industrial Automation & Lab
	05	ETPEC3019 & 3020	Power Electronics & Lab
III (2+0+1)	01	ETPEC3021& 3022	Digital Image Processing & Lab
	02	ETPEC3023 & 3024	Deep Learning & Lab
	03	ETPEC3025 & 3026	Digital System Design & Lab
	04	ETPEC3027 & 3028	Cloud Computing & Lab
	05	ETPEC3029 & 3030	Digital Communication using GNU Radio & Lab
IV (2+0+1)	01	ETPEC4001 & 4002	Radar and Satellite Communication & Lab
	02	ETPEC4003 & 4004	Optical Fiber Communication& Lab
	03	ETPEC4005 & 4006	Generative AI & Lab
	04	ETPEC4007 & 4008	Digital VLSI & Lab
V (2+0+1)	01	ETPEC4011 & 4012	Microwave Engineering & Lab
	02	ETPEC4013 & 4014	Mobile Communication & Lab
	03	ETPEC4015 & 4016	Agentic AI & Lab
	04	ETPEC4017 & 4018	Automotive Electronics & Lab
VI (2+0+1)*	01	ETPEC4021 & 4022	Robotics & Lab
	02	ETPEC4023 & 4024	Wireless Communication beyond 5G & Lab
* The credits of this elective course are to be as per the final year curriculum			

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ETPE3011: Information Theory and Coding

Teaching Scheme		Evaluation Scheme	
Lectures	02 Hrs/Week	ISE I	15 Marks
Total Credits	02	ISE II	15 Marks
		ISE III	10 Marks
		ESE	60 Marks

Course description: This course describes Information theory, entropy, and channels. It also covers various types of codes like linear block codes, cyclic codes, BCH, and convolution codes. The subject deals with Information and channels in detail.

Course Outcomes

As an outcome of completing the Laboratory course, students will be able to:

CO1	Remember fundamentals concepts of Information theory and source coding
CO2	Explain the need of Source coding and Channel coding
CO3	Describe various types of Source coding and Channel coding and decoding
CO4	Apply theoretical concepts to derive various codes for real world signal

Detailed Syllabus:

Unit 1	Information Theory, Entropy, Source coding theorem, Channel models, capacity and coding, Information capacity theorem, Shannon's Limit
Unit 2	Linear Block Coding/Decoding, Matrix description of Linear block codes, Hamming codes, optimal linear codes, Maximum Distance Separable codes
Unit 3	Cyclic Codes, Polynomials, Generation of Cyclic codes, matrix description of cyclic codes, Burst Error Correction, Fire Codes, Golay Codes, Cyclic Redundancy Check, BCH Coding /Decoding, Primitive elements, Minimal Polynomials, Generator Polynomials, Reed Solomon codes.
Unit 4	Convolutional Code, Tree Codes and trellis codes, Polynomial description of Convolutional Codes, Distance Notion, generating function, Matrix description, Viterbi coding, Distance Bound, Performance bound, Turbo Coding/Decoding.

Textbooks:

1. Ranjan Bose, "Information Theory coding and Cryptography", McGraw-Hill Publication, 2nd Edition
2. J C Moreira, P G Farrell, "Essentials of Error-Control Coding", Wiley Student Edition.

Reference Books:

1. R. Avudaiammal, "Information Coding Techniques" Second Edition. Tata McGraw Hill
2. Simon Haykin, "Communication Systems", John Wiley & Sons, Fourth Edition.

Mapping of Course outcomes with Program Outcomes:

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	2	3
CO1	2									1				1	
CO2		2								2				2	
CO3	3	2	1				2			2		2		2	
CO4	3	2	1							2		2		3	

3 – High 2 – Medium 1 – Low

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Assessment:

ISE I, II, III	Shall be based on Class Tests/ Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects

Assessment table:

Assessment Tool	**K1**	**K2**	**K2**	**K3**
	CO1	**CO2**	**CO3**	**CO4**
ISE I (15 Marks)	05	10	00	00
ISE II (15 Marks)	00	05	10	00
ISE III (10 Marks)	00	00	00	10
ESE Assessment (60 Marks)	10	12	26	12

ETPE3012: Lab Information Theory and Coding

Teaching Scheme		Evaluation Scheme	
Lectures	02 Hrs/Week	ISE III	25 Marks
Total Credits	01	ESE	-

Course Outcomes:

As an outcome of completing the Laboratory course, students will be able to:

CO1	Recognize /calculate entropy, mutual information of given signal
CO2	Implement programs to generate various codes
CO3	Apply modern tools to code the real-world signal
CO4	Demonstrate how to compare the performance of coded with un-coded signals

List of Experiments:

Sr. No.	Details
1.	Write & Execute programs to find out entropies and mutual information of given signals for a given channel. Test various types of channels such as a) Noise free channel b) Error free channel
2.	Write & Execute programs to find out entropies and mutual information of given signals for a given channel. Test various types of channels such as a) Binary symmetric channel b) Noisy channel c) Compare channel capacity of above channels including experiment a) & b) channel
3.	Write & Execute programs for generation and evaluation of source coding a) Shannon – Fano coding and decoding
4.	Write & Execute programs for generation and evaluation of source coding a) Huffman Coding and decoding b) Lempel Ziv Coding and decoding
5.	Write& Execute Programs for coding & decoding of Linear block codes.
6.	Write & Execute Programs for coding & decoding of Cyclic codes.
7.	Write & Execute programs for coding and decoding BCH and RS codes.
8.	Write & Execute programs for coding and decoding of convolutional codes
9.	Write & Execute programs to study performance of a coded and uncoded communication
10.	Implement any one type of coding technique for real world 1-D or 2-D signals

Mapping of Course outcomes with Program Outcomes:

Course Outcome	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1				1	2		1		1	1
CO2	2	2	1	1	1				1	2		1		2	1
CO3	2	2	1	1	2		1		1	2		1		2	1
CO4	2	2	2	2	1				1	2		1		3	1

3 – High 2 – Medium 1 – Low

Assessment Table:

Assessment Tool	S1	S2	S2	S2
	CO1	CO2	CO3	CO4
ISE III (25 Marks)	05	10	05	05

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ETPEC3013: Advanced Digital Signal Processing		
Teaching Scheme	**Examination Scheme**	
Lectures: 02 Hrs/ week	ISE I	15
Credits: 02	ISE II	15
	ISE III	10
	ESE	60

Course description: This course is designed to bridge the gap between theoretical DSP algorithms and real-time embedded implementation. It focuses heavily on how to take an equation and make it run efficiently on hardware (DSP Processors, FPGAs, or ARM Cortex-M)

Course Outcomes:

As an outcome of completing the Laboratory course, students will be able to:

CO1	Understanding the way digital systems are used to process the real time analog signals.
CO2	Demonstrate the use of multi rate signal processing and multi resolution analysis
CO3	Application of an adaptive system & linear predictive coding system for detecting anomalies & removing noise.
CO4	Design application in real time domain in communication, computer network, speech, and image

Detailed Syllabus:

Unit 1	Fixed-point vs. Floating-point arithmetic, Q-format notation, quantization errors DSP Architectures: Von Neumann vs. Harvard architecture, Pipelining, VLIW (Very Long Instruction Word) architecture, MAC (Multiply-Accumulate) units, and SIMD (Single Instruction Multiple Data). Platform Overview: Comparison of dedicated DSP Processors, FPGAs and ARM Cortex-M4/M7 microcontrollers (CMSIS-DSP Library).
Unit 2	Multi-rate signal processing implementation: Polyphase decomposition for decimation and interpolation. Multistage implementation of sampling rate conversion; Quadrature Mirror Filters (QMF). Designing a sample rate converter for CD (44.1 kHz) to DAT (48 kHz) audio standards using MATLAB/Python and implementing the structure on an FPGA, Multi resolution analysis using Haar and Daubechies wavelet.
Unit 3	Adaptive Filters Principles of adaptive filter, FIR adaptive filters, Newton Descent algorithm, LMS algorithm, Adaptive noise cancellation, Adaptive equalizer, adaptive echo cancellation. Spectral Estimation: Non-parametric methods and parametric methods. Linear Prediction and Coding Forward and Backward linear prediction, Filtering-FIR Wiener filter, Filtering and linear prediction, non-causal and causal IIR wiener filter, Discrete Kalman filter.
Unit 4	Optimization Techniques, ADC/DAC interfacing protocols (I2S, SPI) for audio codecs, Case studies in audio, image and control system, Real-time Guitar Effects (Delay, Flanger, Reverb) on a DSP Kit,2D-Convolution for Edge Detection on FPGA, PID control loop implementation for motor drive using DSP.

Textbooks:

1. J.G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms, and Applications.
2. S.K. Mitra, Digital Signal Processing: A Computer-Based Approach.

Reference Books:

1. Avtar Singh and S. Srinivasan, Digital Signal Processing: Implementations using DSP Microprocessors.
2. ARM, Digital Signal Processing using the ARM Cortex-M4.

Assessment:

ISE I, II, III	Shall be based on Class Tests/ Assignments / Quizzes /Field visits/ Presentations/ Course Projects

Mapping of Course Outcome with Program Outcomes, Program Specific Outcomes:

PO	**01**	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**12**	**PSO1**	**2**	**3**
CO1	3	3	2	3	3				3	3	2	2	2	2	3
CO2	3	3	2	3	3				2	3	1	2	1	2	3
CO3	3	3	3	2	2				2	3	1	2	1	2	3
CO4	3	2	3	3	2				3	3	1	2	1	2	3

3 – High, 2 – Medium, 1- Low

Assessment Table

Assessment Tool	**K2**	**K2**	**K3**	**K3**
	CO1	**CO2**	**CO3**	**CO4**
ISE I (15)	09	06	00	00
ISE II (15)	00	00	09	06
ISE III (10)	00	00	00	04
ESE (60)	12	12	18	18

ETPEC3014: Lab Advanced Digital Signal Processing		
Teaching Scheme	**Examination Scheme**	
Practical: 02 Hrs/ week	ISE III	25
Credits: 1		

Course Outcomes

As an outcome of completing the Laboratory course, students will be able to:

CO1	Understand how digital systems process real-time analog signals using various architectures and arithmetic formats
CO2	Demonstrate and implement multi-rate signal processing and multi-resolution wavelet analysis
CO3	Design and deploy adaptive systems and linear predictive coding for noise, echo, or interference cancellation
CO4	Design and optimize real-time DSP applications for audio, image processing, and control systems

List of Experiments (Any 10 Experiments)

Sr. No.	Details
1	Fixed-point vs. Floating-point Analysis: Implement a basic FIR filter and compare the effects of quantization errors and Q-format notation on signal-to-noise ratio.
2	Architecture Performance Benchmarking: Compare the execution time of a Multiply-Accumulate (MAC) intensive operation using standard C vs. SIMD instructions on an ARM Cortex-M processor.
3	Multi-rate Sampling - Decimation: Implement polyphase decomposition for decimation to reduce the sampling rate of an audio signal without aliasing.
4	Multi-rate Sampling - Interpolation: Implement interpolation using polyphase structures and observe the spectral images and filter requirements.
5	Audio Standard Conversion: Design and implement a sample rate converter to transition audio from CD standard (44.1 kHz) to DAT standard (48 kHz).
6	Wavelet Analysis: Perform multi-resolution analysis (MRA) on a non-stationary signal using Haar or Daubechies wavelets to identify time-frequency features.
7	Adaptive Noise Cancellation: Implement the LMS (Least Mean Squares) algorithm to adaptively remove background noise from a corrupted speech signal.
8	Adaptive Channel Equalization: Design an adaptive equalizer to compensate for channel distortion in a simulated communication link.
9	Power Spectral Estimation: Compare non-parametric (Periodogram) and parametric (Autoregressive) methods for detecting low-level signals in noise.
10	Linear Predictive Coding (LPC): Implement forward and backward linear prediction to estimate the parameters of a speech signal for compression.
11	Real-time Audio Effects: Implement "Guitar Effects" such as Delay, Flanger, or Reverb on a DSP kit or ARM-based platform using I2S/SPI protocols.
12	2D-Convolution for Image Processing: Implement an edge detection algorithm (e.g., Sobel) on an FPGA using 2D-convolution techniques.

Mapping of Course Outcome with Program Outcomes, Program Specific Outcomes:

PO	01	02	03	04	05	06	07	08	09	10	11	12	PSO1	2	3
CO1	2	2	2	2	2					2		1		1	2
CO2	2	2	2	1	2					1		1		1	2
CO3	2	1	2	1	2					1		1		1	2
CO4	2	2	2	1	2					1		1		1	2

3 – High, 2 – Medium, 1- Low

Assessment Table:

Assessment Tool	S1	S2	S2	S2
	CO1	CO2	CO3	CO4
ISE III (25 Marks)	05	5	10	05

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ETPEC3015: Object Oriented Programming

Teaching Scheme		Evaluation Scheme	
Lectures	02 Hrs/Week	ISEI	15Marks
Total Credits	02	ISE II	15Marks
		ISE III	10Marks
		ESE	60Marks

Course description: This course introduces the fundamental principles and practices of Object-Oriented Programming (OOP) and their application in software development. The course emphasizes the concepts of classes, objects, encapsulation, inheritance, polymorphism, and abstraction, which form the foundation of modern programming paradigms. Students will learn to design modular, reusable, and maintainable software systems using object-oriented techniques. By the end of the course, students will be capable of analyzing real-world problems, designing object-oriented solutions, and implementing robust software applications using standard development tools and environments.

Course Outcomes:

After completion of the course, the student will be able to:

CO1	Understand core concepts of object-oriented programming.
CO2	Design classes and objects using encapsulation and abstraction.
CO3	Implement inheritance and polymorphism in programs.
CO4	Apply exception handling and file handling mechanisms
CO5	Develop small to medium-scale OOP-based applications

Detailed Syllabus:

Unit1	Introduction to Object-Oriented Programming: Evolution of programming paradigms, Procedure-oriented vs Object-oriented, Programming, Basic concepts: objects, classes, methods, message passing, Features of OOP: abstraction, encapsulation, inheritance, polymorphism, Advantages and applications of OOP, Introduction to OOP languages (C++, Java, Python, C#).
Unit2	Classes, Objects and Inheritance: Defining classes and objects, Data members and member functions, Access specifier (public, private, protected), Constructors and destructors, Static members, Object creation and memory management, Scope resolution (where applicable), Concept of inheritance, Types of inheritance (single, multilevel, hierarchical, multiple, hybrid)
Unit3	Polymorphism, Abstraction, Interfaces, and Exception Handling: Method overriding, Dynamic binding / late binding, Virtual functions (conceptual), Use of base and derived classes, Abstract classes and interfaces, Need for abstraction, Difference between abstract class and interface, Exception handling mechanism, Try–catch blocks, multiple catch, User-defined exceptions
Unit4	Advanced Concepts and File Handling: File input and output operations, Object serialization (conceptual), Packages and name spaces, Introduction to generic programming / templates, Multithreading, Overview of GUI programming (conceptual), Introduction to design principles using windows Forms, Form Controls and Properties, XML schema, Introduction to XAML and use of Windows Presentation Foundation (WPF).

Textbooks:.

1. E. Balagurusamy, *Object Oriented Programming with C++*, McGraw Hill
2. Herbert Schildt, *Java: The Complete Reference*, McGraw Hill

Reference Books:

1. Robert Lafore, *Object-Oriented Programming in C++*, SAMS
2. Timothy Budd, *An Introduction to Object-Oriented Programming*, Addison-Wesley

Recommended Tools / Platforms

- **C++**: GCC / Code::Blocks / Visual Studio
- **Java**: JDK + Eclipse / IntelliJ
- **Python**: Python 3.x + PyCharm / VS Code

Mapping of Course outcomes with Program Outcomes:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1													2
CO2	2	2			2					2					2
CO3	2	2			2					2					2
CO4	3	2	2		2					2		2			3
CO5	3	3	3	2	1				2	2		2			2

3 – High 2 – Medium 1–Low Assessment:

ISEI, II, III	Shall be based on Class Tests / Assignments / Quizzes / Field visits / Presentations / Course Projects

Assessment table:

Assessment Tool	K1	K2	K2	K3	K3
	CO1	**CO2**	**CO3**	**CO4**	**CO5**
ISEI (15Marks)	08	07	00	00	-
ISEII (15Marks)	00	00	09	06	-
ISEIII (10 Marks)	00	00	00	00	10
ESE (60Marks)	10	18	18	14	

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ETPEC3016: Lab Object Oriented Programming

Teaching Scheme		Evaluation Scheme	
Practicals	02Hrs/Week	ISE III	25Marks
Total Credits	01	ESE	-

Course Outcomes:

As an outcome of completing the Laboratory course, students will be able to:

CO1	Understand NET Framework, java eclipse, IntelliJ IDEA Community Edition, pycharms for python programming.
CO2	Learn, understand and execute OOPs concepts through examples
CO3	Design small application packages
CO4	Learn software obfuscation and deployment

List of Experiments/ Practicals (perform on any platform such as Microsoft visual studio, pycharm, c++, Eclipse IDE for Java Developers, IntelliJ IDEA Community Edition

Sr. No.	Details
1	Installation of Object-Oriented Platform (such as Microsoft visual studio, pycharm, c++, Eclipse IDE for Java Developers, IntelliJ IDEA Community Edition)
2	Writeandexecuteconsoleapplicationtodisplaymessagesandreadinputsfromuser
3	Program using Class and Objecte.g. Create a class Student with data members such as roll No, name, and marks. Define member functions to input and display student details. Create objects of the class and access class members.
4	Program Demonstrating Constructors and Destructors: e.g. Write a program using default and parameterized constructors. Demonstrate the use of destructor (or finalize concept in Java/python/c#) to show object lifecycle
5	Program Using Inheritance: e.g. Create a base class Employee and derived class Manager. Demonstrate single or multilevel inheritance and access base class members
6	Program Demonstrating Method overloading and Overriding (static and runtime polymorphism) Program to demonstrate dynamic method dispatch: e.g. Create a base class with a method and override it in the derived class. Call the method using base class reference. Dynamic dispatch: Use base class reference to invoke overridden methods of different derived classes at runtime
7	Program Using Abstract Class: e.g. Create an abstract class Shape with abstract method area () and implement it in derived classes like Circle and Rectangle
8	Program Using Interface: e.g. Create an interface Drawable with a method draw () and implement it in multiple classes
9	Program for Exception Handling: e.g. Write a program using try, catch, finally, and user-defined exceptions for handling arithmetic or input errors
10	File Handling Program: e.g. Write a program to write student data into a file and read it back using file streams. Append data to a file
11	Program Using Packages / Namespaces: e.g. Create user-defined packages and access classes from another package
12	Program Using Multithreading: e.g. Create multiple threads using Thread class or Runnable interface and demonstrate concurrent execution.
	Compulsory Mini Project Using OOP Concepts Suggested Mini Projects: • Student Management System

	• Library Management System • Banking System • Inventory Management System • Scientific Calculator • Snake and Ladder game Features to include: • Classes and objects • Inheritance and polymorphism • Exception handling • File handling • Modular design

Assessment Table:

Assessment Tool	**S1**	**S2**	**S2**	**S2**
	CO1	**CO2**	**CO3**	**CO4**
ISE III (25 Marks)	05	05	10	05

ETPEC3017: Industrial Automation

Teaching Scheme		Evaluation Scheme	
Lectures	02 Hrs/Week	ISE I	15 Marks
Total Credits	02	ISE II	15 Marks
		ISE III	10 Marks
		ESE	60 Marks

Course description: After completing this course, students will have a broad and fundamental understanding of industrial automation. Topics range from an overview of common automation industries to an introduction of basic automated system components, such as controllers, I/O, drives, and HMI (Human Machine Interface). In addition, students will learn common automation terminology, tools used in industrial automation, and career options available within this field

Course Outcome:

As an outcome of completing the Laboratory course, students will be able to:

CO1	State the PLC programming skills of timing and sequencing operations.
CO2	Identify the necessity of using DAS, SCADA, and DCS & PLC for Complex projects.
CO3	Understand the interfacing methods and industrial communication protocols
CO4	Understand the process control system principle

Detailed Syllabus:

Unit 1	Signal Conditioning Systems Data Acquisition systems, Data Loggers, Industrial Programmable logic controllers (PLC), Programming techniques, SCADA, Distributed Control Systems (DCS). Human Machine Interface
Unit 2	Introduction to industrial communication protocols- TCP/IP protocol- HART communicator protocol Wireless communication (Ip56, Ip58) LAN – PROFI bus, PROFI Net, Modbus, CAN bus, fieldbus architecture, I/O Link and Industrial Ethernet
Unit 3	Process Control system principles, Basic concepts, Industrial pneumatic and hydraulic systems, SEAL 2 & 3 systems.
Unit 4	Introduction to Fuzzy Neuro Controllers Development of automation systems to industrial processes, IoT, Case studies

Textbooks:

1. Bela G. Liptak, Instrumentation Engineer "s Handbook, CRC Press
2. H. S. Kalsi, Electronic Instrumentation, TMH
3. J. Nagrath & M. Gopal, Control System Engineering, Third edition, New Age International Publication Rangan and Sarma, Instrumentation Systems, TMH
4. Helfric A.D & Cooper W.D, Modern Electronic Instrumentation &Measurement Techniques, Pearson Education

Reference Books:

1. Curtis D Johnson, Process Control; Instrumentation Technology, Pearson Education, 2008
2. PLC manuals from Siemens G.C. Goodwin, S.R.Graebe, M.E. Salgado, Control System Design, Pearson Education

Mapping of Course outcomes with Program Outcomes:

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	1	1			2							2	2		1
CO2	1	1	1		2				1			2	2		
CO3	2	1	1		2				2	2		2		2	
CO4		1			3	1				2		2	2		2

3 – High 2 – Medium 1– Low

Assessment:

ISE I, II, III	Shall be on the basis of Class tests/ Assignments/ Quizzes/ Field Visits/ Presentations/Course Projects

Assessment table:

Assessment Tool	**K1**	**K2**	**K2**	**K2**
	CO1	**CO2**	**CO3**	**CO4**
ISE I (15 Marks)	05	10	00	00
ISE II (15 Marks)	00	05	10	00
ISE III (10 Marks)	00	00	00	10
ESE (60 Marks)	15	15	20	10

ETPEC3018: Lab Industrial Automation

Teaching Scheme		Evaluation Scheme	
Lectures	02 Hrs/Week	ISE III	25 Marks
Total Credits	01	ESE	-

Laboratory Course Outcomes:

As an outcome of completing the Laboratory course, students will be able to:

CO1	Explore PLCs, SCADA, DCS, controllers, motors, actuators, encoders, sensors, and PID loops in automation systems.
CO2	Develop an understanding of economic issues related to industrial Robotic and automation systems.
CO3	Participate in a group atmosphere for the defining, planning, and execution of an open-ended Automation problem.
CO4	Communicate effectively both verbally and in written form through the preparation of journal reports and practical presentation.

List of Experiments:

Sr. No.	Details
1	Analyze PLC, SCADA and write a PLC program for a defined timing and sequence operation
2	Industrial visit for study of SCADA/ DCS implementation.
3	Applications of various types of practical sensor and its interfacing with systems.
4	Implementation/ Simulation of application of automation to any manual systems.
5	Design and development of a tiny robotic system.
6	Development of simple computer vision systems.
7	Analyze various industrial communication protocols.
8	Development of Automation system for industrial process.

Mapping of Course outcomes with Program Outcomes:

Program Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO1				3	2	1						3	1		
CO2		1		3	1							2		2	
CO3				3							2	1			
CO4			2		1					3					

3 – High 2 – Medium 1 - Low

Assessment Table:

Assessment Tool	S1	S2	S3	S3
	CO1	CO2	CO3	CO4
ISE III (25 Marks)	04	05	10	06

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ETPEC3019: Power Electronics

Teaching Scheme		Evaluation Scheme	
Lectures	02 Hrs./Week	ISE I	15 Marks
Total Credits	02	ISE II	15 Marks
		ISE III	10 Marks
		ESE	60 Marks

Course description: Power electronics applies to solid-state devices to efficiently control and convert electrical power. It introduces power converters that regulate voltage, current, and power for various applications.

Course Outcomes:

As an outcome of completing the Laboratory course, students will be able to:

CO1	Identify Power Semiconductor devices and mechanisms to trigger and commutate
CO2	Understand circuits of trigger and commutation, controlled rectifiers, choppers and inverters
CO3	Explore applications of Power Devices
CO4	Solve the numerical related to power devices, controlled rectifiers, choppers and inverters

Detailed Syllabus:

Unit-1	Power Semiconductor Devices: Power diodes, power transistors, power MOSFET, IGBT, SCR, GTO, TRIAC, DIAC, UJT, PUT- construction, steady state and switching characteristics, performance parameters, SCR protection circuits.
Unit-2	Triggering and Commutation of SCR: R and RC triggering, UJT triggering circuits, different commutation techniques – circuits and principles of operation.
Unit-3	Phase Controlled Rectifiers: Phase angle control, phase-controlled rectifiers, single phase half control and full wave-controlled converter, Introduction to cycloconverter.
Unit-4	Chopper& Inverter: Basic chopper classification, basic chopper operation, control strategies, chopper configuration, thyristor chopper circuit, Source filter. Classification of inverter, Series, parallel, bridge inverter, sinusoidal PWM- introduction to space vector modulation -Current Source Inverter. Power electronics applications: Industrial drives chopper-controlled drives, Induction heating, UPS and SMPS.

Textbooks

1. P.C. Sen, “Power Electronics”, Tata McGraw Hill
2. M.H. Rashid, “Power Electronics”, John Wiley & Sons
3. General Electric, “SCR manual”
4. G. K. Dubey, S. R Doradle, “Thyristors Power Controller”

Reference Books

1. J. M. Jalnekar and N. B. Pasalkar, “Power Electronics” Technical Publication
2. M D Singh and K. B Khanchandani, “Power Electronics”, Tata McGraw Hill
3. B.K.Bose, “Power Electronics & A.C. Drives”, Prentice Hall, 1986

Mapping of Course outcomes with Program Outcomes:

Program Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	2	3
CO1	1	1	-	-	-	-	-	-	-	1	1	-	2	1	-
CO2	2	2	-	-	-	-	-	-	-	1	1	-	2	1	-
CO3	2	2	-	-	-	-	-	-	-	1	1	-	2	-	-
CO4	2	2	-	-	-	-	-	-	-	1	1	-	2	1	-

3 – High 2 – Medium 1 - Low

Assessment:

ISE I, II, III	Shall be based on Class Tests/ Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects

Assessment table:

Assessment Tool	K1	K2	K2	K3
	CO1	CO2	CO3	CO4
ISE I (15 Marks)	10	05	00	00
ISE II (15 Marks)	00	10	00	05
ISE III (10 Marks)	00	05	00	05
ESE Assessment (60 Marks)	12	30	06	12

ETPEC3020: Lab Power Electronics

Teaching Scheme		Evaluation Scheme	
Practicals	02 Hrs./Week	ISE III	25 Marks
Total Credits	01	ESE	-

Course Outcomes:

As an outcome of completing the Laboratory course, students will be able to:

CO1	Understand the principles of operation, simulation and design procedures of ac-dc, dc-dc converter, dc-ac inverters
CO2	Understand the principles of operation, simulation and characteristic of power devices, method of turn on and turn off of SCR
CO3	Implement set up and test power electronic circuits in the laboratory
CO4	Use Simulation tools.

List of Experiments:

Sr. No.	Details
1	Plot the V/I characteristics of power devices.
2	Implement Firing circuit of SCR and design of Snubber circuit.
3	Perform the commutating circuits of SCR.
4	Plot the TRIAC and DIAC characteristics.
5	Perform Single phase, thyristor –bridge converter with R/RL load
6	To study Series inverter.
7	To study Performance of parallel inverter using two thyristors.
8	Implement SCR application (Anyone).
9	Implement the performance of chopper circuit using SCR (DC chopper).
10	To Study of cyclo-converter circuit using thyristors.

Mapping of Course outcomes with Program Outcomes:

Program Outcome	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	2	3
CO1	2	-	-	2	-	-	-	-	-	-	-	-	2	-	-
CO2	2	-	-	2	-	-	-	-	-	-	-	-	2	-	-
CO3	2	-	-	2	-	-	-	-	-	-	-	-	2	-	-
CO4	2	-	-	2	2	-	-	-	-	-	-	-	2	-	-

3 – High 2 – Medium 1 - Low

Assessment Table:

Assessment Tool	S1	S2	S2	S2
	CO1	CO2	CO3	CO4
ISE III (25 Marks)	04	07	07	07

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ETPEC3021: Digital Image Processing		
Teaching Scheme	**Examination Scheme**	
Lectures: 02 Hrs/ week	ISE I	15
Credits: 02	ISE II	15
	ISE III	10
	End Semester Examination	60

Prerequisites: Knowledge of Digital Signal Processing

Course description: This course covers representation of image in matrix form. Various operations carried out on images to boost the quality of image or to compress the image are covered. Algorithms based on morphology and segmentation led to important applications. Course covers all the spatial and frequency domain techniques for image enhancement. This also exposes to representation and classification of images.

Course Outcomes:

After completing the course, students will be able to:

CO1	Understand digital representation of image and the convolution operation.
CO2	Learn the image processing algorithms for image enhancement and restoration
CO3	Conduct independent study and analysis of image processing problems and Techniques and their applications to real world problems
CO4	Apply various type of segmentation algorithms on image

Detailed Syllabus:

Unit 1	Fundamental of Image Processing: Image Sensing and Acquisition, Image Sampling and Quantization, Digital Image Representation, Basic Relationship between Pixels, Linear and Nonlinear Operations, Image formats, 2D Fourier Transforms, Image Enhancement in Spatial Domain and Frequency Domain Filtering, Color Image Processing,
Unit 2	Image Registration and Restoration: Image Registration, Models of Image Degradation/Restoration Process, Noise Models, Restoration in presence of Noise, Periodic Noise, Reduction by Frequency Domain Filtering, Linear Position Invariant Degradation, Estimating Degradation Function, Inverse Filtering, Wiener Filtering, Constrained Least, Square Filtering, Geometric Mean Filtering, Geometric Transformations
Unit 3	Image Compression: Fundamentals, Compression Models, Entropy Computation, Lossless and Lossy Compression, Image Compression Standards Morphology: Dilation, Erosion, Opening and Closing, Basic Morphological Algorithms, Binary and Gray Scale Morphology
Unit 4	Image Segmentation and Description: Detection of Discontinuities, Edge Linking and Boundary Detection, Thresholding, Region Based Segmentation, Use of Motion in Segmentation, Representation and Description: Representation Schemes, Boundary Descriptors, Regional Descriptions, Relational Descriptors

Textbooks:

1. Rafel Gonzales and Richard Woods, Digital Image Processing, Third Edition, Pearson Education
2. A.K. Jain, Fundamentals of Digital Image Processing, PHI

Reference Books:

1. Rafel Gonzales and Richard Woods, Digital Image Processing with MATLAB, Pearson Education

Mapping of Course outcome with Program Outcomes

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	3	3				1	1	1	1	-	1	3
CO2	3	3	2	3	3				1	1	1	1	-	1	3
CO3	3	3	2	2	2				1	1	1	2	-	1	2
CO4	2	2	2	2	2				1	1	1	2	-	1	3

1 –Low 2 – Medium 3-High

Assessment:

ISE I, II, III	Shall be based on Class Tests/ Assignments / Quizzes /Field visits/ Presentations/ Course Projects

Assessment table

Assessment Tool	**K2**	**K2**	**K3**	**K2**
	CO1	**CO2**	**CO3**	**CO4**
ISE I (15Marks)	05	10	00	00
ISE II (15Marks)	05	05	05	00
ISE III (10 Marks)	00	05	05	00
ESE (60Marks)	12	12	24	12

ETPEC3022: Lab Digital Image Processing		
Teaching Scheme	**Examination Scheme**	
Practical: 02 Hrs/ week	ISE III	25
Credits: 1		

Course Outcomes

As an outcome of completing the Laboratory course, students will be able to:

CO1	Demonstrate image information
CO2	Manipulate various image operations
CO3	Manipulate image using various filters
CO4	Differente between spatial and frequency domain operation

List of Experiments

Sr. No.	**Details**
1	Study image information and various image formats
2	Write programs to perform arithmetic and logical operations on image
3	Write programs to perform geometric operations on image
4	Implement various Image enhancement algorithms
5	Implement various spatial domain filters on images
6	Implement various frequency domain filters on images
7	Perform different morphological operations on image
8	Implement image segmentation using different edge detection techniques
9	Implement image segmentation using thresholding for different images
10	Implement region-based image segmentation for multiple applications

Mapping of Course outcomes with Program Outcomes:

Program Outcome	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	2	3
CO1	2	2	1	1	2	-	-	-	-	-	-	2	-	-	2
CO2	2	3	2	2	2	-	-	-	-	-	-	2	-	-	2
CO3	3	2	3	3	3	-	-	-	-	-	-	2	-	-	2
CO4	3	3	2	3	3	-	-	-	-	-	-	2	-	-	2

3 – High 2 – Medium 1 - Low

Assessment Table:

Assessment Tool	**S1**	**S2**	**S2**	**S2**
	CO1	CO2	CO3	CO4
ISE III (25 Marks)	5	5	10	5

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ETPEC3023: Deep Learning		
Teaching Scheme	**Examination Scheme**	
Lectures: 02 Hrs/ week	ISE I	15
Credits: 02	ISE II	15
	ISE III	10
	End Semester Examination	60

Course Outcomes:

After completing the course students will be able to

CO1	Transition from shallow neural networks to deep architecture and optimization strategies.
CO2	Master Convolutional Neural Networks (CNNs) for image and video analysis.
CO3	Understand sequence modeling for time-series and telecom data using RNNs &Transformers.
CO4	Implement deep learning models using modern frameworks (PyTorch/TensorFlow).

Detailed Syllabus:

Unit 1	Optimization and Training of Deep Neural Networks: Building on Fundamentals: Review of MLP and Backpropagation (brief recap). The Vanishing and Exploding Gradient problems, Optimization Algorithms: Moving beyond SGD. Momentum, Nesterov, Adagrad, RMSProp, and Adam optimization, Regularization Strategies: L1/L2 regularization, Dropout, Early Stopping, Data Augmentation techniques. Hyper parameter Tuning: Weight initialization techniques (Xavier/Glorot, He initialization), Batch Normalization, and Layer Normalization, Deep Learning Frameworks: Introduction to computation graphs, tensors, and automatic differentiation (Autograd) using PyTorch or TensorFlow.
Unit 2	Convolutional Neural Networks (CNNs): Image processing basics: Image Formation, Image Representation, Linear Filtering in Time and Frequency domain, Correlation, Convolution, Edge Detection CNN Architecture: Convolution operation, Pooling layers (Max, Average, Global Average), Stride, Padding, and Receptive fields. Classic Architectures: LeNet-5, AlexNet, VGG-16/19. Modern Architectures & Residual Learning: ResNet (Skip connections), Inception modules (GoogLeNet), MobileNet (Depth-wise separable convolutions for efficient computing). Advanced Vision Tasks: Object Detection (YOLO, SSD architectures—mathematical overview), Semantic Segmentation (U-Net architecture). Transfer Learning: Fine-tuning pre-trained models for custom datasets.
Unit 3	Sequence Modeling and Recurrent Networks: Sequence Data: Handling time-series and sequential data (relevant to Telecom signals). Recurrent Neural Networks (RNN): Unfolded architecture, Backpropagation Through Time (BPTT). Gated Architectures: The Long Short-Term Memory (LSTM) cell structure, Gated Recurrent Units (GRU). Applications: Time-series forecasting, Sentiment analysis, Sequence-to-Sequence models (Encoder-Decoder architecture).

Unit 4	Attention Mechanisms and Transformers: Limitations of RNNs: Bottlenecks in sequential processing. Attention Mechanisms: The concept of Attention, Dot-product attention, Multi-head Self-Attention. The Transformer Architecture: Encoder-Decoder Stacks, Positional Encoding. Modern NLP & Vision Transformers: Introduction to BERT (Bidirectional Encoder Representations from Transformers), GPT concepts, and Vision Transformers (ViT). Introduction to Unsupervised Deep Learning and Generative Models.

Textbooks:

1. "Deep Learning", Ian Goodfellow, Yoshua Bengio, and Aaron Courville, MIT Press
2. "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow",Aurélien Géron, O'Reilly Media.

Reference Books:

1. "Deep Learning with Python", François Chollet, Manning Publications.
2. "Dive into Deep Learning", Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola,. (https://d2l.ai/).
3. "Neural Networks and Deep Learning", Michael Nielsen.

Assessment:

ISE I, II, III	Shall be on the basis of Class Tests/ Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects

Mapping of course outcome with program outcomes:

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	2	3
CO1	2	2	2									1	2		_
CO2	2	2	2									1	1		2
CO3	2	2	2		2							1	1		2
CO4	2	2	2	2	2							1	1		2

1-Low **2-Medium** **3-High**

Assessment Table

Assessment Tool	**K2**	**K2**	**K3**	**K3**
	CO1	**CO2**	**CO3**	**CO4**
ISE I (15)	09	06	00	00
ISE II (15)	00	00	09	06
ISE III (10)	00	00	00	10
ESE Assessment (60)	12	12	12	24

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ETPEC3024: Lab Deep Learning		
Teaching Scheme	**Examination Scheme**	
Practical: 02 Hrs/ week	ISE III	25
Credits: 1		

Course Outcomes

As an outcome of completing the Laboratory course, students will be able to:

CO1	Learn transition from shallow neural networks to deep architectures and optimization strategies.
CO2	Master Convolutional Neural Networks (CNNs) for image and video analysis.
CO3	Understand sequence modeling for time-series and telecom data using RNNs and Transformers.
CO4	Implement deep learning models using modern frameworks (PyTorch/TensorFlow).

List of Experiments (Any 10 Experiments)

Sr. No.	Details
1	Implement a simple linear regression model using automatic differentiation (Autograd) and visualize the computation graph
2	Study the Impact of Hyperparameters and Optimizers by training a Multi-Layer Perceptron (MLP) on an image dataset and plot training loss curve for SGD optimizer
3	Study the Impact of Hyperparameters and Optimizers by training a Multi-Layer Perceptron (MLP) on an image dataset and plot training loss curve for RMSProp optimizer
4	Study the Impact of Hyperparameters and Optimizers by training a Multi-Layer Perceptron (MLP) on an image dataset and plot training loss curve for Adam optimizer. Compare the training loss curves from experiment #3 and #4.
5	Mitigating Overfitting with Regularization- Observe the effect of Dropout on overfitting vs. underfitting
6	Mitigating Overfitting with Regularization- Observe the effect of Batch Normalization on overfitting vs. underfitting
7	Design a custom CNN architecture to classify images from a dataset. Plot the confusion matrix for the test set
8	Utilize pre-trained state-of-the-art models like ResNet-50 or VGG-16 for transfer learning for object classification and compare the convergence speed of Transfer Learning vs. training from scratch from experiment #4
9	Implement an LSTM network to predict the next value in the sequence based on a window of past values
10	Implement a model to classify reviews as positive or negative sentiment

Mapping of Course Outcome with Program Outcomes, Program Specific Outcomes:

PO	01	02	03	04	05	06	07	08	09	10	11	12	PSO1	2	3
CO1	2	3	1	2	3					1		1		1	2
CO2	2	2	2	2	3					2		1		1	2
CO3	2	2	3	1	2					1		1		1	2
CO4	2	2	2	1	3					1		1		1	2

3 – High, 2 – Medium, 1- Low

Assessment Table:

Assessment Tool	S1	S2	S2	S2
	CO1	CO2	CO3	CO4
ISE III (25 Marks)	05	05	05	10

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ETPEC3025: Digital System Design

Teaching Scheme		Evaluation Scheme	
Lectures	02Hrs/Week	ISE I	15 Marks
Total Credits	02	ISE II	15 Marks
		ISE III	10 Marks
		ESE	60 Marks

Course description: This course introduces the concept of hardware design and implementation using Hardware Description Languages like VHDL. Students also learn about the architecture of different Programmable Logic Devices like PAL, PLA, CPLD, FPGA etc. Students will be able to simulate and test hardware and optimize their designs. They will learn about the use of FPGAs in digital design and the full FPGA design flow.

Course Outcomes:

After completing the course, the students will be able to:

CO1	Identify the different process steps in HDL design flow, basics of VHDL and architectures.
CO2	Implement combinational and sequential digital circuits using different styles of modeling and Finite State machines
CO3	Prepare the design of digital systems to meet a given set of specifications using VHDL or finite state machines.
CO4	Understand simulation, synthesis process and architectures of programmable devices

Detailed Syllabus:

Unit 1	Fundamentals of VHDL and Modeling Styles: Introduction to HDL, HDL design flow, VHDL, Features of VHDL, Levels of Abstraction, Language Constructs, Entity, Architecture, Data types, constants, Signals and variables, Libraries and Packages, Functions and Procedures. Dataflow modelling: Concurrent Statements. Behavioral Modeling: Process statement, Inertial and Transport Delay Models, Signal Drivers, Sequential statements, IF, CASE, NULL, Loop, Wait, Exit, Next statements, Assertion and Report statements, block statement. Structural Modeling: Component declaration, component instantiation, Generics.
Unit 2	Combinational Logic Design Using VHDL VHDL modeling of basic gates, half and full adder, subtractor, multiplexers, multiplier, ALU, decoders, parity checker, Comparator, priority encoder, (Dataflow, behavioral and structural modeling), Introduction to Verilog.
Unit 3	Sequential Logic Design Using VHDL VHDL modeling of D, T, JK, Shift Registers, Counters, Implementation of Moore and Mealy Machines, Asynchronous Sequential Machines, Applications like Traffic light controller, lift controller or any other.
Unit 4	VHDL Simulation and Synthesis Writing a Test Bench, Simple examples of Test Benches, Compilation and Simulation of VHDL code, Simulation deltas, Synthesis Process, RTL Description, Translation, Boolean Optimization, Mapping to Gates, Architecture of PAL, PLA, CPLD and FPGA.

Text Books

1. Charles Roth, “Digital Design with VHDL”, Thomson Learning, India Edition
2. John Wakerly, “Digital Design: Principal and Practices”, Pearson Education
3. Douglus Perry, “VHDL Programming by example”, TMH, fourth edition

Reference Books

1. J. Bhasker, “VHDL Primer”, PHI
2. J. Bhasker, “A VHDL synthesis Primer”, BSP, New Delhi
3. Wayne Wolf, "FPGA-Based System Design," Prentice Hall

Mapping of course outcome with program outcomes:

Program outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1		3				3							1		
CO2			2		3				2		2		2		
CO3			1		1				1		2	2	3		
CO4		2			2								1		

3-High 2-Medium 1-Low

Assessment:

ISE I, II, III	Shall be on the basis of Class tests/ Assignments/ Quizzes/ Field Visits/ Presentations/Course Projects

Assessment Table:

Assessment Tool	**K1**	**K2**	**K3**	**K2**
	CO1	**CO2**	**CO3**	**CO4**
ISE I (15 marks)	05	10	--	--
ISE II (15 marks)	--	10	05	--
ISE III (10 marks)	--	05	05	--
ESE (60 marks)	06	24	12	18

ETPEC3026: Lab Digital System Design

Teaching Scheme		Evaluation Scheme	
Practicals	02 Hrs/Week	ISE III	25 Marks
Total Credits	01	ESE	-

Course Outcomes

As an outcome of completing the Laboratory course, students will be able to:

CO1	Demonstrate HDL design flow with the help of CAD design tools
CO2	Execute programs using VHDL with different modeling techniques and finite state machines
CO3	Synthesize, simulate and download programs on FPGA platforms

List of Experiments: (Minimum eight)

Sr. No.	Name of the experiment
1.	Demonstrate and practice to use CAD design tools to model digital circuits.
2.	Implement simple circuits using data flow modeling: Gate, half adder, MUX, function
3.	Write simple VHDL programs to use different operators of VHDL: relational, logical, data types
4.	Implement combinational circuits using data flow modeling (conditional statement): MUX, Decoder, Prime number. Write test bench to generate waveforms and hardware.
5.	Implement combinational digital circuits using behavioral modeling: Priority Encoder, full adder, parity generator/checker. Write test bench to generate waveforms and hardware.
6.	Implement sequential digital circuits using behavioral modeling: D, J-K flipflops, 3-bit counter, up/down counter, ring counter. Write test bench to generate waveforms and hardware.
7.	Implement digital circuits using structural modeling: 4-bit adder using half and full adder, 8-bit inverter using 1-bit inverter, 8:1MUX using 2:1 MUX. Write test bench to generate waveforms.
8.	Implement types of counter with 1 Hz frequency to download on FPGA platform: 4-bit counter, decade counter, ring counter. Write test bench to generate waveforms and hardware.
9.	Implement FSMs using VHDL: Mealy and Moore Machines
10.	Write simple Verilog programs. (Any four programs).
11.	Design and develop Lift/Traffic controller on FPGA.

Mapping of Course outcomes with Program Outcomes:

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1					2								2		
CO2				2	1						2	3	3		
CO3				2	1						2	1	1		

3 – High 2 – Medium 1– Low

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Assessment:

ISE III: ISE III shall be Term work, consisting of record of experiments/assignments based on the syllabus. The experiments will comprise of Modeling, Simulation and Synthesis and Hardware verification using programmable logic Target boards using Xilinx ISE/Aldec / Vivado

Assessment Table:

Assessment Tool	**S1**	**S2**	**S2**
	CO1	**CO2**	**CO3**
ISE III : Term Work (25 Marks)	05	16	04

ETPEC3027: Cloud Computing

Teaching Scheme		Evaluation Scheme	
Lectures	02 Hrs/Week	ISEI	15 Marks
Total Credits	02	ISEII	15 Marks
		ISEIII	10 Marks
		ESE	60 Marks

Course Outcomes:

As an outcome of completing the course, students will be able to:

CO1	Analyzethecomponentsofcloudcomputingshowinghowbusinessagilityinan organization can be created.
CO2	Evaluate the deployment of web services from cloud architecture.
CO3	Critique the consistency of services deployed from a cloud architecture
CO4	Criticallyanalyzecasestudiestoderivethebestpracticemodeltoapplywhen developing and deploying cloud-based applications

Detailed Syllabus:

Unit1	Cloud Computing Fundamentals Cloud Computing definition, Characteristics of Cloud Computing, Core Components of Cloud Computing, Models in Cloud Computing: Deployment models–Private cloud, public cloud, Hybrid cloud, Community cloud and Service models-IaaS, PaaS, SaaS Concept of Tenancy, Multi-Tenancy. Introduction to Grid Computing, Applications of cloud computing, Benefits of cloud computing, Limitations of cloud computing.
Unit2	Cloud architecture and Service Models: Cloud Architecture overview, Cloud Service layers: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS), Extended service models: Identity as a Service (IDaaS), Security as a Service (SECaaS), Compliance as a Service (CaaS)
Unit3	Cloud Infrastructure and Virtualization Infrastructure– Cloud Infrastructure components: Clients, Security, Network and Services, Virtualization fundamentals, Virtualization types: Server virtualization, Storage virtualization, Network virtualization, Hypervisors: Introduction and types, Virtualization management, Load balancing concepts
Unit4	Cloud Security & Platforms: Security: Cloud Security Risks and challenges, privacy and data protection, Operating system and virtualization security, Authentication and Client access, Infrastructure, network, host and application-level security Cloud Platform & Implementations: Amazon EC2 & S3, Google App Engine, Open – source cloud platforms: Eucalyptus, Open stack, Open Nebula, Inter-cloud concepts, Cloud applications and use cases

Textbooks

1. Cloud Computing for Dummies by Judith Hurwitz, R. Bloor, M. Kanfman, F. Halper (Wiley India Edition)
2. Enterprise Cloud Computing by Gautam Shroff, Cambridge
3. Cloud Security by Ronald Krutzand Russell Dean Vines, Wiley-India
4. Google Apps by Scott Granneman, Pearson

Reference Books

5. Cloud Security & Privacy by Tim Malhar, S. Kumara swammy, S. Latif (SPD, O'REILLY)
6. Cloud Computing: A Practical Approach, Antohy T Velte, et.al. McGraw Hill,
7. Cloud Computing Bible by Barrie Sosinsky, Wiley India
8. Stefano Ferrettiet. al. QoS–awareClouds",2010IEEE3rdI Conference on Cloud Computing

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9. Virtualization for Dummies: Wiley India.
10. Resources available on e-learning site http://www.e-gecaect.com
11. Microsoft Technical Journal, Google Cloud Platform resources

Mapping of Course outcomes with Program Outcomes:

Program Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	2	3
CO1	3	2			1			1				3			
CO2	1	3	2		2						3	2			
CO3	1		3	2	2					3		3			
CO4	3		2	3	2			3							

3 –High 2 – Medium 1 –Low

Assessment:

ISEI, II, III	Shall be on the basis of Class tests/Assignments/Quizzes/Field Visits/ Presentations/Course Projects

Assessment table:

Assessment Tool	**K1**	**K2**	**K2**	**K3**
	CO1	**CO1, CO2**	**CO3**	**CO4**
ISE–I (15 Marks)	05	10	00	00
ISE–II (15 Marks)	00	00	10	05
ISE- III (10 Marks)	00	00	05	05
ESE (60Marks)	10	20	15	15

ETPEC3028: Lab Cloud Computing

Teaching Scheme		Evaluation Scheme	
Practicals	02 Hrs/Week	ISEIII	25 Marks
Total Credits	01	ESE	-

Course Outcomes

As an outcome of completing the Laboratory course, students will be able to:

CO1	Understand virtualization concept
CO2	Use cloud services provided by Amazon, Google ,Azure
CO3	Design and evaluate cloud architecture and service models (IaaS, PaaS, SaaS, etc.)
CO4	Demonstrate practical skills in deploying and managing cloud platforms and applications

List of Experiments: Perform any six experiments.

Sr.No.	Details
1	Installing Ubuntu (server edition) using virtual box, and study virtualization.
2	Installing Open stack cloud: Creating sandbox environment using Virtual Box
3	Setting up and using an instance on public IaaS cloud
4	Setting up Team Viewer Software: a) Accessing remote PC on the host PCb) Sharing of files within the desktop shared PC
5	Exploring Git Hub to learn features such as a. How to create repositories on GitHub., b. How source code can be uploaded /downloaded from repositories., c. Making code commits in repositories. ., GitHub issue tracking features.
6	Transfer larger files/ folders to another computer using cloud storage service
7	Understanding Software as a Service: Sales Force
8	Understanding Platform as a Service: Microsoft, Azure
9	Understanding Infrastructure as a Service: AmazonS3
10	Understand Google Apps and create Google forms.

Mapping of Course outcomes with Program Outcomes:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			1	1						3		1
CO2			3						2		2	1
CO3			3				1				2	3
CO4			3	2	2			2			3	2

3–High 2–Medium 1-Low

Assessment Table

Assessment Tool	S1	S3	S4	S2
	CO1	CO2	CO3	CO4
ISEIII (25 Marks)	05	05	10	05

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ETPEC3030–Lab Digital Communication Using GNU Radio

Teaching Scheme	Examination Scheme:
Practical:2 Hrs/Week	ISEIII: 25Marks
Credits:1	

Course Outcomes:

After completing the course, students will be able to:

CO1	Understand the architecture of GNU Radio and Software Defined Radio (SDR) and create basic signal processing flowgraphs using GNU Radio Companion.
CO2	Analyze the effects of sampling rate and quantization on digital signals and verify the Nyquist sampling criterion through simulation.
CO3	Generate and analyze digital baseband signals using different line coding techniques and observe their time-domain behavior.
CO4	Apply pulse shaping techniques such as rectangular, raised cosine, and root raised cosine filters to reduce inter-symbol interference (ISI).
CO5	Implement and analyze digital modulation schemes such as BPSK, QPSK, 8-PSK, and QAM using constellation diagrams and waveform observation.
CO6	Model the Additive White Gaussian Noise (AWGN) channel and evaluate its impact on signal quality and constellation performance.
CO7	Measure and analyze Bit Error Rate (BER) performance for various digital modulation schemes and compare simulated results with theoretical values.
CO8	Design and implement an Orthogonal Frequency Division Multiplexing (OFDM) system and analyze the role of FFT, IFFT, and cyclic prefix.
CO9	Evaluate overall digital communication system performance by integrating transmitter, channel, and receiver blocks in GNU Radio.
CO10	Develop practical skills in simulation-based analysis of digital communication systems using GNU Radio for real-world and SDR-based applications.

List of Experiments:

1.	Introduction to GNU Radio and SDR • Study of GNU Radio architecture • GNU Radio Companion (GRC) blocks and flowgraph creation • Basic signal generation and visualization (time & frequency domain)
2.	Sampling and Quantization • Effect of sampling rate on digital signals • Quantization noise and resolution analysis • Nyquist criterion verification
3.	Digital Baseband Signal Generation • Binary data source generation • Unipolar and bipolar NRZ signaling • Baseband waveform observation
4.	Pulse Shaping Techniques • Rectangular pulse shaping

	• Raised cosine and root raised cosine filters • ISI reduction analysis
5.	Digital Modulation Schemes • Binary Phase Shift Keying (BPSK) • Quadrature Phase Shift Keying (QPSK) • 8-PSK modulation and constellation analysis
6.	Quadrature Amplitude Modulation (QAM) • 16-QAM and 64-QAM implementation • Symbol mapping and demapping • Constellation diagram study
7.	Digital Demodulation • Coherent demodulation of BPSK/QPSK • Symbol recovery and decision making • Bit error observation
8.	Additive White Gaussian Noise (AWGN) Channel • AWGN channel modeling • Effect of noise on constellation and BER • SNR variation study
9.	Bit Error Rate (BER) Analysis • BER measurement for BPSK/QPSK/QAM • BER vs SNR performance curves • Comparison with theoretical results
10	Channel Coding Techniques • Hamming code implementation • Convolutional coding and Viterbi decoding • BER improvement with coding
11	Digital Communication over SDR Hardware • Transmission using RTL-SDR / USRP • Real-time digital communication link Over-the-air BPSK/QPSK transmission
12	OFDM System Implementation • OFDM transmitter and receiver design • FFT/IFFT operations • Cyclic prefix and multipath mitigation
13	Adaptive Modulation • Switching between BPSK, QPSK, QAM • Performance trade-offs with SNR • Throughput analysis
14	End-to-End Digital Communication System • Complete transmitter–channel–receiver chain • Performance evaluation • Practical SDR-based system demonstration
15	Digital Communication with Multipath Channel • Rayleigh fading channel modeling • Effect of fading on BER • Equalization basics

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Mapping of Course Outcomes with Program Outcomes, Program Specific Outcomes:

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	3	1	-	-	3					–		2	2	3
CO2	3	3	-	2	2					–		1	3	2
CO3	3	2	1	-	2					–		1	3	2
CO4	3	3	2	2	2					–		1	3	2
CO5	3	3	2	2	3					–		1	3	3
CO6	3	3	-	3	2					–		1	3	2
CO7	3	3	-	3	2					–		1	3	2
CO8	3	3	3	3	3					–		2	3	3
CO9	3	3	3	3	3					2		2	3	3
CO10	2	1	2	2	3					2		3	2	3

3–High 2– Medium 1-Low

Assessment Table

Assessment Tool	**S1**	**S2**	**S2**	**S2**
	CO1	**CO2**	**CO3**	**CO4**
ISEIII (25Marks)	03	12	05	05

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