St. Thomas College of Engineering & Technology
Vellilode, Sivapuram PO. Mattanur. Kannur District, Kerala
Approved by AICTE New Delhi, Govt. Of Kerala and Affiliated to APJ Abdul Kalam Technological University

COURSE HANDOUT

(B. Tech - Semester 3)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

COLLEGE VISION

To be an Institute of repute recognized for excellence in education, innovation, and social contribution.

COLLEGE MISSION

M1: Infrastructural Relevance - Develop, maintain and manage our campus for our stakeholders.
M2: Life-Long Learning - Encourage our stakeholders to participate in lifelong learning through industry and academic interactions.
M3: Social Connect - Organize socially relevant outreach programs for the benefit of humanity.

DEPARTMENT VISION

To produce professionally competent, ethically sound and socially responsible Electronics and Communication Engineers.

DEPARTMENT MISSION

M1: Provide excellent infrastructure and lab facilities for quality education.

M2: Promote industry-academic interactions to keep up with technological advancements.

M3: Develop interpersonal skills and social responsibility among students through project-based and team-based learning.

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

Graduates of B. Tech ECE program after graduation will:

PEO1: Exemplify technical competence in designing, analyzing, testing and fabricating electronic circuits.

PEO2: Acquire leadership qualities, rapport, communication skills in the organization and adapt to changing professional and societal needs.

PEO3: Work effectively as individuals and as team members in multidisciplinary projects

PROGRAM OUTCOMES (POS)

Engineering Graduates will be able to:

PO1 Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 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.

PO3 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.

PO4 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.

PO5 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.

PO6 The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7 Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 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.

PO11 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.

PO12 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 (PSO)

PSO1: Define, design, implement, model, and test electronic circuits and systems that perform signal processing functions.

PSO2: Segregate and select appropriate technologies for implementation of a modern communication system.

CONTENTS

COURSE INFORMATION SHEETS OF SEMESTER 3 COURSES

GYMAT 301

MATHEMATICS FOR ELECTRICAL SCIENCE AND PHYSICAL SCIENCE - 3

COURSE INFORMATION SHEET

PROGRAMME: ECE (UG)	**DEGREE**: BTECH
COURSE: MATHEMATICS FOR ELECTRICAL SCIENCE AND PHYSICAL SCIENCE -3	**SEMESTER: 3** **L-T-P-CREDITS**: 3-0-0-3
COURSE CODE: GYMAT301 **REGULATION**: 2024	**COURSE TYPE**:NON CORE
COURSEAREA/DOMAIN: APPLIED MATHEMATICS	**CONTACT HOURS**:36
CORRESPONDING LAB COURSE CODE (IF ANY): NIL	**LAB COURSE NAME**: NIL

SYLLABUS

MODULE	DETAILS	HOURS
I	Fourier Integral, From Fourier series to Fourier Integral, Fourier Cosine and Sine integrals, Fourier Cosine and Sine Transform, Linearity ,Transforms of Derivatives, Fourier Transform and its inverse, Linearity ,Transforms of Derivative. (Text 1: Relevant topics from sections 11.7,11.8,11.9)	9

II	Complex Function, Limit, Continuity, Derivative, Analytic functions, Cauchy-Riemann Equations (without proof), Laplace's Equations, Harmonic functions, Finding harmonic conjugate, Conformal mapping, Mappings of w= z^2 ,w=e^z ,w=$\frac{1}{z}$, w= sin z. (Text 1: Relevant topics from sections 13.3, 13.4, 17.1, 17.2, 17.4)	9
III	Complex Integration: Line integrals in the complex plane (Definition &Basic properties), First evaluation method, Second evaluation method, Cauchy's integral theorem (without proof) on simply connected domain, Independence of path, Cauchy integral theorem on multiply connected domain (without proof), Cauchy Integral formula (without proof). (Text 1: Relevant topics from sections 14.1, 14.2, 14.3)	9
IV	Taylor series and Maclaurin series, Laurent series (without proof),Singularities and Zeros – Isolated Singularity, Poles, Essential Singularities, Removable singularities, Zeros of Analytic functions – Poles and zeroes, Formulas for Residues, Residue theorem (without proof),Residue Integration- Integral of Rational Functions of cos θ and sin θ. (Text 1: Relevant topics from sections 15.4, 16.1, 16.2, 16.3, 16.4)	9
	Total hours	36

TEXT BOOKS/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T1	Advanced Engineering Mathematics Erwin Kreyszig John Wiley & Sons 10th edition,2016
R1	Complex Analysis Dennis G. Zill, Patrick D.Shanahan Jones & Bartlett 3rd edition, 2015
R2	Higher Engineering Mathematics , B. V. Ramana, McGraw-Hill Education , 39th edition,2023
R3	Higher Engineering Mathematics , B.S. Grewal , Khanna Publishers , 44th edition, 2018

R4	Fast Fourier Transform -Algorithms and Applications , Kim, Jae Jeong Hwang , Springer , 1st edition,2011

COURSE PREREQUISITES:

COURSE CODE	COURSE NAME	DESCRIPTION	SEMESTER
GYMAT 301	MATHEMATICS FOR ELECTRICAL SCIENCE AND PHYSICAL SCIENCE - 3	Basic knowledge in Complex numbers.	S 3

COURSE OBJECTIVES:

1.	To introduce the concept and applications of Fourier transforms in various engineering fields.
2.	To introduce the basic theory of functions of a complex variable, including residue integration and conformal transformation, and their applications.

COURSE OUTCOMES:

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

COs / CO-PO/PSO MAPPING. /BLOOM'S TAXONOMY LEVEL	PO1	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
GYMAT301.1	Determine the Fourier transforms of functions and apply them to solve problems arising in engineering.													
	3	3		2								2	3	2
	APPLY													
GYMAT301.2	Understand the analyticity of complex functions and apply it in conformal mapping.													
	3	3		2								2	1	1
	APPLY													
GYMAT301.3	Compute complex integrals using Cauchy's integral theorem and Cauchy's integral formula.													

	3	**3**		**2**								**2**	1	2
	APPLY													
GYMAT301.4	Understand the series expansion of complex function about a singularity and apply residue theorem to compute real integrals.													
	3	**3**		**2**								**2**	1	2
	APPLY													
MAPPING AVERAGE	**3**	**3**		**2**								2	1.50	1.75

JUSTIFICATION FOR CO-PO/PSO MAPPING:

CO	PO/PSO	MAPPING LEVEL	JUSTIFICATION
GYMAT 301.1	PO1	3	Demonstrates strong fundamental knowledge of mathematics to solve geological or applied science problems.
	PO2	3	Formulates and analyzes problems using mathematical models and techniques.
	PO4	2	Requires selection and application of appropriate Fourier methods to evaluate and interpret results in practical contexts.
	PO12	2	Fourier analysis is foundational in many advanced courses and real-life applications (e.g., DSP, telecommunications), encouraging students to continue learning.
	PSO1	3	Direct application of Fourier transform theory to solve problems in fields like electrical, electronics, and communication engineering.
	PSO2	2	Students use the Fourier transform as a tool for frequency domain analysis of signals and systems.
GYMAT 301.2	PO1	3	Applies mathematical reasoning to understand and interpret natural phenomena.
	PO2	3	Solves domain-specific problems using advanced mathematical tools.

	PO4	2	Conformal mapping helps model and analyze physical systems, allowing students to study system behavior and validate results through simulations**.**
	PO12	2	Mastery of advanced mathematical concepts like conformal mapping enables students to pursue further studies. It helps them adapt to emerging mathematical tools and techniques in engineering and research. This fosters a mindset for lifelong learning.
	PSO1	1	This outcome strengthens students' capability to apply complex analysis in real-world engineering contexts such as electromagnetic theory, fluid mechanics, and structural analysis, enhancing their problem-solving skills using conformal transformations.
	PSO2	1	By learning and applying analyticity and conformal mapping, students gain exposure to mathematical tools and techniques used in simulations and design of engineering systems, supporting software-based and analytical approaches in professional practice.
GYMAT 301.3	PO1	3	Understands and applies core mathematical concepts to geological processes or technical applications.
	PO2	3	Develops and validates mathematical models for real-world geological problems.
	PO4	2	Complex integration helps model and interpret real-life engineering systems. It supports analytical investigation and verification of results in research and simulations.
	PO12	2	Learning complex integral techniques develops problem-solving habits and mathematical maturity. This prepares students to adapt to advanced studies and emerging analytical tools throughout their careers.
	PSO1	1	This outcome reinforces the application of mathematical theorems like Cauchy's in solving engineering problems, strengthening their analytical capabilities in contexts such as electromagnetics or control systems.

	PSO2	2	Cauchy's theorems are foundational in many engineering tools and techniques. Mastery of these supports simulation, design, and analytical tasks in professional practice and advanced software environments.
GYMAT 301.4	PO1	3	Uses mathematical skills for analyzing field or lab data relevant to the domain.
	PO2	3	Interprets and solves complex problems with analytical and numerical techniques.
	PO4	2	The ability to work with complex series and evaluate real integrals using residues aids in the mathematical investigation of real-world engineering problems and supports accurate solution development and validation.
	PO12	2	Understanding these advanced mathematical methods prepares students for future research and learning. It supports the development of skills required to adopt modern analytical tools and techniques throughout their careers.
	PSO1	1	Mastery of complex series and the residue theorem directly enhances students' capacity to solve real engineering problems in domains like electrical circuits, vibrations, and heat conduction.
	PSO2	2	These concepts are widely used in mathematical modeling and simulatio Proficiency in them helps students perform accurate analysis using engin and theoretical methods.

CORRELATION Levels: 3- Substantial (High) 2- Moderate (Medium) 1-Slight (Low)

GAPS IN THE SYLLABUS-TO MEET INDUSTRY/PROFESSION REQUIREMENTS

SL NO:	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POS /PSOS

CONTENT BEYOND THE SYLLABUS/ADVANCED TOPICS/DESIGN

SL NO:	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POS /PSOS
1	Applications of complex analysis in engineering	Bridge course - Providing few real-life examples	PO1,PO2, PO12,PSO1,PSO2

WEB SOURCE REFERENCES:

1.	□ https://nptel.ac.in/courses/111/105/111105096/
2.	□ https://nptel.ac.in/courses/111/101/111101054/

DELIVERY TECHNOLOGIES

CLASSROOM WITH BLACK BOARD/WHITE BOARD/SMART BOARD	▯	**ICT TOOLS**	
CLASSROOM WITH LCD PROJECTOR		**ELECTRONIC CLASSROOM**	

INSTRUCTION METHODS

FACE TO FACE INSTRUCTION	Direct	▯	**FLIPPED CLASSROOM**	▯
	Project-based instruction		**BLENDED LEARNING**	
	Problem-based instruction		**ONLINE COURSES/MOOCs**	
	Technology enhanced learning		**OTHERS (IF ANY)**	

	Experiential learning			
	Participative learning			

CO ASSESSMENT TOOLS-DIRECT

ASSIGNMENTS	✓	**TUTORIALS**	✓	**SERIES EXAMINATIONS**	✓	**UNIVERSITY EXAM**	✓
LAB PRACTICES		**VIVA**		**INTERNAL LAB EXAM**		**REPORT/ DOCUMENT PREPARATION**	
PRESENTATION		**EVALUATION BY GUIDE**		**INTERIM EVALUATION**		**FINAL EVALUATION**	

CO ASSESSMENT TOOLS –INDIRECT

ASSESSMENT OF COURSE OUTCOMES (BY COURSE EXIT (END) SURVEY)	✓

ASSESSMENT ITEMS /CLASS SESSIONS/LAB/FIELD/TUTORIAL HOURS FOR EACH COURSE OUTCOMES

CO	**ASSESSMENT ITEMS**	**CLASS SESSIONS**	**LAB/FIELD/TUTORIAL HOURS**
GYMAT301.1	S1,A1	11	
GYMAT301.2	S2,A2	15	
GYMAT301.3	S2,A2	9	
GYMAT301.4	S3,A3	13	
		TOTAL HOURS OF INSTRUCTION : 48	

Prepared by:
KRISHNAPRIYA P K

Approved by HOD

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PCECT302

SOLID STATE DEVICES

COURSE INFORMATION SHEET

PROGRAMME: ECE (UG)	**DEGREE**: BTECH
COURSE: SOLID STATE DEVICES	**SEMESTER: S3** **L-T-P-CREDITS**: 3:1:0:4
COURSE CODE: PCECT302 **REGULATION**:2024	**COURSE TYPE**: CORE
COURSE AREA/DOMAIN: ELECTRONICS AND COMMUNICATION ENGINEEERING	**CONTACT HOURS**:5 PERIODS/WEEK + 1 REMEDIAL HOUR
CORRESPONDING LAB COURSE CODE (IF ANY): NIL	**LAB COURSE NAME**: NIL

SYLLABUS

MODULE	DETAILS	HOURS
I	.Review of Semiconductor physics: Equilibrium and steady state conditions, Concept of effective mass and Fermi level, Density of states & Effective density of states, Equilibrium concentration of electrons and holes. Excess carriers in semiconductors: Generation and recombination mechanisms of excess carriers, quasi-Fermi levels. Carrier transport in semiconductors: Drift, conductivity and mobility, variation of mobility with temperature and doping, Hall Effect. Diffusion, Einstein relations, Poisson equations, Continuity equations, Current flow equations, Diffusion length, Gradient of quasi-Fermi level.	13
II	PN junctions: Contact potential, Electrical Field, Potential and Charge distribution at the junction, Biasing and Energy band diagrams, Ideal diode equation. Bipolar junction transistor: Transistor action, Base width modulation, Current components in a BJT, Derivation of current components.	12

III	Metal Semiconductor contacts: Electron affinity and work function, Ohmic and Rectifying Contacts, current voltage characteristics. Ideal MOS capacitor: band diagrams at equilibrium, accumulation, depletion and inversion, surface potential, CV characteristics, effects of real surfaces, threshold voltage, body effect. MOSFET- Drain current equation of enhancement type MOSFET (derivation) - linear and saturation region, Drain characteristics, transfer characteristics.	11
IV	MOSFET scaling: Need for scaling, constant voltage scaling and constant field scaling. Sub- threshold conduction in MOS. Short channel effects in MOSFETs: Channel length modulation, Drain Induced Barrier Lowering, Velocity Saturation, Threshold Voltage Variations and Hot Carrier Effects. MESFET and FinFET: Structure, operation and advantages.	8
Total hours		**44**

TEXT BOOKS/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T1	Semiconductor device Fundamentals Robert Pierret Pearson Education 1/e, 1996
T2	Physics of Semiconductor Devices Michael shur Pearson Education 1/e, 2019
T3	Semiconductor Physics and Devices, 3ed, An Indian Adaptation S.M. Sze, M.K. Lee Wiley 3/e, 2021
R1	Semiconductor Physics and Devices Neamen McGraw Hill 4/e, 2017
R2	Physics of Semiconductor Devices Sze S.M John Wiley 3/e, 2015
R3	Semiconductor Devices: Physics and Technology Sze S.M John Wiley 3/e, 2016
R4	Operation and Modelling of the MOS Transistor Yannis Tsividis Oxford University Press 3/e,2010
R5	Semiconductor Physics and Devices, , Sze S.M., M.K. Lee, An Indian

	Adaptation 3ed, 2021
R6	Fundamentals of Semiconductor Devices, Achuthan, K N Bhat, McGraw Hill 1e,2015

COURSE PREREQUISITES:

COURSE CODE	COURSE NAME	DESCRIPTION	SEMESTER
GBPHT121	Physics of Electrical Science		S1/S2

COURSE OBJECTIVES:

1	This course explains the physical processes and working principles of semiconductor devices, while relating the device performance to material parameters and design criteria.

COURSE OUTCOMES:

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

COs / CO-PO/PSO MAPPING. /BLOOM'S TAXONOMY LEVEL	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
PCECT302.1	Apply Fermi-Dirac statistics to compare equilibrium carrier concentration.													
	3												2	
	APPLY													
PCECT302.2	State different carrier transport mechanisms in extrinsic semiconductors and obtain the current densities due to this transport.													
	3	2											3	
	APPLY													
PCECT302.3	Apply the concept of semiconductor physics to solve the current components in semiconductor devices.													
	3	2										2	3	
	APPLY													
PCECT302.4	Analyze the response of semiconductor devices for different biasing conditions													
	3	2	2									2	3	2

	APPLY													
PCECT302.5	Outline the effects of scaling in semiconductor devices.													
	3	2	2									2	2	3
	UNDERSTAND													
MAPPING AVERAGE	**3**	**2**	**2**									**2**	**2.6**	**2.5**

JUSTIFICATION FOR CO-PO/PSO MAPPING:

CO	PO/ PSO	MAPPING LEVEL	JUSTIFICATION
PCECT302.1	PO1	3	Requires application of mathematics and physics fundamentals, especially statistics.
	PSO1	2	Helps in understanding electronic device behavior essential for circuit modeling
PCECT302.2	PO1	3	Involves deep understanding of semiconductor physics.
	PO2	2	Needs interpretation and solving of engineering problems related to carrier motion.
	PSO1	3	Strongly supports modeling and analysis of electronic circuits using transport principles.
PCECT302.3	PO1	3	Uses scientific principles to analyze current components.
	PO2	2	Involves solving engineering device behavior problems.
	PO12	2	Understanding current components helps students learn on their own and keep up with new technologies, supporting life-long learning.
	PSO1	3	Direct application in analyzing and designing devices for signal processing.
PCECT302.4	PO1	3	Needs theoretical understanding of device behavior.
	PO2	2	Involves solving practical problems of biasing.

	PO3	2	Students apply engineering knowledge to analyze how semiconductor devices respond under different biasing conditions
	PO12	2	Encourages learning about modern circuit operation under various conditions.
	PSO1	3	Crucial for implementing and testing biased circuits.
	PSO2	2	Useful in communication circuit design involving different biasing levels.
PCECT302.5	PO1	3	Involves understanding of miniaturization and its impact.
	PO2	2	Requires analysis and comparison of scaled vs unscaled device behavior
	PO3	2	Students apply engineering knowledge to analyze and outline the effects of scaling in semiconductor devices.
	PO12	2	Encourages awareness of emerging trends and technologies.
	PSO1	2	Affects circuit performance and reliability.
	PSO2	3	Highly relevant for modern, high-speed, compact communication systems.

CORRELATION Levels: 3- Substantial (High) 2- Moderate (Medium) 1-Slight (Low)

GAPS IN THE SYLLABUS-TO MEET INDUSTRY/PROFESSION REQUIREMENTS

SL NO:	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POS /PSOS
1	Lack of basic knowledge on how semiconductor devices are made	Conduct a session on IC fabrication process (intro level)	PO1, PO12, PSO2

CONTENT BEYOND THE SYLLABUS/ADVANCED TOPICS/DESIGN

SL NO:	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POS /PSOS
1	Overview of how mobile chips (like in smartphones) work	Include a simple presentation or discussion	PO1, PO2, PSO1

WEB SOURCE REFERENCES:

SL NO:	DESCRIPTION
1	https://nptel.ac.in/courses/117106091
2	https://www.youtube.com/watch?v=kpP7cDcKrOE&t=1617s
3	https://www.youtube.com/watch?v=Kp-jS6NHsB8&list=PLF178600D851B098F

DELIVERY TECHNOLOGIES

CLASSROOM WITH BLACK BOARD/WHITE BOARD/SMART BOARD	▯	**ICT TOOLS**	▯
CLASSROOM WITH LCD PROJECTOR	▯	**ELECTRONIC CLASSROOM**	

INSTRUCTION METHODS

FACE TO FACE INSTRUCTION	Direct	▯	**FLIPPED CLASSROOM**	▯
	Project-based instruction		**BLENDED LEARNING**	
	Problem-based instruction		**ONLINE COURSES/MOOCs**	
	Technology enhanced learning	▯	**OTHERS (IF ANY)**	
	Experiential learning			
	Participative learning	▯		

CO ASSESSMENT TOOLS-DIRECT

ASSIGNMENTS	▯	**TUTORIALS**	▯	**SERIES EXAMINATIONS**	▯	**UNIVERSITY EXAM**	▯
LAB PRACTICES		**VIVA**		**INTERNAL LAB EXAM**		**REPORT/ DOCUMENT PREPARATION**	
PRESENTATION		**EVALUATION BY GUIDE**		**INTERIM EVALUATION**		**FINAL EVALUATION**	

CO ASSESSMENT TOOLS -INDIRECT

ASSESSMENT OF COURSE OUTCOMES (BY COURSE EXIT (END) SURVEY)	▯

ASSESSMENT ITEMS /CLASS SESSIONS/LAB/FIELD/TUTORIAL HOURS FOR EACH COURSE OUTCOMES

CO	ASSESSMENT ITEMS	CLASS SESSIONS	LAB/FIELD/TUTORIAL HOURS
PCECT302.1	S1,A1,T1,T2	7	-
PCECT302.2	S1,A1,T3	7	-
PCECT302.3	S2,A1,T4,T5	16	-
PCECT302.4	S2,A2,T6	16	-
PCECT302.5	S3,A3	10	-
		TOTAL HOURS OF INSTRUCTION	56

Prepared by **Approved by HOD**

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PCECT303

ANALOG CIRCUITS

COURSE INFORMATION SHEET

PROGRAMME: ECE (UG)	**DEGREE**: BTECH
COURSE: ANALOG CIRCUITS	**SEMESTER: 3** **L-T-P-CREDITS**: 3-1-0-4
COURSE CODE: **REGULATION**:2024	**COURSE TYPE**: CORE
COURSE AREA/DOMAIN: CIRCUITS AND SYSTEMS	**CONTACT HOURS**:4hrs/week
CORRESPONDING LAB COURSE CODE (IF ANY): PCECL307	**LAB COURSE NAME**: Analog Circuits Lab

SYLLABUS

MODULE	DETAILS	HOURS
I	Wave Shaping Circuits: RC differentiating and integrating circuits, Analysis of First order RC low pass and high pass filter for step input -rise time, bandwidth. Diode Clipping and clamping circuits. BJT/MOSFET Biasing: Need for biasing, DC load line, operating point, BJT biasing (CE configuration)– fixed bias & voltage divider bias (Design &analysis). MOSFET biasing,	10
II	BJT Amplifiers: Design of RC coupled CE amplifier - Small signal analysis of CE amplifier using hybrid- π model (low and mid frequency`). The high frequency hybrid-π model of BJT, Miller effect, High frequency response of single stage CE amplifier, short circuit current gain, cut-off frequency fβ& unity gain bandwidth fT . MOSFET Amplifiers: Design of CS amplifier, Small signal analysis using hybrid- π model (mid frequency only), Small signal voltage gain, input & output impedance, CS stage with current source load and diode connected load. Multistage BJT Amplifiers: Types of multistage amplifiers, Effect of cascading on gain and bandwidth. Small signal	12

	voltage gain, input & output impedance of BJT cascode amplifier using hybrid-π model.	
III	Feedback amplifiers: The general feedback structure, Effect of negative feedback on gain, bandwidth, noise reduction and distortion. The four basic feedback topologies, Analysis of discrete BJT circuits in voltage-series and voltage-shunt feedback topologies - voltage gain, input and output impedance. Oscillators: Classification, criterion for oscillation, Wien bridge oscillator, Hartley and Crystal oscillator. (working principle and design equations of the circuits; analysis of Wien bridge oscillator only required).	11
IV	Power amplifiers: Classification, Transformer coupled class A power amplifier, push pull class B and class AB power amplifiers, complementary- symmetry class B and Class AB power amplifiers, class C and D power amplifier - efficiency and distortion (no analysis required) Linear Voltage Regulators: Types of voltage regulators- series and shunt -working and design, load & line regulation, short circuit protection and fold back protection.	11
Total hours		**44**

TEXT BOOKS/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T1	Electronic Devices and Circuit Theory. Robert Boylestad and L Nashelsky, Pearson11th edition,2015
T2	Microelectronic Circuits Sedra A. S. and K. C.Smith, Oxford University Press, 2013 6th edition,2013
T3	Electronic Circuits and Devices Theodore F. Bogart;Beasley, Jeffrey S.; Guillermo Rico Pearson Education India 6th edition
R1	Fundamentals of Microelectronics Razavi B. Wiley 2nd edition,2015
R2	Electronic Devices and Circuits David A Bell Oxford University Press 5th

	edition,2008
R3	Electronic Circuits Analysis and Design 1D. Meganathan Yes Dee Publishing 1st edition,2023
R4	Analysis and Design of Electronic Circuits K. Gopakumar OWL Books 1st edition,2023

COURSE PREREQUISITES:

COURSE CODE	COURSE NAME	DESCRIPTION	SEMESTER
BEE/ (GYEST104)	Basic Electrical Engineering	It provides foundational knowledge of electric circuits, laws, and components, serving as a prerequisite for understanding the behaviour and analysis of analog electronic circuits.	S1

COURSE OBJECTIVES:

1. To introduce and verify basic principles, operation and applications of the various analog electronic circuits and devices
2. To understand and analyze the design and working of amplifiers and their configurations.

COURSE OUTCOMES:

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

COs / CO-PO/PSO MAPPING. /BLOOM'S TAXONOMY LEVEL	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
PCECT303.1	Design wave shaping circuits using first order RC network and diodes													
	3	**3**	**2**		**2**							**2**	**3**	**2**
	APPLICATION													
PCECT303.2	Analyze single stage and multistage BJT amplifier circuits using equivalent models.													
	3	3										2	3	
	APPLICATION													
PCECT303.3	Apply the principles of feedback in the design of oscillators.													
	3	3	2		2							2	3	2

	APPLICATION													
PCECT303.4	Design power amplifiers and voltage regulator circuits.													
	3	3	2		2							2	3	2
	APPLICATION													
MAPPING AVERAGE	3	3	2		2							2	3	2

JUSTIFICATION FOR CO-PO/PSO MAPPING:

CO	PO/PSO	MAPPING LEVEL	JUSTIFICATION
PCECT303.1	PO1	3	Involves core electronic engineering knowledge in RC circuits and diode behaviour.
	PO2	3	Requires problem analysis to determine the correct design approach.
	PO3	2	Involves circuit design but not full-fledged system development.
	PO5	2	Use of modern simulation tools (e.g., L T Spice) for circuit analysis/design.
	PO12	2	Students refer to evolving diode characteristics and modern simulation tools, promoting independent learning beyond the classroom.
	PSO1	3	Core skill: defining and implementing signal processing circuits.
	PSO2	2	Wave shaping is foundational for analog front-ends in communication systems, contributing to technology selection.
PCECT303.2	PO1	3	Deep understanding of transistor operation and amplifier characteristics is essential.
	PO2	3	Involves identifying circuit behavior under different bias and signal conditions, and analyzing gain, bandwidth, etc.
	PO5	2	

	PO12	2	Encourages continuous learning through comparison of classical models with current technologies and self-exploration using circuit simulation software.
	PSO1	3	Direct application in designing and modeling analog amplification circuits for signal processing.
	PSO2	2	Amplifier knowledge is vital in communication transmitters/receivers; helps in system-level design understanding.
PCECT303.3	PO1	3	Requires understanding feedback theory, circuit principles, and application to oscillator design.
	PO2	3	Analysis of loop gain, stability, and frequency determination requires critical thinking.
	PO3	2	Students design basic oscillator circuits like RC Phase Shift, Wien Bridge, etc., matching design specs.
	PO5	2	Circuit simulations using modern EDA tools aid in analysis and waveform verification.
	PO12	2	Introduces feedback concepts that students will revisit in control systems, communication circuits, etc.
	PSO1	3	Oscillators are fundamental signal sources in electronic systems – aligns with PSO1 objectives.
	PSO2	2	Used in transmitters and frequency synthesizers in communication systems.
PCECT303.4	PO1	3	Applies electronic fundamentals in power amplification and voltage control.
	PO2	3	Analyzing load conditions, efficiency, thermal stability, and line/load regulation involves problem-solving.
	PO3	2	Involves designing Class A/B/AB amplifiers and regulators using design specifications.
	PO5	2	Use of simulation tools to assess power dissipation, efficiency, and stability.
	PO12	2	Power electronics and regulators evolve; learning this gives students a base for industrial applications and newer technologies.

	PSO1	3	Core to implementing and testing practical analog systems.
	PSO2	2	Regulators and amplifiers are used in various blocks of communication systems, including base stations, modulators, etc.

CORRELATION Levels: 3- Substantial (High) 2- Moderate (Medium) 1-Slight (Low)

GAPS IN THE SYLLABUS-TO MEET INDUSTRY/PROFESSION REQUIREMENTS

SL NO:	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POS /PSOS
1	"Oscillator Phase Noise and Frequency Stability"	Assignment planned on the topic	PO1, PO2, PO4, PO5,PSO1, PSO2

CONTENT BEYOND THE SYLLABUS/ADVANCED TOPICS/DESIGN

SL NO:	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POS /PSOS
1.	Practical Design of Real Time Interfacing and Circuits	Workshop/Seminar	PO1.PO2,PO3,PO4, PO5,PO9,PO10,PO12,PSO1,PSO2

WEB SOURCE REFERENCES:

SL NO:	DESCRIPTION
1	https://archive.nptel.ac.in/courses/108/106/108106188/

DELIVERY TECHNOLOGIES

CLASSROOM WITH BLACK BOARD/WHITE BOARD/SMART BOARD	▯	**ICT TOOLS**	
CLASSROOM WITH LCD PROJECTOR	▯	**ELECTRONIC CLASSROOM**	

INSTRUCTION METHODS

FACE TO FACE INSTRUCTION	Direct	▯	**FLIPPED CLASSROOM**	
	Project-based instruction		**BLENDED LEARNING**	
	Problem-based instruction		**ONLINE COURSES/MOOCs**	
	Technology enhanced learning	▯	**OTHERS (IF ANY)**	
	Experiential learning			
	Participative learning			

CO ASSESSMENT TOOLS-DIRECT

ASSIGNMENTS	▯	**TUTORIALS**	▯	**SERIES EXAMINATIONS**	▯	**UNIVERSITY EXAM**	▯
LAB PRACTICES		**VIVA**		**INTERNAL LAB EXAM**		**REPORT/ DOCUMENT PREPARATION**	
PRESENTATION		**EVALUATION BY GUIDE**		**INTERIM EVALUATION**		**FINAL EVALUATION**	

CO ASSESSMENT TOOLS -INDIRECT

ASSESSMENT OF COURSE OUTCOMES (BY COURSE EXIT (END) SURVEY)	▯

ASSESSMENT ITEMS /CLASS SESSIONS/LAB/FIELD/TUTORIAL HOURS FOR EACH COURSE OUTCOMES

CO	ASSESSMENT ITEMS	CLASS SESSIONS	LAB/FIELD/TUTORIAL HOURS
PCECT303.1	S1, A1, T1	12	2
PCECT303.2	S2, A1, T2	14	2
PCECT303.3	S2, A2	12	-
PCECT303.4	S3, A3	12	-
		TOTAL HOURS OF INSTRUCTION	55

Prepared by
Sreetha Sreedhar K

Approved by HOD

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PBECT304

LOGIC CIRCUIT DESIGN

COURSE INFORMATION SHEET

PROGRAMME: ECE (UG)	**DEGREE**: BTECH
COURSE: LOGIC CIRCUIT DESIGN	**SEMESTER: III** **L-T-P-R 3:0:0:1 CREDITS**: 4
COURSE CODE: PBECT304 **REGULATION**:2024	**COURSE TYPE**: CORE
COURSE AREA/DOMAIN: DIGITAL ELCTRONICS	**CONTACT HOURS**:6 HRS/WEEK
CORRESPONDING LAB COURSE CODE (IF ANY): PCECL308	**LAB COURSE NAME**: LOGIC CIRCUIT DESIGN LAB

SYLLABUS

MODULE	DETAILS	HOURS
I	**Introduction to digital circuits**: Review of number systems representation conversions, Arithmetic of Binary number systems, Signed and unsigned numbers, BCD. **Boolean algebra**: Theorems, sum of product and product of sum - simplification, canonical forms- min term and max term, Simplification of Boolean expressions - Karnaugh map (upto 4 variables), Implementation of Boolean expressions using universal gates	9
II	**Combinational logic circuits**- Half adder and Full adders, Subtractors, BCD adder, Ripple carry and carry look ahead adders, Decoders, Encoders, Code converters, Comparators, Parity generator, Multiplexers, De-multiplexers, Implementation of Boolean algebra using MUX. Introduction to Verilog HDL – Basic language elements, Basic implementation of logic gates and combinational circuits	9
III	**Sequential Circuits**: SR Latch, Flip flops - SR, JK, Master-Slave JK, D and T Flip flops. Conversion of Flip flops, Excitation table and characteristic equation. Shift registers- SIPO, SISO, PISO, PIPO and Universal shift registers. Ring and Johnsons counters. Design of Asynchronous, Synchronous and Mod N counters.	9
IV	**Finite state machines** - Mealy and Moore models, State	9

	graphs, State assignment, State table, State reduction. **Logic Families**: -Electrical characteristics of logic gates (Noise margin, Fanin, Fan-out, Propagation delay, Transition time, Power -delay product) -TTL, ECL, CMOS. Circuit description and working of TTL and CMOS inverter, CMOS NAND and CMOS NOR gates.	
Total hours		**36**

TEXT BOOKS/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T1	Digital Fundamentals, Thomas L. Floyd Pearson Education 11th Edition, 2017
T2	Fundamentals of Digital Logic with Verilog Design Stephen Brown McGraw Hill Education 2 nd Edition
R1	Digital Design: With an Introduction to the Verilog HDL, VHDL, and System Verilog M Morris Mano, Michael D. Ciletti Pearson India 6 th Edition, 2018
R2	Fundamentals of Digital Circuits A. Ananthakumar PHI 4 th Edition, 2016
R3	Introduction to Logic Circuits & Logic Design with Verilog Brock J. LaMeres Springer 2 nd Edition, 2019
R4	Digital Design Verilog HDL and Fundamentals Joseph Cavanagh CRC Press 1 st Edition, 2008
R5	Digital Circuits and Systems D.V. Hall Tata McGraw Hill 1989

COURSE PREREQUISITES:

COURSE CODE	COURSE NAME	DESCRIPTION	SEMESTER
GYEST104	INTRODUCTION TO ELECTRICAL & ELECTRONICS ENGINEERING	It provides the foundational knowledge of electrical and electronic circuits, components, and systems that are essential for understanding and working with digital technologies.	I/II

COURSE OBJECTIVES:

1	To understand the number systems in digital systems
2	To introduce the basic postulates of Boolean algebra, digital logic gates and Boolean expressions
3	To design and implement combinational and sequential circuits
4	To design and implement digital circuits using Hardware Descriptive Language like Verilog on FPGA

COURSE OUTCOMES:

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

COs / CO-PO/PSO MAPPING. /BLOOM'S TAXONOMY LEVEL	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
PBECT304.1	Apply the knowledge of digital representation of information and Boolean algebra to deduce optimal digital circuits.													
	3	**3**	**2**	**2**								**3**	**3**	**2**
	APPLY													
PBECT304.2	Design and implement combinational logic circuits, sequential logic circuits and finite state machines													
	3	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**			**3**	**3**	**2**
	EVALUATE													
PBECT304.3	Design and implement digital circuits on FPGA using hardware description language (HDL)													
	3	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**
	EVALUATE													
PBECT304.4	Outline the performance of logic families with Respect to different parameters													
	3		**2**									**3**	**2**	**2**
	UNDERSTAND													
MAPPING AVERAGE	3.00	3.00	2.50	2.67	3.00	3.00	3.00	3.00	3.00	3	3	3	2.75	2

JUSTIFICATION FOR CO-PO/PSO MAPPING:

CO	PO/PSO	MAPPING LEVEL	JUSTIFICATION
PBECT304.1	PO1	3	Students get core engineering fundamentals—specifically, digital logic and Boolean algebra. These are foundational concepts in electronics and communication engineering. Applying these concepts to design optimal circuits directly reflects strong use of engineering principles
	PO2	3	Students are required to analyse digital problems such as circuit optimization, logic simplification, and binary representation of information. This involves critical analysis and decomposition of the problem into solvable components
	PO3	2	Designing optimal digital circuits involves selecting suitable logic components and optimizing the design using Karnaugh Maps or Boolean expressions.
	PO4	2	Students often need to explore different design alternatives and test circuit behaviour through simulation or analysis to achieve optimization. This involves investigation skills
	PO12	3	The field of digital design is constantly evolving. The ability to continuously update knowledge on digital representation techniques and logic optimization is essential.
	PSO1	3	This CO focuses on applying Boolean algebra and digital principles to design and optimize digital circuits. These are foundational skills for building electronic systems, especially those involved in signal processing such as encoders, decoders, multiplexers, etc. Students define logic requirements, design

			circuits, model them using Boolean expressions or HDL, and test their functionality
	PSO2	2	While the primary focus of the CO is on logic design, these skills indirectly support communication system design, where digital circuits like modulators/demodulators, encoders/decoders, or data converters are integral. The knowledge gained here enables students to choose suitable logic components for communication subsystems
PBECT304.2	PO1	3	Designing digital circuits requires in-depth understanding of Boolean algebra, logic gates, and electronics principles that strongly apply engineering knowledge.
	PO2	3	Students must analyze circuit specifications, truth tables, and timing requirements before design, which demonstrates thorough problem analysis.
	PO3	3	Students will gain knowledge in designing and developing solutions in the form of logic circuits and FSMs.
	PO4	3	Simulation and testing of logic and sequential circuits require problem-solving, debugging, and verifying behavior under various inputs.
	PO5	3	Students use simulation tools (e.g., ModelSim, Xilinx) for design and testing, satisfying modern engineering tool usage.
	PO6	3	Logic circuits are used in real-time applications and implementing them improves understanding of socially relevant designs.

	PO7	3	Efficient circuit design reduces power usage and hardware complexity, supporting sustainability goals.
	PO8	3	Encourages ethical design, such as avoiding plagiarism in HDL code and responsibly using licensed tools and open-source IPs.
	PO9	3	Students typically perform lab and project work in teams, encouraging team collaboration and leadership.
	PO12	3	As digital technologies evolve, learning modern circuit design tools and methods fosters lifelong learning.
	PSO1	3	This involves complete digital system development (FSMs, sequential/combinational logic on circuit definition, design, and testing
	PSO2	2	Understanding and implementing control and timing logic is relevant to communication subsystems.
PBECT304.3	PO1	3	Students apply digital electronics concepts, logic design, and HDL coding—core technical knowledge areas.
	PO2	3	Requires analyzing functional requirements of digital circuits and converting them into HDL models.
	PO3	3	Involves complete design life cycle—writing HDL, simulating, synthesizing, and implementing on FPGA.
	PO4	3	Testing and debugging HDL designs on FPGA demands investigative skills for timing, logic errors, and optimization.
	PO5	3	Students use FPGA tools such as Vivado, Quartus, ModelSim, etc.

	PO6	3	HDL-based circuit design has applications in areas like medical electronics, automotive, and communication—helping address real-world needs.
	PO7	3	Efficient FPGA design reduces power consumption and hardware usage—supporting sustainability goals.
	PO8	3	Students must follow ethical practices in IP core usage, licensing, and responsible coding.
	PO9	3	Design projects are often collaborative, enhancing teamwork and task delegation.
	PO10	3	Students document HDL designs and communicate technical details through simulation results and project reports.
	PO11	3	Designing on FPGA within resource constraints builds project planning, budgeting and time management skills.
	PO12	3	Digital design tools and HDLs continuously evolve, making self-learning of tools and techniques essential.
	PSO1	3	Students design, test, and implement digital circuits using HDL on hardware platforms.
	PSO2	2	HDL is widely used in communication systems (e.g., protocol design, digital filters, encoding/decoding). Students learn how to choose appropriate HDL modules and platforms.
PBECT304.4	PO1	3	Understanding logic families (TTL, CMOS, ECL, etc.) and comparing parameters like speed, power, noise margin, fan-out relies on core electronics engineering concepts
	PO3	2	Involving design, knowledge of logic family parameters supports design decisions, such as

			selecting suitable logic types for specific applications.
	PO12	3	Logic families evolve (e.g., low-power CMOS, BiCMOS), and staying updated on new families or improved versions is key for continuing professional development.
	PSO1	2	Understanding the electrical characteristics of logic families is essential for reliable design and testing of digital circuits, impacting parameters like propagation delay and loading.
	PSO2	2	Selecting logic families based on speed or power requirements influences digital communication hardware design.

CORRELATION Levels: 3- Substantial (High) 2- Moderate (Medium) 1-Slight (Low)

GAPS IN THE SYLLABUS-TO MEET INDUSTRY/PROFESSION REQUIREMENTS

SL NO:	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POs /PSOs
1	Familiarization of System Design through HDL	Expert Talk /Hands on Session /Attend MOOC Course(nptel)/Laboratory Session	PO1, PO2, PO3, PO4, PO5, PO9, PO10, PO12, PSO1(3), PSO2(2)

CONTENT BEYOND THE SYLLABUS/ADVANCED TOPICS/DESIGN

SL NO:	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POS /PSOS
1	Implementation of digital circuit designs on FPGA	Design Activities (Project/Assignment Ideas)	PO1, PO2, PO3, PO4, PO5, PO9, PO12.PSO1 (3), PSO2 (2)
2	Exposure to latest trends in IC Design	Seminar/Expert Talk	PO1, PO2, PO3, PO4, PO5, PO12 PSO1 (3), PSO2 (2)

WEB SOURCE REFERENCES:

SL NO:	DESCRIPTION
1	Nptel Course: Fundamentals of Digital Circuits
2	Nptel Course: System Design through Verilog
3	http://www.electronics-tutorials.ws/logic/logic_1.html
4	https://archive.nptel.ac.in/courses/117/106/117106086/
5	https://archive.nptel.ac.in/courses/106/105/106105185/

DELIVERY TECHNOLOGIES

CLASSROOM WITH BLACK BOARD/WHITE BOARD/SMART BOARD	▯	**ICT TOOLS**	▯
CLASSROOM WITH LCD PROJECTOR	▯	**ELECTRONIC CLASSROOM**	

INSTRUCTION METHODS

FACE TO FACE INSTRUCTION	Direct	▯	**FLIPPED CLASSROOM**	
	Project-based instruction	▯	**BLENDED LEARNING**	
	Problem-based instruction		**ONLINE COURSES/MOOCs**	
	Technology enhanced learning	▯	**OTHERS (IF ANY)**	
	Experiential learning			
	Participative learning			

CO ASSESSMENT TOOLS-DIRECT

ASSIGNMENTS		**TUTORIALS**		**SERIES EXAMINATIONS**	▯	**UNIVERSITY EXAM**	▯
LAB PRACTICES		**VIVA**		**INTERNAL LAB EXAM**		**REPORT/ DOCUMENT PREPARATION**	▯
PRESENTATION	▯	**EVALUATION BY GUIDE**		**INTERIM EVALUATION**	▯	**FINAL EVALUATION**	▯

CO ASSESSMENT TOOLS -INDIRECT

ASSESSMENT OF COURSE OUTCOMES (BY COURSE EXIT (END) SURVEY)	▯

ASSESSMENT ITEMS /CLASS SESSIONS/LAB/FIELD/TUTORIAL HOURS FOR EACH COURSE OUTCOMES

CO	ASSESSMENT ITEMS	CLASS SESSIONS	LAB/FIELD/TUTORIAL HOURS
PBECT304.1	S1, PBL	14	16(PBL)
PBECT304.2	S2, S3, PBL	30	
PBECT304.3	S2, PBL	4	
PBECT304.4	S3,PBL	5	
		TOTAL HOURS OF INSTRUCTION	53 +16(PBL)

Prepared by:
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Approved by HOD:
Prof.Nithin C

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GNEST305

INTRODUCTION TO AI AND DATA SCIENCE

COURSE INFORMATION SHEET

PROGRAMME: ECE (UG)	**DEGREE**: BTECH
COURSE: INTRODUCTION TO AI AND DS	**SEMESTER: 3** **L-T-P-CREDITS**: 3-1-0-4
COURSE CODE: **REGULATION**: GNEST305: 2024 SCHEME	**COURSE TYPE**: CORE
COURSE AREA/DOMAIN: COMPUTER SCIENCE/IT	**CONTACT HOURS**: 3
CORRESPONDING LAB COURSE CODE (IF ANY): NIL	**LAB COURSE NAME**: NIL

SYLLABUS

MODULE	DETAILS	HOURS
I	**Introduction to AI and Machine Learning**: Basics of Machine Learning - types of Machine Learning systems-challenges in ML- Supervised learning model example- regression models- Classification model example- Logistic regression- unsupervised model example- K-means clustering. Artificial Neural Network-Perceptron-Universal Approximation Theorem(statement only)-Multi-Layer Perceptron-Deep Neural Network-demonstration of regression and classification problems usingMLP.(Text-2)	11
II	**Mathematical Foundations of AI and Data Science**:Role of linear algebra in Data representation and analysis–Matrix decomposition-Singular Value Decomposition (SVD)- Spectral decomposition- Dimensionality reduction technique-Principal Component Analysis (PCA). (Text-1)	11
III	**Applied Probability and Statistics for AI and Data Science**: Basics of probability-random variables and statistical measures - rules in probability- Bayes theorem and its applications- statistical estimation-Maximum Likelihood	11

	Estimator (MLE) - statistical summaries- Correlation analysis- linear correlation(direct problems only)-regression analysis-linear regression (using least square method)(Textbook4)	
IV	**Basics of Data Science**: Benefits of data science-use of statistics and Machine Learning in Data Science- data science process - applications of Machine Learning in Data Science- modelling process- demonstration of ML applications in data science-Big Data and Data Science.(For visualization the software tools like Tableau, PowerBI, R or Python can be used. For Machine Learning implementation,Python,MATLAB or R can be used.)(Textbook-5)	11
Total hours		**44**

TEXT BOOKS/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T1	Introduction to Linear Algebra : Gilbert Strang
T2	Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow : Aurélien Géron
R1	Datascience: concepts and practice : Kotu, Vijay,and Bala Deshpande
R2	Probability and Statistics for Data Science : Carlos Fernandez- Granda

COURSE PREREQUISITES: NIL

COURSE CODE	COURSE NAME	DESCRIPTION	SEMESTER

COURSE OBJECTIVES:

1	Demonstrate a solid understanding of advanced linear algebra concepts, machine learning algorithms and statistical analysis techniques relevant to engineering applications,principles and algorithms.
2	Apply theoretical concepts to solve practical engineering problems, analyze data to extract meaningful insights,and implement appropriate mathematical and computational techniques for AI and data science applications.

COURSE OUTCOMES:

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

COs / CO-PO/PSO MAPPING. /BLOOM'S TAXONOMY LEVEL	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
GNEST305.1	Apply the concept of machine learning algorithms including neural networks and supervised/unsupervised learning techniques for engineering applications.													
	3	**3**	**3**	**3**										
	APPLY													
GNEST305.2	Apply advanced mathematical concepts such as matrix operations, Singular values, and principal component analysis to analyze and solve engineering problems.													
	3	**3**	**3**	**3**										
	APPLY													
GNEST305.3	Analyze and interpret data using statistical methods including descriptive statistics correlation, and regression analysis to derive Meaningful insights and make informed decisions.													
	3	**3**	**3**	**3**									**1**	
	APPLY													
GNEST305.4	Integrate statistical approaches and machine learning techniques to ensure practically feasible solutions in engineering contexts.													
	3	**3**	**3**	**3**									**1**	
	APPLY													
MAPPING AVERAGE	**3**	**3**	**3**	**3**									**1**	

JUSTIFICATION FOR CO-PO/PSO MAPPING:

CO	PO/PSO	MAPPING LEVEL	JUSTIFICATION
GNEST305.1	PO1	**3**	Students apply mathematical foundations (e.g., linear algebra, probability) in understanding ML principles.
	PO2	**3**	Identifying where and how AI/ML is applicable to solve real-world problems is a core learning outcome.
	PO3	**3**	Students begin to understand how AI can be integrated into engineering systems for intelligent solutions.
	PO4	**3**	Students analyze ML examples and case studies that involve data-driven investigation.
GNEST305.2	PO1	**3**	Regression and classification models rely heavily on mathematical concepts such as linear algebra, calculus, and statistics. Students apply foundational knowledge to understand and implement these models.
	PO2	**3**	Supervised learning models are used to solve practical engineering and real-world problems, such as prediction and classification tasks. Students learn to choose appropriate models and evaluate their performance.
	PO3	**3**	By implementing regression and classification models, students design data-driven solutions, integrate them into broader systems, and optimize model performance.
	PO4	**3**	Students train, test, and validate supervised models using datasets, perform error analysis, and interpret results—key aspects of engineering investigation and data interpretation.
GNEST305.3	PO1	**3**	K-means clustering and other unsupervised learning techniques rely on mathematical concepts such as

			Euclidean distance, centroids, and optimization. Students apply this foundational knowledge to understand how clustering algorithms group data.
	PO2	**3**	Students learn to identify problems suitable for unsupervised approaches and use clustering to uncover patterns in unlabeled data, which is common in engineering and data science applications.
	PO3	**3**	Clustering algorithms are used to design solutions in fields like customer segmentation, fault detection, and image analysis. Students learn to implement and tune clustering methods to produce meaningful groups.
	PO4	**3**	Students explore datasets, perform clustering, analyze group characteristics, and validate cluster quality—skills essential for conducting meaningful data-driven investigations.
	PSO1	**1**	Applying sustainable principles while designing electronic circuits and signal processing systems encourages the use of energy-efficient and eco-friendly components, reducing power consumption and electronic waste. This aligns with PSO1's emphasis on modeling and testing responsible systems.
GNEST305.4	PO1	**3**	Understanding and implementing neural networks, including MLP, requires application of mathematical concepts like matrix operations, calculus (for backpropagation), and linear algebra. This CO ensures students apply these fundamentals in a practical AI context.
	PO2	**3**	Students use ANN models to formulate and solve real-world regression and classification problems,

			such as image or signal recognition, which are core applications in engineering and AI systems.
	PO3	**3**	Designing neural network models involves choosing appropriate architectures, activation functions, and optimization methods, enabling students to build AI components that address complex tasks.
	PO4	**3**	Students are trained to experiment with ANN models, analyze performance metrics (like accuracy and loss), tune hyperparameters, and interpret results, which develops their skills in data-driven investigation and validation.
	PSO1	**1**	Sustainable engineering principles guide students to choose energy-efficient components, low-power designs, and recyclable materials in signal processing systems, aligning with environmentally responsible engineering practices.

CORRELATION Levels: 3- Substantial (High) 2- Moderate (Medium) 1-Slight (Low)

GAPS IN THE SYLLABUS-TO MEET INDUSTRY/PROFESSION REQUIREMENTS

SL NO:	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POS /PSOS
1	Practical session on data visualization using software tools like Python not included	Workshop on Python	PO1,PO2,PO3,PO4, PO5,PO6,PO7,PO8, PO9,PO10,PO11,PO 12,PSO1(1)

CONTENT BEYOND THE SYLLABUS/ADVANCED TOPICS/DESIGN

SL NO:	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POS /PSOS
1	Future trends and scope of Artificial Intelligence in Industry	Learning materials on Future trends and scopes in Artificial Intelligence	PO1,PO2,PO3,PO4, PO5,PO6,PO7,PO8, PO9,PO10,PO11,PO 12,PSO1(1)

WEB SOURCE REFERENCES:

SL NO:	DESCRIPTION
1	

DELIVERY TECHNOLOGIES

CLASSROOM WITH BLACK BOARD/WHITE BOARD/SMART BOARD	✓	**ICT TOOLS**	
CLASSROOM WITH LCD PROJECTOR	✓	**ELECTRONIC CLASSROOM**	

INSTRUCTION METHODS

FACE TO FACE INSTRUCTION	Direct	✓	**FLIPPED CLASSROOM**	✓
	Project-based instruction		**BLENDED LEARNING**	✓
	Problem-based instruction		**ONLINE COURSES/MOOCs**	
	Technology enhanced learning		**OTHERS (IF ANY)**	
	Experiential learning			
	Participative learning			

CO ASSESSMENT TOOLS-DIRECT

ASSIGNMENTS	✓	**TUTORIALS**	✓	**SERIES EXAMINATIONS**	✓	**UNIVERSITY EXAM**	✓
LAB PRACTICES		**VIVA**		**INTERNAL LAB EXAM**		**REPORT/ DOCUMENT PREPARATION**	
PRESENTATION		**EVALUATION BY GUIDE**		**INTERIM EVALUATION**		**FINAL EVALUATION**	

CO ASSESSMENT TOOLS -INDIRECT

ASSESSMENT OF COURSE OUTCOMES (BY COURSE EXIT (END) SURVEY)	✓

ASSESSMENT ITEMS /CLASS SESSIONS/LAB/FIELD/TUTORIAL HOURS FOR EACH COURSE OUTCOMES

CO	**ASSESSMENT ITEMS**	**CLASS SESSIONS**	**LAB/FIELD/TUTORIAL HOURS**
GNEST305.1	S1,A1,T1	**14**	1
GNEST305.2	S2,A1,T2	**14**	1
GNEST305.3	S2,A2,T3	**14**	1
GNEST305.4	S3,A3,T4	**14**	1
		TOTAL HOURS OF INSTRUCTION	**60**

Prepared by **Approved by HOD**

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UCHUT347

ENGINEERING ETHICS AND SUSTAINABLE DEVELOPMENT

COURSE INFORMATION SHEET

PROGRAMME: ECE (UG)	**DEGREE**: BTECH
COURSE: ENGINEERING ETHICS AND SUSTAINABLE DEVELOPMENT	**SEMESTER: 3** **L-T-P-CREDITS**: 2-0-0-2
COURSE CODE: **REGULATION**: UCHUT347: 2024 SCHEME	**COURSE TYPE**: NON- CORE
COURSE AREA/DOMAIN: HUMANITIES AND SOCIAL SCIENCES	**CONTACT HOURS**: 2
CORRESPONDING LAB COURSE CODE (IF ANY): NIL	**LAB COURSE NAME**: NIL

SYLLABUS

MODULE	DETAILS	HOURS
I	Fundamentals of ethics - Personal vs. professional ethics, Civic Virtue, Respect for others, Profession and Professionalism, Ingenuity, diligence and responsibility, Integrity in design, development, and research domains, Plagiarism, a balanced outlook on law - challenges - case studies, Technology and digital revolution-Data information, and knowledge, Cybertrust and cybersecurity, Data collection & management, High technologies: connecting people and places-accessibility and social impacts, Managing conflict, Collective bargaining Confidentiality, Role of confidentiality in moral integrity, Codes of Ethics. Basic concepts in Gender Studies - sex, gender, sexuality, gender spectrum: beyond the binary, gender identity, gender expression, gender stereotypes, Gender disparity and discrimination in education, employment and everyday life, History of women in Science & Technology, Gendered technologies & innovations, Ethical values and practices in connection with gender - equity, diversity & gender justice, Gender policy and women/transgender empowerment initiatives.	6

II	Introduction to Environmental Ethics: Definition, importance and historical development of environmental ethics, key philosophical theories (anthropocentrism, biocentrism, ecocentrism). Sustainable Engineering Principles: Definition and scope, triple bottom line (economic, social and environmental sustainability), life cycle analysis and sustainability metrics. Ecosystems and Biodiversity: Basics of ecosystems and their functions, Importance of biodiversity and its conservation, Human impact on ecosystems and biodiversity loss, An overview of various ecosystems in Kerala/India, and its significance. Landscape and Urban Ecology: Principles of landscape ecology, Urbanization and its environmental impact, Sustainable urban planning and green infrastructure.	6
III	Hydrology and Water Management: Basics of hydrology and water cycle, Water scarcity and pollution issues, Sustainable water management practices, Environmental flow disruptions and disasters. Zero Waste Concepts and Practices: Definition of zero waste and its principles, Strategies for waste reduction, reuse, reduce and recycling, Case studies of successful zero waste initiatives. Circular Economy and Degrowth: Introduction to the circular economy model, Differences between linear and circular economies, degrowth principles, Strategies for implementing circular economy practices and degrowth principles in engineering. Mobility and Sustainable Transportation: Impacts of transportation on the environment and climate, Basic tenets of a Sustainable Transportation design, Sustainable urban mobility solutions, Integrated mobility systems, E-Mobility, Existing and upcoming models of sustainable mobility solutions.	6
IV	Renewable Energy and Sustainable Technologies: Overview of renewable energy sources (solar, wind, hydro, biomass), Sustainable technologies in energy production and	6

	consumption, Challenges and opportunities in renewable energy adoption. Climate Change and Engineering Solutions: Basics of climate change science, Impact of climate change on natural and human systems, Kerala/India and the Climate crisis, Engineering solutions to mitigate, adapt and build resilience to climate change. Environmental Policies and Regulations: Overview of key environmental policies and regulations (national and international), Role of engineers in policy implementation and compliance, Ethical Considerations in environmental policy-making. Case Studies and Future Directions: Analysis of real-world case studies, Emerging trends and future directions in environmental ethics and sustainability, Discussion on the role of engineers in promoting a sustainable future.	
Total hours		**24**

TEXT BOOKS/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
R1	Ethics in Engineering Practice and Research ,Caroline Whitbeck ,Cambridge University Press & Assessment ,2nd edition & August 2011
R2	Sustainable Engineering Principles and Practice Bhavik R. Bakshi, Cambridge University Press & Assessment 2019
R3	Engineering Ethics,M Govindarajan, S,Natarajan and V S,Senthil Kumar,PHI

	Learning Private Ltd,New Delhi 2012
R4	Ethics in Engineering Mike W Martin and Roland Schinzinger, Tata McGraw Hill Publishing Pvt Ltd, Delhi 4" edition, 2014

COURSE PREREQUISITES: NIL

COURSE CODE	COURSE NAME	DESCRIPTION	SEMESTER

COURSE OBJECTIVES:

1	Equip with the knowledge and skills to make ethical decisions and implement gender- sensitive practices in their professional lives.
2	Develop a holistic and comprehensive interdisciplinary approach to understanding engineering ethics principles from a perspective of environment protection and sustainable development.
3	Develop the ability to find strategies for implementing sustainable engineering solutions.

COURSE OUTCOMES:

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

COs / CO-PO/PSO MAPPING. /BLOOM'S TAXONOMY LEVEL	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
UCHUT347.1	Develop the ability to apply the principles of engineering ethics in their professional life)													
						3	**2**	**3**	**3**	**2**		**2**		
	APPLY													
UCHUT347.2	Develop the ability to exercise gender-sensitive practices in their professional lives													
		1				**3**	**2**	**3**	**3**	**2**		**2**		
	ANALYSE													
UCHUT347.3	Develop the ability to explore contemporary environmental issues and sustainable practices.													
						3	**3**	**2**	**3**	**2**		**2**		
	EVALUATE													
UCHUT347.4	Develop the ability to analyse the role of engineers in promoting sustainability and climate													

	resilience.													
		1				3	3	2	3	2		2		
	ANALYSE													
UCHUT347.5	Develop interest and skills in addressing pertinent environmental and climate-related challenges through a sustainable engineering approach.													
						3	3	2	3	2		2		
	APPLY													
MAPPING AVERAGE		**1.00**				**3**	**2.6**	**2.4**	**3**	**2**		**2**		

JUSTIFICATION FOR CO-PO/PSO MAPPING:

CO	PO/PSO	MAPPING LEVEL	JUSTIFICATION
UCHUT347.1	PO6	**3**	Evaluates the societal and environmental impact of engineering choices.
	PO7	**2**	Connects ethical practices with sustainable development goals.
	PO8	**3**	Demonstrates strong awareness of professional ethics and responsibility.
	PO9	**3**	Works ethically in teams with respect for diversity
	PO10	**2**	Communicates ethical concerns effectively.
	PO12	**2**	Recognizes the need for lifelong ethical learning.
UCHUT347.2	PO2	**1**	Applies basic logical understanding
	PO6	**3**	Considers gender equity in societal impact.
	PO7	**2**	Evaluates sustainable development with inclusivity and equity
	PO8	**3**	Demonstrates ethical behavior inclusive of gender sensitivity.
	PO9	**3**	Encourage teamwork with gender balance and mutual respect
	PO10	**2**	Communicates effectively and inclusively.
	PO12	**2**	Engages in continuous learning for social responsibility and equity.
UCHUT347.3	PO6	**3**	Understands the impact of engineering on society and environment.

	PO7	**3**	Recognizes the importance of sustainability in engineering decisions.
	PO8	**2**	Applies ethics in environmental protection.
	PO9	**3**	Collaborates to achieve sustainable goals.
	PO10	**2**	Communicates environmental findings effectively.
	PO12	**2**	Pursues lifelong learning on environment advancements.
UCHUT347.4	PO2	**1**	Critically analyses sustainability and resilience challenges.
	PO6	**3**	Evaluates social/environmental impact in the climate context.
	PO7	**3**	Understands the broader goals of sustainability and resilience.
	PO8	**2**	Acts ethically in climate-sensitive decisions.
	PO9	**3**	Works with stakeholders to promote sustainability.
	PO10	**2**	Shares insights and awareness about resilience.
	PO12	**2**	Develops continuous interest in addressing climate issues.
UCHUT347.5	PO6	**3**	Assesses the long-term impact of engineering solutions.
	PO7	**3**	Promotes sustainability and climate-resilient designs.
	PO8	**2**	Practices ethical and environmental accountability.
	PO9	**3**	Collaborates in multidisciplinary teams on climate projects.
	PO10	**2**	Presents climate solutions in a socially relevant manner.
	PO12	**2**	Continually adapts to new development in sustainability

CORRELATION Levels: 3- Substantial (High) 2- Moderate (Medium) 1-Slight (Low)

GAPS IN THE SYLLABUS-TO MEET INDUSTRY/PROFESSION REQUIREMENTS

SL NO:	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POS /PSOS
1			

CONTENT BEYOND THE SYLLABUS/ADVANCED TOPICS/DESIGN

SL NO:	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POS /PSOS
1	Conduct Interdisciplinary Workshops	Guest Talk	PO6, PO8, PO10, PO12

WEB SOURCE REFERENCES:

SL NO:	DESCRIPTION
1	Sustainable development & 21st century engineering | Vk Saraswat | TEDxIITHyderabad

DELIVERY TECHNOLOGIES

CLASSROOM WITH BLACK BOARD/WHITE BOARD/SMART BOARD	✓	**ICT TOOLS**	✓
CLASSROOM WITH LCD PROJECTOR		**ELECTRONIC CLASSROOM**	

INSTRUCTION METHODS

FACE TO FACE INSTRUCTION	Direct	✓	**FLIPPED CLASSROOM**	✓
	Project-based instruction	✓	**BLENDED LEARNING**	✓
	Problem-based instruction		**ONLINE COURSES/MOOCs**	
	Technology enhanced learning		**OTHERS (IF ANY)**	

	Experiential learning			
	Participative learning			

CO ASSESSMENT TOOLS-DIRECT

ASSIGNMENTS		**TUTORIALS**		**SERIES EXAMINATIONS**		**UNIVERSITY EXAM**	✓
LAB PRACTICES		**VIVA**		**INTERNAL LAB EXAM**		**REPORT/ DOCUMENT PREPARATION**	✓
PRESENTATION	✓	**EVALUATION BY GUIDE**		**INTERIM EVALUATION**		**FINAL EVALUATION**	

CO ASSESSMENT TOOLS -INDIRECT

ASSESSMENT OF COURSE OUTCOMES (BY COURSE EXIT (END) SURVEY)	✓

ASSESSMENT ITEMS /CLASS SESSIONS/LAB/FIELD/TUTORIAL HOURS FOR EACH COURSE OUTCOMES

CO	ASSESSMENT ITEMS	CLASS SESSIONS	LAB/FIELD/TUTORIAL HOURS
UCHUT347.1	Activity: Reflective Journaling	**8**	
UCHUT347.2	Report on Case Studies	**5**	
UCHUT347.3	Report on Case Studies	**3**	
UCHUT347.4	Report on Case Studies	**7**	
UCHUT347.5	Report on Case Studies	**8**	
		TOTAL HOURS OF INSTRUCTION	**31**

Prepared by **Approved by HOD**

Sreelakshmi Prasad.

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PCECL307

ANALOG CIRCUITS LAB

COURSE INFORMATION SHEET

PROGRAMME: ECE (UG)	**DEGREE**: BTECH
COURSE: ANALOG CIRCUITS LAB	**SEMESTER: 3** **L-T-P-CREDITS**: 3-1-0-4
COURSE CODE: **REGULATION**:2024	**COURSE TYPE**: LABORATORY
COURSE AREA/DOMAIN: CIRCUITS AND SYSTEMS	**CONTACT HOURS**:3hrs/week
CORRESPONDING THEORY COURSE CODE **(IF ANY)**: PCECT303	**THEORY COURSE NAME**: Analog Circuits

SYLLABUS

MODULE	DETAILS	HOURS
PART-A	**Part A: Experiments with Discrete Components (Any 6 mandatory)** 1. RC Integrating and Differentiating Circuits 2. Diode Clipping and Clamping Circuits 3. CE Amplifier – Gain Design & Frequency Response 4. CS MOSFET Amplifier – Gain Design & Frequency Response 5. Cascaded Amplifier (CE-CE) – Gain Design & Frequency Response 6. Cascode Amplifier – Gain Design & Frequency Response 7. Feedback Amplifiers – Current Series & Voltage Series 8. RC Oscillators – Phase Shift or Wien Bridge Oscillator 9. Power Amplifiers – Class B & Class AB (Transformer less) 10. Transistor Series Voltage Regulator – Load & Line Regulation	3HRS/EXPT

PART-B	**Part B: Simulation Experiments (Any 6 mandatory)** To be done using QUCS, Ki Cad, LTSPICE, or SPICE variants. Experiments parallel to Part A (1 to 10) to simulate the corresponding circuits.	3HRS/EXPT
Total hours		**33**

TEXT BOOKS/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T1	Electronic Devices and Circuits David A Bell Oxford University Press 5th edition,2008
T2	Electronic Circuits Analysis and Design 1D. Meganathan Yes Dee Publishing 1st edition,2023

COURSE PREREQUISITES:

COURSE CODE	COURSE NAME	DESCRIPTION	SEMESTER
		NIL	

COURSE OBJECTIVES:

- Familiarize students with the design of analog circuits using discrete components.
- Familiarize students with the simulation of basic analog circuits using software tools.

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COURSE OUTCOMES:

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

COs / CO-PO/PSO MAPPING. /BLOOM'S TAXONOMY LEVEL	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
PCECL307.1	Design and demonstrate the functioning of basic analog circuits using discrete components													
	3	**2**	**2**						**3**			**3**	**3**	**2**
	APPLY													

PCECL307.2	Design and simulate the functioning of basic analog circuits using simulation tools													
	3	**2**	**2**		3				**3**			**3**	**3**	**2**
	APPLY													
PCECL307.3	Conduct trouble shooting of a given circuit and to analyze it.													
	3	**2**	**2**						**3**			**3**	**3**	**3**
	APPLY													
MAPPING AVERAGE	3	2	2		3				3			3	3	2.3

JUSTIFICATION FOR CO-PO/PSO MAPPING:

CO	PO/PSO	MAPPING LEVEL	JUSTIFICATION
PCECL307.1	PO1	3	It requires the application of fundamental knowledge in electronics and circuits.
	PO2	2	The activities require analyzing the circuit behaviour and solving design or functional issues, especially during troubleshooting.
	PO3	2	Designing circuits both practically and through simulation involves developing solutions for functional requirements.
	PO9	3	All activities generally involve collaborative learning and teamwork during labs and projects.
	PO12	3	Activities like troubleshooting, simulation, and hands-on design foster self-learning skills, particularly troubleshooting
	PSO1	3	Students define, design, implement, and test basic analog circuits (amplifiers, filters, oscillators), which are fundamental to **signal processing functions** like amplification, filtering, and waveform shaping.
	PSO2	2	Analog circuits demonstrated here are foundational to communication systems (e.g., modulation circuits), hence enabling students to **segregate and select appropriate circuits for communication subsystems**.
PCECL307.2	PO1	3	It requires the application of fundamental knowledge in electronics and circuits.

	PO2	2	The activities require analyzing the circuit behaviour and solving design or functional issues, especially during troubleshooting.
	PO3	2	Designing circuits both practically and through simulation involves developing solutions for functional requirements.
	PO5	3	Simulation tools usage maps strongly here (SPICE), justifying a level 3 mapping for the simulation activity.
	PO9	3	All activities generally involve collaborative learning and teamwork during labs and projects.
	PO12	3	Activities like troubleshooting, simulation, and hands-on design foster self-learning skills, particularly troubleshooting
	PSO1	3	Simulation provides opportunities to **model and test electronic circuits** digitally before physical implementation, contributing directly to signal processing system development.
	PSO2	2	Simulation tools expose students to circuit modelling relevant to **communication system building blocks**, although the direct system-level implementation is partial, so mapping is moderate.
PCECL307.3	PO1	3	It requires the application of fundamental knowledge in electronics and circuits.
	PO2	2	The activities require analyzing the circuit behaviour and solving design or functional issues, especially during troubleshooting.
	PO3	2	Designing circuits both practically and through simulation involves developing solutions for functional requirements.
	PO9	3	All activities generally involve collaborative learning and teamwork during labs and projects.
	PO12	3	Activities like troubleshooting, simulation, and hands-on design foster self-learning skills, particularly troubleshooting
	PSO1	3	Troubleshooting strengthens the capability to analyze and rectify signal processing circuits, ensuring they function correctly as per design specifications, fully aligning with **PSO1**.

	PSO2	3	By analyzing faults in circuits, students learn to evaluate and **select correct circuit strategies** beneficial in communication systems development, justifying a moderate (2) mapping.

CORRELATION Levels: 3- Substantial (High) 2- Moderate (Medium) 1-Slight (Low)

GAPS IN THE SYLLABUS-TO MEET INDUSTRY/PROFESSION REQUIREMENTS

SL NO:	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POS /PSOS
1	Lacks PCB design	Conduct workshops to introduce basic PCB design using Ki Cad	PO1, PO2, PO3, PO4, PO5,PO12, PSO1

CONTENT BEYOND THE SYLLABUS/ADVANCED TOPICS/DESIGN

SL NO:	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POS /PSOS
1.	Small circuit designs using discrete components/ICs	Link provided. Interested students shall implement small projects during free time or SIG hours	PO1,PO2,PO3,PO5, PO9,PO10,PO12, PSO1

WEB SOURCE REFERENCES:

SL NO:	DESCRIPTION
1	https://www.allaboutcircuits.com/projects/category/analog/

DELIVERY TECHNOLOGIES

CLASSROOM WITH BLACK BOARD/WHITE BOARD/SMART BOARD	▯	**ICT TOOLS**	
CLASSROOM WITH LCD PROJECTOR		**ELECTRONIC CLASSROOM**	

INSTRUCTION METHODS

FACE TO FACE INSTRUCTION	Direct		**FLIPPED CLASSROOM**	
	Project-based instruction	▯	**BLENDED LEARNING**	
	Problem-based instruction		**ONLINE COURSES/MOOCs**	
	Technology enhanced learning	▯	**OTHERS (IF ANY)**	
	Experiential learning	▯		
	Participative learning			

CO ASSESSMENT TOOLS-DIRECT

ASSIGNMENTS		**TUTORIALS**		**SERIES EXAMINATIONS**		**UNIVERSITY EXAM**	▯
LAB PRACTICES	▯	**VIVA**	▯	**INTERNAL LAB EXAM**	▯	**REPORT/ DOCUMENT PREPARATION**	▯
PRESENTATION		**EVALUATION BY GUIDE**		**INTERIM EVALUATION**		**FINAL EVALUATION**	

CO ASSESSMENT TOOLS -INDIRECT

ASSESSMENT OF COURSE OUTCOMES (BY COURSE EXIT (END) SURVEY)	▯

ASSESSMENT ITEMS /CLASS SESSIONS/LAB/FIELD/TUTORIAL HOURS FOR EACH COURSE OUTCOMES

CO	ASSESSMENT ITEMS	CLASS SESSIONS	LAB/FIELD/TUTORIAL HOURS
PCECL307.1	CA,IE	-	LAB-21HRS

PCECL307.2	CA,IE	-	LAB-12HRS
PCECL307.3	CA,IE	-	LAB-21+12 HRS
		TOTAL HOURS OF INSTRUCTION	33

Prepared by
Sreetha Sreedhar K

Approved by HOD

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PCECL308

LOGIC CIRCUIT DESIGN LAB

COURSE INFORMATION SHEET

PROGRAMME: ECE (UG)	**DEGREE**: BTECH
COURSE: LOGIC CIRCUIT DESIGN LAB	**SEMESTER: III** **L-T-P-R 0:0:3:0 CREDITS**: 2
COURSE CODE: PCECL308 **REGULATION**:2024	**COURSE TYPE**: LAB
COURSE AREA/DOMAIN: DIGITAL ELCTRONICS	**CONTACT HOURS**:3 HRS/WEEK
CORRESPONDING LAB COURSE CODE (IF ANY):	**LAB COURSE NAME**:

SYLLABUS

EXPERIMENT NO:	EXPERIMENTS	HOURS
	Part A – List of Experiments using digital components (Any Six experiments mandatory)	
1	Realization of functions using basic and universal gates (SOP and POS forms).	3
2	Design and Realization of half/full adder and subtractor using basic gates and universal gates.	3
3	4-bit adder/subtractor and BCD adder using 7483	3
4	Study of Flip Flops: S-R, D, T, JK and Master slave JK FF using NAND gates	3
5	Asynchronous Counter: 3 bit up/down counter, Realization of Mod N Counter	3
6	Synchronous Counter: Realization of 4-bit up/down counter, Realization of Mod-N counters	3
7	Ring counter and Johnson Counter.	3
8	Realization of counters using IC’s (7490, 7492, 7493).	3
9	Realization of combinational circuits using MUX & DEMUX, using ICs (74150, 74154)	3
10	Sequence Generator / Detector	3
	Part B – Simulation Experiments (Any Six experiments mandatory)	

1	Experiment 1: Realization of Logic Gates and Familiarization of FPGAs (a) Familiarization of a small FPGA board and its ports and interface. (b) Create the .pcf files for your FPGA board. (c) Familiarization of the basic syntax of Verilog Development of Verilog modules for basic gates, synthesis and implementation in the above FPGA to verify the truth tables. (e) Verify the universality and non-associativity of NAND and NOR gates by uploading the corresponding Verilog files to the FPGA boards.	3
2	Experiment 2: Adders in Verilog (a) Development of Verilog modules for half adder in any of the 3 modeling styles (b) Development of Verilog modules for full adder in structural modeling using half adder	3
3	Experiment 3: Mux and Demux in Verilog (a) Development of verilog modules for a 4x1 MUX. (b) Development of Verilog modules for a 1x4 DEMUX.	3
4	Experiment 4: Flipflops and counters (a) Development of Verilog modules for SR, JK and D flipflops. (b) Development of Verilog modules for a binary decade/Johnson/Ring counter	3
5	Experiment 5. Multiplexer and Logic Implementation in FPGA (a) Make a gate level design of an 8 : 1 multiplexer, write to FPGA and test its functionality. (b) Use the above module to realize any logic function	3
6	Experiment 6. Flip-Flops and their Conversion in FPGA (a) Make gate level designs of J-K, J-K master-slave, T and D flip-flops, implement and test them on the FPGA board. (b) Implement and test the conversions such as T to D, D to T, J-K to T and J-K to D	3
7	Experiment 7: Asynchronous and Synchronous Counters in FPGA (a) Make a design of a 4-bit up down ripple counter using T-flip-flops in the previous experiment, implement and test them on the FPGA board. (b) Make a design of a 4-bit up down synchronous counter using T-flip-lops in the previous	3

	experiment, implement and test them on the FPGA board	
8	Experiment 8: Universal Shift Register in FPGA (a) Make a design of a 4-bit universal shift register using D-flip-flops in the previous experiment, implement and test them on the FPGA board. (b) Implement ring and Johnson counters with it.	3
9	Experiment 9. BCD to Seven Segment Decoder in FPGA (a) Make a gate level design of a seven-segment decoder, write to FPGA and test its functionality. (b) Test it with switches and seven segment display. Use output ports for connection to the display.	3
Total hours		57

TEXT BOOKS/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T1	Verilog HDL Synthesis: A Practical Primer J. Bhasker B. S. Publications, 2001
T2	Fundamentals of Logic Design Roth C.H Jaico Publishers. V Ed., 2009 5th Edition
R1	Verilog HDL :A guide to digital design and synthesis Palnitkar S. Prentice Hall; 2003. 2nd Edn.

COURSE PREREQUISITES: NIL

COURSE OBJECTIVES:

1	Familiarise the students with the Digital Logic Design through the implementation of Logic Circuits.
2	Familiarise the students with the HDL based Digital Design and FPGA boards

COURSE OUTCOMES:

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

COs / CO-PO/PSO MAPPING. /BLOOM'S TAXONOMY LEVEL	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
PCECL308.1	Design and demonstrate the functioning of various combinational and sequential circuits using ICs.													
	3	**3**	**3**	**2**					**3**			**3**	**3**	**2**
	APPLY													
PCECL308.2	Apply an industry compatible hardware description language to implement digital circuits													
	3	**1**	**1**	**3**	**3**				**3**	1		**3**	**3**	**2**
	APPLY													
PCECL308.3	Implement digital circuits on FPGA boards and connect external hardware to the board													
	3	**1**	**1**	**3**	**3**				**3**	**1**		**3**	**3**	**2**
	APPLY													
PCECL308.4	Function effectively as an individual and in a team to accomplish the given task.													
	3	**3**	**3**		**3**				**3**			**3**	**1**	**1**
	APPLY													
MAPPING AVERAGE	3	2.00	2.00	2.67	3.00				3.00	1		3	2.5	1.75

JUSTIFICATION FOR CO-PO/PSO MAPPING:

CO	PO/PSO	MAPPING LEVEL	JUSTIFICATION
PCECL308.1	PO1	3	Strongly involves applying fundamental concepts of digital electronics and logic design.
	PO2	3	Requires analysis of circuit functionality and behavior to design correct combinational and sequential logic circuits.
	PO3	3	Focus is on designing and demonstrating digital solutions using ICs—directly addresses this PO.

	PO4	2	Involves experimentation, testing circuits for correctness, and interpreting results to verify performance.
	PO9	3	Students typically work in teams for lab-based tasks, promoting collaboration while also requiring individual contributions.
	PO12	3	Encourages learning of evolving digital ICs and technologies beyond classroom theory, a key component of lifelong learning
	PSO1	3	The CO involves **designing and demonstrating circuits** (both combinational and sequential), which directly supports **design, implementation, and testing** of electronic circuits as mentioned in PSO1.
	PSO2	2	The CO has an **indirect link** to communication systems, as basic combinational/sequential circuits are **building blocks** in communication system design, but the CO does not explicitly address communication applications.
PCECL308.2	PO1	3	Requires foundational knowledge of digital electronics and hardware description languages (HDL) to implement functional digital systems.
	PO2	1	Involves limited problem analysis; focus is more on translating known designs into HDL rather than exploring or analyzing open-ended problems.
	PO3	1	While it includes design using HDL, the design complexity may be minimal or already defined, hence low emphasis.
	PO4	3	Includes simulation, verification, and debugging of HDL-based designs—key aspects of investigation and evaluation.

	PO5	3	Strong use of modern industry-relevant tools (e.g., Xilinx Vivado, ModelSim, Quartus) for design, simulation, and implementation.
	PO9	3	Students work individually and in groups during lab activities, encouraging collaboration and independent problem solving.
	PO10	1	May involve minimal reporting or explanation of HDL code; however, formal communication (e.g., documentation or presentation) is not the primary focus.
	PO12	3	Working with HDL promotes self-learning of industry-relevant tools and languages, fostering continuous skill development aligned with industry trends.
	PSO1	3	HDL implementation of digital circuits directly relates to design, modeling, and implementation of electronic circuits, which are core to PSO1.
	PSO2	2	Using HDL can be part of selecting appropriate technologies for modern communication systems, though the CO does not explicitly focus on communication.
PCECL308.3	PO1	3	Involves core knowledge of digital logic, circuit interfacing, and FPGA architecture to implement functional systems.
	PO2	1	Problem-solving is limited to predefined hardware interfacing tasks; not focused on deep analytical problem resolution.
	PO3	1	Although design is part of the implementation, the task may involve replicating existing designs rather than creating new solutions.
	PO4	3	Debugging, testing, and validating FPGA outputs with connected hardware requires systematic investigation and analysis.

	PO5	3	Strong exposure to industry-relevant tools like Xilinx Vivado/Intel Quartus, and hands-on use of FPGA boards.
	PO9	3	Execution of hardware interfacing tasks is often done in pairs or groups, emphasizing collaborative and individual efforts.
	PO10	1	Minimal communication demands; may involve basic reporting or explaining implementation to instructors or peers.
	PO12	3	Hands-on work with FPGA fosters adaptability and ongoing learning of emerging digital hardware platforms and tools.
	PSO1	3	Implementing circuits on FPGA involves design, implementation, testing, and often modeling—all core elements of PSO1.
	PSO2	2	FPGAs are widely used in modern communication systems. This CO involves selecting and interfacing external hardware, supporting PSO2 indirectly.
PCECL308.4	PO1	3	Applying technical knowledge individually and in teams to complete digital circuit tasks reflects sound understanding of core engineering concepts.
	PO2	3	Collaborative problem-solving and task division requires analysis of circuit-related challenges, enhancing group-based learning.

	PO3	3	Team projects often involve planning, designing, and implementing solutions together—directly aligning with this PO.
	PO5	3	Teams typically use modern simulation or FPGA tools collaboratively, requiring joint technical engagement.
	PO9	3	This CO directly corresponds to PO9, focusing on functioning effectively in diverse roles, both independently and as a group member.
	PO12	3	Working in teams fosters soft skills like adaptability, communication, and openness to peer learning—critical for lifelong learning.
	PSO1	1	This CO is focused on teamwork and collaboration, not directly on technical aspects like circuit design or signal processing.
	PSO2	1	Similarly, this CO does not involve technology selection or communication systems. It is a **soft skill-oriented** outcome.

CORRELATION Levels: 3- Substantial (High) 2- Moderate (Medium) 1-Slight (Low)

GAPS IN THE SYLLABUS-TO MEET INDUSTRY/PROFESSION REQUIREMENTS

SL NO:	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POS /PSOS
1	Lack of industry-level HDL project design	Add a **mini-project** on implementing a digital subsystem (e.g., ALU, UART controller, memory interface, or FSM).	PO1, PO2, PO3, PO4, PO5, PO12 PSO1 (3), PSO2 (2)

CONTENT BEYOND THE SYLLABUS/ADVANCED TOPICS/DESIGN

SL NO:	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POS /PSOS
1	Mini Project: Design of ALU or UART using Verilog	Students design a basic ALU or UART controller using Verilog, simulate, and implement on FPGA.	PO1, PO2, PO3, PO4, PO5, PO12 PSO1 (3), PSO2 (2)
2	Design of a BCD to 7-Segment Decoder	A complete Verilog project implemented on FPGA and connected to physical display hardware.	PO1, PO3, PO5, PO9 PSO1
3	Team-Based HDL Project with Report and Presentation	Collaborative implementation of a design problem, including documentation and demonstration.	PO3, PO9, PO10, PO1 PSO1, PSO2

WEB SOURCE REFERENCES:

SL NO:	DESCRIPTION
1	Nptel Course: Fundamentals of Digital Circuits
2	Nptel Course: System Design through Verilog
3	http://www.electronics-tutorials.ws/logic/logic_1.html
4	https://archive.nptel.ac.in/courses/117/106/117106086/
5	https://archive.nptel.ac.in/courses/106/105/106105185/

DELIVERY TECHNOLOGIES

CLASSROOM WITH BLACK BOARD/WHITE BOARD/SMART BOARD	▯	**ICT TOOLS**	
CLASSROOM WITH LCD PROJECTOR		**ELECTRONIC CLASSROOM**	

INSTRUCTION METHODS

FACE TO FACE INSTRUCTION	Direct		**FLIPPED CLASSROOM**	
	Project-based instruction	▯	**BLENDED LEARNING**	
	Problem-based instruction		**ONLINE COURSES/MOOCs**	
	Technology enhanced learning		**OTHERS (IF ANY)**	
	Experiential learning	▯		
	Participative learning			

CO ASSESSMENT TOOLS-DIRECT

ASSIGNMENTS		**TUTORIALS**		**SERIES EXAMINATIONS**		**UNIVERSITY EXAM**	▯
LAB PRACTICES	▯	**VIVA**	▯	**INTERNAL LAB EXAM**	▯	**REPORT/ DOCUMENT PREPARATION**	▯
PRESENTATION		**EVALUATION BY GUIDE**		**INTERIM EVALUATION**		**FINAL EVALUATION**	

CO ASSESSMENT TOOLS -INDIRECT

ASSESSMENT OF COURSE OUTCOMES (BY COURSE EXIT (END) SURVEY)	▯

ASSESSMENT ITEMS /CLASS SESSIONS/LAB/FIELD/TUTORIAL HOURS FOR EACH COURSE OUTCOMES

CO	ASSESSMENT ITEMS	CLASS SESSIONS	LAB/FIELD/TUTORIAL HOURS
PCECL308.1	CA,IE		24
PCECL308.2	CA,IE		12
PCECL308.3	CA,IE		6
PCECL308.4	CA,IE		42
		TOTAL HOURS OF INSTRUCTION	42

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