EC

VIMAL JYOTHI
ENGINEERING COLLEGE (AUTONOMOUS)
CHEMPERI - KANNUR I WWW.VJEC.AC.IN

VJEC B. Tech. Syllabus 2024

Semester III

Electronics & Communication Engineering
Branch Code: EC

SEMESTER S3
MATHEMATICS FOR ELECTRICAL SCIENCE AND PHYSICAL SCIENCE-3
(Common to B & C Groups)

Course code	**GYMAT301**	**CIE Marks**	**40**
Teaching Hours/Week (L:T:P:R)	**3:0:0:0**	**ESE Marks**	**60**
Credits	**3**	**Exam Hours**	**2Hrs. 30 MIn**
Prerequisites (if any)	**Basic knowledge in complex numbers**	**Course Type**	**Theory**

Course Objectives:

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

Module No.	Syllabus Description	Contact Hours
1	Fourier integral,From Fourier series to Fourier integral, Fourier cosine and Sine integrals,Fourier Cosine and Sine transforms,Linearity,Transforms of Derivatives,Fourier Transform and its inverse,Linearity, Transforms of Derivative. **(Text1: Relevant topics from sections 11.7, 11.8, 11.9)**	9
2	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=sinz **(Text1: Relevant topics from sections 13.3,13.4,17.1,17.2,17.4)**	9
3	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) **(Text1: Relevant topics from sections 14.1,14.2,14.3)**	9
4	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 Zeros, Formulas for Residues, Residue theorem(without proof), Residue integration-Integral of rational Functions of $\cos\theta$ & $\sin\theta$ **(Text1: Relevant topics from sections 15.4.16.1,16.2,16.3,16.4)**	9

Course Assessment Method
(CIE:40 marks, ESE:60 Marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (written)	Internal Examination-2 (written)	Internal Examination-3 (written)	Total
5	15	5	10	5	40

End Semester Examination Marks(ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions.

Part A	Part B	Total
• 2 Questions from each module • Total of 8 Questions, each carrying 3 Marks $(8\times 3 = 24\ Marks)$	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. $(4\times 9 = 36\ Marks)$	60

Course Outcomes (COs) and Assessment Tool

Course Outcomes		Bloom's Knowledge Level (KL)	Assessment Tool
CO1	Determine the Fourier transforms of functions and apply them to solve problems arising in engineering.	K3	Written Exam & Assignments
CO2	Understand the analyticity of complex functions and apply it in conformal mapping.	K3	
C03	Compute complex integrals using Cauchy's integral theorem and Cauchy's integral formula.	K3	
CO4	Understand the series expansion of complex function about a singularity and apply residue theorem to compute real integrals.	K3	

Note: *1.' Slight (Low), 2.- Moderate (Medium), 3. Substantial (High), - No Correlation*

CO-PO Mapping Table

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	-	2	-	-	-	-	-	-	2
CO2	3	3	-	2	-	-	-	-	-	-	2
CO3	3	3	-	2	-	-	-	-	-	-	2
CO4	3	3	-	2	-	-	-	-	-	-	2

Text Book				
Sl.No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Advanced Engineering Mathematics	Erwin Kreyszig	John Wily &Sons	10th edition,2016

REFERENCE BOOKS				
Sl.No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Complex Analysis	Dennis G.Zill, Patrick D.Shanahan	Jones& Bartlett	3rd edition,2015
2	Higher Engineering Mathematics	B.V Ramana	McGraw-Hill Education	39th edition,2023
3	Higher Engineering Mathematics	B.S Grewal	Khanna Publishers	44th edition, 2018
4	Fast Fourier Transforms-Algorithms and applications	K.R.Rao, Do Nyeon Kim, Jae Jeong Hwang	Springer	1st edition, 2011

SEMESTER S3

SOLID STATE DEVICES

Course Code	PCECT302	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	GBPHT121 (Physics of Electrical Science)	Course Type	Theory

Course Objectives:

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

SYLLABUS

Module No	Syllabus Description	Contact Hours
1	**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, Continuity equations, Current flow equations, Diffusion length.	**13**
2	**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.	**12**

3	**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 - linear and saturation region, Drain characteristics, transfer characteristics.	**11**
4	**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**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1	Internal Examination- 2	Internal Examination- 3	Total
5	15	5	10	5	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4*9 = 36 marks)**	60

Course Outcomes (COs)

At the end of the course students should be able to:

CO	Course Outcome	Bloom's Knowledge Level (KL)	Assessment Tool
CO1	Apply Fermi-Dirac statistics to compare equilibrium carrier concentration.	K3	Written exam and Assignment
CO2	State different carrier transport mechanisms in extrinsic semiconductors and obtain the current densities due to this transport.	K3	Written exam
CO3	Apply the concept of semiconductor physics to solve the current components in semiconductor devices.	K3	Written exam
CO4	Analyze the response of semiconductor devices for different biasing conditions	K3	Written exam
CO5	Outline the effects of scaling in semiconductor devices.	K2	Written exam and Assignment

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3										
CO2	3	2									
CO3	3	2									2
CO4	3	2	2								2
CO5	3	2	2								2

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Semiconductor device Fundamentals	Robert Pierret	Pearson Education	1/e, 1996
2	Physics of Semiconductor Devices	Michael shur	Pearson Education	1/e, 2019
3	Semiconductor Physics and Devices, 3ed, An Indian Adaptation	S.M. Sze, M.K. Lee	Wiley	3/e, 2021
4	Solid State Electronic Devices	Ben G. Streetman and Sanjay Kumar Banerjee	Pearson	6/e, 2010

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Semiconductor Physics and Devices	Neamen	McGraw Hill	4/e, 2017
2	Physics of Semiconductor Devices	Sze S.M	John Wiley	3/e, 2015
3	Semiconductor Devices: Physics and Technology	Sze S.M	John Wiley	3/e, 2016
4	Operation and Modelling of the MOS Transistor	Yannis Tsividis	Oxford University Press	3/e,2010
5	Semiconductor Physics and Devices,	Sze S.M., M.K. Lee,	An Indian Adaptation	3ed, 2021
6	Fundamentals of Semiconductor Devices,	Achuthan, K N Bhat,	McGraw Hill	1e,2015
7	Solid State Devices and Technology	V Suresh Babu	Owl Books	4e,2014

Video Links (NPTEL, SWAYAM…)	
SLNO	**Link ID**
1	https://nptel.ac.in/courses/117106091

SEMESTER S3

ANALOG CIRCUITS

Course Code	PCECT303	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	GXESTl04 Introduction to Electrical & Electronics Engineering	Course Type	Theory

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.

SYLLABUS

Module No	Syllabus Description	Contact Hours
1	**Wave Shaping Circuits:** RC differentiating and integrating circuits, Analysis of First order RC low pass and high pass filter for step input - rise time, band width. 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**
2	**BJT Amplifiers:** Design of RC coupled CE amplifier - Small signal analysis of CE amplifier using hybrid- π model . 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.	**12**
3	**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, RC Phase Shift oscillator, Hartley and Crystal oscillator. (working principle and design equations of the circuits; analysis of Wien bridge oscillator only required). Astable Multi Vibrator.	**11**
4	**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**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment	Internal Examination-1	Internal Examination- 2	Internal Examination- 3	Total
5	15	5	10	5	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 2 sub divisions. **(4X9 = 36 marks)**	60

Course Outcomes (COs)

At the end of the course students should be able to:

CO	Course Outcome	Bloom's Knowledge Level (KL)	Assessment Tool
COl	Design wave shaping circuits using first order RC network and diodes.	K3	Written Exam and Assignment
CO2	Analyze single stage and multistage BJT amplifier circuits using equivalent models.	K3	Written Exam
CO3	Apply the principles of feedback in the design of oscillators.	K3	Written Exam
CO4	Design power amplifiers and voltage regulator circuits.	K3	Written Exam and Assignment

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2		2						2
CO2	3	3			2						2
CO3	3	3	2		2						2
CO4	3	3	2		2						2

Note: *1.' Slight (Low), 2.- Moderate (Medium), 3. Substantial (High), - No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Electronic Devices and Circuit Theory.	Robert Boylestad and L Nashelsky	Pearson	11/e, 2015
2	Microelectronic Circuits	Sedra A. S. and K. C. Smith	Oxford University Press, 2013	6/e, 2013
3	Electronic Circuits and Devices	Theodore F. Bogart; Beasley, Jeffrey S.; Guillermo Rico	Pearson Education India	6/e

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Fundamentals of Microelectronics	Razavi B.	Wiley	2/e, 2015
2	Electronic Devices and Circuits	David A Bel	Oxford University Press	5/e, 2008
3	Electronic Circuits Analysis and Design 1	D. Meganathan	Yes Dee Publishing	1/e, 2023
4	Analysis and Design of Electronic Circuits	K. Gopakumar	OWL Books	1/e,2023

Video Links (NPTEL, SWAYAM…)	
SLNO	**Link ID**
1	https://archive.nptel.ac.in/courses/108/106/108106188/
2	https://archive.nptel.ac.in/courses/108/106/108106188/
3	https://archive.nptel.ac.in/courses/108/106/108106188/

SEMESTER S3

LOGIC CIRCUIT DESIGN

Course Code	PBECT304	CIE Marks	60
Teaching Hours/Week (L: T:P: R)	3:0:0:1	ESE Marks	40
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	GXESTl04 Introduction to Electrical & Electronics Engineering	Course Type	Theory

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

SYLLABUS

Module No	Syllabus Description	Contact Hours
1	**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 (up to 4 variables), Implementation of Boolean expressions using logic gates.	**12**
2	**Combinational logic circuits-** Half adder and Full adders, Subtractors, BCD adder, Ripple carry and carry look ahead adders, Decoders, Encoders, Code converters, 2-bit 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 (CIE Only)	**9**
3	**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. Ring and Johnsons counters. Design of Asynchronous, Synchronous and Mod N counters.	**11**
4	**Finite** state **machines** - Mealy and Moore models, State graphs, State assignment, State table, State reduction. **Logic Families:** -Electrical characteristics of logic gates (Noise margin, Fan-in, 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.	**10**

Suggestion on Project Topics:

- A random sequence generator
- Traffic light controller
- Multiplexer based person priority check in system at airport
- Waveform generator
- Object/Visitor counter
- Fast adders
- Hamming code-based parity checker
- Arithmetic Logic Unit using FPGA

Course Assessment Method
(CIE: 60 marks, ESE: 40 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Project	Internal Examination-1	Internal Examination- 2	Internal Examination- 3	Total
5	35	5	10	5	60

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 2 marks **(8x2 =16marks)**	• Each question carries 6 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 2 sub divisions. **(4x6 = 24 marks)**	40

Course Outcomes (COs)

At the end of the course students should be able to:

CO	Course Outcome	Bloom's Knowledge Level (KL)	Assessment Tool
COl	Apply the knowledge of digital representation of information and Boolean algebra to deduce optimal digital circuits.	K3	Written Exam
CO2	Design and implement combinational logic circuits, sequential logic circuits and finite state machines.	K5	Written Exam and Project
CO3	Design and implement digital circuits on FPGA using hardware description language (HDL).	K5	Project
CO4	Outline the performance of logic families with Respect to different parameters.	K2	Written Exam

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	2							3
CO2	3	3	3	3	3	3	3	3			3
CO3	3	3	3	3	3	3	3	3	3	3	3
CO4	3		2								3

Note: *1.' Slight (Low), 2.- Moderate (Medium), 3. Substantial (High), - No Correlation*

Text Books

SI. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Digital Fundamentals	Thomas L. Floyd	Pearson Education	11th Edition, 2017
2	Fundamentals of Digital Circuits	A. Ananthakumar	PHI	4th Edition, 2016
3	Digital Principles and Design	Donald D. Givone	McGraw Hill	3rd Edition, 2016
4	Fundamentals of Digital Logic with Verilog Design	Stephen Brown	McGraw Hill Education	2"d Edition

Reference Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Digital Design: With an Introduction to the Verilog HDL, VHDL, and System Verilog	M Morris Mano, Michael D. Ciletti	Pearson India	6* Edition, 2018
2	Introduction to Logic Circuits & Logic Design with Verilog	Brock J. La Meres	Springer	2nd Edition, 2019
3	Digital Design Verilog HDL and Fundamentals	Joseph Cavanagh	CRC Press	1" Edition, 2008
4	Digital Circuits and Systems	D.V. Hall	Tata McGraw Hill	1989

Video Links (NPTEL, SWAYAM...) and Online resources

Sl No	Link ID
1	https://archive.nptel.ac.in/courses/117/106/117106086/
2	https://archive.nptel.ac.in/courses/106/105/106105185/
3	https://nevonprojects.com/digital-electronics-projects/ https://robu.in/product-category/electronic-components/ https://www.electronicsforu.com/category/electronics-projects/hardware-diy

PBL Course Elements

L: Lecture (3 Hrs.)	R: Project (1 Hr.), 2 Faculty Members		
	Tutorial	Practical	Presentation
Lecture deliver	Project identification	Simulation/ Laboratory work / Workshops	Presentation (Progress and Final Presentations)
Group discussion	Project Analysis	Data Collection	Evaluation
Question answer Sessions/ Brainstorming Sessions	Analytical thinking and self-learningg	Testing	Project Milestone Reviews, Feedback, Project reformation (If required)
Guest Speakers (Industry Experts)	Case Study/ Field Survey Report	Prototyping	Poster Presentation / Video Presentation: Students present their results in a 2 to 5 minutes video

Assessment and Evaluation for Project Activity

Students are required to complete course projects in groups of maximum three members.

SI. **No**	**Evaluation for**	**Allotted Marks**
1	Project Planning and Proposal	5
2	Contribution in Progress Presentations and Question Answer Sessions	5
3	Involvement in the project work and Team Work	5
4	Execution and implementation	10
5	Final Presentations	5
6	Project Quality, Innovation and Creativity	5
	Total	35

Project Assessment and Evaluation criteria (35 Marks)

1. **Project Planning and Proposal** (S **Marks)**
   - Clarity and feasibility of the project plan
   - Research and background understanding
   - Defined objectives and methodology
2. **Contribution in Progress Presentation** and **Question** Answer Sessions (5 **Marks)**
   - Individual contribution to the presentation
   - Effectiveness in answering questions and handling feedback
3. **Involvement in the Project Work and Team Work (5 Marks)**
   - Active participation and individual contribution
   - Teamwork and collaboration
4. **Execution and Implementation (10 Marks)**
   - Adherence to the project timeline and milestones
   - Application of theoretical knowledge and problem-solving
   - Implementation using FPGA
   - Final Result
5. **Final Presentation (S Marks)**
   - Quality and clarity of the overall presentation
   - Individual contribution to the presentation
   - Effectiveness in answering questions
6. **Project Quality, Innovation, and Creativity (5 Marks)**
   - Overall quality and technical excellence of the project
   - Innovation and originality in the project
   - Creativity in solutions and approaches

Project Assessment and Evaluation Criteria (35 Marks)- Evaluation rubrics

1. Project Planning and Proposal (5 Marks)

Criteria	**Excellent (5)**	**Good (4)**	**Satisfactory (3)**	**Needs Improvement (2-1)**
Clarity & Feasibility	Clear, well-structured, and highly feasible plan	Good structure with minor feasibility issues	Somewhat clear but lacks depth	Unclear, unrealistic, or lacks structure
Research & Background Understanding	Comprehensive research with strong understanding	Good research but some gaps	Basic research, limited depth	Poor research, lacks understanding
Defined Objectives & Methodology	Clearly defined, well-structured methodology	Objectives and methodology are mostly clear	Somewhat defined but lacks clarity	Vague or poorly defined methodology

2. Contribution in Progress Presentation and Q&A (5 Marks)

Criteria	**Excellent (5)**	**Good (4)**	**Satisfactory (3)**	**Needs Improvement (2-1)**
Individual Contribution	Significant, well-prepared contribution	Moderate contribution, some engagement	Minimal but noticeable effort	Little to no participation
Effectiveness in Answering Questions	Confident, clear, and well-informed responses	Good answers with minor gaps	Somewhat hesitant or incomplete responses	Struggles to answer, lacks clarity

3. Involvement in Project Work and Teamwork (5 Marks)

Criteria	**Excellent (5)**	**Good (4)**	**Satisfactory (3)**	**Needs Improvement (2-1)**
Active Participation	Highly engaged, proactive, and responsible	Consistently involved but minor lapses	Participates but lacks consistency	Rarely contributes
Teamwork & Collaboration	Excellent collaboration, strong teamwork	Good teamwork, minor issues	Some participation but occasional conflicts	Poor teamwork, conflicts arise

4. Execution and Implementation (10 Marks)

Criteria	**Excellent (5)**	**Good (4)**	**Satisfactory (3)**	**Needs Improvement (2-1)**
Adherence to Timeline	Follows timeline effectively	Minor deviations	Some delays but managed	Significant delays, poor time management
Application of Theoretical Knowledge	Excellent application of concepts	Good application, some gaps	Basic application, lacks depth	Poor application, lacks understanding
Implementation using FPGA	Well-executed, functional, and optimized	Functional with minor flaws	Basic implementation, some issues	Poor or incomplete implementation
Final Result	Fully functional, meets/exceeds expectations	Functional with minor flaws	Partially functional	Non-functional or incomplete

5. Final Presentation (5 Marks)

Criteria	**Excellent (5)**	**Good (4)**	**Satisfactory (3)**	**Needs Improvement (2-1)**
Quality & Clarity	Highly structured, engaging, and clear	Mostly clear, some minor gaps	Understandable but lacks engagement	Poorly structured, difficult to follow
Individual Contribution	Strong contribution, confident delivery	Good contribution, some minor gaps	Basic contribution, minimal effort	Little to no participation
Effectiveness in Q&A	Clear, confident, and insightful responses	Good responses with minor issues	Struggles with some responses	Poor or unclear answers

6. Project Quality, Innovation, and Creativity (5 Marks)

Criteria	**Excellent (5)**	**Good (4)**	**Satisfactory (3)**	**Needs Improvement (2-1)**
Technical Excellence	Highly technical, well-executed project	Good technical quality with minor flaws	Basic execution, lacks complexity	Poor execution, lacks depth
Innovation & Originality	Very innovative, unique approach	Some innovative elements	Limited originality, common approach	No innovation, copied ideas

SEMESTER S3

INTRODUCTION TO ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

(Common to Group B and C)

Course Code	**GYEST305**	**CIA Marks**	**40**
Teaching Hours/Week (L: T:P: R)	**3:1:0:0**	**ESE Marks**	**60**
Credits	**4**	**Exam Hours**	**2 Hrs. 30 Min.**
Prerequisites (if any)	**None**	**Course Type**	**Theory**

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, Implement appropriate mathematical and computational techniques for AI and data science applications.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**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, Types of Neural networks - Perceptron - Universal Approximation Theorem (statement only)- Multi-Layer Perceptron - Deep Neural Network- demonstration of regression and classification problems using MLP.(Text-2).	11

2	**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**
3	**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 Estimator (MLE) - statistical summaries- Correlation analysis- linear correlation (direct problems only)- regression analysis- linear regression (using least square method) (Text book 4)	**11**
4	**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. (Text book-5)	**11**

Course Assessment Method (CIA: 40 marks, ESE: 60 marks)

Continuous Internal Assessment Marks (CIA):

Attendance	**Assignment/ Micro project/ IBM data science certification**	**Internal Examination-1 (Written)**	**Internal Examination-2 (Written)**	**Internal Examination- 3 (Written)**	**Total**
5	**15**	**5**	**10**	**5**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24 marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 subdivisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs) and Assessment Tool

At the end of the course students should be able to:

	Course Outcome	Bloom's Knowledge Level (KL)	Assessment Tool
CO1	Apply the concept of machine learning algorithms including neural networks and supervised/unsupervised learning techniques for engineering applications.	**K3**	Written exam
CO2	Apply advanced mathematical concepts such as matrix operations, singular values, and principal component analysis to analyze and solve engineering problems**.**	**K3**	Written exam
CO3	Analyze and interpret data using statistical methods including descriptive statistics, correlation, and regression analysis to derive meaningful insights and make informed decisions.	**K3**	Written exam
CO4	Integrate statistical approaches and machine learning techniques to ensure practically feasible solutions in engineering contexts.	**K3**	Written exam

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3							3
CO2	3	3	3	3							3
CO3	3	3	3	3							3
CO4	3	3	3	3							3

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Introduction to Linear Algebra	Gilbert Strang	Wellesley-Cambridge Press	6th edition, 2023
2	Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow	Aurélien Géron	O'Reilly Media, Inc.	2nd edition,2022
3	Mathematics for machine learning	Deisenroth, Marc Peter,A. Aldo Faisal, and Cheng Soon Ong	Cambridge University Press	1st edition. 2020
4	Fundamentals of mathematical statistics	Gupta, S. C., and V. K. Kapoor	Sultan Chand & Sons	9th edition, 2020
5	Introducing data science: big data, machine learning, and more, using Python tools	Cielen, Davy, and Arno Meysman	Simon and Schuster	1st edition, 2016

Reference Books				
1	Data science: concepts and practice	Kotu, Vijay, and Bala Deshpande	Morgan Kaufmann	2nd edition, 2018
2	Probability and Statistics for Data Science	Carlos Fernandez - Granda	Center for Data Science in NYU	1st edition, 2017
3	Foundations of Data Science	Avrim Blum, John Hopcroft, and Ravi Kannan	Cambridge University Press	1st edition, 2020
4	Statistics For Data Science	James D. Miller	Packt Publishing	1st edition, 2019
5	Probability and Statistics - The Science of Uncertainty	Michael J. Evans and Jeffrey S. Rosenthal	University of Toronto	1st edition, 2009
6	An Introduction to the Science of Statistics: From Theory to Implementation	Joseph C. Watkins	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj https://www.math.arizo	Preliminary Edition.

SEMESTER S3/S4
ECONOMICS FOR ENGINEERS
(Common to All Groups)

Course Code	**UCHUT346**	**CIE Marks**	**50**
Teaching Hours/Week (L: T:P: R)	**2:0:0:0**	**ESE Marks**	**50**
Credits	**2**	**Exam Hours**	**2 Hrs. 30 Min.**
Prerequisites (if any)	**None**	**Course Type**	**Theory**

Course Objectives:

1. Understanding of finance and costing for engineering operation, budgetary planning and control
2. Provide fundamental concept of micro and macroeconomics related to engineering industry.
3. Deliver the basic concepts of Value Engineering

SYLLABUS

Module No	Syllabus Description	Contact Hours
1	Basic Economics Concepts - Basic economic problems – Production Possibility Curve – Utility – Law of diminishing marginal utility – Law of Demand - Law of supply – Elasticity - measurement of elasticity and its applications – Equilibrium- Changes in demand and supply and its effects Production function - Law of variable proportion – Economies of Scale – Internal and External Economies – Cobb-Douglas Production Function	**6**
2	Cost concepts – Social cost, private cost – Explicit and implicit cost – Sunk cost - Opportunity cost - short run cost curves - Revenue concepts Firms and their objectives – Types of firms – Markets – Perfect Competition – Monopoly - Monopolistic Competition - Oligopoly (features and equilibrium of a firm) Behavioral Economics – Decision-making biases, bounded rationality, and engineering applications.	**7**
3	Monetary System – Money – Functions - Central Banking – Inflation - Causes and Effects – Measures to Control Inflation - Monetary and Fiscal policies – Deflation Taxation – Direct and Indirect taxes (merits and demerits) – GST, National income – Concepts - Circular Flow – Methods of Estimation and Difficulties - Stock Market – Functions- Problems faced by the Indian stock market – Demat Account and Trading Account – Stock market Indicators SENSEX and NIFTY	**6**

4	Value Analysis and value Engineering - Cost Value, Exchange Value, Use Value, Esteem Value - Aims, Advantages and Application areas of Value Engineering - Value Engineering Procedure - Break-even Analysis – Cost Benefit Analysis - Capital Budgeting - Process planning	**6**

Course Assessment Method
(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Micro Project	Internal Examination-1	Internal Examination- 2	Internal Examination- 3	Total
5	25	5	10	5	50

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• Minimum 1 and Maximum 2 Questions from each module • Total of 6 Questions, each carrying 3 marks **(6x3 =18 marks)**	• Two questions will be given from each module, out of which l question should be answered. • Each question can have a maximum of 2 sub divisions. • Each question carries 8 marks **(4x8 = 32 marks)**	50

Course Outcomes (COs)

At the end of the course students should be able to:

CO	Course Outcome	Bloom's Knowledge Level (KL)	Assessment Tool
CO 1	Understand the fundamentals of various economic issues using laws and learn the concepts of demand, supply, elasticity and production function.	K2	Internal Exams and Micro Project
CO 2	Develop decision making capability by applying concepts relating to costs and revenue, and acquire knowledge regarding the functioning of firms in different market situations.	K3	
CO 3	Outline the macroeconomic principles of monetary and fiscal systems, national income and stock market.	K2	

CO 4	Make use of the possibilities of value analysis and engineering, and solve simple business problems using break even analysis, cost benefit analysis and capital budgeting techniques.	K3	

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	3	-	-	-	3	2
CO2	3	2	-	-	-	3	-	-	-	3	2
CO3	3	2	-	-	-	-	-	-	-	3	2
CO4	3	2	-	-	-	3	-	-	-	3	2

Note: *1.' Slight (Low), 2.- Moderate (Medium), 3. Substantial (High), - No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Managerial Economics	Geetika, Piyali Ghosh and Chodhury	Tata McGraw Hill	2015
2	Engineering Economy	H. G. Thuesen, W. J. Fabrycky	PHI	1966
3	Engineering Economics	R. Paneerselvam	PHI	2012
4	Thinking, Fast and Slow	Daniel Kahneman	Farrar, Straus and Giroux	2011
5	An Introduction to Behavioral Economics (3rd ed.)	Wilkinson, N., & Klaes M	Macmillan International Higher Education	2018

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Engineering Economy	Leland Blank P.E, Anthony Tarquin P. E	Mc Graw Hill	7TH Edition
2	Indian Financial System	Khan M. Y.	Tata McGraw Hill	2011
3	Engineering Economics and analysis	Donald G. Newman, Jerome P. Lavelle	Engg. Press, Texas	2002
4	Contemporary Engineering Economics	Chan S. Park	Prentice Hall of India Ltd	2001

SEMESTER S3/S4

ENGINEERING ETHICS AND SUSTAINABLE DEVELOPMENT

(Common to All Groups)

Course Code	**UCHUT347**	**CIE Marks**	50
Teaching Hour/Week (L:T:P:R)	2:0:0:0	**ESE Marks**	50
Credits	2	**Exam Hours**	2Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. Equip with the knowledge and skills to make ethical decision and implement gender-sensitive practices in their professional lives.

2. Develop a holistic and comprehensive interdisciplinary approach to understanding engineering ethics principles from a prospective of Environment Protection and sustainable development.

3. Develop the ability to find Strategies for implementing sustainable Engineering solutions.

SYLLABUS

Module No.	Syllabus Description	Contact Hour
1	**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 and 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 and technology, Gendered technology and innovations, Ethical value and practices in connection with gender – equity diversity & gender justice, **Gender policy and women/transgender empowerment initiatives**.	**6**
2	**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	**6**

	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.	
3	**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**
4	**Renewable Energy and Sustainable Technologies:** Overview of renewable energy sources (solar, wind, hydro, biomass), Sustainable technologies in energy production and 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.	**6**

Course Assessment Method
(CIE: 50 marks, ESE: 50)

Continuous Internal Evaluation Marks (CIE):

Attendance	Portfolio	Internal Examination-1	Internal Examination- 2	Internal Examination- 3	Total
5	**25**	**5**	**10**	**5**	**50**

Continuous internal evaluation will be based on individual and group activities undertaken throughout the course and the portfolio created documenting their work and learning. The portfolio will include reflections, project reports, case studies, and all other relevant materials.

- The students should be grouped into groups of size 4 to 6 at the beginning of the semester. These groups can be the same ones they have formed in the previous semester.
- Activities are to be distributed between 2 class hours and 3 Self-study hours.
- The portfolio and reflective journal should be carried forward and displayed during the 7th Semester Seminar course as a part of the experience sharing regarding the skills developed through various courses.

Sl No	Item	Particulars	Group/Individual (G/I)	Marks
1	Reflective Journal	Weekly entries reflecting on what was learned, personal insights, and how it can be applied to local contexts.	I	5
2	Micro Project (Detailed documentation of the project, including methodologies, findings and reflections)	1 a) Perform an Engineering ethics Case Study analysis and prepare a report 1 b) Conduct a literature survey on 'Code of Ethics for Engineers' and prepare a sample code of ethics	G	8
		2. Listen to a TED talk on a Gender-related topic, do a literature survey on that topic and make a report citing the relevant papers with a specific analysis of the Kerala context	G	5
		3. Undertake a project study based on the concepts of sustainable development* - Module II, Module III & Module IV	G	12
3	Activities	One activity* each from Module II, Module III & Module IV	G	15
4	Final Presentation	A comprehensive presentation summarising the key takeaways from the course, personal reflections, and proposed future actions based on the learnings.	G	5
		Total Marks		**50**

*Can be taken from the given sample activities/projects

Evaluation Criteria:

- **Depth of Analysis:** Quality and depth of reflections and analysis in project reports and case studies.
- **Application of Concepts**: Ability to apply course concepts to real-world problems and local contexts.
- **Creativity**: Innovative approaches and creative solutions proposed in projects and reflections.
- **Presentation Skills**: Clarity, coherence, and professionalism in the final presentation.

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• Minimum of one question from each module. • Total of 6 questions, each carrying 3 marks. **(6 x 3 = 18 marks)**	• Each question carries 8 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 subdivisions. **(4 x 8 = 32 marks)**	**50**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcomes		Bloom's Knowledge Level (KL)	Assessment Tool
CO1	Develop the ability to apply the principles of engineering ethics in their professional life.	K3	Written exam, Portfolio and course end survey
CO2	Develop the ability to exercise gender-sensitive practices in their professional lives	K4	
CO3	Develop the ability to explore contemporary environmental issues and sustainable practices.	K3	
CO4	Develop the ability to analyse the role of engineers in promoting sustainability and climate resilience.	K4	
CO5	Develop interest and skills in addressing pertinent environmental and climate-related challenges through a sustainable engineering approach.	K3	

Note: K1- Remember, K2 - understand, K3 – Apply, K4 – Analysis, K5 – Evaluate, K6 – Create

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	-	-	-	3	3	3	2	-	-
CO2	-	2	-	-	-	3	3	3	2	-	-
CO3	-	-	-	-	-	3	2	3	2	-	-
CO4	-	2	-	-	-	3	2	3	2	-	-
CO5	-	-	-	-	-	3	2	3	2	-	-

Note: *1.' Slight (Low), 2.- Moderate (Medium), 3. Substantial (High), - No Correlation*

Reference Books				
Sl No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition & Year**
1	Ethics in Engineering Practice and Research	Caroline Whitbeck	Cambridge University Press & Assessment	2nd edition & August 2011
2	Virtue Ethics and Professional Roles	Justin Oakley	Cambridge University Press & Assessment	November 2006
3	Sustainability Science	Bert J. M. de Vries	Cambridge University Press & Assessment	2nd edition & December 2023
4	Sustainable Engineering Principles and Practice	Bhavik R. Bakshi	Cambridge University Press & Assessment	2019
5	Engineering Ethics	M Govindarajan, S Natarajan and V S Senthil Kumar	PHI Learning Private Ltd, New Delhi	2012

6	Professional ethics and human values	RS Naagarazan	New age international (P) limited New Delhi	2006
7	Ethics in Engineering	Mike W Martin and Roland Schinzinger,	Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi	4" edition, 2014

Suggested Activities/Projects:

Module-II

- Write a reflection on a local environmental issue (e.g., plastic waste in Kerala backwaters or oceans) from different ethical perspectives (anthropocentric, biocentric, ecocentric).
- Write a life cycle analysis report of a common product used in Kerala (e.g., a coconut, bamboo or rubber-based product) and present findings on its sustainability.
- Create a sustainability report for a local business, assessing its environmental, social, and economic impacts
- Presentation on biodiversity in a nearby area (e.g., a local park, a wetland, mangroves, college campus etc) and propose conservation strategies to protect it.
- Develop a conservation plan for an endangered species found in Kerala.
- Analyze the green spaces in a local urban area and propose a plan to enhance urban
- ecology using native plants and sustainable design.
- Create a model of a sustainable urban landscape for a chosen locality in Kerala.

Module-III

- Study a local water body (e.g., a river or lake) for signs of pollution or natural flow disruption and suggest sustainable management and restoration practices.
- Analyse the effectiveness of water management in the college campus and propose improvements - calculate the water footprint, how to reduce the footprint, how to increase supply through rainwater harvesting, and how to decrease the supply-demand ratio.
- Implement a zero waste initiative on the college campus for one week and document the challenges and outcomes.
- Develop a waste audit report for the campus. Suggest a plan for a zero-waste approach.
- Create a circular economy model for a common product used in Kerala (e.g., coconut oil, cloth etc)
- Design a product or service based on circular economy and degrowth principles and present a business plan.
- Develop a plan to improve pedestrian and cycling infrastructure in a chosen locality in Kerala

Module-IV

- Evaluate the potential for installing solar panels on the college campus including cost-benefit analysis and feasibility study.
- Analyse the energy consumption patterns of the college campus and propose sustainable alternatives to reduce consumption - What gadgets are being used? How can we reduce demand using energy-saving gadgets?
- Analyse a local infrastructure project for its climate resilience and suggest improvements.
- Analyse a specific environmental regulation in India (e.g., Coastal Regulation Zone) and its impact on local communities and ecosystems.
- Research and present a case study of a successful sustainable engineering project in Kerala/India (e.g., sustainable building design, water management project, infrastructure project).
- Research and present a case study of an unsustainable engineering project in Kerala/India highlighting design and implementation faults and possible corrections/alternatives (e.g., a housing complex with water logging, a water management project causing frequent floods, infrastructure project that affects surrounding landscapes or ecosystems).

SEMESTER 3

ANALOG CIRCUITS LAB

Course Code	**PCECL307**	**CIE Marks**	**50**
Teaching Hours/Week (L: T:P: R)	**0:0:3:0**	**ESE Marks**	**50**
Credits	**2**	**Exam Hours**	**2 Hrs. 30 Min.**
Prerequisites (if any)	**None**	**Course Type**	**Lab**

Course Objectives:

1. Familiarise the students with the analog circuits design using discrete components.
2. Familiarise the students with simulation of basic analog circuits.

SYLLABUS

Expt. No.	Experiments
Part A – List of Experiments using discrete components (Any Six experiments mandatory)	
1	RC Integrating and Differentiating Circuits – (Transient analysis with different inputs and frequency response).
2	Diode Clipping and Clamping Circuits (Transient and transfer characteristics)
3	CE amplifier – Design for a specific voltage gain and plot frequency response characteristics.
4	CS MOSFET amplifier - Design for a specific voltage gain and plot frequency response characteristics.
5	Cascaded amplifier (CE – CE) - Design for a specific voltage gain and plot frequency response characteristics.
6	Cascode amplifier - Design for a specific voltage gain and plot frequency response characteristics.
7	Feedback amplifiers (current series & voltage series) - Design for a specific voltage gain and plot frequency response characteristics
8	RC oscillators – RC phase shift or wien bridge oscillator
9	Power amplifiers (Transformer less) – Class B & Class AB.
10	Transistor series voltage regulator – Design for a specific output voltage . (plot load & line regulation characteristics) .

Part B – Simulation Experiments (Any Six experiments mandatory) The experiments shall be conducted using LT SPICE tool.	
1	RC Integrating and Differentiating Circuits – (Transient analysis with different inputs and frequency response).
2	Diode Clipping and Clamping Circuits (Transient and transfer characteristics)
3	CE amplifier – Design for a specific voltage gain and plot frequency response characteristics.
4	CS MOSFET amplifier - Design for a specific voltage gain and plot frequency response characteristics.
5	Cascaded amplifier (CE – CE) - Design for a specific voltage gain and plot frequency response characteristics.
6	Cascode amplifier - Design for a specific voltage gain and plot frequency response characteristics.
7	Feedback amplifiers (current series & voltage series) - Design for a specific voltage gain and plot frequency response characteristics
8	RC oscillators – RC phase shift or wien bridge oscillator
9	Power amplifiers (Transformer less) – Class B & Class AB.
10	Transistor series voltage regulator – Design for a specific output voltage . (plot load & line regulation characteristics) .

Course Assessment Method
(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work	Result with valid inference/ Quality of Output	Total
5	25	20	50

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	15	10	10	5	50

- ***Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified record.***
- ***Endorsement by External Examiner:*** *The external examiner shall endorse the record*

Course Outcomes (COs)

At the end of the course students should be able to:

	Course Outcome	Bloom's Knowledge Level (KL)
COl	Design and demonstrate the functioning of basic analog circuits using discrete components..	**K3**
CO2	Design and simulate the functioning of basic analog circuits using simulation tools	**K3**
CO3	Conduct troubleshooting of a given circuit and to analyze it.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO- PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	-	-	-	-	-	3	-	3
CO2	3	2	2	-	3	-	-	-	3	-	3
CO3	3	2	2	-	-	-	-	-	3	-	3

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Electronic Devices and Circuits	David A Bel	Oxford University Press	5/e, 2008
2	Electronic Circuits Analysis and Design 1	D. Meganathan	Yes Dee Publishing	1/e, 2023
3	Electronic Devices and Circuits	David A Bel	Oxford University Press	5/e, 2008

Continuous Assessment (25 Marks)

1. **Preparation and Pre-Lab Work (7 Marks)**

   - Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
   - Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

2. **Conduct of Experiments (7 Marks)**

   - Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
   - Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
   - Teamwork: Collaboration and participation in group experiments.

3. **Lab Reports and Record Keeping (6 Marks)**
   - Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
   - Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.
4. **Viva Voce (5 Marks)**
   - Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.

Internal Exam (20Marks)

1. Procedure/Preliminary Work/Design/Algorithm (10 Marks)

- Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
- Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
- Creativity and logic in algorithm or experimental design.

2. Conduct of Experiment/Execution of Work (5 Marks)

- Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

3. Result with Valid Inference/Quality of Output (5 Marks)

- Accuracy of Results: Precision and correctness of the obtained results.
- Analysis and Interpretation: Validity of inferences drawn from the experiment .

ASSESSMENT RUBRICS

Preparation and Pre-Lab Work (7 Marks)

Description	Score	Marks Scored
Fully prepared, pre-lab work complete and detailed.	7	
Well prepared with minor omissions.	6	
Good preparation, some missing points.	5	
Partially prepared, pre-lab work incomplete.	4	
Minimal preparation.	3	
Very poor preparation.	2	
Almost no preparation.	1	
Not prepared at all.	0	

Conduct of Experiments (7 Marks)

Description	Score	Marks Scored
Excellent execution, all steps followed with precision.	7	
Experiment conducted very well with minor slips.	6	
Good execution with some errors.	5	
Basic experiment done but lacks accuracy.	4	
Poor conduct, key steps missed.	3	
Very poor execution.	2	
Attempted but largely incorrect.	1	
Not done.	0	

Lab Reports and Record Keeping (6 Marks)

Description	Score	Marks Scored
Complete, neat, and accurate records.	6	
Well written with small errors.	5	
Good, but needs improvements.	4	
Incomplete or untidy.	3	
Major parts missing.	2	
Very poor record.	1	
No report submitted.	0	

Viva Voce (5 Marks)

Description	Score	Marks Scored
Excellent understanding and confident answers.	5	
Good understanding with minor mistakes.	4	
Moderate knowledge with some difficulty.	3	
Poor understanding.	2	
Very limited responses.	1	
Did not attend or answer.	0	
Total marks (out of 25)		
Signature of the staff		

Evaluation Pattern for End Semester Examination (50 Marks)

1. Procedure/Preliminary Work/Design/Algorithm (10 Marks)

- Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
- Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
- Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
- Creativity and logic in algorithm or experimental design.

2. Conduct of Experiment/Execution of Work/Programming (15 Marks)

- Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

3.Result with Valid Inference/Quality of Output (10 Marks)

- Accuracy of Results: Precision and correctness of the obtained results.
- Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

4. Viva Voce (10 Marks)

- Ability to explain the experiment, procedure results and answer related questions .
- Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. Record (5 Marks)

- Completeness, clarity, and accuracy of the lab record submitted.

SEMESTER S3

PCECL 308- LOGIC CIRCUIT DESIGN LABORATORY

Course Code	PCECL308	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Lab

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

Expt. No.	Experiments
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).
2	Design and Realization of half/full adder and subtractor using basic gates and universal gates.
3	4 bit adder/subtractor and BCD adder using 7483
4	Study of Flip Flops : S-R, D, T, JK and Master slave JK FF using NAND gates
5	Asynchronous Counter : 3 bit up/down counter, Realization of Mod N Counter
6	Synchronous Counter: Realization of 4-bit up/down counter, Realization of Mod-N counters
7	Ring counter and Johnson Counter.
8	Realization of counters using IC's (7490, 7492, 7493).
9	Realization of combinational circuits using MUX & DEMUX, using ICs (74150, 74154)
10	Sequence Generator / Detector
Part B – Simulation Experiments (Any Six experiments mandatory) The experiments shall be conducted using Verilog and implementation using small FPGA	

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.
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	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.
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 counters
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
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
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 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.

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.

Course Assessment Method (CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	25	20	50

Internal Examination:

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work	Result with valid inference/ Quality of Output	Total
10	5	5	20

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	15	10	10	5	50

- ***Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified record.***
- ***Endorsement by External Examiner: The external examiner shall endorse the record***

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
COl	Design and demonstrate the functioning of various combinational and sequential circuits using ICs	**K3**
CO2	Apply an industry compatible hardware description language to implement digital circuits	**K3**
CO3	Implement digital circuits on FPGA boards and connect external hardware to the boards	**K3**
CO4	Function effectively as an individual and in a team to accomplish the given task.	**K2**

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO- PO Mapping (Mapping of Course Outcomes with Program Outcomes)

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

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl.No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Verilog HDL Synthesis: A Practical Primer	J. Bhasker	B. S. Publications,	2001
2	Fundamentals of Logic Design	Roth C.H	Jaico Publishers. V Ed., 2009	5th Edition

Reference Books				
Sl.No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Verilog HDL :A guide to digital design and synthesis	Palnitkar S.	Prentice Hall; 2003.	2nd Edn.,
2	https://de-iitr.vlabs.ac.in/	IIT KHARAGPUR		
3	https://github.com/os-fpga/Virtual-FPGA-Lab	FPGA experiments		
4	https://youtu.be/oNh6V91zdPY?si=D15EvPf0No6LdNTl	NPTEL resources(digital lab experiments)		
5	https://youtu.be/w3jNkZ-5s-U?si=6WpQ0-1DnPAQQTOz	NPTEL resources(verilog experiments)		

Continuous Assessment (25 Marks)

1. **Preparation and Pre-Lab Work (7 Marks)**
   - Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
   - Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

2. **Conduct of Experiments (7 Marks)**

- Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
- Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
- Teamwork: Collaboration and participation in group experiments.

3. Lab Reports and Record Keeping (6 Marks)

- Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
- Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

4. Viva Voce (5 Marks)

- Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.

Internal Exam (20Marks)

1. **Procedure/Preliminary Work/Design/Algorithm (10 Marks)**

- Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
- Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
- Creativity and logic in algorithm or experimental design.

2. **Conduct of Experiment/Execution of Work (5 Marks)**

- Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

3. **Result with Valid Inference/Quality of Output (5 Marks)**

- Accuracy of Results: Precision and correctness of the obtained results.
- Analysis and Interpretation: Validity of inferences drawn from the experiment.

Evaluation Pattern for End Semester Examination (50 Marks)

1. Procedure/Preliminary Work/Design/Algorithm (10 Marks)

- Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
- Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
- Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
- Creativity and logic in algorithm or experimental design.

2. Conduct of Experiment/Execution of Work/Programming (15 Marks)

- Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

3. Result with Valid Inference/Quality of Output (10 Marks)

- Accuracy of Results: Precision and correctness of the obtained results.
- Analysis and Interpretation: Validity of inferences drawn from the experiment or

quality of program output.

4. Viva Voce (10 Marks)

- Ability to explain the experiment, procedure results and answer related questions
- Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. Record (5 Marks)

- Completeness, clarity, and accuracy of the lab record submitted.

ASSESSMENT RUBRICS

Preparation and Pre-Lab Work (7 Marks)

Description	Score	Marks Scored
Fully prepared, pre-lab work complete and detailed.	7	
Well prepared with minor omissions.	6	
Good preparation, some missing points.	5	
Partially prepared, pre-lab work incomplete.	4	
Minimal preparation.	3	
Very poor preparation.	2	
Almost no preparation.	1	
Not prepared at all.	0	

Conduct of Experiments (7 Marks)

Description	Score	Marks Scored
Excellent execution, all steps followed with precision.	7	
Experiment conducted very well with minor slips.	6	
Good execution with some errors.	5	
Basic experiment done but lacks accuracy.	4	
Poor conduct, key steps missed.	3	
Very poor execution.	2	
Attempted but largely incorrect.	1	
Not done.	0	

Lab Reports and Record Keeping (6 Marks)

Description	Score	Marks Scored
Complete, neat, and accurate records.	6	
Well written with small errors.	5	
Good, but needs improvements.	4	
Incomplete or untidy.	3	
Major parts missing.	2	
Very poor record.	1	
No report submitted.	0	

Viva Voce (5 Marks)

Description	Score	Marks Scored
Excellent understanding and confident answers.	5	
Good understanding with minor mistakes.	4	
Moderate knowledge with some difficulty.	3	
Poor understanding.	2	
Very limited responses.	1	
Did not attend or answer.	0	
Total marks (out of 25)		
Signature of the staff		

CERTIFICATE OF APPROVAL

This is to certify that the syllabus for the courses of **Semester 3 of the B.Tech Programme in Electronics and Communication Engineering** has been reviewed and duly approved by the following academic bodies of **Vimal Jyothi Engineering College**:

1. The **Board of Studies of Electronics and Communication Engineering,** in its meeting held on **30/04/2025.**
2. The **Academic Council,** in its meeting held on **12/5/2025.**

This syllabus shall be implemented **with effect from the academic year 2025–2026 onwards.**

HoD/Program Coordinator

Dean Academics

Principal

PRINCIPAL
VIMAL JYOTHI ENGINEERING COLLEGE
CHEMPERI - 670632

VIMAL JYOTHI ENGINEERING COLLEGE
Dated.....
CHEMPERI-670 632