COURSE HANDOUT

(B. Tech - Semester 6)

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

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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 6 COURSES

A

ECT302

ELECTROMAGNETICS

COURSE INFORMATION SHEET

PROGRAMME: ECE (UG)	**DEGREE**: BTECH
COURSE: ELECTROMAGNETICS	**SEMESTER:** 6 **L-T-P-CREDITS**: 3-1-0-4
COURSE CODE: **REGULATION**: ECT302:2019	**COURSE TYPE**: GROUP-CORE THEORY
COURSE AREA/DOMAIN: ELECTROMAGNETICS	**CONTACT HOURS**: 6
CORRESPONDING LAB COURSE CODE (IF ANY): ECL411	**LAB COURSE NAME**: ELECTROMAGNETICS LAB

SYLLABUS

MODULE	DETAILS	HOURS
I	Introduction to Electromagnetic Theory. Review of vector calculus- curl, divergence, gradient. Rectangular, cylindrical and spherical coordinate systems. Expression of curl divergence and Laplacian in cartesian, cylindrical and spherical coordinate system. Electric field and magnetic field, Review of Coulomb's law, Gauss law and Amperes current law. Poisson and Laplace equations, Determination of E and V using Laplace equation.	10
II	Derivation of capacitance and inductance of two wire transmission line and coaxial cable. Energy stored in Electric and Magnetic field. Displacement current density, continuity equation. Magnetic vector potential. Relation between scalar potential and vector potential. Maxwell's equation from fundamental laws. Boundary condition of electric field and magnetic field from Maxwells equations. Solution of wave equation.	10
III	Propagation of plane EM wave in perfect dielectric, lossy medium, good conductor, media-attenuation, phase velocity, group velocity, skin depth. Reflection and refraction of plane electromagnetic waves at boundaries for normal & oblique incidence (parallel and perpendicular polarization), Snell's law of refraction, Brewster angle.	8

IV	Power density of EM wave, Poynting vector theorem. Polarization of electromagnetic wave-linear, circular and elliptical polarisation. Uniform lossless transmission line - line parameters. Transmission line equations, Voltage and Current distribution of a line terminated with load. Reflection coefficient and VSWR. Derivation of input impedance of transmission line.	10
V	Transmission line as circuit elements (L and C). Development of Smith chart - calculation of line impedance and VSWR using smith chart. The hollow rectangular wave guide –modes of propagation of wave-dominant mode, group velocity and phase velocity -derivation and simple problems only	8
Total hours		**46**

TEXT BOOKS/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T1	John D. Kraus, Electromagnetics, 5/e, TMH, 2010.
T2	Mathew N O Sadiku, Elements of Electromagnetics, Oxford University Press, 6/e, 2014.
T3	William, H. Hayt, and John A. Buck. Engineering Electromagnetics. McGraw-Hill, 8/e McGraw-Hill, 2014.
R1	Edminister, “Schaum’s Outline of Eletromagnetics”, 4/e, McGraw-Hill, 2014.
R2	Jordan and Balmain , Electromagnetic waves and Radiating Systems, PHI, 2/e,2013
R3	Martin A Plonus , Applied Electromagnetics, McGraw Hill, 2/e,1978.
R4	Nannapaneni Narayana Rao, Elements of Engineering Electromagnetics, Pearson, 6/e, 2006.
R5	Umran S. Inan and Aziz S. Inan, Engineering Electromagnetics, Pearson, 2010.

COURSE PREREQUISITES:

COURSE CODE	COURSE NAME	DESCRIPTION	SEMESTER
MAT102	**Vector Calculus**	This course introduces the concepts and applications of differentiation and integration of vector valued functions, differential equations, Laplace and Fourier Transforms.	2

COURSE OBJECTIVES:

1	To impart knowledge on the basic concepts of electric and magnetic fields and its 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
ECT302.1	To summarize the basic mathematical concepts related to electromagnetic vector fields.													
	3	3	1	1								2		1
	UNDERSTAND													
ECT302.2	Analyse Maxwell's equation in different forms and apply them to diverse engineering problems.													
	3	3	1	1								2	2	3
	APPLY													
ECT302.3	To analyse electromagnetic wave propagation and wave polarization.													
	3	3	1	1								2	2	3
	APPLY													
ECT302.4	To analyse the characteristics of transmission lines and solve the transmission line problems using Smith chart.													
	3	3	1	1								2	2	2
	APPLY													
ECT302.5	To analyse and evaluate the propagation of EM waves in Wave guides.													
	3	3	1	1								2	1	3
	APPLY													
MAPPING AVERAGE	3	3	1	1								2	1.8	2.4

JUSTIFICATION FOR CO-PO/PSO MAPPING:

CO	PO/PSO	MAPPING LEVEL	JUSTIFICATION
ECT302.1	PO1	3	The mathematical foundation of vector calculus is essential for understanding electromagnetic field theory, enabling students to apply engineering knowledge to real-time EM problems.
	PO2	3	Interpreting electromagnetic quantities (E, H, D, B fields) enhances students' ability to analyze engineering problems using theoretical concepts and mathematical tools.
	PO3	1	Understanding fields supports conceptual design of electronic/communication systems where EM principles are involved.
	PO4	1	Mathematical interpretation of EM fields develops analytical skills enabling investigation through modelling, derivations, and simulations.
	PO12	2	Exposure to advanced mathematical tools fosters independent learning and adaptability to evolving EM and communication technologies.
	PSO2	1	Understanding field behavior assists in choosing appropriate wireless technologies, frequency bands, and propagation models for modern communication systems.
ECT302.2	PO1	3	Mathematical understanding of integral/differential forms of Maxwell's equations enhances strong foundational knowledge required for EM-based engineering analysis.
	PO2	3	Applying Maxwell's equations to wave propagation, boundary conditions, and material interaction equips students to analyze complex real-world electromagnetic problems.

	PO3	1	Insight into EM field behavior supports conceptual/system-level design of antennas, microwave components, RF circuits, and communication subsystems.
	PO4	1	Students learn to investigate problems using field modeling and simulations involving EM structures and propagation environments.
	PO12	2	Since EM theory is continuously evolving with advanced communication technologies (5G/6G, IoT, radar), this CO enables students to adapt and upgrade their knowledge.
	PSO1	2	Maxwell's equations form the theoretical basis for design and testing of RF systems, transmission media, and high-frequency circuitry crucial in signal processing hardware.
	PSO2	3	Understanding EM wave propagation and field interaction helps in selecting appropriate communication techniques, frequency bands, and technologies suited to modern systems.
ECT302.3	PO1	3	Understanding wave propagation and polarization requires strong knowledge of EM theory and engineering mathematics.
	PO2	3	Analyzing propagation characteristics in free space, guided media, and various materials develops ability to identify and solve complex EM engineering problems.
	PO3	1	Knowledge of polarization and propagation principles aids in designing antennas, microwave links, and RF components with desired performance.
	PO4	1	The analysis of electromagnetic wave propagation and polarization involves investigating complex field behavior in different media using mathematical models. This enables students to interpret results and

			solve real-world engineering problems related to wireless communication and RF systems.
	PO12	2	With rapid advancement in propagation-based technologies (satellite, 5G/6G, optical links), this CO supports continuous learning of modern communication techniques.
	PSO1	2	Propagation analysis is essential for modeling and validating wireless transmission lines and RF circuits used for signal processing applications.
	PSO2	3	Understanding polarization and propagation enables selection of suitable frequency bands, antennas, and communication technologies for reliable modern systems.
ECT302.4	PO1	3	Understanding voltage/current distribution, impedance transformation, and VSWR on transmission lines requires strong knowledge of EM theory and engineering mathematics.
	PO2	3	Students analyse mismatched lines, reflections, and losses in various practical scenarios and interpret Smith chart readings to solve complex communication problems.
	PO3	1	Knowledge of transmission line behavior assists in designing matching networks and RF/microwave systems for optimal signal transfer.
	PO4	1	Using Smith chart and analytical methods to investigate line performance and optimize parameters strengthens practical problem-solving skills in real-life communication systems.
	PO12	2	Transmission line concepts are essential for evolving technologies (satellite, IoT, 5G/6G); this CO promotes continuous learning and adaptability to new communication standards.

	PSO1	2	Accurate modelling of transmission lines is crucial for designing and validating high-frequency circuits and signal processing units.
	PSO2	2	Understanding line characteristics supports appropriate selection of RF components, cables, connectors, antennas, and propagation media for modern communication systems.
ECT302.5	PO1	3	Understanding wave propagation modes, cut-off frequency, and field distribution in waveguides requires strong fundamentals of electromagnetic theory and mathematical concepts.
	PO2	3	Students evaluate attenuation, dispersion, and mode behavior to analyse engineering problems involving guided EM waves in practical systems.
	PO3	1	Knowledge of guided wave propagation supports design and development of microwave components such as filters, couplers, and waveguide-based RF systems.
	PO4	1	Analysis using theoretical and simulation tools for waveguide performance enables investigation of real-time microwave engineering challenges.
	PO12	2	Emerging technologies in radar, satellite, and 5G/6G demand continuous learning of modern waveguide applications; hence, this CO encourages future skill upgrading.
	PSO1	1	Understanding guided wave behaviour is essential for modelling, implementing, and testing high-frequency microwave circuits used in signal processing and communication hardware.
	PSO2	3	Evaluating waveguide properties helps in choosing suitable transmission media and components for modern communication systems requiring high efficiency and low loss.

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			
2			

CONTENT BEYOND THE SYLLABUS/ADVANCED TOPICS/DESIGN

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

WEB SOURCE REFERENCES:

SL NO:	DESCRIPTION
1	https://nptel.ac.in/courses/108104087
2	https://nptel.ac.in/courses/115104088

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
ECT302.1	S1, A1,T1	13	1
ECT302.2	S1, A2,T2	11	1
ECT302.3	S2, A2, T3	9	1
ECT302.4	S2, S3, A3,T4	16	1
ECT302.5	S3, A3,T5	4	1
		TOTAL HOURS OF INSTRUCTION	58

Prepared by-Ms.SUJISHA P P **Approved by HOD**

B

ECT304

VLSI CIRCUIT DESIGN

COURSE INFORMATION SHEET

PROGRAMME: ECE (UG)	**DEGREE**: BTECH
COURSE: VLSI CIRCUIT DESIGN	**SEMESTER:** **L-T-P-CREDITS**: 3-1-0-4
COURSE CODE: ECT304 **REGULATION**:2019 SCHEME	**COURSE TYPE**: CORE
COURSE AREA/DOMAIN: CIRCUIT AND SYSTEMS	**CONTACT HOURS**: 4
CORRESPONDING LAB COURSE CODE (IF ANY):	**LAB COURSE NAME**:

SYLLABUS

MODULE	DETAILS	HOURS
I	VLSI Design Methodologies. Introduction: Moore's law .ASIC design, Full custom ASICs, Standard cell based ASICs, Gate array based ASICs, SoCs, FPGA devices, ASIC and FPGA Design flows, Top-Down and Bottom-Up design methodologies. Logical and Physical design. Speed power and area considerations in VLSI design	11
II	Static CMOS Logic Design MOSFET Logic Design - NMOS Inverter (Static analysis only), basic logic gates, CMOS logic, Static and transient analysis of CMOS inverter, Switching power dissipation and delays. Realization of logic functions with static CMOS logic, Pass transistor logic, and transmission gate logic	9
III	Dynamic logic Design and Storage Cells Dynamic Logic Design-Pre charge- Evaluate logic, Domino Logic, NP domino logic. Read Only Memory-4x4 MOS ROM Cell Arrays(OR,NOR,NAND) Random Access Memory –SRAM-Six transistor CMOS SRAM cell, DRAM –Three transistor and One transistor Dynamic Memory Cell.	8
IV	Arithmetic circuits	5

	Adders: Static adder, Carry-Bypass adder, Linear Carry-Select adder, Square- root carry- select adder. Multipliers: Array multiplier	
V	Fabrication techniques and MOSFET physical Design Material Preparation Purification and Crystal growth (CZ process), wafer preparation Thermal Oxidation- Growth mechanisms, Dry and Wet oxidation. Diffusion and ion implantation techniques. Epitaxy : molecular beam epitaxy. Lithography- Photo lithographic sequence, Electron Beam Lithography, Etching and metal deposition techniques. MOSFET Fabrication techniques Twin-Tub fabrication sequence, Fabrication process flow. Layout Design and Design rules, Stick Diagram and Design rules-micron rules and Lambdarules. (definitions only).layout of CMOS Inverter, two input NAND and NOR gates.	**13**
Total hours		**46**

TEXT BOOKS/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T1	Sung –Mo Kang & Yusuf Leblebici, CMOS Digital Integrated Circuits-Analysis & Design, McGraw-Hill, Third Ed., 2003
T2	S.M. SZE, VLSI Technology, 2/e, Indian Edition, McGraw-Hill,2003
T3	Wayne Wolf, Modern VLSI design, Third Edition, Pearson Education,2002.
R1	Michael John Sebastian Smith, Application Specific Integrated Circuits, Pearson Education,2001.
R2	Neil H.E. Weste, Kamran Eshraghian, Principles of CMOS VLSI Design- A Systems Perspective, Second Edition. Pearson Publication, 2005.
R3	Jan M. Rabaey, Digital Integrated Circuits- A Design Perspective, Prentice Hall, Second Edition, 2005.

R4	Razavi - Design of Analog CMOS Integrated Circuits,1e, McGraw Hill Education India Education, New Delhi, 2003.

COURSE PREREQUISITES:

COURSE CODE	COURSE NAME	DESCRIPTION	SEMESTER
ECT201	Solid State Devices		S3
ECT 203	Logic Circuit Design.		S3
ECT202	Analog Circuits		S4

COURSE OBJECTIVES:

1	This course aims to impart the knowledge of VLSI design methodologies and Digital VLSI circuit design.

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
ECT304.1	Explain the various methodologies in ASIC and FPGA design.													
	3		**3**									**2**	**3**	**3**
	UNDERSTAND													
ECT304.2	Design VLSI Logic circuits with various MOSFET logic families.													
	3	**2**	**3**									**2**	**3**	**3**
	APPLY													
ECT304.3	Compare different types of memory elements.													
	3	**2**	**3**									**2**	**3**	**3**
	UNDERSTAND													
ECT304.4	Design and analyse data path elements such as Adders and multipliers.													
	3	**2**	**3**									**2**	**3**	**3**
	APPLY													
ECT304.5	Explain MOSFET fabrication techniques and layout design rules.													
	3		**2**									**2**	**3**	**3**

	UNDERSTAND													
MAPPING AVERAGE	**3**	**2**	**2.8**									**2**	**3**	**3**

JUSTIFICATION FOR CO-PO/PSO MAPPING:

CO	PO/PSO	MAPPING LEVEL	JUSTIFICATION
ECT301.1	PO1	3	Understanding ASIC/FPGA methodologies requires strong engineering fundamentals involving device technologies and design flows.
	PO3	3	Students gain insight into system-level design approaches such as top-down and bottom-up, supporting basic design-related decision making.
	PO12	2	Exposure to evolving VLSI methodologies promotes continuous learning as technologies and design strategies change rapidly.
	PSO1	3	Knowledge of ASIC/FPGA flows directly supports modelling and implementation of digital signal-processing hardware.
	PSO2	3	Learning different design approaches helps in selecting appropriate technologies for modern communication and embedded systems.
ECT301.2	PO1	3	Students apply engineering fundamentals to design CMOS, pass-transistor, and transmission-gate circuits.
	PO2	2	Requires basic analytical skills to understand switching characteristics, power dissipation, and delays.
	PO3	3	Involves the design and development of logic gates and logic networks using different MOS logic families.
	PO12	2	Encourages learning updated logic design strategies as device technologies scale.
	PSO1	3	Strongly related to implementing logic blocks essential for digital and signal-processing circuits.

	PSO2	3	Helps learners choose suitable logic styles for communication hardware and low-power VLSI systems.
ECT301.3	PO1	3	Understanding ROM, SRAM, DRAM architecture involves applying engineering knowledge of MOS devices and circuits.
	PO2	2	Analysis of memory cell behaviour, stability, and read/write mechanisms strengthens problem-solving skills.
	PO3	3	Students evaluate memory configurations, which supports elementary design considerations in storage elements.
	PO12	2	Promotes lifelong learning due to rapid advancements in memory technologies.
	PSO1	3	Memory blocks are core components of digital systems, aligning with modelling and testing of circuits.
	PSO2	3	Enables the selection of suitable memory technologies for communication and embedded applications.
ECT301.4	PO1	3	Designing adders and multipliers requires strong understanding of MOS circuits and arithmetic logic principles.
	PO2	2	Requires analyzing delay, area, and performance of arithmetic circuits.
	PO3	3	Students design and analyze hardware elements like carry-select adders and array multipliers—key components in complex systems.
	PO12	2	Builds capacity for continuous improvement as architectures evolve for speed and power optimization.
	PSO1	3	Arithmetic units form the core of digital signal-processing circuits, aligning directly with PSO1.
	PSO2	3	Supports implementation of data path modules used in communication signal-processing hardware.

ECT301.5	PO1	3	Understanding fabrication steps such as oxidation, lithography, diffusion, and deposition requires strong engineering fundamentals.
	PO3	2	Knowledge of layout rules and stick diagrams supports the basic design of physical VLSI structures.
	PO12	2	Encourages lifelong learning as fabrication technologies continually advance
	PSO1	3	Essential for modelling and implementing accurate physical designs of signal-processing circuits.
	PSO2	3	Enables informed selection of fabrication technologies suitable for communication ICs and SoC platforms.

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 clarity on job roles, required skills, and career paths.	Placement-Oriented Awareness Session on VLSI Job Roles	PO1, PO2, PO3, PO12, PSO1. PSO2
2	Limited exposure to EDA tools and layout simulation.	Introduce lab sessions on Microwind.	PO3, PO5,PSO1

CONTENT BEYOND THE SYLLABUS/ADVANCED TOPICS/DESIGN

SL NO:	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POS /PSOS
1	Physical Design (Back-End VLSI)- Floor planning, Placement, Routing	Industry Lecture on Physical Design	PO1, PO2, PO3, PO4, PO5, PO12, PSO1. PSO2

WEB SOURCE REFERENCES:

SL NO:	DESCRIPTION
1	

2	
3	
4	

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
ECT304.1	S1,A1,T1	10	1
ECT304.2	S1,A2,T2	8	1
ECT304.3	S2,A2,T3	7	1
ECT304.4	S2,S3,A3,T4	4	1
ECT304.5	S3,A3,T5	12	1
		TOTAL HOURS OF INSTRUCTION	**46**

Prepared by **Approved by HOD**

Manu Thomas

C

ECT 306

INFORMATION THEORY & CODING

COURSE INFORMATION SHEET

PROGRAMME: ECE (UG)	**DEGREE: BTECH**
COURSE: INFORMATION THEORY & CODING	**SEMESTER: S6** **L-T-P-CREDITS: 3-1-0-4**
COURSE CODE: ECT306 **REGULATION:2019**	**COURSE TYPE: CORE**
COURSE AREA/DOMAIN: COMMUNICATION	**CONTACT HOURS: 6 H/WEEK**
CORRESPONDING LAB COURSE CODE (IF ANY):	**LAB COURSE NAME:**

SYLLABUS

MODULE	DETAILS	HOURS
I	**Entropy, Sources and Source Coding** Entropy, Properties of Entropy, Joint and Conditional Entropy, Mutual Information, Properties of Mutual Information. Discrete memoryless sources, Source code, Average length of source code, Bounds on average length, Uniquely decodable and prefix-free source codes. Kraft Inequality (with proof), Huffman code. Shannon's source coding theorem (both achievability and converse) and operational meaning of entropy.	10
II	**Channels and Channel Coding** Discrete memoryless channels. Capacity of discrete memoryless channels. Binary symmetric channels (BSC), Binary Erasure channels (BEC). Capacity of BSC and BEC. Channel code. Rate of channel code. Shannon's channel coding theorem (both achievability and converse without proof) and operational meaning of channel capacity. Modeling of Additive White Gaussian channels. Continuous-input channels with average power constraint. Differential entropy. Differential Entropy of Gaussian random variable. Relation between differential entropy and entropy. Shannon-Hartley theorem (with proof – mathematical subtlities regarding power constraint may be overlooked). Inferences from Shannon Hartley theorem – spectral efficiency versus SNR per bit, power-limited and	11

	bandwidth-limited regions, Shannon limit, Ultimate Shannon limit.	
III	**Introduction to Linear Block Codes** Overview of Groups, Rings, Finite Fields, Construction of Finite Fields from Polynomial rings, Vector spaces. Block codes and parameters. Error detecting and correcting capability. Linear block codes. Two simple examples -Repetition code and single parity-check code. Generator and parity-check matrix. Systematic form. Maximum likelihood decoding of linear block codes. Bounded distance decoding. Syndrome. Standard array decoding.	11
IV	**A Few Important Classes of Algebraic codes** Cyclic codes. Polynomial and matrix description. Interrelation between polynomial and matrix view point. Systematic encoding. Decoding of cyclic codes. (Only description, no decoding algorithms) Hamming Codes, BCH codes, Reed-Solomon Codes.	7
V	**Convolutional and LDPC Codes** Convolutional Codes. State diagram. Trellis diagram. Maximum likelihood decoding. Viterbi algorithm. Low-density parity check (LDPC) codes. Tanner graph representation. Message-passing decoding for transmission over binary erasure channel.	**5**
Total hours		**44**

TEXT BOOKS/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T1	"Elements of Information Theory", Joy A Thomas, Thomas M Cover, Wiley-Interscience.
T2	"Information Theory, Inference and Learning Algorithms", David JC McKay, Cambridge University Press
T3	"Principles of digital communication", RG Gallager, Cambridge University Press
R1	"Digital Communication Sysmtes", Simon Haykin, Wiley.
R2	"Introduction to Coding Theory", Ron M Roth, Cambrdige University Press

R3	Shu Lin & Daniel J. Costello. Jr., Error Control Coding : Fundamentals and Applications, 2nd Edition.
R4	Modern Coding Theory, Rüdiger Urbanke and TJ Richardson, Cambdridge University Press.

COURSE PREREQUISITES:

COURSE CODE	COURSE NAME	DESCRIPTION	SEMESTER
MAT 201	Linear Algebra and Calculus		S3
MAT 204	Probability, Random Process and Numerical Methods		S4
ECT 204	Signals and Systems.		S4

COURSE OBJECTIVES:

ECT306	This course aims to lay down the foundation of information theory introducing both source coding and channel coding. It also aims to expose students to algebraic and probabilistic error-control codes that are used for reliable transmission.

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
ECT306.1	Explain measures of information – entropy, conditional entropy, mutual information													
	3													
ECT306.2	Apply Shannon's source coding theorem for data compression.													
	3	3	2	3	3									3
ECT306.3	Apply the concept of channel capacity for characterize limits of error-free													

	transmission.													
	3	3	2	3	3	2						2		3
ECT306.4	Apply linear block codes for error detection and correction													
	3	3	2	3	3	2						2		3
ECT306.5	Apply algebraic codes with reduced structural complexity for error correction													
	3	3	2	3	3	2						2		
ECT306.6	Understand encoding and decoding of convolutional and LDPC codes													
	3	3	2	3	3	2						2		
MAPPING AVERAGE	3	3	2	3	3	2						2		

JUSTIFICATION FOR CO-PO/PSO MAPPING:

CO	PO/PSO	MAPPING LEVEL	Justification for Mapping
ECT306.1	PO1	3	Requires strong application of engineering mathematics and fundamental concepts to explain information measures such as entropy and mutual information.
	PO2	3	Involves analytical reasoning to interpret and compare different information measures for communication systems.
ECT306.2	PO1	3	Requires strong application of engineering mathematics and communication theory to apply Shannon's source coding theorem.

	PO2	3	Involves analysing data compression limits and efficiency using theoretical and analytical reasoning.
	PO3	2	Moderately applies design concepts to select suitable source coding techniques for compression.
	PO4	3	Involves investigation and evaluation of compression performance through analytical or numerical methods.
	PO5	3	Requires extensive use of modern computational and simulation tools to analyse source coding schemes.
	PSO2	3	Strongly enhances programme-specific skills related to data compression and digital communication systems.
ECT306.3	PO1	3	Requires strong application of engineering mathematics and communication theory to understand channel capacity limits.
	PO2	3	Involves analytical evaluation of channel behaviour to determine limits of error-free transmission.
	PO3	2	Moderately applies design concepts to assess suitable communication schemes within capacity constraints.
	PO4	3	Involves investigation and evaluation of channel performance using analytical or simulation-based methods.
	PO5	3	Requires extensive use of modern computational and simulation tools to analyse channel capacity.
	PO6	2	Moderately considers professional and engineering constraints while analysing communication system limits.
	PO12	2	Encourages continuous learning to understand evolving channel models and communication technologies.

	PSO2	3	Strongly enhances programme-specific skills related to channel analysis in digital communication systems.
ECT306.4	PO1	3	Requires strong application of engineering mathematics and coding theory to implement linear block codes.
	PO2	3	Involves analysing error patterns and code performance for effective error detection and correction.
	PO3	2	Moderately applies design concepts to choose suitable linear block codes for given communication requirements.
	PO4	3	Involves investigation and evaluation of coding performance through analytical or simulation-based methods.
	PO5	3	Requires extensive use of modern computational and simulation tools to analyse coding schemes.
	PO6	2	Moderately considers system constraints while selecting coding techniques for reliable communication.
	PO12	2	Promotes continuous learning to understand advancements in error control coding techniques.
	PSO2	3	Strongly enhances programme-specific skills related to error control coding in digital communication systems.
ECT306.5	PO1	3	Requires strong application of engineering mathematics and algebraic coding principles for error correction.
	PO2	3	Involves analysing code structure and error correction capability using analytical reasoning.
	PO3	2	Moderately applies design concepts to select suitable algebraic codes with reduced complexity.

	PO4	3	Involves investigation and evaluation of coding performance through analytical or simulation methods.
	PO5	3	Requires extensive use of modern computational and simulation tools to analyse algebraic codes.
	PO6	2	Moderately considers system and implementation constraints while applying algebraic coding techniques.
	PO12	2	Encourages continuous learning to understand advanced algebraic coding methods and their applications.
ECT306.6	PO1	3	Requires strong application of engineering mathematics and coding theory to understand convolutional and LDPC codes.
	PO2	3	Involves analysing encoding and decoding processes to evaluate error correction performance.
	PO3	2	Moderately applies design concepts to assess suitable coding schemes for reliable communication.
	PO4	3	Involves investigation and evaluation of coding performance through analytical or simulation-based methods.
	PO5	3	Requires extensive use of modern computational and simulation tools to analyse decoding algorithms.
	PO6	2	Moderately considers system and implementation constraints in practical coding applications.
	PO12	2	Promotes continuous learning to keep pace with advanced channel coding techniques.

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			

WEB SOURCE REFERENCES:

SL NO:	DESCRIPTION
1	https://share.google/bwu0YjU3wDOiESW6n
2	https://share.google/2RbGfzjzh25RKa3Hb

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
ECT306.1	S1,A1,T1	10	
ECT306.2	S1, T2	2	
ECT306.3	S1,A2,T3	14	
ECT306.4	S2,A2,T4	12	
ECT306.5	S2,S3,A3,T5	9	
ECT306.6	S3,A3,T6	8	
		TOTAL HOURS OF INSTRUCTION	55

Prepared by Arya C **Approved by HOD**

D

ECT 362

INTRODUCTION TO MEMS

COURSE INFORMATION SHEET

PROGRAMME: *ECE (UG)*	**DEGREE**: BTECH
COURSE: INTRODUCTION TO MEMS	**SEMESTER:** S6 **L-T-P-CREDITS**: 2-1-0-3
COURSE CODE: ECT362 **REGULATION**:2024	**COURSE TYPE**: ELECTIVE
COURSEAREA/DOMAIN: Micro Electro Mechanical Systems (MEMS) / Microsystems / Microelectronics :	**CONTACT HOURS**:35
CORRESPONDING LAB COURSE CODE (IF ANY):	**LAB COURSE NAME**:

SYLLABUS

MODULE	DETAILS	HOURS
I	MEMS and Microsystems: Applications – multidisciplinary nature of MEMS – principles and examples of Micro sensors and micro actuators – micro accelerometer –comb drives - Micro grippers – micro motors, micro valves, micro pumps, Shape Memory Alloys. Actuation and Sensing techniques: Thermal sensors and actuators, Electrostatic sensors and actuators, Piezoelectric sensors and actuators, magnetic actuators	8
II	Review of Mechanical concepts: Stress, Strain, Modulus of Elasticity, yield strength, ultimate strength – General stress strain relations – compliance matrix. Overview of commonly used mechanical structures in MEMS - Beams, Cantilevers, Plates, Diaphragms – Typical applications Flexural beams: Types of Beams, longitudinal strain under pure bending – Deflection of beams – Spring constant of cantilever – Intrinsic stresses	5

III	Scaling laws in miniaturization - scaling in geometry, scaling in rigid body dynamics, Trimmer force scaling vector, scaling in electrostatic and electromagnetic forces, scaling in electricity and fluidic dynamics, scaling in heat conducting and heat convection. Materials for MEMS – Silicon – Silicon compounds – Silicon Nitride, Silicon Dioxide, Silicon carbide, Poly Silicon, GaAs , Silicon Piezo resistors. Polymers in MEMS – SU-8, PMMA, PDMS, Langmuir – Blodgett Films.	9
IV	Micro System fabrication – Photolithography – Ion implantation-Diffusion – Oxidation – Chemical vapour deposition – Etching Overview of Micro manufacturing – Bulk micro manufacturing, Surface micro machining , LIGA process –Microstereo lithography	7
V	Micro system Packaging: general considerations in packaging design – Levels of Micro system packaging. Bonding techniques for MEMS: Surface bonding, Anodic bonding, Silicon - on - Insulator, wire bonding, Sealing – Assembly of micro systems. Overview of MEMS areas : RF MEMS, BioMEMS, MOEMS, NEMS	**6**
Total hours		**35**

TEXT BOOKS/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T1	1. Chang Liu, Foundations of MEMS, Pearson 2012
T2	Tai-Ran Hsu, MEMS and Microsystems Design and Manufacture, TMH, 2002
R1	Chang C Y and Sze S. M., VLSI Technology, McGraw-Hill, New York, 2000

R2	Julian W Gardner, Microsensors: Principles and Applications, John Wiley & Sons, 1994
R3	Mark Madou, Fundamentals of Micro fabrication, CRC Press, New York, 1997
R4	Stephen D. Senturia, Microsystem design, Springer (India), 2006.
R5	Thomas B. Jones, Electromechanics and MEMS, Cambridge University Press, 2001
R6	Gregory T.A. Kovacs, Micromachined Transducers Sourcebook, McGraw Hill, 1998

COURSE PREREQUISITES:

COURSE CODE	COURSE NAME	DESCRIPTION	SEMESTER
EST130	Basics of Electrical and Electronics Engineering	This course provides fundamental knowledge of electrical circuits, electronic components, and basic electrical principles, which are essential for understanding MEMS sensors, actuators, and interfacing concepts.	S1
EST100	Engineering Mechanics	This course introduces fundamental concepts of mechanics such as stress, strain, bending, and material behavior, which are essential for analyzing mechanical structures like beams, cantilevers, plates, and diaphragms used in MEMS.	S1

COURSE OBJECTIVES:

ECT362	This course introduces students to the rapidly emerging, multi-disciplinary, and exciting field of Micro Electro Mechanical Systems.

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
ECT362.1	Describe the working principles of micro sensors and actuators													

	3	**3**											**3**	
	UNDERSTAND													
ECT362.2	Identify commonly used mechanical structures in MEMS													
	3	3											2	
	UNDERSTAND													
ECT362.3	Explain the application of scaling laws in the design of micro systems													
	3	3	2										2	
	ANALYZE													
ECT362.4	Identify the typical materials used for fabrication of micro systems													
	3	3											2	
	APPLY													
ECT362.5	Explain the principles of standard micro fabrication techniques													
	3	3											3	
	APPLY													
ECT362.6	Describe the challenges in the design and fabrication of Micro systems													
	3	3												3
MAPPING AVERAGE	3	3	2.0										2.4	3.0

JUSTIFICATION FOR CO-PO/PSO MAPPING:

CO	PO/PSO	MAPPING LEVEL	JUSTIFICATION
ECT362.1	PO1	3	Strongly applies fundamentals of physics, electronics, and mechanics to understand operating principles of MEMS sensors and actuators.
	PO2	3	Requires analysis of micro-scale forces, actuation mechanisms, and sensing principles.
	PO12	3	Introduces emerging MEMS technologies, motivating continuo

	PSO1	3	Strongly relates to core ECE concepts applied to MEMS sensors and actuators.
	PSO2	3	Moderately relates to understanding of MEMS as an emerging interdisciplinary technology.
ECT362.2	PO1	3	Uses engineering mechanics knowledge such as beams, cantilevers, plates, and diaphragms at micro-scale.
	PO2	3	Involves analysis of mechanical behavior and structure selection in MEMS devices.
	PO12	2	Encourages awareness of evolving micro-structure designs in MEMS.
	PSO1	3	Strong application of mechanical and electronic principles relevant to ECE-based MEMS systems.
	PSO2	2	Moderately supports understanding of MEMS structures used in advanced applications.
ECT362.3	PO1	3	Strongly applies physics and mathematical concepts to explain scaling effects in MEMS.
	PO2	3	Requires analytical reasoning to study force, electrical, thermal, and fluidic scaling laws.
	PO3	1	Provides limited exposure to design considerations influenced by scaling laws.
	PO12	2	Develops understanding of micro-scale phenomena, encouraging further self-learning.
	PSO1	3	Strong linkage to micro-scale physical principles relevant to ECE applications.
	PSO2	2	Moderately contributes to understanding design constraints in emerging MEMS technologies.
ECT362.4	PO1	3	Strong use of materials science and semiconductor fundamentals.

	PO2	2	Moderately involves comparison and analysis of material properties for MEMS fabrication.
	PO3	1	Limited contribution to design decisions through material selection.
	PO12	2	Encourages awareness of new materials used in MEMS research and industry.
	PSO1	2	Moderately supports ECE core knowledge related to semiconductor materials.
	PSO2	3	Strong relevance to fabrication technologies and emerging MEMS applications.
ECT362.5	PO1	3	Strong application of engineering knowledge related to fabrication processes.
	PO2	3	Requires analysis of fabrication steps, techniques, and process limitations
	PO3	2	Moderately supports understanding of fabrication-driven design constraints.
	PO12	2	Introduces advanced fabrication technologies, encouraging life-long learning.
	PSO1	2	Moderately related to ECE system realization concepts.
	PSO2	3	Strongly aligned with fabrication, integration, and emerging technology domains.
ECT362.6	PO1	3	Applies multidisciplinary engineering knowledge to understand MEMS challenges.
	PO2	3	Strong analytical requirement to identify and evaluate fabrication and packaging issues.
	PO3	2	Moderately contributes to understanding design trade-offs and constraints.
	PO12	2	Highlights evolving challenges, reinforcing the need for continuous learning.
	PSO1	2	Moderately relates to system-level understanding in ECE applications.
	PSO2	3	Strong relevance to advanced MEMS integration and emerging application areas.

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

WEB SOURCE REFERENCES:

SL NO:	DESCRIPTION
1	**Introduction to MEMS (IIT Madras) — NPTEL** Course page / preview: https://onlinecourses.nptel.ac.in/noc24_ee36/preview.
2	**MEMS and Microsystems (IIT Kharagpur) — NPTEL** **https://onlinecourses.nptel.ac.in/noc23_ee68/preview**
3	**Microfabrication and MEMS (IIT Bombay) — NPTEL / SWAYAM** **Course page / preview:** **https://onlinecourses.nptel.ac.in/noc20_ee20/preview**

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
ECT362.1	S1,A1	10	
ECT362.2	S1,A2,T1	9	
ECT362.3	S2,,A2,T2	**11**	
ECT362.4	S2,S3,A3,T3,T4,T5	**10**	
ECT362.5	S3,A3	**10**	
ECT362.6	A3,S3		
		TOTAL HOURS OF INSTRUCTION	50

Prepared by
ARSHA C DINESH

Approved by HOD

E

HUT 300

INDUSTRIAL ECONOMICS AND FOREIGN TRADE

COURSE INFORMATION SHEET

PROGRAMME: ECE (UG)	**DEGREE**: BTECH
COURSE: INDUSTRIAL ECONOMICS AND FOREIGN TRADE	**SEMESTER: S6** **L-T-P-CREDITS**: 3-0-0-3
COURSE CODE: **REGULATION**:HUT 300-2019	**COURSE TYPE**: COMMON COURSE
COURSE AREA/DOMAIN: ECONOMICS	**CONTACT HOURS**:4 HRS/WEEK
CORRESPONDING LAB COURSE CODE (IF ANY): -	**LAB COURSE NAME**: -

SYLLABUS

MODULE	DETAILS	HOURS
I	Scarcity and choice - Basic economic problems- PPC – Firms and its objectives – types of firms – Utility – Law of diminishing marginal utility – Demand and its determinants – law of demand – elasticity of demand – measurement of elasticity and its applications – Supply, law of supply and determinants of supply – Equilibrium – Changes in demand and supply and its effects – Consumer surplus and producer surplus (Concepts) – Taxation and deadweight loss.	7
II	Production function – law of variable proportion – economies of scale – internal and external economies – Isoquants, isocost line and producer's equilibrium – Expansion path – Technical progress and its implications – Cobb-Douglas production function - Cost concepts – Social cost: private cost and external cost – Explicit and implicit cost – sunk cost - Short run cost curves - long run cost curves – Revenue (concepts) – Shutdown point	7

	– Break-even point.	
III	Perfect and imperfect competition – monopoly, regulation of monopoly, monopolistic completion (features and equilibrium of a firm) – oligopoly – Kinked demand curve – Collusive oligopoly (meaning) – Non-price competition – Product pricing – Cost plus pricing – Target return pricing – Penetration pricing – Predatory pricing – Going rate pricing – Price skimming.	6
IV	Circular flow of economic activities – Stock and flow – Final goods and intermediate goods - Gross Domestic Product - National Income – Three sectors of an economy- Methods of measuring national income – Inflation- causes and effects – Measures to control inflation- Monetary and fiscal policies – Business financing- Bonds and shares -Money market and Capital market – Stock market – Demat account and Trading account - SENSEX and NIFTY	7
V	Advantages and disadvantages of international trade - Absolute and Comparative advantage theory - Heckscher - Ohlin theory - Balance of payments – Components – Balance of Payments deficit and devaluation – Trade policy – Free trade versus protection – Tariff and non-tariff barriers.	**8**
Total hours		**35**

TEXT BOOKS/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
R1	Gregory N Mankiw, ‘Principles of Micro Economics’, Cengage Publications
R2	. Gregory N Mankiw, ‘Principles of Macro Economics’, Cengage Publications

R3	Dwivedi D N, ‘Macro Economics’, Tata McGraw Hill, New Delhi.
R4	Francis Cherunilam, ‘International Economics’, McGraw Hill, New Delhi. “Communication Systems”, Simon Haykin, Wiley.
R5	Mithani D M, ‘Managerial Economics’, Himalaya Publishing House, Mumbai.

COURSE PREREQUISITES:

COURSE CODE	COURSE NAME	DESCRIPTION	SEMESTER
	NIL		

COURSE OBJECTIVES:

HUT 300	To equip the students to take industrial decisions and to create awareness of economic environment.

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
HUT300.1	Explain the problem of scarcity of resources and consumer behaviour, and to evaluate the impact of government policies on the general economic welfare. (Cognitive knowledge level.													
	2										**3**			
	UNDERSTAND													
HUT300.2	Take appropriate decisions regarding volume of output and to evaluate the social cost of production.													
	2	2			2	2	3				3		1	1
	APPLY													
HUT300.3	Determine the functional requirement of a firm under various competitive conditions													

	2	2	1								3			1
	ANALYZE													
HUT300.4	Examine the overall performance of the economy, and the regulation of economic fluctuations and its impact on various sections in the society.													
	2	2	1			2					3			1
	ANALYZE													
HUT300.5	Determine the impact of changes in global economic policies on the business opportunities of a firm.													
	2	2	1								3		1	1
	ANALYZE													
MAPPING AVERAGE	2	2	1		2	2	3				3		1	1

JUSTIFICATION FOR CO-PO/PSO MAPPING:

CO	PO/PSO	MAPPING LEVEL	JUSTIFICATION
HUT 300.1	PO1	2	Introduces students with core economic principles such as scarcity, demand, and welfare economics that provide supporting knowledge for understanding constraints affecting engineering and industrial systems.
	PO 11	3	Evaluation of government policies, taxation, and welfare impact directly supports financial awareness, cost considerations, and economic feasibility analysis in project planning and management.
HUT 300.2	PO1	2	Production and cost concepts strengthen background knowledge relevant to industrial and engineering decision-making.
	PO2	2	Output and cost decisions require systematic analysis of alternatives, constraints, and outcomes.
	PO5	2	Cost analysis and break-even decisions can be supported using basic analytical and computational tools such as spreadsheets and graphs.
	PO6	2	Evaluation of social and external costs creates awareness of the societal impact of production activities and engineering decisions.

	PO7	3	Strong emphasis on social cost and externalities promotes understanding of sustainable and environmentally responsible production practices.
	PO11	3	Cost structures, output planning, and break-even analysis support financial planning and project feasibility assessment.
	PSO1	1	Concepts of cost, output optimization, and break-even analysis strengthen decision-making skills required during design, implementation, and testing of electronic systems, where performance must be balanced with cost and efficiency.
	PSO2	1	Evaluation of social and external costs creates basic awareness of sustainable and responsible technology choices in modern communication system deployment.
HUT 300.3	PO1	2	Knowledge of market structures supports application of engineering concepts in industrial contexts.
	PO2	2	Analysis of firm behaviour under competition strengthens analytical and reasoning skills.
	PO3	1	Understanding competitive requirements provides limited support in aligning technical solutions with market needs.
	PO11	3	Pricing strategies and competition analysis contribute to managerial and financial decision-making
	PSO2	1	Understanding competitive and market requirements indirectly supports selection of appropriate communication technologies based on cost–performance trade-offs.
HUT 300.4	PO1	2	Macroeconomic indicators provide contextual knowledge relevant to large-scale engineering projects.
	PO2	2	Evaluation of inflation and policy measures enhances analytical capability.
	PO3	1	Economic performance analysis offers limited input for contextualizing design decisions.

	PO6	2	Creates awareness of societal effects of economic fluctuations such as inflation and unemployment.
	PO11	3	Monetary and fiscal policy knowledge supports financial planning and economic assessment of projects.
	PSO2	1	Macroeconomic awareness indirectly assists in choosing suitable communication technologies by considering market conditions, investment climate, and deployment feasibility.
HUT 300.5	PO1	2	International trade concepts provide background knowledge influencing engineering-based industries.
	PO2	2	Analysis of global policy changes strengthens ability to assess external constraints.
	PO3	1	Global economic awareness offers limited support in adapting engineering solutions to market conditions.
	PO11	3	Trade policies and tariffs affect financial decisions and global project feasibility.
	PSO1	1	Knowledge of global economic trends provides contextual support for scalability and feasibility considerations in electronic and signal processing systems.
	PSO2	1	Understanding global policies indirectly aids selection of modern communication technologies aligned with international standards and markets.

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
	No coverage of Platform-based markets (Amazon, Uber, Flipkart)	Will be covered during module 3 lectures	PO1, PO2, PO6, PO8, PO11, and PO12

CONTENT BEYOND THE SYLLABUS/ADVANCED TOPICS/DESIGN

SL NO:	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POS /PSOS

WEB SOURCE REFERENCES:

SL NO:	DESCRIPTION
1	https://www.classcentral.com/course/swayam-international-economics-203324?utm_source=chatgpt.com

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
HUT 300.1	S1,A1	10	
HUT 300.2	S1,A2	8	
HUT 300.3	S2,A2	6	
HUT 300.4	S2,S3,A3	9	
HUT 300.5	S3,A3	9	
		TOTAL HOURS OF INSTRUCTION	42

Prepared by
Sreetha Sreedhar K

Approved by HOD

ECT 308

COMPREHENSIVE COURSE WORK

COURSE INFORMATION SHEET

PROGRAMME: ECE (UG)	**DEGREE**: BTECH
COURSE: COMPREHENSIVE COURSE WORK	**SEMESTER: S6** **L-T-P-CREDITS**:1:0:0
COURSE CODE: ECT308 **REGULATION**:2019	**COURSE TYPE**: OBJECTIVE TEST
COURSE AREA/DOMAIN: ELECTRONICS AND COMMUNICATION ENGINEERING	**CONTACT HOURS**:2 PERIODS/WEEK
CORRESPONDING LAB COURSE CODE (IF ANY): NIL	**LAB COURSE NAME**: NIL

SYLLABUS

DETAILS	HOURS

COURSE OBJECTIVES:

- The objective of this Course work is to ensure the comprehensive knowledge of each student in the most fundamental Program core courses in the curriculum.Five core courses credited from Semesters 3, 4 and 5 are chosen for the detailed study in this course work.

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
ECT308.1	Apply the knowledge of circuit theorems and solid state physics to solve the problems in electronic Circuits													
	3	3	1									2	3	1
	UNDERSTAND													

ECT308.2	Design a logic circuit for a specific application													
	3	3	1									2	3	1
	UNDERSTAND													
ECT308.3	Design linear IC circuits for linear and non-linear circuit applications.													
	3	3	1								1	2	3	1
	UNDERSTAND													
ECT308.4	Explain basic signal processing operations and Filter designs													
	3	2										2	3	1
	UNDERSTAND													
ECT308.5	Explain existent analog and digital communication systems													
	3	2	1									2	1	3
	UNDERSTAND													
MAPPING AVERAGE	**3**	**2.6**	**1**									**2**	**2.6**	**1.4**

JUSTIFICATION FOR CO-PO/PSO MAPPING:

ECT308.1	PO1	3	Students apply circuit theorems and solid-state physics principles to analyze and solve numerical and practical problems in electronic circuits.
	PO2	3	Students analyze electronic circuits using appropriate theoretical models to interpret behavior and arrive at correct solutions.
	PO3	1	Students demonstrate basic ability to use known methods to solve standard circuit problems with limited emphasis on design.

	PO12	2	Problem-solving exercises encourage students to independently revisit concepts, practice applications, and improve analytical skills.
	PSO1	3	Strong application of circuit theory and solid-state concepts enables effective analysis and solution of core electronic circuits relevant to the program domain.
	PSO2	1	The acquired problem-solving skills provide foundational understanding applicable to communication-related electronic circuits at an introductory level.
ECT308.2	PO1	3	Students apply fundamental digital electronics concepts and logic principles to realize application-oriented logic circuits
	PO2	3	Students analyze the functional requirements and logical behavior of the system to derive suitable logic expressions and circuit configurations.
	PO3	1	Students perform basic logic circuit realization using standard design procedures with limited emphasis on optimization or innovation.
	PO12	2	Design and verification tasks promote independent learning through iterative refinement and validation of logic circuits.

	PSO1	3	Logic circuit design strengthens core skills required for developing digital subsystems relevant to the program’s electronics domain.
	PSO2	1	The designed logic circuits provide introductory exposure to digital building blocks used in communication and embedded systems.
ECT308.3	PO1	3	Students apply fundamental concepts of linear integrated circuits and electronic principles to design linear and non-linear IC-based circuits.
	PO2	3	Students analyze circuit performance and operating characteristics to ensure correct functioning of linear and non-linear IC applications.
	PO3	1	Students carry out basic IC circuit realization using standard configurations with limited scope for optimization or advanced design.
	PO12	2	Design, simulation, and testing activities encourage self-learning and continuous improvement of problem-solving skills.
	PSO1	3	Design and implementation of linear IC circuits strengthen core competencies required for analog signal processing and electronics system development.

	PSO2	1	The IC circuits designed provide foundational understanding of circuit blocks used in communication and related electronic systems.
ECT308.4	PO1	3	Students apply fundamental mathematics, electronics, and signal concepts to explain basic signal processing operations and filter principles.
	PO2	2	Students analyze signal characteristics and filter responses to understand system behavior in time and frequency domains.
	PO12	2	Independent study of signal operations and filter behavior encourages self-learning and continuous improvement of conceptual knowledge.
	PSO1	3	Strong understanding of signal processing operations and filter designs supports core competencies required for signal processing and electronics applications.
	PSO2	1	Knowledge of basic filters and signal operations provides introductory exposure to building blocks used in communication systems.
ECT308.5	PO1	3	Students apply fundamental mathematics, electronics, and communication principles to explain the structure and operation of analog and digital communication systems.

	PO2	2	Students analyze the functional blocks and performance characteristics of communication systems to understand signal transmission and reception.
	PO3	1	Students demonstrate basic understanding of standard communication system models with limited involvement in system design.
	PO12	2	Independent study of communication techniques and system behavior promotes self-learning and continuous knowledge enhancement.
	PSO1	1	**PSO1 (Level 1):** Understanding existing communication systems provides basic exposure to electronics and signal processing concepts relevant to the program.
	PSO2	3	Detailed study of analog and digital communication systems strongly supports program-specific competencies in communication system analysis and applications.

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

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
ECT308.1	MCQ	4	
ECT308.2	MCQ	4	
ECT308.3	MCQ	4	

ECT308.4	MCQ	4	
ECT308.5	MCQ	4	
		TOTAL HOURS OF INSTRUCTION	20

Prepared by **Approved by HOD**

Athira V

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ECL 332

COMMUNICATION LAB

COURSE INFORMATION SHEET

PROGRAMME: ECE (UG)	**DEGREE**: BTECH
COURSE:	**SEMESTER: S6** **L-T-P-CREDITS**: 0-0-3-2
COURSE CODE: ECL 332 **REGULATION**:2019	**COURSE TYPE**: PRACTICAL
COURSE AREA/DOMAIN: CIRCUITS	**CONTACT HOURS**: 3 H/WEEK
CORRESPONDING LAB COURSE CODE (IF ANY):	**LAB COURSE NAME**:

SYLLABUS

EERIMENT NO.	NAME OF EXPERIMENT	HOURS
A	**Any two experiments are mandatory. The students shall design and setup simple prototype circuits with the help of available ICs. They can observe Waveforms produced by these circuits for standard ideal inputs.**	
1	FM generation and demodulation using PLL	3
2	Generation and Detection of PCM signals	3
3	Generation and Detection of Delta modulated signals	3
4	Generation and Detection of BPSK	3
5	Generation and Detection of 16-QPSK	3
B	**All experiments are mandatory. The students shall write scripts to simulate components of communication systems. They shall plot various graphs that help to appreciate and compare performance.**	

1	Performance of Waveform Coding Using PCM 1. Generate a sinusoidal waveform with a DC offset so that it takes only positive amplitude value. 2. Sample and quantize the signal using an uniform quantizer with number of representation levels L. Vary L. Represent each value using decimal to binary encoder. 3. Compute the signal-to-noise ratio in dB. 4. Plot the SNR versus number of bits per symbol. Observe that the SNR increases linearly.	3
2	Pulse Shaping and Matched Filtering 1. Generate a string of message bits. 2. Use root rasied cosine pulse p(t) as the shapig pulse, and generate the corresponding baseband signal with a fixed bit duration Tb. You may use roll-off factor as $\alpha = 0.4$. 3. Simulate transmission of baseband signal via an AWGN channel 4. Apply matched filter with frequency response $Pr(f) = P^*(f)$ to the received signal. 5. Sample the signal at mTb and compare it against the message sequence.	3
3	Eye Diagram 1. Generate a string of message bits. 2. Use rasied cosine pulse p(t) as the shapig pulse, and generate the corresponding baseband signal with a fixed bit duration Tb. You may use roll-off factor as $\alpha = 0.4$. 3. Use various roll off factors and plot the eye diagram in each case for the received signal. Make a comparison study among them.	3
4	Error Performance of BPSK 1. Generate a string of message bits. 2. Encode using BPSK with energy per bit Eb and represent it using points in a signal-space. 3. Simulate transmission of the BPSK modulated signal via an AWGN channel with variance N0/2. 4. Detect using an ML decoder and plot the probability of error as a function of SNR per bit Eb/N0.	3
5	Error Performance of QPSK 1. Generate a string of message bits. 2. Encode using QPSK with energy per symbol Es and represent it using points in a signal-space. 3. Simulate transmission of the QPSK modulated signal via an AWGN channel with variance N0/2 in both I-channel and Q-channel. 4. Detect using an ML decoder and plot the probability of error as a function of SNR per bit Eb/N0 where Es = 2Eb.	3

C	**Any two experiments are mandatory. The students shall emulate communication systems with the help of software-defined-radio hardware and necessary control software. Use available blocks in GNU Radio to implement all the signal processing. These experiments will help students to appreciate better how theoretical concepts are translated into practice.**	
1	Familiarization with Software Defined Radio (Hardware and Control Software) 1. Familiarize with an SDR hardware for reception and transmission of RF signal. 2. Familiarize how it can be interfaced with computer. 3. Familiarize with GNU Radio (or similar software's like Simulink/ Lab-View) that can be used to process the signals received through the SDR hardware. 4. Familiarize available blocks in GNU Radio. Study how signals can be generated and spectrum (or power spectral density) of signals can be analyzed. Study how filtering can be performed.	3
2	FM Reception 1. Receive digitized FM signal (for the clearest channel in the lab) using the SDR board. 2. Set up an LPF and FM receiver using GNU Radio. 3. Use appropriate sink in GNU Radio to display the spectrum of signal. 4. Resample the voice to make it suitable for playing on computer speaker.	3
3	FM Transmission 1. Use a wave file source. 2. Set up an FM transmitter using GNU Radio. 3. Resample the voice source and transmit using the SDR.	3
	Total hours	**27**

TEXT BOOKS/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T1	Carl Laufer, “The Hobbyist’s Guide to the RTL-SDR: Really Cheap Software Defined Radio”
T2	Neel Pandeya, “Implementation of a Simple FM Receiver in GNU Radio,” https://kb.ettus.com/
T3	WH Tranter, KS Shanmugan, TS Rappaport, KL Kosbar, “Principles of Communication Systems Simulation with Wireless Applications”, Prentice Hall

COURSE PREREQUISITES:

COURSE CODE	COURSE NAME	DESCRIPTION	SEMESTER
ECT 305	Analog and Digital Communication		
ECT 303	Digital Signal Processing		

COURSE OBJECTIVES:

ECL 332	• The experiments are categorized into three parts Part A, Part B and Part C. • The experiments in Part A involves design and setting up of prototype circuits on breadboard or trainer kits. • The experiments in Part B are software simulations and can be done using GNU Octave or Python. Other softwares such as MATLAB/ SCILAB/ LabVIEW can also be used. • The experiments in Part C are emulations using SDR (software-designedradio) dongle connected to laptops. A control software has to be in- stalled on the laptops. A combination of open-source GNU Radio soft- ware, RTLSDR (for reception) and HackRF / LimeSDR (for trans- mission) can be used to conduct these experiments. Other platforms such as LabView with NI-USRP or Simulink with RTL-SDR can also be used.

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
ECL332.1	Setup simple prototype circuits for waveform coding and digital modulation techniques working in a team.													
	3	3	3	2	3				3	2		1	3	3
	Apply													
ECL332.2	Simulate the error performance of a digital communication system using standard binary and M -ary modulation schemes.													
	3	3	3	2	3							1		3
	Analyze													

ECL332.3	Develop hands-on skills to emulate a communication system with software-designed-radio working in a team.													
	3	3	3	3	3				3	2		3		3
	Apply													
MAPPING AVERAGE	3	3	3	2.33	3				3	2		1.67	3	3

JUSTIFICATION FOR CO-PO/PSO MAPPING:

CO	PO/PSO	MAPPING LEVEL	JUSTIFICATION
ECL332.1	PO1	3	Requires strong application of core engineering knowledge to understand and implement the concepts involved.
	PO2	3	Involves analysing technical problems and interpreting results using appropriate engineering methods.
	PO3	3	Directly applies engineering design principles to develop and implement effective technical solutions
	PO4	2	Moderately involves investigation, interpretation, and validation of results through experiments or studies.
	PO5	3	Requires extensive use of modern engineering tools and techniques for implementation and analysis.
	PO9	3	Strongly promotes teamwork through collaborative activities, discussions, and shared responsibilities.
	PO10	2	Moderately develops communication skills through reporting, presentation, and explanation of technical work.
	PO12	1	Provides basic awareness of the need for continuous learning in adopting new tools and technologies.
	PSO1	3	Strongly enhances programme-specific technical competence relevant to the specialization.

	PSO2	3	Strongly develops skills in using industry-relevant tools and techniques related to the programme.
ECL332.2	PO1	3	Requires strong application of engineering fundamentals to understand and implement the given concepts.
	PO2	3	Involves analysing technical problems and interpreting results using systematic engineering approaches.
	PO3	3	Directly applies engineering design principles to develop and implement appropriate technical solutions.
	PO4	2	Moderately involves investigation and analysis of system behaviour through experiments or case studies.
	PO5	3	Requires extensive use of modern engineering tools and techniques for implementation and analysis.
	PO12	1	Provides basic exposure to self-learning and awareness of emerging tools and technologies.
	PSO2	3	Strongly develops skills in using programme-specific and industry-relevant tools and techniques.
ECL332.3	PO1	3	Requires strong application of engineering fundamentals to understand and implement advanced concepts.
	PO2	3	Involves detailed analysis of complex problems using appropriate engineering and analytical techniques.
	PO3	3	Directly applies engineering design principles to develop and implement effective and optimized solutions.
	PO4	3	Extensively involves investigation, experimentation, and interpretation of results to draw valid conclusions.

	PO5	3	Requires extensive use of modern engineering tools and techniques for modelling, analysis, and validation.
	PO9	3	Strongly emphasizes teamwork through collaborative problem-solving and coordinated task execution.
	PO10	2	Moderately develops communication skills through documentation, presentations, and technical discussions.
	PO12	3	Strongly promotes self-directed learning and adaptation to new tools and emerging technologies.
	PSO2	3	Strongly develops programme-specific skills using advanced, industry-relevant tools and techniques.

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

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
ECL331.1	CA,IE		6
ECL331.2	CA,IE		15
ECL331.3	CA,IE		6
		TOTAL HOURS OF INSTRUCTION	27

Prepared by Sreetha Sreedhar K **Approved by HOD**

ECD334

MINI PROJECT

COURSE INFORMATION SHEET

PROGRAMME: ECE (UG)	**DEGREE**: BTECH
COURSE: MINI PROJECT	**SEMESTER:** SIX **L-T-P-R :** 0-0-3 **CREDITS**: 2
COURSE CODE: ECD 334 **REGULATION**: 2019	**COURSE TYPE**: ESC COURSE
COURSE AREA/DOMAIN: Electronics System Design involving • Programming (Embedded / High-level languages) • Hardware or Hardware–Software co-design • Application of fundamentals of Electronics and Communication Engineering	**CONTACT HOURS**: 6 HOURS/WEEK
CORRESPONDING LAB COURSE CODE (IF ANY): NIL	**LAB COURSE NAME**: NONE

SYLLABUS

MODULE	DETAILS
CO1	Be able to practice acquired knowledge within the selected area of technology for project development.
CO2	Identify, discuss and justify the technical aspects and design aspects of the project with a systematic approach.
CO3	Reproduce, improve and refine technical aspects for engineering projects.
CO4	Work as a team in development of technical projects.
CO5	Communicate and report effectively project related activities and findings.

TEXT BOOKS/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION

COURSE PREREQUISITES:

COURSE CODE	COURSE NAME	DESCRIPTION	SEMESTER
CSD 334	MINI PROJECT	1. Fundamental concepts of Electronics and Communication Engineering. 2. Basic understanding of system design and problem-solving methodology.	Six

COURSE OBJECTIVES:

1	

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
ECD334.1	Identify technically and economically feasible problems (Cognitive Knowledge Level: Apply).													
	3	**3**	**3**	**2**		**3**						**2**	**2**	**1**
	APPLY													
ECD334.2	Identify and survey the relevant literature for getting exposed to related solutions and get familiarized with software development processes (Cognitive Knowledge Level: Apply).													
	3	**3**	**3**	**2**		**3**					**3**	**2**	**3**	**2**
	APPLY													
ECD334.3	Perform requirement analysis, identify design methodologies and develop adaptable & reusable solutions of minimal complexity by using modern tools & advanced programming techniques. (Cognitive Knowledge Level: Apply).													
	3	**3**	**3**	**2**		**3**					**3**	**2**	**3**	**2**
	APPLY													
ECD334.4	Prepare technical report and deliver presentation.(Cognitive Knowledge Level: Apply).													
								3		**3**	**3**	**2**	**2**	**1**
	APPLY													
ECD334.5	Apply engineering and management principles to achieve the goal of the project.: Apply).													
								3	**3**	**3**		**2**	**2**	**1**

	APPLY													
MAPPING AVERAGE	**3.0**	**3.0**	**3.0**	**2.0**		**3.0**		**3.0**	**3.00**	**3.00**	**3.0**	**2.0**	**2.0**	**1.2**

JUSTIFICATION FOR CO-PO/PSO MAPPING:

CO	PO/PSO	MAPPING LEVEL	JUSTIFICATION
ECD334.1	PO1	3	The mini project requires strong application of engineering fundamentals, mathematics, and core electronics concepts to design and implement a functional system, hence a high level of contribution.
	PO2	3	Students analyze real-world problems, identify system requirements, and formulate appropriate solutions during project development, demonstrating strong problem analysis skills.
	PO3	3	The project involves designing and developing a working model that meets specified requirements and constraints, directly addressing the design and development outcome.
	PO4	2	Basic investigation, testing, and validation of the developed system are carried out to evaluate performance and functionality, resulting in a moderate level of contribution.
	PO6	3	The mini project addresses practical engineering problems with societal relevance, promoting awareness of professional responsibilities and engineering solutions in real-life contexts.
	PO12	1	Students gain introductory exposure to self-learning through literature review, tool exploration, and implementation of new concepts beyond the syllabus, leading to a low but relevant contribution.
	PSO1	2	The project moderately applies domain-specific knowledge of Electronics and Communication Engineering in system design and implementation.
	PSO1	1	Limited use of advanced tools and emerging technologies is involved, providing a basic contribution to professional skill development.

ECD334.2	PO1	3	Students apply in-depth knowledge of engineering fundamentals and core ECE concepts to explain and justify the technical aspects of the project, resulting in a strong contribution.
	PO2	3	The project demands systematic analysis of design requirements, constraints, and alternatives, enabling strong problem analysis and decision-making skills.
	PO3	1	Design activities are limited to refinement and discussion of existing system architecture, leading to a low level of direct design contribution.
	PO4	2	Moderate investigation is carried out through simulation, testing, and validation of design choices to support technical justifications.
	PO6	3	Ethical responsibility, safety considerations, and societal relevance of the proposed solution are strongly addressed while justifying the design approach.
	PO11	3	The mini project involves planning, task allocation, resource management, and timely execution, contributing significantly to project management skills.
	PO12	2	Students engage in continuous learning by reviewing literature, learning new tools, and updating design strategies, resulting in a moderate contribution.
	PSO1	3	Strong application of Electronics and Communication Engineering principles is demonstrated in analyzing and justifying system design and performance.
	PSO2	2	Moderate use of modern engineering tools, software, and platforms is involved in analyzing and presenting the project outcomes.
ECD334.3	PO1	3	Students extensively apply core engineering principles and ECE fundamentals to refine system components and improve overall project performance.
	PO2	3	Strong analytical skills are demonstrated by identifying limitations, diagnosing issues, and proposing improvements to enhance system functionality.
	PO3	3	Significant design modifications and refinements are carried out to improve efficiency, reliability, and performance of the developed system.
	PO4	2	Moderate investigation through testing, experimentation, and performance evaluation is conducted to validate improvements made to the system.
	PO6	3	Improvements consider safety, reliability, and societal relevance, showing strong professional and ethical responsibility.

	PO11	3	Effective planning, coordination, and management of project activities are required to implement refinements within given constraints.
	PO12	2	Students engage in continuous learning by exploring alternative methods, tools, and technologies to enhance the project.
	PSO1	3	Advanced application of Electronics and Communication Engineering knowledge is demonstrated while refining technical subsystems.
	PSO2	2	Moderate use of modern engineering tools and techniques is employed for system optimization and performance analysis.
ECD334.4	PO8	3	Strong emphasis is given to professional ethics, responsibility, mutual respect, and collaborative behavior while working in a team environment.
	PO10	2	Moderate level of communication skills is developed through technical discussions, review presentations, and documentation within the project team.
	PO11	2	Basic project management skills such as task allocation, scheduling, and coordination are practiced during team-based project execution.
	PO12	3	Team-based learning encourages continuous self-learning, peer learning, and adaptation to new tools and technologies throughout the project lifecycle.
	PSO1	1	Limited direct application of core ECE technical knowledge is involved, as the outcome primarily focuses on teamwork rather than technical depth.
	PSO2	3	Strong use of collaborative tools, modern platforms, and teamwork-oriented engineering practices enhances professional and technical skill development.
ECD334.5	PO8	3	Strong emphasis is placed on ethical reporting, academic integrity, and professional responsibility in documenting and presenting project work.
	PO9	3	Effective teamwork is demonstrated through coordinated preparation of reports and presentations, ensuring clarity and consistency of communicated outcomes.
	PO10	3	High-level communication skills are developed through technical report writing, oral presentations, demonstrations, and viva-voce examinations.
	PO12	2	Moderate engagement in self-learning is involved while improving technical writing skills and presentation methods based on feedback.
	PSO1	3	Strong application of ECE domain knowledge is reflected in clearly explaining system design, implementation, and results in reports and presentations.

	PSO2	3	Extensive use of modern tools, software platforms, and presentation techniques is employed to effectively communicate technical content.

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

WEB SOURCE REFERENCES:

SL NO:	DESCRIPTION

DELIVERY TECHNOLOGIES

CLASSROOM/LAB WITH BLACK 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/ MOCK TESTS	✔	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	PRACTICAL HOURS
ECD334.1		-	2 HOURS
ECD334.2		-	3 HOURS
ECD334.3		-	2 HOURS
ECD334.4		-	2 HOURS
ECD334.5		-	3 HOURS
		TOTAL HOURS OF INSTRUCTION	12 CLASS HOURS

Prepared by ARSHA C DINESH

Approved by HOD