St. Thomas College of Engineering & Technology

Vellilode, Sivapuram PO. Mattanur. Kannur District, Kerala

Approved by AICTE New Delhi, Govt. Of Kerala and Affiliated to APJ Abdul Kalam Technological University

COURSE

HANDOUT

(B. Tech - Semester 8)

St. Thomas College of Engineering & Technology

Vellilode, Sivapuram PO. Mattanur. Kannur District, Kerala

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

COLLEGE VISION

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

COLLEGE MISSION

M1: Infrastructural Relevance - Develop, maintain and manage our campus for our stakeholders.

M2: Life-Long Learning - Encourage our stakeholders to participate in lifelong learning through industry and academic interactions.

M3: Social Connect - Organize socially relevant outreach programs for the benefit of humanity.

DEPARTMENT VISION

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

DEPARTMENT MISSION

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

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

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

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

Graduates of B. Tech ECE program after graduation will:

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

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

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

PROGRAM OUTCOMES (POS)

Engineering Graduates will be able to:

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

PO2 Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

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

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

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

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

PO10 Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11 Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12 Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSO)

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

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

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CONTENTS

COURSE INFORMATION SHEETS OF SEMESTER 8 COURSES

ECT 402

WIRELESS COMMUNICATION

COURSE INFORMATION SHEET

PROGRAMME: ECE (UG)	DEGREE: BTECH
COURSE: WIRELESS COMMUNICATION	SEMESTER: 8 L-T-P-CREDITS: 2-1-0-3
COURSE CODE: REGULATION:2019	COURSE TYPE: THEORY
COURSE AREA/DOMAIN: COMMUNICATION	CONTACT HOURS:6hrs/week
CORRESPONDING LAB COURSE CODE (IF ANY): NIL	LAB COURSE NAME: -

SYLLABUS

MODULE	DETAILS	HOURS
MODULE-1	Introduction to Wireless Communication Systems: Generations: 2G, 3G, 4G, 5G. Wireless LAN, Bluetooth and Personal Area networks, Broadband Wireless Access -- WiMAX Technology. Wireless Spectrum allocation, Standards. Cellular System Design Fundamentals : Frequency Reuse, channel assignment strategies, Handoff strategies, Interference and system capacity, trunking and grade off service, improving coverage and capacity – cell splitting, sectoring, microcells.	8 hrs
MODULE-2	Path loss and shadowing : Free space path loss, Two-Ray model, Shadowing, Statistical Multipath Channel Models : Time-varying channel impulse response, Narrowband fading, Wideband fading models, Delay spread and Coherence bandwidth,	7 hrs

	Doppler spread and Coherence time, Flat fading versus frequency selective fading, Slow fading versus fast fading, Discrete-time model.Capacity of Wireless Channels : Review of Capacity in AWGN, Capacity of flat fading channel – Ergodic capacity, Capacity with Outage, Capacity with CSI-R.	
MODULE-3	Digital Signaling for Flat fading Channels: Analysis of Average Error Probability and Outage probability of BPSK in flat-fading channels. Multi-carrier Modulation: Data transmission using multicarrier modulation for frequency-selective fading channels. Overlapping subchannels, Mitigation of Subcarrier Fading, Discrete Implementation of multicarrier – OFDM. Cyclic prefix, Peak-toaverage-power-ratio.	7 hrs
MODULE-4	Diversity : Receiver diversity – selection combining, maximal ratio combining. Transmitter diversity – Alamouti scheme for 2x2 MIMO. Equalization : Equalization – Linear and non-linear equalization, Zero forcing, MMSE equalizers. LMS algorithm. Adaptive Equalization. Multiuser Systems : Uplink and Downlink, Multiple Access, Frequency-Division Multiple Access (FDMA), Time-Division Multiple Access (TDMA), Code-Division.Multiple Access (CDMA), Orthogonal Frequency-Division Multiple Access (OFDMA).	8 hrs
MODULE-5	Ground wave propagation, Plane earth reflection, Space wave and surface wave, Spherical earth propagation, Tropospheric waves, Ionospheric propagation, Effects of earth's magnetic field,Critical frequency, Maximum usable Frequency, Virtual height.	7 hrs
Total hours		**37 hrs**

TEXT BOOKS/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T1	Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2005
T2	Theodore S. Rappaport, Wireless communication: Principles and Practice, 2/e, Pearson Education, 1990

COURSE PREREQUISITES:

COURSE CODE	COURSE NAME	DESCRIPTION	SEMESTER
ECT 305	Analog & Digital Communication	The basics concepts that are essential for understanding radio channel behaviour and wireless system design is dealt there.	S5

COURSE OBJECTIVES:

- This course aims to introduce students to basic theory and principles of wireless communication systems in general, and cellular systems in particular.
- It also introduces basics of radio wave propagation
.

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	PS O 2
ECT 402.1	Summarize the basics of cellular system and cellular design fundamentals.													
	3	3	2		1			2				2		3
	UNDERSTAND													
ECT 402.2	Describe the wireless channel models and discuss capacity of wireless channels.													
	3	3	3		3							2		3
	UNDERSTAND													
ECT 402.3	Analyze the performance of the modulation techniques for flat-fading channels and multicarrier modulation.													

	3	3	3		3									3

ANALYZE

ECT 402.4	Illustrate how receiver performance can be enhanced by various diversity techniques.

	3	3	3		3									3

APPLY

ECT 402.5	Identify advantages of various equalization techniques and multiple-access techniques in wireless communication.

	3	3	3		3									3

APPLY

ECT 402.6	Calculate system parameters such antenna height, range, maximum usable frequency in different modes of radio wave propagation.

	3	3	3										2	2

APPLY

MAPPING AVERAGE	3.0	3.0	2.8		2.6		2.0			2.0		2.8

JUSTIFICATION FOR CO-PO/PSO MAPPING:

CO	PO/PSO	MAPPING LEVEL	JUSTIFICATION
ECT 402.1	PO1	3	Students apply fundamental engineering knowledge to understand cellular system design and frequency reuse.
	PO2	3	Identifying factors like interference, handoff, and cell splitting involves analyzing complex cellular design problems.
	PO3	2	Identifying factors like interference, handoff, and cell splitting involves analyzing complex cellular design problems.
	PO5	1	Exposure to cellular technologies motivates use of modern engineering tools like simulation tools for cellular planning.
	PO8	2	Cellular design includes awareness of service quality and societal communication needs.
	PO12	2	Forms the base for continuous learning of emerging cellular technologies (4G/5G/6G).

	PSO2	3	Helps students select appropriate cellular technologies and architectures for system implementation.
ECT 402..2	PO1	3	Uses mathematical principles to explain fading, path loss, and channel capacity.
	PO2	3	Channel modeling demands analytical skills to interpret random process behavior
	PO3	3	Enables performance evaluation of wireless links under different propagation conditions.
	PO5	3	Requires using simulation tools to visualize channel characteristics.
	PO12	2	Encourages continuous learning about advanced models used in modern wireless standards.
	PSO2	3	Supports selection of appropriate modulation and coding technologies based on channel behavior.
ECT 402.3	PO1	3	Uses mathematical signal processing concepts to evaluate modulation performance.
	PO2	3	Requires identifying problems associated with fading and proposing analytical solutions.
	PO3	3	Directly supports design/analysis of modern modulation schemes such as OFDM.
	PO5	3	Uses modern software tools to simulate multicarrier systems.
	PSO2	3	Helps in selecting suitable modulation formats for various communication standards.
ECT 402.4	PO1	3	Applies communication theory and engineering fundamentals to diversity improvement.
	PO2	3	Requires analytical understanding of multipath fading and combining techniques.
	PO3	3	Supports design of improved, robust wireless receiver architectures
	PO5	3	Use of tools for comparing different diversity schemes.
	PSO2	3	Enables selection of diversity methods suitable for modern wireless systems.
ECT 402.5	PO1	3	Uses signal fundamentals to understand ISI and equalization.

	PO2	3	Requires problem-solving to analyze multiple accessing techniques for bandwidth and interference management.
	PO3	3	Supports design and evaluation of MA schemes in communication systems.
	PO5	3	Requires tool-based visualization of equalization performance.
	PSO2	3	Helps identify suitable multiple access strategies for specific wireless system implementations.
ECT 402.6	PO1	3	Applies engineering physics and math to propagation and link-budget calculations.
	PO2	3	Involves analytically solving propagation-related communication problems.
	PO3	3	Supports wireless system design in terms of coverage and performance estimation.
	PO12	2	Encourages continuous learning of propagation and antenna behavior in modern standards .
	PSO2	2	Helps select appropriate propagation models and antenna configurations for communication system deployment

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	Missing Modern Multiple Access Techniques	An additional assignment on the topic be given	PO1, PO2, PO3, PO5,PO12, PSO1, PSO2

CONTENT BEYOND THE SYLLABUS/ADVANCED TOPICS/DESIGN

SL NO:	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POS /PSOS
1.	Implementation of 5G NR Concepts	Link provided.Those interested can watch it. https://youtu.be/DtEnxv3AoE8 ?si=X4RlfXja97cHv14N	PO1,PO2,PO3,PO5, PO12, PSO1,PSO2

WEB SOURCE REFERENCES:

SL NO:	DESCRIPTION
1	https://youtube.com/playlist?list=PL33AB52ED9A7873C0&si=n1F2quuZlfWhjQvA

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
ECT 402.1	S1,A1,T1	16	
ECT 402.2	S1,A2,T2	13	
ECT 402.3	S2,A2,T3	7	
ECT 402.4	S2,S3	4	
ECT 402.5	S2,S3,A3	6	
ECT 402.6	S3,A3,T4	9	
		TOTAL HOURS OF INSTRUCTION	55

Prepared by
Sreetha Sreedhar K

Approved by HOD

ECT 424

SATELLITE COMMUNICATION

COURSE INFORMATION SHEET

PROGRAMME: *ECE (UG)*	**DEGREE**: BTECH
COURSE: SATELLITE COMMUNICATION	**SEMESTER**: S8 **L-T-P-CREDITS**: 2-1-0-3
COURSE CODE: ECT424 **REGULATION**:2024	**COURSE TYPE**: ELECTIVE
COURSEAREA/DOMAIN :COMMUNICATION	**CONTACT HOURS**:35
CORRESPONDING LAB COURSE CODE (IF ANY): ECL411	**LAB COURSE NAME**: ELECTROMANETICS LAB

SYLLABUS

MODULE	DETAILS	HOURS
I	**Satellite Orbits:** Introduction to Satellite Communication,Historical background, Basic concepts of Satellite Communications, Kepler'slaws of planetary motion, types of satellite orbits,orbit determination.Definitions of terms for Earth-Orbiting Satellites, Orbital Elements,Apogee and Perigee Heights,satellite stabilization,orbital effects on satellites performance. Antenna Look Angles, The Polar Mount Antenna, Limits of Visibility, launch systems for geostationary satellites.	7
II	**Satellite System:** *The Space Segment* Introduction, The Power Supply, Attitude&Orbit Control, Satellite stabilization, Station Keeping, Thermal Control, TT&C Subsystem, Transponders, Antenna Subsystem *The Earth Segment* Types of earth station, architecture & design considerations .Transmit-Receive Earth Station ,Wideband receiver, the input demultiplexer, the power amplifier, Satellite tracking.	7

III	**The Satellite Link design :** Introduction,Transmission Theory,System Noise Temperature and G/T Ratio, Design of Downlinks Ku-Band GEO Satellite Systems, Uplink Design , Design for Specified CNR: Combining CNR and C/I Values in Satellite Links ,System Design for Specific Performance. Regional &global satellite systems INSAT, INTELSAT& INMARSAT.	6
IV	**Modulation & Multiple Access** Introduction,Digital Modulation techniques preferred in satellites, Multiple Access,Frequency Division Multiple Access (FDMA) ,Time Division Multiple Access (TDMA), Transmitter Power in TDMA Networks,Demand Assignment Multiple Access (DAMA), Random Access (RA) , Packet Radio,Systems and Protocols, Code Division Multiple Access (CDMA)	7
V	**Satellite Application:** Introduction, Frequency bands, , Comparison between Satellite & terrestrial networks, Satellite Telephony,SatelliteTelevision,DTH,Satellite Radio broadcasting,Remote Sensing Satellite;Classification, orbits,payloads,Weather ForecastingSatellites:Orbits,payloads. Navigation Satellite:Basic principles of satellite navigation, GPS Position Location Principle functional segments of GPS, Indian Contribution to positioning systems. NGSO satellite systems.	**8**
	Total hours	**35**

TEXT BOOKS/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T1	Dennis Roddy, Satellite Communications, 4th Edition, McGraw- Hill

	International edition, 2006
T2	Timothy Pratt,Jeremy E,Allnutt, Satellite Communications, Wiley, 3rd Edition, October 2019
R1	Gerard Maral,Michel Bousquet,Zhili Sun, Satellite Communications Systems: Systems, Techniques and Technology,Wiley,6thedition,April 2020
R2	Anil K. Maini, Varsha Agrawal, Satellite Communications, Wiley India Pvt. Ltd.,2015
R3	TRI.T. HA, Digital Satellite Communications, McGraw-Hill,second edition

COURSE PREREQUISITES:

COURSE CODE	COURSE NAME	DESCRIPTION	SEMESTER
ECT305	Analog &Digital communication	The course Analog & Digital Communication (ECT305) introduces the fundamental principles, techniques, and practical aspects of modern communication systems. It provides a detailed understanding of both analog and digital signal transmission, starting from basic signal representation to advanced modulation and detection techniques.	S5

COURSE OBJECTIVES:

ECT424	This course aims to impart the basic knowledge of satellite communication 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
ECT424.1	Define satellite communications& possible satellite orbits.													
	3	3											3	

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
ECT424.2														
UNDERSTAND														
Describe satellite communication subsystems& launching mechanisms of satellites.														
	3	3												2
UNDERSTAND														
ECT424.3														
Calculate link budgets.Provide an in-depth treatment of satellite communication systems operation and planning														
	3	3	3											2
APPLY														
ECT424.4														
Analyze the various methods of satellite access.														
	3	3			2								3	
ANALYZE														
ECT424.5														
Discuss various applications of satellite communications														
	3	3											3	
UNDERSTAND														
MAPPING AVERAGE	3	3	3		2								3	2

JUSTIFICATION FOR CO-PO/PSO MAPPING:

CO	PO/PSO	MAPPING LEVEL	JUSTIFICATION
ECT424.1	*PO1*	*3*	*Students gain fundamental engineering knowledge of satellite concepts, Kepler's laws, and orbital classifications.*
	PO2	*3*	*Students analyze basic orbital parameters such as altitude, inclination, and period.*
	PSO1	*3*	*Strengthens core ECE fundamentals related to communication systems and propagation concepts.*
ECT424.2	*PO1*	*3*	Students understand satellite subsystems such as payload, transponders, power systems, TT&C, and launch vehicles.
	PO2	*3*	Students analyze subsystem interconnections and functional roles in satellite operation.

	PSO2	2	Enhances practical knowledge of hardware elements used in modern satellite systems.
ECT424.3	PO1	3	Application of electromagnetic theory, noise analysis, and system parameters.
	PO2	3	Students analyze signal losses, noise temperature, SNR, and C/N ratios.
	PO3	3	Students design satellite links that satisfy performance specifications.
	PSO2	2	Use of computational tools for satellite network planning and optimization.
ECT401.4	PO1	3	**Students apply core engineering knowledge of communication theory, bandwidth utilization and modulation schemes in studying FDMA, TDMA, CDMA and DAMA techniques.**
	PO2	3	**Students critically analyze and compare different satellite access methods based on efficiency, capacity, delay and interference.**
	PO5	2	**Students use modern computational tools and simulation software to evaluate the performance of multiple access techniques.**
	PSO1	3	**Students apply ECE domain knowledge to analyze multiple access communication systems used in satellite networks.**
ECT424.5	PO1	3	**Students apply fundamental engineering knowledge to understand and explain satellite applications such as television broadcasting, GPS, weather forecasting, remote sensing and defense communication.**
	PO2	3	**Students analyze application-specific requirements such as coverage area, bandwidth, reliability and latency while studying different satellite-based services.**

	PSO1	3	*Students apply core ECE communication system knowledge to interpret and relate satellite communication principles with real-world applications.*

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	NPTEL. (2017). *Satellite Communication Systems*. Prof. Kalyan Kumar Bandyopadhyay, IIT Kharagpur. Retrieved from https://archive.nptel.ac.in/courses/117/105/117105131/
2	NPTEL. (2017). *Satellite Communication – Course Overview*. Retrieved from https://onlinecourses-archive.nptel.ac.in/noc17_ec14/preview N
3	NPTEL. (n.d.). *Principles of Communication Systems-I*. Retrieved from https://onlinecourses-archive.nptel.ac.in/noc17_ee06/course NPTEL Online Co

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
ECT424.1	S1,A1,T1	10	
ECT424.2	S1,A2	10	
ECT424.3	S2,A2,A3,T3	10	
ECT424.4	S2,S3,A3	10	
ECT424.5	S3,A3,T3	11	
		TOTAL HOURS OF INSTRUCTION	41

Prepared by
ARSHA C DINESH   **Approved by HOD**
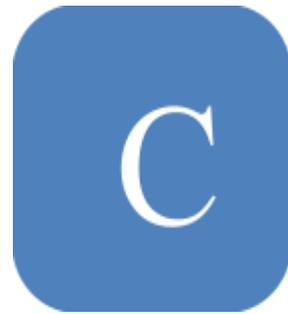
ECT 416

MODERN COMMUNICATION SYSTEMS

<h1 style="text-align:center">COURSE INFORMATION SHEET</h1>

PROGRAMME: ECE (UG)	DEGREE: BTECH
COURSE: MODERN COMMUNICATION SYSTEMS	SEMESTER: S7 L-T-P-CREDITS: 2-1-0-3
COURSE CODE: ECT416 REGULATION:2019	COURSE TYPE: ELECTIVE
COURSE AREA/DOMAIN: COMMUNICATION	CONTACT HOURS: 6 H/WEEK
CORRESPONDING LAB COURSE CODE (IF ANY):	LAB COURSE NAME:

SYLLABUS

MODULE	DETAILS	HOURS
I	Need for Multi carrier system, Basics of Orthogonal Frequency Division Multiplexing (OFDM), Multiple access for OFDM systems, Orthogonal Frequency Division Multiple Access (OFDMA), Single carrier Frequency Division Multiple Access (SC-FDMA). Cellular concept, path loss and shadowing, Doppler shift, Multipath effect, Significance of diversity in wireless communication systems.	8
II	Introduction to current wireless technologies, background and current scenario, future wireless network requirements, IEEE 802.11 (Wi-Fi) standards and applications (IEEE	9

	802.11a/b/g/n/ac/ax), HiperLAN technology, WPAN (IEEE 802.15.1, IEEE 802.15.3 & IEEE 802.15.4) and WMAN (IEEE 802.16a -WiMAX), Space time wireless standards, IEEE 802.16 (Wi-Max standard), 3GPP-LTE standard, Millimeter wave characteristics, Channel performance at 60 GHz, Development of millimeter wave standards, Indoor and outdoor applications for millimeter wave communications. 6G Networks – Use Cases and Technologies.	
III	Introduction of IoT, characteristics, physical and logical design of IoT, IoT Enabling Technologies – Wireless Sensor networks, Cloud computing. Introduction to IoT, Evolution of IoT, IoT Networking Components. IoT Connectivity Technologies – Zigbee, Wireless HART, RFID, NFC, LoRa, WiFi, Bluetooth. IoT Communication Technologies – Infrastructure Protocols – IPv6, 6LoWPAN, Data Protocols – MQTT, MQTT-SN, CoAP. IoT Case Studies and Future Trends – Agricultural IoT, Vehicular IoT, Healthcare IoT.	7
IV	Introduction to Intelligent Vehicular Communication – Evolution, Vehicular Networks and ITS, Vehicular Communication Standards/ Technologies – DSRC, IEEE 802.11p WAVE, IEEE 1609, IEEE 802.15.7 - Visible Light Communication (VLC), 4G/5G-Device to Device (D2D), 6G Cellular Networks and Connected Autonomous Vehicles, Operational Scenario – Collision Avoidance.	6
V	Software radio concepts, Operating frequency bands, Transmitter and Receiver specifications of SDR, Architecture of SDR, Introduction of cognitive radio,significance of cognitive radio and spectrum subleasing, spectrum sharing in cognitive radio, implementation of cognitive radio.	**5**

	Total hours	36

TEXT BOOKS/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T1	Aditya K. Jagannatham, "Principles of Modern Wireless Communication Systems", Tata McGraw Hill, 2016.
T2	T.L. Singal, "Wireless Communications", Tata McGraw Hill Education Private Limited, Second Edition, 2011.
T3	K. C. Huang, Z. Wang, "Millimeter Wave Communication systems", John Wiley & Sons.
R2	Sudip Misra, Anandarup Mukherjee & Arijit Roy. "Introduction to IoT". Cambridge University Press. 2021.
R1	Dipankar Raychaudhuri, Mario Gerla, "Emerging Wireless Technologies and the Future Mobile Internet", Cambridge University Press, 2011.
R2	ArshdeepBahga, A., & Vijay Madisetti V. "Internet of Things: A hands-on approach".Vpt., 2014.

COURSE PREREQUISITES:

COURSE CODE	COURSE NAME	DESCRIPTION	SEMESTER
MAT 204	Probability, Random Process and Numerical Methods,		S4
ECT 305	Analog and Digital Communication,		S5
ECT 306	Information Theory and Coding		S6

COURSE OBJECTIVES:

ECT416	This course aims to impart knowledge on the basics of modern communication systems and the breakthrough wireless technologies.

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
ECT416.1	Explain OFDM, OFDMA and SC-FDMA techniques used in cellular communication													
	3	**3**	**3**		**2**									**3**
ECT416.2	Discuss the different wireless communication standards for short range communication													
	3	3	3			3						1		3
ECT416.3	Explain the IoT architecture and various connectivity technologies used in IoT Systems													
	3	3	3			3								3
ECT416.4	Understand the various communication standards for connected autonomous vehicles													
	3	3	3			3						1		3
ECT416.5	Explain the significance and architecture of software defined radio and cognitive radio													
	3	3	3		2									3
MAPPING AVERAGE	3	3	3		2	3						1		3

JUSTIFICATION FOR CO-PO/PSO MAPPING:

CO	PO/PSO	MAPPING LEVEL	JUSTIFICATION
ECT416.1	PO1	3	Strong application of mathematics and communication engineering fundamentals to explain multicarrier modulation concepts
	PO2	3	Involves analysing complex communication system behaviours such as subcarrier allocation, PAPR, and frequency-selective fading.
	PO3	3	Supports designing cellular system components where suitable multicarrier techniques must be selected based on performance needs.
	PO5	2	Requires the use of modern tools or simulation platforms to study and compare multicarrier modulation schemes.
	PSO2	3	Enables selecting appropriate modulation and access technologies for modern wireless communication systems.
ECT416.2	PO1	3	Applies core communication engineering knowledge to understand the principles behind various short-range wireless standards.
	PO2	3	Requires analysing the technical differences, performance factors, and constraints of standards such as Bluetooth, ZigBee, UWB, and Wi-Fi.
	PO3	3	Supports evaluating and selecting suitable short-range standards while considering system requirements and practical design constraints.
	PO6	3	Encourages assessing societal, safety, and regulatory aspects associated with deploying short-range wireless technologies.
	PO12	1	Promotes awareness of the need to keep learning new and evolving wireless standards in a rapidly changing technology landscape.

	PSO2	3	Helps in selecting appropriate short-range technologies for modern communication system implementations.
ECT416.3	PO1	3	Uses foundational engineering and communication knowledge to understand layered IoT architectures and underlying connectivity principles.
	PO2	3	Requires analysing different IoT communication technologies by comparing their range, bandwidth, power constraints, and application suitability.
	PO3	3	Supports choosing and designing appropriate IoT connectivity solutions based on system requirements and environmental considerations.
	PO6	3	Involves understanding societal, safety, and regulatory implications of deploying IoT devices and networks in real-world environments.
	PSO2	3	Enables selecting appropriate communication technologies for implementing efficient and reliable IoT systems.
ECT416.4	PO1	3	Applies fundamental communication and signal processing concepts to understand SDR architecture and reconfigurable radio principles.
	PO2	3	Requires analysing how SDR and cognitive radio adapt to spectrum conditions, evaluate performance metrics, and address complex wireless challenges.
	PO3	3	Supports designing flexible radio systems where modulation, bandwidth, and protocols can be configured to meet application and environmental requirements.
	PO6	3	Involves understanding regulatory, safety, and spectrum-management issues associated with dynamic spectrum access and autonomous radio operation.

	PO12	1	Promotes continuous learning, as SDR and cognitive radio technologies evolve rapidly with modern wireless standards and AI-driven spectrum techniques.
	PSO2	3	Enables selecting advanced radio technologies that enhance the performance and adaptability of modern communication systems.
ECT416.5	PO1	3	Applies core engineering and signal processing fundamentals to understand reconfigurable radio architectures and spectrum adaptation mechanisms.
	PO2	3	Involves analysing how SDR and cognitive radio systems sense, interpret, and respond to complex wireless environments.
	PO3	3	Supports designing flexible radio systems where modulation schemes, communication protocols, and frequency bands can be dynamically configured.
	PO5	2	Requires using modern tools and software platforms such as GNU Radio or simulation environments to study SDR and cognitive radio behaviour.
	PSO2	3	Enables selecting advanced reconfigurable radio technologies for modern communication system implementations.

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 detailed 5G/6G architecture exposure	Conduct a seminar on Architectural Evolution from 4G LTE to 5G NR and Towards 6G Intelligent Networks	PO1,PO2,PO3,PO5, PO6,PO12,PSO2

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.udemy.com/share/10aJLu/
2	https://nptel.ac.in/courses/117105144

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
ECT416.1	S1,A1,T1	9	1
ECT416.2	S1,A2,T2	12	1
ECT416.3	S2,A2,T3	9	1
ECT416.4	S2,S3,A3,T4	7	1
ECT416.5	S3,A3,T5	7	1
		TOTAL HOURS OF INSTRUCTION	49

Prepared by Arya C   **Approved by HOD**

ECT 468

RENEWABLE ENERGY SYSTEMS

COURSE INFORMATION SHEET

PROGRAMME: ECE (UG)	DEGREE: BTECH
COURSE: RENEWABLE ENERGY SYSTEMS	SEMESTER: L-T-P-CREDITS: 2-1-0-NIL
COURSE CODE: ECT468 REGULATION: 2019 SCHEME	COURSE TYPE: CORE
COURSE AREA/DOMAIN: RENEWABLE ENERGY SYSTEMS	CONTACT HOURS: 5
CORRESPONDING LAB COURSE CODE (IF ANY): NIL	LAB COURSE NAME: NIL

SYLLABUS

MODULE	DETAILS	HOURS
I	Introduction to Renewable Energy (RE)Sources:World energy scenario, Overview of conventional energy sources, their limitation, need of renewable energy, potential & development of renewable energy sources,Renewable energy in India, An overview of types of renewable energy systems - Wind power, Hydropower (micro and mini), Solar energy,Biomass, Bio-fuel, Geothermal Heat energy, Pros and cons; Applications.	7
II	Solar Energy: Introduction to photovoltaic (PV) systems - Principle of PV conversion;Commercial solar cell, Thin film PV device fabrication - LPCVD, APCVD, PECVD;Tandem Solar cell fabrication; Solar power extraction using PV-Cells, I-V Characteristics,PV-Inverters without D.C. to D.C. converters, stand alone and grid collected PV systems,Grid interfacing-with isolation, without isolation, Maximum power point tracking-Methods(MPPT), PV-Inverters with D.C. to D.C. converters-on low frequency side and high frequency side with isolation, without isolation.	8
III	Wind Energy: Sources and potentials, Evaluation of Wind Intensity, Topography, General Classification of Wind Turbines-Rotor Turbines, Multiple-Blade Turbines, Drag Turbines, Lifting Turbines, System Toroidal Rotor Amplifier Platform (TARP)–Wind amplified rotor platform (WARP), Generators and speed control used in wind power	6

	energy: Fixed speed with capacitor bank, Rotor resistance control, SCIG and DFIG, Synchronous Generator-external magnetized, Synchronous Generator-permanent magnets.	
IV	Electronic conversion systems application to renewable energy generation systems: Basic schemes and functional advantages, Power control and management systems for grid integration, island detection systems, synchronizing with the grid; Issues in integration of converter based sources; Network voltage management; Power quality management and Frequency management; Influence of PV/WECS on system transient response	6
V	Introduction to grid connectivity of RE systems, smart grid and emerging technologies,operating principles and models of smart grid components, key technologies for generation,networks, loads and their control capabilities; Evolution of electricity metering, key components of smart metering, overview of the hardware used for smart meters, smart metering protocols. Structure and main components of a distribution management system, Supervisory control and data acquisition (SCADA), distribution system modelling, new trends for smart grids, topology analysis, power flow analysis.	8
Total hours		35

TEXT BOOKS/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T1	Nayak J. K. and Sukhatme S. P. (2006), Solar Energy: Principles of Thermal Collection and Storage, Tata McGraw Hill.
T2	Muhannad H. R. (2004); Power Electronics: Circuits, Devices and Applications, Pearson Prentice Hall.
R1	Wind power plants and projects developments, Joshua Earnest and T Wizelius, PHI, New Delhi, 2011.
R2	Handbook of renewable energy technology, World Scientific, Singapore, 2011.
R3	Garg H. P. and Prakash S. (2000); Solar Energy: Fundamental and Application, Tata McGraw Hill
R4	Goswami D. Y. (2015); Principles of Solar Engineering, Taylor and Francis
R5	Gellings C. W. (2009); The Smart Grid: Enabling Energy Efficiency and Demand Response, First Edition, CRC Press

R6	Teodorescu R. Liserre M. Rodriguez P. (2011); Grid Converters for Photovoltaic and Wind Power Systems, First Edition, Wiley-IEEE Press

COURSE PREREQUISITES:

COURSE CODE	COURSE NAME	DESCRIPTION	SEMESTER
NIL			

COURSE OBJECTIVES:

1	This course helps the students to understand environmental issues with conventional fuels, the new methodologies/technologies for the effective utilization of renewable energy sources. They will be conversant with the characteristics of solar PV and wind power sources. Also, they will have an in-depth understanding of electronic conversion systems application to renewable energy generation systems and the synchronization with smart grid systems. The courses equip the students to pursue further specialized areas of study such as renewable energy and green consumer electronics, industrial control systems and smart grid, and renewable energy systems which are essentially based on this course.

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
ECT468.1	Understand the need, importance and scope of various Non-Conventional sources of energy													
	2						2					1		
	UNDERSTAND													
ECT468.2	Outline the concepts and technologies related to renewable energy systems using wind and Solar-PV													
	2												2	1
	UNDERSTAND													
ECT468.3	Understand the integration of smart grid with renewable energy systems													
	2		2										2	2
	UNDERSTAND													
ECT468.4	Explain the concept of distribution management system.													
	2													2

ECT468.5	UNDERSTAND												
	Describe the fundamentals of Smart metering												
	3												1
	APPLY												
MAPPING AVERAGE	2.2		1.0				2.0				1.0	2.0	1.5

JUSTIFICATION FOR CO-PO/PSO MAPPING:

CO	PO/PSO	MAPPING LEVEL	JUSTIFICATION
MCN401.1	PO1	2	Enables students to apply fundamental scientific principles to analyze the efficiency and feasibility of various non-conventional energy systems.
	PO7	2	Develops awareness of environmental sustainability through the study of clean and renewable energy alternatives.
	PO12	1	Encourages lifelong learning by motivating students to explore emerging renewable technologies and evolving global energy trends.
MCN401.2	PO2	2	Applies fundamental engineering knowledge to understand the operating principles of wind and solar-PV technologies.
	PSO1	2	Develops the ability to identify, analyze, and interpret technical aspects of renewable energy systems for effective problem solving.
	PSO2	1	Utilizes discipline-specific competencies to examine wind and solar-PV systems relevant to professional engineering practice.
MCN401.3	PO1	2	Applies core engineering principles to understand the technical functioning and interoperability of smart grids with renewable sources.
	PO3	1	Enhances the ability to design and evaluate integrated smart grid solutions that efficiently accommodate renewable energy inputs.
	PSO1	2	Utilizes domain-specific knowledge to analyze renewable energy technologies and their role in modern smart grid architectures.

	PSO2	2	Demonstrates competency in assessing real-time monitoring, control, and communication aspects involved in smart grid–renewable energy integration.
MCN401.4	PO1	2	Applies fundamental engineering principles to understand the operational functions and analytical tools used in a Distribution Management System.
	PSO2	2	Demonstrates the ability to assess modern automation, control, and monitoring technologies essential for efficient distribution system management.
MCN401.5	PO1	3	Utilizes basic engineering principles to understand the measurement, communication, and data acquisition concepts in smart metering.
	PSO2	1	Demonstrates capability in analyzing advanced metering technologies and their role in real-time monitoring and efficient energy management.

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	Insufficient practical exposure to industry-grade renewable energy tools, system design software, SCADA-based monitoring, and field-level operation of Solar-PV and Wind systems.	Case studies on MPPT implementation, inverter control, and grid-integration issues.	PO1,PO2,PO3,PO7, PO12,PSO1,PSO2

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://onlinecourses.nptel.ac.in/noc23_ee60/preview?
2	https://nptel.ac.in/courses/113104084?
3	https://nptel.ac.in/courses/101104546?
4	https://onlinecourses.nptel.ac.in/noc23_ee60/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

ECT468.1	S1,A1,T1	8	1 HOUR
ECT468.2	S1,S2,S3,A2,A3,T2,	25	1 HOUR
ECT468.3	S3,A3,T3	5	1 HOUR
ECT468.4	S3,A3,T4	2	1 HOUR
ECT468.5	S3,A3,T5	2	1 HOUR
	TOTAL HOURS OF INSTRUCTION	48	

Prepared by
Athira V

Approved by
HOD

ECT 404

COMPREHENSIVE COURSE VIVA

COURSE INFORMATION SHEET

PROGRAMME: ECE (UG)	DEGREE: BTECH
COURSE: COMPREHENSIVE COURSE VIVA	SEMESTER: S8 L-T-P-CREDITS: 0:0:1:1
COURSE CODE: ECT404 REGULATION:2019	COURSE TYPE: VIVA
COURSE AREA/DOMAIN: ELECTRONICS AND COMMUNICATION ENGINEEERING	CONTACT HOURS:2 PERIODS/WEEK
CORRESPONDING LAB COURSE CODE (IF ANY): NIL	LAB COURSE NAME: NIL

SYLLABUS

DETAILS	HOURS
Phase 1 Target ● Literature study/survey of published literature on the assigned topic ● Formulation of objectives ● Formulation of hypothesis/ design/ methodology ● Formulation of work plan and task allocation. ● Block level design documentation ● Seeking project funds from various agencies ● Preliminary analysis/ Modeling / Simulation/ Experiment/ Design/ Feasibility study ● Preparation of Phase 1 report	

COURSE OBJECTIVES:

- The objective of this Course viva is to ensure the basic knowledge of each student in the most fundamental core courses in the curriculum.
- The viva voce shall be conducted based on the core subjects studied from third to eighth semester.
- This course helps the learner to become competent in placement tests and other competitive examinations.

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
ECT404.1	Explain digital systems, compare different logic families and how they're made, and describe the VLSI design process for creating logic circuits.													
	3	2	3		2						2	3	3	2
	UNDERSTAND													
ECT404.2	Use circuit theorems and solid-state physics to explain how to design and analyze analog circuits and op-amp circuits for specific uses.													
	3	3	3	2	2							3	3	2
	UNDERSTAND													
ECT404.3	Combine ideas from signals, systems, DSP, control, and coding to describe how to design and analyze reliable communication and control systems													
	3	2	3	3	2	1					1	3	3	3
	UNDERSTAND													
ECT404.4	Summarize the basics of electromagnetic fields, explain how antennas work, and discuss how to design and analyze them for different applications.													
	3	2	3	2	2							3	3	3
	UNDERSTAND													
ECT404.5	Explain the fundamentals of communication systems and describe how to use techniques like modulation, coding, and receiver design to create reliable analog and digital communication systems.													
	3	2	3	3	2	1					1	3	3	3
	UNDERSTAND													
MAPPING AVERAGE	**3**	**2.2**	**3**	**2.5**	**2**	**1**					**1.33**	**3**	**3**	**2.6**

JUSTIFICATION FOR CO-PO/PSO MAPPING:

CO	PO/ PSO	MAPPING LEVEL	JUSTIFICATION
ECT404.1 Explain digital systems, compare different logic families and how they're made, and describe the VLSI design process for creating logic circuits.	PO1	3	Involves fundamentals of digital electronics, logic families, and VLSI basics.
	PO2	2	Requires comparing logic families
	PO3	3	VLSI design flow and logic circuit creation directly map to design processes.
	PO5	2	Study of VLSI involves modern design tools
	PO11	2	VLSI design process helps students plan and manage the stages, resources, and cost involved in digital system design
	PO12	3	Knowledge of VLSI and logic families demands continuous updating with evolving technologies.
	PSO1	3	Understand digital systems helps design and model circuits.
	PSO2	2	Knowledge of logic families helps choose right digital technology.
ECT404.2 Use circuit theorems and solid-state physics to explain how to design and analyze analog circuits and op-amp circuits for specific uses.	PO1	3	Use of analog fundamentals, solid-state concepts
	PO2	3	Analytical problem-solving for circuit theorems and op-amps.
	PO3	3	Circuit design and performance evaluation directly relate to PO3.
	PO4	2	Requires verification of circuit behaviour and analysis.
	PO5	2	Exposure to simulation tools
	PO12	3	Analog domain constantly evolving—requires continuous learning.
	PSO1	3	Analog and op-amp circuits directly used in designing and testing systems.
	PS02	2	Analog concepts help pick suitable circuits for communication use.
ECT404.3 Combine ideas	PO1	3	Requires multi-domain engineering knowledge

	PO2	2	Analytical mid-level reasoning is required.
from signals, systems, DSP, control, and coding to describe how to design and analyze reliable communication and control systems	PO3	3	Connection to system-level design and integration.
	PO4	3	Investigation and analysis of system behaviour
	PO5	2	Involves tools like MATLAB.
	PO6	1	Reliability/communication systems slightly involves ethical responsibility.
	PO11	1	designing and analyzing communication and control systems requires planning, coordinating multiple subsystems, and managing the overall system development process
	PO12	3	Need for lifelong learning due to rapid technology changes.
	PSO1	3	Signal, DSP, and control ideas used to model and test systems.
	PSO2	3	Helps choose correct DSP/coding methods for communication.
ECT404.4 Summarize the basics of electromagnetic fields, explain how antennas work, and discuss how to design and analyze them for different applications.	PO1	3	Requires knowledge of EM theory, field equations, antenna parameters.
	PO2	2	Involves solving basic EM/antenna problems.
	PO3	3	Antenna design concepts directly address PO3.
	PO4	2	Involves analyzing antenna behaviour and characteristics.
	P05	2	EM simulation tools (HFSS) conceptually linked.
	PO12	3	RF/antenna field rapidly evolving—requires continuous learning.
	PSO1	3	Antenna and EM basics → used in designing and analysing RF systems.
	PSO2	3	Antennas and EM → essential technologies in communication systems.
ECT404.5 Explain the fundamentals of communication systems and	PO1	3	Theoretical foundations of analog & digital communication.
	PO2	2	Medium level analytical problem solving

describe how to use techniques like modulation, coding, and receiver design to create reliable analog and digital communication systems.	PO3	3	Receiver/modulator design aligns with system design
	PO4	3	Evaluating communication system performance involves investigation skills.
	PO5	2	Tools like MATLAB conceptually used.
	PO6	1	Ethical issues in communication process.
	PO11	1	communication systems using modulation, coding, and receiver design involves planning, organizing design steps, and managing system-level implementation
	PO12	3	Rapidly evolving communication technologies require lifelong learning.
	PSO1	3	Modulation and receiver concepts → help model and evaluate circuits.
	PSO2	3	Helps select proper communication techniques for modern systems.

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
ECT404.1	VIVA		
ECT404.2	VIVA		
ECT404.3	VIVA		
ECT404.4	VIVA		
ECT404.5	VIVA		
	TOTAL HOURS OF INSTRUCTION		

Prepared by

Nithin C

Approved by HOD

ECD 416

PROJECT PHASE 2

COURSE INFORMATION SHEET

PROGRAMME: ECE (UG)	**DEGREE**: BTECH
COURSE: PROJECT PHASE 2	**SEMESTER: S8** **L-T-P-CREDITS**: 0:0:12:4
COURSE CODE: ECD416 **REGULATION**:2019	**COURSE TYPE**: PROJECT
COURSE AREA/DOMAIN: ELECTRONICS AND COMMUNICATION ENGINEEERING	**CONTACT HOURS**:12 PERIODS/WEEK
CORRESPONDING LAB COURSE CODE (IF ANY): NIL	**LAB COURSE NAME**: NIL

SYLLABUS

DETAILS
Phase 1 Target ● In depth study of the topic assigned in the light of the report prepared under Phase - I; ● Review and finalization of the approach to the problem relating to the assigned topic. ● Preparing a detailed action plan for conducting the investigation, including teamwork. ● Detailed Analysis/ Modeling / Simulation/ Design/ Problem Solving/Experiment as needed. ● Final development of product/ process, testing, results, conclusions and future directions. ● Preparing a paper for Conference Presentation/ Publication in Journals, if possible. ● Presenting projects in Project Expos conducted by the University at the cluster level and/ or state level as well as others conducted in India and abroad. ● Filing Intellectual Property Rights (IPR) if applicable. ● Preparing a report in the standard format for being evaluated by the Department Assessment Board. ● Final project presentation and viva voce by the assessment board including the external expert.

COURSE OBJECTIVES:

1	- To apply engineering knowledge in practical problem solving. - To foster innovation in design of products, processes or systems. - To develop creative thinking in finding viable solutions to engineering problems.

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
ECD416.1	Model and solve real world problems by applying knowledge across domains													
	2	2	2	1	2	2	2	1	1	1	1	2	3	3
	APPLY													
ECD416.2	Develop products, processes or technologies for sustainable and socially relevant applications													
	2	2	2		1	3	3	1	1		1	1	3	3
	APPLY													
ECD416.3	Function effectively as an individual and as a leader in diverse teams and to comprehend and execute designated tasks													
									3	2	2	1	3	3
	APPLY													
ECD416.4	Plan and execute tasks utilizing available resources within timelines, following ethical and professional norms													
					2			3	2	2	3	2	3	3
	APPLY													
ECD416.5	Identify technology/research gaps and propose innovative/creative solutions													
	2	3	3	1	2							1	3	3
	ANALYZE													
ECD416.6	Organize and communicate technical and scientific findings effectively in written and oral forms													
					2			2	2	3	1	1	3	3
	APPLY													
MAPPING AVERAGE	**2**	**2.33**	**2.33**	**1**	**1.80**	**2.50**	**2.50**	**1.75**	**1.8**	**2**	**1.6**	**1.33**	**3**	**3**

JUSTIFICATION FOR CO-PO/PSO MAPPING:

CO	PO/ PSO	MAPPING LEVEL	JUSTIFICATION
ECD416.1 Model and solve real world problems by applying knowledge across domains	PO1	2	Requires application of basic engineering science and mathematics to understand real-world system behaviour.
	PO2	2	Involves identifying and analysing practical problems to propose feasible engineering solutions.
	PO3	2	Need to apply engineering principles to develop and evaluate solutions across domains.
	PO4	1	Requires basic ability to conduct literature survey and refer existing solutions.
	PO5	2	Utilizes modern engineering tools/software for modelling and simulating real-world problems.
	PO6	2	Considers societal relevance while solving real-world problems.
	PO7	2	Addresses sustainability and environmental impact while proposing solutions.
	PO8	1	Requires awareness of professional and ethical responsibilities.
	PO9	1	Minor teamwork elements while analyzing multidisciplinary problems.
	PO10	1	Communicating problem definition and solution approach.
	PO11	1	Exposure to basic project-level constraints while analyzing problems.
	PO12	2	Need lifelong learning to solve emerging real-world engineering problems.

	PSO1	3	Solving real-world problems requires defining, modelling, and verifying electronic/signal-processing systems, directly contributing to PSO1.
	PSO2	3	Problem-solving includes selecting suitable communication technologies for real-world applications.
ECD416.2 Develop products, processes or technologies for sustainable and socially relevant applications	PO1	2	Applies foundation knowledge of science/engineering to create feasible solutions.
	PO2	2	Requires analysis of user needs and constraints before designing solutions.
	PO3	2	Aligned with designing sustainable, technically sound systems and processes.
	PO5	1	Requires engineering tools, simulation software, modelling platforms for solution development.
	PO6	3	Considers societal relevance while developing products.
	PO7	3	Directly connected to sustainable engineering and environmental responsibility.
	PO8	1	Requires adherence to ethical norms in solution development.
	PO9	1	Minor teamwork elements in framing socially relevant solutions.
	PO11	1	Applies project-level management constraints in designing solutions.
	PO12	1	Requires continuous learning about sustainable technologies.
	PSO1	3	Students design, implement and test functional electronic circuits/systems as part of solution development.
	PS02	3	Designing solutions requires choosing appropriate communication architectures, standards, and technologies.

ECD416.3 Function effectively as an individual and as a leader in diverse teams and to comprehend and execute designated tasks	PO9	3	Strongly mapped—focuses on teamwork, coordination, and leadership.
	PO10	2	Requires effective communication with teams and stakeholders.
	PO11	2	Involves task planning, scheduling, and resource management.
	PO12	1	Continuous learning for effective team functioning and leadership skills.
	PSO1	3	Effective team execution involves end-to-end system development—designing, modelling, implementing and testing electronic/signal-processing circuits.
	PSO2	3	Team-based engineering tasks often require evaluating, comparing and selecting communication technologies
ECD416.4 Plan and execute tasks utilizing available resources within timelines, following ethical and professional norms	PO5	3	Uses modern tools/software for planning/scheduling tasks.
	PO8	3	Ethics and professionalism are essential while meeting deadlines.
	PO9	2	Directly related to team coordination and task execution
	PO10	2	Requires communication of plans, schedules, and progress
	P011	3	Strongly aligned with project management and resource allocation.
	PO12	2	Reinforces continuous learning to execute tasks efficiently.
	PSO1	3	Systematic planning and execution is essential for complete cycle of circuit/system definition, modelling, implementation and testing.
	PSO2	3	Projects involving communication systems demand selecting correct protocols, hardware and tools

ECD416.5 Identify technology/research gaps and propose innovative/creative solutions	PO1	2	Uses engineering fundamentals to identify technological gaps.
	PO2	3	Requires strong analytical skills to interpret problem gaps.
	PO3	3	Innovation requires application of design principles and engineering judgement.
	PO4	1	Directly aligned with investigation, experimentation, and research analysis.
	PO5	2	Requires modelling, simulation, and analysis using engineering tools.
	PO12	1	Involves lifelong learning and research orientation.
	PSO1	3	Identifying gaps drives the design, modelling and testing of new/improved electronic/signal-processing circuits
	PSO2	3	Innovative communication solutions require identifying shortcomings and selecting suitable modern communication technologies
ECD416.6 Organize and communicate technical and scientific findings effectively in written and oral forms	PO5	2	Uses tools/software for preparing reports and presentations
	PO8	2	Ethical communication of data and results.
	PO9	2	Communication essential during team interactions
	PO10	3	Strongly mapped – strong emphasis on technical communication (oral & written).
	PO11	1	Minor project-related documentation skills
	PO12	1	Continuous improvement of communication skills through learning.
	PSO1	3	Documenting and presenting analysis, design and test results of electronic/signal-processing systems directly contributes to PSO1
	PSO2	3	Documentation and presentation of communication system analysis/design inherently involve justification of technology selection

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
ECD416.1	IE-2,FE		
ECD416.2	EG,FE		
ECD416.3	IE-1, IE-2, EG		
ECD416.4	IE1		
ECD416.5	EG, IE-1, IE-2, FE		
ECD416.6	IE-1, IE-2, FE, EG, REPORT		
		TOTAL HOURS OF INSTRUCTION	

*IE-INTERIM EVALUATION

*FE- FINAL EVALUATION

*EG-EVALUATION BY GUIDE

Prepared by   **Approved by HOD**

Nithin C