SEMESTER 8

ELECTRONICS & COMMUNICATION ENGINEERING

SEMESTER S8

WIRELESS SENSOR NETWORKS

Course Code	PEECT861	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. The course aims to expose students to computer networks taking a top-down approach of viewing from the layer of user applications and zooming into link layer protocols.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction, application, and challenges of wireless sensor networks (WSN). **Wireless LANS and PANS:** Introduction, Fundamentals of WLANs, IEEE 802.11 standard, HIPERLAN standard, Bluetooth**,** **Wireless WANs and MANs :** Cellular architecture, 2G/3G/4G/5G Cellular Networks, WLL**, IEEE 802.15 Standard:** Physical layer, Data link layer, MAC protocols **Wireless Internet**	**9**
2	Network architecture: Sensor network scenarios, Optimization goals and figures of merit, Design principles of WSNs, Service interfaces of WSNs. Communication Protocols: Physical layer: Wireless channel and communication fundamentals, Physical layer and transceiver design considerations in WSNs.	**9**

3	Mobile ad hoc networks and wireless sensor networks, Field buses and wireless sensor networks, Enabling technologies for wireless sensor networks. Mobile IP, TCP in wireless domain, TCP-BUS and Ad Hoc TCP, Split TCP, WAP, optimising Web over wireless.	**9**
4	WSN architecture: Single node architecture: Hardware components, Energy consumption of sensor nodes, Low power wireless sensor networks, Routing protocols-LEACH, PEGASIS and RPL, Operating systems and execution environments, Case Study: TinyOS and nesC 50 Other examples.	**9**

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

Continuous Internal Evaluation Marks (CIE):

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

End Semester Examination Marks (ESE)

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

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

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the principles of wireless networks concepts and their standards.	**K2**
CO2	Illustrate various concepts on the basics of wireless sensor networks and mobile adhoc networks.	**K2**
CO3	Develop single node wireless sensor architecture	**K3**
CO4	Analyse the network architecture and the communication protocols of wireless sensor networks	**K4**

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

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

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	2	2	2	-	-	-	-	-	-	2
CO2	3	2	2	2	2	-	-	-	-	-	-	2
CO3	3	2	2	2	2	-	-	-	-	-		2
CO4	3	2	2	2	2	-	-	-	-	-	-	2

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Ad Hoc Wireless Networks: Architectures and Protocols	Siva Ram Murthy C. and Manoj B. S.	Pearson Education	2nd Edition, 2017
2	Protocols And Architectures for Wireless Sensor Networks	Holger Karl & Andreas Willig	John Wiley	2nd Edition, 2017

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Wireless Communications and Networks	William Stallings	Prentice Hall	2nd Edition, 2017
2	Fundamentals of Wireless Sensor Networks - Theory and Practice	Waltenegus Dargie , Christian Poellabauer	John Wiley & Sons Publications	2nd Edition, 2019

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/106105160
2	https://nptel.ac.in/courses/106105160
3	https://nptel.ac.in/courses/106105160
4	https://nptel.ac.in/courses/106105160

SEMESTER S8

RF ENGINEERING

Course Code	PEECT862	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	Microwaves &Antennas	Course Type	Theory

Course Objectives:

1. To learn the analysis, design and simulation of Radio Frequency (RF) Circuits and Components for wireless communication systems.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	RF circuit introduction - Importance of radio frequency design, RF behaviour of resistors inductors and capacitors Planar Transmission Lines – Micro strip lines and Strip lines – Constructional Features Impedance Matching Networks-Design of Matching Circuits using Lumped Elements, Single Stub tuning, Quarter-Wave Transformers, Multi-Section Transformer – Binomial Transformer	9
2	RF Filter Design- Filter Design using insertion loss technique –Active RF components- Bipolar Junction Transistor – Construction-Functionality-Power Frequency Limitations of High Frequency transistors. GaAs devices - Familiarization of RF Field Effect Transistors and High Electron Mobility Transistors–Constructional details RF circuit measurements and characterization- Using Vector Network analyser – S parameter, Reflection Coefficient and Insertion Loss Measurement Modelling and Simulation of RF circuits using – Open source or Commercial EM Simulation Software	11
3	Amplifier design using S-parameters - Characteristics of Amplifier Power Relations, Stability Considerations – Stability Circles, Tests for	8

	Unconditional Stability High frequency amplifier design – Single stage amplifier Design – Design for maximum gain, Low noise amplifier design	
4	Basic oscillator model -Feedback oscillator design—Negative Resistance Oscillator- Dielectric Resonator Oscillator - YIG Tuned Oscillator Mixer - Basic characteristics – Single-Ended Mixer Design, Single-balanced and double-balanced mixers	**8**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

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

End Semester Examination Marks (ESE)

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

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

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the basic idea about RF networks and working of RF filter circuits	**K2**
CO2	Describe the behaviour of RF components and application of Network analyser in parameter measurement	**K2**
CO3	Apply the principle of RF networks in the designing of RF amplifiers,	**K3**
CO4	Apply the principle of RF networks in the designing RF Oscillators and Mixers	**K3**

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

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

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

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	RF Circuit Design: Theory & Applications	Ludwig, Reinhold	Pearson Education India	2/e., 2000.
2	Microwave and RF design of wireless systems	Pozar, David M.	John Wiley & Sons	2/e, 2011

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Advanced RF & microwave circuit design: the ultimate guide to superior design.	Radmanesh, Matthew M	Author House,	2/e, 2017
2	Secrets of RF circuit design	Carr, Joseph J.	McGraw-Hill Education.	2/e, 2001
3	Radio-frequency and microwave communication circuits: analysis and design.	Misra, Devendra K	John Wiley & Sons,	2/e, 2019
4	Radio Frequency & Microwave Electronics	Mathew M. Radmanesh	Pearson Education Asia,	2nd Edition, 2017
5	RF/microwave circuit design for wireless applications.	Rohde, Ulrich L., and David P. Newkirk	John Wiley & Sons,	2nd Edition, 2017
6	Radio frequency circuit design.	Davis, W. Alan, and Krishna Kumar Agarwal.	John Wiley,	2nd Edition, 2017
7	RF Circuit Design.	Christopher, Bowick, Ajluni Cheryl, and Blyler John.	Newnes,	2nd Edition, 2015
8	Design of RF and microwave amplifiers and oscillators.	Abrie, Pieter LD.	Artech House	2nd Edition, 2019

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc23_ee36/preview
2	https://archive.nptel.ac.in/courses/108/105/108105189/
3	https://archive.nptel.ac.in/courses/117/102/117102012/

SEMESTER S8

RENEWABLE ENERGY SYSTEMS

Course Code	PEECT 863	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. To develop in-depth knowledge for the various renewable energy resources available at a location and assessments of its potential, using tools and techniques.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Renewable Energy (RE)Sources: World energy scenario, Over view 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.	9
2	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.	9
3	Wind Energy: Sources and potentials, 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 energy: Fixed speed with capacitor bank,	9

	Rotor resistance control, SCIG and DFIG, Synchronous Generator-external magnetized, Synchronous Generator-permanent magnets.	
4	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. Introduction to grid connectivity of RE systems, smart grid and emerging technologies, operating principles and models of smart gird components.	**9**

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

Continuous Internal Evaluation Marks (CIE):

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

End Semester Examination Marks (ESE)

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

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

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the need, importance and scope of various Non-Conventional sources of energy	**K2**
CO2	Outline the concepts and technologies related to renewable energy systems using wind and Solar-PV	**K2**
CO3	Illustrate the integration of smart grid with renewable energy systems	**K3**
CO4	Explain the concept of distribution management system.	**K2**

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

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

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

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Solar Energy: Principles of Thermal Collection and Storage	Nayak J. K. and Sukhatme S. P.	Tata McGraw Hill	3/e. 2008
2	Power Electronics: Circuits, Devices and Applications	Muhannad H. R.	Pearson Prentice Hall	4/e, 2017
3	Smart Grid Technology and Applications	Nick Jenkins, Janaka Ekanayake [et al.]	Wiley India Ltd	1/e, 2015
4	Design of Smart Power Grid Renewable Energy Systems	Ali Keyhani	Wiley-IEEE Press	1/e, 2016

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Handbook of renewable energy technology	Ahmed F Zobaa and Ramesh Bansal	World Scientific	1/e, 2011
2	Solar Energy: Fundamental and Application	Garg H. P. and Prakash S.	Tata McGraw Hill	2/e, 2015
3	The Smart Grid: Enabling Energy Efficiency and Demand Response	Gellings C. W.	CRC Press	1/e, 2009
4	Grid Converters for Photovoltaic and wind Power Systems,	Teodorescu R. Liserre M. Rodriguez P.	Wiley – IEEE press	1/e, 2011

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc21_ph33/preview
2	https://nptel.ac.in/courses/103103206
3	https://onlinecourses.nptel.ac.in/noc22_ch27/preview

SEMESTER S8

CYBER SECURITY

Course Code	PEECT864	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To understand the fundamental concepts of cybersecurity, including various types of cyber threats and attacks.
2. To learn and apply basic security measures, mechanisms, and best practices to protect systems and data from threats

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction**: **Security basics** – Aspects of network security – Attacks – Different types – Hackers – Crackers – Common intrusion techniques –Trojan Horse, Virus, Worm. **Security threats** - Sources of security threats- Motives - Target Assets and vulnerabilities – Consequences of threats- E-mail threats - Web-threats - Intruders and Hackers, Insider threats, Cybercrimes.	9
2	Security services and mechanisms, OS **Security** – Protection Mechanisms –Authentication & Access control – Discretionary and Mandatory access control **Firewall**- Need for firewall, Characteristics, Types of firewall, Firewall Basing, **Intrusion Detection System**- Types, Goals of IDS, IDS strengths and Limitations.	9

3	**Cryptography**: **Basic Encryption & Decryption** – Transposition & substitution ciphers – Caesar substitution – Polyalphabetic substitutions – Crypt analysis – **Symmetric key algorithms** – Feistel Networks – Confusion – Diffusion – DES Algorithm – Strength of DES – Comparison & important features of modern symmetric key algorithms – **Public key cryptosystems** – The RSA Algorithm – Diffie Hellman key exchange – comparison of RSA & DES – Message Authentication & Hash functions – Digital signature	**9**
4	**Introduction to Cyber Crime and law:** Cyber Crimes, Types of Cybercrime, Hacking, Attack vectors, Cyberspace and Criminal Behaviour, Clarification of Terms, Traditional Problems Associated with Computer Crime, Introduction to Incident Response, Digital Forensics, Computer Language, Network Language, Realms of the Cyber world, A Brief History of the Internet, Recognizing and Defining Computer Crime, Contemporary Crimes, Comp. as Targets, Contaminants and Destruction of Data, Indian IT ACT 2000.	**9**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

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

End Semester Examination Marks (ESE)

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

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

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the basics of network security, including different types of attacks, common intrusion techniques, and various security threats, including those posed by hackers, crackers, and cybercriminals.	**K2**
CO2	Identify and explain various security services and mechanisms, including OS security, authentication and access control, firewall types and characteristics, and intrusion detection systems	**K2**
CO3	Describe cryptography principles, including encryption, ciphers, symmetric and public key algorithms, RSA, Diffie Hellman, authentication, hash functions, and digital signatures.	**K2**
CO4	Illustrate cybercrime and related laws, including types, attack vectors, incident response, digital forensics, and the Indian IT Act 2000.	**K2**

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

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

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

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Computer Network Security	Joseph M Kizza	Springer Verlag	2/e, 2013
2	Cryptography and Network Security Principles and Practice	William Stallings	Pearson Education Asia	10/e, 2022
3	Network Security Essentials	William Stallings	Pearson Education	6/e, 2022
4	Fundamentals of Network Security	Eric Maiwald	Tata McGraw-Hill	2/e, 2012

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Anti-Hacker Tool Kit	Mike Shema	Mc Graw Hill	4/e, 2018
2	Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives	Nina Godbole and Sunit Belpure	Wiley	2/e, 2019
2	Mark Stamp's Information Security Principles and Practice	Deven N. Shah	Wiley	4/e, 2021

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	Introduction to Cyber Security, by Dr. Jeetendra Pande, Uttarakhand Open University, Haldwani:-https://onlinecourses.swayam2.ac.in/nou19_cs08/preview
2	Firewalls and Intrusion Detection Systems on Computer - Cryptography and Network Security by Prof. D. Mukhopadhyay, Department of Computer Science and Engineering, IIT Kharagpur
3	Cryptography and Network Security, by Prof. Sourav Mukhopadhyay, IIT Kharagpur:- https://onlinecourses.nptel.ac.in/noc22_cs90/preview
4	https://www.meity.gov.in/writereaddata/files/itbill2000.pdf https://www.meity.gov.in/writereaddata/files/it_amendment_act2008%20%281%29_0.pdf

SEMESTER S8

LOW POWER VLSI

Course Code	PEECT866	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To impart knowledge on different sources of power dissipation, power minimization techniques, switched capacitance minimization and working principle of adiabatic logic circuits

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Physics of Power dissipation in MOSFET devices** Need for low power circuit design, MIS Structure **Deep submicron transistor design issues: Short channel effects** Channel Length Modulation , Surface scattering, Punch through, Velocity saturation, Impact ionization, Hot electron effects, Body Effect, Narrow width effect, V_{th} roll-off, Drain Induced Barrier Lowering, Gate Induced drain leakage, Tunneling Through Gate Oxide, Subthreshold Leakage Current, **Emerging Technologies for Low Power:** Hi-K Gate Dielectric, Lightly Doped Drain–Source, Silicon on Insulator,	9
2	**Sources of power dissipation in digital ICs** – **Dynamic Power Dissipation:** Short Circuit Power: Short Circuit Current of Inverter , Short circuit current dependency on input rise and fall time, Variation of shortcircuit current with load capacitance. Switching power dissipation: Switching Power of CMOS Inverter, Switching activity and its effects. Glitching Power: Glitches and its effect on power dissipation	9

	Static Power Dissipation: Sources of Leakage Power, Effects of V_{dd} and V_t on speed, Constraints on V_t Reduction.	
3	**Low-Power Design Approaches-** **Supply Voltage Scaling for Low Power:** Effect of Supply voltage on Delay and Power Effect of Supply voltage on Static and Dynamic Power Multi VDD ,Dynamic VDD, Dynamic Voltage and Frequency Scaling (DVFS) Approaches. Architectural Level Approaches: Pipelining and Parallel Processing **Leakage power reduction Techniques:** Effect of threshold voltage on Leakage Power Transistor stacking, MTCMOS, VTCMOS Power gating& Clock gating Techniques.	**9**
4	**Circuit Design Styles for Low Power-** **Non clocked circuit design style:** Fully Complementary logic. NMOS and Pseudo –NMOS logic, Differential Cascode Voltage Switch logic(DCVS) **Clocked design style:** Basic concept, Dynamic Logic, Domino logic, Differential Current Switch Logic. **Adiabatic switching** – Adiabatic charging, Adiabatic amplification, Adiabatic logic gates, Pulsed power supplies.	**9**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

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

End Semester Examination Marks (ESE)

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

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

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Describe the impact of technology scaling on power dissipation in digital ICs and various short channel effects	**K2**
CO2	Discuss the different sources of power dissipation in digital ICs.	**K2**
CO3	Describe the various approaches for power management in digital ICs.	**K2**
CO4	Apply various clocked and non-clocked design styles for logic implementation	**K3**
CO5	Describe the use of Adiabatic switching for power management in digital ICs.	**K2**

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

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**											**2**
CO2	**3**											**2**
CO3	**3**			**2**								**2**
CO4	**3**	**2**	**3**		**3**							**2**
CO5	**3**											**2**

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Design of Analog CMOS Integrated Circuits	Behzad Razavi	McGraw-Hill	2/e, 2002
2	CMOS: Circuits Design, Layout and Simulation,	Baker, Li, Boyce,	Prentice Hall India,	4/e, 2015
3	Microelectronic Circuits	Sedra & Smith	Oxford University Press	8/e,2020

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	CMOS Analog Circuit Design,	Phillip E. Allen, Douglas R. Holbery	Oxford University Press	3/e, 2018
2	Fundamentals of Microelectronics	Behzad Razavi	Wiley student Edition	2/e, 2018
3	Analysis and Design of Analog Integrated Circuits	Meyer Gray, Hurst, Lewis	Wiley	6/e, 2020

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	www.youtube.com/@b_razavi, www.youtube.com/@analogicdesign-iitm5234
2	www.youtube.com/@b_razavi, www.youtube.com/@analogicdesign-iitm5234
3	www.youtube.com/@b_razavi, www.youtube.com/@analogicdesign-iitm5234
4	Switching Circuits and Logic Design by Prof. Indranil Sengupta Lectures 47-51

SEMESTER S8

BLOCK CHAIN

Course Code	PEECT867	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To create awareness and understanding among students on the foundation of block chain technology

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Blockchain – Definition, architecture, elements of blockchain, benefits and limitations, types of blockchain. Consensus – definition, types, consensus in blockchain. Decentralization – Decentralization using blockchain, Methods of decentralization, Routes to decentralization, Blockchain and full ecosystem decentralization.	9
2	Consensus Algorithms, Crash fault-tolerance (CFT) algorithms – Paxos, Raft. Byzantine fault- tolerance (BFT) algorithms – Practical Byzantine Fault Tolerance (PBFT), Proof of work (PoW), Proof of stake (PoS), Types of PoS. Bitcoin – Definition, Cryptographic keys – Private keys, public keys, addresses. Transactions – Lifecycle, coinbase transactions, transaction validation. Blockchain – The genesis block. Mining – Tasks of miners, mining algorithm, hash rate. Wallets – Types of wallets.	9
3	Smart Contracts – Definition, Smart contract templates, Oracles, Types of oracles, Deploying smart contracts. Decentralization terminology –	9

	Decentralized applications, Decentralized Autonomous Organizations. Use cases of Blockchain technology – Government, Health care, Finance, Supply chain management. Blockchain and allied technologies – Blockchain and Cloud Computing, Blockchain and Artificial Intelligence.	
4	Ethereum – The Ethereum network. Components of the Ethereum ecosystem – Keys and addresses, Accounts, Transactions and messages. The Ethereum Virtual Machine, Blocks and blockchain. The Solidity language – The layout of a Solidity source code, Structure of a smart contract, variables, data types, control structures, events, inheritance, libraries, functions, error handling. Smart contracts Case study: Voting, Auction.	**9**

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

Continuous Internal Evaluation Marks (CIE):

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

End Semester Examination Marks (ESE)

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

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

Course Outcomes (COs)

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

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Explain the fundamental concepts of blockchain technology.	**K2**
CO2	Summarize the classification of consensus algorithms.	**K2**
CO3	Explain the concepts of first decentralized cryptocurrency bitcoin.	**K2**
CO4	Explain the use of smart contracts and its use cases.	**K2**
CO5	Develop simple applications using Solidity language on Ethereum platform	**K2**

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

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**				**3**							**2**
CO2	**3**				**3**							**2**
CO3	**3**		**3**	**3**	**3**	**2**		**2**				**2**
CO4	**3**		**3**	**3**	**3**	**2**		**2**				**2**
CO5	**3**		**3**	**3**	**3**	**2**		**2**				**2**

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Mastering Blockchain: A deep dive into distributed ledgers, consensus protocols, smart contracts, DApps, cryptocurrencies, Ethereum, and more,	Imran Bashir	Packt Publishing,	Third edition, 2020.

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Solidity Programming Essentials: A beginner's guide to build smart contracts for Ethereum and blockchain,.	Ritesh Modi,	Packt Publishing,	First edition, 2018
2	Blockchain Technology: Concepts and Applications,	Kumar Saurabh, Ashutosh Saxena,	Wiley Publications,	First Edition, 2020
3	Blockchain Technology, ,	Chandramouli Subramanian, Asha A George, et al	Universities Press (India) Pvt. Ltd	First edition, August 2020.
4	Mastering Blockchain: Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Applications,	Lorne Lantz, Daniel Cawrey	O'Reilly Media	First edition, 2020.
5	Mastering Ethereum: Building Smart Contracts and DApps,	Andreas M. Antonopoulos, Gavin Wood	O'Reilly Media	First edition, 2018

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc22_cs44/preview
2	https://onlinecourses.swayam2.ac.in/aic21_ge01/preview
3	https://archive.nptel.ac.in/courses/106/104/106104220/
4	https://onlinecourses.nptel.ac.in/noc20_cs01/preview

SEMESTER S8

ANTENNA THEORY AND WAVE PROPAGATION

Course Code	PEECT868	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	ELECTROMAGNETICS	Course Type	Theory

Course Objectives:

1. To gain a comprehensive knowledge about design and development of advanced antennas

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Antenna theory**: Radiation mechanism from an antenna, Current Distribution on a Thin Wire Antenna, Friis Transmission Equation and Radar Range Equation. Infinitesimal dipole, small dipole, Small circular loop antenna. Biconical antenna, Triangular sheet and Bow-tie antenna TravelingWave and Broadband Antennas, Fractal Antennas	9
2	**Microstrip antennas**: Radiation mechanism, Rectangular Patch and Circular Patch, Quality Factor, Bandwidth, and Efficiency, Input Impedance, Coupling, Circular Polarisation, Substrates for microstrip antennas **Antenna Measurements** Measurement of Antenna Range, Radiation Patterns, Gain and Directivity, Radiation Efficiency, Impedance, Current Polarization	9

3	**Reconfigurable antennas-types-** principles of frequency, polarisation and pattern reconfigurable antennas **Metamaterial based antennas-** Fundamentals of metamaterials, metasurface, SRR **Smart Antennas:** Introduction, Smart-Antenna Analogy Smart Antennas' Benefits and drawbacks, Antenna Beamforming ,Mobile Ad hoc Networks (MANETs)	**9**
4	**Radio Wave Propagation** 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.	**9**

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

Continuous Internal Evaluation Marks (CIE):

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

End Semester Examination Marks (ESE)

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

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

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Analyse the radiation mechanism of antennas	**K3**
CO2	Design and measure the parameters of a microstrip antenna	**K4**
CO3	Analyse and design advanced antennas	**K4**
CO4	Explain the different modes and parameters of radio wave propagation	**K2**

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

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

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

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Antenna Theory: Analysis and Design,	Constantine A. Balanis	Wiley	4th Edition, 2016
2	Microstrip Antenna Design Handbook	By Ramesh Garg ·	Artech	1/e, 2001
3	Antennas and radio Wave propagation	R.E.Collin	McGraw Hill	2/e, 2001
4	Metamaterials for Antenna Applications	Amit K. Singh, Mahesh P. Abegaonkar, Shiban Kishen Koul ·	CRC Press	2/e, 2021
5	Reconfigurable antennas	Suvadeep Choudhury	IoP Publishing	2/e, 2023

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Microwave Engineering,	David M. Pozar	Wiley India	4/e, 2012.
2	Antenna and Wave Propagation	Raju GSN	Pearson	1/e, 2009
3	Modern Antenna Design,	Thomas A. Milligan	IEEE PRESS, Wiley Inter science	2/e, 2005
4	Antennas for all applications	J D Kraus	Tata McGraw hill	3/e, 2002

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/108/101/108101092/
2	https://nptel.ac.in/courses/108101092
3	https://www.youtube.com/watch?v=TziHD1NDQ0I
4	https://archive.nptel.ac.in/courses/112/105/112105165/

SEMESTER S8

ANTENNA THEORY AND DESIGN

Course Code	PEECT865	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	5/3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	ELECTROMAGNETICS	Course Type	Theory

Course Objectives:

1. To gain a comprehensive knowledge about design and development of advanced antennas

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Antenna theory: Radiation mechanism from an antenna, Current Distribution on a Thin Wire Antenna, Friis Transmission Equation and Radar Range Equation. Retarded potential concept, Infinitesimal dipole, small dipole, Small circular loop antenna. Biconical antenna, Triangular sheet and Bow-tie antenna Traveling Wave and Broadband Antennas, Fractal Antennas Array antennas; Binomial array, Dolph Chebyshev array, Electronic Beam steering principle	11
2	Microstrip antennas: Radiation mechanism, Rectangular Patch and Circular Patch, Quality Factor, Bandwidth, and Efficiency, Input Impedance, Coupling, Circular Polarisation, Substrates for microstrip antennas, Feeding methods, Transmission line model Broad banding of microstrip antenna using stacked elements, compact circularly polarised antennas, Design of microstrip line (using software) Antenna Measurements Measurement of Antenna Range, Radiation Patterns, Gain and Directivity, Radiation Efficiency, Impedance, Current Polarization	11
3	Reconfigurable antennas-types- principles of frequency, polarisation and pattern reconfigurable antennas	11

	Metamaterial based antennas- Fundamentals of metamaterials, metasurface, SRR Smart Antennas: Introduction, Smart-Antenna Analogy Smart Antennas' Benefits and drawbacks, Antenna Beamforming, Mobile Ad hoc Networks (MANETs)	
4	Radio Wave Propagation Ground wave propagation, Plane earth reflection, Space wave and surface wave, Duct propagation, Spherical earth propagation, Tropospheric waves, Tropospheric scatter, Ionospheric propagation, Effects of earth's magnetic field, Critical frequency, Maximum usable Frequency, Virtual height.	**11**

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

Continuous Internal Evaluation Marks (CIE):

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

Criteria for Evaluation (Evaluate and Analyse): 20 marks

1. Familiarise design tools for a microstrip antenna; Design and simulate any one of the types of antennas mentioned in the syllabus. The parameters for evaluation are Gain, directivity, radiation efficiency, return loss, radiation patterns etc. (10 marks)
2. Using lithographic techniques and design tools, fabricate the actual prototype of the designed antenna. (5 marks)
3. Measure the performance parameters in terms of return loss gain and radiation pattern using the network analyser, anechoic chamber and associated equipment.(5 marks)

End Semester Examination Marks (ESE)

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

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

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Analyse the radiation mechanism of antennas	**K3**
CO2	Design and measure the parameters of a microstrip antenna	**K4**
CO3	Analyse and design advanced antennas	**K4**
CO4	Explain the different modes and parameters of radio wave propagation	**K2**

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

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

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

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Antenna Theory: Analysis and Design,	Constantine A. Balanis	Wiley	4th Edition, 2016
2	Microstrip Antenna Design Handbook	By Ramesh Garg ·	Artech	1/e, 2001
3	Antennas and radio Wave propagation	R.E. Collin	McGraw Hill	2/e, 2001
4	Metamaterials for Antenna Applications	Amit K. Singh, Mahesh P. Abegaonkar, Shiban Kishen Koul ·	CRC Press	2/e, 2021
5	Reconfigurable antennas	Suvadeep Choudhury	IoP Publishing	2/e, 2023

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Microwave Engineering,	David M. Pozar	Wiley India	4/e, 2012.
2	Antenna and Wave Propagation	Raju GSN	Pearson	1/e, 2009
3	Modern Antenna Design,	Thomas A. Milligan	IEEE PRESS, Wiley Inter science	2/e, 2005
4	Antennas for all applications	J D Kraus	Tata McGraw hill	3/e, 2002

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/108/101/108101092/
2	https://nptel.ac.in/courses/108101092
3	https://www.youtube.com/watch?v=TziHD1NDQ0I
4	https://archive.nptel.ac.in/courses/112/105/112105165/

SEMESTER S8

INTERNET OF THINGS

Course Code	OEECT 831	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. This course aims to introduce IoT fundamentals.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction to IoT technology:** Definitions of IoT, Characteristics of IoT devices – power, computational constraints, IoT Architectural view – Middleware based architecture, Service oriented architecture, M2M Communication and IoT, Typical application areas of IoT technology (case studies of at least four domains) - Energy management and Smart grid, IoT for Home, Cities, Environment monitoring, Agriculture, Supply chain and customer monitoring	9
2	**Components of IoT technology:** Identification/Addressing - Electronic Product Codes, RFID, ubiquitous code, IPv4, IPv6. Sensors and Actuators*. IoT Hardware**, IoT Software – overview of Operating systems, Firmware, Middle ware, Application software used in IoT. Connectivity for IoT devices – characteristics.	9
3	**Communication technologies for IoT :** Zigbee - key features, architecture, limitations, Bluetooth technology - bluetooth stack, piconet, scatternet, limitations, Bluetooth Low Energy (key features, architecture, limitations), Wifi (IEEE 802.11) technology – key features, limitations, Cellular	9

	technology – GSM, 3G, 4GLTE (overview), features, limitations, LoRa technology – features, LoRaWAN architecture, 6LoWPAN – features, protocol stack, Narrow Band (NB- IoT) – features, applications, Sigfox – features, applications	
4	**IoT Data Management :** Storage technologies for IoT hardware – Volatile, Non-volatile, Embedded (MTP/OTP), external flash (NAND/NOR), DRAM, eflash, UFS, eMMC (overview of technologies). Cloud and IoT, Cloud computing – architecture, advantages of cloud computing, Software as a Service (SaaS), Platform as a Service (PaaS), Infrastructure as a Service (IaaS). Case study of commercial cloud computing platforms like - Microsoft Azure IoT Suite, Google Cloud's IoT Platform, IBM Watson IoT Platform. IoT analytics	**9**

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

Continuous Internal Evaluation Marks (CIE):

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

End Semester Examination Marks (ESE)

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

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

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain in a concise manner the architecture of IoT	**K2**
CO2	Identify various hardware and software components used in IoT	**K3**
CO3	Discuss the various communication technologies and interfaces in IoT	**K2**
CO4	Describe the usage of modern technologies like cloud computing for data management in IoT	**K2**

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

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

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

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Internet of Things: Architecture and Design Principles	Rajkamal	McGraw Hill (India) Private Limited.	2nd edition, 2022
2	Internet of Things (A Hands-on- Approach)	Vijay Madisetti and Arshdeep Bahga	Orient Blackswan Private Limited - New Delhi	1st Edition, 2015

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Internet of things: A survey on enabling technologies, protocols, and applications	Al-Fuqaha	IEEE Communications Surveys & Tutorials	1/e, 2015
2	The Internet of Things	Samuel Greengard	The MIT Press Essential Knowledge series Paperback	1/e, 2015
3	The Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems	Ovidu Vermesan and Peter Friess	River Publishers	1/e, 2013
4	. Internet of Things - From Research and Innovation to Market Deployment	Peter Friess, Ovidiu Vermesan	River Publishers	1/e, 2014

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://youtu.be/WUYAjxnwjU4?si=s58W-NKMrEQMaJ8m https://youtu.be/BXDxYh1EV2w?si=8oFtQB9vycC_c-t2
2	https://youtu.be/z3VEZPwl5gA?si=tNuzG_By-KBU3ks_ https://youtu.be/SXz0XR68dwE?si=1tVN1g9FQcGp87li https://youtu.be/TvzgzO6xKrY?si=gYzJstW51MTNsgKj
3	https://youtu.be/qko-f1VDhCM?si=0tWM_OHS395ESV_w https://youtu.be/d9QfVpCG00Y?si=qeHk8tPg_torr2yX https://youtu.be/1zQ8wbBozqI?si=7vOSHMt8OT3nQINO
4	https://youtube.com/playlist?list=PLE7VH8RC_N3bpVn-e8QzOAHziEgmjQ2qE&si=rr5Fpuew5q9_Y4qg

SEMESTER S8

SATELLITE AND RADAR COMMUNICATION

Course Code	OEECT832	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To analyze operational principles of satellite communication systems
2. To apply radar techniques to detect and track targets

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Satellite orbit and orbital equations, Kepler‟s laws of planetary motion, locating satellite in the orbit, locating satellite with respect to earth, Look angle calculation, coverage angle and slant range, orbital perturbations, satellite launching, orbital effects in communication subsystem performance. Satellite subsystems, Attitude and orbit control system, Telemetry tracking command and monitoring, power system, communication subsystem, satellite antennas.	9
2	Satellite link design- Basic link analysis, Interference analysis, terrestrial interference, Intermodulation interference, inter-symbol interference and rain induced attenuation, uplink power control, system availability, system design for link without frequency reuse and system design for link with frequency reuse.	9
3	Basics of Radar: Introduction, Range, Radar Waveforms, Simple form of Radar Equation, Radar Block Diagram and Operation, Radar Frequencies and Applications, Prediction of Range Performance, Minimum Detectable	9

	Signal, Receiver Noise, Modified Radar Range Equation	
4	CW and Frequency Modulated Radar: Doppler Effect, CW Radar – Block Diagram, Applications of CW radar. FM-CW Radar: FM-CW Radar, Range and Doppler Measurement, Block Diagram and Characteristics (Approaching/ Receding Targets), FM-CW altimeter, Multiple Frequency CW Radar. MTI and Pulse Doppler Radar: Introduction, Principle. MTI versus Pulse Doppler Radar. Tracking Radar: various techniques of Tracking with Radar	**9**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

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

End Semester Examination Marks (ESE)

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

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

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Illustrate the principles of satellite communication	**K2**
CO2	Design and analysis of satellite link	**K3**
CO3	Illustrate Radar Fundamentals like Radar Equation and Applications.	**K2**
CO4	Compare various types of Radars and tracking techniques	**K2**

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

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

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

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Satellite Communications	Timothy Pratt, Jeremy Allnutt	Wiley	3rd Edition, 2021
2	Introduction to Radar Systems	Merrill I. Skolnik	Tata McGraw-Hill	2nd Edition, 2017

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Digital Satellite Communications	Tri, T.Ha,	McGraw-Hill Education	2nd Edition, 2017
2	Satellite Communications Systems Engineering	Pritchard,	Pearson Education	2nd Edition, 2006
3	Radar: Principles, Technology, Applications	Byron Edde	Pearson	1st Edition, 2004
4	Understanding Radar Systems	Simon Kinsley and Shaun Quegan	John Wiley& Sons	1st Edition 1999

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/117/105/117105131/
2	Same as above
3	https://archive.nptel.ac.in/courses/108/105/108105154/
4	Same as above