Maharshi Dayanand University, Rohtak

(A State University established under Haryana Act No. XXV of 1975)
(NAAC Accredited 'A+' Grade)

Scheme of Studies and Examination

B.Tech (Electronics and Communication Engineering)

Semester 7th and 8th

Modified Scheme effective from 2023-24

Course code and definitions:

Course Code	Definitions
L	Lecture
T	Tutorial
P	Practical
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management courses
PCC	Professional Core Courses
LC	Laboratory Courses
MC	Mandatory Courses
PT	Practical Training
S	Seminar
TH	Theory
PR	Practical

General Notes:

1. Mandatory courses are non-credit courses in which students will be required passing marks in internal assessments.
2. Students will be allowed to use non programmable scientific calculator. However, sharing of calculator will not be permitted in the examination.
3. Students will be permitted to opt for any elective course run by the department. However, the department shall offer those electives for which they have expertise. The choice of the students for any elective shall not be binding for the department to offer, if the department does not have expertise. To run the elective course a minimum of 1/3rd students of the class should opt for it.

MAHARSHI DAYANAND UNIVERSITY, ROHTAK
SCHEME OF STUDIES & EXAMINATIONS
B.TECH (Electronics and Communication Engineering)
SEMESTER –7th w.e.f. 2023-24

Sr. No.	Category	Course Code	Course Title	Hours per week			Total Contact Hrs. per week	Credit	Examination Schedule (Marks)				Duration of Exam (Hours)
				L	T	P			Mark of Classwork	Theory	Practical	Total	
1	Professional Core Course	PCC-ECE-410G	Mobile Communication and Networks	3	0	0	3	3	25	75	-	100	3
2	Professional Core Course	PCC-ECE-401G	Fiber Optic Communication	3	0	0	3	3	25	75	-	100	3
3	Professional Core Course	PCC-ECE-402-G	Antenna and Wave	3	0	0	3	3	25	75	-	100	3
4,5	Professional Elective Course	Refer to Annexure-I	Professional Elective-III	3	0	0	3	3	25	75	-	100	3
6,7, 8	Professional Elective Course	Refer to Annexure-I	Professional Elective-IV	3	0	0	3	3	25	75	-	100	3
9	Mandatory Course	MC-417-G	Constitution of India	2	0	0	2	0	Grading	-	-	-	-
10	LAB	LC-ECE-405-G	Data Communication Networking Lab	0	0	2	2	1	25	-	25	50	3
11	Project	PROJ-ECE-407-G	Project Stage-I			2	2	1	50	-	100	150	3
TOTAL CREDIT								**17**	**200**	**375**	**125**	**700**	

MAHARSHI DAYANAND UNIVERSITY, ROHTAK
Modified SCHEME OF STUDIES & EXAMINATIONS
B.TECH (Electronics and Communication Engineering)
SEMESTER –8th w.e.f. 2023-24

Sr. No.	Category	Course Code	Course Title	Hours per week			Total Contact Hrs. per week	Credit	Examination Schedule (Marks)				Duration of Exam (Hours)
				L	T	P			Marks of Class work	Theory	Practical	Total	
12, 13, 14, 15	Professional Elective Course	Refer to Annexure-I	Professional Elective-V	3	0	0	3	3	25	75	-	100	3
15	Professional Core Course	PCC-ECE-403-G	Satellite Communication	3	0	0	3	3	25	75	-	100	3
16	Professional Core Course	PCC-ECE-404-G	Microwave theory and technique	3	0	0	3	3	25	75	-	100	3
17	Professional Core Course	LC-ECE-406-G	Wireless & Satellite Communication Lab	0	0	2	2	1	25	-	25	50	3
18	Open Elective Course	Refer to Annexure-II	Open Elective	3	0	0	3	3	25	75	-	100	3
19	Project	PROJ-ECE-408-G	Project Work II/ Dissertation	-	-	8	8	4	100	-	150	250	3
		TOTAL CREDIT						**17**	**225**	**300**	**175**	**700**	

Annexure I

Professional Elective-III

S. No.	Course Code	Course Title
4	PEC-ECE-411-G	Data Communication Networking & Security
5	PEC-ECE-412-G	Error Correcting Codes

Professional Elective-IV

S. No.	Course Code	Course Title
6	PEC-ECE-413-G	Wireless Sensor Networks
7	PEC-ECE-414-G	Radar and Sonar
8	PEC-ECE-431-G	Internet of things

Professional Elective-V

S. No.	Course Code	Course Title
12	PEC-ECE-415-G	Embedded System
13	PEC-ECE-416-G	High speed Electronics
14	PEC-ECE-421-G	Mixed Signal Design
15	PEC-ECE-332-G	Advanced Mobile Communication

Annexure-II

Open Elective Courses-I

S. No.	Course Code	Course Title
21	OEC-ECE-417-G	Renewable Energy Resources
22	OEC-ME-455-G	Composite Materials
23	OEC-BME-419-G	Biosensors
24.	OEC-CE-417-G	Disaster Management
25.	OEC-CE-402-G	Solid & Hazardous waste management
27.	OEC –ME-402G	Operations Research
28.	OEC –EE-412G	Electrical Power Generation

Course code	**PEC-ECE-410-G**				
Category	**Professional Elective Course**				
Course title	**Mobile Communication and Networks**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 7th**
	3	**0**	0	**3**	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Outcomes: At the end of the Course, the student will have the ability to:

C410.1	Understand basics of cellular systems and developments of Wireless Standards
C410.2	Examine various fading effects and visualize the large scale signal propagation models
C410.3	Analyze the various modulation and multiple access schemes used in Cellular systems
C410.4	Designing and visualizing the architecture of various mobile systems
C410.5	Finding the mobility management in each cellular system

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C410.1	3	-	-	-	-	2	2	-	2	3	2	3	3	-	2
C410.2	3	3	-	-	2	3	-	-	3	2	1	3	3	-	3
C410.3	3	3	3	3	3	3	3	-	2	3	-	3	3	-	2
C410.4	3	-	-	-	-	-	-	-	-	3	-	2	3	-	1
C410.5	3	3	3	-	3	-	-	-	1	1	-	1	3	-	-

Course Coordinator and Instructor _ Dr. Vikas Nandal

UNIT I

Cellular concepts- Cell structure, frequency reuse, cell splitting, channel assignment, handoff, interference, capacity, power control; Wireless Standards: Overview of 2G 3G, 4G and 5G cellular mobile standards..

UNIT II

Propagation mechanism, reflection, refraction, diffraction and scattering, large scale signal propagation and lognormal shadowing. Fading channels-Multipath and small-scale fading-Doppler shift, average and rms delay spread, coherence bandwidth and coherence time, flat and frequency selective fading, slow and fast fading.

Okumura Model, Hata Model, PCS Extension to Hata Model, Wideband PCS Microcell Model, Indoor Propagation Models-Partition losses (Same Floor), Partition losses between Floors, Log-distance path loss model.

UNIT III

Multiple access schemes-FDMA, TDMA, CDMA and SDMA. Modulation schemes- BPSK, QPSK and variants, QAM, MSK and GMSK, multicarrier modulation, OFDM and OFDMA. Diversity Techniques- Polarization Diversity, Frequency Diversity, Time Diversity.

UNIT IV

Introduction to LTE: History, Architecture - MIMO and space time signal processing, spatial multiplexing, System examples :GSM, EDGE, GPRS, IS-95, CDMA 2000 and WCDMA, GSM: Architecture, – UMTS: Architecture- 3G, 4G and 5G mobile communications.

Text/Reference Books:

1. WCY Lee, Mobile Cellular Telecommunications Systems, McGraw Hill, 1990.
2. WCY Lee, Mobile Communications Design Fundamentals, Prentice Hall, 1993.
3. Raymond Steele, Mobile Radio Communications, IEEE Press, New York, 1992.
4. AJ Viterbi, CDMA: Principles of Spread Spectrum Communications, Addison Wesley, 1995.
5. VK Garg &JE Wilkes, Wireless & Personal Communication Systems, Prentice Hall, 1996.
6. Erik Dahlman , 4G, LTE-Advanced Pro and The Road to 5G
7. Sassan Ahmadi, 5G NR: Architecture, Technology, Implementation, and Operation of 3GPP New Radio Standards Hardcover – 1 June 2019
8. T.S.Rappaport, “Wireless Communications Principles and Practice”, PHI, II Edition, 2006.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand cellular concepts and signal propagation in mobile communication.
2. Perform small simulations and plot results on modulation techniques.
3. Analysis performance of different generations of mobile communications.
4. Solve numerical problems on different multi-access and modulation schemes of mobile communications

Course code	**PCC-ECE-401-G**				
Category	**Professional Core Course**				
Course title	**Fiber Optical Communication**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 7th**
	03	**0**	0	**3**	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Outcomes: At the end of the Course, the student will have the ability to:

C403.1	Describe the basic elements of optical fiber link, fiber modes configurations and structures
C403.2	Analyze the different kinds of losses including distortion.
C403.3	Analyze the optical source materials.
C403.4	Estimate the noise performance in optical receivers.
C403.5	Explain fiber splicing techniques, operational WDM and solitons.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C403.1	3	-	1	2	-	-	-	-	-	-	2	3	2	3	3
C403.2	3	2	2	2	2	2	1	-	-	-	2	2	2	3	3
C403.3	3	2	3	2	2	2	1	-	-	-	2	2	2	2	3
C403.4	3	2	2	2	2	2	1	-	-	-	2	3	2	2	3
C403.5	3	2	2	2	3	2	1	-	-	-	2	3	2	2	3

Course Coordinator and Instructor _ Dr. Suresh Kumar

Unit – I

Introduction: Elements of Optical communication system. Principle of working, Ray Theory and electromagnetic mode theory for optical propagation. Type of optical fibers, step index and graded index and their characteristics. Optical losses: Attenuation, Absorption, Scattering, dispersion, polarization, and fiber bend losses. Fabrication techniques of fiber.

Unit – II

Optical Sources: Basic concepts of light source: LED and Lasers. Working principle, Shape geometry, efficiency, Fabry Perot laser, quantum well lasers, and MQM and Quantum dot lasers. Characteristics of both LED and Lasers. Optical Detectors: Working principle, PN, PIN diodes, APD. Efficiency and effect of noise.

Unit – III

Link Budget: Link design, path loss calculations, safety margin and budgeting. Optical termination and distribution system. Optical Amplifiers and Modulation: EDFA, SOA and Raman amplifiers. Intensity modulation, concept of WDM and DWDM systems and networks.

Unit – IV

System Effects: Nonlinear effects in fiber optic links. Concept of self-phase modulation, four wave mixing, Kerr effect. Soliton based communication system

TEXTBOOK:

Optical Fiber Communications: John M Senior; Pearson.

REFERENCE BOOKS:

1. Optical Communication Systems: John Gowar; PHI.
2. Optical Fiber Communications: Gerd Keiser; TMH

Course code	**PCC-ECE-402-G**				
Category	**Professional Core Course**				
Course title	**Antennas and Propagation**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 7th**
	03	**0**	0	**3**	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Outcomes: At the end of the Course, the student will have the ability to:

C404.1	Understand the working principles of the Antenna.
C404.2	Analyze the properties of different types of antennas and their design
C404.3	Design and mathematical analysis of various practical antennas and their feeding methods.
C404.4	Analyze performance of various antenna arrays and their comparison.
C404.5	Understand basic Concepts of Smart Antennas.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C404.1	3	-	-	-	-	2	2	-	2	3	2	3	2	3	2
C404.2	3	3	2	2	2	-	-	-	3	2	-	3	2	3	2
C404.3	3	3	2	3	3	-	-	-	-	3	-	3	2	3	2
C404.4	3	3	-	-	-	-	-	-	2	3	-	2	2	3	2
C404.5	3	-	-	2	3	2	2	-	2	2	2	3	2	3	2

Course Coordinator and Instructor _ Dr. Vikas Nandal

Unit – I

Fundamental Concepts- Physical concept of radiation, Radiation pattern, near-and far-field regions, reciprocity, directivity and gain, effective aperture, polarization, input impedance, efficiency, Friis transmission equation, radiation integrals and auxiliary potential functions.
Radiation from Wires and Loops- Infinitesimal dipole, finite-length dipole, linear elements near conductors, dipoles for mobile communication, small circular loop.

Unit – II

Aperture and Reflector Antennas- Huygens' principle, radiation from rectangular and circular apertures, design considerations, Babinet's principle, Radiation from sectoral and pyramidal horns, design concepts, prime-focus parabolic reflector and cassegrain antennas

Unit – III

Broadband Antennas- Log-periodic and Yagi-Uda antennas, frequency independent antennas, broadcast antennas. Micro strip Antennas- Basic characteristics of micro strip antennas, feeding methods, methods of analysis, design of rectangular and circular patch antennas.

Unit – IV

Antenna Arrays- Analysis of uniformly spaced arrays with uniform and non-uniform excitation amplitudes, extension to planar arrays, synthesis of antenna arrays using Schelkunoff polynomial method, Woodward-Lawson method. Basic Concepts of Smart Antennas- Concept and benefits of smart antennas, fixed weight beam forming basics, Adaptive beam forming.

Text/Reference Books:

1. J.D. Kraus, Antennas, McGraw Hill, 1988.
2. C.A. Balanis, Antenna Theory - Analysis and Design, John Wiley, 1982.
3. R.E. Collin, Antennas and Radio Wave Propagation, McGraw Hill, 1985.
4. R.C. Johnson and H. Jasik, Antenna Engineering Handbook, McGraw ill, 1984.
5. I.J. Bahl and P. Bhartia, Micro Strip Antennas, Artech House, 1980.
6. R.K. Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill, 2005
7. R.E. Crompton, Adaptive Antennas, John Wiley

Course code	**PEC-ECE-411-G**				
Category	**Professional Elective Course**				
Course title	**Data Communication Networking & Security**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 7th**
	3	**0**	0	**3**	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Outcomes: At the end of the Course, the student will have the ability to:

C405.1	Define the fundamental concepts of analog and digital transmission of data communication networks.
C405.2	Understand various network configurations and topologies of data communication networks.
C405.3	Interpret various detection and correction techniques used in data communication networks
C405.4	Analyze various communication architectures and their protocols in data communication networks
C405.5	Describe the technical aspects of data communications on the Internet

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C405.1	1	-	-	-	3	-	-	-	-	-	-	-	-	-	1
C405.2	1	3		3	3		2	-	-	-	2	2	1	-	1
C405.3	3	1	3	3	3	3	2	2	1	2	2		3	-	3
C405.4	-	3	-	3	-	-	-	-	1	-	-	-	3	1	-
C405.5	1	-	-		3	-	-	-		-	-	-	-	-	1

Course Coordinator and Instructor _ Dr. Shamsher Singh

UNIT-I

Overview of Data Communication and Networking: Data communications, Uses of computer Networks, The Internet, Protocols and standards, Layered tasks, OSI model, TCP/IP model.

Data and Signals, Analog and Digital, Periodic Analog Signals, Digital Signals, Transmission impairment, Data Rate Limits, Performance, Digital Transmission, Digital-to-Digital Conversion, Analog-to-Digital Conversion, Analog Transmission, Digital-to-analog Conversion, Analog-to-analog Conversion

UNIT II

Physical layer: Bandwidth utilization: Multiplexing, FDM, WDM, TDM, Transmission Media, Guided Media, Unguided Media: Wireless, Switching, Circuit-Switched Networks, Datagram Networks. Modulation of digital data, Telephone Network,

Data Link Layer: Data link layer design issues, Error Detection and Correction, Data Link Control and Protocols, Types of errors, Detection, Error correction, Flow and error control.

UNIT III

Network Layer: Internetworks, Addressing: IP Address Classes, Subnet, CIDR, Routing, ARP, IP, ICMP, IPV6, Unicast routing, Unicast routing protocol, Multicast routing, Multicast routing protocols.

Transport layer: Process to process delivery, Elements of transport protocols, User datagram protocol (UDP), Transmission control protocol (TCP), Data traffic, Congestion, Congestion control, Quality of service, Techniques to improve QOS, Integrated services, Differentiated services, QOS in switched networks.

UNIT IV

Application layer: DNS-Domain Name System, Electronic mail, File transfer, HTTP, World wide web (WWW), Digitizing audio and video, Audio and video compression, Voice over IP.

Network Security: Cryptography, Symmetric key Algorithms (DES, AES), Public key Algorithms-RSA, Digital Signatures, Firewall

Text Books/Reference Books:

1. Data Communication and Networking by Behrouz A. Forouzan (Fourth Edition), Tata McGraw Hill
2. Computer Networks by Andrew S. Tanenbaum (Fifth Edition), Pearson Education
3. Introduction to Data communications and Networking ,W.Tomasi, Pearson education
4. Stallings William, Data and Computer Communication, Pearson Education (2000) 7th ed.

Course code	**PEC-ECE-412-G**				
Category	**Professional Elective Course**				
Course title	**Error Correcting Codes**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 7th**
	3	**0**	0	**3**	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Outcomes: At the end of the Course, the student will have the ability to:

C406.1	Understand the information theory and coding in the communication system.
C406.2	Understand the requirements error correcting codes in the communication system
C406.3	Analyze the various properties of different coding techniques used in digital communication systems.
C406.4	Illustrate the various coding techniques like, block codes, cyclic codes, convolution codes, etc.
C406.5	Understand the various limitations of error correction and detection in coding technique

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C406.1	3	3	1			1	1			-		3		3	3
C406.2	3	3	1	-		1	1			-		3		3	3
C406.3	3	3	2			1	1			-		3		3	3
C406.4	3	3	2	-		1	2			-		3		3	3
C406.5	3	3	2			1	1			-	-	3	-	3	3

Course Coordinator and Instructor _ Dr. Shamsher Singh

UNIT I

Concept of information and entropy, Shannon theorem, Relation among Different entropies, Mutual information and self-information, channel capacity of different channels ,Basic conception of coding , Advantage of coding ,Source encoding and channel coding.

UNIT II

Linear block codes: introduction to linear block code. Syndrome and error detection Minimum distance of block code, Error detecting and error correcting capabilities of a block code, Hamming codes. Application of block codes for error control in data storage system.

UNIT III

Cyclic Codes: Description, Generator and parity check matrices, encoding, Syndrome computation and error detection, decoding, cyclic hamming codes, shortened cyclic codes, error trapping decoding for cyclic codes. BCH codes, Decoding of BCH codes. Idempotent and Mattson-Solomon polynomials; Reed-Solomon codes, MDS codes**,**

UNIT IV

Convolution codes, Encoding of convolutional codes, State diagrams, Trellis Diagram, structural and distance properties, Maximum likelihood decoding, sequential decoding algorithm, Application of convolutional codes in ARQ system. Introduction to Space time codes, Diversity, orthogonal space –time block codes.

Text/Reference Books:

1. F.J. McWilliams and N.J.A. Slone, The theory of error correcting codes, 1977.
2. R.E. Balahut, Theory and practice of error control codes, Addison Wesley, 1983.

Course code	**PEC-ECE-413-G**				
Category	**Professional Elective Course**				
Course title	**Wireless Sensor Networks**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 7th**
	03	**0**	0	**3**	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Outcomes: At the end of the Course, the student will have the ability to:

C407.1	Define the fundamental concepts of working of Sensors
C407.2	Understand various challenges involved in fielding of sensor network
C407.3	Elaborate various protocols that lead to communication between sensors
C407.4	Analyze various security protocols for securing the sensor network
C407.5	Describe the technical architecture of sensor networks

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C407.1	1	-	-	-	3	-	-	-	-	-	-	-	-	-	1
C407.2	1	3		3	3		2	-	-	-	2	2	1	-	1
C407.3	3	1	3	3	3	3	2	2	1	2	2		3	-	3
C407.4	-	3	-	3	-	-	-	-	1	-	-	-	3	1	-
C407.5	1	-	-		3	-	-	-		-	-	-	-	-	1

Course Coordinator and Instructor _ Dr. Suresh Kumar

Unit – I

Introduction to Sensor Networks, unique constraints and challenges, Advantage of Sensor Networks, Applications of Sensor Networks, Types of wireless sensor networks, Mobile Ad-hoc Networks (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor Networks. Issues and challenges in wireless sensor networks

Unit – II

Routing protocols, MAC protocols: Classification of MAC Protocols, S-MAC Protocol, B-MAC protocol, IEEE 802.15.4 standard and ZigBee

Unit – III

Dissemination protocol for large sensor network. Data dissemination, data gathering, and data fusion; Quality of a sensor network; Real-time traffic support and security protocols. Design Principles for WSNs, Gateway Concepts Need for gateway, WSN to Internet Communication, and Internet to WSN Communication

Unit – IV

Single-node architecture, Hardware components & design constraints, Operating systems and execution environments, introduction to TinyOS and nesC

Text/Reference Books:

1. Waltenegus Dargie , Christian Poellabauer, " Fundamentals Of Wireless Sensor Networks Theory And Practice" , By John Wiley & Sons Publications ,2011
2. Sabrie Soloman, " Sensors Handbook" by McGraw Hill publication. 2009
3. Feng Zhao, Leonidas Guibas, " Wireless Sensor Networks", Elsevier Publications,2004
4. Kazem Sohrby, Daniel Minoli, " Wireless Sensor Networks": Technology, Protocols and Applications, Wiley-Inter science
5. Philip Levis, And David Gay "TinyOS Programming" by Cambridge University Press 2009

Course code	**PEC-ECE-414-G**				
Category	**Professional Elective Course**				
Course title	**Radar & Sonar Engineering**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 7th**
	3	**0**	0	**3**	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Outcomes: At the end of the Course, the student will have the ability to:

C408.1	Define the fundamental concepts of Radar functioning
C408.2	Understand various Types of Radar and their applications
C408.3	Interpret various issues that occurs in Radar Receiver
C408.4	Analyze various methods of SONAR propagation
C408.5	Describe the technical aspects of SONAR working

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C408.1	1	-	-	-	3	-	-	-	-	-	-	-	-	-	1
C408.2	1	3		3	3		2	-	-	-	2	2	1	-	1
C408.3	3	1	3	3	3	3	2	2	1	2	2		3	-	3
C408.4	-	3	-	3	-	-	-	-	1	-	-	-	3	1	-
C408.5	1	-	-		3	-	-	-		-	-	-	-	-	1

Course Coordinator and Instructor _ Dr. Suresh Kumar

Unit – I

Introduction: Radar basic block diagram, operation, working principle, frequency used. Evolution of Radar technology and its application in various fields with historical perspective.

Unit – II

Radar Equation: Simple form of Radar equation, prediction of range, performance, minimum detectable signal, Receiver Noise, Signal to Noise Ratio. Transmitter power, Pulse repetition frequency, range ambiguity, system losses and propagation effects. CW and Frequency Modulated Radars: Basic block diagram of CW and FMCW radar. Working principle, application and limitations.

Unit – III

MTI and Pulse Doppler Radar: Introduction, Delay Line Cancellers, Multiple or staggered, Pulse repetition frequencies, range-Gated Doppler Filters, Digital Signal Processing, Other MTI delay line, Limitation of MTI performance, Non-coherent MTI, Pulse Doppler Radar, MTI from a moving platform. Tracking in Radar: Tracking with Radar, Sequential Lobing, Conical Scan, Monopulse Tracking Radar, Tracking in range, Acquisition.

Unit – IV

Receivers, Display & Duplexers: Radar Receivers, Noise Figure, Mixer, Low-noise Front ends, Displays, Duplexer, Receiver protectors. Introduction to SONAR: Working principle, propagation, transmission and reception of signals. Signal to Noise Ratio, types of Sonar and their applications

TEXT BOOK:

1. Introduction to Radar Systems: Merrill I. Skolnik, ; MGH

REFERENCE BOOK:

1. Electronic Communication Systems : Kennedy; TMH

Course code	**PEC-ECE-431-G**				
Category	**Professional Elective Course**				
Course title	**Internet of things**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 7th**
	3	**0**	0	**3**	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Outcomes: At the end of the Course, the student will have the ability to:

C431.1	Understand the concepts of Internet of Things
C431.2	Analyze basic protocols of network and communication aspects
C431.3	Understand where the IoT concept fits within the broader ICT industry and possible future trends
C431.4	Understand the concepts of Developing Internet of Things
C431.5	Use the knowledge and skills acquired during the course to build and test a complete, working IoT system involving prototyping, programming and data analysis

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C431.1	3	3	-	-	-	-	-	-	-	-	3	3	2	3	3
C431.2	3	3	-	-	-	-	-	-	-	-	3	3	2	3	3
C431.3	3	3	-	-	-	-	-	-	-	-	3	3	2	3	3
C431.4	3	3	2	-	-	-	-	-	-	-	3	3	2	3	3
C431.5	3	3	2	-	-	-	-	-	-	-	3	3	2	3	3

INTRODUCTION TO IoT : Introduction to IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Communication models & APIs, Enabling Technologies of IoT, IoT& M2M (Machine to Machine), Difference between IoT and M2M, SDN and NFV for IoT, Challenges in IoT,Web of Things vs Internet of things

UNIT II

NETWORK AND COMMUNICATION ASPECTS: Wireless medium access issues, MAC protocol survey, Survey routing protocols, Data acquiring, organising, processing and analytics, Sensor Technology, actuator, sensor data communication protocols.

UNIT III

DEVELOPING INTERNET OF THINGS: Internet of Things: Design Methodology and case studies, Data Collection and Storage Using a Cloud Platform in IoT.

UNIT IV

RESOURCE MANAGEMENT IN IoT: Domain specific applications of IoT, Home automation, Industry applications, Smart cities, Streetlight monitoring and control, Environment Monitoring, Logistics, agriculture, productivity and Other IoT applications.

TEXT/REFERENCE BOOKS:

1. Vijay Madisetti, ArshdeepBahga, ―Internet of Things: A Hands-On Approach

2.Rajkamal- Internet of Things Architecture and Design Principles

3.Arshdeep Bahga and Vijay Madisetti , "Internet of Things, a hands on approach" , Universities Press (India) Pvt. Ltd. 2017.

4.Rajkumar Buyya, Amir Vahid Dastjerdi, "Internet of Things Principles and Paradigms"Copyright © 2016 Elsevier Inc.

5.William Stallings, " Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud" Publisher: Addison-Wesley 2015

Course Outcomes: At the end of the course, students will demonstrate the ability to 1. Illustrate the fundamentals of IoT 2. Identify suitable hardware and interfaces for IoT deployments. 3. Develop cloud computing model and service options. 4. Illustrate data analytics and security for IoT

Course code	**MC-417-G**				
Category	**Mandatory Courses**				
Course title	**Constitution of India**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 7th**
	2	**0**	**0**	**0**	
Class work	Grading				
Exam	--				
Total	--				
Duration of Exam					

Course Outcomes: At the end of the Course, the student will have the ability:

C409.1	Express the basic structure, nature and preamble of the constitution of India.
C409.2	Classify the distribution of legislative, administrative and financial powers between the Union and the States
C409.3	Understand the qualifications and powers of President, Governor and Judiciary.
C409.4	Comprehend the concepts of fundamental rights and fundamental duties.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C409.1	-	-		-	-	3	2	3			-	2	-	-	-
C409.2	-	-		-	-	3	2	3			-	2	-	-	-
C409.3	-	-		-	-	3	3	3			-	2	-	-	-
C409.4	-	-		-	-	3	2	3			-	2	-	-	-

Course Coordinator and Instructor _ Pulkit Berwal

Unit – I

Philosophy of Indian Constitution: Salient features of Indian Constitution, Preamble, and Nature of Indian Constitution, Procedure for amendment of the Constitution.

Unit – II

Federal structure and distribution of legislative and financial powers between the Union and the States

Unit – III

Organs of Governance: President – Qualification and Powers of the President, Governor Qualification and Powers of Governor, Parliament: Composition, Qualifications and Disqualifications, Judiciary: Appointment, Tenure and Removal of Judges.

Unit – IV

Fundamental Rights: Origin and development of Fundamental rights, Need for fundamental rights. Introduction to Right to equality, Right to freedom, Right against exploitation, Right to freedom of religion, Cultural and Education rights and Fundamental duties.

References:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S.N. Busi, Dr. B.R. Ambedkar framing of Indian Constitution, latest Edition
3. M.P. Jain, Indian Constitution Law, Lexis Nexis, latest edition
4. D.D. Basu, Introduction to Constitution of India, Lexis Nexis, latest edition.

MC-317G is mandatory non-credit course in which the students will be awarded grades.

Note: 1. The evaluation of Constitution of India. According to performance, the students are awarded grades A, B, C, F. A student who is awarded F' grade is required to repeat Constitution of India: Excellent: A; Good: B; Satisfactory: C; Not Satisfactory: F.

Course code	**LC-ECE-405-G**				
Category	**Laboratory Course**				
Course title	**Data Communication Networking Lab**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 7th**
	0	**0**	2	**3**	
Class work	25 Marks				
Exam	25 Marks				
Total	50 Marks				
Duration of Exam	3 Hours				

Course Outcomes: At the end of the Course, the student will have the ability to:

C410.1	Define fundamental concepts of different types of transmission media.
C410.2	Understand various digital modulation techniques
C410.3	Demonstrate LAN using different topologies like bus, ring, star & tree.
C410.4	Analyze the operation for configuration of modem and hub
C410.5	Capable to learn how to configure a router with the static routing.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C410.1	1	-	-	-	3	-	-	-	-	-	-	-	-	-	2
C410.2	1	3		3	3	-	2	-	-	-	2	2	1	-	2
C410.3	3	1	3	3	3	3	2	2	1	2	2	-	3	-	3
C410.4	1	3	-	3	-	-	-	-	1	-	-	-	3	1	-
C410.5	1	-	-	-	3	-	-	-	-	-	-	-	-	-	1

Course Coordinator and Instructor _ Dr. Shamsher Singh

List of Experiments (Perform any 10 experiments)

1. Overview of Boson Simulator or Cisco Packet Tracer or Netsim and Matlab
2. To study various network topologies
3. To study network components and categories of networks
4. Experiment for various keying techniques like ASK, FSK, PSK and QAM
5. Describe various techniques for Encoding, decoding and Digital data communication.
6. Experiment with various error detection and flow control techniques
7. To study the connections of hubs, switchers and routers.
8. To establish connections of LAN, MAN and WAN
9. To learn and observe the usage of different networking commands e.g. PING, TRACEROUTE. Learning remote login using telnet session. Measuring typical average delays between different locations of the network.
10. Observe the need for router configuration. To compare the working of 1750, 2620 and 2621 series of routers on the basis of bandwidth
11. Understand the subnet mask.
12. Understand the need of a routing mechanism in a router.

13. Learn how to configure a router with the static routing.
14. To observe the working of IP protocol. Exploring the routing tables for different routers.
15. Observe how the TCP/IP applications (e.g., DNS, Telent, FTP) exchange the control information and data.
16. Experiment with various application layer protocols

Course code	**PROJ-ECE-407-G**				
Category	**Project**				
Course title	**Project Stage-I**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 7th**
	0	**0**	4	**5**	
Class work	50 Marks				
Exam	100 Marks				
Total	150 Marks				
Duration of Exam	3 Hours				

The object of Project Stage I is to enable the student to take up investigative study in the broad field of Electronics & Communication Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work.

The assignment to normally include:
1. Survey and study of published literature on the assigned topic;
2. Working out a preliminary Approach to the Problem relating to the assigned topic;
3. Conducting preliminary Analysis/Modelling/Simulation/Experiment/Design/Feasibility;
4. Preparing a Written Report on the Study conducted for presentation to the Department;
5. Final Seminar, as oral Presentation before a departmental committee.

Course Outcomes: At the end of the Course, the student will have the ability to:

C411.1	Analyze and identify the engineering problems to formulate the literature survey
C411.2	Undertake problem identification, formulation and solution
C411.3	Apply knowledge for carrying out the project in team and perform documentation effectively
C411.4	Demonstrate the knowledge, skills and attitudes of a professional engineer

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C411.1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
C411.2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
C411.3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
C411.4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Course Coordinator and Instructor _ Dr. Vikas Nandal

Course code	**PEC-ECE-415-G**				
Category	**Professional Elective Course**				
Course title	**Embedded Systems**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 8th**
	3	**0**	0	**3**	
Class work	25				
Exam	75				
Total	100				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Outcomes: At the end of the Course, the student will have the ability to:

C412.1	Classify the various types and technologies of microcontroller and embedded system
C412.2	Illustrate the internal architecture and working of PIC microcontroller
C412.3	Analyze the internal architecture, working, addressing modes, interfacing and programming of 8051
C412.4	Illustrate the role, design concept and application of Embedded systems

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
C412.1	3	3	-			2-		-	-	1		1	3	-	3
C412.2	3	3	2			2		-	-	1	-	2	3	-	3
C412.3	3	3	2			2		-	-	1	-	2	3	-	3
C412.4	3	2	2			2		-	-	1	-	2	3	-	3

Course Coordinator and Instructor _ Dr. Manoj Kumar

UNIT I

INTRODUCTION OF MICROCONTROLLER: Different types of microcontrollers: Embedded microcontrollers, External memory microcontrollers; Processor Architectures: Harvard V/S Princeton , CISC V/S RISC; microcontrollers memory types; microcontrollers features : clocking, i/o pins, interrupts, timers, peripherals.

UNIT II

MICROCONTROLLER ARCHITECTURE: Introduction to PIC microcontrollers, Architecture and pipelining, program memory considerations, Addressing modes, CPU registers, Instruction set, simple operations.

UNIT III

Microcontrollers - Microcontroller 8051- Architecture, Pin Diagram, I/O Ports, Internal RAM and Registers, Interrupts, Addressing Modes, Memory Organization and External Addressing, Instruction Set, Assembly Language Programming, Real Time Applications of Microcontroller- Interfacing with LCD, ADC, DAC, Stepper Motor, KeyBoard and Sensors.

UNIT IV

Embedded Systems-Introduction, Classification, Processors, Hardware Units, Software Embedded into System, Applications and Products of Embedded Systems, Structural Units in Processor, Memory Devices, I/O Devices, Buses, Interfacing of Processor Memory and I/O Devices, Case Study of an Embedded System for a Smart Card.

TEXT BOOKS :

1.B. B. Brey: The Intel Microprocessors, Architecture, Programming and Interfacing, Pearson Education.
2.Design with PIC Microcontrollers by John B. Peatman , Pearson.
3.Raj Kamal: Embedded Systems- Architecture, Programming and Design, TMH, New Delhi.
4.V. Udayashankara and M. S. Mallik arjunaswamy: 8051 Microcontroller, TMH, New Delhi

REFERENCE BOOKS:

1.Mazidi and Mazidi: The 8051 Microcontroller and Embedded Systems, Pearson Education.
2.A. V. Deshmukh: Microcontroller (Theory and Application), TMH.
3.D. V. Hall: Microprocessors and Interfacing, TMH
4.Programming and Customizing the 8051 Microcontroller : Predko ; TMH.
5.Programming Embedded Systems in C and C++ : Michael Barr; SHROFF PUB. & DISTR

Course code	**PEC-ECE-416-G**				
Category	**Professional Elective Course**				
Course title	**High Speed Electronics**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 8th**
	3	**0**	0	**3**	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Outcomes: At the end of the Course, the student will have the ability to:

C413.1	Understand significance and the areas of application of high-speed electronics circuits.
C413.2	Understand the properties of various components used in high speed electronics.
C413.3	Familiar with quantitatively model and analyze high speed electronic Devices.
C413.4	Design and analysis of various types of amplifiers and mixers.
C413.5	Demonstrates the various types of PCB processes technologies and design challenges

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C413.1	3	3					1	1			2	3	3	3	1
C413.2	2	3					1	1			2	3	3	3	1
C413.3	3	3	3				1	1			2	3	3	3	1
C413.4	3	3	3				1	1			2	3	3	3	1
C413.5	3	3	3				1	1			2	3	3	3	1

Course Coordinator and Instructor _ Dr. Manoj Kumar

UNIT: I

Transmission line theory (basics) crosstalk and nonideal effects; signal integrity: impact of packages, vias, traces, connectors; non-ideal return current paths, high frequency power delivery, methodologies for design of high-speed buses; radiated emissions and minimizing system noise.

UNIT: II

Noise Analysis: Sources, Noise Figure, Gain compression, Harmonic distortion, Inter-modulation, Cross-modulation, Dynamic range.

Devices: Passive and active, Lumped passive devices (models), Active (models, low vs High frequency)

UNIT: III

RF Amplifier Design, Stability, Low Noise Amplifiers, Broadband Amplifiers (and Distributed) Power Amplifiers, Class A, B, AB and C, D E Integrated circuit realizations, Cross-over distortion Efficiency RF power output stages.

Mixers –Up conversion Down conversion, Conversion gain and spurious response. Oscillators Principles. PLL Transceiver architectures.

UNIT:IV

Printed Circuit Board Anatomy, CAD tools for PCB design, Standard fabrication, Microvia Boards. Board Assembly: Surface Mount Technology, Through Hole Technology, Process Control and Design challenges.

Text/Reference Books:

1. Stephen H. Hall, Garrett W. Hall, James A. McCall "High-Speed Digital System Design: A Handbook of Interconnect Theory and Design Practices", August 2000, Wiley-IEEE Press.
2. Thomas H. Lee, "The Design of CMOS Radio-Frequency Integrated Circuits", CambridgeUniversity Press, 2004, ISBN 0521835399.
3. Behzad Razavi, "RF Microelectronics", Prentice-Hall 1998, ISBN 0-13-887571-5.
4. Guillermo Gonzalez, "Microwave Transistor Amplifiers", 2nd Edition, Prentice Hall.
5. Kai Chang, "RF and Microwave Wireless systems", Wiley.
6. R.G. Kaduskar and V.B.Baru, Electronic Product design, Wiley India, 2011

Course code	**PEC-ECE-421-G**				
Category	**Professional Elective Course**				
Course title	**MIXED SIGNAL DESIGN**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 8th**
	3	**0**	**0**	**3**	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Outcomes: At the end of the Course, the student will have the ability to:

C414.1	Understand and apply the concepts for mixed signal MOS circuits.
C414.2	Study and analyze the characteristics of IC based CMOS filters.
C414.3	Understand and design of various data converter architecture circuits.
C414.4	Analyze the signal to noise ratio and modeling of mixed signals.
C414.5	Study and Design of oscillators and phase lock loop circuits.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C414.1	3	3				1	1				1	3		3	2
C414.2	3	3					1				1	3		3	2
C414.3	3	3	3			1	1				1	3		3	2
C414.4	3	3	2			1	1				1	3		3	2
C414.5	3	3	3			1	1				1	3		3	2

Course Coordinator and Instructor _ Dr. Manoj Kumar

UNIT I

Submicron CMOS Circuit Design:

Submicron CMOS: Overview and Models, CMOS process flow, Capacitors and Resistors. Digital circuit design: The MOSFET Switch, Delay Elements, An Adder. Analog Circuit Design: Biasing, Op-Amp Design, Circuit Noise.

UNIT II

Integrator Based CMOS Filters:

Integrator Building Blocks- low pass filter, Active RC integrators, MOSFET-C Integrators, g_m- C integrators, Discrete time integrators. Filtering Topologies: The Bilinear transfer function, The Biquadratic transfer function, Filters using Noise shaping.

UNIT III

Data Converter Architectures:

DAC Architectures- Resistor string, R-2R ladder Networks, Current Steering, Charge Scaling DACs, Cyclic DAC, and Pipeline DAC. ADC Architectures- Flash, Two-step flash ADC, Pipeline ADC, Integrating ADC's, Successive Approximation ADC.

Data Converter Modeling and SNR:

Sampling and Aliasing: A modeling approach, Impulse sampling, The sample and Hold, Quantization noise. Data converter SNR: An overview, Clock Jitter, Improving SNR using Averaging, Decimating filter for ADCs, Interpolating filter for DACs, Band pass and High passsinc filters - Using feedback to improve SNR.

UNIT IV

Oscillators and PLL:

LC oscillators, Voltage Controlled Oscillators. Simple PLL, Charge pumps PLLs, Non ideal effects in PLLs, Delay Locked Loops.

References:

1. CMOS Mixed Signal Circuit Design by R.Jacob Baker, Wiley India, IEEE Press, reprint 2008.
2. CMOS Circuit Design, Layout and Simulation by R.Jacob Baker, Wiley India, IEEE Press, Second Edition, reprint 2009.
3. Design of Analog CMOS Integrated Circuits by Behzad Razavi, McGraw Hill, 33 Reprint, 2016.

Course code	**PEC-ECE-432-G**				
Category	**Professional Elective Course**				
Course title	**Advanced Mobile Communications**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 8th**
	3	**0**	**0**	**3**	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Outcomes: At the end of the Course, the student will have the ability to:

C415.1	To analyze and compare the different generations of mobile communication technologies from 1G to 5G, and understand the key advancements in each generation..
C415.2	To explain the potential and different usage scenarios of 5G technology, and describe the technical aspects of 5G, including millimeter wave communication, carrier aggregation, and small cells
C415.3	To describe the architecture and components of a 5G network, including New Radio (NR), centralized RAN, and multi-access edge computing (MEC), and understand the concepts of software defined networking (SDN) and network function virtualization (NFV).
C415.4	To analyze the current state and challenges of 5G deployment, including the issues with spectrum access and usage, connectivity in rural areas, and the potential of non-terrestrial front haul/backhaul solutions such as LEOs and HAP/UAV

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C414.1	**3**	**3**				**1**	**1**				**1**	**3**		**3**	**2**
C414.2	**3**	**3**					**1**				**1**	**3**		**3**	**2**
C414.3	**3**	**3**	**3**			**1**	**1**				**1**	**3**		**3**	**2**
C414.4	**3**	**3**	**2**			**1**	**1**				**1**	**3**		**3**	**2**

UNIT I

Mobile Communications Overview: Evolution from 1G to 5G, Analog voice systems in 1G, digital radio systems in 2G, voice and messaging services, TDMA based GSM, CDMA, 2.5G (GPRS), 2.75G (EDGE); IMT2000, 3G UMTS, W-CDMA, HSPA, HSPA+, 3G services and data rates, IMT Advanced, 4G, LTE, VoLTE, OFDM, MIMO, LTE Advanced Pro (3GPP Release 13+), IMT2020, enhancements in comparison to IMT Advanced.

UNIT II

Introduction to 5G Communication: 5G potential and applications, Usage scenarios, enhanced mobile broadband (eMBB), ultra reliable low latency communications (URLLC), massive machine type communications (MMTC), D2D communications, V2X communications, Spectrum for 5G, spectrum access/sharing, millimeter Wave communication, channels and signals/waveforms in 5G, carrier aggregation, small cells, dual connectivity

UNIT III

5G Network: New Radio (NR), Standalone and non-standalone mode, non-orthogonal multiple access (NOMA), massive MIMO, beam formation, PHY API Specification, flexible frame structure, Service Data Adaptation Protocol (SDAP), centralized RAN, open RAN, multi-access edge computing (MEC); Introduction to software defined networking (SDN), network function virtualization (NFV), network slicing; restful API for service-based interface, private networks.

UNIT IV

Current state and Challenges ahead: 5G penetration in developed countries; deployment challenges in low-middle income countries, stronger backhaul requirements, dynamic spectrum access and usage of unlicensed spectrum, contrasting radio resource requirements, large cell usage, LMLC, possible solutions for connectivity in rural areas (BharatNet, TVWS, Long-range WiFi, FSO); non-terrestrial fronthaul / backhaul solutions: LEOs, HAP/UAV.

Text and References Books:

1. Mobile Communications by Jochen Schiller Pub: Financial Times / Imprint of Pearson

2. Mobile Cellular Telecommunications: Analog and Digital Systems by William Lee, Pub: McGraw Hill Education

3. Mobile Communications Design Fundamentals by William Lee, Pub: Wiley India Pvt. Ltd.

4. Wireless Communications: Principles and Practice by Theodore S. Rappaport, Pub: Pearson

Course Outcomes: At the end of this course students will demonstrate the ability to

1. Understand the evolution of mobile communication standards developed over the years.

2. Perform computations and solve numerical problems on different frequency division multiple access techniques.

3. Assess how softwarization of network functions helps in scalability and ease of operations.

4. Evaluate the use of advanced techniques in cellular communications.

Course code	**PCC-ECE-403-G**				
Category	**Professional Core Course**				
Course title	**SATELLITE COMMUNICATION**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 8th**
	3	**0**	**0**	**3**	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Outcomes: At the end of the Course, the student will have the ability to:

C415.1	To understand various aspects of satellite communication and satellite link design equations.
C415.2	To analyze analog and digital satellite communication techniques and signal to noise ratio.
C415.3	To understand various aspects such as orbital equation, subsystems in satellite, link budget and multiple access schemes.
C415.4	To analyze various special purpose communication satellites.
C415.5	To understand and analyze LASER communication in satellite-to-satellite communication.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C415.1	3	2	3	-	-	-	-		-	3	-	3	2		2
C415.2	3	2	3	1	-	-	-	-	-	3	-	3	2		2
C415.3	3	2	3	2		-	-	-	-	3	2	3	2		2
C415.4	2	1	1	-	-			-	-	1	1	2	2		2
C415.5	3	2	2	-	-	-	-	-	-	2	-	2	2		2

Course Coordinator and Instructor _ Dr. Vikas Sindhu

UNIT-I

PRINCIPLES OF SATELLITE COMMUNICATION: Evolution & growth of communication satellite, Synchronous satellite, Satellite frequency allocation & Band spectrum, Advantages of satellite communication, Active & Passive satellite, Applications of satellite communication, Block diagram of transponder and Earth Station, Satellite communication with respect to Fiber Optic Communication.

COMMUNICATION SATELLITE LINK DESIGN: Introduction, General link design equations, System noise temperature, C/N & G/T ratio, Atmospheric & Ionospheric effects on link design, Complete link design.

UNIT-II

ANALOG SATELLITE COMMUNICATION: Introduction, Baseband analog(Voice) signal, FDM techniques, S/N & C/N ratio in frequency modulation in satellite link, S/N ratio in FM with multiplexed telephone signal in satellite link, Single channel per carrier(SCPC) systems, Analog FM/FDM TV satellite link, Energy disposal in FM/FDM systems.

DIGITAL SATELLITE COMMUNICATION: Advantages of digital communication, Elements of digital satellite communication systems, Digital baseband signals, Digital modulation techniques like MSK, QAM, QPSK.

UNIT-III

MULTIPLE ACCESS TECHNIQUES: Introduction, TDMA, TDMA-Frame structure, TDMA-Burst structure, TDMA-Frame efficiency, TDMA- Superframe, TDMA Frame acquisition & Synchronization, TDMA compared to FDMA, TDMA Burst Time Plan. FDMA- FDM/FM/FDMA, Preassigned FDMA, Demand assigned FDMA, Spade System, Limitations of FDM/FM/FDMA, Comparison of TDMA and FDMA.

SATELLITE ORBITS: Introduction, Kepler's laws, Synchronous orbit, Orbital parameters, Satellite location with respect to earth, Look angles, Earth coverage & slant range, Eclipse effect, station keeping, Satellite stabilization, Geostationary and other orbits, Mechanism of launching a satellite.

UNIT-IV

SPECIAL PURPOSE COMMUNICATION SATELLITES: BDS, INMARSAT, INTELSAT, VSAT(data broadband satellite), MSAT(Mobile Satellite Communication technique), Sarsat (Search & Rescue satellite) & LEOs (Lower earth orbit satellite), LANDSAT, Defense satellite.

LASER SATELLITE COMMUNICATION: Introduction, Link analysis, Optical satellite link transmitter, Optical satellite link receiver, Satellite Beam Acquisition, Tracking & Positioning.

TEXT BOOK/ REFERENCE BOOK:

1. Satellite Communication: D.C. Aggarwal; Khanna.
2. Timothy Pratt Charles W. Bostian, Jeremy E. Allnutt: Satellite Communications: Wiley India. 2nd edition 2002
3. Tri T. Ha: Digital Satellite Communications: Tata McGraw Hill, 2009
4. Dennis Roddy: Satellite Communication: 4th Edition, McGraw Hill,2009

course code	**PCC-ECE-404-G**				
Category	**Professional Core Course**				
Course title	**Microwave Theory and Techniques**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 7th**
	03	**0**	0	**3**	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Outcomes: At the end of the Course, the student will have the ability to:

C416.1	Analyze and design the different types of waveguides
C416.2	Classify and visualize the different microwave components and their properties
C416.3	Explain passive and active microwave devices and design principles.
C416.4	Justify that during analysis/synthesis of microwave system the different mathematical treatment is required compared to general circuit analysis.
C416.5	Design microwave systems for different practical applications.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C416.1	3	2				1	1				1	3	3	3	3
C416.2	3	3	2			1	1			1		3	3	3	3
C416.3	3	3	2			1	1			1		3	3	3	3
C416.4	3	3	1			1	1		2	1		3	3	3	3
C416.5	3	2	3			1	1		2	1		2	3	3	3

Course Coordinator and Instructor _ Er. Khushboo

UNIT: I

WAVEGUIDES:

Introduction to Microwaves-History of Microwaves, Microwave Frequency bands; Applications of Microwaves: Civil and Military, Medical, EMI/ EMC. comparison with transmission lines, propagation in TE & TM mode, rectangular wave guide, TEM mode in rectangular wave guide, characteristic impedance, introduction to circular waveguides and planar transmission lines.

UNIT: II

MICROWAVE COMPONENTS:

Directional couplers, tees, hybrid ring, S-parameters, attenuators, cavity resonators, mixers& detectors, matched Load, phase shifter, wave meter, and Ferrite devices: Isolators, circulators.

MICROWAVE TUBES:

Limitation of conventional tubes; Construction, operation and properties of Klystron amplifier, reflex Klystron, magnetron, TWT, BWO, crossed field amplifiers.

UNIT: III

MICROWAVE SOLID STATE DEVICES:

Varactor diode, Tunnel diode, Schottky diode, GUNN diode, IMPATT, TRAPATT and PIN diodes. MASER, parametric amplifiers.

MICROWAVE MEASUREMENTS:

Power measurement using calorimeter & bolometers, measurement of SWR, frequency wavelength and impedance. Microwave bridges

UNIT: IV

MICROWAVE SYSTEMS:

Microwave Systems- Radar, Terrestrial and Satellite Communication, Radio Aids to Navigation, RFID, GPS. Modern Trends in Microwaves Engineering- Effect of Microwaves on human body, Medical and Civil applications of microwaves, Electromagnetic interference and Electromagnetic Compatibility (EMI & EMC), Monolithic Microwave ICs, RFMEMS for microwave components, Microwave Imaging.

TEXT BOOKS:

1. Samuel Liao, Microwave devices and circuits, PHI
2. M .Kulkarni, Microwave devices & Radar Engg, Umesh
3. R.E. Collins, Microwave Circuits, McGraw Hill
4. K.C. Gupta and I.J. Bahl, Microwave Circuits, Artech house

REFERENCE BOOK:

1. Microwaves and Radar : A.K. Maini; Khanna

Course code	**LC-ECE-406-G**				
Category	**Laboratory Course**				
Course title	**WIRELESS & SATELLITE COMMUNICATION LAB**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 8th**
	0	**0**	**2**	**3**	
Class work	25 Marks				
Exam	25 Marks				
Total	50 Marks				
Duration of Exam	3 Hours				

Course Outcomes: At the end of the Course, the student will have the ability to:

C417.1	To Establish connection between earth stations and satellite with different uplink and downlink frequencies.
C417.2	To understand transfer of audio and video signal through satellite and transmission of telemetry data.
C417.3	To find out the delay of signal in satellite links.
C417.4	To analyze and understand the radiation pattern of Yagi Uda & Folded dipole, Circular & Triangular Patch antenna.
C417.5	To analyze and understand FHSS Modulation & demodulation, DSSS and CDMA Technology.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C417.1	3	1	2	2	-	-	-	-	-	3	-	-	2	-	2
C417.2	3	1	2	2	-	-	-	-	-	3	-	-	2	-	2
C417.3	3	3	3	2	-	-	-	-	-	2	2	-	2	-	2
C417.4	3	1	2	2	2	-	-	-	-	3	-	-	2	-	2
C417.5	3	1		-	-	-	-	-	-	2	-	-	2	-	2

Course Coordinator and Instructor _ Dr. Vikas Sindhu

LIST OF EXPERIMENTS:

1. To set up a satellite communication link & study of change in uplink & downlink frequency.

2. To Study Transmission of Audio & Video Signals & Data communication over satellite link.

3. To Study Transmission of telemetry data like temperature & light intensity over satellite link

4. To measure the propagation delay of a signal in a Satellite communication Link.

5. To study different GPS data like longitude, latitude & different types of dilute of precision using a GPS receiver..

6. To study selection of various PN codes like Gold, Barker & MLS in CDMA technology .

7. To study generation (spreading) & demodulation (Despreading) of of DSSS modulated signal

8. To study Voice communication over DSSS.

9. To study Minimum shift keying modulation & demodulation.

10. To study radiation pattern & calculate beam width for Yagi uda & Folded dipole antenna.

11. To study radiation pattern & calculate beam width for Circular & Triangular Patch Antenna.

12. to study FHSS Modulation & demodulation & transfer of numeric data.

NOTE:

At least ten experiments are to be performed.

Course code	**OEC-ECE-417-G**				
Category	**Open Elective course**				
Course title	**Renewable Energy Resources**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 8th**
	3	**0**	0	**3**	
Class work	25				
Exam	75				
Total	100				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Outcomes: At the end of the Course, the student will have the ability to:

C421.1	Describe various conventional and nonconventional energy resources
C421.2	Explain the working principle of Solar Thermal power plant
C421.3	Describe Geothermal energy resources build smart society applications
C421.4	Explain working principle of MHD power plant
C421.5	Discuss working principle of fuel cell
C421.6	Explain various renewable energy resources

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C421.1	3	-	-	-	-	2	2	-	2	3	2	3	3		2
C421.2	3	3	-	-	2	3	-	-	3	2	1	3	3		3
C421.3	3	3	3	3	3	3	3	-	2	3	-	3	3		2
C421.4	3	-	-	-	-	-	-	-	-	3	-	2	3		1
C421.5	3	3	3	-	3	-	-	-	1	1	-	1	3		-
C421.6															

Course Coordinator and Instructor _ Er. Khushboo

UNIT-I

Introduction: Various non-conventional energy resources- Introduction, availability, classification, relative merits and demerits. Solar Cells: Theory of solar cells. Solar cell materials, solar cell array, solar cell power plant, limitations.

UNIT-II

Solar Thermal Energy: Solar radiation, flat plate collectors and their materials, applications and performance, focussing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations.
Thermo-electrical and thermionic Conversions: Principle of working, performance and limitations.

UNIT-III

Geothermal Energy: Resources of geothermal energy, thermodynamics of geothermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations. Magneto-hydrodynamics (MHD): Principle of working of MHD Power plant, performance and limitations. Fuel Cells: Principle of working of various types of fuel cells and their working, performance and limitations.

UNIT-IV

Wind Energy: Wind power and its sources, site selection, criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics, performance and limitations of energy conversion systems.
Ocean Thermal Energy Conversion (OTEC): Availability, theory and working principle, performance and limitations. Wave and Tidal Wave: Principle of working, performance and limitations.

Text/Reference Books:

1. Raja etal, “Introduction to Non-Conventional Energy Resources” Scitech Publications.
2. John Twideu and Tony Weir, “Renewal Energy Resources” BSP Publications, 2006.
3. M.V.R. Koteswara Rao, “Energy Resources: Conventional & Non-Conventional” BSP Publications,2006.
4. D.S. Chauhan,”Non-conventional Energy Resources” New Age International.
5. C.S. Solanki, “Renewal Energy Technologies: A Practical Guide for Beginners” PHI Learning.
6. Peter Auer, "Advances in Energy System and Technology". Vol. 1 & II Edited by Academic Press.
7. Godfrey Boyle, “Renewable Energy Power For A Sustainable Future”, Oxford University Press.

Course code	**OEC-ME-455-G**				
Category	**Open Elective Course**				
Course title	**Composite Materials**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 8th**
	3	**0**	0	**3**	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Outcomes: At the end of the Course, the student will have the ability to:

C422.1	Identify and understand the basic mechanical behavior of composite materials and make sound prediction on the likely behavior of new combinations of materials
C422.2	Apply the choices made for using certain types of composites in certain applications with reference to composite properties.
C422.3	Demonstrate a practical understanding of composite properties and fabrication techniques, and to be able to make realistic suggestions for the evaluation of composite behavior, where appropriate
C422.4	Analyse the micromechanical properties of fibre reinforced composites

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C422.1	3	3		2	2	3	3		2		1	3			
C422.2	3	3		2	2	3	3		2		3	3			
C422.3	3	2	1	3	3	3	3		2		2	3			
C422.4	3	3		3			3					3			

Course Coordinator and Instructor _ Dr. Vikas Nandal

Unit-1 Introduction: Classifications of Engineering Materials, Concept of composite materials, Matrix materials, Functions of a Matrix, Desired Properties of a Matrix, Polymer Matrix (Thermosets and Thermoplastics), Metal matrix, Ceramic matrix, Carbon Matrix, Glass Matrix etc. Types of Reinforcements/Fibers: Role and Selection or reinforcement materials, Types of fibres, Glass fibers, Carbon fibers, Aramid fibers , Metal fibers, Alumina fibers, Boron Fibers, Silicon carbide fibers, Quartz and Silica fibers, Multiphase fibers, Whiskers, Flakes etc., Mechanical properties of fibres. Material properties that can be improved by forming a composite material and its engineering potential

Unit-2 Matrix composites: Classification based on Matrix Material: Organic Matrix composites, Polymer matrix composites (PMC), Carbon matrix Composites or Carbon-Carbon Composites, Metal matrix composites (MMC), Ceramic matrix composites (CMC);

Unit-3 Reinforced Composites: Classification based on reinforcements: Fiber Reinforced Composites, Fiber Reinforced Polymer (FRP) Composites, Laminar Composites, Particulate Composites, Comparison with Metals, Advantages & limitations of Composites

Unit-4 Testing of Composites: Mechanical testing of composites, tensile testing, Compressive testing, Intra-laminar shear testing, Inter-laminar shear testing, Fracture testing etc.

TEXT/ REFERENCE BOOKS:

1. Materials characterization, Vol. 10, ASM hand book
2. Mechanical Metallurgy by G. Dieter Mc-Graw Hill
3. Thermal Analysis of Materials by R.F. Speyer, Marcel Decker
4. Engineering Materials: Polymers, Ceramics and Composites A.K Bhargava Prentice Hall India

Course code	**OEC-BME-419-G**				
Category	**Open Elective Course**				
Course title	**BIOSENSORS**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 8th**
	3	**0**	0	**3**	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Outcomes: At the end of the Course, the student will have the ability to:

C423.1	Understand the basic principles of biosensing in terms of biological, chemical and optical/photonic responses
C423.2	Demonstrate knowledge of the general principles of sampling and analysis, statistical presentation and manipulation of data generated by biosensors
C423.3	Demonstrate familiarity with the literature on biosensors, including up to date knowledge of the state of the art and the direction of future developments
C423.4	Understand and integrate knowledge from other engineering disciplines, particularly biomedical engineering
C423.5	Demonstrate knowledge of the industrial and socioeconomic context of biosensor development and market

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C423.1	3	3		2	2	3	3		2		1	3	3		2
C423.2	3	3		2	2	3	3		2		3	3	3		1
C423.3	3	2	1	3	3	3	3		2		2	3	3		3
C423.4	3	3		3			3					3	3		2
C423.5	3	3			3		3				2	3	3		2

Course Coordinator and Instructor _ Dr. Anil Sangwan

UNIT:I

Overview of biosensors and their electrochemistry: Molecular reorganization: Enzymes, Antibodies and DNA, Modification of bio recognition molecules for Selectivity and sensitivity, Fundamentals of surfaces and interfaces

UNIT:II

Bioinstrumentation and bioelectronics devices: Principles of potentiometry and potentiometric biosensors, Principles of amperometry and amperometric biosensors, Optical Biosensors based on Fiber optics, Introduction to Chemometrics, Biosensor arrays; Electronic nose and electronic tongue.

UNIT:III

Iron-Selective Field-Effect Transistor (ISFET), Immunologically Sensitive Field Effect Transistor (IMFET). Fabrication and miniaturization techniques.

UNIT:IV

Sensor-to-Frequency Conversion Data-Acquisition Systems: Hardware and Software of Data Acquisition System (DAS), Electronic Interface, Integrated Sensors, Wireless integration. Smart sensor, Nano sensor.

Text Books: 1. Gardner, J.W., Microsensors, Principles and Applications, John Wiley and Sons (1994). 2. Kovacs, G.T.A., Micromachined Transducer Sourcebook, McGraw□Hill (2001).
3. Turner, A.P.F., Karube,I., and Wilson G.S., Biosensors□Fundamentals and Applications, Oxford University Press (2008)
4. Jon Cooper, *Biosensors A Practical Approach*, Bellwether Books
5. Manoj Kumar Ram, Venkat R, Bhethanabolta, *Sensors for chemical and biological applications*, CRC Press

Disaster Management		
Course Code	**OEC-CE-417G**	**External Marks: 75**
Credits	**3**	**Internal Marks: 25**
L-T-P	**3-0-0**	**Total Marks: 100**
		Duration of Examination: 3hrs

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Outcomes: At the end of the Course, the student will have the ability to:

C424.1	Explain disaster management basics and theory
C424.2	Compare hazards, disasters and associated natural phenomena and their interrelationships, causes and their effects
C424.3	Compare anthropogenic hazards, man made disasters and associated activities and their interrelationships of the subsystems
C424.4	Evaluate by conducting DM study including data search, analysis and presentation of a disaster case study
C424.5	Understand the execution and implementation of Disaster Management

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C424.1	3	3													
C424.2						3		3				3			
C424.3						3		3				3			
C424.4				3	3										
C424.5					3					3					

Course Coordinator and Instructor _ Dr. Shamsher Singh

Unit-I

Module 1: Introduction

Definition of Disaster, hazard, Global and Indian scenario, role of engineer, importance of study in human life, long term effects of disaster. Geological Mass Movement and land disasters, Atmospheric disasters, Disaster Mitigation

Unit-II

Module 2: Natural Disaster

Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion

Module 3: Man-made Disasters

Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.

Unit -III

Module 4: Case Studies

Damage profile analysis- Uttarkashi/Bhuj/Latur earthquakes. Forest Related disasters, Mining disasters, Atmospheric disasters.

Unit IV

Module 5: Disaster Management

Importance of public awareness, Preparation and execution of emergency management programme. Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India. Use of Internet and software for effective disaster management. Applications of GIS, Remote sensing and GPS in this regard.

Reference Books

- Singhal J.P. Disaster Management, Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
- Tushar Bhattacharya, Disaster Science and Management, McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367, ISBN-13: 978-1259007361]
- Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011

Solid & Hazardous waste management		
Course Code	**OEC –CE-402G**	**External Marks: 75**
Credits	**3**	**Internal Marks:25**
L-T-P	**3-0-0**	**Total Marks: 100**
		Duration of Examination: 3h

Note: Examiner will set 9 questions in total, with two questions from each section and one question covering all the section which will be Q. 1. Question number 1 will be compulsory and of short answer type. Each question carries equal marks (15 marks). Students have to attempt five questions in total by selecting one question from each section

Course Outcomes: At the end of the Course, the student will have the ability to:

C425.1	Understanding of problems of municipal waste, biomedical waste, hazardous waste, e-waste, industrial waste etc.
C424.2	Knowledge of legal, institutional and financial aspects of management of solid wastes
C424.3	Knowledge of legal, institutional and financial aspects of management of solid wastes
C424.4	Understand engineering, financial and technical options for waste management

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C425.1			3		3	3	3	3	3		3				
C425.2	1		3		1	2	3	2	3		3				
C425.3	2		2		3	2	2	1	3		2				
C425.4	3	3	1	3	2	3	3				3				

Course Coordinator and Instructor _ Dr. Shamsher malik

Unit I

Module:1 Sources and Composition of Municipal Solid Waste

Introduction, Sources and Types of solid waste, Composition of Solid Waste and its Determination, Properties of Municipal Solid Waste

Module:2 Solid Waste Generation and Collection

Quantities of Solid Waste, Measurements and methods to measure solid waste quantities, Solid waste generation and collection, Factors affecting solid waste generation rate, Quantities of materials recovered from MSW.

Unit II

Module:3 Handling, Separation and Processing of Solid Waste

Handling and separation of solid waste at site- Material separation by pick in, screens, float and separator magnets and electromechanical separator and other latest devices; Waste handling and separation at Commercial and industrial facilities, Processing of solid waste at residence, Commercial and industrial site - Storage, conveying, compacting, Shredding, pulping, granulating etc.

Module:4 Disposal of Municipal Solid Waste

Landfill: Classification, planning, sitting, permitting, landfill processes, landfill design, landfill operation, use of old landfill; Combustion and energy recovery of municipal solid waste, effects of combustion, undesirable effects of Combustion

Unit III

Module:5 Hazardous Waste Management

Definition, identification, and classification of hazardous solid waste. The magnitude of the problem; Hazardous waste: Risk assessment, Environmental legislation, Characterization, and site assessment.

Module:6 Biological Treatment of Solid and Hazardous Waste

Composting; bioreactors; anaerobic decomposition of solid waste; principles of biodegradation of toxic waste; inhibition; co-metabolism; oxidative and reductive processes; slurry phase bioreactor; in-situ remediation.

Unit IV

Module:7 Radioactive Waste Management

Fundamentals Sources, measures and health effects; nuclear power plants and fuel production; waste generation from nuclear power plants; disposal options.

Module:8 Electronic waste management

E waste- Definition, composition; environmental and human health issues, recovery of metals from E waste, E waste management,

Suggested Books:

1. Basics of Solid and Hazardous Waste Mgmt. Tech. by Kanti L.Shah 1999, Prentice Hall.

2. Solid And Hazardous Waste Management 2007 by S.C.Bhatia Atlantic Publishers & Dist.

3. John Pichtel Waste Management Practices CRC Press, Taylor and Francis Group 2005.

Course code	OEC –ME-402-G				
Category	Open Elective Courses (OEC) (Semester-VIII) List-III				
Course title	**OPERATIONS RESEARCH**				
Scheme and Credits	L	T	P	**Credits**	Semester-VIII
	3	0	0	3	
Objectives:	The aims of operation research include solving operational questions, solving questions related to resources' operations, and solving decision-making questions. Operational research has a relation with different areas of study and it has several applications. Operation research is considered as a tool of productivity. In comparison to traditional approaches, operation research provides more extensive, quantitative, and detailed information about different issues and managers can implement their decisions based on quantitative analyses. Operation research will be a good assistance for managers in different areas.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 10 parts of 2.5 marks from all units and remaining eight questions of 12.5 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Course Outcomes: At the end of the Course, the student will have the ability to:

C426.1	Understand operational research and linear programming
C426.2	Study and analyze different deterministic models and advance LP
C426.3	Study and analyze waiting and project line models
C426.4	Simulate, validate different models, and study Monte-Carlo methods
C426.5	Description of decision process and SIMON model types

Mapping of Course Outcomes to Program Outcomes:

CO/P	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

O															
C426.1	2	2		2								3			3
C426.2		2										3			2
C426.3	2				2							3			2
C426.4		2								2		3			1
C426.5					2							3			2

Course Coordinator and Instructor _ Dr. Vikas Sindhu

UNIT-I

Introduction: Definition, role of operations research in decision-making, applications in industry. Concept on O.R. model building –Types & methods.

Linear Programming (LP): Programming definition, formulation, solution- graphical, simplex GaussJordan reduction process in simplex methods, BIG-M methods computational, problems.

UNIT-II

Deterministic Model: Transportation model-balanced & unbalanced, north west rule, Vogel's Method, least cost or matrix minimal, Stepperg stone method, MODI methods, degeneracy, assignment, traveling salesman, problems.

Advanced Topic Of LP: Duality, PRIMAL-DUAL relations-its solution, shadow price, economic interpretation, dual-simplex, post-optimality & sensitivity analysis, problems.

UNIT-III

Waiting Line Models: Introduction, queue parameters, M/M/1 queue, performance of queuing systems, applications in industries, problems.

Project Line Models: Network diagram, event, activity, defects in network, PERT & CPM, float in network, variance and probability of completion time, project cost- direct, indirect, total, optimal project cost by crashing of network, resources leveling in project, problems.

UNIT-IV

Simulation: Introduction, design of simulation, models & experiments, model validation, process generation, time flow mechanism, Monte Carlo methods- its applications in industries, problems.

Decision Theory: Decision process, SIMON model types of decision making environment-certainty, risk, uncertainty, decision making with utilities, problems.

Text Books:

1) Operation Research – TAHA, PHI, New Delhi.

2) Principle of Operations Research – Ackoff, Churchaman, arnoff, Oxford IBH, Delhi.

Reference Books :

1) Operation Research- Gupta & Sharma, National Publishers, New Delhi.
2) Quantitative Techniques- Vohra, TMH, New Delhi 8. Principles of operation Research (with Applications to Managerial Decisions) by H.M.Wagher, Prentice Hall of India, New Delhi.
3) Operation Research – Sharma, Gupta, Wiley Eastern, New Delhi.
4) Operation Research – Philips, Revindran, Solgeberg, Wiley ISE.

Course code	OEC –EE-412G					
Category	Open Elective Courses (OEC) (Semester-VIII) List-I					
Course title	**ELECTRICAL POWER GENERATION**					
Scheme and Credits	L	T	P	**Credits**	Semester-VIII	
	3	0	0	3		
Objectives:	The aims of Electrical power generation include: The aim of subject is to get knowledge about power generation and its related issues.					
Class work	25 Marks					
Exam	75 Marks					
Total	100 Marks					
Duration of Exam	03 Hours					

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 10 parts of 2.5 marks from all units and remaining eight questions of 12.5 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Course Outcomes: At the end of the Course, the student will have the ability to:

C428.1	Analyze and study about energy resources, their trends and generation through power plants	
C428.2	Study and mathematically analyze power generation planning	
C428.3	Description of different conventional sources for power generation	
C428.4	Study of different type of energy conservation and management methods	

Mapping of Course Outcomes to Program Outcomes:

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C428.1				3	3							3		2	
C428.2	3	1			2									2	
C428.3	2	1													2
C428.4	2				2	2					3				2

Course Coordinator and Instructor _ Dr. Vikas Sindhu

UNIT-I

INTRODUCTION: Energy sources, their availability, recent trends in Power Generation, Interconnected Generation of Power Plants.

UNIT-II

POWER GENERATION PLANNING: Load forecasting, load curves, load duration curve, Base load and Peak load Power Plants, connected Load, maximum demand, demand factor, Group diversity factor, load factor, significance of load factor, plant factor, capacity factor, selection of unit size, No. of Units, reserves, cost of power generation, Depreciation, tariff.

UNIT-III

CONVENTIONAL ENERGY SOURCES: Selection of site, capacity calculations, classification, Schematic diagram and working of Thermal Power Stations, Hydro Electric Plant, Nuclear Power Plant and Diesel Power Stations.

UNIT-IV

ELECTRIC ENERGY CONSERVATION & MANAGEMENT: Energy management, Energy Audit, Energy Efficient Motors, Co-generation.

TEXTBOOKS:

1. Electric Power Generation, B.R.Gupta
2. Power Generation, Operation and Control, Wood and Wollenberg, John Wiley & Sons,1984.

REF. BOOKS:

1. A Course in Electric Power System, Soni, Gupta, Bhatnagar, Dhanpat Rai & Sons
2. Power System Engineering, Nagrath & Kothari, Tata Mc-Graw Hill, New Delhi
3. Power Plant Engg: G.D. Rai
4. Electric Power: S.L. Uppal (Khanna Publishing)

Course code	**PROJ-ECE-408-G**				
Category	**Project**				
Course title	**Project Work II/ Dissertation**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 8th**
	0	**0**	**8**	**6**	
Class work	100				
Exam	150				
Total	250				
Duration of Exam	03 Hours				

The object of Project Work II & Dissertation is to enable the student to extend further the investigative study taken up under EC P1, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership.

Course Outcomes: At the end of the Course, the student will have the ability to:

CO1	Detail study of the problem faced in previous semester in topic of project/reseach
CO2	Describe methodology to approach the issue laid down
CO3	Development of the project hardware/software based.
CO4	Optimization of the performance of the work done
CO5	Prepare and submit the final report of the project.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	-	-	3	-	-	-	-	-	-	-	-	-	1
CO2	1	3		3	3		2	-	-	-	2	2	1	-	1
CO3	3	1	3	3	3	3	2	2	1	2	2		3	-	3
CO4	-	3	-	3	-	-	-	-	1	-	-	-	3	1	-
CO5	1	-	-		3	-	-	-		-	-	-	-	-	1

Course Coordinator and Instructor _ Dr. Suresh Kumar

The assignment to normally include:

1. In depth study of the topic assigned in the light of the Report prepared under PROJ-ECE-407-G.

2. Review and finalization of the Approach to the Problem relating to the assigned topic.

3. Preparing an Action Plan for conducting the investigation, including team work.

4. Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed.

5. Final development of product/process, testing, results, conclusions and future directions.

6. Preparing a paper for Conference presentation/Publication in Journals, if possible.

7. Preparing a Dissertation in the standard format for being evaluated by the Department.

8. Final Seminar Presentation before a Departmental Committee.