Heritage Institute of Technology

M.Tech. – Electronics and Communication Engineering

CURRICULUM STRUCTURE

RELEASE DATE: July, 2018

Version:1.0

1st. Year, Semester 1

A. Theory								
Sl No	**Course Type**	**Code**	**Course Title**	**Contact Hrs/Week**				**Credits**
				L	T	P	Total	
1	Professional Core 1	**ECEN5101**	Antenna and Radiating Systems	3	0	0	3	3
2	Professional Core 2	**ECEN5102**	Wireless and Mobile Communication	3	0	0	3	3
3	Professional Elective I (Prog. Specific Professional Elective)	**ECEN5131**	1) Wireless Ad Hoc and Sensor Networks	3	0	0	3	3
		ECEN5132	2) Photonics and Optical Communication Networks					
		ECEN5133	3) Statistical Process in Communication					
4	Professional Elective II (Prog. Specific Professional Elective)	**ECEN5141**	1) Satellite Communication and applications	3	0	0	3	3
		ECEN5142	2) Multimedia Communication					
		ECEN5143	3) Cryptography and Network Security					
5	Mgt. Group	**ECEN5103**	Research Methodology & IPR	2	0	0	2	2
6	Audit 1	**DIMA5116**	Disaster Management	2	0	0	2	0
		INCO5117	Constitution of India					
		PDLS5118	Personality Development					
		YOGA5119	Stress Management by Yoga					
		SANS5120	Sanskrit for Technical Knowledge					
Total Theory				16	0	0	16	14

B. Practical								
1	Professional lab1	**ECEN5151**	Antenna and Radiating Systems lab	0	0	4	4	2
2	Professional lab2	**ECEN5152**	Wireless and Mobile Communication lab	0	0	4	4	2
Total Practical				**0**	**0**	8	8	**4**
Total for Semester				**16**	**0**	**8**	**24**	**18**

1st. Year, Semester 2

A. Theory								
Sl No	**Course Type**	**Code**	**Course Title**	**Contact Hrs/Week**				**Credits**
				L	T	P	Total	
1	Professional Core 3	**ECEN5201**	Advanced Digital Communication Techniques	3	0	0	3	3
2	Professional Core 4	**ECEN5202**	Advanced DSP & applications	3	0	0	3	3
3	Professional Elective III (Prog. Specific Professional Elective)	**ECEN5231**	1) Telecommunication Systems and Engineering	3	0	0	3	3
		ECEN5232	2) Image Processing and Pattern Recognition					
4	Professional Elective IV (Prog. Specific Professional Elective)	**ECEN5241**	1) Cognitive Radios and networks	3	0	0	3	3
		ECEN5242	2) Microwave Measurement and Instrumentation					
		ECEN5243	3) Design of Communication Equipments and Systems					
5		**ECEN5293**	Term Paper & Seminar	0	0	4	4	2
6	Aud 2	**Any course from Professional Elective III or Professional Elective IV buckets**	Audit Course 2	2	0	0	2	0
Total Theory				**14**	**0**	**4**	**18**	**14**

B. Practical								
1	Professional lab 3	**ECEN5252**	Advanced DSP & applications lab	0	0	4	4	2
2	Professional lab 4	**ECEN5253**	Design and Simulation lab	0	0	4	4	2
Total Practical				**0**	**0**	8	**8**	**4**
Total for Semester				**14**	**0**	**12**	**26**	**18**

2nd. Year, Semester 1

A. Theory								
Sl No	**Course Type**	**Code**	**Course Title**	**Contact Hrs/Week**				**Credits**
				L	T	P	Total	
1	Professional Elective V (Prog. Specific Professional Elective)	**ECEN6131**	1) Remote Sensing	3	0	0	3	3
		ECEN6132	2) IOT					
		ECEN6133	3) MIMO					
2	Open Elective	**MATH6121**	1) Optimization Techniques	3	0	0	3	3
			2) Industrial Safety					
			3) Cost Management of Engineering Projects					
Total of Theory				6	0	0	6	6
B. Sessional								
1	Dissertation	**ECEN6195**	Dissertation Phase I	0	0	20	20	10
Total of Semester				6	0	20	26	16

2nd. Year, Semester 2

Sl No	Course Type/Code	Code	Course Title	Contact Hrs/Week				Credits
				L	T	P	Total	
1	Dissertation	**ECEN6295**	Dissertation Phase II	0	0	32	32	14
2	Viva Voce	**ECEN6297**	Comprehensive Viva Voce	-	-	-	-	2
Total of Semester						**32**	**32**	**16**

Total Credits: 68

Heritage Institute of Technology

M.Tech. – Electronics and Communication Engineering

SYLLABI

RELEASE DATE: July, 2018

Version:1.0

First Year Syllabus

First Year, First Semester:

Course Title: Antenna and Radiating Systems					
Course Code : ECEN5101					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

Students will come to know about:

1. Antenna – Radiation, VSWR, aperture.

2. Types of antennae and antenna arrays including microstrip antenna.

3. Testing principles of antennae.

4. EMI and EMC and associated hazards.

Module- I [8L]
A. Review of Maxwell's Equation; Radiation of e.m waves and introducing Antenna; Vector Potential and Retarded Vector Potential; Radiation fields of a Hertzian dipole(electric); Duality Principle, Radiation fields due to short magnetic dipole.
B. Antenna Characteristics: Radiation Pattern, Beam Width; Radiation Resistance and efficiency; Directivity and Gain; Impedance, VSWR, Polarization; Effective height and Receive Aperture; Noise Temperature of Antenna

Module- II [8L]
A. Review of basic wire based antennas, Characteristics and properties of : Travelling Wave Antenna, Helical Antenna, Folded Dipole, Yagi-Uda Array, Loop Antenna, Electrically Short Antennas, Broad Band Antenna
B. Antenna Arrays: electric Field due to 2 element arrays, N element Arrays; Pattern Multiplication; Phased array.

Module- III [8L]
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A. Radiation from apertures, general formulas for scattering and diffraction in and effective area of apertures. Different kind of aperture antennas. Reflector antennas. Appropriate methods for solving reflector antenna problems. Primary feed system design.

B. Microstrip Antenna(MSA),Active Integrated MSA, Compact MSA with enhanced gain, Broadband Antenna(MSA), Dual frequency & Dual polarized MSA Application of broadcasting, microwave links, satellite communication and radio astronomy.

Module- IV [8L]

A. Methods of Propagation: Ground Wave Propagation, Components of ground wave, Field strength dependence on physical factors. Sky wave Propagation;Space wave propagation. Friss Transmission Formula, SNR of a Radio Link.

B. Basic Terms and Definitions, A Summary of EMI and Related instruments, Error Analysis, Conducted Emission Test procedures, Radiated Emission Test Procedures, Radiated – Susceptibility Test Procedures. LISN

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References:

1. R.E Collin, Antennas & Radio wave propagation (McGraw-Hill Book Co.)
2. Jordan and Balmain, Electromagnetic Waves and Radiating Systems (PrenticeHall of India)
3. M.L Skolink, Introduction to radar systems (McGraw-Hill Book Co.)
4. P Bhartia and I.J. Bhal, Millimeter wave Engineering & Applications
5. Albart Smith, Radio Engineering Principle and Applications
6. M. Dolukhanov, Propagation of Radio Waves (Mir Publication)
7. R.Garg,P.Bhartia,Indu Bhal,A.Ittipibom ; Microstrip Antenna Design hand book –Artech House
8. Girish Kumar & K.P.Roy—Broad band Microstrip Antenna-=Artech. House
9. Kin. Lu. Wong ; Compact and Broadband Microstrip Antenna—John Willey & Sons.

Course Title: WIRELESS and MOBILE COMMUNICATION					
Course Code : ECEN 5102					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcomes:

1. The students will understand the challenges of wireless and mobile communication.

2. They will be able to analyse the factors like fading, SNR.

3. The students should be able to explain the working of a cellular system- both GSM and CDMA.

4. They will have knowledge about protocols like TCP/IP.

Module I: [8 L]

Introduction - evolution of wireless and mobile radio communications, mobile radio systems around the world, trends in cellular radio and personal communication, first generation (1G), second generation (2G), third generation (3G) and 4G mobile cellular networks, Concept of SDR and UMTS.

Cellular concept – Limitations of conventional mobile system, Introduction to mobile cellular communication, concept of frequency reuse, cluster size, cellular system architecture, channel assignment strategies, call handoff strategies - hard

handoff and soft handoff, prioritizing handoff; interference and system capacity, improving capacity in cellular systems – cell splitting, sectoring, microcell zone concept.

Module II: [10 L]

Different mobile communication systems – GSM services and features, system architecture, GSM radio subsystem, GSM channel types, location updating and call setup, WAP, SCSD, GPRS, EDGE, 3G W-CDMA; CDMA digital cellular standard, comparison between GSM and CDMA, 3G CDMA 2000, IMT-2000.

Module III: [10 L]

Radio Channels and their Characterisation – Different propagation models – Hata , Okimura models, Free space propagation, Multipath propagation, diversity techniques, Co-channel interference, Propagation effects - scattering, ground reflection, fading, Log-normal shadowing.

Wireless networks – Advantages and applications of Wireless LAN, WLAN technology – RF and IR wireless LAN, diffuse, quasi diffuse and point-to-point IR wireless LAN, IEEE802.11 and its architecture, Physical layer, MAC layer, Introduction to WIFI, HIPERLAN2, Bluetooth – Bluetooth architecture.

Module IV: [6 L]

Mobile network and transport layer – Introduction to Mobile IP, requirements, IP packet delivery, Agent discovery, Registration, Tunneling and encapsulation, Optimization, Reverse tunneling; Mobile adhoc networks – Routing, Destination sequence distance vector, Dynamic source routing and Alternative metrics; Traditional TCP – Congestion control, Slow start, Fast retransmit / fast recovery, Implications of mobility; classical TCP improvements – Indirect TCP, Snooping TCP, Mobile TCP,Fast retransmit.

Future of mobile communication – 3G to 4G.

References:

1. Theodore S. Rappaport, Wireless communications: principles and practice, PHI / Pearson education.

2. J. Schiller, Mobile communications, Addison-Wesley.

3. William C. Y. Lee, Mobile cellular telecommunication – analog and digital systems, McGraw Hill, 2nd ed.

4. Wang, Wireless communication System, Pearson Education

5. Talukdar, Mobile computing, TMH

6. J.W.Mark, W. Zhuang, Wireless Communication and Networking, PHI

7. A. Santamaria et al, Wireless LAN systems, Artech House.

8. Stallings, Wireless Communication & Networks, Pearson Education

9. K. Feher, Wireless digital communications, Prentice Hall of India.

9. Roy Blake, Wireless communication technology, Thomson Delmer.

Course Title : WIRELESS AD HOC AND SENSOR NETWORKS					
Course Code : ECEN5131					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course outcomes:

1.Students will develop the ability to apply knowledge of mathematics, science and engineering in the areas of communication engineering.

2. They will be able to analyze a situation and interpret a data in ad hoc networks.

3. Students will acquire knowledge to learn and apply modeling based approach through the extensive use of simulator tools.

4. Students will be able to understand and develop ability to participate in research work.

Module I: [10 L]

Ad hoc wireless Network: Introduction, Basic concept on ad hoc network, static and mobile ad hoc network, transmitter-receiver constraints, Applications.

MAC protocol: Hidden terminal, Exposed terminal, IEEE802.11 in ad hoc mode.

Routing protocols: Proactive, Reactive and hybrid routing protocol, Destination sequenced distance vector algorithm, Dynamic source routing, Ad hoc on-demand routing, Location aided routing, Link reversal routing.

Module II: [10L]

Analysis of TCP performance in wireless ad hoc network: TCP window management and problems, different solution schemes, QoS in wireless ad hoc network – analysis of degradation of receiver sensitivity, practical solutions.

Achieving energy efficiency in wireless ad hoc network: Different schemes to increase the lifetime of the node in ad hoc network – MAC layer protocol, Routing protocol.

Module III: [8 L]

Localization Management: Location acquisition technique, location sensing technique, location aware routing protocol. Primary and secondary source , Different principles like weighted centriod algorithm to locate sources. Security for wireless ad hoc network: Security goals, threats and challenges, Different schemes of security in ad hoc network, routing security. Spectrum utilization – Generic Access Network (GAN) and other methods

Module IV: [6 L]

. Sensors- sensor networking, WSN, hardware and software platforms, OS for WSN, distributed sensor network, healthcare monitoring, environmental sensing, industrial monitoring, smart city concept.

Reading:

1.”Ad Hoc Wireless Networks – Architectures and Protocols” - C.Siva Ram Murthy and B.S. Manoj – Pearson Education

2.Mobile Ad Hoc Networking – Stefano Basagni, Marco Conti, Silvia Giardano, Ivan Stojmenovic – Wiley India

3.”Ad Hoc Mobile Wireless Networks : Principles Protocols and Applications” – Basavaraju – Aurbach Publications

4.Security and Quality of Service in Ad Hoc Wireless Networks – Amitabh Misra – Cambridge University Press

5.”Ad Hoc Mobile Wireless Networks – Protocols and Systems” - Chai K. Toh – Prentice Hall

Course Title:PHOTONICS AND OPTICAL COMMUNICATION NETWORKS					
Course Code : ECEN5132					
Contact Hours per week	L	T	P	Total	Credit Points
	4	0	0	4	4

Course Outcomes:

1. Students will know about the different modes, devices,detectors, amplifiers using optical fiber communication.

2. They will have knowledge about various types of systems with their strengths and weaknesses.

3. The students will know about different types of optical networks.

Module I: Photonics: [10 L]

o Introduction to Photonic materials and Photonic Devices.

o Optical waveguides., Optical Fiber Modes and Configurations

o Optical fibers - application specific optical fibres, Photonic Bandgap Optical Fibers.

o Graded Index and Single Mode Fibers.

o Optical couplers;

o Fiber.Bragg gratings

o Electro-optic devices

o Semiconductor lasers and light-emitting diodes

o Photodetectors PIN, Photodiodes and Avalanche Photodiodes.

o Optical Amplifiers- doped fiber amplifier.

Module II: Optical Communication: [8 L]

o Analog and Digital Optical Transmitters and Receivers concepts,

o Loss- limited and dispersion- limited lightwave systems,

o Long-haul systems with In-Line Amplifiers,

o Dispersion compensation techniques in optical communication systems,

o Power budget and rise-time.

Module III: Coherent lightwave systems: [8 L]

o Modulation and Demodulation schemes for coherent communication,

o System performance issues.

Multichannel Lightwave systems:

o WDM components and devices,

o Multiplexing techniques and system performance considerations.

Module IV: Optical Networks: [10 L]

o Network topologies,

o SONET/SDH,

o Broadcast-and- Select WDM Networks- single-hop networks, multihop Networks,

o Wavelength routed networks,

o Photonic packet switching

o Soliton Communication

References:

1. Keiser, G. , Optical Fiber Communications, Mcgraw Hill

2. John Senior, Optical Fiber Communications: Principles and Practice, Prentice Hall

3. Ajoy Ghatak & K. Thyagarajan, Cambridge University Press

4. Govind R. Agrawal, Fiber Optic Communication Systems, Wiley

Course Title: STATISTICAL PROCESS IN COMMUNICATION					
Course Code : ECEN5133					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

1. Students will know about the different matrices and filters used in communication systems.

2. They will have knowledge about modeling of signals.

3. The students will know about techniques of detection.

4. The students will be able to differentiate between filters.

Module I: [10 L]

Revision of linear algebra:

Special matrix forms – diagonal matrix, exchange matrix, triangular matrix, Toeplitz matrix, Hankel matrix, symmetric matrix,

parametric matrix, centro symmetric matrix.

Eigen values, Eigen value solutions.

Random process:

Definition and description of random processes with practical examples.

Time average, ensemble average, covariance, autocorrelation, cross correlation.

Stationary process, ergodic process, WSS process, power spectrum of random processes.

Filtering of random processes – filtering of white noise, spectral shaping filter, spectral factorization.

Special random processes – Autoregressive moving average process, autoregressive process, moving average process, harmonic process.

Module II: [10 L]

Signal modeling:

Least square method, Pade approximation method, filter design using Pade approximation, Prony's method of signal

modeling, filter design using Prony's method, FIR least square inverse filter, iterative prefilters,

Stochastic models – ARMA model, AR model, MA model.

Module III: [9 L]

Binary symmetric channel:

Principle, properties, bit error properties.

Theories and hypothesis:

Decision theory, Bay's likelihood ratio, ideal observer strategy, Neyman-Pearson strategy, Bay's strategy for single and multiple

sample values, optimum linear estimation composite hypothesis testing, optimum detection with incomplete knowledge of

the signal, adaptive detection and estimation.

Module IV: [9 L]

Filters:

Principle of optimum filter, matched filter, achievable bit error rate.

FIR Wiener filter – principle and design.

Linear prediction in noise, noise cancellation

IIR Wiener filter – causal, non causal.Kalman filter.

References:

1. Digital communication, 4th ed. - J. G. Proakis, MGH International edition.

2. Digital and Analog Communication Systems, 7th ed. – Leon W. Couch, PHI.

3. Digital Communication – Zeimer, Tranter.

4. Statistical digital signal processing and modeling, - Monson N. Hays – Wiley.

Course Title:SATELLITE COMMUNICATION and APPLICATIONS					
Course Code : ECEN5141					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

1. Students will know about the orbits and different modules of a satellite.

2. They will have knowledge about satellite links and various factors affecting the QOS of the links.

3. The students will be able to explain the differences between TDMA, FDMA, DAMA etc. access techniques.

4. They will be able to explain VSAT. GPS.

Module I: [8 L]

Introductory topics**:**

A brief history of satellite communication, future scope and present scenario.

Orbital Mechanism: Orbits, look angle, orbital period and velocity, azimuth and orbital inclination, coverage angle, orbital perturbation, mechanism of satellite placement in geostationary orbit. Indian Satellite scenario. Satellite Subsystems: Communication, telemetry, tracking & command, power, attitude & orbital control, antenna subsystems.

Module II: [10 L]

Earth Station: Fundamentals & general system architecture, Earth station antenna, gain, poynting loss, G/T variation and it's measurement, antenna tracking, power amplifier, low noise amplifier, up converter, down converter, transponder hopping, polarization hopping, redundancy configuration.

Satellite transponder: transponder model, transponder channelization, Transponder frequency plans, Effect of fading.

Satellite Link Design: Basic link analysis, interference analysis and attenuation due to rain, link with and without frequency reuse.

Module III: [9 L]

Multiple Access Techniques:

Frequency Division Multiple Access: SPADE, FDM-FM-FDMA, Companded FDM-FM-FDMA and SSB-AM-FDMA, intermodulation products in FDMA, optimized carrier-to-intermodulation plus noise ratio.

Time division Multiple Access: Principle, TDMA frame structure, TDMA Burst structure, TDMA Superframe structure, Frame acquisition and synchronization. TDMA timing. Demand Assignment Multiple Access and Digital Speech interpolation. ERLANG B Formula. Type of demand assignment, DAMA characteristics, Real time frame reconfiguration, DAMA interfaces, SCPC-DAMA, Digital Speech interpolation. Satellite packet communication.

Module IV: [9 L]

Propagation effects: Propagation effects and their impact on satellite earth link.

Introduction to VSAT systems: low earth orbit and non-geostationary satellite systems. Direct broadcast Television and Radio. Satellite Navigation and the global positioning system. Network configuration, multi-access and networking, network error control, polling VSAT network.

Mobile satellite network: Operating environment. MSAT network concept, CDMA MSAT relink.

References:

1. Tri T. Ha, Digital Satellite Communication, TMH.

2. Timothy Pratt, Charles Bostian, Teremy Allnutt, Satellite Communication, John Wiley & Sons.

3. J. J. Spilker, Jr., Digital Communication by Satellite, Prentice Hall.

4. Bruce R. Elbert, Satellite Communication Applications Hand Book, Artech House

Course Title: MULTIMEDIA COMMUNICATION					
Course Code : ECEN5142					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

1. Students will know about the different media classification, media characteristics.

2. They will have knowledge about various types of compression coding and memory systems.

3. The students will know about different architectures used and media modeling.

Module I: [10 L]

Multimedia Introduction: Media and Data Streams, Classification of media and Properties of multimedia system. Sound, Images & Video : Speech synthesis, Speech Recognition, Raster display, Image recognition, TV, HDTV, Speech transmission, Image transmission.

Module II: [10 L]

Compression : Huffman Coding, Runlength coding, JPEG, MPEG, DVI, H.261

Storage Media : CDDA, CDROM, CDROM (XA)

Multimedia Operating system: Resource Management, Process Management: EDF

Module III: [9 L]

Rate monotonic Algorithms. System Architecture: Quick Time, MDBMS.

Synchronization: Lip & Pointer Synchronization, Synchronization Reference Model, Case Study.

Module IV: (9 L)

Multimedia Communications: Delay compensation, QoS negotiation protocols, Architectures and Issues for Distributed Multimedia Systems, Prototype Multimedia systems: Video-on-Demand, Video conferencing. Multimedia Information: Delay-sensitive and Time-based Media data Modeling

References:

1. Ralf Steinmetz and KlaraNahrstedt, “Multimedia: Computing, Communications and Applications”, Prentice Hall PTR, 1995.

2. Franklin Kuo, Wolfgnag and J.J. Garsia, “Multimedia Communications, Protocols and Applications”, Prentice Hall PTR 1998.

Course Title: CRYPTOGRAPHY AND NETWORK SECURITY					
Course Code : ECEN5143					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcomes:

1. Students will know about the basics and different standards used.

2. They will have knowledge about important cryptography techniques.

3. The students will know about algorithms applied for encryption.

4. They will acquire knowledge about security challenges and some concepts in web security.

Module I: [12 L]

Introduction: Principles of security, Overview of network security and cryptography, OSI Security architecture, model for network security, classification of attacks (Reply, Reflection, Man – in – the – middle), Virus, Worm, Trojan Horse, Spam etc.

Symmetric ciphers: Algorithm types and modes, classical encryption techniques, block ciphers and Data Encryption Standard (DES), Advanced Encryption Standard (AES), Contemporary Symmetric Ciphers, and confidentiality using symmetric encryption

Module II: [9 L]

Public Key Cryptography: Public key Infrastructure (PKI), RSA, key management, Diffe-Hellman key exchange, elliptic curve arithmetic, elliptic curve cryptography.

Message Authentication and Hash Functions: Authentication requirements, authentication functions, message authentication codes

Module III: [9 L]

Hash functions, security of Hash functions and MACs. Hash Algorithms: MD5 Message Digest Algorithm, Secure Hash Algorithm, Digital Signature Algorithm, Digital Signature Standard. Network Security Applications: Authentication Applications (Kerberos), Electronic Mail Security (SMIME), IP Security (IPSec)

Module IV: [8 L]

Web Security (SSL and TLS), E – cash and Secure Electronic Transaction (SET), System security using Firewalls and VPNs. Advance Applications of Network Security: Smart cards and security, Enterprise Application Security, Biometric Authentication, Database Access Control, Security and Privacy Issues in RFIDs

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References:

1. William Stallings, Cryptography and Network Security—Principles and Applications, Pearson Edu.

2. Atul Kahate, Cryptography and Network Security, Tata McGraw Hill.

3. Trappe & Washington, Introduction to Cryptography with Coding theory, Pearson Education.

4. William Stallings, Network Security Essentials, Pearson Education.

5. Kaufman, Perlman & Speciner, Network Security, Pearson Education.

6. Behrouz A. Forouzan, , Cryptography and Network Security, McGraw – Hill

Course Title :Antenna and Radiating Systems Laboratory					
Course Code : ECEN5151					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**4**	**4**	**2**

Course Outcomes:

Students will know about the different experimental set-ups to measure various parameters related to antennae. They will study radiation pattern for antenna, will acquire practical knowledge about Smith chart and stub matching. The students will also learn to study spectral analysis of signals.

At least, 8 experiments are to be carried out.

1. Plotting of Standing Wave Pattern along a transmission line when the line is open-circuited, short-circuited and terminated by a resistive load at the load end.

2. Measurement of Input Impedance of a terminated coaxial line using shift in minima technique.

3. Study of Smith chart on MATLAB platform.

4. Simulation study of Smith chart - Single and double stub matching.

5. Radiation Pattern study of dipole antenna.

6. Radiation Pattern study of a folded-dipole antenna.

7. Radiation pattern study of Helical Antenna.

8. Parametric study (Gain, Directivity, HPBW and FNBW) of three, five and seven element Yagi Uda configurations.

9. Radiation pattern study of a Pyramidal Horn Antenna.

10. Spectrum analysis of different analog signals (sine, triangular, square) using spectrum analyzer.

Course Title : Wireless and Mobile Communication Laboratory					
Course Code : ECEN5152					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**4**	**4**	**2**

Course Outcomes:

- The students will be able to correlate different theories of wireless communication and fiber optics with practical experiments
- They will understand operations of repeater station, GPS and GSM cellular systems
- They will learn the procedures for testing radio parameters
- Students will learn working of fiber optic links
- They will understand bending losses, NA

List of Experiments:

1. Study of working of Repeater stations with the help of Satellite communication system
2. Study of Global system for Mobile (GSM) system along with waveforms of different timing signals
3. Study of Global Positioning System (GPS) and plotting of active satellites with SNR etc.
4. Measurement of some important receiver parameters of a radio receiver like:

i) SNR ;ii) Distortion with ISM band radio.

5. Measurement of some important transmitter parameters of a radio receiver like:

   VSWR for i) different antennae and ii) at different frequencies with ISM band radio.

6. Measurement of propagation loss, bending loss and connector loss in an optical fiber
7. Study of LASER characteristics

8. Measurement of wavelength of an optical fiber source

9. Study of a fiber optic analog link, study of PAM

10. Study of Frequency Division Multiplexing (FDM) and De multiplexing

11. Study of a fiber optic data link and study of TDM

12. Measurement of numerical aperture of an optical fiber

At least, 8 experiments are to be carried out in the semester.

Course Title : Research Methodology & IPR					
Course Code : ECEN5103					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	2	**0**	**0**	**2**	**2**

Research Methodology and IPR

Course Outcomes:

At the end of the course, students will be able to

1. Understand research problem formulation
2. Analyze research related information
3. Follow research ethics
4. Understand the ultimate importance of ideas, concept and creativity
5. Importance of IPR for individuals and nations
6. Appreciate that IPR protection provides incentive to inventors for further research work

Syllabus Contents:

Module I (6L)
Meaning of research problem, Sources of research problem, Criteria and characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problems, data collection, analysis, interpretation, necessary instrumentations.

Module II (6L)
Effective literature studies approaches and analysis

Plagiarism, Research ethics

Module III (6L)
Effective technical writing, how to write report, Paper

Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Module IV (6L)
Nature of Intellectual Property: Patents, Design, Trade and Copyright, Process of Patenting and Development: technological research, innovation, patenting, and development. International Scenario: International cooperation on Intellectual property. Procedure for grants of patents, Patenting under PCT.

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical indication.

New developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge case studies, IPR and IITs.

References:

- Stuart Melville and Wayne Goddard, "Research and methodology: An introduction for science & engineering students'"
- Wayne Goddard and Stuart Melville, "Research and methodology: An introduction"
- Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
- Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007
- Mayall, "Industrial Design", McGraw Hill, 1992
- Niebel, "Product Design", McGraw Hill, 1974
- Asimov, "Introduction to Design", Prentice Hall, 1962
- Robert P. Merges, Peter S. Menell, Mark A Lemley, "Intellectual Property in New Technological Age", 2016
- T. Ramappa, "Intellectual Property Rights Under WTO", S Chand, 2008

Course Title : Audit Course 1					
Course Code : DIMA5116					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	2	**0**	**0**	**2**	**0**

DISASTER MANAGEMENT

Course Outcomes: -Students will be able to:

1. learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

Syllabus

	Units	CONTENTS	Hours
Module -I	1	**Introduction on Disaster** Disaster: Definition Types of Disaster • Natural Disaster: such as Flood, Cyclone, Earthquakes, Landslides etc. • Man-made Disaster: such as Fire, Industrial Pollution, Nuclear Disaster, Biological Disasters, Accidents (Air, Sea, Rail & Road), Structural failures (Building and Bridge), War & Terrorism etc. • Differences, Nature and Magnitude	3

		• Factors Contributing to Disaster Impact and Severity
		• Repercussions of various types of Disasters
		  o Economic Damage
		  o Loss of Human and Animal Life
		  o Destruction of Ecosystem
		  o Outbreaks of Disease and Epidemics
		  o War and Conflict
		Natural Disaster-prone areas in INDIA
		• Areas prone to
		  o Earthquake
		  o Floods and Droughts,
		  o Landslides and Avalanches;
		  o Cyclonic And Coastal Hazards such as Tsunami;
		Trends of major Disasters and their Impact on India
		• Lessons Learnt from Recent Disasters	

	2	**Introduction to Disaster Management** What is Disaster Management Different Phases of Disasters Disaster Management Cycles Disaster Management Components • Hazard Analysis • Vulnerability Analysis • Prevention and Mitigation • Preparedness • Prediction and Warning • Response • Recovery Disaster Management Act, 2005 National Disaster Management Structure Organizations involved in Disaster Management	3
Module -II	1	**Overview on Hazard Analysis and Vulnerability Analysis** **Disaster Preparedness** • Disaster Risk Assessment, People's Participation in Risk Assessment • Disaster Risk Reduction • Preparedness Plans • Community preparedness: Emergency Exercises/ Trainings/Mock Drills	3

	2	**Disaster Prediction and Warning**
		• Activities
		  o Tracking of disaster
		  o Warning mechanisms
			3

		○ Organizational response ○ Public education ○ Communication ○ Evacuation planning • Current tools and models used for Prediction and Early Warnings of Disaster ○ Application of Remote Sensing ○ Data From Meteorological and other agencies ○ Smartphone/ Web based Apps for Disaster Preparedness and Early Warning used in different parts of Globe	
Module -III	1	**Disaster Response** • Crisis Management: The Four Emotional Stages of Disaster ○ Heroic Phase ○ Honeymoon Phase ○ Disillusionment Phase ○ Reconstruction Phase • Need for Coordinated Disaster Response ○ Search, Rescue, Evacuation, Medical Response and Logistic Management ○ Psychological Response and Management (Trauma, Stress, Rumor and Panic) • Role of Government, International and NGO Bodies	3
	2	**Post-disaster Situation Awareness** • Need for Situation Awareness in Post Disaster scenario • Challenges in communication of situational data from affected areas • Need for community-driven disaster management for reliable situation awareness • Crowd-sourcing of situational data: Issues and challenges **Post-disaster Damage and Need Assessment** • Current Trends and Practices – RAPID Damage and Need Assessment • SPHERE standards in Disaster Response • ICT based techniques for Post-disaster damage and need assessment	3
Module -IV	1	**Rehabilitation, Reconstructions and Recovery** • Reconstruction and Rehabilitation as a Means of Development. • Post Disaster effects and Remedial Measures • Creation of Long-term Job Opportunities and • Livelihood Options • Disaster Resistant House Construction • Sanitation and Hygiene • Education and Awareness • Dealing with Victims' Psychology • Long-term Counter Disaster Planning	3
	2	**Disaster Mitigation** • Meaning, Concept and Strategies of Disaster Mitigation • Emerging Trends in Mitigation • Structural Mitigation and Non-Structural Mitigation • Programs of Disaster Mitigation In India	3

SUGGESTED READINGS:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies", New Royal book Company.
2. Sahni, Pardeep et.al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall of India, New Delhi.
3. Goel S. L., Disaster Administration And Management Text And Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi.

First Year, Second Semester (M.Tech, ECE)

Course Title:ADVANCED DIGITAL COMMUNICATION TECHNIQUES					
Course Code : ECEN5201					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcomes:

1. Students will learn about the transmission techniques, synchronization in digital communication.

2. They will know about the modulation schemes, OFDM etc.

3. The students will acquire knowledge about the CDMA in details.

4. The students will have clear idea about estimation and detection schemes. They will be able to design reliable channel codings.

Module – I [9 L]

Review of random variables and random processes

Review of baseband digital signal transmission –PCM DM ADM ADPCM. Inter Symbol Interference (ISI)

Nyquist criteria for no ISI in band limited channel

Parametric decoding: Sub-band coding APC LPC voice excited vocoder

Synchronization – Symbol and Frame synchronization

Equalizer: Linear equalization Decision feedback equalizer iterative equalizer and decoding

Module – II [9 L]

Digital Modulation:

Review of modulation schemes – BPSK DPSK QPSK M-ary PSK QASK MSK BFSK M-ary FSK –

principles transmitters receivers signal space presentation bandwidth efficiency

GMSK Orthogonal frequency division multiplexing (OFDM) – principle generation and detection

Bit error performance of bandpass signal – Narrow band noise model Error performance of BASK BPSK

BFSK MSK Comparison of bandwidth efficiency and error performance of modulation schemes

Module – III [9 L]

Multiplexing and multiple access : TDM/TDMA FDM/FDMA Space DMA ALOHA –slotted ALOHA and reservation ALOHA CSMA-CD CSMA- CA basic techniques and comparative performances

Spread spectrum modulation: Principle of DSS, processing gain jamming margin single tone interference probability of error

Principle of frequency hopped spread spectrum (FHSS) – slow frequency and fast frequency hopping

Principle of CDMA Multiple access interference (MAI) and limit of simultaneous users

Digital cellular CDMA system – forward and reverse link error rate performance

Module – IV [9 L]

Optimum Detection and Estimation:

Noise vector in signal space Bayes detection of received signal, optimum M-ary receiver design

Decision region and minimum error probability

Optimum detection of 16 QAM signal, MPSK signal orthogonal and bi orthogonal signal

Decision criterion: maximum likelihood Neyman Pearson and Minimax decision criterion

Estimation: Linear estimation – simple mean Linear mean squared error Wiener filter

Non linear estimation: Bayes estimation MAP ML estimates

Introduction to source coding (Hofmann and Shanon).

Introduction to error control coding (Linear Block Code and Convolution).

References:

1. Digital Communications 4th edition J G Proakis MGH international Edition

2. Principle of Communication Systems Taub and Schilling 7th edition TMH

3. Digital Communications :Fundamentals and Applications 2nd edn 2008 Bernard Sklar and Pabitra Kumar Ray Pearson Education

4. Principle of Digital Communications Simon Haykin Wiley Student Edition

5. Digital Communications Zeimer and Tranter CRC Press

6. Analog and digital Communication, B.P. Lathi, Oxford University Press.

Course Title: ADVANCED DIGITAL SIGNAL PROCESSING(DSP) and APPLICATIONS					
Course Code : ECEN5202					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

1. Students will know about the different transforms applied in signal processing.

2. They will have knowledge about LTI systems, Digital filters.

3. The students will know about multi- rate processing, wavelet transforms.

Prerequisite: The student must be conversant with frequency domain analysis of discrete time signals and systems. They will be familiar with the various kind of adaptive filter design technique. Multirate Signal Processing fundamentals and applications of Wavelet Transforms will be covered.

Module I: [8 L]

Frequency Domain Analysis of Discrete Time Domain Signals and Systems: 6L

The concept of frequency in continuous time and discrete time signals. Fourier series for discrete periodic signals, Fourier Transform of discrete aperiodic signals, Power spectral densities of discrete aperiodic signals, Relationship between Fourier Transform and Z-Transform. Properties of Fourier Transform in discrete time domain; Time reversal, convolution, correlation, Wiener-Khintchine theorem, frequency shifting, modulation, windowing theorem, differentiation in digital frequency domain.Symmetry property for various types of signals.

Module II: [10 L]

Frequency Domain Characteristics of LTI Systems

Response to complex exponential signals, steady state and transient response to sinusoidal signals, steady state response to periodic signals, response to aperiodic signals. Relation between system function H (z) and frequency response function h(w). Input-output correlation function and spectra, correlation functions and power spectra for random input signals.

Invertibility of LTI systems, minimum/maximum/mixed phase systems, homomorphic systems and homomorphic deconvolution.DFT & FFT.Computation of DFT and it's properties, computation of DFT via FFT, chirp z-transform.

Module III: [9 L]

Design of Digital Filters

Design of FIR filters, Effect of various windows, Effect of finite register length, statistical analysis, stability effect, frequency sampling, Optimization Algorithm.

Adaptive Filters design, Single input, multiple input, State-Space Kalman Filter, Extended Kalman Filter, Unscented Kalman Filter Sample-Adaptive Filters, Recursive Least Square (RLS) Adaptive Filters, The Steepest-Descent Method, LMS Filter.

Power Spectrum

Estimation of Power Spectrum and Correlation, Non-parametric and Parametric methods, Minimum Variation Estimation methods, Eigen Analysis algorithm, Power Spectrum analysis using DFT, Maximum Entropy Spectral Estimation, Model-Based

Power Spectral Estimation.

Module IV: [8 L]

Multirate Signal Processing

Sampling Rate Conversion; Decimation and Interpolation; Time and Frequency Domain Characterization; Filters in Sampling Rate Alteration Systems; Multi-rate Design of Decimator and Interpolator; Poly-phase Techniques; Poly-phase Down-sampler and Interpolator; Poly-phase Filter Design; Two-channel QMF Banks. Alias free FIR and IIR QMF Banks; Perfect Reconstruction

Two-channel FIR Filter Banks; M-Channel Filter Banks Design; Cosine-Modulated M-channel Filter Banks Design;Wavelet Transforms

Fourier Transform and its limitations, Short Time Fourier Transform, Continuous Wavelet Transform, Discretization of the Continuous Wavelet Transform, Multiresolution Approximations; Wavelet and Scaling Function Coefficients, Orthonormality of

Compactly Supported Wavelets, Bi-orthogonal Decomposition, Harr Wavelets, The Daubechies Wavelets Construction, Fast Wavelet Transform and Image Compression, Denoising using Wavelets, Perfect Reconstruction Filter bank design using Wavelets.

References:

1. Discrete – Time Signal Processing by A.V. Oppenheim and R. W. Schafer, with J. R. Buck (Prentice- Hall, 1998)

2. Digital Signal Processing Using MATLAB by V. K. Ingle and J. G. Proakis (Books/Cole,2000)

3. Digital Signal Processing: A Computer Based Approach by S.K. Mitra (Second edition , McGraw-Hill, 2001)

4. Digital Signal Processing: Principles, Algorithms and Applications by J. G. Proakis and D. G. Manolakis.

5. Digital Filter Design and Analysis, Antino, TMH.

6. Digital Signal Processing- Rabiner and Gold, PHI.

Course Title: TELECOMMUNICATION SYSTEMS & ENGINEERING					
Course Code : ECEN5231					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

1. Students will know about the different telephone networks, ADSL etc.

2. They will have knowledge about digital telephone systems and local area networks- features and parameters.

3. The students will be aware of ISDN and its operation.

Module I: Telephone Network [12 L]

• Introductory terminology;

Grade of Service, QoS, Blocking Network, Lost call handling. Erlang and Poisson Traffic formulas one-way and both-way circuits.

• Local Networks – subscriber loop design, shape and size of a serving area, voice Frequency Repeaters, Tandem Routing, Dimensioning of Trunks

• Switching & Signaling for analog Telephone networks: Switching concepts – Cross-bar switching . Signaling concepts: Supervisory signaling – E & M signaling – In-band & out-of-band signaling

• Design of long distance links: Design essentials for LOS Microwave systems, Path analysis or Link Budget, Fading , Diversity and Hot stand-by operation, VSAT networks, concept of Last Mile

Broadband connectivity – ADSL & HDSL

Module II: Digital Telephone Systems [12 L]

• PCM – PCM line Codes – Regenerative repeaters – Signal to noise ratio for PCM signals – North American DS1 – the European E1 digital hierarchy – Filter – distortion – echo – cross talk – SONET and SDH – PCM Switching :'Time – space – Time Switch – 'Space – Time – Space' Switch – Digital Network Synchronization – Digital loss

Module III: Local Area Networks [6 L]

• LAN topologies – overview of IEEE / ANSI LAN protocols – WLANS – different 802.11standards

Module IV: ISDN [8 L]

• ISDN - background & goals of ISDN – protocols – structures – ISDN and OSI

• ATM and B-ISDN – User-Network interface (UNI) configuration and architecture – ATM cell structure – cell delineation algorithm – ATM layering & B-ISDN . Advantages of BISDN

References:

1. Wiley Series in Telecommunications and Signal Processing by Roger L. Freeman

2. Telecommunication System Engineering, By N. N. Deb.

3. Telecommunication Switching, Viswanathan.

4. Telecommunication, Fraser.

Course Title: IMAGE PROCESSING AND PATTERN RECOGNITION					
Course Code : ECEN5232					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

1. Students will know about the basics of image processing, spatial filtering etc.

2. They will have knowledge about techniques applied for pattern recognition.

3. The students will know about image clustering and face recognition.

Module I: [10 L]

Image Processing Basics: Image definition, a simple image formation model, basic concepts of image sampling and quantization, representing a digital image, concept of pixel/ pel, spatial and gray level resolution, some basic relationships between pixels : Neighbors of a pixel, Adjacency, Connectivity, Path, Connected component, Connected component labeling. Distance measures: the three essential properties, Euclidean, City-Block and Chess-Board distance, concept of image operations on a pixel basis.

Popular image processing methodologies: Spatial domain technique : contrast stretching, basic point processing, thresholding function, concept of mask/ sub image, mask processing/ filtering, gray-level slicing, bit-plane slicing.

Basics of spatial filtering : convolution mask/kernel, concept of sliding mask throughout the image-space, smoothing(averaging) filter/ low pass filter. Image segmentation by global and local gray level thresholding, region growing, region splitting and merging techniques. Morphological algorithms: thinning, thickening, skeletons.

Color image processing: Perception of color: color fundamentals. Two popular color models: RGB & HSI, concept of RGB & HSI space and their conceptual relationships, mathematical conversion from RGB to HSI space and vice versa.

Module II: [10 L]

Pattern Recognition

Basics of pattern recognition: Concept of a pattern: feature, feature vectors and classifiers. Importance of pattern recognition. Basic concept of fuzzy pattern recognition, linearly separable and inseparable classes, classes with some overlapping regions, convex and non-convex paradigm in this aspect.

Clustering: Basic concept of cluster analysis. Similarity (Proximity) metrics (indices) and clustering criteria. Partitional clustering: Extraction of natural groups that are inherent in some data set by hard c-means (k-means), fuzzy cmeans.

Concept of getting stuck to a local optimum (in objective functional space) by k-means and fuzzy c-means due to their initiation/ starting point. Fuzzy cluster validity index: Xie-Beni index.

Classification and prediction: Definition of classification and prediction. Basic task of a classifier. Concept of training & testing data and overfitting. Bayes classification: Bayes' Theorem, Naïve Bayesian classification. Classification by Backpropagation: Multilayer Perceptron (MLP) neural network and Backpropagation algorithm.

Global optimization techniques: Genetic Algorithms (Gas): Cycle of genetic algorithms, selection (Roulette wheel and Tourment) crossover, mutation, evaluation of fitness function, incorporation of elitism in GAs. Multi-objective

optimization using GAs. Simulated Annealing (SA): Analogy with physical annealing process, concept of energy and mechanism of energy minimization using SA, Necessity of an uphill movement during the process. Hybridization with partitional clustering techniques.

Module III:[9 L]

Image clustering applications: Mechanism of extracting pixel-patterns from a gray-scale image in various ways: e.g. forming feature space (like a two column matrix) treating the gray-value of center-pixel (of a local window) as the first feature and averaged value over a square-shaped local window (3x3 or 5x5 or like that) as the second feature, construction of high-dimensional feature space: e.g. treating all the pixel-gray-values of a local window as features (i.e. for 3x3 window 9-dimensional feature space will result). Application of partitional clusterings in the above mentioned feature-space to recognize the objects in the concerned image.

Module IV: [9 L]

Applications in multispectral and multitemporal remotely sensed imagery: Identification of different land cover types from multispectral remote image data using supervised/ unsupervised classification: Clustering by Histogram peak selection & and its limitation in this context (i.e. remote image analysis). Unsupervised Change Detection using

squared-error clustering methodologies: The algorithm, process, key challenges, error estimations like missed alarms, false alarms and overall error, need of ground truth.

Image mining: Need, Image search and retrieval. Bottleneck of Text based image mining/ retrieval, Visual feature based image mining: Content-based image retrieval (CBIR).

Image based face recognition: Basic technique for Eigen face generation & recognition.

References:

1. R. C. Gonzalez and R. E. Woods, *Digital Image Processing*, Pearson Education Asia, 2004

2. S.K. Pal, A.Ghosh, and M.K. Kundu, *Soft Computing for Image Processing*, Physica

3. Verlag, (Springer), Heidelberg,1999.

4. R. O. Duda, P.E. Hart and D. G. Stork, *Pattern Classification*, John Wiley & Sons (Low Priced Edition).

5. Anil K. Jain and R.C.Dubes, *Algorithms for Clustering Data*, Prentice Hall.

6. S. Theodoridis and K. Koutroumbus, *Pattern Recognition*, Elsevier.

7. A. Ghosh, S. Dehuri, and S. Ghosh (editors). *Multi-Objective Evolutionary*

8. *Algorithms for Knowledge Discovery from Databases*. Springer, Berlin,

9. 2008.

10. Anil K. Jain, *Fundamentals of Digital Picture Processing*, Prentice Hall.

Course Title :COGNITIVE RADIOS AND NETWORKS					
Course Code : ECEN5241					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

The following outcomes (COs) are expected from the students after completion of the course –

a) An ability to apply knowledge of mathematics, science and engineering in the emerging areas of RF communication.

b) An ability to analyze a situation.

c) An ability to learn and apply modular approach.

d) An ability to understand research work in new areas of cognitive radios and spectrum hole sensing.

e) Development of a passion to pursue next generation wireless communication.

Module I: [8 L]

INTRODUCTION TO SOFTWARE DEFINED RADIO

Definitions and potential benefits, software radio architecture evolution, technology tradeoffs and architecture implications. Differences between software enable radio and software defined radio. Essential functions of the software radio, basic SDR, hardware architecture, Computational processing resources, software architecture, top level component interfaces, interface topologies among plug and play modules.

Module II: [8 L]

COGNITIVE RADIO TECHNOLOGY

Introduction – Radio flexibility and capability – Aware – Adaptive – Comparison of Radio capabilities and Properties – Available Technologies – IEEE 802 Cognitive Radio related activities – Application, position awareness in cognitive radios, optimization of radio resources, Artificial Intelligence Techniques.

Module III: [10 L]

COGNITIVE RADIO DESIGN AND CHALLENGES

Cognitive Radio – functions, components and design rules, Cognition cycle – orient, plan, decide and act phases, Inference Hierarchy, Architecture maps, Building the Cognitive Radio Architecture on Software defined Radio Architecture. Design Challenges associated with CR – Hardware requirements – Hidden primary user problem – detecting spread spectrum primary users – sensing duration and frequency – security

Module IV: [8 L]

SPECTRUM SENSING

Spectrum sensing, spectrum management, spectrum mobility, spectrum sharing, upper layer issues, cross – layer design, applications of cognitive radios to optimize spectrum utilization, to reduce transmit power reduction and to improve data rate even in noisy conditions. Matched filter – waveform based sensing – cyclostationary based sensing – Energy detector based sensing – Radio Identifier – Cooperative sensing- other sensing methods.

TOTAL: 34 PERIODS

Reading:

1. Joseph Mitola III, "Software Radio Architecture: Object-Oriented Approaches to wireless system Engineering", John Wiley & Sons Ltd. 2000

2. Thomas W. Rondeau, Charles W. Bostain, "Artificial Intelligence in Wireless communication", ARTECH HOUSE. 2009.

3. Bruce A. Fette, "Cognitive Radio Technology", Elsevier, 2009.

4. Ian F. Akyildiz, Won- Yeol Lee, Mehmet C. Vuran, Shantidev Mohanty, "Next generation / dynamic spectrum access / cognitive radio wireless networks: A Survey" Elsevier Computer Networks, May 2006

5. Simon Haykin, "Cognitive Radio: Brain-Empowered Wireless Communication", IEEE Journal on selected areas in communications, Feb 2005.

6. Markus Dilinger, Kambiz Madani, Nancy Alonistioti, "Software Defined Radio", John Wiley, 2003

7. Huseyin Arslan,"Cognitive Radio, SDR and Adaptive System", Springer, 2007.

8. Bruce A. Fette, "Cognitive Radio Technology", Elsevier, 2009.

Course Title: MICROWAVE MEASUREMENT AND INSTRUMENTATION					
Course Code : ECEN5242					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcomes:

At the end of the course, the students will acquire the following.

1. Knowledge about the microwave measurement procedures

2. Ability to analyse instruments like spectrum analyzer, Vector Network analyzer etc.

MODULE I : [10 L]

Introduction to Radio Frequency and Microwave Measurement.

: Microwave Detectors and Sensors. Different types of microwave detectors, their functions and applications. Microwave sensors – working principles and applications

Microwave Power Measurement- Low Power Measurement- Bolometer technique. High Power Measurement – Calorimetric method

MODULE II : [10 L]

Microwave Attenuation Measurement

Microwave Frequency Measurement. Slotted Line technique. Wave meter method - Absorption and Transmission type wave meter

Microwave Impedance Measurement – Slotted Line technique to measure VSWR and unknown Load Impedance. Application of Smith chart in transmission line measurement

MODULE III : [9 L]

Microwave Cavity parameter measurement. – Cavity Q measurement by Slotted Line technique. Swept Frequency method Decrement methodMeasurement of Dielectric constant of a solid and liquid at microwave frequency by Waveguide method.

Cavity perturbation method

MODULE IV : [9 L]

Introduction to Microwave Instrumentation:

Spectrum Analyzer ; Block diagram of a spectrum analyzer – operational features of functional units and applications of Spectrum Analyzers.

Vector Network Analyzer (VNA) : Block diagram of VNA operational aspects of different functional units comprising VNA. Measurement of Scattering parameters and other applications.

Time Domain Reflectometer (TDR) : Block diagram of TDR and its working principle

Reflection coefficient measurement and interpretation of Time domain Reflected waveform.

Industrial applications of TDR.

References:

1. G.H.Bryant- Principles of Microwave Measurements- Peter Peregrinus

Ltd.

2. T.S.Laverghetta- Hand book on Microwave Testing

3. S.F.Adam- Microwave Theory & Application- Prentice Hall, Inc

4. A.E. Bailey, Ed. Microwave Measurements- Peter Peregrinus Ltd

5. Annapurna Das and S K Das Microwave Engineering TMH Publications

6. HP Application Notes

Course Title :DESIGN OF COMMUNICATION EQUIPMENTS AND SYSTEMS					
Course Code : ECEN5243					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

The following outcomes (COs) are expected from the students after completion of the course –

a) An ability to apply knowledge in designing electronics for communication engineering.

b) An ability to analyze and interpret data.

c) An ability to learn and apply modelling based approach through the extensive use of simulator tools.

d) An ability to pursue research work in new areas of communication equipments and systems.

Module I: [10 L]

Design Considerations of Communication equipments and systems:
Implementing Radio Link, Path profile, RF path loss calculations, Transmitter / Receiver parameters and their significance – SNR, SINAD, sensitivity, Hum and Noise, Quieting, Distortion, Rated RF power, RF power, Fade Margin.

Study and evaluation of Performance parameters for data communication like Bit and symbol error rates, Spectral Bandwidth calculations.

Module II: [10 L]

Design of various blocks of communication equipments such as PLL, Equalizer, Interleaver, Interference consideration in processor / controller enabled radios- desensitization problem, means to mitigate the problem – detailed study of clock speed & shape, PCB design.

Module III: [10 L]

PCB Design and EMI/EMC

PCB design practices for Analog and Mixed signal circuits- Ground loops, Precision circuits, supply isolation, shielding and guarding – different techniques. PCB design practices for High Speed Digital circuits, signal integrity and EMC. EMI/EMC testing standards and compliance.

Module IV: [8 L]

Types of antenna – selection procedure for correct antenna, measurement of the network performance – different techniques.

Emulation of testing procedure in laboratory, test procedures for Receiver / Transmitter parameters with different standards like CEPT, EIA.

Reading:

1. "High-speed Digital Design- A Handbook of Black Magic" – Howard Johnson, Martin Graham- Prentice Hall.

2. "EMC for Product Designers" – Tim Williams – Elsevier 2007.

3. "Digital Communication" – B. Sklar – Pearson Ed.

4. "Circuit Design for RF Transceiver" – D. Leenaerts, Johan van dar Tang, Cicero S. Vaucher – kluwer Academic Publishers, 2003

5. "Practical Radio Engineering & Telemetry for Industry" – David Bailey – Elsevier, ISBN 0750658037.

Course Title: Advanced Digital Signal Processing(DSP) & Applications Laboratory					
Course Code : ECEN5252					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	4	4	2

Course outcomes:

The students will acquire understanding of the following:

1.Basics of sampling, convolution etc, Z-transform

2. DFT and FFT and their applications

3.Filters – IIR and FIR

4.Digital filters, multirate signal procesing.

Simulation Laboratory using standard Simulator:

1. Convolution of two sequences using graphical methods and using commands- verification of the properties of convolution.

2. Z-transform of various sequences – verification of the properties of Z-transform.
3. Twiddle factors – verification of the properties.

4. DFTs / IDFTs using matrix multiplication and also using commands.

5. Circular convolution of two sequences using graphical methods and using commands, differentiation between linear and circular convolutions.

6. Verifications of the different algorithms associated with filtering of long data sequences and Overlap –add and Overlap-save methods.

7. Butterworth filter design with different set of parameters.
8. Chebyshev filter design with different set of parameters.

9. FIR filter design using rectangular, Hamming and Blackman windows.

Hardware Laboratory using Xilinx FPGA:

1. Writing of small programs in VHDL and downloading onto Xilinx FPGA.
2. Mapping of some DSP algorithms onto FPGA.

Course Title: DESIGN AND SIMULATION LABORATORY					
Course Code : ECEN5253					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**4**	**4**	**2**

Course Outcome: Designing graphical user interfaced models of various communication systems/ subsystems with the help of suitable advanced software e.g. MATLAB/ OCTAVE/LABVIEW/ NS/ PUFF/ IE3D/ ANSOFT/ HFSS/ CST/ QUALNET/ MICROWAVE OFFICE etc. for detailed study of their operating principle and their performance vis-a-vis practical limitations like, channel bandwidth, noise, attenuation etc.

Suggested topics are

1. ADPCM – granular noise & quantization noise.

2. MPSK – signal bandwidth, PSD, distinguishability, scatter plot etc.

3. Digital filters – ripples in pass band & stop band, slope in transition band, poles & zeros etc.

4. Optimum filters for receiving base band random binary data – Pe vs. S/N.

5. Signal bandwidth and Pe vs. S/N in different modes of line coding.

6. Signal bandwidth and Pe vs. S/N in different modes of modulation.

7. Error rates in error control for different types of error control coding.

8. Throughput vs. input density in different MAC protocols.

9. DSSS – error rate due to different types of chip code.

10. Fading channel/ multipath transmission and Rake receiver.

11. Cellular architecture, WiFi, WiMAX using QUALNET.

12. OFDM using QUALNET.

13. Different routing algorithms & protocols.

14. Characterization of micro strip antenna.

15. Characterization of transmission lines.

16. Study of important parameters and practical considerations in microwave circuits.