DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SCHEME OF INSTRUCTIONS AND SYLLABUS FOR POST GRADUATE STUDIES

M. Tech. in Communication Systems Engineering

Visvesvaraya National Institute of Technology, Nagpur-MH

July 2015

VISION AND MISSION
OF
VISVESVARAYA NATIONAL INSTITUTE OF TECHNOLOGY, NAGPUR

VISION

To contribute effectively to the national endeavour of producing quality human resource of world class standard by developing a sustainable technical education system to meet the changing technological needs of the Country, incorporating relevant social concerns and to build an environment to create and propagate innovative technologies for the economic development of the Nation.

MISSION

The Mission of VNIT is to achieve high standards of excellence in generating and propagating knowledge in engineering and allied disciplines. V.N.I.T. is committed to providing an education that combines rigorous academics with joy of discovery. The Institute encourages its community to engage in a dialogue with society to be able to effectively contribute for the betterment of humankind.

VISION AND MISSION
OF
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING, V. N. I. T.
Nagpur

VISION

To be the epitome of academic rigor, still flexible to accommodate every student and faculty for basic, current and future technologies in electronics and communication engineering.

MISSION

To be a center of excellence and provide best platform for students and staff for their growth.

Department of Electronics & Communication Engineering offers one M. Tech. program, namely, ***M. Tech. in Communication System Engineering***. These are four semester program, wherein student has to complete certain number of credits as indicated in Table 1. Each subject (or course) has certain number of credits. There are two types of subjects: Core and elective. Core courses are compulsory and some courses from electives are to be taken to complete the required credits.

TABLE 1. CREDIT REQUIREMENTS FOR POST GRADUTE STUDIES

Postgraduate Core (PC)		**Postgraduate Elective (PE)**	
Category	Credit	Category	Credit
Departmental Core (DC)	36	Departmental Electives (DE)	16
Total	36	Total	16
Grand Total PC + PE			52

The number of credits attached to a subject depends on number of classes in a week. For example a subject with 3-1-0 (L-T-P) means it has 3 Lectures, 1 Tutorial and 0 Practical in a week. This subject will have four credits (3x1 + 1x1 + 0x1 = 4). If a student is declared pass in a subject, then he/she gets the credits associated with that subject. Depending on marks scored in a subject, student is given a Grade. Each grade has got certain grade points as follows:

Grades	AA	AB	BB	BC	CC	CD	DD	FF
Grade Points	10	09	08	07	06	05	04	Fail

The performance of a student will be evaluated in terms of two indices, viz. the Semester Grade Point Average (SGPA) which is the Grade Point Average for a semester and Cumulative Grade Point Average (CGPA) which is the Grade Point Average for all the completed semesters at any point in time. SGPA & CGPA are:

$$SGPA = \frac{\sum_{semester}(Course\ credits\ X\ Grade\ points)\ for\ all\ courses\ except\ audit}{\sum_{semester}(Course\ credits\ )\ for\ all\ courses\ except\ audit}$$

$$CGPA = \frac{\sum_{All\ semester}(Course\ credits\ X\ Grade\ points)\ for\ all\ courses\ with\ pass\ grade\ except\ audit}{\sum_{All\ semester}(Course\ credits\ )\ for\ all\ courses\ except\ audit}$$

Students can Audit a few subjects. i.e., they can attend the classes and do home work and give exam but they will not get any credit for that subject. Audit subjects are for self-enhancement of students.

Programme: M. Tech. in Communication System Engineering

Programme Educational Objectives of M. Tech. in Communication System Engineering

1. To impart concepts of Communication Systems and Engineering through the use of analytical techniques, experiments, computer simulation methods, and other modern engineering tools and software in the analysis and design of variety of Electronics and Communication Engineering effectively.
2. To develop student's capacity of building new and up-coming areas of research in Communication System Engineering.
3. To make students aware of socio-economic and legal aspects of communication technology and help them take up careers in communication technology research, manufacturing, network planning, operation and maintenance.

Programme Outcomes of M. Tech. in Communication System Engineering

- **The Department of Electronics and Communication Engineering has a strong focus on providing students with a strong background in mathematics, science and engineering. The department provides students with adequate practical training by way of laboratory sessions, design and problem based learning.**
- **By working amid project groups of various projects sponsored by DST, BARC (Govt. of India funded projects), students can participate and gain research experience which will be useful for pursuing a career in various government and private R&D centres in India and abroad.**
- **Through the work experience gained from hands-on projects conducted by the expert faculties from the department and at various reputed organizations in India and abroad, students will have up to date knowledge of the specific field and can pursue career in that field later.**
- **With an exposure to socio-economic and legal aspects, students will also be able to pursue careers in communication network planning, management, operation etc.**

CREDIT REQUIREMENTS FOR M.Tech. (COMMUNICATION SYSTEM ENGINEERING)

Program Core (PC)		Program Elective (PE)	
Category	Credit	Category	Credit
Departmental Core (DC)	36	Departmental Electives (DE)	16
Grand Total PC + PE			**52**

Details of credits:

I Semester				II Semester			
CORE				**CORE**			
Code	**Course**	**L-T-P**	**Cr**	**Code**	**Course**	**L-T-P**	**Cr**
ECL412	Advanced Digital Signal Processing	3-0-0	3	ECL427	Broadband Communication	3-0-0	3
ECP412	Advanced Digital Signal Processing Lab	0-0-2	1	ECL409	Radio Frequency Circuit Design	3-0-0	3
ECL422	Statistical Signal Analysis	3-0-0	3	ECP409	Radio Frequency Circuit Design Lab.	0-0-2	1
ECL434	Wireless Digital Communication	3-0-0	3	ECL516	Converged Communication Networks	3-0-0	3
ECP518	Communication Systems Lab I	0-0-2	1				
ECL520	Computational electro-magnetics	3-0-0	3				
	Total No of Credits		**14**		**Total No of Credits**		**10**
ELECTIVE (Theory: maximum two Lab: maximum two)				**ELECTIVE (Maximum three theory and lab optional)**			
ECL402	Comm. Net. & Network Applications	3-0-0	3	ECP519	Communication Systems Lab II	0-0-2	1
ECP402	Comm. Net. & Network Applications Lab	0-0-2	1	ECL406	Mobile Communication Systems	3-0-0	3
ECL424	Optical Communication	3-0-0	3	ECL411	Digital Image Processing	3-0-0	3
ECL423	Image Analysis and Computer Vision	3-0-0	3	ECL416	Fuzzy Logic and Neural Networks	3-0-0	3
ECP423	Image Analysis and Computer Vision Lab.	0-0-2	1	ECL511	Non-linear system modeling	3-0-0	3
ECL512	Topics in communication systems	3-0-0	3	ECL515	Intelligent system design	3-0-0	3
	Total No of Credits (maximum)		**8**		**Total No of Credits (maximum)**		**10**
III Semester				**IV Semester**			
CORE				**CORE**			
Code	**Course**	**L-T-P**	**Cr**	**Code**	**Course**	**L-T-P**	**Cr**
ECD501	Project – Phase I	0-0-0	3	ECD502	Project – Phase II	0-0-0	9
	Total No of Credits		**3**		**Total No of Credits**		**9**
ELECTIVE (Theory: maximum three Lab: maximum two)					**ELECTIVE**		
ECL433	Digital IC Design	3-0-0	3				
ECP433	Digital IC Design Lab	0-0-2	1				
ECL424	Optical Communication	3-0-0	3				
ECL423	Image Analysis and Computer	3-0-0	3				

	Vision						
ECP423	Image Analysis and Computer Vision Lab.	0-0-2	1				
	Total No of Credits (maximum)		**11**		**Total No of Credits (maximum)**		**0**

M.Tech. (Communication System Engineering)
LIST OF CORE COURSES

Course Code	Course Title	L-T-P (Hrs)	Credits	
ECL409	Radio Frequency Circuit Design	3-0-0	3	
ECP409	Radio Frequency Circuit Design Lab.	0-0-2	1	
ECL412	Advanced Digital Signal Processing	3-0-0	3	
ECP412	Advanced Digital Signal Processing Lab.	0-0-2	1	
ECL434	Wireless Digital Communication	3-0-0	3	
ECL422	Statistical Signal Analysis	3-0-0	3	
ECL427	Broadband Communication	3-0-0	3	
ECL516	Converged Communication Networks	3-0-0	3	
ECP518	Communication Systems Lab I	0-0-2	1	
ECL520	Computational electro-magnetics	3-0-0	3	
ECD505	Project – Phase I	0-0-0	3	
ECD506	Project – Phase II	0-0-0	9	

LIST OF ELECTIVE COURSES

ECL402	Comm. Net. & Network Applications	3-0-0	3	
ECP402	Comm. Net. & Network Applications Lab	0-0-2	1	
ECL403	Embedded Systems	3-0-0	3	
ECP403	Embedded Systems Lab.	0-0-2	1	
ECL404	RF & Microwave Engg.	3-0-0	3	
ECL405	Optical Communication	3-0-0	3	
ECL406	Mobile Communication Systems	3-0-0	3	
ECL410	Satellite Communication	3-0-0	3	
ECL411	Digital Image Processing	3-0-0	3	
ECL413	Adaptive Signal Processing	3-0-0	3	
ECL416	Fuzzy Logic and Neural Networks	3-0-0	3	
ECL418	Network Planning and Management	3-0-0	3	
ECL419	Wireless Sensor Networks	3-0-0	3	
ECL420	Smart Antennas	3-0-0	3	
ECL433	Digital IC Design	3-0-0	3	
ECP433	Digital IC Design Lab	0-0-2	1	
ECL424	Industrial Communication Systems	3-0-0	3	
ECL425	High Power RF Devices and Systems	3-0-0	3	
ECP519	Communication Systems Lab II	0-0-2	1	
ECL511	Non-linear System Modeling	3-0-0	3	
ECL512	Topics in Communication Systems	3-0-0	3	
ECL513	Synchronization and Tracking	3-0-0	3	
ECL514	Electromagnetic Interference and Compatibility	3-0-0	3	
ECL515	Intelligent System Design	3-0-0	3	
ECL517	Communication Techniques	3-0-0	3	
ECP440	Cyber Laws and Telecom Regulation Workshop	0-0-2	1	
ECP441	Network Standards Workshop	0-0-2	1	
ECP442	Software Engineering Workshop	0-0-2	1	

***Course Name**: ECL412- Advanced Digital Signal Processing*
***Offered in:** I Semester (Odd Semester)*
***Scheme and Credit:** [(3-0-0); Credits: 3]*
***Type of Course:** Core*
***Course Assessment Method:** Continuous Evaluation*
***Course Assessment Method:** Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).*
***Course Objectives:** To study the advances in digital signal processing mechanism. To study various data compression mechanism such as DCT, DWT, LZW, etc. To study the DSP processors used for digital signal processing applications.*
Course Outcomes:
1: To study and understand the concepts related with various transform
2: To study the application of various transform for data compression
3: To analyze the notion of noise and its removal
4: To understand various DSP processor sand its architecture and to implement the methods studied on those hardware platforms

Syllabus: Introduction to Speech processing, Speech production model, Linear predictive coding for speech, Yule-Walker equations, Short Time Fourier Transform (STFT) , analysis of speech signals using STFT.
Multi rate signal processing, decimator, interpolator, poly-phase decomposition, Noble identities, application to Discrete multi-carrier transmission, sigma-delta ADC.
Data compression, lossy and lossless compression, LZW compression, Arithmetic coding, Discrete Cosine Transform (DCT) and its application to still image compression, audio compression
Introduction to Wavelet transform: Properties of wavelet transform, DWT, filter implementation of DWT, applications of DWT for image denoising and Scaling functions as signaling pulses in communication
Introduction to commercial DSP processors & DSP architecture

References:

1. Introduction to data compression,Khalid Sayood,Elsevier,Second
2. Digital signal processing a computer based approach,S.K.Mitra,TMH,Third
3. Digital signal processing & applications,Dag stranneby and William walker,Elsevier,Second
4. Wavelet Transforms: Introduction to Theory and Applications,A.M.Rao & A.S.Bopardikar, Pearson Edition

***Course Name**: ECL 422 - Statistical Signal Analysis*
***Offered in:** I Semester (Odd Semester)*
***Scheme and Credit:** [(3-0-0); Credits: 3]*
***Type of Course:** Core*
***Course Assessment Method:** Continuous Evaluation*
***Course Assessment Method:** Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).*
***Course Objectives:** To understand the basics of various random variables and their analysis such as PDF and CDF. To understand the details of stochastic processes. To understand the details of statistical signal analysis in the application of electronic communication.*

Course Outcomes:
1: To study and understand the concepts of different random distribution functions.
2.To understand applications of random distribution functions in electronic communication systems.
2: To study the application of queuing theory, Markov processes and their applications in ***computer networks***

Syllabus: Review of random variables, PDF, CDF, mean and correlation
Definition of stochastic processes. Stationary and ergodic processes. Correlation and Spectra, Linear systems with stochastic inputs, discrete time processes.
Applications to communication systems: factorization and innovations, shot noise and thermal noise modeling, modulation, bandlimited processes and sampling.
Introduction to queuing theory, Markov processes, applications of queuing theory to computer networks, sensor networks etc.

References:

1. A. Papoulis, "Probability, Random Variables and Stochastic Processes", 2e, MGH
2. George R. Cooper, Clare D. McGillem, "Probabilistic Methods of Signal and System Analysis", 3e, Oxford University Press
3. Mendenhall, Beaver, Beaver, "Introduction to Probability and Statistics", 12e, Thomson
4. D. Bertsekas, Robert Gallager, "Data Networks", PHI Learning

Course Name*: ECL434-Wireless Digital Communication*
Offered in: *I Semester (Odd Semester)*
Scheme and Credit: *[(3-0-0); Credits: 3]*
Type of Course: *Core*
Course Assessment Method: *Continuous Evaluation*
Course Assessment Method: *Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).*
Course Objectives: *To understand the basics of wireless digital communication used for mobile telephony. To study the basic methodologies of cellular system designing. To study various modulation mechanisms. To understand the wireless channel characterization. To understand the various multiplexing mechanisms. To understand the interference measurement and reduction techniques.*
Course Outcomes:

1. This course provides the students deep knowledge in modern digital communication systems at the theoretical & practical level and introduces the most advanced standards, the future of digital wireless communication systems & networks.
2. The course will focus on modern digital wireless communication systems including the cellular concept, mobile radio environment, signals generation, modulation & processing.
3. At the end of course, students will should able to work in the communication industry & in mobile communication networks.

Syllabus: Introduction to wireless digital communication systems; block diagram of a typical RF transceiver, radio propagation and cellular engineering concepts; frequency reuse, frequency management and channel assignment, handoff and handoff strategies, trunking theory, coverage and capacity improvements, medium access techniques, FDMA, TDMA, CDMA, SDMA.
Modulation methods: Basic digital modulation methods; ASK, PSK and FSK; Quadrature multiplexing and its applications; advanced modulation methods QPSK, QAM, MSK, GMSK, applications of

differential coding, OFDM, MIMO.
Spread Spectrum methods: basics; generation and properties of PN sequences, DS-SS system analysis; slow and fast FH-SS system; performance analysis.
Interference measurement and reduction, co-channel and other interference, Diversity methods for Mobile Wireless Radio Systems, concepts of diversity branch and signal paths, combining and switching methods, C/N and C/I ratio improvements, average Pe improvements

References:

1. Wireless Communication: Principles and Practices ,Theodore Rappaport, Pearson Education 2nd edition
2. Wireless Digital Communication, Feher, PHI
3. Digital communication, John Proakis, Tata- McGraw-Hill, 3rd edition
4. Digital communication, Simon Haykin ,Wiley
5. Communication systems, Simon Haykin ,Wiley, 4th edition

***Course Name**: ECL520-Computational Electromagnetic*
***Offered in:** I Semester (Odd Semester)*
***Scheme and Credit:** [(3-0-0); Credits: 3]*
***Type of Course:** Core*
***Course Assessment Method:** Continuous Evaluation*
***Course Assessment Method:** Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).*
***Course Objectives:** To understand the basics of electromagnetic fields. To understand the finite element methods and methods of moments. To study the applications of these methods in the wireless communication systems.*
Course Outcomes:

1. This course defines capacitors, inductors and resistors in terms of its primary electric and magnetic quantities like electric charge, electric potential, electric current, electric and magnetic flux.
2. It illustrates the concept of finite difference methods and finite element methods
3. It also explains universal concepts in three-dimension real world, i.e., electro-magnetic wave propagation in free-space.
4. The students will learn to define electric and magnetic fields, calculate electric and magnetic fields from stationary and dynamic charge and current distributions, solve simple electrostatic boundary problems, describe simple models for electromagnetic interaction with media, be able to choose adequate models and solution methods for specific problems, solve problems analytically and numerically, it also incorporates the understanding of method of moments and their applications.

Syllabus: Introduction to electromagnetic fields: review of vector analysis, electric and magnetic potentials, boundary conditions, Maxwell's equations, diffusion equation, Poynting vector, wave equation.
Finite Difference Method (FDM): Finite Difference schemes, treatment of irregular boundaries, accuracy and stability of FD solutions, Finite-Difference Time-Domain (FDTD) method
Finite Element Method (FEM): Variational and Galerkin Methods, shape functions, lower and higher order elements, vector elements, 2D and 3D finite elements, efficient finite element computations
Method of Moments (MOM): integral formulation, Green's functions and numerical integration, other integral methods: boundary element method, charge simulation method Applications of these methods for EM simulation of waveguides, micro-striplines and other planar components, antennas, scatterers, radars.

References:

1. M. V. K. Chari and S. J. Salon, Numerical methods in electromagnetism, Academic Press.
2. M. N. O. Sadiku, Numerical techniques in electro-magnetics, CRC Press.
3. N. Ida, Numerical modeling for electromagnetic non-destructive evaluation, Chapman and Hall.
4. S. R. H. Hoole, Computer aided analysis and design of electromagnetic devices, Elsevier Science Publishing Co.
5. J. Jin, The Finite Element Method in electromagnetics, 2nd Ed., John Wiley and Sons.
6. P. P. Silvester and R. L. Ferrari, Finite elements for electrical engineers, 3rd Ed., Cambridge University Press.

***Course Name**: ECL402-Communication Networks & Network Applications*
***Offered in:** I Semester (Odd Semester)*
***Scheme and Credit:** [(3-0-0); Credits: 3]*
***Type of Course:** Elective*
***Course Assessment Method:** Continuous Evaluation*
***Course Assessment Method:** Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).*
***Course Objectives:** To study various protocols used in electronic communication such as TCP/IP, ALOHA, etc. to study the network management concept. To understand the need of network security and various networking security issues.*

Course Outcomes:

1. This course provides students with an overview of the concepts and fundamentals of data communication and computer networks.
2. Through the course, students will be able to understand the fundamental concepts of computer networking and familiar with the basic taxonomy and terminology of the computer networking area.
3. The course introduces the student about to advanced networking concepts and gain expertise in some specific areas of networking such as the design and maintenance of individual networks

Syllabus: Networks and services; network topologies; switching methods; network evolution; concept of layered architecture; the OSI model; the TCP/IP model; standardization and standards organizations. Study of telephone network; PCM-TDM based IDN; circuit switching; space and time division switching; signaling methods; store-and-forward switching. ISDN fundamentals; SS#7; Frame relay and ATM networks; SONET and SDH;
LANs and MAC protocols; ALOHA, slotted ALOHA, CSMA and CSMA-CD protocols; IEEE 802.3 protocol and MAC frame format. Details of 802.3 hardware options; 100 Mbps and 1000 Mbps Ethernet LANs, switches, bridges and VPN; Wireless LANs; LAN applications; client-server architecture;
Network Layer: services offered to the transport layer, internal organization as datagram or virtual circuit subnets; routing algorithms; congestion control; internetworking; Study of IPv4 and IP v6, DNS and Internet routing protocols.
Transport Layer: Design issues; study of TCP; connection setup and removal; flow control; reliable and efficient delivery, timer management. The TCP/IP protocol stack: ICMP, IGMP, UDP, BOOTP, DHCP etc.
Network applications: World Wide Web and HTTP; Web servers and browsers, Content Engines; FTP and TFTP; SMTP and MIME; DNS; multimedia networking; streaming stored audio and video; Internet audio and video communications.
Network Security: Principles of cryptography; authentication; integrity, key distribution and certification;

secure e-mail; Fire-walls
Network management: issues in network management; infrastructure for NM, MIB, SNMP, RMON, ASN1

References:

1. Communication Networks ; Leon-Garcia and Widjaja TMH 3e
2. Computer Networks, a systems approach Peterson and Davie- Morgan Kauffman Harcourt India 3rd edition
3. Computer Networks Tanenbaum A. S.; PHI. 4th edition
4. Data Comuncation and Networking B. Forouzan TMH 4th edition
5. Data and Computer Communication Stallings William PHI 6th edition
6. Computer Networking, a top-down approach featuring the Internet; Kurose and Ross ; Addison Wesley (Low Price Edition)
7. Computer Communications and Networking Technologies- Gallo and Hancock ;Thomson Learning 2nd edition

***Course Name**: ECL416 -Fuzzy Logic and Neural Network*
***Offered in:** I Semester (Odd Semester)*
***Scheme and Credit:** [(3-0-0); Credits: 3]*
***Type of Course:** Elective*
***Course Assessment Method:** Continuous Evaluation*
***Course Assessment Method:** Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).*
***Course Objectives:** To study various concepts related to fuzzy logic and artificial neural networks. To apply these concepts to various fields of engineering.*

Course Outcomes:

1. This course designed to identify and describe fuzzy logic techniques and their roles in building intelligent machines and to recognize the feasibility of applying a soft computing methodology for a particular problem.
2. This course also helps to apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems, apply genetic algorithms to combinatorial optimization problems, and apply neural networks to pattern classification and regression problems.
3. By the end of this course, students will effectively use existing software tools to solve real problems using fuzzy logic as soft computing approach.
4. At the end students will also learn the applications of artificial neural network and basics of self organizing maps.

Syllabus: Crisp sets & Fuzzy Sets : Introduction, Concepts, Fuzzy operations, General Aggregation of operation, Fuzzy relations, Binary relations, Equivalance & similarity relations, Fuzzy relation equation. Applications: Natural, Engineering, Management & Decision making & Computer science.
Supervised and Unsupervised Learning, Multilayer feed forward networks, back propogation algorithm. RBF networks, RLS algorithm, Single layer feedback networks, Hopfield networks, Applications of ANN. SOM,

References:

1. "Fuzzy Sets Uncertainty & Information", George Klir, Prentice Hall, 2nd Edition
2. "Introduction to Artificial Neural Systems", Zurada J. M., West Publishing Co, MN,1994, 2nd Edition

***Course Name**: ECL427 **-** Broadband Communication*
***Offered in:** II Semester (Even Semester)*
***Scheme and Credit:** [(3-0-0); Credits: 3]*
***Type of Course:** Core*
***Course Assessment Method:** Continuous Evaluation*
***Course Assessment Method:** Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).*
***Course Objectives:** To study various concepts related to broadband communication. To understand digital satellite links, frequencies and channel allocations. To understand the multi-carrier communication systems.*
Course Outcomes:

1. This course provides an introductory overview on broadband communication networks.
2. The course covers major aspects of communication networks, such as network design, performance evaluation, protocols and technologies.
3. This course focuses on the network modelling by using mathematical tools, such as queuing theory and stochastic processes, and network optimization, which can provide guaranteed transmission performance with efficient usage of network resources.

Syllabus: Satellite Communication Systems: Orbital aspects of satellite communication, Attitude and orbit control system, Telemetry tracking and command system (TTC), Power subsystems, Antennas, Reliability
Satellite link design, System noise temperature, G/T ratio, Down link design, Uplink design, Link for specified (C/N) base-band noise signal.
Digital Satellite Links, Frequencies and channel allocations, Modulation techniques, QPSK, QAM, BER analysis, medium access methods for satellite communication.
Multi-carrier communication systems: DMT, OFDM, MIMO systems, space-time coding, WiFi, WiMax, UWB systems

References:

1. Timothy Pratt, Charles Bostian, Jeremy Allnut,"Satellite communication" John Willey and Sons Inc. Second edition
2. W. L. Pritchard, H.G. Suyderhoud, R.A. Nelson, "Satellite Communication Systems Engineering" Pearson Education Second edition
3. Wayne Tomasi "Advanced Electronic communications" PHI Learning, Fifth edition
4. Frank.R. Dungan," Electronic Communication Systems" International Thomson
5. Publishing Company Third edition
6. J. Proakis, "Digital Communication" 4e, TMH
7. Simon Haykin, "Communication Systems", 4e, John Wiley

***Course Name**: ECL409-Radio Frequency Circuit Design*
***Offered in:** II Semester (Even Semester)*
***Scheme and Credit:** [(3-0-0); Credits: 3]*
***Type of Course:** Core*
***Course Assessment Method:** Continuous Evaluation*

Course Assessment Method: *Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).*
Course Objectives: *To understand issues involved in design for GHz frequencies. To understand theoretical background relevant for design of active and passive circuits for RF front end in wireless digital communication systems.*
Course Outcomes:

1. This course covers the analysis, design and simulation of radio frequency (RF) circuits and components for communication systems and industrial applications.
2. This course is useful to students for understanding fundamental RF circuit and system design skills and it introduces students the basic RF electronics utilized in the industry and how to build up a complex RF system from basis.

Syllabus: Characteristics of passive components for RF circuits. Passive RLC networks. Transmission lines. Two-port network modeling. S-parameter model. The Smith Chart and its applications.
Active devices for RF circuits: SiGe MOSFET, GaAs pHEMT, HBT and MESFET. PIN diode. Device parameters and their impact on circuit performance.
RF Amplifier design: single and multi-stage amplifiers. Review of analog filter design. Low-pass, high-pass, band-pass and band-reject filters. Bandwidth estimation methods. Voltage references and biasing.
Low Noise Amplifier design: noise types and their characterization, LNA topologies, power match vs noise match. Linearity and large-signal performance.
RF Power amplifiers: General properties. Class A, AB and C PAs. Class D, E and F amplifiers. Modulation of power amplifiers.
Analog communication circuits: Mixers, phase-locked loops, oscillators and synthesizers.
Design and performance characterization. Transreceiver design

References:

1. The Design of CMOS Radio Frequency Integrated Circuits,Lee Thomas H,Cambridge University Press.
2. Design of Analog CMOS integrated circuits,Razavi Behzad,McGraw Hill
3. VLSI for wireless communication,Bosco Leung,Pearson Education

Course Name*: ECL516-Converged Communication Networks*
Offered in: *II Semester (Even Semester)*
Scheme and Credit: *[(3-0-0); Credits: 3]*
Type of Course: *Core*
Course Assessment Method: *Continuous Evaluation*
Course Assessment Method: *Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).*
Course Objectives: *To understand various types of network and their integration. To understand concepts related with source coding. To understand different signaling protocols and modern networking technologies.*
Course Outcomes:

1. ***To understand the concept of different technologies based on IP communication.***
2. ***To understand various aspects related with source coding for different media types.***
3. ***To understand and analyze different signaling protocols and its implementation for IP communication.***
4. ***to gain insight of evolving cellular and non-cellular networks***

Syllabus: Review of circuit switched digital telephony, signaling and transmission, ISDN, SS7. Evolution of packet switched networks, Internet and LANs. The TCP/IP protocol stack. Introduction to XoIP, network convergence, Needs of individual users, enterprises and network operators. How XoIP is expected to meet all these concerns.
Source coding (speech, audio and video coding): PCM, ADPCM, LP coding, CELP, RPE-LTP, adaptive sub-band coding, MPEG standards for audio and video coding.
Signaling protocols: Review of H.323, MEGACO protocols, Session Initiation Protocol (SIP), detailed study of SIP, implementation of SIP through Java.
Media Transport: Need of special media transport protocols, RTP, RTCP, RTSP, QoS issues, routing, security etc.
Modern network technologies: mobile communication 3G, 4G, IMS, wireless LANs, wired networks. New services like IP-TV, multimedia conference calls, presence management, device and access independent services. VXML based applications

References:

1. IP Telephony- O. Hersent, D. Gurle and JP Petit- Pearson Education Asia
2. Multimedia Communications – J. D. Gibson (Editor) – Harcourt India
3. IP Telephony – Bill Douskalis – Prentice Hall
4. Multicast Communication- R. Wittman, M.Zitterbart-Morgan Kaufman

***Course Name**: ECL403 -Embedded Systems*
***Offered in:** II Semester (Even Semester)*
***Scheme and Credit:** [(3-0-0); Credits: 3]*
***Type of Course:** Elective*
***Course Assessment Method:** Continuous Evaluation*
***Course Assessment Method:** Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).*
***Course Objectives:** To introduced the students to concepts of embedded systems. To offer them a level of confidence in microcontroller based system design. To introduce them to the concepts of ARM architectures and RTOS.*
Course Outcomes:

1. The aim of this course is to provide the student with a detailed understanding of Microcontrollers and Embedded systems.
2. The course covers fundamentals of Architecture, Assembly Language Programming, Instruction set, Serial Communication and Interfacing techniques of 8051 Microcontroller.
3. By the end of course, students are able to design an application specific embedded system.

Syllabus: Introduction to embedded systems, microcontrollers 8051 family, architecture, register set, instruction set, programming, interrupts, stack, timers on-chip and off chip peripherals interfacing and programming, Keys, keyboards, LEDs, 7Seg multiplexed display interfacing, ADC,DAC, Stepper motor LCD dot matrix interfacing, Serial communication, sensors and actuators, instrumentation amplifier, Design examples , introduction to ARM, features, architecture, instruction set features, Concepts of RTOS.

References:

1. M A Mazidi, J G Mazidi, R D McKinlay, The 8051 Microcontroller and Embedded Systems Using Assemble and C, Pearson/Prentice Hall, 2nd Ed
2. Kenneth Ayala, The 8051 Microcontroller, Cengage learning, India, 2004 3rd Ed

3. Lyla B Das; Embedded Systems and Integrated Approach, Pearson, India, 2013, first edition,
4. K M Bhurchandi, A K Ray, Advanced microprocessors and Peripherals, McGraw Hill Education India, 2012, 3rd ed
5. Rajkamal, Microcontrollers, Archi, Progr, interfacing and Sys design, Pearson, India, 2nd ed, 2012
6. K V Shibu, Introduction to Embedded Systems, Tata McGraw Hill Education, India, 2009

***Course Name**: ECL 406 -Mobile Communication Systems*
***Offered in:** II Semester (Even Semester)*
***Scheme and Credit:** [(3-0-0); Credits: 3]*
***Type of Course:** Elective*
***Course Assessment Method:** Continuous Evaluation*
***Course Assessment Method:** Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).*
***Course Objectives:** To study the various mobile telephony generations such as 2G, 3G, 4G systems. To understand the need for going from 2G to higher generation networks. To understand the details of the various generations and their abilities and limitations. To understand various modulation and multiplexing mechanisms.*
Course Outcomes:

1. This course provides an introduction to fundamental technologies of the mobile telecommunications.
2. Through this course, students examine fundamental concepts of mobile cellular communications and specifics of current and proposed cellular systems.

3. Course introduces fundamental concepts of physical layer such as propagation loss, multi-path fading and methods of reducing fading effects, Equalization and Diversity Techniques are included in the course.
4. At the end students should have knowledge about Cellular standards including 2G code-division multiple access (CDMA), IS-95A, 2.5G IS-95B, 2G time-division multiple access (TDMA), Global System for Mobile (GSM), and Evolution of GSM technologies towards 4G

Syllabus: The second generation (2G) systems: GSM: services, features, architecture, radio link, channel types, frames, call handling. CDMA IS95: forward and reverse channels, system architecture, call handling.
2.5G systems: GPRS: data rates, basic services, system architecture, protocols, coding schemes, mobility management, hardware and software components EDGE: evolution, advanced modulation methods, radio transmission and data rates, services and protocols.
The 3G systems: Introduction, evolution of 3G networks, ITU IMT 2000, CDMA 2000: bandwidth, chip rate, channels, spreading and modulation, power control, soft handoff, EV-DO, EV-DV
UMTS: radio access network, spreading and modulation, channels, core network.
Wireless LANs: IEEE 802.11 system and protocol architecture, physical layer and MAC, options like 802.11b, a g etc. and their purpose.
Bluetooth: User scenarios, layered architecture, link management, L2CAP, SDP, IEEE 802.15

References:

1. "Mobile Communication", Jochen Schiller, Pearson Education, 2nd Edition
2. "Wireless Communication: Principles and Practice", Theodore Rappaport, Pearson Education, 2nd Edition

***Course Name**: ECL411-Digital Image Processing*
***Offered in:** II Semester (Even Semester)*
***Scheme and Credit:** [(3-0-0); Credits: 3]*
***Type of Course:** Elective*
***Course Assessment Method:** Continuous Evaluation*
***Course Assessment Method:** Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).*
***Course Objectives:** To understand the basics of digital image processing as a branch of signal processing. To study various algorithms used in the image processing applications. To study various applications of digital image processing.*
Course Outcomes:

1. This course offers fundamentals of digital image processing and algorithms that are used.
2. At the end of the course the student should have a clear impression of the breadth and practical scope of digital image processing and have arrived at a level of understanding that is the foundation for most of the work currently underway in this field.
3. Students will be able to implement basic image processing algorithms using different tools such as MATLAB, Java.

Syllabus: Elements of visual perception, Digital Image fundamentals, Basic image processing steps, Image Transforms, Image enhancement in spatial and frequency domain, linear gray level transformations, Histogram equalization and specification, smoothing & sharpening spatial filters. Image degradation models, image restoration, inverse filtering, Wiener filtering. Image reconstructions from projections, radon transform, projection theorem of computerized tomography. Morphological image processing, dilation, erosion, Basic morphological algorithms, thinning algorithms. Edge detection, Edge linking & Boundary Detection, watershed segmentation algorithm , Introduction to object recognition., color image processing ,RGB and HSI color models, Gray level to color transformation.

References:

1. Digital Image Processing,Gonzalez R.C. and Woods R.E,Pearson,Second
2. Digital Image Processing,Pratt W.K.,Wiley,Third
3. Fundamentals of Digital Image Processing,A.K.Jain,PHI

***Course Name**: ECL433- Digital IC Design*
***Offered in:** III Semester (Odd Semester)*
***Scheme and Credit:** [(3-0-0); Credits: 3]*
***Type of Course:** Elective*
***Course Assessment Method:** Continuous Evaluation*
***Course Assessment Method:** Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).*
***Course Objectives:** to understand basics of hardware description languages. To implement various examples of digital IC designs using hardware description languages.*
Course Outcomes:

1. This course covers an introduction to various hardware description languages and their associated methodologies for designing digital systems.
2. It also provides in-depth coverage, which includes applications to the simulation and synthesis of digital systems.

3. The students will get familiar with the process of digital integrated circuit synthesis, together with place and route, starting from HDL code to silicon/gate array level.

Syllabus: Basic concepts of hardware description languages. Hierarchy, Concurrency, Logic and Delay modeling. Structural, Data-flow and Behavioral styles of hardware description. Architecture of event driven simulators. Syntax and Semantics of VHDL. Variable and signal types, arrays and attributes. Operators, expressions and signal assignments. Entities, architecture specification and configurations. Component instantiation. Concurrent and sequential constructs. Use of Procedures and functions, Examples of design using VHDL.
Syntax and Semantics of Verilog. Variable types, arrays and tables. Operators, expressions and signal assignments. Modules, nets and registers, Concurrent and sequential constructs. Tasks and functions, Examples of design using Verilog. Synthesis of logic from hardware description.

References:

1. VHDL,Z. Navabi,McGraw Hill International Ed. 1998
2. Verilog HDL: A Guide to Digital Design and Synthesis,S. Palnitkar,"Prentice Hall NJ, USA),19
3. VHDL Primer,J.Bhaskar,Pearson Education Asia,2001
4. Verilog HDL Synthesis - A Practical Primer, "J.Bhaskar", Star Galaxy Publishing,(Allentown, PA)",1998

***Course Name**: ECL424 - Optical Communication*
***Offered in:** III Semester (Odd Semester)*
***Scheme and Credit:** [(3-0-0); Credits: 3]*
***Type of Course:** Elective*
***Course Assessment Method:** Continuous Evaluation*
***Course Assessment Method:** Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).*
***Course Objectives:** To study various concepts related to optical communication. To understand basics of total internal reflection. To understand various optical sources and detector. To understand various modes of communication through optical fibre.*
Course Outcomes

1. This course designed to enable students to develop a full understanding of the components and the design and operation of optical fibre communication systems and introduces the principles of wavelength division multiplexed (WDM) systems, RF photonic systems and passive optical networks (PONs).
2. Students are able to understand the characteristics and limitations of system components like laser diodes, external modulators, optical fibre, and optical amplifiers.

3. By the end of this course students will be able to analyze the performance of both analog and digital optical fibre systems and calculate the system bandwidth, noise, probability of error and maximum usable bit rate of a digital fibre system.

Syllabus: Optical Fibre: Basic concepts of optical communication. The nature of light. Light as an Electromagnetic Wave, Polarisation, Interference. Transmitting light on a Fibre Refractive index, Fibre refractive index profiles, Modes of propagation. Light Propagation in Multimode Fibre, Snell's Law Critical Angle, Numerical aperture.
Optical Sources: Light Emitting Diodes (LEDS), The Semiconductor Junction Diode, Construction and Operation of LED's , Heterojunctions (Practical LED's) , Characteristics of LED'S, Lasers, Principle of the LASER, Semiconductor Laser Diodes
Optical Detectors: Photoconductors, Photodiodes, P-N Diodes, P-I-N Diodes, Schottky-Barrier Photodiodes, Avalanche Photodiodes (APDS), Hetero-interface Photodetectors, Travelling Wave photodetectors, Phototransistors
Optical Communication Systems: Point-to-point Transmission Systems, Modulation techniques, On-off key, Multi state coding, Forward Error correction, Receiving the signal, Timing recovery, Bandwidth Occupancy

References:

1. "Optical Fibre Communication Practice and Principles", Senior
2. "Fibre Optic Communication", D. C. Agrawal
3. "Optical Communication", Keiser

***Course Name**: ECL 423 - Image Analysis and Computer Vision*
***Offered in:** III Semester (Odd Semester)*
***Scheme and Credit:** [(3-0-0); Credits: 3]*
***Type of Course:** Elective*
***Course Assessment Method:** Continuous Evaluation*
***Course Assessment Method:** Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).*
***Course Objectives:** to understand the role of digital image processing in the field of computer vision. To understand various mechanisms responsible for image segmentation, motion analysis, motion estimation, computational imaging and super resolution. To study and understand the 3 dimensional imaging mechanisms. To study and understand the image and video compression mechanisms. To understand the basics of color image processing. To study various applications of computer vision systems.*
Course Outcomes:

Syllabus: Review of basics of Digital image processing, Introduction about computer vision: What is computer vision, advantages and disadvantages of computer vision, general applications of computer vision
Feature detection and matching: Points and patches, edges, lines, Segmentations:
Feature based alignment: 2D and 3D feature based alignments algorithms and applications, Pose estimation algorithms.
Motion estimation: Differential motion analysis methods, optical flow, detection of specific motion patterns, image stitching, motion models for tracking, alignments, compositing.
Image and video Compression techniques.
Computational imaging: super resolution, blur removal, image matting and compositing, texture analysis and synthesis, stereo imaging, basic concepts, and applications.
3D image processing techniques: basics of 3D images, 3D sensing, camera calibrations, and reconstructions, 3D from 2D image, surface based representations, point based representations, and volumetric based representations, and model based reconstruction, recovering textures from 3D images and applications of 3D imaging techniques, 3D shape recognition.
Object Recognition techniques

Basics Colour image processing: Color fundamentals, color models, color transformation, color segmentation, smoothing, and sharpening.
Case studies of computer vision projects such as content-based image retrieval, face recognition etc.

References:

1. "Computer Vision: Algorithms and Applications" by "Richard Szeliski"Springer, 2010
2. "Computer Vision", "Shapiro and Stockman," Prentice Hall, 2001
3. "Image Processing, Analysis, and Machine Vision", "Sonka, Hlavac, and Boyle" Cengage Learning, 2009.
4. "Fundamentals Of Machine Vision", by "Harley R. Myler" PHI Learning (2003)
5. "Computer Vision: A Modern Approach" by "Forsyth, David A., Ponce, Jean" PHI Learning (2009)
6. "Pattern Recognition and Image Analysis" by", " Earl Gose Steve Jost and Richard Johnsonbaugh", PHI (2009)
7. "Fundamentals of Digital image processing", by "Anil K. Jain", PHI, 2010
8. "Digital image processing", by Rafael C. Gonzalez and Richard E. Woods," Pearson Education 3rd Edition.

***Course Name**: ECL410 -Satellite Communication*
***Offered in:** III Semester (Odd Semester)*
***Scheme and Credit:** [(3-0-0); Credits: 3]*
***Type of Course:** Elective*
***Course Assessment Method:** Continuous Evaluation*
***Course Assessment Method:** Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).*
***Course Objectives:** To understand the basics of satellite communications and satellite systems. To understand the designing of satellite links. To understand the signal processing required for satellite communications. To understand the earth station details and their designing.*
Course Outcomes:

1. This course presents the fundamentals of satellite communications link design and provides an overview of practical considerations.

2. Existing systems are described and analyzed, including direct broadcast satellites, VSAT links, and Earth-orbiting and deep space spacecraft.

3. Topics include satellite orbits, link analysis, antenna and payload design, interference and propagation effects, modulation techniques, coding, multiple access, and Earth station design

Syllabus: Orbital aspects of satellite communication, Orbit mechanisms, Equation of orbit, Locating satellite in orbit, Orbital elements, Orbital area coverage, Look angles, Slant range,
Space craft subsystems, Attitude and orbit control system, Telemetry tracking and command system (TTC), Power subsystems, Antennas, Reliability
Satellite link design, System noise temperature, G/T ratio, Down link design, Uplink design, Link for specified (C/N) base-band noise signal.
Digital Satellite Links, Frequencies and channel allocations, Modulation techniques, QPSK, QAM, BER analysis, medium access methods for satellite communication.
Earth station technology, Earth station design for low system noise temperature. Equipment for earth stations, LNA and HPA.
VSAT systems- overview of VSAT systems, Access control protocols, multiple access selection,

modulation, coding and interference issues

References:

1. Satellite communication, "Timothy Pratt, Charles Bostian, Jeremy Allnut",John Willey and Sons Inc, 2nd edition
2. Satellite Communication Systems Engineering,"W. L. Pritchard, H.G. Suyderhoud, R.A. Nelson, ",Pearson Education, 2nd edition
3. Advanced Electronic communications, Wayne Tomasi, Prentice Hall of India Pvt. Ltd, 5th edition
4. Electronic Communication Systems, Frank.R. Dungan, International Thomson Publishing Company, 3rd edition
5. Satellite Communication,Roddy, 2nd edition
6. Satellite Communication Technology,Dr. K. Miya, 2nd edition

***Course Name**: ECL404-RF & Microwave Engineering*
***Offered in:** III Semester (Odd Semester)*
***Scheme and Credit:** [(3-0-0); Credits: 3]*
***Type of Course:** Elective*
***Course Assessment Method:** Continuous Evaluation*
***Course Assessment Method:** Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).*
***Course Objectives:** To study the basics of RF and microwave spectrum. To study various microwave tubes and different semiconductor devices. To understand the measurement of various RF related parameters. To study the applications of microwaves.*
Course Outcomes:

1. This course gives an introductory overview of different microwave devices and their applications
2. To analyze different microwave devices and their characteristics using various parametric analysis
3. At the end of the course, the focus is given towards applications of microwave engineering in various fields.

Syllabus: Introduction: RF & Microwave spectrum, Historical Background, Typical application of RF & Microwaves, Microwave Tubes: Limitation of conventional tubes in microwaves, Two cavity and multicavity Klystron, Reflex Klystron, Magnetron,Travelling wave tube, Backward wave oscillator – working principles, characteristics. Semiconductor Microwave Device: Tunnel diode,Gunn diode, IMPATT diode,TRAPATT diode, Microwave bipolar transistor,hetrojunction bipolar transistor, Parametric amplifier, Passive Components : S- matrix, Directional coupler, Bethe-hole coupler, Magic tee, Hybrid ring,Circulator,Isoletor. Microwave Measurement: Measurement of VSWR-Low, Medium and High, Measurement of power, Bolometer, Frequency measurement, Impedence measurement. Application of Microwaves: Introduction to satellite communication, Radar, Industrial application of microwaves.

References:

1. Microwave Devices & Circuits S.Y.Liao Pearson Education/PHI
2. Microwave Engineering ,Monojit Mitra ,Dhanpath Rai New Delhi
3. Microwaves ,K.C.Gupta ,New Age Publishers
4. Microwave Engineering ,Kulkarni ,Dhanpat Rai New Delhi

***Course Name**: ECL413-Adaptive Signal Processing*

Offered in: *III Semester (Odd Semester)*
Scheme and Credit: *[(3-0-0); Credits: 3]*
Type of Course: *Elective*
Course Assessment Method: *Continuous Evaluation*
Course Assessment Method: *Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).*
Course Objectives: *To understand the need for adaptive mechanisms. To understand various methods to deal with adaptive signal processing. To study the role of adaptive signal processing in the field of electronics and communication engineering.*
Course Outcomes:

1. The primary objective of this course is to develop the ideas of optimality and adaptation in signal processing.
2. The students will discuss the design, analysis, and implementation of digital signal processing systems that can be considered optimal in some sense.
3. Through this course students will be able to understand why adaptation is required if a system is to remain optimal in a continually changing environment and why an emphasis is placed on developing adaptive algorithms with applications to specific engineering problems.

Syllabus: Vectors, Matrices and Eigen Analysis. Application to adaptive signal processing. Stochastic Processes, Ensemble average, mean, average power, auto and cross correlation functions, stationarity and white noise, Auto-regressive process. Least Squares and LMS algorithms, Normal equations, properties. Eigen System decomposition. Gradient search technique, convergence properties of LMS. Normalized LMS algorithm. Recursive solution techniques, RLS algorithm. Application to noise cancellation, modeling of physical processes, communications.
References:

1. S. Haykin, Adaptive filter theory, Prentice Hall, 1986.
2. B. Widrow and S.D. Stearns, Adaptive signal processing, Prentice Hall, 1984.
3. Widrow B., Stearns S.D.; Adaptive Signal processing; Prentice Hall, 1984
4. Treichler J.R.; Theory and Design of adaptive filters ; PHI, 2002

Course Name*: ECL418-Network Planning and Management*
Offered in: *III Semester (Odd Semester)*
Scheme and Credit: *[(3-0-0); Credits: 3]*
Type of Course: *Elective*
Course Assessment Method: *Continuous Evaluation*
Course Assessment Method: *Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).*
Course Objectives: *To study Network traffic data analysis and forecasting, resource planning, procurement and installation. To study Telecom network operation and maintenance system. To understand various issues of enterprise network operations and LAN design. To understand various issues related to protocol managements.*
Course Outcomes:

1. This course introduces analyzing and forecasting of electronic communication network traffic data with understanding of various network issues by considering different case studies.
2. To understand various network management aspects.
3. At the end this course gives an understanding of various communication network management protocols

Syllabus: Network traffic data analysis and forecasting, resource planning, procurement and installation
Telecom network operation and maintenance system. Case studies of ISDN, ATM, GSM, CDMA networks.
Enterprise need analysis and LAN design, component selection, procurement and installation.
Network management issues such as configuration management, fault and maintenance management, security and access management.
Management protocols such as SNMP, web based management tools such as Netconf, management protocol issues such as scalability, efficiency, effectiveness etc.

References:

1. Subramanian ; Network Management ; Addison Wesley (Low Price Edition)
2. McCabe J.D., Network analysis, architecture and design, Elsevier
3. FitzGerald J., Dennis A., Business Data Communications and networking,

***Course Name**: ECL419 -Wireless Sensor Networks*
***Offered in:** III Semester (Odd Semester)*
***Scheme and Credit:** [(3-0-0); Credits: 3]*
***Type of Course:** Elective*
***Course Assessment Method:** Continuous Evaluation*
***Course Assessment Method:** Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).*
***Course Objectives:** To study constraints and analysis of challenges of wireless sensor networks. To study issues of networking of sensor nodes. To understand different Sensor network platform and tools, application case studies, trends and future*
Course Outcomes:

1. To understand different type of challenges associated with WSNs
2. To understand different type of protocols related with different layers
3. At the end, sensor network platform and tools, application case studies are given to strengthen the knowledge of WSNs to its realistic applications.

Syllabus: Constraints and challenges, advantages of wireless sensor networks, applications. Localization and tracking, collaborative localization, Bayesian state estimation, tracking multiple objects,. Networking sensors, Medium access control protocols, geographic energy aware routing, attribute based routing, infrastructure establishment, time synchronization. Sensor tasking and control, sensor network databases, query interfaces, aggregation. Sensor network platform and tools, application case studies, trends and future.

References:

1. Zhao Feng, Guibas Leonidas; Wireless Sensor Networks, Elsevier

***Course Name**: ECL420-Smart Antennas*
***Offered in: I**V Semester (Even Semester)*
***Scheme and Credit:** [(3-0-0); Credits: 3]*
***Type of Course:** Elective*

Course Assessment Method: *Continuous Evaluation*
Course Assessment Method: *Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).*
Course Objectives: *To study different types of antenna systems. To study the channel characterization. To understand the use of smart antennas for wireless telephony systems.*
Course Outcomes:

1. To understand various types of antenna systems with their usefulness to various need.
2. Understanding the antenna systems in details and their issues to be rectified by smart antennas
3. At the end, various indoor and outdoor channel characteristics and their analysis is done to enhance the smart antenna design.

Syllabus: Array Antenna Fundamentals: Linear Arrays , Array Weighting, Beamsteered Arrays , Circular Arrays ,Fixed Beam and Sectorized Arrays. Sidelobe Cancellors , Retrodirective Arrays. Smart Antennas, benefits of smart antennas, Adaptive Algorithm Basics , Gradient Based Methods, Howells Applebaum Processor , Adaptive Beamforming Elimination of the Effects of Mutual Coupling on Adaptive Antennas. Adaptive Arrays for CDMA , Waveform Diversity Methods, MIMO ExamplesAngle-of-Arrival Estimation, Array Correlation Matrix ,Bartlett AOA Estimation method ,Capon AOA Estimation method , Spectral Estimation Methods .Channel Characterization ,Channel Impulse Response, Slow Fading; Fast Fading; Fast Fading Modeling ,Spreading , Channel Equalization. Methods for Optimizing the Location of Base Stations for Indoor Wireless Communication, Identification and Elimination of Multipath Effects, Signal Enhancement in Multiuser Communication.

References:

1. "Smart Antennas for Wireless Communications", By Frank Gross, McGraw hill
2. "Smart Antennas", Tapan A. Sarkar ,M. C. Wicks, M. Salazar-Palma, R. J. Bonneau, Wiley
3. "Introduction to Smart Antennas", Balanis, Constantine A.Morgan & Claypool

Course Name*: ECL424-Industrial Communication Systems*
Offered in: I*V Semester (Even Semester)*
Scheme and Credit: *[(3-0-0); Credits: 3]*
Type of Course: *Elective*
Course Assessment Method: *Continuous Evaluation*
Course Assessment Method: *Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).*
Course Objectives: *To study different types of interfaces. To understand the need of communication for industrial applications.*
Course Outcomes:

1. To understand different types of interfaces applicable in industrial environment.
2. To study and understand the process of Instrumentation network design and its up-gradation.
3. At the end, the need of communication systems for industrial applications has focused.
4.

Syllabus: Interface: Introduction, principles of interface, serial interface and its standards. Parallel interfaces and buses. Fieldbus: Use of field buses in industrial plants, functions, international standards, performance, use of Ethernet networks, fieldbus advantages and disadvantages. Fieldbus design, installation, economics and documentation.
Instrumentation network design and upgrade: Instrumentation design goals, cost optimal and accurate sensor networks. Global system architectures,advantages and limitations of open networks, HART network

and foundation fieldbus network. PROFIBUS-PA: Basic, architecture, model, network design and system configuration. Designing PROFIBUS-PA and foundation. Fieldbus segments: general considerations, network design.

References:

1. Noltingk B.E. "Instrumentation Reference Book" . 2nd E dition. Butterwort Heinenmann. 1995.
2. B.G. Liptak. Process software and digital networks, 3rd Edition. CRC press, Florida.
3. John Park ,Steve Mackay "Practical Data acquisition for Instrumentation and control systems" Elsevier ,2003
4. Creed Huddleston "Intelligent sensor Design Using the Microchip dsPIC" Elsevier ,2007

***Course Name**: ECL425-High power RF devices and Systems*
***Offered in: I**V Semester (Even Semester)*
***Scheme and Credit:** [(3-0-0); Credits: 3]*
***Type of Course:** Elective*
***Course Assessment Method:** Continuous Evaluation*
***Course Assessment Method:** Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).*
***Course Objectives:** To study different types of high power RF devices. To understand the use of these devices for electronics communication systems.*
Course Outcomes:

1. This course helps in understanding of different types of high power RF devices.
2. To understand the use of these devices for electronics communication systems.
3. At the end case studies gives an overview of applications of these devices for real life applications.

Syllabus: Review of RF & Microwave spectrum, introduction to applications of high power RF & Microwaves
Microwave Tubes: Two cavity and multi-cavity Klystron, Reflex Klystron- relation between repeller voltage and accelerating voltage, relation between repeller voltage and frequency of operation, Transit time and mode number, power frequency characteristics tuning, application.
Traveling wave tube: Study of slow wave structure, M & O type TWT, Expression for optimum value D.C biasing voltage to build up amplification in TWT, application
Magnetron: Operation of magnetron oscillator, mode jumping in magnetron, Rikie diagram and graphical representation of performance characteristics of magnetron, application
Backward wave oscillator: working principles, characteristics. Study of O type BWO
Microwave Passive components for high power systems:
Directional coupler – Bathe hole coupler, double hole coupler, Moreno crossed guide coupler, multi hole coupler, Faraday rotation: Circulator, Isolator, Gyrator
Microwave hybrid circuits – Magic Tee, Rat race, Branch line coupler Waveguide Irises
Cavity Resonators – Rectangular cavity resonator, Q of a rectangular cavity resonator
Microwave Measurement: Measurement of VSWR-Low, Medium and High, Measurement of power, Bolometer, Frequency measurement, Impedance measurement, attenuation measurement Cavity Q measurement.
High power RF system: Case studies, Radar, TV transmission, Satellite Communication Systems.

References:

1. S.Y.Liao; Microwave Devices & Circuits; Pearson Education/PHI
2. Microwave Engineering 3rd Edition, David M Pozar, John Wiley and Sons, 2005
3. Foundation of Microwave Engineering, R E Collin, McGraw Hill International;
4. Microwave Devices & Circuit Design, Ganesh Prasad Srivastava & Vijay Laxmi Gupta, PHI, 2006
5. K.C.Gupta; Microwaves; New Age Publishers

Course Name**: ECL511-**Non Linear Systems Modeling
***Offered in: I**V Semester (Even Semester)*
***Scheme and Credit:** [(3-0-0); Credits: 3]*
***Type of Course:** Elective*
***Course Assessment Method:** Continuous Evaluation*
***Course Assessment Method:** Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).*
***Course Objectives:** To study different types of non – linear systems and their analysis. To understand the use of these systems for electronics and communication.*
Course Outcomes:

1. Students will be conversant various mathematical models used for non-linear system modeling
2. Students will be able to understand, simulate and analyze performance of various communication systems based on non-linear systems

Syllabus: Introduction to nonlinear systems, analysis by phase plane and describing function methods. Nonlinear circuits. Lyapunov stability theory. The Lure problem: Popov's method, circle criterion. Hyperstability. Hamiltonian, Lagrangian and gradient systems
Introduction to dynamical systems, examples of discrete and continuous dynamical systems, Lorenz attractor, Logistic map, Bifurcation ,Chaos in dynamical system
Chaos based communication: chaotic modulation, chaotic multiplexing, chaotic masking. Chaotic oscillator, Chaotic synchronization methods.
Chaos and signal processing: chaos based noise modeling for adaptive filtering, invertible chaotic encryption, chaos based jamming. Control chaos.
Fractal basics, iterated function systems, fractal applications.

References:

1. *Khalil, Hassan K., "*Nonlinear Systems", *Prentice Hall. (2001).*
2. *Steven H, Strogatz , "N*onlinear dynamics and chaos: with applications to physics, biology chemistry and engineering*", Addison Wesley(1994).*
3. M. Vidyasagar, Nonlinear systems analysis. 2nd Edition. Prentice Hall,(1993).
4. Lawrence Perko, "Differential Equations and Dynamical Systems", Springer, Second Edition (1996);
5. V. M. Popov : Hyperstability of control systems. Springer Grundleheren series, 1970.
6. Y. A. Yakubovitch and V. M. Starzhinskii, Linear differential equations with periodic coefficients. Wiley, 1975.
7. Francis C. M. Lau, Chi Kong Tse ,"Chaos-based digital communication systems: operating principles, analysis methods, and performance evaluation", Springer, 2003

***Course Name**: ECL512-Topics in Communications Systems*
***Offered in: I**V Semester (Even Semester)*
***Scheme and Credit:** [(3-0-0); Credits: 3]*
***Type of Course:** Elective*
***Course Assessment Method:** Continuous Evaluation*
***Course Assessment Method:** Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).*
Course Objectives: At the end of this course, a student will be familiar with the basics of Information Theory, Coding and recent trends in communication engineering.
Course Outcomes:

1. Student will have understanding of advanced topics in information theory and coding
2. Students will be able to analyse MIMO systems from the information theory point of view

Syllabus:
Introduction to subject, its importance in industry and research.
Concepts of probability, Baye's theorem. Continuous random variables, distribution function, density function, joint probability density functions, statistical average and moments.
Review of entropy, mutual information, channel capacity for discrete and continuous channels, Shannon-Hartley theorem, noisy channels,
Source coding theorem, Shannon Fano codes, Huffman Codes, Arithmetic codes and Lempel-Ziv-welch algorithm,
Linear block codes and their properties, Hamming codes, convolutional codes , Viterbi codes and low density parity check codes, cyclic codes, Turbo codes, Ungerboeck codes.
Concept of diversity, introduction to MIMO systems, space-time coding, MIMO Channels, capacity of MIMO channels, ergodic capacity.
Error Probability Analysis for SISO Channels, Error Probability Analysis for MIMO Channels: Pairwise Error Probability, Coherent Maximum-Likelihood Detection, Detection with Imperfect Channel Knowledge, Joint ML Estimation/Detection
Cooperative communication, amplify forward and decode forward protocols, performance evaluation of cooperative communication systems, full duplex communication, optical wireless communication, Introduction to Massive MIMO

References:

1 Elements of information theory : T.M.Cover and J.A Thomas John Wiley and Sons
2. Communication Systems : S .Haykins; John Wiley and Sons
3. Information Theory Coding and Cryptography :R Bose TMH
4. Analog and Digital Communications: Theory and Lab Work: Abhay Gandhi
5. Communication Systems : A Bruce Carlson; TMH
6. First course in Coding Theory : Oxford University Press

***Course Name**: ECL513-Synchronization and Tracking*
***Offered in: I**V Semester (Even Semester)*
***Scheme and Credit:** [(3-0-0); Credits: 3]*
***Type of Course:** Elective*
***Course Assessment Method:** Continuous Evaluation*
***Course Assessment Method:** Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).*

Course Objectives: *To study different types of synchronization and tracking related issues. To understand the role of synchronization and tracking for electronic communication systems.*

Course Outcomes:

1. To study different types of synchronization and tracking related issues.
2. To understand the role of synchronization and tracking for electronic communication systems.
3. At the end, Chaotic synchronization is given importance.

Syllabus: Network synchronization for TDM networks, timing references and their distribution, hierarchical systems, mutual synchronization.
PLL: Design and analysis of PLL, Loop modeling; linear and non-linear, acquisition and tracking range. Static and dynamic performance. Phase noise and jitter.
Carrier Synchronization methods: Costas Mth power loop, phase ambiguity issues, advances in carrier synchronization
Symbol timing recovery: Early-late gate method, steady state and transient response, modeling and simulation.
Code acquisition and tracking techniques for spread spectrum methods
Carrier synchronization issues in OFDM. Performance degradation due to frequency offset error.
Chaotic synchronization

References:

1. Proakis John ; Digital communication(Third Edition); Tata- McGraw-Hill.
2. Haykin Simon ; Communication systems (Fourth Edition); Wiley.
3. Korsch H.J., Jodl H.J., Chaos, Springer-Verlag

Course Name*: ECL514-Electromagnetic Interference and Compatibility*
Offered in: I*V Semester (Even Semester)*
Scheme and Credit: *[(3-0-0); Credits: 3]*
Type of Course: *Elective*
Course Assessment Method: *Continuous Evaluation*
Course Assessment Method: *Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).*
Course Objectives: *To study different issues associated with electromagnetic interference and the compatibility. To understand the role of electromagnetic interference and the compatibility for electronic communication systems.*

Course Outcomes:

1. To study different issues associated with electromagnetic interference and the compatibility.
2. To understand the role of electromagnetic interference and the compatibility for electronic communication systems.

Syllabus: Aspects of EMC with examples, Common EMC units, EMC requirements for electronic systems, Radiated emissions, Conducted emissions, ESD. Application of EMC design, Wires, PCB lands, Component leads, resistors, capacitors, inductors, ferrites. Electromechanical devices, Digital circuit devices. Mechanical switches (as suppression) , Noise pick-up modes and reduction techniques for analog circuits. Use of co-axial cables and shielding of signal lines. Simple emission models for wires and PCB lands, Line impedance stabilisation network (LISN), Power supply filters. Power supplies including SMPS. EMI induced failure mechanisms for power electronic equipment. Three conductor lines and crosstalk, Shielded wires , Twisted wires, Multiconductor lines and effects of incident fields, Shielding, Origin effects , prevention of ESD event, its harware and immunity. System design for EMC, Grounding, System configuration, PCB design. EMC in the design of digital circuits. ESD and switching interference

reduction. Susceptibility aspects of power electronic and digital equipment. Shielding of electronic equipment. EMC standards and test equipment.

References:

1. Noise Reduction Techniques in Electronic Systems, 2nd Edition - Ott HW
2. Electrostatic Damage in Electronics : Devices and Systems - Willium B Greason, Johan Wiley and Son'.
3. Digital Bus Hand Book - Joseph Di Giacomo, McGraw-Hill Publishing Company.

***Course Name**: ECL515-Intelligent System Design*
***Offered in: I**V Semester (Even Semester)*
***Scheme and Credit:** [(3-0-0); Credits: 3]*
***Type of Course:** Elective*
***Course Assessment Method:** Continuous Evaluation*
***Course Assessment Method:** Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).*
***Course Objectives:** To study different issues intelligent systems and their designing aspects. To understand the need of artificial intelligence. To understand the importance of soft computing tools in designing the intelligent systems.*
Course Outcomes:

1. To study different issues intelligent systems and their designing aspects.
2. To understand the need of artificial intelligence.
3. To understand the importance of soft computing tools in designing the intelligent systems.

Syllabus: Concept of Intelligent systems, motivation and design features, Modeling of Intelligent Systems. Evolution in ISD. Errors and types of errors for intelligent control, different methods of error estimation. Relevance of Artificial Intelligence in ISD. Relevance of soft computing tools in ISD: Fuzzy logic, Neural network, GA, Rough Sets, SWARM etc. Real Time ISD implementation, software and hardware tools and methodologies used. Case Studies and applications of ISD.

References:

1. Intelligent system Design and applications, Springer, Ajith Abraham, Katrin Franke, Mario Köppen
2. Soft computing and intelligent systems design: theory, tools, and applications, Fakhreddine O. Karray, Clarence W. De Silva, Pearson/Addison Wesley,
3. Intelligent systems design: integrating expert systems, hypermedia, and database technologies
4. Larry Bielawski, Robert Lewand Wiley,
5. Planning in Intelligent Systems: Aspects, Motivations, and Methods, Wout van Wezel (Editor), R. J. Jorna (Editor), Alexander M. Meystel (Editor) , Wiley
6. Intelligent Systems: Architecture, Design, and Control, Alexander M. Meystel, James S. Albus Wiley

***Course Name**: ECL517-Communication Techniques*
***Offered in: I**V Semester (Even Semester)*
***Scheme and Credit:** [(3-0-0); Credits: 3]*
***Type of Course:** Elective*
***Course Assessment Method:** Continuous Evaluation*
***Course Assessment Method:** Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).*
***Course Objectives:** To understand various electronic communication techniques. To understand various modulation methods used for electronic communication. To understand various multiple access mechanism used in electronic communication. To understand the basics of trucking mechanism*
Course Outcomes:

1. To understand various electronic communication techniques.
2. To understand various modulation methods used for electronic communication.
3. To understand various multiple access mechanism used in electronic communication.
4. To understand the basics of trucking mechanism

Syllabus: Review of analog modulation: amplitude modulation and angle modulation. Mathematical modeling of modulation and demodulation, spectral properties, generation, transmission and reception of analog modulated signals. Digital Modulation methods: Basic digital modulation methods; ASK, PSK and FSK; Quadrature multiplexing and its applications; advanced modulation methods QPSK, QAM, MSK, GMSK, applications of differential coding, Spread Spectrum methods: basics; generation and properties of PN sequences, DS-SS system analysis; slow and fast FH-SS system; performance analysis. Multi-carrier systems: DMT, OFDM, MIMO, mathematical model, performance criteria and improvement, implementation issues. Multi-access systems: Trunking theory, coverage and capacity improvements, study of various medium access techniques such as Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), Code Division Multiple Access (CDMA), Space Division Multiple Access (SDMA) and their comparisons.

References:

1. Communication systems(4e), Simon Haykin,Wiley
2. Digital communication, Simon Haykin,Wiley
3. Digital communication (3e), John Proakis, Tata- McGraw-Hill