Dr. A P J Abdul Kalam Technical University, Lucknow
(Formally UPTU)

SYLLABUS

For

B. Tech

Electronic & Communication Engineering

4th Year

[Effective from Session 2016-17]

AKTU, LUCKNOW, U.P
Study and Evaluation Scheme B. Tech. in Electronics Engg/Electronics & Communication Engg/Electronics & Telecommunication Engg
[Effective from the session 2016-17]

YEAR 4th, SEMESTER-VII

S. No.	Course Code	SUBJECT	PERIODS			Evaluation Scheme				Subject Total	Credit
						SESSIONAL EXAM.			ESE		
			L	T	P	CT	TA	Total			
THEORY SUBJECTS											
1.	NOE 07*	Open Elective-I**	3	1	0	30	20	50	100	150	4
2.	NEC 03*	Departmental Elective-III	3	1	0	30	20	50	100	150	4
3.	NEC 701	Optical Communication	3	1	0	30	20	50	100	150	4
4.	NEC 702	Data Communication Networks	3	1	0	30	20	50	100	150	4
5.	NEC 703	VLSI Design	3	1	0	30	20	50	100	150	4
6.	AUC 001	*Human Values & Professional Ethics	2	0	0	15	10	25	50	75	-
PRACTICAL/DESIGN/DRAWING											
7.	NEC 751	Optical Communication & Networking Lab	0	0	2	-	20	20	30	50	1
8.	NEC 752	Electronics Circuit Design Lab	0	0	3	-	20	20	30	50	2
9.	NEC 753	Industrial Training Viva-Voce	0	0	2	-	50	50	-	50	1
10.	NEC 754	Project	0	0	2	-	50	50	-	50	1
11.	NGP 701	General Proficiency	-	-	-	-	-	50	-	50	1
		Total	**15**	**5**	**9**	**150**	**240**	**440**	**560**	**1000**	**26**

**** Open Electives-I**

NOE-071 Entrepreneurship Development
NOE-072 Quality Management
NOE-073 Operation Research
NOE-074 Introduction to Biotechnology
NOE-075 Micro and smart systems

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YEAR 4th, SEMESTER-VIII

S. No.	Course Code	SUBJECT	PERIODS			Evaluation Scheme				Subject Total	Credit
						SESSIONAL EXAM.			ESE		
			L	T	P	CT	TA	Total			
THEORY SUBJECTS											
1.	NOE 08*	Open Elective-II**	3	1	0	30	20	50	100	150	4
2.	NEC 04*	Departmental Elective-IV	3	1	0	30	20	50	100	150	4
3.	NEC 801	Wireless & Mobile Communication	3	1	0	30	20	50	100	150	4
4.	NEC 802	Optical Network	3	1	0	30	20	50	100	150	3
5.	AUC 001	*Human Values & Professional Ethics	2	0	0	15	10	25	50	75	-
PRACTICAL/DESIGN/DRAWING											
6.	NEC 851	Project	0	0	12	-	100	100	250	350	8
7.	NGP 801	General Proficiency	-	-	-	-	-	50	-	50	1
		Total	**12**	**4**	**12**	**120**	**180**	**350**	**650**	**1000**	**24**

**** Open Electives-II**

NOE-081 Non Conventional Energy Resources
NOE-082 Nonlinear Dynamic system
NOE-083 Product Development
NOE-084 Automation and Robotics

LIST OF ELECTIVES:

Elective – III NEC 03* Departmental Elective III

1. NEC 031 Information Theory & Coding
2. NEC 032 Digital Image Processing
3. NEC 033 Voice Over IP
4. NEC 034 Filter Design
5. NEC 035 Applied Fuzzy Electronic Systems

Elective – IV NEC 04* Departmental Elective IV

1. NEC 041 Electronic Switching
2. NEC 042 Digital System Design using VHDL
3. NEC 043 Speech Processing
4. NEC 044 Advanced Display Technologies & Systems
5. NEC 045 Satellite & RADAR systems

INSTITUTE

Vision:

To achieve excellence in technical education and create competent professionals for Industry &Socio-economic development to meet National and International needs.

Mission:

- To achieve academic excellence in technical education through innovative teaching-learning process
- To provide strong fundamental & conceptual knowledge with essential skills to meet current and future needs
- To build strong industry academia connect through industrial & socially relevant projects
- To inculcate right human values and professional ethics

DEPARTMENT OF ECE

Vision:

To become a leading center of excellence in the technical education of Electronics & Communication Engineering and create competent professionals in thrust areas for the development of society and nation

Mission:

- To educate the students with the state of the art technologies through innovative teaching-learning process.
- To enable the graduates to develop the skills required to solve complex real time problems using tools and techniques of Electronics & Communication Engineering practice.
- To develop the spirit of innovation and creativity by collaborating with industries and research establishments to fulfill the needs of society.
- To practice high standards of human values, professional ethics and accountability.

PROGRAMME EDUCATIONAL OBJECTIVES

There are following Program Educational Objectives:

I. Acquire fundamental knowledge of Electronics & Communication Engineering to become employable and capable of pursuing higher studies.

II. Have sound foundation required to develop hardware & software solutions necessary for analysis, design and implementation of modern Electronics & Communication Engineering systems

III. Develop effective communication skills and interpersonal behavior to become a cooperative team member and able leader.

IV. Provide quality and worthy service towards their profession with societal and ethical values.

V. Inculcate the habit of life -long learning needed for higher studies and research and continue to develop new methodologies and technologies

PROGRAMME OUTCOMES (POs) OF B.TECH. (ELECTRONICS & COMMUNICATION ENGINEERING)

Such graduating students attain the ability:

a) Apply the knowledge of mathematics, science and fundamentals of Electronics & Communication Engineering to solve engineering problems.
b) Identify, formulate and analyze complex problems in the field of Electronics & Communication Engineering using first principles of mathematics, natural sciences and engineering.
c) Design and develop system components and processes to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, manufacturability, and sustainability.
d) Design and conduct experiments using research –based knowledge and analyze and interpret data to provide valid conclusions.
e) Use the concepts, techniques and modern engineering tools necessary for prediction, modeling and design of an engineering system.
f) Understand and assess the issues related to society, safety, health and culture and the consequent responsibilities of professional engineering practice.
g) Demonstrate the understanding and knowledge of the impact of engineering solutions in societal and environmental context in order to have sustainable development.
h) Understand and apply ethical principles and responsibilities towards professional engineering practice.
i) Understand individual and team responsibilities to be able to become a member or leader in diverse and multidisciplinary teams.
j) Design and prepare reports and deliver effective presentations by learning oral, verbal and written communication skills to be able to communicate effectively on engineering activities with the engineering community and society at large.
k) Understand the engineering and management principles and apply them to manage projects in multidisciplinary environments.
l) Recognize the need for and engage in life- long learning in the context of technological change.

NEC-701 OPTICAL COMMUNICATION

Preamble

- The course provides an insight into different aspects of Optical Communication, working principles, transmission and reception, systems associated and applications.

Course Objective

- To understand the advantages of optical communication over conventional copper based wired communication system.
- To understand the methods to analyzed the various parameters and solve engineering problems in the area of optical communication.
- To understand the working of optical sources (LED's and LASER's) and apply them to manage projects in multidisciplinary environments.
- To study various optical detectors in societal and environmental context in order to have sustainable development.

Course Outcomes

Students will be able to:

1. Understand advantages of optical communication over conventional copper based wired communication system.
2. Identify basic signal distortions and thus formulate and solve engineering problems in the area of communication.
3. Understand the working of optical sources (LED's and LASER's) and apply them to manage projects in multidisciplinary environments.
4. Study various optical detectors in societal and environmental context in order to have sustainable development.
5. Design point to point optical links and also to understand the concept of optical power meter and WDM to meet desired needs within realistic constraints.

Pre-Requisite

- EM Theory, LASER System and Application

Course Content

UNIT 1

Overview of optical fiber communication: The general system, Advantages of optical fiber communication. Optical spectral band

Optical Fiber waveguides: Introduction, Ray theory transmission Total internal reflection, acceptance angle, numerical aperture, skew rays.

Electromagnetic mode theory for optical propagation: Electromagnetic waves, modes in a planar guide, phase and group velocity, phase shift with total internal reflection and the evanescent field, goos hanchen shift.

UNIT 2

Cylindrical Fiber: modes, mode coupling, step index fibers Graded index fibers, Single mode Fiber: Cut-off wavelength, Mode field diameter and spot size, effective refractive index, Group delay and mode delay factor, The Gaussian approximation, equivalent step index methods.

Signal distortion in optical fibers - Attenuation, Material Absorption, losses in silica glass fibers; Intrinsic absorption, Extrinsic absorption. Linear scattering losses; Ray light scattering, Mie scattering.

Non linear Scattering losses: fiber bending losses;

Dispersion, Chromatic dispersion: material dispersion, waveguide dispersion. Intermodal dispersion: Multimode step index fiber, Multimode graded index fiber.

Overall fiber dispersion Multimode fiber, Dispersion modified single mode fibers, Dispersion–shifted fiber, dispersion flatted fibers, nonzero-dispersion-shifted fibers (MZ-DSF),

Polarization: Fiber birefringence, polarization mode dispersion, polarization-maintaining fibers, Non linear effects: Scattering effects, Kerr effects.

UNIT 3

Optical sources - Light Emitting Diodes (LEDs): Structures, light source materials, Quantum Efficiency on LED Power Modulation of a LED,

Laser Diodes- models and threshold conditions, laser diode rate equations, External quantum efficiency, resonant frequency, laser diode structures and radiation patterns, single mode lasers modulation of laser diodes, laser lines

UNIT 4

Source to fiber power launching, Source Output patterns, Power coupling calculation, Power launching versus wavelength, equilibrium numerical aperture.

Photo detectors: Physical principles of photodiodes: The PIN photo detector, Avalanche photodiodes.

Photo detector Noise: Noise sources, signal to noise ration.

Detector Response time: Depletion layer photocurrent, response time structure of in GaAs APDs, Temperature effect on Avalanche gain, comparison of photo detectors.

UNIT 5

Optical receiver operation: Fundamental receiver operation: Digital signal transmission, error sources, front end amplifier.

Digital receiver performance: Probability of error receiver sensitivity, The Quantum Unit.

Eye Diagram: Eye Pattern Features, BER and Q Factor Measurement Coherent Detection: Fundamental concepts, Homodyne detection, heterodyne detection, IBER comparisons.

Digital links: Point to point links, power penalties.

Text Book:

1. John M. Senior, “Optical Fiber Communications”, PEARSON, 3rd Edition, 2010.

2. Gerd Keiser, “Optical Fiber Communications”, TMH, 4th Edition, 2008.

Reference Books:

1. Govind P. Agrawal, “Fiber Optic Communication Systems”, John Wiley, 3rd Edition, 2004.
2. Joseph C. Plais, “Fiber Optic Communication”, Pearson Education, 4th Ed, 2004.

NEC- 702 DATA COMMUNICATION NETWORKS

Preamble

- The course gives an advanced treatment of different aspects of communication networks like layers of communication, protocols, modulation, multiplexing, applications and related aspects.

Course Objective

- To understand the basic concepts of internet, OSI Model, TCP/IP model to the analysis and design of Data communication and networks
- To understand and analyze the various techniques of error correction and detection, switching, switches and functions of data link layer
- To understand Multiple Access technique and Channelization in order to have sustainable development of data communication
- To Understand the concepts and modern engineering tools such as cryptography and network security for secure data communication system

Course Outcomes

Students will be able to:

1. Apply knowledge of basic concepts of internet, OSI Model, TCP/IP model to the analysis and design of Data communication and networks.
2. Understand and analyze the various techniques of error correction and detection, switching, switches and functions of data link layer.
3. Understand Multiple Access technique like ALOHA, CDMA, CSMA/CD, CSMA/CA, Controlled Access, and Channelization in order to have sustainable development of data communication.
4. Function on routing algorithm, subnet masks and IP addresses to fulfill networking requirements.
5. Use the concepts and modern engineering tools such as cryptography and network security for secure data communication system

Pre-Requisite

- All communication systems

Course Content

UNIT 1

Communication problem and system models, components of communication systems, communication channels and their characteristics, mathematical models for communication channels, multiple access techniques, link budget analysis

UNIT 2

Representation of deterministic and stochastic signals, random noise characterization in communication systems, signal-to-noise ratio, characterization of communication signals and systems: signal space representations, representation of analog and digitally modulated signals, spectral characteristics of modulated signals

UNIT 3

Optimal receivers: Receivers for signals corrupted by AWGN, Error performance Analysis of receivers for memory-less modulation, optimal receivers for modulation methods with memory, OFDM, MIMO, Source Coding, Channel Coding (Hamming codes)

UNIT 4

Error Control, Flow Control, Sliding Window Protocols, HDLC, PPP, Local area networks: Ethernet, Fast Ethernet, Token Ring, Introduction to Gigabit Ethernet and Wireless LANs; Hubs, bridges and switches

UNIT 5

MAC Layer

Static Channel Allocation in LANs and MANs, Dynamic Channel Allocation in LANs and MANs, ALOHA, Carrier Sense Multiple Access Protocols, Collision-Free Protocols, Limited-Contention Protocols, Wavelength Division Multiple Access Protocols, Wireless LAN Protocols, IEEE Standard 802.3

Text Books:

1. Madhow, U., (2008), Fundamentals of Digital Communication, Cambridge University Press
2. Lathi, B. P. & Ding, Z., (2010), Modern Digital and Analog Communication Systems, Oxford University Press
3. Stallings, W., (2010), Data and Computer Communications, Pearson.
4. Andrew S. Tanenbaum, “Computer Networks” Pearson.
5. Ajit Pal, “Data Communication and Computer Networks”, PHI
6. Dimitri Bertsekas, Robert G. Gallager, “Data Networks”, Prentice Hall, 1992

NEC 703 VLSI DESIGN

Preamble

- To provides an exposure to different methods of VLSI design and the principles behind such design.

Course Objective

- To understand the VLSI design methodologies and various techniques required for modern VLSI circuits.
- To understand the concepts of MOSFETs to analyze the working of various MOS based invertors.
- To understand the working and design of different types of semiconductor memories.
- To apply the design of low power CMOS logic circuits to optimize the energy consumption.

Course Outcomes

Students will be able to:

1. Understand various VLSI design methodologies and fabrication techniques required for modern VLSI circuits.
2. Apply basic concepts of MOSFETs to analyze the working of various MOS based invertors.
3. Realize and implement various boolean functions using CMOS invertors.
4. Understand the working and design of different types of semiconductor memories to meet needs related to storage of large data in very small area thus helping in economical and manufacturability context.
5. Design of low power CMOS logic circuits to optimize the energy consumption and thus helping in societal and environmental context in order to have sustainable development.

Pre-Requisite

- Electronics devices, Electronics Circuits, IC Technology

Course Content

UNIT 1

Introduction: A Brief History, Preview, MOS Transistors, CMOS Logic, CMOS Fabrication and Layout, Design Partitioning, Logic Design, Circuit Design, Physical Design, Design Verification, Fabrication, Packaging and Testing.

UNIT 2

Delay: Introduction, Transient Response, RC delay model, Linear Delay Model, Logical Effort of Paths, Timing Analysis Delay Models.

Power: Introduction, Dynamic Power, Static Power

UNIT 3

Energy – Delay Optimization, Low Power Architectures

Interconnect: Introduction, Interconnect Modeling, Interconnect Impact, Interconnect Engineering, Logical Effort with Wires

UNIT 4

Dynamic logic circuits: Introduction, basic principle of pass transistor circuits, synchronous dynamic circuit techniques, dynamic CMOS circuit techniques, domino CMOS logic.

Semiconductor memories: Introduction, DRAM, SRAM, ROM, flash memory.

UNIT 5

Low – Power CMOS Logic Circuits: Introduction, Overview of Power Consumption, Low – Power Design through voltage scaling, Estimation and Optimization of switching activity, Reduction of Switched Capacitance and Adiabatic Logic Circuits.

Design for Testability: Introduction, Fault Types and Models, Controllability and Observability, Ad Hoc Testable Design Techniques, Scan Based and BIST Techniques

Text Book:

1. Neil H.E.Weste, David Money Harris, “CMOS VLSI Design – A circuits and Systems Perspective” Pearson, 4th Edition

2. Sung-Mo Kang & Yosuf Leblebici, “CMOS Digital Integrated Circuits: Analysis & Design”, TMH, 3rd Edition.

Reference Books:

1. D. A. Pucknell and K. Eshraghian, “Basic VLSI Design: Systems and Circuits”, PHI, 3rd Ed., 1994.

2. W.Wolf, Modern VLSI Design: System on Chip, Third Edition, Pearson, 2002.

NEC-031 INFORMATION THEORY & CODING

Preamble

- The course is an advanced treatment of different coding methods associated with information systems.

Course Objective

- To understand the basic concept of Information Theory and Source Coding.
- To understand the various techniques to enhanced the transmission efficiency of the system

Course Outcomes

Students will be able to:

1. Find nature of random signal and its statistical characteristics.
2. Understand how to make code optimum in containing information generated by source.
3. Find the technique to enhance the transmission efficiency of the system.
4. Understand different modulation techniques such as bandwidth limited and power limited.
5. Find the technique to combat transmission impairments.

Pre-Requisite

- Digital Communication

Course Content

UNIT-1

Entropy: Entropy, Joint Entropy and Conditional Entropy, Relative Entropy and Mutual Information, Relationship Between Entropy and Mutual Information, Chain Rules for Entropy, Relative Entropy, and Mutual Information, Jensen's Inequality and Its Consequences, Log Sum Inequality and Its Applications, Data-Processing Inequality, Sufficient Statistics, Fano's Inequality

UNIT-2

Asymptotic Equipartition Property: Asymptotic Equipartition Property Theorem, **Consequences of the AEP:** Data Compression, High-Probability Sets and the Typical Set

Data Compression: Examples of Codes, Kraft Inequality, Optimal Codes, Bounds on the Optimal Code Length, Kraft Inequality for Uniquely Decodable Codes, Huffman Codes, Some Comments on Huffman Codes, Optimality of Huffman Codes, Shannon–Fano–Elias Coding

UNIT-3

Channel Capacity: Examples of Channel Capacity, 7.2 Symmetric Channels, Properties of Channel Capacity, Preview of the Channel Coding Theorem, Definitions, Jointly Typical Sequences, Channel Coding Theorem

UNIT-4

Block Codes

Digital communication channel, Introduction to block codes, Single-parity-check codes, Product codes, Repetition codes, Hamming codes, Minimum distance of block codes, Soft-decision decoding, Automatic-repeat-request schemes

Linear codes

Definition of linear codes, Generator matrices, Standard array, Parity-check matrices, Error syndromes, Error detection and correction, Shortened and extended linear codes

UNIT-5

Convolution codes

Encoding convolutional codes, Generator matrices for convolutional codes, Generator polynomials for convolutional codes, Graphical representation of convolutional codes, Viterbi decoder

Text Books:

1. Joy A. Thomas, Thomas M. Cover, “Elements of information theory”, Wiley-Interscience; 2 edition (July 18, 2006)

2. S. Gravano, “Introduction to Error Control Codes” OUP Oxford (24 May 2001)

3. Robert B. Ash, “Information Theory”, Dover Publications (November 1, 1990)

4. Todd k Moon, “Error Correction Coding: Mathematical Methods and Algorithms ” Wiley, 2005

NEC 751 Optical Communication & Networking Lab

Part - A

1. Familiarization of different types of cables and different commands.

a) Identify Cat5 cable , RJ 45 Connector , Crimping Tool , Wire Stripper
b) Use Wire Stripper for Cutting wire shield and Understanding of Internal Structure of Cat 5 Cable
c) Finding Pin No-1 on RJ 45 Connector and Inserting Wires in connector
d) Crimping of RJ45 connector using Crimping tool
e) Preparation of Straight cable (used for Dissimilar devices such as PC to Switch , PC to router) and Cross cables (used for similar devices such as PC to PC , Router to Router , Switch to Switch)
f) Understand different commands like ping, treacert, ifconfig, dig etc..

2. Making a subnet and configuring router

a) Understand the working of a router & method to access the router via console or using telnet, different types of cables used for connectivity.
b) Different types of show commands & their purpose.
c) Assignment of IP address and enabling layer 3 connectivity.
d) Implement sub netting

3. Configuring web and DHCP servers

a) Understand Internet Information Services tool and its installation.
b) To configure web services using IIS tool.
c) Configure DHCP

4. Configuring VLAN

a) Understand the configuration of Vlan in a switch
b) How to make the port of a switch as an access port & a trunk port, purpose of the Vlan in a network
c) Different types of show commands & their purpose.

5. To implement a simple file transfer protocol (FTP) using connection oriented and connectionless sockets.

6. To develop a concurrent file server that spawns several threads, one for each client requesting a specific file.

7. To develop a simple chatting application using (i) Connection oriented and (ii) Connectionless sockets

Part – B (Any 4 Experiments):

1. To setting up fiber optic analog link
2. Study and measurement of losses in optical fiber.
3. Study and measurement of numerical aperture of optical fiber.
4. Study and perform time division multiplexing (digital).
5. Study of framing in time division multiplexing.
6. Study of Manchester coding and decoding.
7. Study of voice coding and codec chip.
8. Study and measure characteristics of fiber optic LED's and photo detector

NEC 752 Electronics Circuit Design Lab.

In this practical course students will carry out a design oriented project work using various analog/ digital building blocks which they have already studied in their analog electronic/ digital electronic courses such as Electronic circuits, integrated circuits and filter design. The project may include but not restricted to any of the following:

1. Universal op-amp based biquad
2. Universal OTA biquad
3. Amplitude control or stabilization applied to any sinusoidal oscillators
4. Op-amp/ OTA based function generator
5. Any application of log/antilog circuits
6. Any applications of analog multiplier/ divider
7. Any digital system design and its hardware implementation using TTL/ CMOS ICs
8. Any circuit idea (not studied in the course) using 555 Timer in conjunction with any other ICs

The above must include

1. Design the circuit.
2. Make hardware and measure various parameters.
3. Simulation in Spice of the designed circuit.
4. Comparison of measured and simulated results.

A report is to be made for evaluation.

NEC-801 Wireless & Mobile Communication

Preamble

- The course provides the basic foundation of mobile communication. This course covers aspects like working principles, types, modulation methods, channeling and applications.

Course Objective

- To understand the concepts and techniques of mobile radio communication fundamentals like reflection, diffraction, scattering and fading.
- To understand cellular design concepts and apply them in wireless communication
- To design a 3G and 4G wireless communication system to meet desired needs within realistic constraints

Course Outcomes

Student will be able to

1. Understand the concepts and techniques of mobile radio communication fundamentals like reflection, diffraction, scattering and fading.
2. Study various multiple access techniques and fundamentals of equalization in wireless communication
3. Understand cellular design concepts and apply them in wireless communication
4. Design GSM and CDMA and its components in mobile and wireless communication.
5. Design a 3G and 4G wireless communication system to meet desired needs within realistic constraints.

Pre-Requisite

- Digital Communication

Course Content

UNIT-1

Evolution of mobile radio communication fundamentals, General Model of Wireless Communication Link, Types of Signals, Cellular Infrastructure, Cellular System Components, Antennas for Cellular Systems, Operation of Cellular Systems, Channel Assignment, Frequency reuse, Channel Assignment strategies, Handoff Strategies Cellular Interferences, Sectorization; Wireless Channel and Radio Communication, Free Space Propagation Model, Channel Noise and Losses, Fading in Land Mobile Systems, Multipath Fading, Fading Effects on Signal and Frequency, Shadowing; Wireless Channel Modeling: AWGN Channel, Rayleigh Channel, Rician Fading Channel, Nakagami Fading Channel, Ocumura and Hata Path Loss Model; Channel Modelling: Stochastic, Flat Fading, Wideband Time-Dispersive Channel Modelling.

UNIT-2

Theory of Vocoders, Types of Vocoders; Spread Spectrum Modulation, Pseudo-Noise Codes with Properties and Code Generation Mechanisms, DSSS and FHSS Systems, Time Hopping and Hybrid Spread Systems; Multicarrier Modulation Techniques, Zero Inter Symbol Interference Communication Techniques, Detection Strategies, Diversity Combining Techniques: Selection Combining, Threshold Combining, Equal Gain Combining, Maximum Ratio Combining; Spatial Diversity and Multiplexing in MIMO Systems, Channel Estimation,

UNIT-3

Equalization Techniques: Transversal Filters, Adaptive Equalizers, Zero Forcing Equalizers, Decision Feedback Equalizers, and related algorithms; Multiplexing and Multiple Access: FDMA, TDMA, CDMA, OFDMA, SC-FDMA, IDMA Schemes and Hybrid Method of Multiple Access Schemes, RAKE Receiver; Multiple Access for Radio Packet Systems: Pure ALOHA, Slotted ALOHA, CSMA and their versions; Packet and Pooling Reservation Based Multiple Access Schemes.

UNIT-4

GSM system for mobile Telecommunication, General Packet Radio Service, Edge Technology; CDMA Based Standards: IS 95 to CDMA 2000, Wireless Local Loop, IMT 2000 and UMTS, Long Term Evolution (LTE), Mobile Satellite Communication.

UNIT-5

Introduction to Mobile Adhoc Networks, Bluetooth, Wi-Fi Standards, WiMax Standards, Li-Fi Communication, Ultra-Wideband Communication, Mobile data networks, Wireless Standards IMT 2000, Introduction to 4G and concept of NGN.

Text Book:

1. T.S. Rappaport, “Wireless Communication-Principles and practice”, Pearson Publications, Second Edition.
2. Upena Dalal, “Wireless Communication and Networks”, Oxford Press Publications.
3. T L Singal ,“Wireless Communications ”, McGraw Hill Publications.

Reference Books:

1. Andrea Goldsmith, “Wireless Communications”, Cambridge University Press.
2. S. Haykin & M. Moher, “Modern wireless communication”, Pearson, 2005.

NEC-802 OPTICAL NETWORK

Preamble

- The course provides an insight into different aspects of Optical Networks, working principles, and systems associated and applications.

Course Objective

- To understand the different aspects of optical networks, working principles and systems associated and applications

Course Outcomes

Students will be able to:

1. Apply knowledge of optical networks to understand the multiplexing techniques, second generation optical networks, optical layer, and optical packet switching.
2. Understand and analyze the components, optical switches in optical network.
3. Understand SONET/SDH Multiplexing, SONET/SDH layers, SONET Frame structure, SONET/SDH physical layer, Elements of a SONET/SDH infrastructure. ATM: Function of ATM, Adaptation layers, Quality of service.
4. Apply the knowledge of WDM Network Design.
5. Use the concepts and modern engineering tools in optical networks.

Pre-Requisite

- Optical communication

Course Content

UNIT-1

Introduction to Optical Network:- Optical Networks: multiplexing techniques, second generation optical networks. The optical layer, optical packet switching
Transmission Basics: wavelength, frequencies and channel spacing, wavelength standards.
Non linear Effects: Effective length and area, stimulated brillouin scattering, stimulated raman scattering, Propagation in a non linear medium, self phase modulation, cross phase modulation Four wave mixing.

UNIT-2

Components:-Couplers: Principles of operation, Conservation of energy, Isolators and circulators: Principles of operation
Multiplexers and filters: Gratings, diffraction pattern, Bragg grating, Fiber gratings, Fabry-perot filters, multilayers dielectric thin – film filters, Mach-Zehnder interferometers, Arrayed waveguide grating, Acousto-optic tunable filter, High channel count multiplexer Architecture.
Switching: large optical switches, Optical switch Technologies, large electronic switches wavelength converters: Optoelectronic Approch , optical grating, interferometric

techniques wave mixing. Crosstalk: Intra-channel crosstalk, inter-channel crosstalk, crosstalk in Networks, Bidirectional system crosstalk reduction.

UNIT-3

Networks- SONET/SDH: Multiplexing, SONET/SDH layers, SONET Frame structure, SONET/SDH physical layer, Elements of a SONET/SDH infrastructure. ATM: Function of ATM, Adaptation layers, Quality of service.

IP: Routing and forwarding, QOS, WDM Network elements: Optical line terminals, Optical line amplifiers,.

Optical add/Drop multiplexers: Architecture, reconfigurable OADMS, Optical cross connects: All optical OXC configuration.

UNIT-4

WDM Network Design Cost Trade-offs, Light path Topology Design, and Routing and wavelength assignment problems, Dimensioning Wavelength Routing Networks, Network Survivability, Basic Concepts, Protection in SONET/SDH, Protection in client layer, Optical Layer Protection, Different Schemes, Interworking between Layers, Access Networks, Network Architecture Overview, Enhanced HFC, FTTC, PON evolution

UNIT-5

Optical Switching, OTDM, Synchronization, Header Processing,
Buffering, Burst Switching, Deployment Considerations- SONET/SDH core Network

Text Books:

1. R. Ramaswami, & K. N. Sivarajan, “Optical Networks a Practical perspective”, Morgan Kaufmann Publishers, 3rd Ed.
2. U. Black, “Optical Networks: Third Generation Transport Systems”/ Pearson Educations

Reference Books:

1. Biswanath Mukherjee “Optical WDM Networks” Springer Pub 2006.

NEC 041 ELECTRONIC SWITCHING

Preamble

- To provide the knowledge and concept of switching systems in analog and digital communication.

Course Objective

- To understand the concept of switching system in various information exchanges.
- To understand the method to Identify, formulate, and solve traffic engineering problems in the area of digital circuit switch design and modeling of switching systems
- To understand the concept and function of ATM machines, ISDN necessary for prediction, modeling and design of a switching system

Course Outcomes

Student will be able to:

1. Acquire knowledge about evolution of switching systems to analyze them to provide sound understanding of various information exchanges.
2. Able to demonstrate knowledge and understanding of analog and digital switching systems.
3. Identify, formulate, and solve traffic engineering problems in the area of digital circuit switch design and modeling of switching systems.
4. Learn about architecture, signaling, and various controls of Switching Systems to tackle society and safety issues meeting manufacturability, and sustainability constraints.
5. To understand the concept and function of ATM machines, ISDN necessary for prediction, modeling and design of a switching system.

Pre-Requisite

- Principles of Communication, Digital communication

Course Content

UNIT-1

Evolution of switching systems: Introduction, Message switching, Circuits switching, Functions of a switching system, Register- transiator-senders, Distribution frames, Crossbar switch, A general trucking, Electronic switching, Reed- electronic system, Digital switching systems.

UNIT-2

Digital Switching: Switching functions, Space Division Switching, Time Division Switching, Two-Dimensional Switching, Digital Cross-Connect Systems , Digital Switching in an Analog Environment.

UNIT-3

Telecom Engineering: Network Traffic Load and Parameters, Grade of Service and Blocking Probability, Modeling Switching Systems, Incoming Traffic and Service Time Characterization, Blocking models and Loss Estimates, Delay Systems

UNIT-4

Control of switching systems: Introduction, Call-processing functions, Common control, Reliability, availability and security; Stored-program control.

Signalling: Introduction, Customer line signalling, Audio-frequency junctions and trunk circuits, FDM carrier systems, PCM signaling, Inter-register signalling, Common-channel signalling principles, CCITT signalling system no. 6 and 7, Digital customer line signalling.

UNIT-5

Packet Switching: Packet Switching, Statistical Multiplexing, Routing Control (dynamic routing, virtual circuit routing and fixed-path routing), Flow Control, X.25, Frame Relay, TCP/IP

ATM Cells, ATM Service Categories, ATM Switching (ATM Memory Switch, Space-Memory Switch, Memory-Space Switch, Memory-Space-Memory switch, Banyan Network Switch).

Text Books:

1. Thiagarajan Viswanathan & Manav Bhatnagar, “Telecommunication Switching Systems and Networks”, PHI.
2. J.E. Flood, “Telecommunication Switching, Traffic and Networks”, Pearson Education.
3. John C. Bellamy, “Digital Telephony”, John Wiley, 3rd Ed.

NEC 032 - DIGITAL IMAGE PROCESSING

Preamble

- To introduce the student to various image processing techniques.

Course Objective

- To understand the image fundamentals and mathematical transforms which is necessary for image processing
- To understand the image enhancement techniques
- To understand image restoration procedures
- To understand the image compression procedures
- To understand the image segmentation and representation techniques

Course Outcomes

Student will be able to:

1. Apply knowledge of mathematical transforms necessary for image processing.
2. Identify, formulate, and solve engineering problems related to the image enhancement techniques
3. Analyze the various types of Image degradations using Image restoration techniques
4. Analyze the various types of image compression
5. Apply knowledge of image segmentation

Course Content:

UNIT-1

Introduction: Overview of Image Processing, Nature of Image Processing, Application area of image processing, Digital Image Representation, Types of images, Digital Image Processing Operations, Fundamental steps in DIP, Overview of Digital Image Systems, Physical Aspect of Image Acquisition, biological Aspect of Image Acquisition, sampling & quantization, Digital Halftone Process, Image storage and File formats.

UNIT-2

Image Transforms: Need for image transforms, Properties of Fourier transform, Discrete cosine transform, Discrete sine transform, Hadamard transform, Haar transform, Slant transform, SVD and KL transforms, Comparison between transforms.

Image Enhancement: Image Quality and Need for image enhancement, Image enhancement operations, Image enhancement in spatial domain, histogram based techniques, Spatial Filtering concepts, Image smoothing spatial filters, Image Sharpening spatial filters, Image smoothing in frequency domain filtering, Image sharpening in frequency domain, Homomorphism filtering

UNIT-3

Image Restoration: Introduction to degradation, Types of Image degradations, image degradation models, noise modeling, Estimation of degradation functions, Image restoration in presence of noise only, Periodic noise and band – pass and band reject filtering, difference between enhancement & restoration, Image restoration techniques.

UNIT-4

Image Compression: Image compression model, Compression algorithms and its types, Type of redundancy, lossless compression algorithms, Lossy compression algorithms, Image and video compression standards.

UNIT-5

Image Segmentation: Introduction, Detection of Discontinuities, Edge Detection, Hough Transforms and Shape Detection, corner detection, Principle of thresholding, Principle of region - growing.

Text Books:

1. S. Sridhar, “Digital Image Processing”, OXFORD University Press, Second Edition.

2. Rafael C. Gonzalez Richard E woods Steven L. Eddins, ‘‘Digital Image’’, Pearson.

3. Rafael C. Gonzalez Richard E woods Steven L. Eddins, ‘‘Digital Image Processing Using MATLAB’’, Mc Graw Hill, 2nd Edition.

4. Anil K Jain, ‘’Fundamentals of Digital Image Processing”, Pearson.

NEC 033 - VOICE OVER IP

Preamble

- This course provides an in-depth immersion into the foundational theories and technologies of Voice over IP (VoIP).

Course Objective

- To understand the core technologies, theories, and dilemmas that face VoIP network engineers in this field with some key.
- To understand best practices about how to design, deploy, and troubleshoot VoIP networks.
- To utilize multivendor, commercial equipment to prepare for real-world scenarios in industry.

Course Outcomes

- Students successfully completing this course should gain a much greater appreciation of the technologies and procedures required in designing, deploying, and troubleshooting VoIP networks
- Upon successfully completing the course the students will be able to obtain VoIP specific industry certifications, such as the SIP School Certified Associate (SSCA)

Pre-Requisite

- Data Communication Network

Course Content

UNIT-1

Introduction: Carrier-Grade, VoIP, VoIP Challenges, Overview of the IP Protocol Suite, The Internet Protocol, IP Version 6, IP Multicast, The Transmission Control Protocol, The User Datagram Protocol, The Stream Control Transmission Protocol, The Real-Time Transport Protocol, The RTP Control Protocol, Security and Performance Optimization

Speech-Coding Techniques

A Little about Speech, Audio, and Music, Voice Sampling, Voice Quality, Types of Speech Coders, Waveform Coders, Analysis-by-Synthesis Codecs, G.722–Wideband Audio

UNIT-2

Signaling Protocols:

H.323: Multimedia Conferencing over IP The H.323 Architecture, RAS Signaling, Call Signaling, Call Scenarios, H.245 Control Signaling, Conference Calls, Securing an H.323 Network.

The Session Initiation Protocol The SIP Architecture, Overview of SIP Messaging Syntax, Examples of SIP Message Sequences, Redirect and Proxy Servers, The Session Description Protocol, Usage of SDP with SIP, SIP Extensions and Enhancements, Usage of SIP for Features and Services, Interworking

UNIT-3

Distributed Gateways and the Softswitch Architecture

Separation of Media and Call Control, Softswitch Architecture, Protocol Requirements for Controlling Media Gateways, Protocols for Controlling Media Gateways, MGCP, MEGACOP/H.248.1.

UNIT-4

VoIP and SS7

The SS7 Protocol Suite, SS7 Network Architecture, ISUP, Performance Requirements for SS7, SIGTRAN, Interworking SS7 and VoIP Architectures

UNIT-5

Quality of Service

The Need for QoS, Overview of QoS Solutions, The Resource Reservation Protocol, DiffServ, Multiprotocol Label Switching, Combining QoS Solutions

Text Books:

1. Richard Swale, Daniel Collins," Carrier-Grade VoIP", McGraw-Hill Education 3rd Edition,2014.

2. Olivier Hersent, Jean Pierre Petit, David Gurle, "IP Telephony – Deploying Voice Over-IP Protocols", John Wiley & Sons Ltd, 2005

NEC 034 FILTER DESIGN

Preamble

- The main aim of the course is to design analog circuits and systems that perform signal conditioning, signal processing functions, and signal generation using the devices including Op-Amps, amplifiers, and comparators.

Course Objective

- To understand the knowledge of low pass, high pass and band pass filter.
- To understand the various methods for design of first order, second order LPF and BPF.

Pre-Requisite

- Electronic Circuits, Network Analysis and Synthesis,

Course Content

UNIT-1

Introduction: Fundamentals, Types of filters and descriptive terminology, why we use Analog Filters, Circuit elements and scaling, Circuit simulation and modelling.
Operational amplifiers: Opamp models, Opamp slew rate, Operational amplifiers with resistive feedback: Noninverting and Inverting, Analyzing Opamp circuits, Block diagrams and feedback, The Voltage follower, Addition and subtraction, Application of Opamp resistor circuits.

UNIT-2

First order filter: Bilinear transfer functions and frequency response –Bilinear transfer function and its parts, realization of passive elements, Bode plots, Active realization, The effect of A(s), cascade design.

UNIT-3

Second order low pass and band pass filters: Design parameters, Second order circuit, frequency response of low pass and band pass circuits, Integrators and others biquads

UNIT-4

Second order filters with arbitrary transmission zeros: By using summing, By voltage feed forward, cascade design revisited.
Low pass filters with maximally flat magnitude: the ideal low pass filter, Butterworth response, Butterworth pole locations, low pass filter specifications, arbitrary transmission zeros.

UNIT-5

Low pass filter with equal ripple (Chebyshev) magnitude response: The chebyshev polynomial ,The chebyshev magnitude response, Location of chebyshev poles, Comparison of maximally flat & equal–ripple responses, Chebyshev filter design

Inverse chebyshev and cauer filters: Inverse chebyshev response, From specifications to pole and zero locations, Cauer magnitude response, Chebyshev rational functions, Cauer filter design.

Text Book:

1. Rolf. Schaumann, Haiqiao Xiao, Mac. E. Van Valkenburg, “Analog Filter Design”, 2nd Indian Edition, Oxford University Press.

Reference Books:

1. J. Michael Jacob ,”Applications and Design with Analog Integrated Circuits”, Second edition, Pearson.
2. T. Deliyannis, Yichuang Sun, J.K. Fidler, “Continuous-Time Active Filter Design”, CRC Press.

NEC 035 APPLIED FUZZY ELECTRONIC SYSTEMS

Preamble

- To provide the knowledge and concept of fuzzy logic and various application of fuzzy systems.

Course Objective

- To understand the concepts and terminologies of fuzzy systems.
- To study the concepts of crisp sets, fuzzy sets and fuzzy networks.
- To study various applications of fuzzy systems.

Course Content

UNIT-1
History of Fuzzy Logic, Fuzzy Sets, Possibility Distributions, Fuzzy Rules, Fuzzy Sets, Operations of Fuzzy Sets, Properties of Fuzzy Sets, Geometric Interpretations of Fuzzy Sets, Possibility Theory, Fuzzy Relations and their Compositions, Fuzzy Graphs, Fuzzy Numbers, Functions with Fuzzy Arguments, Arithmetic Operations of Fuzzy Numbers.

UNIT-2
Fuzzy Rules: Fuzzy Mapping Rule, Fuzzy Implication Rule, Fuzzy Rule Based Models for Function Approximations, Theoretical Foundation of Fuzzy Mapping Rules, Types of Fuzzy Rule Based Models: Mamdani Model, TSK Model, Standard Additive Model, Fuzzy Implications and Approximate Reasoning: Propositional Logic, First Order Predicate Calculus, Fuzzy Implications, Approximate Reasoning, Criteria and Family of Fuzzy Implications, Possibility vs. Probability, Probability of Fuzzy Event, Probabilistic Interpretations of Fuzzy Sets, Fuzzy Measure.

UNIT-3
Uncertainty in information; Classical Sets, Fuzzy Sets and their properties; Cardinality of Classical Relations and their properties, The a- Level Set, Cardinality of Fuzzy Relations and their properties; Composition; Tolerance and Equivalence relationship; Membership Functions; Fuzzification and Defuzzification process; Fuzzy to Crisp Conversions; Lambda cuts; Extension Principle, Crisp functions and its mapping, Fuzzy functions and its mapping; Fuzzy Numbers; Internal Analysis in Arithmetic.

UNIT-4
Approximate method of Extension, Vertex Method, DSW Algorithm, and Restricted DSW Algorithm and their comparison, Classical Predicate Logic; Fuzzy Logic; Approximate Reasoning; Fuzzy Tautologies, Contradictions, Equivalence, and Logical Proof; Fuzzy Rule Based Systems, Models of Fuzzy AND, OR, and Inverter; Fuzzy

Algebra; Truth Tables; Fuzzy Functions; Concept of Fuzzy Logic Circuits; Fuzzy Flip-Flop; Fuzzy Logic Circuits in Current Mode, Furry Numbers.

UNIT-5

Fuzzy Logic in Control Engineering: Fundamental Issues in Control Engineering, Control Design Process, Semiformal Aspects of Design Process, Mamdani Architecture of Fuzzy Control, The Sugeno-Takagi Architecture. Fuzzy Logic in Hierarchical Control Architecture, Historical Overview and Reflections on Mamdani`s Approach, Analysis of Fuzzy Control System via Lyapunov`s Direct Method, Linguistic Approach to the analysis of Fuzzy Control System, Parameter Plane Theory of Stability, Takagi-Sugeno-Kang Model Of Stability Analysis.

Text Book:

1. John Yen, Reza Langari, “Fuzzy Logic: Intellegent Control and Information”, Pearson Publication.

2. Ahmad M. Ibrahim, “Introduction to Applied Fuzzy Electronics”, Prentice Hall Publication.

3. Ahmad M. Ibrahim, “Fuzzy Logic for Embedded Systems Applications”, Newnes Publications.

4. Witold Pedrycz, Fernando Gomide, “Fuzzy Systems Engineering: Toward Human-Centric Computing”, John Wiley Publications.

NEC 042 DIGITAL SYSTEM DESIGN USING VHDL

Preamble

- This course covers top down design methodology for FPGA and ASIC using VHDL. Hardware Description Language, (VHDL) modeling, simulation and synthesis tools are utilized to elaborate the material covered throughout the course.

Course Objective

- To understand the hardware description language for simulation, synthesis, and implementation of digital system.

Course Outcomes

After completing this course the students should be able to:

- Utilize the top-down design methodology in the design of highly complex digital devices such as FPGAs/ASICs.
- Use learn/use modern hardware/software design tools to develop modern digital systems
- Design verification and test of integrated circuits chips
- Design, implement and test different Field Programmable Gate Array (FPGA) architectures and their

Pre-Requisite

- Digital logic circuits

Course Content

UNIT-1

Introduction to VHDL, reserve words, structures, modeling, objects, data type and operators, sequential statements and processes, sequential modeling and attributes, conditional assignment, concatenation and case, array loops and assert statements, subprograms.

UNIT-2

Digital System Design Automation– Abstraction Levels, System level design flow, RTL design flow, VHDL.

RTL Design with VHDL – Basic structures of VHDL, Combinational circuits, Sequential circuits, Writing Test benches, Synthesis issues, VHDL Essential Terminologies

VHDL Constructs for Structures and Hierarchy Descriptions – Basic Components, Component Instantiations, Iterative networks, Binding Alternatives, Association methods, generic Parameters, Design Configuration

UNIT-3

Concurrent Constructs for RT level Descriptions – Concurrent Signal Assignments, Guarded signal assignment

Sequential Constructs for RT level Descriptions – Process Statement, Sequential WAIT statement, VHDL Subprograms, VHDL library Structure, Packaging Utilities and Components, Sequential Statements.
VHDL language Utilities - Type Declarations and Usage, VHDL Operators, Operator and Subprogram overloading, Other TYPES and TYPE – related issues, Predefined Attributes

UNIT-4
VHDL Signal Model – Characterizing hardware languages, Signal Assignments, Concurrent and Sequential Assignments, Multiple Concurrent Drivers Standard Resolution.

UNIT-5
Hardware Cores and Models - Synthesis rules and styles, Memory and Queue Structures, Arithmetic Cores, Components with Separate Control and Data parts.
Core Design Test and Testability - Issues Related to Design Test, Simple Test benches.

Text Books:
1. Z. Navabi, “VHDL-Modular Design and Synthesis of cores and Systems”, TMH – 3rd Edition.
2. R.D.M. Hunter, T. T. Johnson, “Introduction to VHDL” Spriger Publication, 2010.
3. J Bhasker , “VHDL Primer” –Pearson Education.

Reference Books:
3. C. H. Roth, “Digital System Design using VHDL”, PWS Publishing
4. Douglas Perry, “VHDL- Programming by examples”, MGH

NEC 043 SPEECH PROCESSING

Preamble

- The course provides the basic understanding of Bio-Electronics, its importance, principles, devices, device modeling and application.

Course Objective

- To understand the concept of Digital models for speech signals
- To understand the time domain method of speech sampling.
- To understand the short time Fourier analysis.

Pre-Requisite

- Communication, DSP

Course Content

UNIT-1
Digital models for speech signals: Mechanism of speech production & acoustic phonetics, the acoustic theory of speech production, lossless tube models, and digital models for speech signals.

UNIT-2
Time Domain methods of speech sampling: Time dependent processing of speech, short time energy and average magnitude, short time average zero crossing rate, discrimination between speech& silence, pitch period estimation using parallel processing, short time autocorrelation function & AMDF, pitch period estimation using autocorrelation function.

UNIT-3
Short time Fourier Analysis: Definition and properties, design of filter banks, implementation of filter bank summation method using FFT, spectrographic displays, pitch detection, analysis by synthesis phase, vocoder and channel vocoder.

UNIT-4
Homomorphic speech processing: Homomorphic system for convolution, complex cepstrum of speech, pitch detection using Homomorphic processing, formant estimation, Homomorphic vocoder

UNIT-5
Linear Predictive Coding of Speech: Basic principles of linear predictive analysis, the autocorrelation method, computation of the gain for the model, solution of LPC equations for auto correlation method, prediction error and normalized mean square error, frequency domain interpretation of mean squared prediction error relation of linear predictive analysis to lossless tube models, relation between various speech parameters, synthesis of speech from linear predictive parameters, application of LPC parameters.

Text / Reference Books:

1. R. L. Rabiner & R.W. Schafer, “Digital Processing of speech signals”, Pearson Education.

2. B. Gold and Nelson Morgon, “Speech and audio signal processing”, Wiley India Edition, 2006.

NEC 045 SATELLITE & RADAR SYSTEMS

Preamble

- To provide the knowledge and concept of satellite and radar systems.

Course Objective

- To understand the concept of radar system and their relationship to overall system performance.

Course Outcomes

Students will be able to:

1. Understand the components of a radar system and their relationship to overall system performance.
2. Apply basic science and mathematical concepts to understand the working of radar and its operating environment.
3. Understanding advance radars so as to trace a moving target to manage projects in multidisciplinary environments.
4. To understand the concept of noise to detect the signal in noise for prediction, modeling and design of an engineering system.
5. Study radar clutters, accuracy and ambiguity in radar measurements to solve engineering problems.

Pre-Requisite

- Communication

Course Content

Introduction to radar, radar block diagram and operation, radar frequencies, Applications of radar.
The Radar Equation: Detection of signals in noise , Receiver noise and the signal to noise ratio, Probabilities of detection and false alarm, Integration of Radar Pulses, Radar cross section of targets, Radar cross section fluctuations, Transmitter Power, Pulse Reception Frequency , Antenna Parameters, System Losses.

MTI and Pulse Doppler Radar: Introduction to Doppler and MTI Radar, Delay Line cancellers, Staggered Pulse Reception Frequencies, Doppler Filter Banks, Digital MTI Processing, Moving Target Detector, Limitations to MTI Performance.

Tracking Radar: sequential lobing, conical scan, monopulse Tracking, low angle tracking, tracking in range.

Elements of Satellite Communications, Orbital mechanics, look angle and orbit determination, launches and launch vehicle, orbital effects. Introduction to geo-synchronous and geo-stationary satellites.

Satellite sub-systems: Attitude and Orbit control systems, Telemetry, Tracking and command control system, Power supply system, Introduction to satellite link design, basic transmission theory, system noise temperature and G/T ratio, design of down link and uplink, design of satellite links for specified C/N, satellite data communication protocols.

Direct broadcast satellite television and radio, satellite navigation and the global positioning systems, GPS position location principle, GPS receivers and codes, Satellite Signal Acquisition, GPS navigation Message, GPS Signal Levels, Timing Accuracy, GPS Receiver Operation.

Text / Reference Books:

1. Merrill I. Skolnik " Introduction to Radar Systems", Mc Graw- Hill.
2. J.C.Toomay, Paul J. Hannen "Principles of Radar", PHI Learning.
3. B.Pratt, A.Bostian, "Satellite Communications", Wiley India.
4. D.Roddy, "Satellite Communications", TMH