Syllabus

For

M.Tech.

Electronics & Communication Engineering

(ADVANCE ELECTRONICS & COMMUNICATION ENGINEERING,
TELECOMMUNICATION ENGINEERING,
DIGITAL ELECTRONICS & COMMUNICATION ENGINEERING,
MICROWAVE ENGINEERING,
DIGITAL COMMUNICATION)

(Effective from the Session: 2016-17)
### Study and Evaluation Scheme M. Tech. in Electronics & Communication Engineering
(Effective from Session 2016-17)

#### First Year, Semester-I

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Course Code</th>
<th>Subject</th>
<th>Periods</th>
<th>Credit</th>
<th>Evaluation Scheme</th>
<th>Subject Total</th>
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### Second Year, Semester-III

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### Second Year, Semester-IV

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#### Departmental Elective I
- MTEC 011: RF Circuit Design
- MTEC 012: Information Theory
- MTEC 013: Antenna Theory and Design

#### Departmental Elective II
- MTEC 021: Optical Communication
- MTEC 022: MIMO Communication Systems
- MTEC 023: Next Generation Networks

#### Departmental Elective III
- MTEC 031: Internet of Things
- MTEC 032: Error Control & Coding
- MTEC 033: Microwave Communication Engineering & Systems

#### Departmental Elective IV
- MTEC 041: Advanced Optical Networks
- MTEC 042: Advanced Satellite Communication
- MTEC 043: Cognitive Radio

#### Departmental Elective V
- MTEC 051: Advanced Wireless Networks
- MTEC 052: Optoelectronics Devices and Systems
- MTEC 053: Monolithic Microwave Integrated Circuits
MTEC101 – Advanced Engineering Mathematics

Linear Algebra
Vector spaces: Vector Spaces, Subspaces, Bases and Dimensions and related theorems.
Linear Transforms: Isomorphism, Homomorphism, Matrix representations, Linear Functionals, The Double Dual.

Concept of Random Variables
Introduction, Distribution and Density function, Specific Random Variables, Conditional Distributions, asymptotic approximations for binomial random variable, The Distributions, Mean and Variance, Moments generating functions.

Two Dimensional Random Variables
Bivariate Distributions, One function of two random variables, Two function of two random variables, Joint Moments, Joint Characteristic Functions, Conditional Distributions, Conditional Expected Values, Sequence of Random Variables.

Concept of Stochastic Process

Markov Process and Queuing Theory

Reference Books:
MTEC102 – Advanced Digital Communication

Baseband data transmission- Nyquist criterion for zero ISI, Correlative level coding, Optimum design of transmit and receive filters, Equalization.

Passband Digital transmission- Digital modulation schemes, Carrier synchronization methods, Symbol timing estimation methods.

Error control coding - Linear block codes, cyclic codes-encoding and decoding, Non-binary codes, Convolutional codes, Decoding of convolutional codes, Trellis coded modulation, Interleaver, Turbo coding, Performance measures.

Spread spectrum communication- DS and FH spread spectrum, CDMA system based on FH and DS spread spectrum signals, Applications, Synchronization of spread spectrum signals.

Multichannel and Multicarrier communication Systems, Multi user communication systems.

Reference Books:
2. S. Haykin, Communication systems, John Wiley
3. B.P. Lathi, Zhi Ding, Modern Digital and Analog Communication Systems, Oxford University Press
4. S.Lin&D.J.Costello, Error Control Coding, Pearson

MTEC201 – DISCRETE TIME SIGNAL PROCESSING

INTRODUCTION


Sampling and Reconstruction of Signals: Sampling band-pass signals, Analog-to-digital and digital-to analog conversions.

Multirate Digital Signal Processing:

Introduction, Decimation by a factor D, Interpolation by a factor I, Sampling rate conversion by a rational factor I/D, Filter design and implementation for sampling rate conversion, Multistage implementation of sampling rate conversion, Sampling rate conversion of band-pass signals, Sampling rate conversion by an arbitrary factor, Applications of multirate signal processing.

Multirate Filter Banks:

Maximally decimated filter banks: Errors created in the QMF bank, alias-free QMF system, power symmetric QMF banks, M-channel filter banks, poly-phase representation, perfect reconstruction systems, alias-free filter banks, tree structured filter banks, trans-multiplexers. Para-unitary Perfect Reconstruction Filter Banks: Lossless transfer matrices, filter bank properties induced by paraunitariness, two channel Para-unitary lattices, M-channel FIR Para-unitary QMF banks, transform coding. Linear Phase Perfect Reconstruction QMF Banks: Necessary conditions, lattice structures for linear phase FIR PR QMF banks, formal synthesis of linear phase FIR PR QMF lattice.
Discrete Fourier Transform & Computation

Digital Signal Processors

Reference Books:
5. N. J. Fliege, Multirate Digital Signal Processing, John Wiley & Sons, USA.

MTEC202 – Detection and Estimation Theory
Binary hypothesis testing; Bayes, minimax and Neyman-Pearson tests. Composite hypothesis testing.


Signal detection in continuous time: Detection of deterministic signals in Gaussian noise. Coherent detection in White Gaussian noise.

Reference Books:
1. H.V. Poor, An Introduction to Signal Detection and Estimation, Springer.
**MTEC151 – Optical and Fiber Communication Lab**

1. Measurement of Numerical Aperture
2. Measurement of Attenuation and Bending Loss
3. Study of Analog Link
4. Study of BER and Q-factor estimation in the optical system simulation
5. EDFA design for DWDM link
6. Study the Characteristics of a Communication channels AWGN BSC
7. Analog and Digital Modulation
   - Frequency Modulation and Demodulation
   - QPSK Modulation and Demodulation
8. Conventional Encoder and Decoder

**MTEC152 – Communication Engineering Lab**

**PART I : PCM AND LINK ANALYSIS**

Link establishment, Noise on PCM link, Error detection, BER calculation, Error correction, TDM.

**PART II : DIGITAL MODULATION & KEYING**

ASK, FSK, PSK, QPSK Modulation and Demodulation.

**PART III : CDMA - DSSS**

Modulation, Demodulation & BER measurement.

**PART IV : SIMULATION IN MATLAB ENVIRONMENT**

BPSK, QPSK, FSK Modulation & Demodulation. BER calculation.

**MTEC251 – Modeling and Simulation of Communication System Lab**

1. Study and Analysis of different types of Analog Communication Circuit using Simulation Software (any two circuits)
2. Study and Analysis of different of Digital Communication Systems using Simulation Software (any three)
3. Study and Analysis of Frequency hopped Spread Spectrum System
4. Study and Analysis of Direct Sequence Spread Spectrum System
5. Study and Designing of Equalizers for Digital Communication
6. Study of Eye Pattern using Simulation
7. Study and Implementation of Convolution Codes using Simulation
8. Study and Implementation of Cyclic Codes using Simulation Method
9. Study and Implementation of Linear Block Codes using Simulation
10. Study and Implementation of Optimum Receiver used for Digital Communication
11. Study and Implementation of Lempel Algorithm using Simulation
12. Study and Design of Band Limited Signals with controlled ISI

At least 8 modules have to be performed.
UNIT-I INTRODUCTION:


UNIT-II RF/MICROWAVE AMPLIFIERS:

Types of amplifiers-small signal amplifier design-design of different types of amplifiers - narrow band, high gain, maximum gain, low noise broad band amplifier design - 

Multistage small signal amplifier design, Minimum Noise Multi stage amplifier design, Large signal design, High power amplifiers, Microwave power combining/dividing techniques, signal distortion due to intermodulation products, Multistage amplifiers large signal amplifiers design

UNIT-II RF OSCILLATORS:

RF/Microwave oscillator design-Oscillator versus amplifier design-oscillations conditions, design of transistor oscillators, fixed frequency, Frequency tunable oscillators.

UNIT-IVRF CONVERTERS AND MIXERS:

Rectifier design-detector design Formulation,

Properties of S Parameters, Smith charts, applications on distributed circuit applications, lumped element circuit applications. Mixer design-UP conversion, down conversion, Conversion loss for SSB Mixers, SSB verses DSB Mixers conversion loss, one diode mixers, two diode mixer

UNIT-VRF MATCHING NETWORKS:

Design of matching networks using lumped elements, design rules for matching networks, Using distributed elements -using single stub matching Short or Open circuited stubs.

Reference Books:

2. Vendalin, Microwave Circuit Design using Linear and Nonlinear Techniques, Wiley.
MTEC012 – Information Theory

Unit 1
Entropy, Relative Entropy, and Mutual Information: 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

Unit 3
Entropy Rates of a Stochastic Process: Markov Chains, Entropy Rate, Example: Entropy Rate of a Random Walk on a Weighted Graph, Second Law of Thermodynamics, Functions of Markov Chains

Unit 4
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, Competitive Optimality of the Shannon Code, Generation of Discrete Distributions from Fair Coins

Unit 5
Channel Capacity: Examples of Channel Capacity, Symmetric Channels, Properties of Channel Capacity, Preview of the Channel Coding Theorem, Definitions, Jointly Typical Sequences, Channel Coding Theorem

Reference Books:
MTEC013 – Antenna Theory and Design

Antenna fundamental and definitions: Radiation mechanism - overview, EM fundamentals, Solution of Maxwell's equations for radiation problems, Ideal dipole, Radiation patterns, Directivity and gain, Antenna impedance, Radiation efficiency, Antenna polarization.


Arrays: Array factor for linear arrays, Uniformly excited equally spaced linear arrays, Pattern multiplication, Directivity of linear arrays, Nonuniformly excited equally spaced linear arrays, Mutual coupling, Multidimensional arrays, Phased arrays, Feeding techniques, Perspectives on Arrays.

Broadband antennas: Travelling wave antennas Helical antennas, Biconical antennas Sleeve antennas, and Principles of frequency independent antennas, Spiral antennas, and Log - periodic antennas.

Aperture antennas: Techniques for evaluating gain, Reflector antennas - Parabolic reflector antenna principles, Axi-symmetric parabolic reflector antenna, Offset parabolic reflectors, Dual reflector antennas, Gain calculations for reflector antennas, Feed antennas for reflectors, FiECS representations, Matching the feed to the reflector, General feed model, Feed antennas used in practice.


Method of moments: Introduction of the methods moments, Pocklington's integral equation, Integral equation and Kirchhoff’s networking equations, Source modeling weighted residual formulations and computational consideration, Calculation of antenna and scatter characteristics.

Computational EM: FTTD methods, Geometrical optics, Wedge diffraction theory, Ray fixed coordinate system, Uniform theory of wedge diffraction, E–plane analysis of horn antennas. Cylindrical parabolic antennas, Radiation by a slot on a finite ground plane, Radiation by a monopole on a finite ground plane, Equivalent current concepts, Multiple diffraction formulation by a curved surfaces, Physical optics, Methods of stationary phase, physical theory of diffraction, Cylindrical parabolic reflector antennas.

Reference Books:

2. J. D. Kraus, "Antennas", McGraw Hill TMH.
3. Stutman and Thiele, Antenna theory and design, John Wiley and sons Inc.
MTEC021 – Optical Communication


Soliton systems: Nonlinear effects. Soliton – based communication. High speed and WDM Soliton systems

Reference Books:

1. G.P. Agrawal, Fiber Optic Communication Systems, Wiley
2. B.P. Pal, Guided Wave Optical Components and Devices, Elsevier
3. C.S. Murthy & M. Gurusamy, WDM Optical Networks, PHI
4. R. Ramaswami, K.N. Sivarajan, Optical Networks, Elsevier
5. G.P. Agrawal, Nonlinear Fiber Optics, (4/e), Elsevier
MTEC022 – MIMO Communication Systems

Concept of diversity, introduction to MIMO systems, space-time coding, MIMO Channels, capacity of MIMO channels, ergodic capacity, Space diversity and system based on space diversity, Smart antenna systems and MIMO, MIMO based system architecture; MIMO exploits multipath, Space time processing, Antenna considerations for MIMO.


Cooperative communication, amplify forward and decode forward protocols, performance evaluation of cooperative communication systems, full duplex communication, optical wireless communication, Introduction to Massive MIMO systems.

MIMO channel modeling, MIMO channel measurements, MIMO channel capacity, CDD, Space time coding, advantages and applications of MIMO, MIMO application in 3G, MIMO-1, Spatial multiplexing channel modeling: Multiplexing capability of MIMO channels, Physical modeling of MIMO channels. Modeling MIMO fading channels,

Multi antenna systems, Smart antennas, Multiple Input and Multiple Output systems with various multiple access schemes.

Reference Books:

MTEC023 – Next Generation Networks

UNIT I

Introduction to next generation networks: Communicating in the new Era, New Era of Networking, Technologies influencing change, IP Everywhere, Optical fiber anywhere, wireless access, building blocks for NGN, IP Networks, VOIP, Multi service Flexible Networks architecture. VPNs, Optical Networks, Wire line and Wireless Networks, NGN Services, Network Infrastructure convergence, services convergence, from technology push to service pull.

UNIT II


UNIT III

Multiservice Networks: Origin of multiservice ATM, Next Generation Multi service Networks, Next Generation Multi service ATM switching, Multi protocol Label switching, Networks, Frame Based MPLS, Cell based MPLS, MPLS services and their benefits, multi service provisioning platforms (MSPP) and Multi service switching platform (MSSP)

UNIT IV

NGN Applications: Internet connectivity, e-commerce, call center, third party application service provision, UMTS, WAP, WiMAX, integrated billing, security and directory enable networks.

Reference Books:

1. Next Generation Network Services, Robet Wood, Pearson
MTEC032 – Error Control Coding

Unit 1

Unit 2
Linear Block Codes: Basic Definitions, The Generator Matrix Description of Linear Block Codes, The Parity Check Matrix and Dual Codes, Some Simple Bounds on Block Codes, Error Detection and Correction over Hard-Input Channels, Weight Distributions of Codes and Their Duals, Hamming Codes and Their Duals, Performance of Linear Codes

Unit 3
Cyclic Codes, Rings, and Polynomials: Introduction, Basic Definitions, rings, Quotient Rings, Ideals in Rings, Algebraic Description of Cyclic Codes, Nonsystematic Encoding and Parity Check, Systematic Encoding, Cyclic Encoding, Syndrome Decoding, Binary CRC Codes

Unit 4
Convolutional Codes: Definition of Codes and Equivalent Code, Decoding Convolutional Codes, Some Performance Results, Error Analysis for Convolutional Codes, Puncturing, Suboptimal Decoding Algorithms for Convolutional Codes, Convolutional Codes as Block Codes, Trellis Representations of Block and Cyclic Codes

Reference Books:
2. Shu Lin, Daniel J. Costello, Error Control Coding, Pearson
MTEC031 – Internet of Things

Unit 1
Introduction to the Internet of Things (IoT) : What is the Internet of Things (IoT)? , Technology drivers , Business drivers, Typical IoT applications, Trends and implications

Unit 2
IoT Architectures: Architectures for IoT, Elements of an IoT Architecture, Architectural design considerations

Unit 3
IoT Network protocols (MAC layer): Wireless sensor networks (WSNs) and power consumption, CSMA/CA and slotting, Centralized vs. distributed, State-of-the-art MAC-layer protocols for WSNs

Unit 4
Wireless technologies for IoT (Layer 1 & 2): WiFi (IEEE 802.11), Bluetooth/Bluetooth Smart, ZigBee/ZigBee Smart, UWB (IEEE 802.15.4), 6LoWPAN, Proprietary systems

Unit 5
IoT application programming: Introduction to IoT device programming, IoT application development.

Unit 6
Data analytics for IoT: A framework for data-driven decision making, Descriptive, Predictive and Prescriptive Analytics, Business Intelligence and Artificial Intelligence, Importance of impact and open innovation in data-driven decision making

Reference Books:
Microwave and millimeter wave devices:
Overview of microwave and millimeter wave vacuum tube devices, limitations of microwave vacuum tubes, Gyratron vacuum tube devices.
Advances in microwave and millimeter wave solid state devices, Gunn devices, oscillator using Gunn diode, and injection locked oscillators, IMPATT devices, and microwave and mm wave performance of IMPATT.
Other solid state devices like Tunnel diode, BARITT and TRAPAT.
Microwave and mm wave circuits:
Review of scattering matrix concept in the light of vector network analyzer, impedance matching network k, couplers, power dividers, resonators and filters.
Detectors, mixers, attenuators, phase shifters, amplifier and oscillator
Ferrite based circuits.
Antennas:
Hertzian dipole, loop antenna, helical antenna, frequency independent antenna: Du0Hamel principle, log spiral and log periodic dipole antenna array.
Babinet principle, waveguide slot antenna, microstrip antenna, horn antenna, parabolic reflector.
Antenna arrays and phased array antenna. Antenna measurement.
Microwave and mm wave propagation.
Overview of basic radio wave propagation mechanisms, Friis transmission formula, plane earth propagation model, troposcatter systems, ionosphere propagation, duct propagation, microwaveradio link and calculation of link budget.
Effect on radio wave propagation due to rain, fog, snow, ice, atmospheric gases, Earth’s magnetic field.

Reference Books:
2. David M Pozar, “Microwave Engineering”, John Wiley & Sons
UNIT -I

UNIT –II

UNIT -III

UNIT –IV

UNIT –V

Reference Books:
5. J. Martin, “Communication satellite systems”, PHI publication
MTEC043 – Cognitive Radio


Concept of Cognitive Radio, Software Defined Radio (SDR), Problems Faced by SDR, Cognitive Networks,


Reference Books:

7. T. DarcChiuheh, P. Yun Tsai,” OFDM baseband receiver design for wireless communications”, Wiley.
MTEC041 – Advanced Optical Networks

SONET & SDH:
Brief history of SONET & SDH, Multiplexing hierarchy, Multiplexing structure – Functional components, Problem detection, Virtual tributaries & containers, Concatenation.

Architecture of OTN:
Digital wrapper, control planes, Control signaling, Multiplexing, hierarchies, Current digital hierarchy, revised hierarchies, Optical & Digital Transport hierarchies, Functionality stacks, Encapsulation & Decapsulation, GFP.

WDM, DWDM Topologies:
Relationship with SONET / SDH, EDF, WDM Amplifiers, Multiplexers, WADM I/P & O/P ports, span loss & chromatic, dispersion, Tunable DWDM lasers

Network Topologies & Protection schemes:
Non-negotiable requirements of robust networks, Line & Path protection switching, Type of Topologies, Optical Channel Concatenation, Meshed topologies, PON’s, Optical Ethernets, Wide area Backbones, Metro optical networking

MPLS & Optical networks:

Architecture of IP & MPLS based optical transport Networks:
IP, MPLS & Optical control planes Interworking, The three control planes, Framework for IP Vs. Optical networks, Generalized MPLS use in optical networks, Bidirectional LSP’s in optical network, Next horizon of GMPLS, ODVK General communication channels, Traffic parameters

Link Management protocol (LMP):
What is managed, Data Bearing links, Basic function of LMP, LMP messages, LMP message header, TLW’s control channel Management, LPC, LCV, Fault management, Extending LMP operations to optical links.

Optical compilers:
Building blocks, Serial Binary adder with carry delay, Fiber delay line memory loop, Bit serial, optical counter design, Lumped delay design, Distributed delay design, Time multiplex multiprocessor, Time slot interchange with 2 log 2 (N-1) switch, Hatch design support system

Reference Books:
2. P.E Green, “Optical Networks” Prentice Hall.
5. Tanenbaum Andrew S “Computer Networks” Prentice Hall (India).
MTEC051 – Advanced Wireless Networks

GSM services and features – GSM system architecture – GSM radio subsystem – Frame structure for GSM – Signal processing in GSM – GPRS network architecture – GPRS services and features – 3G UMTS network architecture – UMTS services and features.

WiMAX Genesis and framework: 802.16 standard, WiMAX forum, Other 802.16 standards, Protocol layer topologies - Layers of WiMAX, CS, MAC CPS, Security layer, Physical layer, Reference model, topology.

Frequency utilization and system profiles: Cellular concept, Licensed and unlicensed frequencies, Fixed WiMAX system profiles, Mobile WiMAX profiles.

WiMAX physical layer: OFDM transmission, SOFDMA, subcarrier permutation, 802.16 transmission chains, Channel coding, Turbo coding, Burst profile.

WiMAX MAC and QoS: CS layer, MAC function and frames, Multiple access and burst profile, Uplink bandwidth allocation and request mechanisms, Network entry and QoS management.

Radio engineering considerations: Radio resource management, Advance antenna technology in WiMAX, MBS. WiMAX architecture, Mobility handover and power save modes, Security.

Reference Books:

MTEC052 – Optoelectronics Devices and Systems

Unit-I: Waveguide and Optical Fiber

Dielectric Slab Waveguide (Modes in symmetric slab waveguide, Mode condition, TE & TM polarization, Higher Order modes, Mode Pattern, Modes in Asymmetric slab waveguide), Description of Modes (Types of modes, Guided, Radiation and Leaky modes on ω-β plane, Parameters of single-mode and multi-mode fibers), Multipath dispersion in Step-index and Graded-index fiber, Material dispersion and Pulse distortion, Solitons, Information rate, Signal Degradation (Attenuation loss, Absorption, Rayleigh Scattering, Non-linear Scattering in Fibers), Loss mechanism in Fiber (Losses - Insertion, Return, Intrinsic, Reflection, etc.)

Unit-II: Optical Sources - I (Light Emitting Diode)

Light Emitting Diode: Power & Efficiency; LED structures: Planar LED, Dome LED, Burrus-type LED, Surface emitting LED, Edge emitting LED, Super-luminescent LED, Resonant cavity and quantum dot LEDs; LED-Analog and Digital Transmissions, LED characteristics (optical output power and spectrum, modulation capability, Transient Response, Power-Bandwidth product).

Unit-III: Optical Sources - I (LASER)

Unit IV: Optical Detectors
Optical detection theory, Quantum efficiency & Responsivity, Photo detectors without internal gain (p-n photodiode, PIN photodiode), Photo detectors with internal gain (Avalanche photodiode, Silicon reach through avalanche photodiodes, Germanium avalanche photodiodes, III-V alloy avalanche photodiodes), Photo-detector noise (noise source, Signal-to-Noise ratio), Detector Response time, Avalanche Multiplication Noise, Temperature effect on Avalanche Gain.

Unit V: Electro-Optic Devices
Electro-Optic effects (Kerr, Pockels, and Faraday effects); Q-switching; Modulation of Laser output; Electro-Optic Modulators, Kerr Modulators; Magneto-Optic Devices; Electro-Optic amplitude modulation; Acousto-Optic effect and devices; Switching & logic devices.

Unit VI: Other Optical and Optoelectronic devices
Overview of Optical sensors and its advantage over conventional sensors, Intensitymodulated optical fiber sensors, Interferometric optical fiber sensors; Optical fiber couplers, Directional couplers; Optical isolators, Wavelength Multiplexers & De-multiplexers, Mach–Zehnder interferometer, Optical A/D, and D/A converters, Semiconductor quantum well structures, Quantum wires and dots.

Unit VII: Optoelectronic Materials
Growth and characterization of III-V and II-VI semiconductor materials required for optoelectronic devices for visible and IR range. Ternary and quaternary semiconductors.

Reference Books:
MTEC053 – MONOLITHIC MICROWAVE INTEGRATED CIRCUITS

UNIT I
MIC Technology – Thick film and Thin film technology, Testing methods, Encapsulation and mounting of Devices, Hybrid MIC’s, Monolithic MIC technology (MMIC).

UNIT II
Analysis of stripline and microstripline, Method of conformal Transformation, Characteristic parameters of strip, Microstrip lines, Microstrip Circuit Design, Impedance transformers, Filters, Lumped constant Microstrip circuits.

UNIT III
Coupled Microstrips and Directional couplers, Even and odd mode analysis, Theory of coupled microstrip Directional couplers, Calculations for a coupled pair of Microstrips, Branch line couplers.

UNIT IV
Lumped Elements for MIC’s, Impedance transformers, Directional couplers, branch line couplers, filters, resonators, Design and fabrication of lumped elements, circuits using lumped elements, Comparison with distributed circuits.

UNIT V
Non reciprocal components for MIC’s, Microstrip on Ferrimagnetic substrates, Microstrip circulators. Isolators and phase shifters, Design of microstrip circuits – high power and low power circuits.

TEXT BOOKS:
2. Leo Young,” Advances in Microwaves”, Academic Press.