EC 701 Elective - I (EC - 7011 Wireless Communication)

Unit-I  Introduction
Applications and requirements of wireless services: history, types of services, requirements for the services, economic and social aspects.
Technical challenges in wireless communications: multipath propagation, spectrum limitations, limited energy, user mobility, noise and interference-limited systems.
Propagation mechanism: free space loss, reflection and transmission, diffraction, scattering by rough surfaces, wave guiding.

Unit-II
Wireless Propagation channels
Statistical description of the wireless channel: time invariant and variant two path models, small-scale fading with and without a dominant component, Doppler spectra, temporal dependence of fading, large scale fading.
Wideband and directional channel characteristics: causes of delay dispersion, system theoretic description of wireless channels, WSSUS model, condensed parameters, ultra wideband channels, directional description.

Unit-III
Channel models: Narrowband, wideband and directional models, deterministic channel-modeling methods. Channel sounding: Introduction, time domain measurements, frequency domain analysis, modified measurement methods, directionally resolved measurements.
Antennas: Introduction, antennas for mobile stations, antennas for base stations.

Unit-IV
Transceivers and signal processing: Structure of a wireless communication link: transceiver block structure, simplified models. Modulation formats, demodulator structure, error probability in AWGN channels, error probability in flat-fading channels, error probability in delay and frequency-dispersive fading channels.

Unit V
Diversity: Introduction, microdiversity, macrodiversity and simulcast, combination of signals, error probability in fading channels with diversity reception, transmit diversity.
Equalizers: Introduction, linear equalizers, decision feedback equalizers, maximum likelihood sequence estimation (Viterbi detector), comparison of equalizer structures, fractional spaced equalizers, blind equalizers.

References:
1. Molisch: Wireless Communications, Wiley India.
2. Taub and Schilling: Principles of Communication Systems, TMH.
6. Price: Wireless Communication and Networks, TMH.
EC 701 Elective – I (EC – 7012 Digital Image Processing)

Unit-I
**Digital Image Processing (DIP)**
Introduction, examples of fields that use DIP, fundamental steps in DIP, components of an image processing system.
**Digital Image Fundamentals:** elements of visual perception, image sensing and acquisition, image sampling and quantization, basic relationships between pixels.

Unit-II
**Image Transforms**
Two-dimensional (2D) impulse and its shifting properties, 2D continuous Fourier Transform pair, 2D sampling and sampling theorem, 2D Discrete Fourier Transform (DFT), properties of 2D DFT.
**Other transforms and their properties:** Cosine transform, Sine transform, Walsh transform, Hadamard transform, Haar transform, Slant transform, KL transform.

Unit-III
**Image Enhancement**
**Spatial domain methods:** basic intensity transformation functions, fundamentals of spatial filtering, smoothing spatial filters (linear and non-linear), sharpening spatial filters (unsharp masking and high boost filters), combined spatial enhancement method.
**Frequency domain methods:** basics of filtering in frequency domain, image smoothing filters (Butterworth and Gaussian low pass filters), image sharpening filters (Butterworth and Gaussian high pass filters), selective filtering.

Unit-IV
**Image Restoration**
Image degradation/restoration, noise models, restoration by spatial filtering, noise reduction by frequency domain filtering, linear position invariant degradations, estimation of degradation function, inverse filtering, Wiener filtering, image reconstruction from projection.

Unit-V
**Image Compression**
**Fundamentals of data compression:** basic compression methods: Huffman coding, Golomb coding, LZW coding, Run-Length coding, Symbol based coding.
Digital image watermarking, representation and description- minimum perimeter polygons algorithm (MPP).

**References:**
Unit-I
Neural Network (NN)
Introduction, benefits of neural network, models of a neuron, neural network as directed graph, network architectures, artificial intelligence and neural network.
Learning processes: error correction learning, memory based learning, Hebbian learning, competitive learning, Boltzmann learning, learning tasks, adaptation, statistical nature of learning process, statistical learning theory.

Unit-II
Perceptrons
Single layer perceptrons: adaptive filtering problem, unconstrained optimization technique, linear least squares filter, least mean square algorithm (LMS), perceptron convergence theorem
Multi layer perceptron: architecture, back propagation algorithm, generalization, approximations of functions, network pruning techniques.

Unit-III
Radial Basis Function (RBF) Networks

Unit-IV
Information- Theoretic Models
Entropy, maximum entropy principle, mutual information, Kullback-Leibler divergence, mutual information as an objective function to be optimized, maximum mutual information principle, infomax and redundancy reduction, spatially coherent and incoherent features, independent components analysis, maximum likelihood estimation, maximum entropy method.

Unit V
Dynamically Driven Recurrent Networks
introduction, recurrent network architectures, state space model, non-linear autoregressive with exogenous inputs model, computational power of recurrent networks, learning algorithms, back propagation through time, real time recurrent learning, Kalman filter, decoupled Kalman filter, vanishing gradients in recurrent networks, system identification, model reference adaptive control.

References:
2. Sivanandam, Sumathi and Deepa: Introduction to Neural Networks using Matlab, TMH.
3. Freeman and Skapura: Fundamentals of Neural Networks- algorithms, applications and programming techniques, Pearson Education.
6. Satish Kumar: Neural Networks, TMH.
Unit-I

Overview of satellite systems: Introduction, Frequency allocations for satellite systems.

Orbits and launching methods: Kepler’s three laws of planetary motion, terms used for earth orbiting satellites, orbital elements, apogee and perigee heights, orbit perturbations, inclined orbits, local mean solar point and sun-synchronous orbits, standard time.

Unit-II


Polarization: antenna polarization, polarization of satellite signals, cross polarization discrimination.

Depolarization: ionospheric, rain, ice.

Unit-III

The Space segment: introduction, power supply, attitude control, station keeping, thermal control, TT&C subsystem, transponders, antenna subsystem, Morelos and Satmex 5, Anik-satelites, Advanced Tiros-N spacecraft.

The Earth segment: introduction, receive-only home TV systems, master antenna TV system, Community antenna TV system, transmit-receive earth station.

Unit-IV

The space link: Introduction, Equivalent isotropic radiated power (EIPR), transmission losses, the link power budget equation, system noise, carrier-to-noise ratio (C/N), the uplink, the downlink, effects of rain, combined uplink and downlink C/N ratio, inter modulation noise, inter-satellite links.

Interference between satellite circuits.

Unit-V

Satellite services

VSAT (very small aperture terminal) systems: overview, network architecture, access control protocols, basic techniques, VSAT earth station, calculation of link margins for a VSAT star network.

Direct broadcast satellite (DBS) Television and radio: digital DBS TV, BDS TV system design and link budget, error control in digital DBS-TV, installation of DBS-TV antennas, satellite radio broadcasting.

References:

1. Roddy: Satellite Communications, TMH.
2. Timothy Prattt: Satellite Communications, Wiley India.
EC-703 Optical Communication

Unit-I
Overview of Optical Fiber Communications (OFC): Motivation, optical spectral bands, key elements of optical fiber systems.

Optical fibers: basic optical laws and definitions, optical fiber modes and configurations, mode theory for circular waveguides, single mode fibers, graded-index fiber structure, fiber materials, photonic crystal fibers, fiber fabrication, fiber optic cables.

Unit-II

Power launching and coupling: source to fiber power launching, fiber to fiber joints, LED coupling to single mode fibers, fiber splicing, optical fiber connectors.

Unit-III
Photo detectors: pin photodetector, avalanche photodiodes, photo detector noise, detector response time, avalanche multiplication noise.


Unit-IV
Optical receivers: fundamental receiver operation, digital receiver performance, eye diagrams, coherent detection: homodyne and heterodyne, burst mode receiver, analog receivers.

Digital links: point to point links, link power budget, rise time budget, power penalties.

Analog links: overview of analog links, carrier to noise ratio, multi channel transmission techniques.

Unit-V
Optical technologies
Wavelength division multiplexing (WDM) concepts: operational principles of WDM, passive optical star coupler, isolators, circulators, active optical components: MEMS technology, variable optical attenuators, tunable optical filters, dynamic gain equalizers, polarization controller, chromatic dispersion compensators. Optical amplifiers: basic applications and types of optical amplifiers, Erbium Doped Fiber Amplifiers (EDFA): amplification mechanism, architecture, power conversion efficiency and gain. Amplifier noise, optical SNR, system applications.

Performance Measurement and monitoring: measurement standards, basic test equipment, optical power measurements, optical fiber characterization, eye diagram tests, optical time-domain reflectometer, optical performance monitoring.

References:
1. Keiser: Optical Fiber Communications, TMH.
3. Agarwal: Fiber Optic Communication Systems, Wiley India.
4. Palais: Fiber Optics Communications, Pearson Education.
7. Ghatak and Thyagrajan: Fiber Optics and Lasers, Macmillan India Ltd.
List of Experiments:

1. Launching of light into the optical fiber and calculate the numerical aperture and V-number.
2. Observing Holograms and their study.
5. Construction of Michelson interferometer.
6. Setting up a fiber optic analog link and study of PAM.
7. Setting up a fiber optic digital link and study of TDM and Manchester coding.
EC-704 Microwave Engineering

Unit-I
Microwave Transmission System
General representation of EM field in terms of TEM, TE and TM components, Uniform guide structures, rectangular wave guides, Circular Wave guides, Solution in terms of various modes, Properties of propagating and evanescent modes, Dominant modes, Normalized model voltages and currents, Power flow and energy storage in modes frequency range of operation for single mode working, effect of higher order modes, Strip line and micro strip lines general properties, Comparison of coaxial, Micro strip and rectangular wave guides in terms of band width, power handling capacity, economical consideration etc.

Unit-II
Microwave Networks and Component

Unit-III
Microwave Solid State Devices and Application
PIN diodes, Properties and applications, Microwave detector diodes, detection characteristics, Varactor diodes, parametric amplifier fundamentals, Manley-Rowe power relation MASER, LASER, Amplifiers, Frequency converters and harmonic generators using varactor diodes, Transferred electron devices, Gunn effect, Various modes of operation of Gunn oscillator, IMPATT, TRAPATT and BARITT.

Unit-IV
Microwave Vacuum Tube Devices
Interaction of electron beam with electromagnetic field, power transfer condition. Principles of working of two cavity and Reflex Klystrons, arrival time curve and oscillation conditions in reflex klystrons, mode- frequency characteristics. Effect of repeller voltage variation on power and frequency of output. Principle of working of magnetrons. Electron dynamics in planar and cylindrical magnetrons, Cutoff magnetic field, Resonant cavities in magnetron, II-mode operation Mode separation techniques, Rising sun cavity and strapping. Principle of working of TWT amplifier. Slow wave structures, Approximate gain relationship in forward wave TWT.

Unit-V
Microwave Measurements
Square law detection, Broadband and tuned detectors. Wave-guide probes, Probe and detector mounts, Slotted line arrangement and VSWR meter, Measurement of wave-guide impedance at load port by slotted line, Microwave bench components and source modulation. Measurement of scattering matrix parameters, High, Medium and low-level power measurement techniques, Characteristics of bolometers, bolometer mounts, Power measurement bridges, Microwave frequency measurement techniques, calibrated resonators (transmission and absorption type). Network Analyzer and its use in measurements.

References:
1. Liao: Microwave Devices and Circuits, Pearson Education.
2. Das: Microwave Engineering, TMH.
4. Collins: Foundations of Microwave Engineering, Wiley India.
5. Srivastava and Gupta: Microwave Devices and Circuits, PHI Learning.
7. Pozar: Microwave Engineering, Wiley India.
List of Experiments:

Following illustrative practical should be simulated with the help of any RF simulation software:-

1. Study the characteristics of Klystron Tube and to determine its electronic tuning range.
2. To determine the frequency and wavelength in a rectangular wave-guide working on TE10 mode.
3. To determine the Standing Wave-Ratio and reflection coefficient.
4. To measure an unknown impedance with Smith Chart.
5. To study the V-I characteristics of Gunn Diode.
6. To study the following characteristics of Gunn Diode.
   (a) Output power and frequency as a function of voltage.
   (b) Square wave modulation through PIN diode.
7. Study the function of Magic Tee by measuring the following parameters.
   (a) Measurement of VSWR at different ports and
   (b) Measurement of isolation and coupling coefficient.
8. Study the function of Isolator / Circulator by measuring the following parameters.
   (a) Input VSWR measurement of Isolator / Circulator.
   (b) Measurement of insertion loss and isolation.
9. Study the function of Attenuator (Fixed and Variable type) by measuring the following parameters.
   (a) Input VSWR measurement.
   (b) Measurement of insertion loss and attenuation.
10. Study the function of Multi Hole Directional Coupler by measuring the following parameters.
    (a) To measure main line and auxiliary line VSWR.
    (b) To measure the coupling factor and directivity.
11. Study of a network analyzer and measurements using it.
EC-705 VLSI Design

UNIT I
Practical Consideration and Technology in VLSI Design

UNIT II
Device Modeling
Dc Models, Small Signal Models, MOS Models, MOSFET Models in High Frequency and small signal, Short channel devices, Sub threshold Operations, Modeling Noise Sources in MOSFET’s, Diode Models, Bipolar Models, Passive component Models.

UNIT III
Circuit Simulation
Introduction, Circuit Simulation Using Spice, MOSFET Model, Level 1 Large signal model, Level 2 Large Signal Model, High Frequency Model, Noise Model of MOSFET, Large signal Diode Current, High Frequency BJT Model, BJT Noise Model, Temperature Dependence of BJT.

UNIT IV
Structured Digital Circuits and Systems
Random Logic and Structured Logic Forms, Register Storage Circuits, Quasi Static Register Cells, A Static Register Cell, Micro coded Controllers, Microprocessor Design, Systolic Arrays, Bit-Serial Processing Elements, Algotronix.

UNIT V
CMOS Processing Technology

References:
2. Sorab Gandhi: VLSI Fabrication Principles, Wiley India.
3. Weste and Eshraghian: Principles of CMOS VLSI design, Addison-Wesley
6. Sze: VLSI Technology, TMH.
EC-706 Minor Project and Seminar

The student should select a topic (from the subjects he has studied so far or any topic related to real life problem). He should do the literature survey, analyze the problem and propose some solution for the same. He should prepare a detailed (typed) report regarding the topic and should present the same with the help of power point presentation at the end of the semester. The analysis of the problem may be done with the help of some software or any hardware (which may be made by the student).
**EC-707 Industrial Training**

Duration: 4 weeks after the VI semester in the summer break. Assessment in VII semester.

**SCHEME OF EXAMINATION**

For the assessment of industrial training undertaken by the students, following components are considered with respective weightage.

**A) Term work In Industry Marks allotted**

1. Attendance and General Discipline 05
2. Daily diary Maintenance 05
3. Initiative and Participative attitude during training 05
4. Assessment of training by Industrial Supervisor/s 15

**Total** 30

**B) Practical/Oral Examination (Viva-voce In Institution Marks allotted**

1. Training Report 20
2. Seminar and cross questioning (defense) 30

**Total** 50

Marks of various components in industry should be awarded to the student, in consultation with the Training and Placement Officer (TPO)/ Faculty of the institute, who must establish contact with the supervisor/ authorities of the organization where, students have taken training, to award the marks for term work. During training, students will prepare a first draft of the training report in consultation with the section incharge. After training they will prepare final draft with the help of the TPO/ faculty of the institute. Then, they will present a seminar on their training and will face viva-voce on training in the institute.