Antenna & Wave Propagation
ECC - 701

Unit I

Introduction to antenna: antenna terminology, radiation, retarded potential, radiation field from current element, radiation resistance of short dipole and half wave dipole antenna, network theorems applied to antenna, self and mutual impedance of antenna, effect of earth on vertical pattern and image antenna.

Unit II

Antenna arrays: of point sources, two element array, end fire and broad side arrays, uniform linear arrays of n-elements, linear arrays with non-uniform amplitude distribution (binomial distribution and Chebyshev optimum distribution), arrays of two-driven half wave length elements (broad side and end fire case), principle of pattern multiplication.

Unit III

Types of antennas: Babinet's principles and complementary antenna, horn antenna, parabolic reflector antenna, slot antenna,log periodic antenna, loop antenna, helical antenna, biconical antenna, folded dipole antenna, Yagi-Uda antenna, lens antenna, turnstile antenna. Long wire antenna: resonant and travelling wave antennas for different wave lengths, V-antenna, rhombic antenna, beverage antenna, microstrip antenna.

Unit IV

Antenna array synthesis: introduction, continuous sources, methods-Schelknoff polynomial method, Fourier transform method, Woodward- Lawson method, Taylor's method, Laplace transform method, Dolph- Chebychev method, triangular, cosine and cosine squared amplitude distribution, line source, phase distribution, continuous aperture sources.

Unit V

Propagation of radio wave: structure of troposphere, stratosphere and ionosphere, modes of propagation, ground wave propagation, duct propagation. Sky wave propagation: Mechanism of Radio Wave Bending by Ionosphere, critical angle and critical frequency, virtual height, skip distance and LUF, MUF. Single hop and multiple hop transmission, influence of earths magnetic field on radio wave propagation, Fading Space Wave Propagation: LOS, effective earth's radius, field strength of space or tropospheric propagation.

References:

J. D. Krauss: Antennas;for all applications, TMH.
2. R. E. Collin, Antennas and Wave Propagation, Wiley India Pvt. Ltd.
3. C. A. Balanis: Antenna Theory Analysis and Design, Wiley India Pvt. Ltd.
4. Jordan and Balmain: Electromagnetic Fields and Radiating System, PHI.
5. A. R. Harish and M. Sachidananda: Antennas and wave propagation, Oxford University Press.
6. K. D. Prasad: Antennas and Wave Propagation, Satya Prakashan.
7. B. L. Smith: Mordern Anteenas, 2nd Edition, Springer, Macmillan India Ltd.

List of Experiments: Following illustrative practical should be simulated with the help of any RF simulation software e.g. FEKO / HFSS / IE3D / Microwave Office / Microwave Studio or any other similar software:-

1. To Plot the Radiation Pattern of an Omni Directional Antenna.
2. To Plot the Radiation Pattern of a Directional Antenna.
3. To Plot the Radiation Pattern of a Parabolic Reflector Antenna.
4. To Plot the Radiation Pattern of a Log Periodic Antenna.
5. To Plot the Radiation Pattern of a Patch Antenna.
6. To Plot the Radiation Pattern of a Dipole/ Folded Dipole Antenna.
7. To Plot the Radiation Pattern of a Yagi (3-EL/4EL) Antenna.
8. To Plot the Radiation Pattern of a Monopole/ WHIP/ Collinear Antenna.
9. To Plot the Radiation Pattern of a Broad site Antenna.
10. To Plot the Radiation Pattern of a Square Loop Antenna.

Wireless Communication

ECC-702

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.

3. Haykin: Mordern Wireless Communication, Pearson Education.

4. Upena Dalal: Wireless Communication, Oxford University Press.

5. Rappaport: Wireless Communication, Pearson Education.

6. Price: Wireless Communication and Networks, TMH.

7. Palanivelu and Nakkereeran : Wireless and Mobile Communication, PHI Learning.

8. Chidambara Nathan: Wireless Communication, PHI Learning.

List of Experiments

Study of wireless Communications using Communication Trainer Kits

1. Baseband Communication

2. Adaptive Linear Equalizer

3. Code Division Multiple Access (CDMA) - Multipath

4. Code Division Multiple Access (CDMA) – Multiuser

5. Global System for Mobile Communication (GSM) (Using WiCOMM-T - Wireless Digital Communication Training system – SDR Platform)

6. Spread Spectrum – DSSS Modulation & Demodulation (Using Emona 101 Tranier Kit)

Video Signal Processing

ECC-703

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: 1. Gonzalez and Woods: Digital Image Processing, Pearson Education.

2. Anil Jain: Fundamentals of Digital Image Processing, PHI Learning.

3. Annadurai: Fundamentals of Digital Image Processing, Pearson Education.

4. Sonka, Hlavac and Boyle: Digital Image Processing and Computer Vision, Cengage Learning. 5. Chanda and Majumder: Digital Image Processing and Analysis, PHI Learning.

6. Jayaraman, Esakkirajan and Veerakumar: Digital Image Processing, TMH.

7. William K. Pratt, Digital Image Processing, Wiley India

Experiments list

1. Display of gray scale images

2. Histogram Equalization

3 Design non-linear filtering

4 Determination of edge detection using operators

5 . 2-D DFT and DCT

6 Filtering in Frequency domain

7 Display of colour images

8 Conversion between colour spaces

9 DWT of images

10 Segmentation using watershed transform

Department Elective-V
Active RF device & Circuits

ECC-704 (A)

Unit – I

Introduction: Radio frequency and Microwave circuit applications, Radio frequency waves, RF and Microwave circuit design considerations, Introduction to component basics, Microstrip line, Formulation and properties of S-parameters, Signal Flow graphs, Smith chart Concepts, Types

Unit – II

Applications of Smith chart: Distributed circuits– Transmission lines, Microstrip lines, Lumped element circuits– RC, RL, RLC circuits, Noise, gain and Stability analysis

Unit – III

Impedance Matching networks: Goal of impedance matching, Components for matching, Design of Matching Networks - Matching network design using Lumped elements- RC, RL, RLC circuits, Design of Matching Networks using Distributed Elements- Transmission lines, Microstrip lines, Stubs

Unit – IV

Couplers and Power dividers - Basic properties, Types, Power combining efficiency, Wilkinson Power divider- equal and unequal types, 90° Hybrids, Branch line couplers, N-way combiners, Corporate structures, Spatial combining, Phase shifters – Types, Transmission line type, Reflection types phase shifters.

Unit – V

RF Resonators and Filters - Basic Resonator types, transmission line resonators, Resonant waveguide cavities, Excitation of resonators, RF Filters: Basic filter configurations, Special Filter Realizations, Filter Implementation, Coupled Filter

Unit – VI

CO1: Apply S-parameters signal flow graphs and Smith chart for design of passive circuits CO2: Analyze the performance parameters of RF passive components CO3: Design RF passive circuit for communication applications CO4: Evaluate the performance of RF passive circuits using EDA tools .

Reference Books:

1. Mathew M. Radmanesh, “Radio Frequency and Microwave Electronics”, Pearson Education Asia, 2001.

2. Reinhold Ludwig, Pavel Bretchko, "RF circuit design, theory and applications", Pearson Asia Education, 2nd Edition, 2012.

3. D. Pozar, "Microwave Engineering", John Wiley & Sons, New York, 2005.

4. Inder J Bahl, “ Fundamentals of RF and Microwave Transistor Amplifiers”, John Wiley & sons Inc, 2009

Mobile Communication

ECC-704 (B)

Unit-I

Introduction to cellular mobile system A basic cellular system, performance criteria, uniqueness of mobile radio environment, operation of cellular systems, planning of cellular system. Elements of cellular radio system design General description of problem, concept of frequency reuse channels, co-channel interference reduction factor, desired C/I in an omni-directional antenna system, hand off mechanism, cell splitting, components of cellular systems.

Unit-II

Cell coverage for signal and traffic General introduction, mobile point-to-point model, propagation over water or flat open area, foliage loss, propagation in near- in distance, long distance propagation, path loss from point-to-point prediction model, cell site antenna heights and signal coverage cells, mobile-to-mobile propagation. Cell site antennas and mobile antennas Equivalent circuits of antennas, gain and pattern relationship, sum and difference patterns, antennas at cell site, unique situations of cell site antennas, mobile antennas.

Unit-III

Cochannel interference reduction Cochannel interference, real time cochannel interference measurement at mobile radio transceivers, design of antenna systems - omni directional and directional, lowering the antenna height, reduction of cochannel interference, umbrella- pattern effect, diversity receiver, designing a system to serve a predefined area that experiences cochannel interference. Types of Noncochannel interference Adjacent channel interference, near-end-far-end interference, effect on near-end mobile units, cross-talk, effects of coverage and interference by applying power decrease, antenna height decrease, beam tilting, effects of cell site components, interference between systems, UHF TV interference, long distance interference.

Unit-IV

Frequency management and Channel Assignment Frequency management, frequency spectrum utilization, setup channels, channel assignment, fixed channel assignment, non-fixed channel assignment algorithms, additional spectrum, traffic and channel assignment, perception of call blocking from the subscribers Handoffs and dropped calls Value of implementing handoffs, initiation of handoff, delaying a handoff, forced handoff, queuing of handoff, power- difference handoff, mobile assisted handoff and soft handoff, cell-site handoff and intersystem handoff, dropped call rate formula.

Unit-V

Digital Cellular Systems GSM- architecture, layer modeling, transmission, GSM channels and channel modes, multiple access scheme. CDMA- terms of CDMA systems, output power limits and control, modulation characteristics, call processing, hand off procedures. Miscellaneous mobile systems- TDD systems, cordless phone, PDC, PCN, PCS, non cellular systems.

References:

1. Lee: Cellular and Mobile Telecommunication- Analog & digital systems, TMH.

2. Rappaport: Wireless Communications- principles and practice, Pearson Education.

3. Lee: Mobile communications design fundamentals, Wiley India.

4. Faher Kamilo: Wireless Digital Communication, PHI Learning.

5. Raj Kamal: Mobile Computing, Oxford University Press

Radar & Navigation System

ECC-704 (C)

Unit-I

Introduction The simple form of Radar Equation, Radar Block diagram and Operation, Types of transmitters, duplexer and displays. Radar Frequencies, millimeter and submilimeter waves, Applications of Radar

Unit-II

Radar Equation Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise, Signal to Noise Ratio, Matched filter impulse response, Integration of radar Pulses, Radar Cross Section of Targets, Cross section Fluctuations, Radar Clutter-surface clutter, sea clutter and Land clutter ,weather clutter, Transmitter Power, Pulse Repetition Frequency and Range ambiguities, Antenna Parameters, system losses, propagation effects, other considerations.

Unit-III

CW and FM CW Radar Doppler effect. CW radar. FM CW radar. Airborne Doppler Navigation, Multiple CW radar

Unit-IV

MTI And Pulse Doppler Radar Introduction, Delay line Cancellers, Multiple or staggered Pulse Repetition Frequencies, Range gated Doppler Filters, Block Diagram of Digital Signal Processor, Example of MTI radar Processor, , Pulse Doppler Radar, Non coherent MTI ,MTI from moving platform, Other types of MTI, Airborne radar.

Unit- V

Navigation: Introduction, Four Methods of Navigation Radio Direction Findings: Loop Antenna, Loop input circuits, aural null direction finder, Goniometer, Errors in Direction Finding, Adcock Direction Finder, Its advantages over loop antenna, Radio Ranges: LF/MF Four course Radio Range, VHF Omni Directional Range, and VOR receiving Equipmen Hyperbolic Systems of Navigation: LORAN, DECCA navigation systems.

Reference Books:

1. Introduction to Radar System M.I. Skolnik ,McGraw Hill

2. Elements of Electronic Navigation Systems", Tata McGraw-Hill,

3 . Radar Systems and Radio Aids to Navigation, Sen & Bhattacharya, Khanna publishers

4. Radar Principles", Peyton Z. Peebles ,JohnWiley, 2004

5. J.C Toomay, " Principles of Radar", 2nd Edition –PHI, 2004

6. Radar Systems Analysis and Design Using MATLAB, Bassem R. Mahafza, Ph.D. CHAPMAN & HALL/CRC

7. Radar Engg. Hand Book M.I. Skolnik, Publisher: McGraw Hill

8. Roger J Suullivan, "Radar Foundations for Imaging and Advanced Topics".

9. Global Navigation Satellite Systems Insights into GPS, GLONASS, Galileo, Compass, and others B. Bhatta BSP Books

Department Elective VI
Statistical Signal Processing
ECC-705 (A)

Unit-I

Introduction to fundamental of statistical characterization and analysis of signals Ideas of estimation Optimal linear filtering Geometric ideas Autocorrelation matrices and their properties Eigen-analysis.

Unit-II

Linear Algebra Basics: Concepts of Vector Space Linear Operators on finite dimensional vector spaces Dionlization of Auto- Convariance Matrix (Concept of positive definiteness, Eigen Vector Concept etc.)

Unit-III

Performance Consideration for Optimum Beam former Effect of Signal Mismatch Effect of Bandwidth.

Unit-IV

LMS Algorithm and Application 1.Block processing Versus Adaptive Processing , Introduction to LMSAlgorithm Concepts ofAdaptive linear combiner Steepest descentAlgorithm Proof Of Convergence Of Weight Vector Mean Square Adjustment noise and convergence analysis Application of Adaptive Noise Cancellation , Overview of adaptive lattice filtering

Unit- V

Array Signal Processing Basics 1.Array Fundamental Spatial Signals Array Signal Model The Sensor Array :Spatial sampling 2.Conventional Spatial Filtering:Beam forming Spatiqal matched filter Tapered Beam forming 3. Optimum Array processing Optimum Beam forming Eigennanalysis of the Optimum Beam former Interference Cancellation Performance Tapered Optimum Beam forming The Generalised Side Beam lobe Canceller .

Reference Books

Optimal linear filtering NPTELSyllabus Statistical Signal Processing - Web course NPTEL http://nptel.iitm.ac.in: Prof. R.K. Patney Department of Electrical EngineeringIIT Delhi

1.Parametric Spectral Estimation with emphasis on AR process Modelling Yule Walker Equation and Levison Durbin Algorithm

2. Lattice filter (Derived from Levison Durbin Algorithm)

Low Power VLSI Design
ECC-705 (B)

Unit-I

Introduction: Need for low power VLSI chips, Sources of power dissipation on Digital Integrated circuits. Emerging Low power approaches. Device & Technology Impact on Low Power: Dynamic dissipation in CMOS, Transistor sizing& gate oxide thickness, Impact of technology Scaling, Technology & Device innovation.

Unit-II

Simulation Power analysis: SPICE circuit simulators, gate level logic simulation, capacitive power estimation, static state power, gate level capacitance estimation, architecture level analysis, data correlation analysis in DSP systems, Monte Carlo simulation.

Unit-III

Probabilistic power analysis: Random logic signals, probability & frequency, probabilistic power analysis techniques, signal entropy. Low Power Circuit's: Transistor and gate sizing, network restructuring and Reorganization. Special Flip Flops & Latches design, high capacitance nodes, low power digital cells library.

Unit-IV

Logic level: Gate reorganization, signal gating, logic encoding, state machine encoding, pre-computation logic. Low power Architecture & Systems: Power & performance management, switching activity reduction, parallel architecture with voltage reduction, flow graph transformation, low power arithmetic components.

Unit-V

Low power Clock Distribution: Power dissipation in clock distribution, single driver Vs distributed buffers, Zero skew Vs tolerable skew, chip & package co design of clock network. Special Techniques: Power Reduction in Clock networks, CMOS Floating Node, Low Power Bus Delay balancing, and Low Power Techniques for SRAM.

TEXT BOOKS

1. Gary K. Yeap, "Practical Low Power Digital VLSI Design", KAP, 2002

2. Rabaey, Pedram, "Low Power Design Methodologies" Kluwer Academic

Broadband Optical Network

ECC-705 (C)

Unit-I

Evolution of Broadband Wireless; Fxied Broadband Wireless and Mobile Broadband Wireless; WiMAX, 3G & Wi-Fi Systems; Spectrum Options for Broadband Wireless; Technical Challenges for Broadband Wireless - Wireless Radio Channel:Path loss and Shadowing; Spectrum Scarcity, Quality of Service, Mobility, Portability, Security, Supporting IP in Wireless. Orthogonal Frequency Division Multiplexing, Multicarrier Modulation – OFDM;Introduction to Multiple Antenna Techniques.

Unit-II

WiMAX; Salient Features of WiMAX – Physical Layer & MAC-Layer Overview; Advanced Antenna Systems; Improved Frequency Reuse; Performance Characterization - Throughput and Spectral Efficiency and Sample Link Budgets and Coverage Range.

Unit-III

Design Principles of the WiMAX Network Architecture ,QoS, Security, Mobility Management, Location Management, Handoff Management, Mobile IP, TCP in Wireless, Radio Resource Management.

Unit-IV

LTE System Overview, The Evolution from UMTS to LTE; Requirements and Targets for LTE; LTE Radio Access –Transmission Scheme, Spectrum Flexibility, Channel Dependent Scheduling and Rate Adaptation, Inter-Cell Interference Combining, Multi-Antenna Transmission.; Technologies for LTE; Network Architecture – Overall Architecture Overview, Protocol Architecture .

Unit-V

LTE Advanced – Introduction, Requirements, Main Features, Backward Compatibility, Deployment Aspects, UE Categories for LTE Advanced.

REFERENCES

1. Jeffrey G. Andrews, ArunabhaGhosh and RiasMuhamed, “Fundamentals of WiMAX: Understanding Broadband Wireless Networking”, Pearson Education, 2007.

2. Yan Zhang and Hsiao-Hwa Chen, “Mobile WiMAX : toward broadband wireless metropolitan area networks”,Auerbach Publications, 2007

3. Moray Rumney, "LTE and Evolution to 4G Wireless: Design and Measurement Challenges", Agilent Technologies, 2008.

4. StefaniaSesia, IssamToufik, Matthew Baker, "LTE – The UMTS Long Term Evolution: From Theory to Practice", John Wiley & Sons, 2e, 2011.

5. Luis M. Correia, "Mobile Broadband Multimedia Networks: Techniques, Models and Tools for 4G", Elseiver, 2006.

Open Elective

Internet Technology
ECC-706 (A)

Unit-I

Understand the historical background and evolution of today's Internet To examine network topologies and models (OSI model); To develop an understanding of the technological foundations of the Internet and core Internet protocols (TCP/IP, SMTP, FTP, Telnet, ICMP, RSS, and HTTP)

Unit-II

To understand client/server relationships in the context of the Internet and intranets; To identify important Internet content and graphics formats and understand the access issues they present users and the software they require.

Unit-III

To develop a framework for evaluating web resources and designs. To develop advanced web publishing and design skills using the Hypertext Markup Language (HTML)

Unit-IV

To examine web enhancements possible with web programming techniques (ASP, PHP and JavaScript) To examine other markup beyond HTML, including DHTML, XHTML, and XML for information delivery and data structuring.

Unit-V

To develop an understanding of the Internet in the context of information storage and retrieval models; IR issues, how searchable Internet indexes are constructed, the limitations of search engines, and future trends. To examine Web 2.0, cloud computing, and the mobile web in the context of library services. To consider current and future web issues and trends, especially as they pertain to LIS.

BOOKS- 1.Technical Impact Making Your Information Technology Effective, and Keeping It That Way2.

2. Internet OF things

Embedded System
ECC-706 (B)

UNIT-I:

Introduction to Embedded systems Embedded system overview and applications, features and architecture considerations-ROM, RAM, timers, data and address bus, Memory and I/O interfacing concepts, memory mapped I/O. CISC Vs RISC design philosophy, Von-Neumann Vs Harvard architecture, instruction set, instruction formats, and various addressing modes of 32-bit.

UNIT-II:

Microcontroller Fundamentals for Basic Programming I/O pin multiplexing, pull up/down registers, GPIO control, Memory Mapped Peripherals, programming System registers, Watchdog Timer, need of low power for embedded systems, System Clocks and control.

UNIT- III

Timers, PWM and Mixed Signals Processing Timer, Basic Timer, Real Time Clock (RTC), Timing generation and measurements, Analog interfacing and data acquisition: ADC, Analog Comparators, DMA, Motion Control Peripherals: PWM Module & Quadrature Encoder Interface (QEI). Case Study: Tiva based embedded system application using ADC & PWM.

UNIT-IV

Communication protocols and Interfacing with external devices Synchronous/Asynchronous interfaces (like UART, SPI, I2C, USB), serial communication basics, baud rate concepts, Interfacing digital and analog external device, I2C protocol, SPI protocol & UART protocol.

UNIT V

Embedded networking and Internet of Things Embedded Networking fundamentals, Ethernet, TCP/IP introduction IoT overview and architecture, Overview of wireless sensor networks and design examples. Various wireless protocols and its applications: NFC, ZigBee.

TEXT Books:

1. John Davies, "MSP430 Microcontroller Basics", Newnes, 1st Edition

2. Ajit Pal, "Microcontrollers Principles and applications", PHI

3. B. Kanta Rao, "Embedded Systems", PHI

4. Rajkamal, "Embedded Systems Architecture Programming and design", McGraw Hill,

Micro Electro Mechanical Systems
ECC-706 (C)

UNIT_1 INTRODUCTION TO MICROSYSTEMS

Overview of microelectronics manufacture and Microsystems technology. Definition - MEMS materials. Laws of scaling. The multi disciplinary nature of MEMS. Survey of materials central to micro engineering. Applications of MEMS in various industries.

UNIT_2 MICRO SENSORS AND ACTUATORS

Working principle of Microsystems - micro actuation techniques - micro sensors – types – Microactuators – types – micropump – micromotors – micro – valves – microgrippers – microaccelerometers.

UNIT_3 FABRICATION PROCESS

Substrates - single crystal silicon wafer formation – Photolithography – Ion implantation – Diffusion – Oxidation – CVD - Physical vapor deposition - Deposition epitaxy - etching process.

UNIT_4 MICRO SYSTEM MANUFACTURING

Bulk Micro manufacturing - surface micro machining – LIGA – SLIGA - Micro system packaging materials - die level - device level - system level - packaging techniques – die preparation – surface bonding - wire bonding - sealing.

UNIT_5 MICROSYSTEMS DESIGN AND PACKAGING

Design considerations, Mechanical Design, Process design, Realization of MEMS components using intellisuite. Micro system packaging, Packing Technologies, Assembly of Microsystems, Reliability in MEMS.

TEXT BOOKS

1. Mohamed Gad – el – Hak, "MEMS Handbook", CRC Press, 2002.

2. Rai - Choudhury P. "MEMS and MOEMS Technology and Applications", PHI Learning Private Limited, 2009.

3. Sabrie Solomon, "Sensors Handbook," Mc Graw Hill, 1998.

4. Marc F Madou, "Fundamentals of Micro Fabrication", CRC Press, 2nd Edition, 20

ECC- 707-Industrial Training - II

Students must observe following points to enrich their learning in electrical engineering during industrial training:

- The training must be the advance/ different already done on minor training.
-Industrial environment and work culture.
- Organisational structure and inter personal communication.
- Machines/ equipment/ instruments - their working and specifications.
- Product development procedures and phases.
- Project planning, monitoring and control.
- Quality control and assurance.
- Maintenance system.
- Costing system.
- Stores and purchase systems.
- Roles and responsibilities of different categories of personnel.
- Customer services.
-Problems related to various areas of Work etc.
- Layout if any

To be submitted : The students has to submit the power point presentation of minimum15 slides of the training performed (comprising of points stated above) along with the original certificate of training performed with proper seal and signature of the authorized person.