M.Tech (Digital Communication) **Semester I**

MBM 204: RESEARCH METHODS IN MANAGEMENT

3L-0T-0P-3C **M.M.100**

Module – I: **Meaning and Importance of Research** – Types of Research- Exploratory Research – Descriptive Research – Casual Research - Research Approaches- Research Process ––Defining Research Problem- Selection and necessity of defining the problem.

Module – II: **Research Design** –meaning, need and features of good research design- Important concepts related to research design. Experimental research designs: Before and After without control design, After only with control design, Before and after with control design, Completely randomized design (C.R Design) .

Sampling and Sampling Design – Sampling Methods – Simple Random Sampling – Stratified Sampling – Systematic Sampling – Cluster Sampling – Multistage Sampling, Non–Probability Sampling – Convenience Sampling – Judgment Sampling – Quota Sampling- Snowball sampling.

Module – III: **Data Collection** – Primary and Secondary Data – Designing of Questionnaire –**Measurement and Scaling** – Nominal Scale – Ordinal Scale – Interval Scale – Ratio Scale –Guttman Scale – Likert Scale – Schematic Differential Scale. Descriptive statistics- Measures of central tendency- Dispersion- Skewness -Correlation and Regression Analysis.

Module – IV: **Editing** – Coding – Classification of Data – Tables and Graphic Presentation –Basics of inferential statistics- Types of Errors- **Hypothesis testing** -Parametric test - T-test, Z test, Chi Square test- ANOVA Test. Introduction of SPSS.

Module – V: **Non Parametric Tests** – Kolmogorov – Smirnov Test – Runs Test for Randomness. Sign Test – Median Test –Factor Analysis.

Preparation and Presentation of Research Report- Types of reports- Layout of Research Report- Bibliography-References writing- Precautions for writing Research Report.

Suggested Books:

1. Mark Saunders, Philip Lewis, Adrian Thornbill, Research Methods for Business Students, Pearson,ND
2. Churchill, Iacobucci & Israel, Marketing Research: A South Asian Perspective, Cengage, New Delhi
3. C.R. Kothari, Research Methodology, New Age International.
4. Carver & Nash, Data Analysis with SPSS, Cengage, New Delhi
5. Alan Bryman & Emma Bell, Business Research Methods, Oxford University Press.
6. Donald R. Cooper & Pamela S. Schindler, Business Research Methods 8th Edition, Tata McGraw Hill.
7. K.V.S. Sarma, Statistics made sample, do it yourself on PC, Prentice Hall.

M.Tech (Digital Communication) **Semester I**

MDC 101 ADVANCE DIGITAL SIGNAL PROCESSING

3L-1T-0P-3.5C **M.M.100**

ModuleI: Multirate Digital Signal Processing: Review of DFT, FFT, IIR Filters, FIR Filters, 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, Applications of Multirate Signal Processing, Sampling Rate Conversion of Band pass Signals

ModuleII: Linear Prediction And Optimum Linear Filters: Innovations Representation of a Stationary Random Process, Forward and Backward linear prediction, Solution of the Normal Equations, Properties of linear prediction-Error Filter, AR Lattice and ARMA Lattice- Ladder Filters.

ModuleIII: Power Spectral Estimation: Estimation of Spectra from Finite Duration Observations of a signal, the Periodogram, Use DFT in power Spectral Estimation, Bartlett, Welch and Blackman, Tukey methods, Comparison of performance of Non-Parametric Power Spectrum Estimation Methods

ModuleIV: Speech Signal Processing Digital models for speech signal : Mechanism of speech production – model for vocal tract, radiation and excitation – complete model – time domain processing of speech signal:- Pitch period estimation – using autocorrelation function – Linear predictive Coding: Basic Principles – autocorrelation method – Durbin recursive solution.

ModuleV: Wavelet Transforms Fourier Transform : Its power and Limitations – Short Time Fourier Transform – The Gabor Transform - Discrete Time Fourier Transform and filter banks – Continuous Wavelet Transform – Wavelet Transform Ideal Case – Perfect Reconstruction Filter Banks and wavelets – Recursive multi-resolution decomposition – Haar Wavelet – Daubechies Wavelet.

Reference Books:

1. John G.Proakis, Dimitris G.Manobakis, Digital Signal Processing, Principles, Algorithms and Applications, Third edition, (2000) PHI.
2. Monson H.Hayes – Statistical Digital Signal Processing and Modeling, Wiley, 2002.
3. L.R.Rabiner and R.W.Schaber, Digital Processing of Speech Signals, Pearson Education (1979).
4. Roberto Crist, Modern Digital Signal Processing, Thomson Brooks/Cole (2004)
5. Raghuveer. M. Rao, Ajit S.Bopardikar, Wavelet Transforms, Introduction to Theory and applications, Pearson Education, Asia, 2000.
6. Digital Signal Processing, Sanjit K Mitra, TMH
7. Digital Signal Processing, S.Salivahanan A Vallavaraj, C.Gnanapriya, TMH
8. Digital Signal Processing, A.V. Oppenheim and R.W. Schaffer, PHI
9. Digital Signal Processing, Thomas J. Cavicchi, John Wiley & Sons
10. Digital Signal Processing, Emmanuel Ifeachor, Barry Jervis, Pearson
11. Digital Signal Processing, Chi-Tsong Chen, Oxford
12. Digital Signal Processing, Engelberg, Shlomo, Springer
13. Digital Signal Processing For Measurement, D Antona, Gabriele, New Age International

M.Tech (Digital Communication) **Semester I**

MDC 102: ADVANCE DIGITAL COMMUNICATION

3L-1T-0P-3.5C **M.M.100**

Module I: Orthogonal representation of signal, construction of orthogonal basic function, dimensionality of signal space, AWGN, Review of Fourier Techniques and its application for Linear System analysis, Fourier Transform Properties, Classification of Signals, Spectral Density, Autocorrelation.

ModuleII: Band Pass Modulation and Demodulation- Digital Band pass Modulation Techniques binary PSK, QPSK, M-ary PSK, QAM, MSK, GMSK their Generation, Signal Space representation, Band-width requirements, Detection, Performance analysis and Comparison.

ModuleIII:Spread Spectrum Signals for Digital Communication: Model of Spread Spectrum Digital Communication System, Generation of PN Sequences, Direct Sequence Spread Spectrum Signals, Frequency-Hopped Spread Spectrum Signals, CDMA, time-hopping SS, Synchronization of SS systems.

ModuleIV: An Introduction to Information Theory, Encoding in systematic & Non systematic form, Modeling of Communication Channels, syndrome computation & error detection, Binary symmetry channel, Error correction & detection, B/N trade off.

ModuleV: Coding Techniques Huffman and Lempel-Ziv Source Coding, Channel Capacity, Bounds on Communication, Types of Error Control, Linear Block Codes, Cyclic Codes, Hamming Codes, Convolutional Encoding, State, Tree, Trellis Diagram, Properties of Convolutional Codes, Reed-Solomon Coding and Decoding, BCH CODE ,Trellis coding with expanded signal sets for Band-limited channels, Viterbi decoding.

Text/ Reference Books:

1. John G.Prokis, "Digital communications" 4th edition, Mc GRAW Hill, 2001

2. Stephen G. Wilson, "Digital Modulation and Coding," Pearson education (ASIA) Pte.Ltd, 2003

3. Kamilo Feher, "wireless Digital Communication: modulation and spread spectrum Applications" prentice-Hall of India, 2004

4. Henrik Schulze & Cristion Ludes, "Theory application of OFDM and CDMA wideband wireless communication," john wiley & Son Ltd

5. Andrew J.Viterbi, CDMA: "Principles of spread spectrum communications", prentice- Hall, USA, 1995

M.Tech (Digital Communication) **Semester I**

MVL 111: DIGITAL SYSTEM DESIGN

3L-0T-0P-3C **M.M. 100**

Module 1 Review of Combinational & Sequential Logic Design **Introduction to Programmable Logic Devices:** Overview of PLDs, Simple PLD, Complex PLD, Architecture of CPLD & FPGA

Module 2 **Integrated Circuit Logic family:** Evolution of TTL, IIL (merged structure), CML logic, 10K and 100K series of ECL, Stacked ECL, EFL

Module 3 MSI Logic Circuits: Derived logic building blocks such Decoders/ drivers, Encoders, Multiplexers, De-multiplexers, Magnitude Comparators, applications

MESFET, MESFET Inverter, DCFL, supper buffer FET logic, BFL

Module 4 **Memory Devices:** General memory operations, Programmable logic devices, Semi-conductor memories, SRAM, DRAM, FAMOS, FLOTOX

Module 5 **Testing & Verification:** Testing combinational circuits: Different fault models, path sensitization algorithm**Testing sequential circuits:** Sequential test methods; Functional & Timing simulation, delay models, boundary scan, faults, fault simulation, ATPG, BIST, DFT, Verification

Text / Reference Books:

1. R. J. Tocci : "Digital System: Principles & Applications" – PHI
2. Leo Chartrand, "Advanced Digital Systems: Experiments and Concepts with CPLDs", Cengage Learning.
3. John F. Wakerly, "Digital Design: Principles and Practices", Prentice Hall.
4. Charles H. Roth, "Fundamentals of Logic Design", 5th Ed., Cengage Learning.
5. M. Abramovici, M. A. Breuer & Arthur D," Digital Systems Testing & Testable Design", John-Wiley & Sons.

M.Tech (Digital Communication) **Semester I**

MVL 112: VLSI SIGNAL PROCESSING

3L-0T-0P-3C **M.M. 100**

Module 1: Representation of DSP algorithms. Iteration Bound: Loop Bound Iteration Bound, Algorithms, and Iteration Bound for MultiMate data flow graphs.

Module 2: PIPELINING AND PARALLEL PROCESSING - Introduction, pipelining of FIR filters, parallel processing. Timing Techniques retiming: introduction, properties, and system inequalities, retiming techniques Unfolding: Introduction, algorithm, properties, critical path, and sample period reduction Folding: Introduction, Transformation, register minimization

Module 3: DSP ARCHITECTURES SYSTOLIC ARCHITECTURE DESIGN - Introduction, Design Methodologies, FIR systolic array, matrix matrix multiplication.

Module 4: FAST CONVOLUTION - Cook Toom, Winograd, Iterated convolution. Parallel FIR filters: Fast FIR, parallel architecture for rank order filters.

Module 5: Pipelining of recursive filters Introduction, pipeline interleaving, parallel processing in IIR filters, Scaling and round off noise computation, Bit level arithmetic architecture, parallel multipliers, bit serial multipliers, Canonic Singed digit arithmetic, distributed arithmetic.

Text/ Reference Books:

1. Keshab V Parhi, VLSI Digital Signal Processing, Willey India.

2. Peter Pirsch, Architecture for Digital Signal Processing, Wiley.

3. Magdy A Bayoumi, VLSI design methodologies for DSP architecture

M.Tech (Digital Communication) **Semester I**

MDC 111: ANTENNA THEORY AND TECHNIQUES

3L-0T-0P-3C **M.M. 100**

Module: I. Review of the theory of electromagnetic radiation. Introduction to various antenna types wire, loop and helical antennas, analysis using assumed current distribution.

Module: II. Aperture antennas: slot, wave guide, horn, and reflector antennas. Analysis using field equivalence principle and Fourier transform methods. Linear arrays. Traveling wave & broadband antennas. Antenna measurements.

Module: III. Printed antennas: Feeding methods, transmission line & cavity models, analysis and design of rectangular & circular microstrip antenna.

Module: IV. Arrays: pattern synthesis, planar arrays, phased arrays. Active antennas and arrays. Paraboloidal reflector antenna, different feed configurations, shaped beam antennas, lens antenna.

Module: V. Antennas applications: Antennas for biomedical applications. Smart antennas for mobile communications. Antenna for infrared detectors.

Text/ Reference Books:

1. Antennas, John Kraus, Ronald Marhefka, Tmh
2. Electromagnetic Waves And Radiating Systems, E.C. Jordan And K.G. Balmain,Phi
3. Antenna Theory: Analysis and Design, Constantine A. Balanis, John Wiley & Sons
4. Antenna Theory & Design, Robert S. Elliott, John Wiley & Sons
5. Antennas And Wave Propagation,G. S. N. Raju , Pearson
6. Antennas and Wave Propagation, A.R. Harish, M. Sachidananda,
7.Antenna Theory and Practice, Chatterjee, R., New Age International

M.Tech (Digital Communication) **Semester I**

MDC 112 MIXED SIGNAL SYSTEM DESIGN

3L-1T-0P-3C **M.M. 100**

Module 1: INTRODUCTION - PN Junctions, Bipolar Vs Unipolar Devices, MOS Transistor operation, MOSTransistor as a Switch, NMOS ,PMOS and CMOS Switches, CMOS Inverter ACand DCCharacteristics, Analog Signal Processing, Example of Analog Mixed SignalCircuit Design

Module 2: DIGITAL SUB CIRCUITS - CMOS Logic implementation basics- Logic gates and Flip flops –TransmissionGates, TG based implementation of multiplexers, de-multiplexers, encoders,decoders. Digital Circuits like ALU, Comparator, and Parity generator, Timer, PWM, SRAM and DRAM, CAM

Module 3: ANALOG SUB CIRCUITS - Ideal Operational Amplifier, Inverting and Non-inverting configuration Differentialamplifier basics, VCO, PLL, Comparator characteristics, two stage open loopcomparator ,Switched capacitor fundamentals, Switched capacitor amplifier

Module 4: DATA CONVERTERS: DAC - Static &Dynamic Charatersitics,1 Bit DAC, String DAC, Fully DecodedDAC,PWM DAC, Current scaling, voltage scaling DACs
ADC : Static &Dynamic Characteristics, Nyquist Criteria , Sample & Hold Circuit, Quantization error, Concept of over sampling, Counting ADC, Tracking ADC,Successive approximation ADC, Flash ADC, Dual Slope ADC

Module 5: OVER SAMPLING DATA CONVERTERS - Over sampling fundamentals, Delta – SigmaConverter basics, $\Delta\ \Sigma$ Modulator

Text/ Reference Books:

1. Gray Paul R, Meyer, Robert G, Analysis and Design of Analog Integrated Circuits, 3rd edition, John Wiley & Sons.
2. Jacob Baker, "CMOS Mixed-Signal circuit design", A John Willy & Sons, inc., publications, 2003.
3. Professor Bernhard Boser -"Analysis and Design of VLSI Analog-Digital Interface
4. Integrated Circuits" "Addison Wisely publications" (1991).
5. D A John, Ken Martin, Analog Integrated Circuit Design, 1st Edition, John Wiley
6. CMOS Analog Circuit Design, 2nd edition; by: Allen, Phillip E, Holberg , Douglas R, Oxford University Press, (Indian Edition
7. Ken Martin, Digital Integrated Circuit Design, John Wiley
8. Sedra & Smith, Microelectronics Circuits, 5th Edition, Oxford University Press, (Indian Edition)

M.Tech (Digital Communication) **Semester I**

MVL 113 : ASIC DESIGN

3L-0T-0P-3C **M.M. 100**

Module 1: Introduction to ASICs , Types of ASICs , full custom ASIC , semi custom ASIC , standard cell based ASIC , gate array based ASIC , programmable ASIC , PLD , FPGA , Logical effort.

Module 2: Programmable ASICS, Programmable ASIC Logic cells, Anti fuse- static RAM, EPROM and EEPROM technology, PREP benchmarks, Actel ACT, Xilinx LCA, Altera FLEX, Altera MAX , Architecture of FPGAs (Xilinx Spartan-3 / Altera Cyclone-3).

Module 3: SYNCHRONOUS DESIGN USING PROGRAMMABLE DEVICES- EPROM to Realize a Sequential Circuit, Programmable Logic Devices, Designing a Synchronous Sequential Circuit using a GAL, EPROM, Realization State machine using PLD, FPGA, Xilinx FPGA, Xilinx 2000, Xilinx 3000.).

Module 4: System Design Using Verilog HDL (overview), Verilog Description of combinational Circuits, arrays, Verilog operators.

Module 5: Compilation and simulation of Verilog codes, modeling usingVerilog. Flip Flops, registers, counters, sequential machine, combinational logic circuits, Verilog codes, serial adders.

Text/ Reference Books:

1. M.J.S. Smith, "Application – specific integrated circuits" – Addison – Wesley Longman Inc. 1997.

2. John M Yarbrough "Digital Logic applications and Design", Thomson Learning, 2001

3. Samir Palnitkar, "Verilog HDL", Pearson Education, 1996.

4. Data sheet: Spartan-3 FPGA Family Advanced Configuration Architecture – Xilinx XAPP452 (v1.1) June 25, 2008

5. Cyclone III Device Hand book, Volume 1

6. Andrew Brown, - "VLSI circuits and systems in silicon", Mc Graw Hill, 1991.

M.Tech (Digital Communication) **Semester I**

MDC 113: RF CIRCUIT DESIGN

3L-0T-0P-3C **M.M.100**

Module 1: INTRODUCTION -Importance of Radiofrequency Design, RF Behavior of Passive Components, Chip Components and Circuit Board Considerations, General Transmission Line Equation, Micro strip Transmission Lines

Single- and Multiport Networks: Interconnecting Networks, Network Properties and Applications, Scattering Parameters

Module 2: RF FILTER -Basic Resonator and Filter Configurations, Special Filter Realizations, Filter Implementation, Coupled Filter

Active RF Components and Modeling: Semiconductor Basics, RF Diodes, Bipolar-Junction Transistor, RF Field Effect Transistors, High Electron Mobility Transistors, Diode Models, Transistor Models

Module 3: MATCHING AND BIASING NETWORKS -Impedance Matching Using Discrete Components, Micro strip Line Matching Networks, Amplifier Classes of Operation and Biasing Networks

Module 4: RF TRANSISTOR AMPLIFIER -Characteristics of Amplifiers, Amplifier Power Relations, Stability Considerations, Constant Gain, Noise Figure Circles, Constant VSWR Circles, Broadband, High Power and Multistage Amplifiers.

Module 5: OSCILLATORS AND MIXERS -Basic Oscillator Model, High Frequency Oscillator Configuration, Basic Characteristics of Mixers.

Text/ Reference Books:

1. Reinhold Ludwig, Pavel Bretchko, "*RF Circuit Design*", 1st Indian Reprint, 2001, PearsonEducation Asia

2. B Razavi, "Design of Analog CMOS Integrated Circuits", Mc Graw Hill, 2000

M.Tech (Digital Communication) **Semester I**

MDC 114: DIGITAL IMAGE PROCESSING

3L-0T-0P-3C **M.M. 100**

MODULE 1: INTRODUCTION AND DIGITAL IMAGE FUNDAMENTALS - The origins of Digital Image Processing, Examples of Fields that Use Digital Image Processing, Fundamentals Steps in Image Processing, Elements of Digital Image Processing Systems, Image Sampling and Quantization, Some basic relationships like Neighbors, Connectivity, Distance Measures between pixels, Linear and Non Linear Operations.

Module 2: IMAGE ENHANCEMENT IN THE SPATIAL DOMAIN -Some basic Gray Level Transformations, Histogram Processing, Enhancement Using Arithmetic and Logic operations, Basics of Spatial Filters, Smoothening and Sharpening Spatial Filters, Combining Spatial Enhancement Methods. Image Enhancement in the Frequency Domain. Introduction to Fourier Transform and the frequency Domain, Smoothing andSharpening Frequency Domain Filters, Homomorphic Filtering. Image Restoration.

Module 3:A MODEL OF THE IMAGE DEGRADATION - Restoration Process, Noise Models, Restoration in the presence ofNoise Only Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Linear Position-Invariant Degradations, Estimation of Degradation Function, Inverse filtering, Wiener filtering, ConstrainedLeast Square Filtering, Geometric Mean Filter, and Geometric Transformations.

Module 4:COMPRESSION -Image Compression Coding, Interpixel and Psycho visual Redundancy, ImageCompression models, Elements of Information Theory, Error free comparison, Lossy compression, Imagecompression standards. Image Segmentation: Detection of Discontinuities, Edge linking and boundarydetection, Thresholding, Region Oriented Segmentation, Motion based segmentation.

Module 5: REPRESENTATION AND DESCRIPTION - Representation, Boundary Descriptors, Regional Descriptors, Use of Principal Componentsfor Description, Introduction to Morphology, Some basic Morphological Algorithms. Patterns and PatternClasses, Decision-Theoretic Methods, Structural Methods

Text/ Reference Books:

1. Rafael C. Conzalez & Richard E. Woods, “Digital Image Processing”, 2nd edition, Pearson Education, 2004.
2. A.K. Jain, “Fundamental of Digital Image Processing”, PHI, 2003.
3. Rosefield Kak, “Digital Picture Processing”, 1999.
4. W.K. Pratt, “Digital Image Processing”, 2000.

M.Tech (Digital Communication) **Semester I**

MVL 114: MEMS & MICRO SYSTEM TECHNOLOGY

3L-0T-0P-3C **MM 100**

Module 1: HISTORY OF MICRO-ELECTRO-MECHANICAL-SYSTEMS (MEMS) -Market for MEMS, MEMS Materials: Silicon and other materials , mechanical properties of materials- elasticity, stress and strain, Beams & Structures –cantilevers and bridges, point load & uniform loading, torsional, dynamic system; Piezoelectric & piezoresistive materials.

Module 2: MEMS FABRICATION PROCESSES - Review of IC fabrication process, Micromachining: Bulk micromachining (dry and wet etching), Surface micromachining (deposition, evaporation, sputtering, epitaxial growth), Deep RIE, Advanced Lithography, LIGA process; Multi User MEMS Process.

Module 3: MEMS DEVICES - MEMS Sensors and Actuators (Electrostatic, Electromagnetic, Thermal and Piezo), Bio-MEMS, Optical MEMS, Micro-fluidics MEMS;

Module 4: MEMS PACKAGING - MEMS packaging issues, die-level packaging, micro assembled caps & sealing.

Module 5: APPLICATION CASE STUDIES - MEMS Scanners and Retinal Scanning Displays (RSD), Grating Light Valve (GLV), Digital Micro mirror Devices (DMD), Optical switching, Capacitive Micromachined Ultrasonic Transducers (CMUT), Air bag system, Micro motors, Scanning Probe Microscopy.

Text/ Reference Books:

1. Foundation of MEMS, Second Edition 2011 – Chang Liu, Pearson.
2. Gregory T A, Kovacs Micromachined Transducers Sourcebook, WCB McGraw-Hill,1998.
3. Microsystems Design – by Stephen D. Senturia, Publishers: Kluwer Academic / Springer, 2nd Edition (2005), ISBN: 0792372468
4. Marc Madou, Fundamentals of Microfabrication, CRC Press, New York, 2002.

M.Tech (Digital Communication) **Semester I**

MVL 115: MICROWAVE INTEGRATED CIRCUITS

3L-0T-0P-3C **MM 100**

Module I: METHODS OF ANALYSIS IN MIC Introduction, Types of MICs and their technology, Propagating models, Analysis of MIC by conformal transformation, Numerical method, Hybrid mode analysis, Losses in micro strip, Introduction to slot line and coplanar waveguide.

Module II: COUPLERS AND LUMPED ELEMENTS Introduction to coupled micro strip, Even and odd mode analysis, Branch line couplers, Design and Fabrication of lumped elements for MICs, Comparison with distributed circuits.

Module III:PASSIVE AND ACTIVE DEVICES Ferrimagnetic substrates and inserts, Micro strip circulators, Phase shifters, Microwave transistors, Parametric diodes and amplifiers, PIN diodes, Transferred electron devices, Avalanche diodes, IMPATT, BARITT devices.

Module IV:MODULE-IV HIGH &LOW POWER CIRCUITS Introduction, Impedance transformers, Filters, High power circuits, Low power circuits, MICs in Radar and satellite

Module V: MODULE-V FABRICATION METHODS

Fabrication process of MMIC, Hybrid MICs, Dielectric substances, Thick film and thin film technology and materials, Testing methods, Encapsulation and mounting of devices.

Text/ Reference Books:

1. Gupta K.C and Amarjit Singh, "Microwave Integrated Circuits", John Wiley, New York, 1975.
2. Hoffman R.K "Hand Book of Microwave Integrated Ciruits", Artech House, Boston, 1987
3. "Microwave Engineering" by Prof. GSN Raju, IK International Publishers, 2007
4. "Microwave Engineering" by P.A. Rizzi, PHI, 1999.
5. "Microwave Engineering: Non-reciprocal active and passive circuits" by Joseph Helszajin, McGraw Hill, 1992.

M.Tech (Digital Communication) **Semester I**

MDC 103: ADVANCE DIGITAL SIGNAL PROCESSING LAB USING MAT LAB

0L-0T-2P-2C **MM 100**

1. Program to solve difference equations using conditional statements
2. Program for computing Linear and Circular Convolution using conditional statements
3. Program for up sampling and down sampling of a given sequence using conditional statements
4. Program for simulation of FFT using conditional statements and function calling
5. Program for designing Butterworth, Chebyshev type-I, Chebyshev type-II Analog and Digital Lowpass,Highpass, Band pass, Band stop filters using conditional statements and function calling
6. Program for designing Low pass, High pass, Band pass, Band stop filters using differentWindowing techniques using conditional statements and function calling.
7. Program for Estimating Power Spectral Density of two sinusoids plus Noise Periodogram Estimation
8. Program for computing the convolution by overlap-add method
9. Program for computing the convolution by overlap save method
10. Program for Simulation of DPCM using Function Calling
11. Program for the solution of Normal Equations using Levinson –Durbin algorithm
12. Program for verification of sampling theorem using conditional statements.

M.Tech (Digital Communication) **Semester I**

MDC 104: SEMINAR-I(REVIEW OF LITERATURE FOR RESEARCH)

0L-0T-4P-2C **MM 100**

Students will be grouped intwo to three; will have to decide final research area of thesis, download research papers from IEEE, Elsevier, Springer etc.This activity may also require visiting Learning Resources Centre of other institute of national importance.

Summarizing paper–Reading abstracts and finding ideas, conclusion, highlight of theirapproach, the drawbacks of the papers. Generalize results from a research paper to related research problems.

Comparing the approach -identify weaknesses and strengths in recent research articles in the subject. Practice sessions on how to read, analyzeand summarize research papers.Students in group will have to deliver presentation, prepare a report anda review paper based on analysis.

Internal continuous assessment marks are awarded based on the relevance of the topic, presentation skill, quality of the report and participation.

M.Tech (Digital Communication) **Semester II**

MDC 201 ADVANCEWIRELESS COMMUNICATION SYSTEMS

3L-1T-0P-3.5

Module 1: Cellular Concepts – System Design Fundamentals Cellular concept-channel reuse-handoff strategies-dynamic resource allocation-interference and system capacity-improving capacity and coverage of cellular systems. Second and third generation network standards: GSM standardization-architecture and function partitioning-GSM radio aspects-security aspects-protocol model-call flow sequences-evolution to 2.5G mobile radio networks. IS-95 service and radio aspects, key features of IS-95 CDMA systems-ECWDMA-UMTS physical layer-UMTS network architectur e-CDMA 2000 physical layer.

Module 2: Radio Wave Propagation Free space propagation model- basic propagation mec hanisms –reflection- ground reflection model-diffraction-scattering-practical link budget design -outdoor and indoor propagation models Small scale fading and multipath: Small scale multipath propagation-Impulse response model of a mulitpath channel –small scale multipath measurements-parameters of mobile multipath channels -–types of small scale fading.

Module 3: Capacity of Wireless Channels Capacity of Flat Fading Channel-Channel Distribution Information known – Channel Side Information at Receiver – Channel Side Information at Transmitter and Receiver – Capacity with Receiver diversity – Capacity comparisons – Capacity of Frequency Selective Fading channels. Performance of digital modulation over wireless cha
nnels: Error probability of BPSK, FSK, MSK, GMSK, QPSK, M-ary PSK, M-ary QAM and M-ary FSK on AWGN channels- Fading– Outage Probability– Average Probability of Error – Combined Outage and Average Error Probability.

Module 4: Diversity Realization of Independent Fading Paths – Receiver Diversity – Selection Combining – Threshold Combining – Maximal-Ratio Combining – Equal - Gain Combining – Transmitter Diversity – Channel known at Transmitter – Channel unknown at Transmitter – The Alamouti Scheme-basic concepts of RAKE receivers.

Module 5: Multiple Access Techniques Frequency division multiple access-time division multiple access-spread spectrum multiples access-space division multiple access- packet radio. MIMO and multicarrier modulation: Narrowband MIMO model-parallel decomposition of MIMO channel-MIMO channel capacity-MIMO diversity gain –data transmission using multiple carriers-Multicarrier modulation with overlapping subchannels-mitigation of subcarrier fading-basic concepts of OFDM.

Text/ Reference Books:

1. Andrea Goldsmith, "Wireless Communications," Cambridge University Press, 2005
2. T.S. Rappaport, "Wireless Communications," Pearson Education, 2003
3. Raj Pandya, "Mobile and Personal Communication Systems and Services," Prentice Hall of India, 2002
4. William C.Y. Lee, "Wireless and Cellular Telecommunications," Third edition, Mc. Graw Hill, 2006.

M.Tech (Digital Communication) **Semester II**

MDC 202ADVANCE OPTICAL COMMUNICATION SYSTEMS

3L-1T-0P-3.5C **MM 100**

Module I: FIBER OPTIC WAVES GUIDES: Light wave generation systems, system components, optical fibers, SI, GI, fibers, modes, Dispersion in fibers, limitations due to dispersion, Fiber loss, non-linear effects. Dispersion shifted and Dispersion flattened fibers.

Module II: OPTICAL TRANSMITTERS, RECEIVERS AND AMPLIFIERS Basic concepts, LED's structure, spectral distribution, semiconductor lasers, gain coefficients, modes, SLM and STM operation, Transmitter design, Receiver: PIN and APD design, noise sensitivity and degradation, Receiver amplifier design. Basic concepts of Semiconductor Optical amplifiers and EDFA operation. Coherent, homodyne and heterodyne keying formats, BER in synchronous and asynchronous receivers, Multichannel, WDM, multiple access networks, WDM components, TDM, Subcarrier and Code division multiplexing.

Module III: DISPERSION COMPENSATION

Limitations, Post- and Pre- compensation techniques, Equalizing filters, fiber based gratings, Broad band compensation, soliton communication system, fiber soliton, Soliton based communication system design, High capacity and WDM soliton system.

Module IV: SONET: frame format, overhead channels, payload pointer, Virtual tributaries, multiplexing hierarchy. SDH: Standards, frame structure and features.

Module V: INTRODUCTION TO OPTICAL NETWORKS

First and second generation optical networks: system network evaluation. SONET / SDH, MAN layered architecture broadcast and select networks MAC protocols, test beds, wavelength routing networks.

Text/ Reference Books:

1. Optical Fiber Communication by Gerd Keiser (TMH).
2. Optical Fiber Communication Principles & Practice by John M. Senior (PHI).
3. Optical Communication Systems by John Gowar (PHI).
4. Shinner "Optical Fiber Communication", Pearson.
5. Optical Fibre andLaser: Principles and Applications, De, Anuradha, New Age
6. Opto Electronics and Fibre Optics Communication, Sarkar, D.C,
7. Fiber Optics and Optoelectronics, Khare, Oxford
8. Optical Wdm Networks - Principles andPractice, Biswanath Mukherjee, Oxford
9. OpticalCommunication, Palais, Pearson
10. Optical Fiber Communication: Principles and Systems, Selvarajan, A, Tmh

M.Tech (Digital Communication) **Semester II**

MDC 203 INFORMATION THEORY & CODING

3L-0T-0P-3C **MM 100**

ModuleI: Basic Concepts of Information Theory: A measure of Uncertainty,Binary Sources, Measure of Information for two-dimensional discrete finiteprobability Scheme, Noise characteristics of channel, Basic relationship amongdifferent entropies, Measure of mutual information channel capacity, Capacityof channel with symmetric noise structure BSC and BEC.

Module II: Elements of Encoding: Purpose of encoding separable binary codes,Shannon Fano encoding. Noiseless coding. Theorem of decidability, MCMillen's Theorem. Average length of encoding massage, Shannon's Binaryencoding, Fundamental Theorem of discrete Noiseless coding, Huffman'sMinimum Redundancy codes.

Module III: Coding for Reliable Digital Transmission & Storage: Introduction, types ofcodes, Modulation and Demodulation, Maximum likelihood decoding, types ofcodes, Modulation and Demodulation, Maximum likelihood decoding, types of error, error control strategies.
Introduction to Algebra: Groups, Fields Binary field Arithmetic, Construction
of Galois field GF (2m), Basic Properties of Galois Field GF (2m), Vector Spacer,Matrices.

Module IV: Linear Block Codes: Introduction to Linear Block codes, Syndrome and Errordetection, Minimum distance of block code, Hamming Code.
Cyclic Codes: Description of Cyclic codes, Generator and parity check matrices ofcyclic codes, encoding of cyclic codes syndrome computation & error detectiondecoding of cyclic codes, Error trapping decoding of cyclic codes, Goley Codes.
BCH Codes: Description of codes, Decoding of BCH codes, Implementation ofGaloes Fields Arithmetic, Implementation of error connection.

Module V: Convolution Codes: Encoding of convolution codes, structural properties ofConvolution codes, distance properties of Conventional codes, Distance Properties ofConvolution codes, Maximum likelihood decoding of convolution codes.
Automatic Repeat Request Strategies: Stop and wait, Go back and selectiverepeat ARQ strategies, Hybrid ARQ Schemes.

Text/ Reference Books:

1. F.M Reza: Information Theory, Mc Graw Hill
2. ShuLin & J Costeib: Error Control Coding, PHI
3. Dass, Mullick & Chatterjee: Digital Communication, John Wiley, Ed. 1992
4. Anoop Singh Poonia, "Information Theory of Coding", Dhanpat Rai Publishing Company.
5. Information Theory And Network Coding, Raymond W, Springer

M.Tech (Digital Communication) **Semester II**

MDC 211 SATELLITE COMMUNICATION

3L-0T-0P-3C **MM 100**

Module I: ELEMENTS OF SATELLITE COMMUNICATION

Satellite Systems, Orbital description and Orbital mechanics of LEO, MEO and GSO, Placement of a Satellite in a GSO, Satellite – description of different Communication subsystems, Bandwidth allocation.

Module II: TRANSMISSION, MULTIPLEXING, MODULATION, MULTIPLE ACCESS AND CODING

Different modulation and Multiplexing Schemes, Multiple Access Techniques –FDMA, TDMA, CDMA, and DAMA, Coding Schemes, Satellite Packet Communications.

Module III: SATELLITE LINK DESIGN

Basic link analysis, Interference analysis, Rain induced attenuation and interference, Ionospheric characteristics, Link Design with and without frequency reuse.

Earth Space Propagation Effects: Atmospheric absorption, Rainfall Attenuation, Inospheric scintillation, Telemetry, Tracking and command of satellite.

Detection: QPSK offset QPSK and MSK, Coherent and non-coherent detection, Error rate performance.

Module IV: SATELLITE NAVIGATION AND GLOBAL POSITIONING SYSTEM

Radio and Satellite Navigation, GPS Position Location Principles, GPS Receivers and Codes, Satellite Signal Acquisition, GPS Receiver Operation and Differential GPS

Module V: Synchronization: Principal and techniques, Multiple Access Techniques, FDMA,SPADE system, TDMA system, Concept and configuration, system timing framesformat, SSMA Basu Principles, VSAT, Random Access, Space Communication, linkDesign description of operational in TELSAT and INSAT system.

Text/ Reference Books:

1. Timothy Prett and Charles W. Bostain, "Satellite Communication", John Willy and Sons.
2. Denis Roodi – "Satellite Communication", Mc Graw Hill.
3. William Stallings – "Wireless communication", Pearson
4. Tri T Ha, Digital Satellite Communication, Macmillan Publishing Company.

M.Tech (Digital Communication) **Semester II**

MDC 212ULTRA WIDEBAND COMMUNICATION SYSTEMS

3L-0T-0P-3C **MM 100**

Module I:UWB Signals And Systems With UWB Waveforms
Introduction – Power Spectral Density – Pulse Shape – Pulse Trains – Spectral Masks – Multipath – Penetration Characteristics – Spatial And Spectral Capacities – Speed Of Data Transmission – Gaussian Waveforms – Designing Waveforms For Specific Spectral Masks – Practical Constraints And Effects Of Imperfections.

Module II: Signal Processing Techniques for Uwb Systems and UWB Channel Modeling Effects of a Lossy Medium on A UWB Transmitted Signal – Time Domain Analysis – Frequency Domain Techniques – A Simplified Uwb Multipath Channel Model – Path Loss Model – Two-Ray UWB Propagation Model – Frequency Domain Autoregressive Model.

Module III: UWB Communications and Advanced UWB Pulse Generation
Uwb Modulation Methods – Pulse Trains – UWB Transmitter/Receiver – Multiple Access Techniques In UWB – Capacity Of Uwb Systems – Comparison Of UWB With Other Wideband Communication Systems –Interference And Coexistence Of UWB With Other Systems – Hermite Pulses – Orthogonal Prolate Spheroidal Wave Functions – Wavelet Packets In Uwb Psm – Applications Of UWB Communication Systems.

Module IV: UWB Antennas & Arrays, Position & Location with Uwb Signals
Antenna Fundamentals – Antenna Radiation For Uwb Signals – Conventional Antennas And Impulse Antennas For UWB Systems – Beamforming For UWBSignals – Radar UWB Array Systems – Wireless Positioning And Location – Gps Techniques – Positioning Techniques – Time Resolution Issues – UWB Positioning And Communications.

Module V: UWB Communication Standards and Advanced Topics In UWB Communication Systems UWB Standardization in Wireless Personal Area Networks – Ds-UWB Proposal – Mb-Ofdm UWB Proposal – Ieee Proposals For Uwb Channel Models – UWB Ad-Hoc And Sensor Networks – Mimo And Space-Time Coding For UWB Systems – Self Interference In High Data-Rate UWB Communications –Coexistence Of Ds-UWB With Wimax.

Text/ Reference Books:
1. M. Ghavami, L. B. Michael and R. Kohno, "Ultra Wideband Signals and Systems in Communication Engineering", 2nd Edition, John Wiley & Sons, Ny, Usa, 2007.
Reference Books
2. Jeffrey H. Reed, "An Introduction to Ultra Wideband Communication Systems", Prentice Hall Inc., Nj, Usa, 2005.

M.Tech (Digital Communication) **Semester II**

MDC 213PROBABILITY AND STOCHASTIC PROCESSES

3L-0T-0P-3C **MM 100**

Module 1: Random Variables and their Probability Distributions Random variables, Probability distribution function, Probability density function, Conditional probability, Statistical Independence, Bayes formula. Moments of random variables: Expected value and moments, Mean and variance of random variable, Coefficients of variation, Skewness and kurtosis, Moments, Covariance and Correlation coefficient, Mean and variance of sum and Product of two random variables. Conditional mean and variance, Application of conditional mean and variance.

Module 2: Discrete Random Variables and their Distributions Moment Generation Function, Characteristics Function, Cumulants, Probability generating function, Binomial Distribution, Negative Binomial Distribution, Hypergeometric distribution, Multinomial,
Poisson Distributions, Relationship between various Discrete-Type distributions

Module 3: Continuous Random Variables and their Distributions Normal, Log - Normal, Multivariate Normal, Gamma, Exponential, Chi-square, Weibull, Rayleigh distributions. Relationship between continuous distributions.

Module 4: Transformation of Random Variables Transformation of Single, Several Random Variables, Function of Random Variables, Sum, Differences, Product and Ratio of Two Random Variables, Transformation through characteristic Functions.
Module 5: Stochastic Processes Introduction- Classification of stochastic process, Stationary process (SSS and WSS) Stationary

Module 5: process, Ergodic Process, Independent increment Process, Markov Process, Counting Process, Narrow- Band Process, Normal Process, Wiener-Levy Process, Poisson, Bernoulli, Shot noise Process, Autocorrelation Function.

Text/ Reference Books:

1. Michel K. Ochi, "Applied Probability and Stochastic Processes," John Wiley & Sons, ISSN – 0271-6356, 2008.
2. Paboulis, A, "Probability, Random variables and Stochastic Processes," Mc Graw Hill. New york 1984.
3. Kishor S. Trivedi, "Probability and Statistics with Reliability, Queuing and Computer Science Application," John Wiley, 2002.

M.Tech (Digital Communication) **Semester II**

MDC 214NEURAL NETWORKS & FUZZY LOGIC

3L-0T-0P-3C **MM 100**

ModuleI: Introduction: Neural networks characteristics, History of development in neural networksprinciples, artificial neural net terminology, Model of a neuron, Topology.

Module II: Learning Methods & Neural network models: types of learning, Supervised, Unsupervised, Re-enforcement learning. Knowledge, representation and acquisition. Basic Hopfield model, Basic learning laws, Unsupervised learning, Competitive learning, K-means clusteringalgorithm, Kohonen's feature maps.

Module III: Artificial Neural Networks: Radial basis function neural networks, Basic learning laws inRBF nets, Recurrent back propagation. Introduction to counter propagation networks, CMACnetwork, and ART networks.

ModuleIV: Applications of neural nets: Applications such as pattern recognition, Pattern mapping, Associative memories, speech and decision-making..

Module V: Fuzzy Logic: Basic concepts of fuzzy logic, Fuzzy vs. Crisp set, Linguistic variables,Membership functions, Fuzzy sets & Operations of fuzzy sets, Fuzzy IF- THEN rules,Variable inference techniques, De-Fuzzification, Basic fuzzy inference algorithm, Fuzzysystem design, Antilock Breaking system (ABS), Industrial applications.

Text/ Reference Books:

1. B. Yegnanarayana, "Artificial Neural Networks"PHI
2. J.M. Zurada, "Introduction to artificial neural systems", Jaico Pub.
3. ROSS J.T , "Fuzzy logic with engineering application", TMH
4. Simon Haykin, "Neural Networks", PHI
5. Ahmad M.Ibrahim, "Introduction to applied Fuzzy Electronics",(PHI)
6. P.D. Wassermann, "Neural computing theory & practice", (ANZA PUB).

M.Tech (Digital Communication) **Semester II**

MDC 204ADVANCE COMMUNICATION LAB

0L-0T-4P-2C **MM 100**

Numerical Computing Environments–MATLAB or any other equivalent tool

1. Implementation of digital modulation schemes– BASK, BFSK, BPSK. Plot BER vs Eb/N0 .in AWGN channels.
2. Performance comparison of QPSK, DPSK, MSK & GMSK.
3. Communication over fading channels – Rayleigh fading & Rician fading channels.
4. Comparison of diversity combining techniques – SC, EGC & MRC.
5. Simulation of CDMA systems.
6. Implementation of Matched filter, Correlation receiver & Equalizer.
7. Gram Schmidt Orthogonalization of waveforms.
8. Carrier recovery and bit synchronization.
9. Implementation of multicarrier communication.
10. Plotting Eye pattern.
11. Constellation diagram of various digital modulation schemes.

Miniproject:

12. Miniproject in the area of advanced communication/signal processing
13. Determination of error probabilities for orthogonalsignaling using MATLAB employing (i) Hard Decision (ii) Soft decision decoding.
14. Routing and wavelength assignment algorithms for WDM Optical networks.
15. Comparison of Digital modulation schemes over AWGN and flat fading channels.

M.Tech (Digital Communication) **Semester II**

MDC 205 SEMINAR-II (REVIEW OF LITERATURE FOR RESEARCH)

0L-0T-4P-2C **MM 100**

Each student will separately now continue to download further the research papers in the area, analyze, and allocate individually, the set of papers.

Literature survey Overview -What is literature survey, Functions of literature survey, maintaining a notebook, developing a Bibliography.

Methods of data collection –Observation, survey, contact methods, experimental, determining sample design Searching for publications –Publication databases, search engines and patent databases, Find some/all of the references for a given paper, including those that are not on the web.

Internal continuous assessment marks are awarded based on the relevance of the topic, presentation skill, quality of the report and participation.

M.Tech (Digital Communication) **Semester II**

MGT 103 PROJECT FORMULATION & APPRISAL

3L- 0T-0P-3C **M.M.100**

Module 1 Introduction – project attributes; project life cycle; role of managers; Management – scheduling; Gantt charts; CPM; PERT; crashing; Generation of project ideas – resource allocation; environment analysis – PEST analysis, porter's model; analysis of strategic capabilities – value chain, BCG matrix, flexibility

Module 2 Appraisal methods in project scanning and selection – market appraisal; technical appraisal; environmental appraisal; evaluating intangibles, social appraisal – SCBA, UNIDO, LM, CSR.

Module 3 Total quality management: Introduction - Need for quality - Evolution of quality - Definition of quality -Basic concepts of TQM - Definition of TQM – TQM Framework -Contributions of Deming,TQM principles, The seven traditional tools of quality – New management tools – Six-sigma.

Module 4 **Financial Appraisal:** Time value of money; cost of capital – equity, debt, preference; weighted average cost; marginal and average cost; Capital budgeting – investment appraisal techniques; NPY; IRR; Payback period; replacement decisions; selection of exact discount factor – problems, inflation, taxation;

Module 5: **Risk Analysis** models – single probability analysis; sensitivity analysis; break even analysis; certainty equivalent; uncertainty analysis, simulation; decision tree model; risk and utility.

Recommended Books

1. Khatua Sitangshu. *Project Management and Appraisal*, Oxford University Press
2. Pandey, I.M. *Financial Management*. Vikas Publishing House
3. Prasanna, Chandra. *Financial Management*. Tata McGraw-Hill
4. Maheshwari, S .N. & Maheshwari, S. K. *Advanced Management Accounting Vol.1 & Vol.2*. Vikas Publishing House
5. Paresh Shah. *Management Accounting*. Oxford University Press

M.Tech (Digital Communication) **Semester III**

MDC 301: INTERNSHIP

0L-0T- (6Month) P+4C **MM 100**

As a part of the curriculum, the internship program forms an important component of education. It is an attempt to bridge the gap between an academic institution and the corporate world. The Program, which would be a simulation of real work environment, requires the students to undergo the rigor of professional environment for 180 days internship in relevant industry or recognized research organization. In the process, it provides an opportunity for the students to satisfy their inquisitiveness about the corporate world provides exposure to practicing professional skills as well as in research area and also helps them acquire social skills by being in constant interaction with the professionals of an organization. During internship, some of the students may be offered stipend and/or job offer by the company. This program benefits the student to understand what he/she has studied in the class room and what is being practiced in the industry.

Every student is required to undertake On-the-Job-Training (OJIT) in his/her domain area along with day-to-day functions of the company and may conduct his research work, both at the assistance and the execution level. This will help the student to gain a deeper understanding of the professional work, culture, organizational targets, delivering results, work pressure, etc. of an organization.

M.Tech (Digital Communication) **Semester III**

MDC 302 DISSERTATION PART- I

0L+0T+0P+8C **MM 100**

The project work can be a design project/experimental project and/or computer simulation project on any of the topics in Software ETAP/ MiPOWER / MATLAB / LABVIEW will be used. The project work is allotted individually on different topics. The students shall be encouraged to do their project work in the parent institute itself. If found essential, they may be permitted to continue their project outside the parent institute.Department will constitute an Evaluation Committee to review the project work. The Evaluation committee consists of at least three faculty members of which internal guide and another expert in the specified area of the project shall be two essential members.The student is required to undertake the master research project phase 1 during the third semester and the same is continued in the 4thsemester (Phase 2). Phase 1 consist of preliminary thesis work, two reviews of the work and the submission of preliminary report. First review would highlight the topic, objectives, methodology and expected results. Second review evaluates the progress of the work, preliminary report and scope of the work which is to be completed in the 4th semester. The Evaluation committee consists of at least three faculty members of which internal guide and another expert in the specified area of the project shall be two essential members. The technical paper is to be submitted along with the thesis. The final evaluation of the project will be external evaluation.

Internal and external Continuous assessment:

	Guide	Evaluation Committee	
First Review	**30**	**20**	**Total**
Second Review	**30**	**20**	
Total	**60**	**40**	100

M.Tech (Digital Communication) **Semester III**

MDC 303: SEMINAR-III (REVIEW OF LITERATURE)

0L+0T+4P+2C **MM 100**

Objective: To assess the debating capability of the student to present a technical topic. Also to impart training to students to face audience and present their ideas and thus creating in them self esteem and courage that are essential for engineers.

Individual students are required to choose a topic of their interest from Digital Communication Systems related topics preferably from outside the M.Tech syllabus and give a seminar on that topic about 30 minutes. A committee consisting of at least three faculty members (preferably specialized in Digital Communication Systems) shall assess the presentation of the seminar and award marks to the students. Each student shall submit two copies of a write up of his/her seminar topic. One copy shall be returned to the student after duly certifying it by the chairman of the assessing committee and the other will be kept in the departmental library. Internal continuous assessment marks are awarded based on the relevance of the topic, presentation skill, quality of the report and participation.

M. Tech (Digital Communication) **Semester IV**

MDC 401 DISSERTATION PART- II

0L+0T+P+16C **MM 100**

Objective: To improve the professional competency and research aptitude by touching the areas which otherwise not covered by theory or laboratory classes. The project work aims to develop the work practice in students to apply theoretical and practical tools/techniques to solve real life problems related to industry and current research.

Master Research project phase II is a continuation of project phase I started in the third semester. There would be two reviews in the fourth semester, first in the middle of the semester and the second at the end of the semester. First review is to evaluate the progress of the work, presentation and discussion. Second review would be a pre-submission presentation before the evaluation committee to assess the quality and quantum of the work done. This would be a pre qualifying exercise for the students for getting approval by the departmental committee for the submission of the thesis. At least one technical paper is to be prepared for possible publication in journal or conferences. The technical paper is to be submitted along with the thesis. The final evaluation of the project will be external evaluation.