JECRC™
UNIVERSITY
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School of Engineering and Technology

Course Structure and Syllabus

M. Tech.

Communication Systems

Academic Programs

July, 2017

JECRC University

Faculty of Engineering & Technology

M.Tech. in Communication Systems

Teaching Scheme

Semester I

Subject Code	***Subject***	***Contact Hours L-T-P***	***Credits***	
MEE001A	Information Theory & Coding	3-1-0	4	C
MEE002A	Antenna Theory & Technologies	3-1-0	4	C
MEE003A	Digital Communications Techniques	3-1-0	4	C
MEE004A	Advanced Optical Communications Systems	4-0-0	4	C
MEE005A	Communications Lab –I	0-0-2	2	C
MEE006A	Communications Lab –II	0-0-2	2	C
MEE069A	Seminar	0-0-2	2	C
	Total	**13-3-6**	22	

Semester II

Subject Code	***Subject***	***Contact Hours L-T-P***	***Credits***	
MEE007A	Wireless Sensor Networks	3-1-0	4	C
MEE008A	Digital Image Processing	3-1-0	4	C
MEE009A	Advanced Digital Signal Processing	4-0-0	4	C
MES001A	Research Methodology & Technical Communication	3-0-0	3	C
MEE010A	Advanced Digital Signal Processing Lab	0-0-2	2	C
MEE011A	Advanced Image Processing Lab	0-0-2	2	C
MEE070A	Seminar	0-0-2	2	C
MES002A	Quantitative Techniques & Computer Applications Lab	0-0-1	1	C
	Total	**13-2-7**	22	

Semester III

Subject Code	*Subject*		*Contact Hour L-T-P*	*Credits*	
MEE012A	Switching in Communication Systems	Elective-I	4-0-0	4	S
MEE013A	Microwave Devices and Circuits				
MEE014A	Electromagnetic Interference, Compatibility				
MEE015A	Wireless and Mobile Ad-hoc Networks	Elective-II	4-0-0	4	S
MEE016A	RF Systems & Design				
MEE056A	Data Compression Techniques				
MEE017A	Advance Artificial Neural Networks	Elective–III	4-0-0	4	S
MEE018A	Satellite Communications				
MEE019A	Mathematics for Communication Systems				
MEE020A	Nonlinear Fiber Optics Communication	Elective–IV	4-0-0	4	S
MEE021A	Advance Mobile Communications				
MEE066A	Nanotechnology				
MEE067A	Dissertation Part – I		12	12	C
	Total		**28-0-0**	**28**	

Semester IV

Subject Code	*Subject*	*Contact Hours L-T-P*	*Credits*
MEE068A	Dissertation Part – II	0-0-0	28
	Total	**0-0-0**	**28**

JECRC University

Faculty of Engineering & Technology **Hours: 48**

***M.Tech. in Communication Systems Semester* - I**

Contact Hours (L-T-P): 3-1-0

Information Theory & Coding
(MEE001A)

Course Objectives:

1. *To impart the basic knowledge of Information Theory & Coding.*
2. *To understand the different kind of codes and various coding techniques used in communication system.*
3. *To find the different entropies, channel capacity & rate of information.*

Unit I: Introduction to detection and estimation problems in communications. Binary hypothesis testing: Bayes, Neyman -Pearson, maximum likelihood, MAP and minimum probability of error criteria; Bayes, ML and MAP estimation.

Unit II: Information, entropy, source coding theorem, Markov sources; Channel capacity theorems for discrete and continuous ensembles; Introduction to rate distortion function.

Unit III: Measures of Information, Information contents of discrete sources, the entropy function, Communication channel .Models, Source coding: Prefix codes, Block codes and Tree codes for data compaction,

Unit IV: Discrete-time Channels and their capacity, the Random Coding Band, Block Codes and tree for data transmission. Algebraic codes; Hamming, BCH, Reed-Solomon and Reed-Muller Codes.

Unit V: Algebraic Geometric Codes: Goppa codes and Codes over elliptic curves, signaling with and without bandwidth constraint, combined coding and Modulation: Trellis Coded. Modulation (TCM, One and two dimensional modulations for TCM, Multidimensional TCM, Lattice Codes.

Textbooks:

1. Papoulis, A. and Pillai, S.U., "Probability, Random Variables and Stochastic Processes",Tata McGraw-Hill.
2. Cover, T.M. and Thomas, J.A., "Elements of Information Theory", 2nd Ed., Wiley Interscience.
3. Van Trees, H.L., "Detection, Estimation and Modulation Theory", Part I, Wiley Interscience.
4. Bose, R., "Information Theory, Coding and Cryptography", Tata McGraw-Hill.

Reference books

1. Sayood, K., "Data Compression", Harcourt India. 2000
2. Lafrance, P., "Fundamental Concepts in Communication", Prentice-Hall of India.
3. Lin, S. and Costello Jr., D.J., "Error Control Coding", 2nd Ed., Pearson Prentice-Hall.
4. Blahut, R.E., "Algebraic Codes for Data Transmission", 2nd Ed. Cambridge University Press.
5. Vucetic, B. and Yuan, J., "Turbo Codes: Principles and Applications", Springer.

JECRC University
Faculty of Engineering & Technology **Hours: 48**
***M.Tech. in Communication Systems Semester* - I**
Contact Hours (L-T-P): 3-1-0

Antenna Theory & Technologies
(MEE002A)

Course Objectives:

1. *Introduction of fundamental antenna parameters.*
2. *To introduce the basic concepts of radiation phenomenon.*
3. *Study of various existing antennas for the better understanding of their use for futuristic ones.*
4. *Analysis and design of antennas depending on need and application.*
5. *To be able to pick a particular class of antenna for given specifications.*

Unit I: Review of the theory of electromagnetic radiation: Radiation mechanism-overview , near and far field regions, electromagnetic fundamentals, solution of Maxwell equations for radiation problem, ideal dipole, Directivity and Gain, Antenna impedance, radiation efficiency, antenna polarization.

Unit II: Introduction to various antenna types: Wire, loop and helix antenna, analysis using assumed current distribution, aperture antenna, technique for evaluating gain, types of reflector antenna , slot antenna, horn antenna.

Unit III: Broad-band Antenna: Linear arrays, Broadband antennas, travelling wave antenna, helical antenna, biconical antenna, spiral antenna and lock periodic antenna.

Unit IV: Resonant Antenna: Wire and patches, Yagi-Uda antenna, Microstrip antenna, array factor, pattern multiplication, mutual coupling, phased array, feeding techniques.

Unit V: Recent advancement in Antenna Technologies : Smart antenna, concepts and benefits of smart antenna, fixed weight beam-forming, adaptive beam-forming.

Textbooks:

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

Reference books:

1. Antennas And Wave Propagation,G. S. N. Raju , Pearson
2. Antennas And Wave Propagation,A.R. Harish, M. Sachidananda, Oxford
3. Antenna Handbook: Antenna Theory. T. Lo, S. W. Lee, Springer

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***M.Tech. in Communication Systems* – Semester I**
Contact Hours (L-T-P): 3-1-0

Digital Communication Techniques
(MEE003A)

Course Objectives:
1. Introduction of all the real time signals are analog,
2. Conversion of real time signal in digitized form, make it ready for transmission and again converting it in original signal is covered in this subject.
3. Study of speed of transmission, Error control techniques, bandwidth utilization,
4. limits of resources are different aspects we study.

Unit I: Block diagram and sub-system description of a digital communication system. Sampling of low-pass and band-pass signals, analysis of instantaneous, natural and flat-top sampling, signal reconstruction; PAM and bandwidth considerations.

Unit II: PCM, signal to quantization noise ratio analysis of linear and non-linear quantizes; Line codes and bandwidth considerations; PCM - TDM hierarchies, frame structures, frame synchronization and bit stuffing .Quantization noise analysis of DM and ADM; DPCM and ADPCM; Low bit rate coding of speech and video signals.

Unit III: Baseband transmission, matched filter, performance in additive Gaussian noise; Inter symbol interference (ISI), Nyquist criterion for zero ISI, sinusoidal roll-off filtering, correlative coding, equalizers and adaptive equalizers; Digital subscriber lines.

Unit IV: Geometric representation of signals, generations, detection and probability of error analysis of OOK, BPSK, coherent and non-coherent FSK, QPSK and DPSK; QAM, MSK and multicarrier modulation; Comparison of bandwidth and bit rate of digital modulation schemes. Maximum likelihood decoding; Correlation receiver, equivalence with matched filter.

Unit V: Recent advancement in Digital Communication.

Textbooks:

1. Haykin, S., "Communication Systems", 4th Ed., John Wiley & Sons.
2. Lathi, B.P. and Ding, Z., "Modern Digital and Analog Communication Systems", Intl. 4th Ed., Oxford University Press.

Reference books:

1. Roden, M.S., "Analog and Digital Communication Systems", 5th Ed., Discovery Press.
2. Sklar, B., and Ray, P.K., "Digital Communication: Fundamentals and Applications", 2nd Ed., Dorling Kindersley (India).
3. Roddy, D., and Coolen, J., "Electronic Communication",4th Ed., Dorling Kindersley (India).

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***M.Tech. in Communication Systems* – Semester I**
Contact Hours (L-T-P): 4-0-0

Advanced Optical Communications Systems
(MEE004A)

Course Objectives:

1. *To introduce the concept of light propagation through optical fiber.*
2. *To provide the knowledge of various optical sources, couplers, photo detectors, optical fiber sensors and multiplexing techniques.*
3. *To equip the knowledge of splicing, coupling between fibers.*
4. *To develop the fiber optic links.*
5. *To study the fundamentals of fiber optics and applications.*

Unit I: Optical fibers: review of fundamentals, Signal distortion and attenuation, Intermodal and intramodal dispersion, dispersion flattened and dispersion compensated fibers, Profile dispersion, and study of PMD.

Unit II: Laser diode and photodiode, Photo detector noise analysis, Analog and Digital communication link design. WDM, DWDM, optical couplers.

Unit III: Mach-Zehnder interferometer multiplexer, optical add/drop multiplexers, isolators, circulators, optical filters, tunable sources and tunable filters, arrayed waveguide grating, diffraction grating, optical amplifiers, optical integrated circuits. Characterization of optical fibers, OTDR

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

Unit V: Optical switching, WDM networks, Classification of optical sensors. Intensity modulated, phase modulated and spectrally modulated sensors.

Textbooks:

1. Optical Fiber Communications, Keiser, Gerd, TMH
2. Optical Communication System, Johan Gowar, Phi

Reference books:

1. Optical Fiber Communication: Principles And Practice,: John M Senior, Pearson
2. Optical Fiber Communication: Principles and Systems, Selvarajan, A, TMH
3. Fiber Optics and Optoelectronics, Khare, Oxford

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Contact Hours per week: 2 hrs

Communication Systems Lab- I
(MEE005A)

List of Experiments

Tools : Numerical Computing Environments –MATLAB or any other equivalent tool.

S. No.	Experiment
1.	Implementation of digital modulation schemes – BASK, BFSK. Plot BER vs E_b / N_0 in AWGN channels.
2.	Implementation of digital modulation schemes – BPSK. Plot BER vs E_b / N_0 in AWGN channels.
3.	Performance comparison of QPSK & DPSK.
4.	Performance comparison of MSK & GMSK.
5.	Communication over fading channels – Rayleigh fading channels.
6.	Communication over fading channels – Rician fading channels.
7.	Comparison of diversity combining techniques – SC, EGC & MRC.
8.	Simulation of CDMA systems.
9.	Implementation of Matched filter, Correlation receiver.
10.	Implementation of Matched filter, Equalizer.
11.	Gram Schmidt Orthogonalization of waveforms.
12.	Carrier recovery and bit synchronization.
13.	Implementation of multicarrier communication.
14.	Plotting Eye pattern.
15.	Constellation diagram of various digital modulation schemes.

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Communication Systems Lab- II
(MEE006A)

List of Experiments

Tools : Numerical Computing Environments – IE3D and Optiwave.

1. To study different types of antenna (Wire antenna, Micro strip antenna, array antenna, reflector antenna, lens antenna) and antenna parameters like directivity, gain.
2. To study the phenomenon of linear, circular and elliptical Polarization.
3. Design, Simulate and Analyze the VSWR, reflection co-efficient of a Monopole and Dipole Antennas using the HFSS/IE3D.
4. Design, simulate, and analyze the VSWR, reflection co-efficient of a Array Antenna using HFSS/IE3D.
5. Design, simulate, and analyze the VSWR, reflection co-efficient of a probe feed Waveguide Horn Antenna using HFSS/IE3D.
6. Design, simulate, and analyze Magic-T and its behavior using HFSS/IE3D.
7. Design, simulate, and analyze shielded cylindrical dielectric resonator using HFSS/IE3D.
8. Design, simulate, and analyze the frequency response of a band pass filter using HFSS/IE3D.
9. Write a program in Matlab to plot the radiation pattern of Dipole and Mono pole antenna.
10. To perform the numerical evaluation of directivity for half wave dipole.
11. Write a program in Matlab to plot radiation pattern of Loop antenna.
12. Write a program in Matlab to plot radiation pattern of linear array antenna.
13. Write a program in Matlab to design radiation pattern of Micro strip Antenna.
14. Write a program in Matlab to plot radiation pattern for Broad-side antenna array.
15. Write a program in Matlab to plot 3D radiation pattern for End fire antenna array.

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Contact Hours (L-T-P): 3-1-0

Wireless Sensor Networks
(MEE007A)

Course Objectives:

1. *Develop an understanding of architect sensor networks for various application setups.*
2. *To get students acquainted with suitable medium access protocols and radio hardware.*

Unit I: Challenges for Wireless Sensor Networks-Characteristics requirements-required mechanisms, Difference between mobile ad-hoc and sensor networks, Applications of sensor networks-Enabling Technologies for Wireless Sensor Networks.

Unit II: Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes , Operating Systems and Execution Environments, Network Architecture - Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts.

Unit III: Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC , The Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management,

Unit IV: Assignment of MAC Addresses, Routing Protocols- Energy-Efficient Routing, Geographic Routing. Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control.

Unit V: Operating Systems for Wireless Sensor Networks, Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators, State-centric programming.

Textbooks:

1. Holger Karl & Andreas Willig, “Protocols And Architectures for Wireless Sensor Networks", John Wiley, 2005.
2. Feng Zhao & Leonidas J. Guibas, “Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.

Reference books:

1. Kazem Sohraby, Daniel Minoli, & Taieb Znati, “Wireless Sensor Networks-Technology, Protocols, And Applications”, John Wiley, 2007.
2. Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003.
3. Bhaskar Krishnamachari, ”Networking Wireless Sensors”, Cambridge Press,2005.
4. Mohammad Ilyas And Imad Mahgaob,”Handbook Of Sensor Networks: Compact Wireless And Wired Sensing Systems”, CRC Press, 2005.
5. Wayne Tomasi, “Introduction to Data Communication and Networking”, Pearson ducation, 2007.

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Contact Hours (L-T-P): 3-1-0

Digital Image Processing
(MEE008A)

Course Objectives:

1. *Cover the basic theory and algorithms that are widely used in digital image processing.*
2. *Expose students to current technologies and issues that are specific to image processing.*
3. *Develop hands-on experience in using computers to process images.*
4. *Develop critical thinking about shortcomings of the state of the art in image processing*

Unit I: Fundamentals of Image Processing: Introduction – fundamental steps in digital image processing – image sensing and acquisition – sampling and quantization – pixel relationships – color fundamentals and models, file formats, image operations – arithmetic, geometric and morphological -sampling and quantization.

Unit II: Image enhancement: Spatial domain - gray level transformations – histogram processing – basics of spatial filtering – smoothing and sharpening spatial filters - frequency domain - filtering in frequency domain – discrete fourier transform, fast fourier transform – smoothing and sharpening filters – homomorphic filtering.

Unit III: Image segmentation and feature analysis: Detection of discontinuities– edge operators– edge linking and boundary detection –threshold– region based segmentation – morphological watersheds– motion segmentation, feature analysis and extraction – spatial techniques.

Unit IV: Multi resolution analysis and compressions: Multi resolution analysis: image pyramids – multi resolution expansion – wavelet transforms in one dimension - image compression: fundamentals – models – elements of information theory – error free compression – lossy compression – image compression standards

Unit V: Applications of image processing: Image classification – image recognition – image understanding – video motion analysis– image fusion – steganography – digital compositing – mosaics – color image processing – string matching – syntactic recognition of strings.

Textbooks:

1. Jain. K, Fundamentals of Digital Image Processing, Pearson Education, 2003.

Reference books:

1. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, 2nd edition, Pearson Education, 2003.
2. Milan Sonka et.al Image Processing, Analysis and Machine Vision, 2nd edition, Thomson Learning, 2001.

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Advanced Digital Signal Processing
(MEE009A)

Course Objective:

1. *Analysis of signal processing methods and tools*
2. *Filter design method.*
2. *Method of leading algorithms for various applications.*

Unit I: Digital Signal Processing: Digital signal processing - sampling of analog signals, selection of sample frequency,signal-processing systems, frequency response, transfer functions, signal flow graphs, filter structures, adaptive digital signal processing algorithms, discrete fourier transform - the discrete fourier transform, fast fourier transform - fast fourier transform algorithm, image coding, discrete cosine transforms.

Unit II: Digital Filters And Finite Word Length effects: Finite impulse response filters – finite impulse response filter structures, finite impulse response chips, infinite impulse response filters, specifications of infinite impulse response filters, mapping of analog transfer functions, mapping of analog filter structures**.**

Unit III: Multirate DSP: Decimation by a factor D, interpolation by a factor i, filter design and implementation for sampling rate conversion, multistage implementation of sampling rate conversion - sampling rate conversion by an arbitrary factor – applications of multirate signal processing digital filter banks - quadrature mirror filter bank.

Unit IV: DSP Processors and dsp applications: General purpose Digital Signal Processors: Texas Instruments TMS320 family Motorola DSP 56333 family – analog devices ADSP 2100 family – Instruction set of TMS320C50 – simple programs. FFT Spectrum Analyser – musical sound processing. Power System applications, Image Processing Applications.

Unit V: Arithmetic units and integrated circuit design: Conventional number system, redundant number system, residue number system - bit-parallel and bit-serial arithmetic, basic shift accumulator, reducing the memory size, complex multipliers, improved shift - accumulator - layout of very large scale integrated circuits, fast fourier transform processor, discrete cosine transform processor and interpolator as case studies.

Textbooks:

1. Monson H. Hayes, Statistical Digital Signal Processing and modeling, John Wiley and sons, 2003.
2. Sajit K. Mitra, 'Digital Signal Processing – A Computer Based Approach', Tata McGraw Hill Publishing Company Ltd., New Delhi, 1998

Reference books:

1. John G. Proakis and Dimitris G. Manolakis, 'Digital Signal Processing, Algorithms and Applications'. PHI, New Delhi, 1995
2. Lars Wanhammer, DSP Integrated Circuits, Academic press, NewYork, 2002.
3. Oppenheim. A. V, Discrete-time Signal Processing Pearson education, 2000.
4. Emmanuel C. Ifeachor, Barrie W. Jervis, Digital signal processing – A practical approach, 2nd edition, Pearson edition, Asia.

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Contact Hours (L-T-P): 4-0-0 **hours- 48**

Research Methodology & Technical Communication
(MES001A)

Course Objective:

1. *To gain insights into how scientific research is conducted.*
2. *To help in critical review of literature and assessing the research trends, quality and extension potential of research and equip students to undertake research.*
3. *To learn and understand the basic statistics involved in data presentation.*
4. *To identify the influencing factor or determinants of research parameters.*

UNIT 1:	**Research Methodology-Introduction:** Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India
UNIT 2:	**Defining the Research Problem:** What is a Research Problem?, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem **Research Design:** Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs
UNIT 3:	**Sampling Design:** Census and Sample Survey, Implications of a Sample Design, Steps in Sampling Design, Criteria of Selecting a Sampling Procedure, Characteristics of a Good Sample Design, Different Types of Sample Designs, How to Select a Random Sample?, Random Sample from an Infinite Universe, Complex Random Sampling Designs **Measurement and Scaling Techniques:** Measurement in Research, Measurement Scales, Sources of Error in Measurement, Tests of Sound Measurement, Technique of Developing Measurement Tools, Scaling, Meaning of Scaling, Scale Classification Bases, Important Scaling Techniques, Scale Construction Techniques

UNIT 4:	**Methods of Data Collection:** Collection of Primary Data, Observation Method, Interview Method, Collection of Data through Questionnaires, Collection of Data through Schedules, Difference between Questionnaires and Schedules, Some Other Methods of Data Collection, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method **Processing and Analysis of Data:** Processing Operations, Some Problems in Processing, Elements/Types of Analysis, Statistics in Research, Measures of Central Tendency, Measures of Dispersion, Measures of Asymmetry (Skewness), Measures of Relationship, Simple Regression Analysis, Multiple Correlation and Regression, Partial Correlation, Association in Case of Attributes
UNIT 5:	**Sampling Fundamentals:** Need for Sampling, Some Fundamental Definitions, Important Sampling Distributions, Central Limit Theorem, Sampling Theory, Sandler's A-test, Concept of Standard Error, Estimation, Estimating the Population Mean (μ), Estimating Population Proportion, Sample Size and its Determination, Determination of Sample Size through the Approach Based on Precision Rate and Confidence Level, Determination of Sample Size through the Approach Based on Bayesian Statics

Outcome:

At the end of the course, the student should be able to:

1. Gain insights into how scientific research is conducted.
2. Help in critical review of literature and assessing the research trends, quality and extension potential of research and equip students to undertake research.
3. Learn and understand the basic statistics involved in data presentation.
4. Identify the influencing factor or determinants of research parameters.

Text Book: Research Methodology – Methods & Techniques by C. R. Kothari, New age International Publisher

Notes for Examiner / Paper Setter:

1. 1st Question shall be of 20 marks and compulsory for all. It may consist of Multiple Choice Questions (MCQ) of one mark each and short answer questions of one or two marks.
2. One question of 10 marks shall be set from each Unit which may have parts including numericals. Paper setter may give internal choice, if required.
3. Students will be required to attempt all questions compulsorily.

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Contact Hours per week: 2 hrs

Advance Digital Signal Processing Lab

(MEE010A)

1. TO write a MATLAB/SCILAB program to common continues time signals and discrete time signal-

   Impulse, step, ramp and sinusoidal sequences.
2. TO write a MATLAB/ SCILAB program to find the impulse response of a system defined by a difference equation.
3. Generate a Gaussian number with mean=20 and variance=40. Also plot the PDF of generated number.
4. Generate Gaussian number with mean=0 and variance=1.Plot the generated number and calculate 3rd moment i.e. skewness using-

$$\text{Skew}(X_1, X_2, ..., X_n) = \frac{1}{N}\sum_{j=0}^{1}\left[\frac{Xj - mean}{\sigma}\right]\text{^}3$$

5. Plot the following Expressions of H(z) in Z plane.

   1. $\dfrac{2Z^{-1} + 9Z^{-2} + 18^{-3} + 48^{-4}}{3Z^{-1} + 3Z^{-2} + 15Z^{-3} - 12Z^{-4}}$
   2. $\dfrac{5Z^{-1} - 9Z^{-2} + 16Z^{-3} - 14Z^{-4}}{Z^{-1} - 2Z^{-2} + 10Z^{-3} - 4Z^{-4} + 64Z^{-5}}$
6. Determine the factor form of following Z transform

   1. $G(z) = \dfrac{2Z^4 + 7Z^3 + 48Z^2 + 56Z}{32Z^4 + 3Z^3 - 15Z^2 + 18Z - 12}$
   2. $G(z) = \dfrac{4Z^4 - 9Z^3 + 15Z^2 - 7}{Z^4 - 2Z^3 + 10Z^2 + 6Z + 64}$
7. TO write a MATLAB/SCILAB program to compute linear convolution and de-convolution of two given sequences.
8. TO write a MATLAB/SCILAB program to compute circular convolution of two given sequences.

9. TO write a MATLAB/SCILAB program to find the DFT and IDFT of a sequence.

10. TO write a MATLAB/SCILAB program to find the linear convolution of two sequence using DFT method.

11. TO write a MATLAB/SCILAB program to find the circular convolution of two sequence using DFT method.

12. Generate Gaussian distributed numbers and uniformly distributed numbers and find the correlation between them.

13. TO write a MATLAB/SCILAB program to plot magnitude response and phase response of digital Butter worth

a) Low pass filter

b) High pass filter

c) Band pass filter

d) Band stop filter

14. TO write a MATLAB/SCILAB program to plot magnitude response and phase response of digital Chebyshev type-1

a) Low pass filter

b) High pass filter

c) Band pass filter

d) Band stop filter

15. TO write a MATLAB/SCILAB program to plot magnitude response and phase response of digital Chebyshev type-2

a) Low pass filter

b) High pass filter

c) Band pass filter

d) Band stop filter

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Advanced Image processing lab
(MEE011A)

1. Write a Program on MATLAB/SCILAB software for Zooming and Shrinking of Image.

2. Write a Program on MATLAB/SCILAB software for Gray Level Transformation.

3. Write a Program on MATLAB/SCILAB software for Histogram Processing and Equalization.

4. Write a Program on MATLAB/SCILAB software for Spatial Domain Filtering (LPF).

5. Write a Program on MATLAB/SCILAB software for Spatial Domain Filtering (HPF).

6. Write a Program on MATLAB/SCILAB software for Frequency Domain Filtering for Low Pass.

7. Write a Program on MATLAB/SCILAB software for Frequency Domain Filtering for High Pass.

8. Write a Program on MATLAB/SCILAB software for Morphological Image Processing.

9. Write a Program on MATLAB/SCILAB software for Line Detection.

10. Write a Program on MATLAB/SCILAB software for Edge Detection.

11. Write a Program on MATLAB/SCILAB software for JPEG Compression.

12. Write a Program on MATLAB/SCILAB software for Image Restoration.

13. Write a Program on MATLAB/SCILAB software for conversion between color spaces.

14. Write a Program on MATLAB/SCILAB software for 2-D DFT and DCT.

15. Write a Program on MATLAB/SCILAB software to to change the transform from DCT to DFT in JPEG files.

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Quantitative Techniques & Computer Applications Lab
(MES002A)

Various Methods and Uses of Advance Excel Formulas: Vlookup, Hlookup, Sumif, Sumifs, Sumproduct, Dsum, Countif, Countifs, If, Iferror, Iserror, Isna, Isnumber, Isnontext, Isblank, Istext, Getpivotdata, Dcount, Dcounta, Or, And, Search, Index, Match Etc

Various Methods and Uses of IF Conditions: When should use the "IF" Conditions?, Creation of Multiple IF Conditions in One Cell,Use the IF Conditions with the Other Advance Functions, How to use nested IF statements in Excel with AND, OR Functions

ADVANCED EXCEL OPTIONS : Various Methods of Filter and Advance Filter options, Creating and Updating Subtotals, Various Methods of Text to Column options, Uses of Data Grouping and Consolidation options, Uses of Goal Seek and Scenarios Manager, Various Method of Sorting Data, Creating, Formatting and Modifying Chart, Data Validation, Creating drop down lists using different data sources, Linking Workbooks and Uses of Edit Link options, Excel Options, Customizing the Quick Access Tool Bar, Formula Auditing features and Trace formula error

Pivot Tables & Charts : Various Methods and Options of Pivot Table, Using the Pivot Table Wizard, Changing the Pivot Table Layout, Subtotal and Grand total Options, Formatting, Grouping Items, Inserting Calculated Fields, Pivot Table Options, Calculation in Pivot Table, Display and Hide Data in Field, Select, Move & Clear Pivot Data, Creating and Modifying Pivot Chart

Advance Use of Function: Mixing Function to get Various MIS Outputs, Creating Data Table, Advance Data Validation, Using conditional formatting with Formulas and Function, Using Name Manager, Array Formulas

Importing Data from External Sources: Macros, What is a Macro?, Creating Excel Macro, Running Macros and Editing, Automating Tasks with Macro

(A) SPSS Package

An Overview of SPSS : Mouse and keyboard processing, frequently –used dialog boxes, Editing output, Printing results, Creating and editing a data file

Managing Data: Listing cases, replacing missing values, computing new variables, recording variables, exploring data ,selecting cases, sorting cases, merging files

Graphs: Creating and editing graphs and charts

Frequencies: Frequencies, bar charts, histograms, percentiles

Descriptive Statistics: measures of central tendency, variability, deviation from normality, size and stability, Cross Tabulation and chi-square analyses, The means Procedure

Bivariate Correlation: Bivariate Correlation, Partial, Correlations and the correlation matrix

The T-test procedure: Independent –samples, paired samples, and one sample tests

The one way ANOVA procedure: One way analysis of variance

General Linear model: Two –way analysis of variance

General Linear model: three –way analysis of variance and the influence of covariates, Simple Linear Regression, Multiple regression analysis, Multidimensional scaling, Factor analysis, Cluster analysis

Text Book: Research Methodology – Methods & Techniques by C. R. Kothari, New age International Publisher

Notes for Examiner / Paper Setter:

1. 1st Question shall be of 16 marks and compulsory for all. It may consist of Multiple Choice Questions (MCQ) of one mark each and short answer questions of one or two marks.
2. One question of 14 marks shall be set from each Unit which may have parts including numericals. Paper setter may give internal choice, if required.
3. Students will be required to attempt all questions compulsorily.

JECRC University
Faculty of Engineering & Technology **Hours:48**
***M.Tech. in Communication Systems* – Semester III**
Contact Hours (L-T-P): 4-0-0

Switching in Communication Systems
(MEE012A)

Course objective:

1. *Mechanism of wired as wellwireless switching networks.*
2. *Issues related to wired as well wireless packet switching networks.*

Unit I Introduction: Basic line circuits in telephony and telegraphy; long-haul communication circuits; principles of circuits switching, & signaling: schemes, CCS7; Review of transmission systems - cable, radio, microwave optical, satellite, troposcatter.

Unit II Review: Strowger's and crossbar switches; space-time-and space time division switching; single stage and multi-stage switching network and example, principles of large scale switch design.

Unit III Properties of connecting networks: mathematical models of network states, rearrange ability: wide-sense and strict sense non-blocking criteria, slepian- Duguid Theorem, Paull's Theorem.

Unit IV Traffic Engineering and Teletraffic Theory: Markov processes representing traffic, calculation of blocking probability, stationary probability measures for ergodic Markov processes, combinatorial interpretation, and calculation of blocking probability.

Unit V Switching Network Control and management: data networks and protocols, ISDN, Message Handling systems/intelligent networks, multi service broadband switching fabrics- ATM

Textbooks:

1. Flood, J.E., "Telecommunication Switching, Traffic and Networks", Pearson Education.
2. Bertsekas, D. and Gallager, R., "Data Networks", 2nd Ed., Prentice-Hall of India.

Reference books:

1. Bellamy, J.C., "Digital Telephony", 3rd Ed., John Wiley & Sons 2002
2. Bear, D., "Principles of Telecommunication Traffic Engineering", 3rdEd. Peter Peregrinus.
3. Stallings, W., "ISDN and Broadband ISDN with Frame Relay and ATM", 4th Ed., Pearson Education.
4. Black, U., "MPLS and Label Switching Networks", Pearson Education.
5. Schwartz, M., "Telecommunication Networks: Protocols, Modeling and Analysis", Pearson Education.
6. Stallings, W., "Data and Computer Communication", 8th Ed., Pearson Education.

JECRC University
Faculty of Engineering & Technology **Hours:48**
***M.Tech. in Communication Systems* – Semester III**
Contact Hours (L-T-P): 4-0-0

Microwave Devices and Circuits
(MEE013A)

Course Objectives:

1. *Review of Microwave communication starts*
2. *Study of LOS Communication, Satellite Communication, Mobile Communication,Wireless Communication*
3. *Study of amplifier, filter, mixer, transmitter unit , receiver unit that can support this range of frequency.*
4. *Analysis of Travelling Wave Tube, Klystron, Megnetron, Wave guides, Circulators,Isolators are some of microwave Devices.*

Unit I Klystron Amplifier – Reflex Klystron Amplifier, Travelling wave tube Amplifier, Magnetron Oscillator and Modulator, Varactor diode, Parametric amplifier and applications, diode detector and mixer, GUNN, Tunnel IMPATT diode oscillators, Masers and lasers.

Unit II Scattering parameters- S-Matrix, Attenuator, Phase shifters, T Junctions, Hybrid T Junctions, Directional couplers, Isolator, Properties of ferrite devices, Faraday rotation, Gyrator, Circulator, Scattering parameter measurement.

Unit III Review of resonant circuits – principle of Microwave resonators, field analysis of cavity resonators,

Unit IV Characteristics of filters, Narrow and wide band filters, Filter and resonant applications, Frequency multiplier and frequency Discrimination.

Unit V Characteristics of Microwave Antennas, Half Wave Dipole, Array, Horn, Paraboloidal Reflector, feeds, Lens and slot Antennas, Leaky and surface wave Antennas, Broad band Antennas, Micro strip Antennas, Antenna measurements.

Textbooks:

1. Roddy.D., "Microwave Technology" Reston Publications.1986.

Reference books:

1. Chatterjee R. "Microwave Engineering "East West Press. 1988.
2. Rizzi.P."Microwave Engineering Passive circuits". Prentice Hall.1987
3. Clock.P.N. "Microwave Principles and Systems" Prentice Hall.1986.

JECRC University
Faculty of Engineering & Technology **Hours:48**
***M.Tech. in Communication Systems* – Semester III**
Contact Hours (L-T-P): 4-0-0

Electromagnetic Interference & Compatibility
(MEE014A)

Course Objectives:

1. *Analysis of Wave transmission in the atmosphere, cable, wave guide or space is nothing else but generation of electric and magnetic fields and their travelling with distance*
2. *Channel noise that corrupt our message is disturbance in field generated by source and inclusion of field present in environment.*
3. *Study of different Electromagnetic fields and how they can disturb specific mode of transmission, how we can protect our message and reduce Interference.*

Unit I EMI-EMC definitions and Units of parameters; Sources and victim of EMI; Conducted and Radiated EMI Emission and Susceptibility; Transient EMI, ESD; Radiation Hazards.

Unit II Conducted, radiated and transient coupling; Common ground impedance coupling; Common mode and ground loop coupling; Differential mode coupling; Near field cable to cable coupling, cross talk;

Unit III Field to cable coupling; Power mains and Power supply coupling. Shielding, Filtering, Grounding, Bonding, Isolation transformer, Transient suppressors, Cable routing, Signal control. Component selection and mounting; PCB trace impedance;

Unit IV Routing; Cross talk control; Power distribution decoupling; Zoning; Grounding; Vias connection; Terminations.

Unit V Open area test site; TEM cell; EMI test shielded chamber and shielded ferrite lined anechoic chamber; Tx /Rx Antennas, Sensors, Injectors / Couplers, and coupling factors; EMI Rx and spectrum analyzer; Civilian standards-CISPR, FCC, IEC, EN; Military standards-MIL461E/462.

Textbooks:

1. V.P.Kodali, "Engineering EMC Principles, Measurements and Technologies", IEEE Press, New York, 1996.
2. Henry W.Ott., "Noise Reduction Techniques in Electronic Systems", A Wiley Inter Science Publications, John Wiley and Sons, New York, 1988.

Reference books:

1. Bemhard Keiser, "Principles of Electromagnetic Compatibility", 3rd Ed, Artech hourse, Norwood, 1986.

2. C.R.Paul,"Introduction to Electromagnetic Compatibility" , John Wiley and Sons, Inc, 1992.

Don R.J.White Consultant Incorporate, "Handbook of EMI/EMC", Vol I-V, 1988.

JECRC University
Faculty of Engineering & Technology **Hours:48**
M.Tech. in Communication Systems – III Semester
Contact Hours (L-T-P) : 4-0-0

Wireless & Mobile Ad-Hoc Networks
(MEE015A)

Course Objectives:

1. *Objective of this course is to study the Technical background of transmission fundamentals, communication networks, protocols and TCP/IP Suite, antennas and propagation signal encoding techniques, spread spectrum coding and error control.*
2. *We will study the basic concept of wireless networking, Satellite communications, cellular transmission principles, cordless systems and wireless local loop mobile internet protocol and wireless access protocol.*
3. *To introduce the wireless LANs (Wireless local area network technology), IEEE standards, CDMA standards, System architecture for code division multiple access voice applications in code division multiple access system.*
4. *Students will be taught about RF engineering and facilities, global system for mobile communication architecture and interfaces, radio link features in global system for mobile communication, global system for mobile communication logical channels and frame structure, speech coding in global system for mobile communication.*

Unit I: Transmission concepts: Technical background - transmission fundamentals - communication networks –protocols and TCP/IP Suite - antennas and propagation signal - encoding techniques - spread spectrum coding and error control.
Unit II: Wireless networking: Satellite communications- cellular transmission principles- cordless systems and wireless local loop mobile internet protocol and wireless access protocol.
Unit III: Wireless LANs: Wireless local area network technology – institute of electrical and electronics engineering, 802 - 11 wireless local area network standard.
Unit IV: CDMA standards: System architecture for code division multiple access - network and data link layers of code division multiple access – signaling applications in code division multiple access system - voice applications in code division multiple access system.
Unit V: RF engineering and facilities: Wireless data - cellular communication fundamentals - global system for mobile communication architecture and interfaces – radio link features in global system for mobile communication - global system for mobile communication logical channels and frame structure - speech coding in global system for mobile communication.

Text book:

1. William Stallings, Wireless Communication and Networking, Pearson Education, Asia 2005.

Reference books:

1. Garg. V. K, Smolik. K, Applications of CDMA in Wireless/Personal Communications, Prentice Hall, 2004.
2. Garg V. K, Principles and Applications of GSM, Prentice Hall, 2002

JECRC University
Faculty of Engineering & Technology **Hours:48**
***M.Tech. in Communication Systems* – Semester III**
Contact Hours (L-T-P): 4-0-0

RF Systems & Design
(MEE016A)

Course Objectives:

The objective of the course is to provide the participants the state of the art knowledge in the field of RF circuits and systems. The course would explain various methodologies presently prevalent in the industry for the design of RF filters, various RF active and passive circuits, industrial microwave systems, etc. The course would start with a brief theoretical foundation of RF circuits for the above specified applications. In addition, the participants would be exposed to the state of the art modeling and simulation schemes currently being used for the design of RF circuits and systems.

Unit I CMOS: Introduction to MOSFET Physics , Noise: Thermal, shot, flicker, popcorn noise Transceiver Specifications: Two port Noise theory, Noise Figure, THD, IP2, IP3, Sensitivity, SFDR, Phase noise - Specification distribution over a communication link Transceiver Architectures: Receiver: Homodyne, Heterodyne, Image reject, Low IF Architectures – Transmitter: Direct upconversion, Two step upconversion

Unit II S-parameters with Smith chart – Passive IC components - Impedance matching networks Amplifiers: Common Gate, Common Source Amplifiers – OC Time constants in bandwidth estimation and enhancement – High frequency amplifier design Low Noise Amplifiers: Power match and Noise match – Single ended and Differential LNAs – Terminated with Resistors and Source Degeneration LNAs.

Unit III Feedback Systems: Stability of feedback systems: Gain and phase margin, Root-locus techniques– Time and Frequency domain considerations, Compensation Power Amplifiers: General model – Class A, AB, B, C, D, E and F amplifiers, Linearisation Techniques – Efficiency boosting techniques – ACPR metric – Design considerations

Unit IV PLL: Linearised Model – Noise properties, Phase detectors – Loop filters and Charge pumps Frequency Synthesizers: Integer-N frequency synthesizers – Direct Digital Frequency synthesizers .

Unit V Mixer: characteristics -Non-linear based mixers: Quadratic mixers – Multiplier based mixers: Single balanced and double balanced mixers, subsampling mixers Oscillators: Describing Functions, Colpitts oscillators, Resonators, Tuned Oscillators, Negative resistance oscillators – Phase noise

Textbooks:

1. T.Lee, "Design of CMOS RF Integrated Circuits", Cambridge, 2004
2. B.Razavi, "RF Microelectronics", Pearson Education, 1997

Reference books:

1. Jan Crols, Michiel Steyaert, "CMOS Wireless Transceiver Design", Kluwer Academic Publishers, 1997
2. B.Razavi, "Design of Analog CMOS Integrated Circuits", McGraw Hill, 2001.

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***M.Tech. in Communication Systems* – Semester III**
Contact Hours (L-T-P): 4-0-0

Data compression techniques
(MEE056A)

Course Objectives:

1. *Understand the two major compression techniques, their merits and demerits.*
2. *Discuss important issues in data compression.*
3. *Estimate the effect and efficiency of a data compression algorithm.*
4. *Use lossless and lossy applications to compress data/multimedia.*
5. *Learn how to design and implement compression algorithms.*

Unit I: Compression features:
Special features of multimedia – graphics and image data representations – fundamental concepts in video and digital audio – storage requirements for multimedia applications - need for compression - taxonomy of compression techniques – overview of source coding, source models, scalar and vector quantization theory – evaluation techniques – error analysis and methodologies.

Unit II Text compression:
Compaction techniques – huffmann coding, adaptive huffmann coding, arithmetic coding, shannon-fano coding,dictionary techniques, Lempel-Ziv-Welch family algorithms .
Unit III: Audio compression:
Audio compression techniques- µ- law and a- law companding. frequency domain and filtering – basic sub-band coding – application to speech coding – G.722 – Application to audio coding – moving picture expert group audio, progressive encoding for audio – silence compression, speech compression techniques – format and CELP Vocoders.

Unit IV: Image compression:
Predictive techniques – delta modulation, pulse code modulation, differential pulse code modulation - optimal predictors and optimal quantization – contour based compression – transform coding – joint photographic expert group standard – sub-band coding algorithms - design of filter banks – wavelet based compression - implementation using filters – embedded zerotree wavelet, set partitioning in hierarchical trees coders – joint photographic expert group 2000 standards - JBIG, JBIG2 standards.

Unit V: Video compression:
Video compression techniques and standards – moving picture expert group video coding I moving picture expert group – 1 and 2 – moving picture expert group video coding II – moving picture expert group – 4 and 7 – motion estimation and compensation techniques– H.261 Standard, digital visual interface technology – production level video performance – digital visual interface real time compression, packet video.

Text books:

1. Peter Symes, Digital Video Compression, McGraw Hill Pub., 2004.
2. Mark S. Drew, Ze-Nian Li, Fundamentals of Multimedia, PHI, 1st Edition, 2003.

Reference books:

1. Khalid Sayood, Introduction to Data Compression, Morgan Kauffman Harcourt India, 2nd Edition, 2000.
2. David Salomon, Data Compression – The Complete Reference, Springer Verlag New York Inc., 2nd Edition, 2001.
3. Yun Q.Shi, Huifang Sun, Image and Video Compression for Multimedia Engineering - Fundamentals, Algorithms & Standards, CRC press, 2003.

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Faculty of Engineering & Technology **Hours:48**
***M.Tech. in Communication Systems* – Semester III**
Contact Hours (L-T-P): 4-0-0

Advanced Artificial Neural Networks
(MEE017A)

Course Objectives:

1. *Understand and explain strengths and weaknesses of the neural-network algorithms*
2. *Determine under which circumstances neural networks are useful in real application*
3. *Distinguish between supervised and unsupervised learning and explain the key principles of the corresponding algorithms*
4. *Efficiently and reliably implement the algorithms introduced in class on a computer, interpret the results of computer simulations*
5. *Describe principles of more general optimization algorithms.*
6. *Write well-structured technical reports in English presenting and explaining analytical calculations and numerical results*
7. *Communicate results and conclusions in a clear and logical fashion*

Unit I Fundamentals: Introduction & Motivation, Biological Neural Networks and simple models, The Artificial Neuron Model; Hopfield Nets; Energy Functions and Optimization; Neural Network Learning Rules: Hebbian Learning Rule, Perceptron Learning Rule, Delta Learning Rule Widrow-Hoff Rule, Correlation Learning Rule, Winner –Take-All Learning rule, Out Star Learning Rule, summary of Learning rules.

Unit II Single layer perceptron classifiers: Classification model, features and decision regions, discriminant functions, linear machine and minimum distance classification, nonparametric training concept training and classification using the discrete perceptron: algorithm and example, single layer continuous perceptron network for linearly separable classifications, multicategory

Unit III Multilayer feed forward networks: Linearly no separable pattern classification delta learning rule for multiperceptron layer. Generalized Delta Learning rule. Feed forward Recall and Error Back Propagation Training; Examples of Error Back-Propagation. Training errors: Learning Factors; Initial weights, Cumulative Weight Adjustment versus Incremental Updating, steepness of activation function, learning constant, momentum method, network architecture Versus Data Representation, Necessary number of Hidden Neurons. application of Back propagation Networks in pattern recognition & Image processing, Madaunes: Architecture & Algorithms.

Unit IV Single Layer Feedback Network: Basic concepts of dynamical systems, mathematical foundation of discrete-time hop field networks, mathematical foundation of Gradient-Type Hopfield networks, and transient response of continuous time networks. example solution of

optimization problems: summing networks with digital outputs, minimization of the traveling salesman tour length, solving simultaneous linear equations.

Unit V Associative Memories I: Basic concepts, linear associator basic concepts of recurrent auto associative memory, retrieval algorithm, storage algorithm, storage algorithms performance considerations, performance concepts of recurrent auto associative memory, energy function reduction capacity of recurrent auto associative memory, memory convergence versus corruption, fixed point concept, modified memory convergence towards fixed points, advantages and limitations.

Textbooks:

1. J.M.Zurada: Introduction to Artificial Neural Systems, Jaico Publishers
2. Dr. B. Yagananarayana, Artificial Neural Networks, PHI, New Delhi.

Reference books:

1. Kishan Mehrotra, Chelkuri K. Mohan, Sanjay Ranka: Elements of Artificial Neural Networks, Penram International
2. Introduction Neural Networks Using MATLAB 6.0 - by S.N. Shivanandam, S. Sumati, S. N. Deepa,1/e, TMH, New Delhi.
3. Fundamental of Neural Networks – By Laurene Fausett

JECRC University
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***M.Tech. in Communication Systems* – Semester III**
Contact Hours (L-T-P): 4-0-0

Satellite Communications
(MEE018A)

Course Objective:
Satellite communication is most popular mode of transmission and reception of information at very long distance points. TV, Radio, Voice Channels, Mobile Communication, GPS, Weather forecasting , all are sub parts of this subject. We study, how to decide the location and operating bandwidth of satellite, what factors decide life, performance, cost of satellite link.

Unit I 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.

Unit II Different modulation and Multiplexing Schemes, Multiple Access Techniques – FDMA, TDMA, CDMA, and DAMA, Coding Schemes.

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

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

Unit V Satellite Packet Communications, Intelsat series – INSAT series –VSAT, mobile satellite services, INMARSAT, Satellite and Cable Television, DBS (DTH), VSAT, Satellite Phones.

Textbooks:

1. Wilbur L. Pritchard, H.G. Suyderhoud, Robert A. Nelson, Satellite Communication Systems Engineering, Prentice Hall, New Jersey, 2006.
2. Timothy Pratt and Charles W.Bostain, Satellite Communications, John Wiley and Sons, 2003.

Reference books:

1. D.Roddy, Satellite Communication, McGraw-Hill, 2006.
2. Tri T Ha, Digital Satellite Communication, McGrawHill, 1990.
3. B.N.Agarwal, Design of Geosynchronous Spacecraft, Prentice Hall, 1993.

JECRC University
Faculty of Engineering & Technology **Hours: 48**
***M.Tech. in Communication Systems* – Semester III**
Contact Hours (L-T-P): 4-0-0

Mathematics for Communication Systems
(MEE019A)

Course Objective:

1. *About various mathematical tools required to analyse and develop various signal processing algorithms for the current state of art in research in Wireless Digital Communication Systems.*

Unit I Numbers and their accuracy, Computer Arithmetic, Mathematical preliminaries, Errors and their Computation, General error formula, Error in a series approximation.

Unit II Bisection Method, Iteration method, Method of false position, Newton-Raphson method, Methods of finding complex roots, Muller's method, Rate of convergence of Iterative methods, Polynomial Equations.

Unit III Finite Differences, Difference tables Polynomial Interpolation: Newton's forward and backward formula Central Difference Formulae: Gauss forward and backward formula, Stirling's, Bessel's, Everett's formula. Interpolation with unequal intervals: Langrange's Interpolation, Newton Divided Introduction, Numerical differentiation, Numerical Integration: Trapezoidal rule, Simpson's 1/3 and 3/8 rule, Boole's rule, Waddle's rule., difference formula, Hermite's Interpolation,

Unit IV Picard's Method, Euler's Method, Taylor's Method, Runge-Kutta Methods, Predictor Corrector Methods, Automatic Error Monitoring and Stability of solution. Frequency chart, Curve fitting by method of least squares, fitting of straight lines, polynomials, exponential curves etc,

Unit V Data fitting with Cubic splines, Regression Analysis, Linear and Non linear Regression, Multiple regression, Statistical Quality Control methods.

Textbooks:

1. Rajaraman V, "Computer Oriented Numerical Methods", Pearson Education

Reference books:

1. Gerald & Whealey, "Applied Numerical Analyses", AW

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***M.Tech. in Communication Systems* – Semester III**
Contact Hours (L-T-P): 4-0-0

Nonlinear Fiber Optics Communication
(MEE020A)

Course Objective:

To familiarize students with various optical devices and mechanisms which are being used in different kind of optical networks such as FTTx, PONs as well as RoF.

Unit I Fiber Characteristics: Material and fabrication, Fiber losses, Chromatic dispersion, Polarization-Mode dispersion, Fiber Nonlinearities: Nonlinear refraction, Stimulated Inelastic scattering, Importance of Nonlinear effects. Maxwell's equations, Fiber modes: Eigen value equation, Characteristics of fundamental mode, Pulse propagation Equation, Numerical Methods: Split Step Fourier method, Finite difference method.

Unit II Different Propagation Regimes, Dispersion-Induced pulse broadening , Third-order dispersion, Dispersion management : GVD-induced Limitation, Dispersion compensation, Comparison of third order dispersion, SPM-Induced spectral changes, Effect of group-velocity dispersion, Higher order Nonlinear effects: self steepening, Effect of GVD on optical shocks.

Unit III Optical solitons: Modulation instability: Linear stability analysis, Gain spectrum, Ultra short pulse generation, Fiber solitons: Inverse scattering methods, Fundamental and higher order solitons, Dark, Dispersion-managed and bi-stable solitons, Perturbation methods, fiber losses, solitons amplification, soliton interaction, Higher order Effects, XPM-Induced nonlinear coupling and modulation instability, XPM-Paired solitons,Spectral and temporal effects, Spectral and temporal effects, Application of XPM

Unit IV Four Wave Mixing: Origin of four-wave mixing, Theory of four-wave mixing, Phase matching Techniques, Applications of four-wave mixing.

Stimulated Raman Scattering**:** Basic concepts, Raman-gain spectrum, threshold, Coupled amplitude equations, Solitions effects: Raman solitons, Raman lasers.

Unit V Stimulated Brillouin Scattering: Basic concepts,SBS Dynamics: Coupled amplitude equations,SBS with Q-switched pulses Relaxation Oscillators, Modulation instability and chaos, Parameters: SPM-Based techniques, XPM-based techniques, FWM-based techniques, Variations in n2 values, Fibers with silica cladding: Tappered fibers with air cladding, Micro structured fibers, Non silica fibers, Super continuum generation: Picoseconds, CW, Femtosecond pulses pumping ,Temporal and spectral evolution , Harmonic Generation

Textbooks

1. Non linear Fiber Optics, Govind P. Agrawal, Elsevier.

Reference Books

1. G.Kaiser, Optical Fiber Communication, MC-Graw-Hill.
2. J.M.Senior,Optical Fiber Communication Principles & Practice, PHI

JECRC University
Faculty of Engineering & Technology **Hours: 48**
***M.Tech. in Communication Systems* – Semester III**
Contact Hours (L-T-P): 4-0-0

Advance Mobile Communications
(MEE021A)

Course Objectives:

1. *To familiarize students with various technologies traversed in the complete evolution path from 2G to 4G and beyond.*
2. *To provide sound understanding to the students about the various technologies from mathematical perspective.*

Unit I Cellular concept. Mobile radio propagation. Co-channel interference. Diversity. Multiple accesses. Cellular coverage planning. Wireless networking.
Unit II Wireless systems and standards. Fading channels, spreading codes, power control. WAP and other protocols for internet access. Data transmission in GSM and UMTS, TCP in wireless environment, multi-user detection and its performance analysis.
Unit III Blue-tooth and other wireless networks, system comparison.
Unit IV Spread spectrum concept. Basics of CDMA. Properties and generation of PN sequences. Applications of CDMA to cellular communication systems.
Unit V Second and third generation CDMA systems/ standards. Multicarrier CDMA. Synchronization and demodulation .Diversity techniques and rake receiver.

Textbooks:

1. Mobile Cellular Telecommunications, W.C.Y. Lee,Tmh
2. Wireless Communication and Networking, Misra, Tmh

Reference books:

1. Wireless Communications, Theodore S. Rappaport, Pearson
2. Wireless Communication and Networking, William Stallings, Pearson
3. Wireless Communication, Pena Dalal, Oxford
4. Broadband Wireless Communications, Jiangzhou Wang, Springer
5. Wireless and Mobile Communication, Kumar, Sanjeev, New Age International

JECRC University
Faculty of Engineering & Technology **Hours: 48**
M.Tech. in* VLSI & Embedded System *Semester III
Contact Hours (L-T-P): 4-0-0

Nanotechnology
(MEE066A)

Course Objectives:
1.Introduction the basic concepts of nanotechnology to Engineers .
2. Cover the unique opportunities provided by the nano-scale and focuses on the engineering issues of fabricating and applying structures designed to take advantage of these opportunities.
3. Defining nanotechnology and nanofabrication. It then moves to the unique features available in nano-scale structures such as large surface-to-volume ratios, quantum size effects, unique chemical bonding opportunities, dominance of physical optics, surface control of reactions and transport, and the creation of structures on the same size scale as basic features in living cells. 4.
4. Fabrication methods used in nanotechnology and then into nanostructure applications.
5.Approaches found in top-down, bottom-up, and hybrid fabrication approaches are explained and discussed in the lecture format.

Unit I: Atomic structure:
Basic crystallography, Crystals and their imperfections, Diffusion, Nucleation and crystallization, Metals, Semiconductors and Insulators, Phase transformations , Ceramic materials.
Unit II: Physical Properties of Materials:
Electrical and Thermal properties, Optical properties of materials, Magnetic properties of materials, Density of states, Coulomb blockade, Kondo effect, Hall effect,Quantum Hall Effect.
Unit III: Nanostructures:
Introduction to Nanotechnology, Zero dimensional nanostructures - Nano particles, One dimensional nanostructures - Nano wires and Nano rods.
Unit IV: Two dimensional nanostructures - Films, Special nano materials, Nano stuctures fabricated by Physical Techniques, Properties of Nano-materials, Applications of Nano structures, Basics of Nano-Electronics.
Unit V: Characterization of Nanomaterials:
SPM Techniques - Scanning Tunneling Microscopy, Atomic Force Microscopy, Magnetic Force Microscopy, Electron Microscopy - Scanning Electron Microscope, Transmission Electron Microscope.

Text books:
1.Introduction to solid state Physics: C.Kittel
Reference books:
1. Introduction to theory of solids: H.M. Roenberg
2. Physics and Chemistry of materials: Joel I. Gersten
3.Handbook of Nanotechnology: Bharat Bhushan(springer

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Faculty of Engineering & Technology **Hours: 48**
***M.Tech. in Communication Systems* – Semester III**
Contact Hours (L-T-P):

Dissertation Part-I
(MEE067A)

Subject Objectives:

The objective of this subject is to provide exposure to the current technology by devoting 1year for project in the interest area of students according to current research areas in electronics and communication engineering. This project can be done in any industry or in the university campus under the guidance of faculty of Electronics and Communication Engineering department.

Faculty of Engineering & Technology **Hours: 48**
***M.Tech. in Communication Systems* – Semester IV**
Contact Hours (L-T-P):

Dissertation Part-II
(MEE068A)

Subject Objectives:

The objective of this subject is to provide exposure to the current technology by devoting 1year for project in the interest area of students according to current research areas in electronics and communication engineering. This project can be done in any industry or in the university campus under the guidance of faculty of Electronics and Communication Engineering department.