Curriculum & Syllabi

of

Master of Technology

In

Communication Engineering

(w.e.f. 2018-19)

Vision
Mission
Program Educational Objectives
Program Outcomes
Program Specific Outcomes
Overall Credit Structure
Curriculum
Syllabus

Offered By

ELECTRONICS AND COMMUNICATION ENGINEERING DEPARTMENT
M. M. M. UNIVERSITY OF TECHNOLOGY,
GORAKHPUR-273010, UP
August 2021

Department of Electronics and Communication Engineering
CURRICULA & SYLLABI
M. Tech. Communication Engineering

Vision:

To become a leader of education, research and innovation in the area of Electronics and Communication Engineering and to train students to be innovative and well prepared professionals in the area of Electronics and Communication Engineering.

Mission:

1. Educate and mentor students to meet the current as well as future challenges by providing them with a firm foundation in both theory and practice of Electronics and Communication Engineering.
2. Create, develop and disseminate new knowledge by top quality applied research in Electronics and Communication Engineering by interacting with government agencies and private industry.
3. Promote a sense of leadership and service to the society.

Program Educational Objectives (PEOs)

PEO-1: To enable students in Communication engineering with experts and professionals in the present generation of Advanced RF communication techniques.

PEO-2: To develop the capability of independent research project in RF communication engineering applying research principles and methods

PEO-3: To train the postgraduate in communication engineeringwith the depth knowledge of various subjects of state-of-art interest like advanced, smart antennas, satellite, microwave & mobile Communication

PEO-4: To train the postgraduate having the knowledge of different simulation tools used for measure the performance and diagnose the RF communication systems

PEO-5: To prepare students for Compiling and interpreting research data and presenting them in an appropriate format with scientific presentation, taking into consideration scientific principles and methodology, as well as practical applicability.

PEO-6: To train students a high level of autonomy, accountability, credibility, ethics, and responsibility for all personal work outputs in the advanced RF and microwave fields.

Programs Outcomes (POs)

M.Tech. Communication Engineering students will demonstrate the ability to:

PO-1 An ability to understand concept of advanced Communication Engineering challenges and problems.

PO-2 Educate and mentor students to address future challenges.

PO-3 An ability to independently carry out research /investigation and development work to solve practical problems.

PO-4 Design and implement an independent research project in Communication field applying research principles and methods.

PO-5 Create, develop and disseminates new knowledge in the field of communication engineering.

PO-6 Recognise the need for life- long -learning and prepare oneself to understand, select and apply appropriate techniques and modern engineering and IT tools to solve complex problems of communication field for environment and society context.

Programs Specific Outcomes (PSOs)

PSO-1 An ability to understand the issues and challenges related to advanced communication system.

PSO-2 An ability to solve complex communication engineering problems, using latest hardware and software tools, along with analytical skills to achieve cost effective and appropriate solutions.

PSO-3 Wisdom of social and environmental awareness along with ethical responsibility to have a successful career and to sustain passion and zeal for real-world applications using optimal resources as an entrepreneur.

The Overall Credit Structure for PG Programme

Credit Courses			
Postgraduate Core (PC)		**Postgraduate Elective (PE)**	
Category	**credits**	**Category**	**credits**
Maths (M)	4	Program Electives (PE)	16
Program Core (PC)	22		
Minor Project (MP)	4		
Dissertation (D)	18		
Seminar	2		
Total	**50**	**Total**	**16**
Grand Total	**66 (minimum)**		
Audit Courses			
Audit Course (Other Departments) (AC)	6		
Total	**6**		

Credit Structure for M. Tech. in Digital Systems & Communication Engg.

Category Semesters	**I**	**II**	**III**	**IV**	**Total**
Maths (M)	4	-	-	-	4
Programme Core (PC)	13	9	-	-	22
Program Electives (PE)	-	8	8	-	16
Minor Project (MP)	-	-	4	-	4
Dissertation (D)			4	14	18
Seminar (S)	-	-	-	2	2
Total	**17**	**17**	**16**	**16**	**66**

Department of Electronics and Communication Engineering
M.M.M. University of Technology, Gorakhpur (U.P.)

Curriculum for M.Tech (Communication Engg.)

Junior year, Semester-I

S. No.	Category	Paper Code	Course Name	L-T-P	Credits
1.	M	MAS-112/ MMS-606	Advanced Engg. Mathematics	3-1-0	4
2.	PC	MEC-201	Advanced Digital Communication	3-1-2	5
3.	PC	MEC-202	Advanced Digital Signal Processing	3-1-0	4
4.	PC	MEC-203A	Optical Communication System	3-1-2	5
			Audit		
			Total		**18**

Junior year, Semester-II

S. No.	Category	Paper Code	Course Name	L-T-P	Credits
1.	PC	MEC-204A	Optical Wireless Communication	3-1-0	4
2.	PC	MEC-205A#	Mobile Communication Systems	3-1-2	5
3.	PE1	MEC-2**		3-1-0	4
4.	PE2	MEC-2**		3-1-0	4
			Audit		
			Total		**17**

 # Effective from session 2019-20. Earlier the subject code was MEC-205 with 4 credits.

Senior year, Semester-III

S. No.	Category	Paper Code	Course Name	L-T-P	Credits
1.	PE3	MEC-***		3-1-0	4
2.	PE4	MEC-***		3-1-0	4
3.	MP	MEC-220	Minor Project	0-0-8	4
4.	D	MEC-230	Dissertation Part-I	0-0-8	4
			Total		**16**

- Minor Project should be completed during the summer vacation after second semester.

Senior year, Semester-IV

Sr. No.	Category	Paper Code	Course Name	L-T-P	Credits
1.	S	MEC-240	Seminar	0-0-4	2
2.	D	MEC-250	Dissertation Part-II	0-0-28	14
			Total		**16**

<u>Audit Subjects</u>

S. No.	Course Code	Name of the Course	Prerequisite Subject	L-T-P	Credits
1.	BCS-01	Introduction to Computer Programming	None	2-1-2	--
2.	MCS-206	Information Security and Cyber Laws	None	3-0-0	--

3.	MBA 109	Research Methodology	None	3-0-1	--

PE-1 and PE-2

S. No.	Course Code	Name the Course	Prerequisite Subject	L-T-P	Credits
1.	MEC-251	ISDN and Broadband Networks		3-1-0	4
2.	MEC-252	Microwave Devices & Ckts		3-1-0	4
3.	MEC-253	Opto-Electronics Integrated Circuits		3-1-0	4
4.	MEC-254	Digital Image Processing		3-1-0	4
5.	MEC-256	Advanced Coding Theory		3-1-0	4
6.	MEC-257	Embedded Systems		3-1-0	4
7.	MEC-258	Internet of Things (IOT)		3-1-2	5
8.	MEC-259	Linear Algebra and Stochastic Process		3-1-0	4
9.	MEC-260	RFIC		3-1-0	4

PE-3 and PE-4

S. No.	Course Code	Name the Course	Prerequisite Subject	L-T-P	Credits
1.	MEC-163	Neural Networks		3-1-0	4
2.	MEC-261	Antenna Design and MIMO Systems	Antenna and Wave Propagation	3-1-0	4
3.	MEC-262	Satellite Communication		3-1-0	4
4.	MEC-263	Inter & Intra-net		3-1-0	4
5.	MEC-264	Body Area Networks		3-1-0	4
6.	MEC-265	IC Design	VLSI Technology & Design	3-1-0	4
7.	MEC-168	High Speed Devices and Circuits		3-1-0	4

MMS 606 ADVANCED ENGINEERING MATHEMATICS

Course category	:	Basic Sciences & Maths (BSM)
Pre-requisites	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, assignments, quizzes, One Minor and One Major Theory Examination.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course

1. To find out the dimension of vector spaces
2. To describe the differences between finite-difference and finite-element methods for solving PDEs;
3. To solve Elliptical (Laplace/Poisson) PDEs using finite differences;
4. To solve functional using Euler method.

Topics Covered

UNIT-I

Vector spaces and Linear transformation: Vector spaces, subspaces, Linear dependence, Basis and Dimension, Linear transformations, Kernel & images, matrix representation of linear transformation, change of basis, Eigen values and Eigen vectors of linear operators, diagonalization. 9

UNIT-II

Numerical Techniques: Solution of algebraic and transcendental equations using bisection, Regula Falsi and Newton Raphson's method, Numerical solution to linear system, LU factoring decomposition, Cholesky method, Gauss Seidal method, Numerical eigen value problem, Jacobi, Givens method 9

UNIT-III

Calculus of Variation: Functionals, Euler's equation and its generalization. One and several independent variables. Initial value problems. Weierstrass's sufficiency condition for weak and strong minima and maxima 9

UNIT-IV

Numerical Solution of Partial Differential Equations: Classification of partial differential equations of the second order. Laplace equations and its solution by Liebmann's process. Poisson equation. Solution of Parabolic, Eliptic and Hyperbolic Equations. Applications to Engineering. 9

Textbooks

1. K. Hoffman, R Kunze, Linear Algebra, Prentice Hall of India, 1971.
2. I. M. Gelfrand, S. V. Fomin, Calculus of Variation, Dover Publications.
3. M. D. Raisinghania, Advanced Differential Equations, Schand Publishers.
4. P. Kandasamy, K.Thilagavathy & K.Gunavathy, Numerical Methods, S. Chand Publ.

SYLLABI

MEC-201 ADVANCED DIGITAL COMMUNICATION

Course category	:	Program Core (PC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand basic components and representation of digital communication systems.
2. Design Optimum receivers with linear and decision-feedback equalizers.
3. Analyze performance of Multichannel, Multicarrier Systems and Spread Spectrum Signals
4. Analyse the digital communication system through Fading Multipath Channels.

Topics Covered

UNIT I 9

Overview of Digital Communication: Digital communication system model. Sampling theorem, Communication channels, characteristics and Models, Signal space representations. Digitally modulated signals-Representations. Constellation diagram and design of transmitter and receiver for BPSK,QPSK,M-PSK,16-QAM, FSK, MSK and GMSK and their BER performance analysis in AWGN channel.

UNIT II 9

Communication Through Band-Limited Linear Filter Channels: Optimum receiver for channels with ISI and AWGN. Linear equalization, Decision feedback equalization, Turbo equalization, Self recovering equalization

UNIT III 9

Multichannel, Multicarrier Systems and Spread Spectrum Signals: Model of Spread spectrum system. Direct sequence spread spectrum signals. Frequency -Hopped spread spectrum signals. Performance of spread spectrum system in jamming environment, Synchronization of spread spectrum signals.

UNIT IV

Digital Communications through Fading Multipath Channels: Characterization and model. Frequency-Non selective, slowly fading channel, performance analysis of MRC, EGC, SC Diversity techniques over flat fading channel, Digital signalling over a frequency-selective, slowly fading channel, Coded waveforms for fading channel, Multiple access techniques, Capacity of multiple access methods, CDMA, Random access methods. 9

Experiments:

1. Experiment on QPSK digital Modulation.
2. Experiment on M-ary QAM for different fading channels.
3. Analysis of Bit Error Rate (BER) for BPSK digital Modulation.
4. Analysis of Bit Error Rate (BER) for BFSK digital modulation
5. Analysis of BER for ASK digital modulation.
6. Study of ASK, PSK and FSK digital modulation using MATLAB.

Books & References:
1. John G. Proakis, Digital Communications, 4/e, McGraw-Hill
2. Viterbi, A. J., and J. K. Omura, Principles of Digital Communication and Coding. NY: McGraw-Hill, 1979,ISBN: 0070675163.
3. Marvin K Simon, Sami M Hinedi, William C Lindsey - Digital Communication Techniques – Signal Design & Detection, PHI.
4. MIT OpenCourseWare, Electrical Engineering and Computer Science, Principles of Digital communication II, Spring 2006
5. Aazhang B. Digital Communication Systems (Connexions Web site). January 22, 2004. available at:http://cnx.rice.edu/content/col10134/1.3

MEC-202 Advanced Digital Signal Processing

Course category	:	Program Core (PC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand theory of multirate DSP and wavelets and capable of designing wavelet filters.
2. To be able to design prediction filters and understand solution of normal equation.
3. Estimate power spectrum of signals using different methods.
4. To study of basic wavelet transform methods

Topics Covered

UNIT-I 9

Basics of Multirate systems and its application, up sampling and Down - Sampling, Fractional Sampling rate converter. Polyphase decomposition. Efficient realisation of Multirate systems.Uniform filter banks and it's implementation using polyphase decomposition.

UNIT-II 9

Two channel Quadrature Mirror Filter Banks, Perfect Reconstruction, M-channel PR QMFB.Time Frequency Analysis, Heisenberg's uncertinity principle. Short time fourier transform - Gabor transform. Continous Wavelet Tranform and it's properties. Multi Resolution Analysis, Discrete Wavelet Transform, Orthonormal Wavelet Analysis - Filterbank interpertation. Haar and Daubechise wavelets, Bi-orthogonal wavelets and Filter bank interpretation

UNIT-III 9

B-Spline wavelets, Wavelet packets.2D wavelt transforms. Application of wavelet tranform for data compression, noise reduction. Linear Prediction -Forward and Backward Prediction - Levinson-Durbin Algorithm, Schur Algorithm

UNIT-IV 9

Power spectrum estimation of signals: Wide Sense Stationary Random Processes. Power spectral density. Non parametric methods: periodogram,Backman-Tuckey method. Parametric method: ARMA, AR processes, Yule-Walker method

Books & References:

1. P. P. Vaidyanathan, Multirate Systems and Filterbanks, Prentice Hall
2. Wavelet Transforms - Bopadikar and Rao, Pearson Education
3. Insight into wavelets, K. P. Soman, Prentice Hall India
4. Digital signal Processing, By John G. Proakis, Dimitris G. Manolakis, Pearson Education

MEC-203A Optical Communication Systems

Course category	:	Program Core (PC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Know the fundamentals of active and passive components of optical communication system.
2. Knowledge of working and analysis of optical amplifiers and important parts at the transmitter (Semiconductor lasers/LEDs, modulators etc) as well as at the receiver sides (optical detector etc.) of the optical communications system.
3. To introduce the different types of optical amplifiers SOA, EDFA and RA with respect to operation principle and its applications.
4. To familiarize the theory of non-linearity and optics of anisotropic media and about the nonlinear effects and Solitons.

Topics Covered

Unit-I 9

Lightwave system components-Optical Transmitters and receivers–concepts, components and design. Control of Longitudinal Modes – Design of Optical transmitters.

Unit-II 9

Receiver Noise and sensitivity. Sensitivity degradation- Receiver Design.Architecture and Design of Light wave systems- Loss limited and Dispersion limited lightwave systems.

Unit-III 9

Optical amplifiers-Various types-Design of EDFAs- Various Techniques for Dispersive management: WDM systems –Components and performance issues.

Unit-IV 9

Soliton based systems- Impact of amplifier noise-Timing Jitter, Gordon – Hauss Effect, Bit Error Rate Performance.Coherent light wave systems-Concepts, Modulation Formats and Bit Error Rate Performance.

List of Experiments

1. MAT Lab based experiments.
2. Experiments on various losses.
3. Experiments are the pulse broadening of a fiber optic communication link.

4. Setting up a fiber optic digital link.
5. Fiber Optics on PC: An interactive simulation package to study various aspects of fiber optics.

Books & References:

1. Govind P. Agrawal: Fiber Optic Communication System, John Wiley and Sons, 2003
2. W J Diggonet, Rare earth Doped Fiber Lasres and Amplifiers
3. Hasegawa, Solitons in Optical Communications
4. Govind P. Agrawal: Nonlinear Optics, Academic press 2nd Ed.

MEC-204A OPTICAL WIRELESS COMMUNICATION

Course category	:	Program Core (PC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Ability to understand the basic concepts and regulation of optical sources in OWC channel.
2. Analyse the basic difference between the indoor and outdoor OWC and challenges occured in the communication.
3. Understanding the concept and application of different modulation techniques on outdoor FSO channel.
4. Analysis of Communication system based on BER analysis, considering the effect of different atmospheric turbulence and implementation of diversity technique for the improvement of channel error.

Topics Covered

UNIT I 9

Introduction: Brief History, OWC/RF comparison, Link configuration, OWC challenges, safety and regulations, LEDs, Lasers, its characteristics, Photodetectors: PIN & APD.

UNIT II 9

Channel Modelling: Introduction to indoor OWC channel, Outdoor channel: losses & atmospheric turbulence model.

UNIT III 9

Modulation techniques: OOK, M-PPM, PIM,DHPIM,OPolSKsubcarrier modulation etc, Detection techniques - Photon counter, PMT, coherent techniques,

UNIT IV 9

System Performance: Bit error rate evaluation in presence of atmospheric turbulence, concept of adaptive threshold, FSO performance under the Effect of atmospheric turbulence, Diversity Techniques. Review of recent advancement in OW communication, discussion of challenges, potential applications, state of the art, and prospects.

Books & References:

1. Z. Ghassemlooy, W. Popoola, S.Rajbhandari "Optical Wireless Communications: System and Channel Modelling with MATLAB" CRC Press 1st edition
2. Murat Uysal, Carlo Capsoni, et. al, "Optical Wireless Communications: An Emerging Technology (Signals and Communication Technology)" Springer, 1st edition

MEC-205A MOBILE COMMUNICATION SYSTEMS

Course category	:	Program Core (PC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Analyze the mobile radio propagation and the channel modelling.
2. Understand the concept of mobile wireless communication.
3. Understand the concept of cellular communication.
4. Knowledge of evolution of Wireless technologies.

Topics Covered

UNIT I 9

Radio propagation characteristics, models for path loss, shadowing & multipath fading delay spread, coherence bandwidth, coherence time, Doppler spread Jake's channel model, probability distribution function (PDF) and cumulative distribution function (CDF) of multipath fading and shadowing, distribution for composite fading channel. Monte Carlo simulation of multipath fading channel.

UNIT II 9

Digital modulation for mobile radio, BER performance analysis under fading channel, MRC, EGC and SC diversity techniques and rake demodulator, introduction to spread spectrum communication, multiple access techniques used in mobile wireless communications: FDMA/TDMA/CDMA.

UNIT III 9

Cellular concept, frequency reuse basic theory of hexagonal cell layout, spectrum efficiency, FDM/TDM, cellular system, channel allocation schemes, handover analysis, cellular CDMA, soft capacity, Erlang capacity comparison, a review of handover analysis in 4G and 5G network system.

UNIT IV 9

Evolution of Wireless technologies; review of 1G,2G,3G,4G and 5G**,** Wireless standards-GSM, IS-95, UMTS-IMT-2000, signaling, call control, mobility management and location tracing, wireless internet, ad hoc wireless networks, broadband wireless and quality of service, location management, pervasive healthcare.

Experiments:

1. Simulations of fading channels modeled by Rayleigh distribution.
2. Simulation of BPSK and QPSK in multipath fading channels.
3. Simulation M-ary PSK in Lognormal modeled shadowing channels.
4. Simulation of performance of MRC an EGC diversity techniques in multipath fading

channels.

Books & References:

1. Theodore S. Rappaport, Wireless Communications Principles and Practice, PHI.
2. Vijay Garg, Wireless Communications and Networkings, Elsevier.
3. William C.Y. Lee, Mobile Cellular Telecommunication, Analog and Digital Systems, McGraw Hill.
4. Kamilo Feher, Wireless Digital Communications, Modernization & Spread Spectrum Applications, PHI.
5. Kaveh Pahlavan and Allen H. Levesque" Wireless Information Networks", Wiley.

MEC-251 ISDN and Broadband Networks

Course category	:	Program Elective (PE)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand the basic concepts of ISDN channels, layered model, protocols and interworking between computer networks and switching components.
2. Understand concepts of broadband networks and functioning of Frame Relay.
3. Understand the functioning of ATM standard, protocols and services.
4. Know about SMDS interface services and ISDN protocols.

Topics Covered

Unit-I 9

ISDN Channels, Access interface, functional devices and reference, Overview of ISDN services, Protocol structure, D- Channel Layer 3 Protocols, Numbering and addressing, ISDN Products.

Unit-II 9

Broadband networks - need, Fast packet switching, Frame relay, Cell relay & ATM, FDDI, SMDS. Frame Relay – Basic Definition, Protocol Architecture, Permanent and switched VC, Frame relay standards, Multicast services.

Unit-III 9

ATM – ATM standards, Terms and Concepts, B-ISDN Protocol Architecture, Physical Layer, ATM Layer, AAL, ATM services.

Unit-IV

ATM switches. SMDS Overview, SMDS Interface & Services. ISDN, B-ISDN and Internet Protocols. 9

Books & References:

1. Kessler & Southeick: “ISDN” – McGraw Hill, 3e, 1996.
2. William Stallings: “ISDN” – Pearson Education

MEC-252 Microwave Device & Circuits

Course category	:	Program Elective (PE)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand the operation of active microwave devices & its uses for microwave communications
2. Know the design concepts of passive microwave components and its application in microwave power distribution.
3. Analyse and synthesize Microwave networks
4. Understand and explain the fabrication steps of Microwave ICs and estimate its performance characteristics

Topics Covered

Unit-I 9

Microwave Devices: Tunnel Diode, Microwave Bipolar Transistors, HBTs, JFETs, MESFET, HEMTs, Mos Transistors and memory devices, CCDs. Transferred electron devices

Unit-II 9

Principle of Operation and characteristics of Gunn diode, TRAPATT and IMPATT diodes, GaAs Diode, RWH Theory, LSA Diode. Avalanche Transit Time Devices: Read diode IMPATT Diode, TRAPATT Diode, BARITT Diode, Parametric Devices.

Unit-III 9

Microwave Network Representations: S-matrix representations, matrices of some typical, microwave components such as attenuator, matched load, power divider, directional coupler, magic tee etc.

Unit-IV 9

Lumped element in MICs, Material and Fabrication Technique, Technology of hybrid MICs, Design of MIC components- transitions,

Books & References:

1. S.Y. Liao, "Microwave devices & Circuits", Prentice Hall of India, 3rd Ed..1995.
2. G.P. Srivatava,Vijay Laxmi Gupta,"Microwave Devices and Circuit Design" PHI,2006
3. M L Sisodia, G S Raghuvanshi, Microwave Circuits and Passive Devices, New Age International (p) Ltd, 2001

MEC-253 Opto-Electronics Integrated Circuits

Course category	:	Program Elective (PE)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0

Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand optoelectronic properties of semiconductor.
2. Understand the theory of designing optical sources.
3. Knowledge about the different optical detection scheme.
4. Evaluation of optoelectronic modulation and switching devices.

Topics Covered

Unit-I 9

Optoelectronic Properties of Semiconductor: effect of temperature and pressure on bandgap, Carrier scattering phenomena, conductance processes in semiconductor, bulk and surface recombination phenomena Optical Properties of Semiconductor, EHP formation and recombination, absorption in semiconductors, Effect of electric field on absorption, absorption in quantum wells, radiation in semiconductors, deep level transitions, Augur recombination's

Unit-II 9

Junction theory, Schottky barrier and ohmic contacts, semiconductor heterojunctions, LEDs, Photo detectors, Solar Cells, Lasers: Operating Principles, Various Structures and its types

Unit-III 9

Special Detection Schemes: Phototransistors, Modulated Barrier Photodiode, Schottky Photdiode, MSM photodiode

Unit-IV 9

Optoelectronic modulation and switching devices: Analog and Digital modulation, Franz-Keldysh and Stark effects modulators, Electro-optic modulators, Optolectronic Integrated Circuits(OEICs): Need for hybrid and monolithic integration, OEIC transmitters and receivers

Books & References:

1. Semiconductor Optoelectronic Devices By Pallab Bhattachrya, Prentice Hall Publications.
2. Physics of Semiconductor Devices, By S.M. Sze, Wiley Publications.
3. Optoelectronics and Photonics: Principles and Practices, by S. O. Kasap, Prentice Hall Publications.

1. Integrated Optoelectronics, by Ebeling, Springer-Verlag, Berlin, 1992

MEC-254 Digital Image Processing

Course category	:	Program Elective (PE)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination

Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Review the fundamental concepts of a digital image processing system.
2. Analyze images in the frequency domain using various transforms.
3. Evaluate the techniques for image enhancement and image restoration.
4. Interpret image segmentation and representation techniques.

Topics Covered

Unit-I 9

Introduction to Digital Image model and Transforms: Digital Image Representation, Image Processing Systems, Digital Image fundamentals, Image model, Sampling & Quantization, Introduction to Fourier Transform, Properties, DFT, FFT, Separable Image Transform, Hough Transform.

9

Unit- II

Image Enhancement: Spatial Frequency Domain methods, Histogram modification techniques, Direct histogram modification techniques, Direct histogram specifications, Image Smoothening, Image Sharpening. 9

Unit-III

Image Restoration & Encoding: Degradation model, Diagonalization of Circulant and Block Circulant matrices, Algebraic Approach, Inverse Filtering, Wiener Filtering. 9

Image Encoding:Fidelity criteria, The Encoding Process, Error – free encoding relative to fidelity criteria.

Unit-IV

Image Segmentation: Detection of discontinuities, Edge Linking & Boundary Linking, Thresholding, Region oriented Segmentation.

Books & References:

1. Rafael C. Gonzalez, Paul Wintz: “Digital Image Processing” – Prentice Hall
2. Anil K Jain: “Fundamentals of Digital Image Processing” – Prentice Hall
   1. 3.A Resenfeld, A.C. Kak: “Digital Image Processing” – Academic Press

MEC-256 Advanced Coding Theory

Course category	:	Program Elective (PE)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand the basics of coding theories & the various capacity reduction-based coding techniques.
2. Able to understand the tree diagram, different algorithms and burst errors correcting codes.
3. Able to understand the various M-ary signaling and TCM performance analysis and implementational considerations.
4. Able to understand the turbo decoders.

Topics Covered

Unit-I 9

Linear block codes, encoding and decoding, cyclic codes, Non-binary codes. Linear convolutional encoders – Structural properties of convolutional codes – State diagrams – Transparent convolutional codes – Receiver phase offset and Differential decoding – Trellis diagrams – Viterbi algorithm – Performance analysis – Design and Implementation of Viterbi decoder – Punctured convolutional codes.

Unit-II

Tree diagrams – The Fano algorithm – The Stack algorithm – Performance analysis for Sequential decoders – Burst error correcting codes – Decoding of single burst error correcting cyclic codes – Fire Interleaved codes – Phased burst error correcting codes – Concatenated codes 9

Unit-III

M-ary signaling – One and Two-dimensional TCM – Multiple TCM – Decoding and performance analysis – Implementational considerations. 9

Unit-IV

Turbo decoder, Interleaver, Turbo decoder MAP and log MAP deicers Iterative turbo decoding. Optimum decoding of turbo codes 9

Books & References:

1. S. Lin & D. J. Costello, Error Control Coding (2/e), Pearson, 2005.
2. B.Vucentic & J. Yuan, Turbo Codes, Kluwer, 2000
3. C.B. Schlegel & L.C. Perez, Trellis and Turbo Coding Wiley.
4. Stephen B. Wicker, "Error control systems for Digital communication and storage", Prentice Hall Upper Saddle River, NJ, 1994.
5. E. Biglieri, et al. "Introduction to Trellis coded modulation with Applications", Macmillan Publishers,1991.
6. R. Johannesson and K.S. Zigangirov, "Fundamentals of Convolutional coding", IEEE Series on Digital and Mobile Communication, Wiley-IEEE Press, 1999.

MEC-257 Embedded Systems

Course category	:	Program Elective (PE)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. The student will be able to understand the concept of embedded system, microcontroller, different components of microcontroller and their interactions.
2. Student will be able to get familiarized with programming environment to develop embedded solutions.
3. Student will be able to program ARM microcontroller to perform various tasks.
4. Student will be able to understand the key concepts of embedded systems such as I/O, timers, interrupts and interaction with peripheral devices.

Topics Covered

Unit-I 9

Introduction to Embedded Systems: Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems, Applications.

9

Unit-II

Embedded Processor: Devices & Architecture of 8051/89C51 Motorola, PIC, AVR, etc. Review of memory Architecture, I/ O, Timer/ Counter & Interrupts.

9

Unit-III

RTOS Based Embedded & Task Communication: Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Shared Memory, Message Passing, Remote Procedure Call and Sockets, Task Synchronization: Task Communication/Synchronization Issues, Task Synchronization Techniques, Device Drivers, How to Choose an RTOS. 9

Unit-IV

Embedded Communication Protocols: Embedded Networking: Introduction – Serial/Parallel Communication – Serial communication protocols -RS232 standard – RS485 – Synchronous Serial Protocols -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I^2C) – PC Parallel port programming -ISA/PCI Bus protocols

Books & References:

1. Burns, Alan and Wellings, Andy: “Real-Time Systems and Programming Languages", 2e, Addison-Wesley-Longman, 1997.
2. Raymond J.A. Bhur and Donald L.Bialey: " An Introduction to real time systems: Design to networking with C/C++" – Prentice Hall, 1999.
3. Grehan Moore, and Cyliax: "Real time Programming: A guide to 32 Bit Embedded Development” – Addison-Wesley-Longman, 1998.
4. Heath, Steve: "Embedded Systems Design" – Newnes, 1997.
5. Frank Vahid and Tony Givargis: Embedded System Design: A Unified Hardware /Software Introduction” – Wiley 2001

MEC-258 Internet of Things (IoT)

Course category	:	Program Elective (PE)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination

Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Knowledge about IoT architecture outline and standards considerations.
2. Review IoT architectures at state of art.
3. Understand concept of IoT data link layer & network layer protocols.
4. Understand the concept of transport & session layer protocols.

Topics Covered

Unit-I 9

IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. M2M and IoT Technology Fundamentals- Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service (XaaS), M2M and IoT Analytics, Knowledge Management 9

Unit-II

Reference Architecture: IoT Architecture-State of the Art – Introduction, State of the art, Reference Model and architecture, IoT reference Model - IoT Reference Architecture Introduction, Functional 9
View, Information View, Deployment and Operational View, Other Relevant architectural views. Real-World Design Constraints- Introduction, Technical Design constraints-hardware is popular again, Data representation and visualization, Interaction and remote control.

9

Unit-III

IoT Data Link Layer & Network Layer Protocols: PHY/MAC Layer(3GPP MTC, IEEE 802.11, IEEE 802.15), Wireless HART,Z-Wave, Bluetooth Low Energy, Zigbee Smart Energy, DASH7 - Network Layer-IPv4, IPv6, 6LoWPAN, 6TiSCH,ND, DHCP, ICMP, RPL, CORPL, CARP

Unit-IV

Transport & Session Layer Protocols: Transport Layer (TCP, MPTCP, UDP, DCCP, SCTP)-(TLS, DTLS) – Session Layer-HTTP, CoAP, XMPP, AMQP, MQTT
Service Layer Protocols & Security Service Layer -oneM2M, ETSI M2M, OMA, BBF – Security in IoT Protocols – MAC 802.15.4, 6LoWPAN, RPL, Application Layer

Experiments

IoT architecture outline, standards considerations

1. Understand SENSEnuts protocol stack code architecture
2. To develop a code for LED blink operation for SENSEnuts device.

M2M and IoT Technology Fundamentals- Devices and gateways

3. Get to know the type of devices in SENSEnuts platform.

M2M and IoT Analytics/Data representation and visualization

4. Get to know the working of SENSEnuts GUI.
5. To develop a code to read temperature and light sensor data from sensor module attached to radio module.
6. To develop a code to broadcast the temperature and light sensor data in the network, catch it at destination and display it in GUI.

Technical Design constraints

7. To develop a code to program the temperature and light sensor with threshold values, and catch the interrupt generated by them when threshold is passed.
8. To check the change in link quality as the distance between two nodes increase.
9. To check previous experiment at three different channel frequencies supported by 802.15.4.
10. To implement following 4 Coordinator selection mechanisms after active scan at mac layer for node association
    a) Node tries to associate with a coordinator giving best link quality.
    b) Node tries to get associated with Pan Coordinator first and if not found tries toassociate with any other coordinator.

c) Node tries to associate with a specific coordinator with given ID every time.
d) Node tries to associate only on specific channels.

IoT Data Link Layer & Network Layer Protocols

11. Get to know 802.15.4 and its operation.
12. To check the impact of dynamic channel selection by PAN coordinator on the network when Pan Coordinator is switched off and then on while the network is running in a non-acknowledged broadcast network.
13. To check the impact of reduced size task queues on the capability of device.
14. To check the impact of increase in payload size on the network.
15. To create a MBR (mac based routing) based multi-hop network.
16. To create a LBR (level based routing-multipath) based multi-hop network and check the impact of node failure on LBR's functionality. Also check the advantage of MBR support in LBR.
17. To create an AODV based multi-hop network.

Battery Saving and Link Quality Control

18. To modify the code of LBR to make it battery and link quality aware.
19. To modify the code of AODV to make it battery and link quality aware.
20. To implement sleep and wake mechanism in SENSEnuts nodes.
21. To implement an algorithm to control transmission power of the node dynamically based on link quality.

Security Aspects

22. To make one node in LBR as malicious node and drop packets sent through it.

Advance Experiments

23. To develop a MATLAB interface to receive all the data sent by wireless nodes in MATLAB rather than SENSEnuts GUI and develop graphs in matlab based on data received.
24. To simulate a resistance control mechanism in MATLAB based on data received from SENSEnuts device

Books & References:

1. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1 st Edition, Academic Press, 2014.
2. Peter Waher, "Learning Internet of Things", PACKT publishing, BIRMINGHAM – MUMBAI
3. Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer
4. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118- 47347-4, Willy Publications
5. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on Approach)", 1 st Edition, VPT, 2014.
6. http://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot/index.html

MEC-259 Linear Algebra and Random Process

Course category	:	Program Elective (PE)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination

Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand concept of vector spaces.
2. Understand the concept of probability spaces.
3. Summarize the concepts associated with random process and to compute the power spectral density of the output of the system.
4. Recognize the usage of random process in telecommunication engineering and to solve the corresponding problems.

Topics Covered

Unit I: 9

Vector spaces. Four fundamental vector spaces of the matrix. Rank-Nullity theorem. Projection theorem.- Linear transformation matrix with different basis- Gram-Schmidt orthogonalization procedure. QR factorization. Eigen values and Eigen vectors. Diagonalization of the matrix. Schur's lemma. Hermitian Matrices- Unitary Matrices - Normal Matrices. Singular Value Decomposition.

Unit II: 9

Probability spaces. Random variables and random vectors. Distributions and densities-Conditional distributions and densities. Independent random variables. Transformation of random variables Expectations. Indicator. Moment generating function. Characteristic function. Multiple random variable. Gaussian random vector. Co-variance matrix. Complex random variables. Sequence of random variable-Central limit theorem.

Unit III: 9

Strictly stationary random process. Wide sense stationary random process. Complex random process. Jointly strictly and wide sense stationary of two random processes. Correlation matrix obtained from random process. Ergodic process. Independent random process. Uncorrelated random process. Random process as the input and output of the system. Power spectral density.

Unit IV: 9

White random process. Gaussian random process. Cyclo-stationary random process. Wide sense cyclo stationary random process. Sampling and reconstruction of random process. Band pass random process.

Books & References:

1.R.B.Ash & C.Doleans-Dade, "Probability and Measure Theory (2/e)", Elsevier, 2005
2. A.Papoulis, S.U.Pillai, "Probability, Random variables and Stochastic processes" 4th edition Tata-Mc Hill (4/e) ,2001
3. G.Strang, "Linear Algebra", Thomson Brooks/Cole Cengage Hill (4/e), 2006
4. Stakgold, I., Green"s "Functions and Boundary value Problems (e)", Wiley,1998
5. E.S.Gopi, "Mathematical summary for digital signal processing applications with Matlab", Springer,2011.
6. E.Wong & B.Hajek, "Stochastic Processes in Engineering systems", Springer, 1985.
7. R.B.Ash & W.A.Gardner, "Topics in stochastic processes", Academic Press, 1975.
8. Recent literature in Linear Algebra and Stochastic Processes.

MEC-260 RFIC

Course category	:	Program Elective (PE)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4

Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Introduce with RF and wireless technology with related applications and design issues.
2. Acquire the basic knowledge of LNA technologies, topologies, and the layout of cascade devices.
3. Analyse general considerations and performance parameters of mixers and oscillators.
4. To get idea about different power amplifiers, and RF transceiver design.

Topics Covered

UNIT-I

Introduction to RF and Wireless Technology: Complexity comparison, Design bottle necks, Applications, Issues in RF Design: Noise, Linearity and Signals

Unit-II

Basics of LNA technologies, LNA topologies, CS stage with inductive load, Resistive feedback, Alternative LNA technologies, layout of cascade devices

UNIT-III

Mixers and Oscillators: General Considerations and Performance Parameter of Mixer circuit, Up & Down Conversion Mixers, Cascaded Stages, oscillators, Frequency synthesizers

UNIT-IV

Power Amplifiers: General considerations, Classification, High Frequency Power Amplifiers, large signal impedance matching, linearization techniques.
On-chip Passive Devices and integrated passive devices used in RF transceiver design

Books & References:

1. Behzad Razavi, RF Microelectronics Prentice Hall of India, 2001.
2. Thomas H. Lee, The Design of CMOS Radio Integrated Circuits, Cambridge University Press
3. John W. M. Rogers and Calvin Plett, " Radio Frequency Integrated Circuit Design" Second Edition, Artec House Publication

MEC-163 Neural Networks

Course category	:	Program Elective (PE)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Learn the concept of Neural Networks and its subsystems like ANN, learning concepts, neuron models
2. Understand basic of Hop field model and different types of learning models
3. Learn the concept of radial basis function and its learning laws and counter propagation networks
4. Analyze the applications of neural networks

Topics Covered

UNIT-I 9

Neural networks characteristics, History of development in neural networks principles, Artificial neural net terminology, Model of a neuron, Topology, Learning, types of learning, Supervised, Unsupervised and Reinforcement learning, Knowledge representation and acquisition.

UNIT-II 9

Basic Hop field model, Basic learning laws, Unsupervised learning, Competitive learning, K-means clustering algorithm, Kohonen`s feature maps.

UNIT-III 9

Radial basis function neural networks, Basic learning laws in RBF nets, Recurrent back propagation, Introduction to counter propagation networks, CMAC network, and ART networks.

UNIT-IV 9

Applications of neural nets such as pattern recognition, Optimization, associative memories, speech and decision making. VLSI implementation of neural networks

Books & References:

1. J.M. Zurada: "Introduction to artificial neural systems"- Jaico Pub,2009
1. Simon Haykin : "Neural Networks"- PH, 1999

MEC-261 Antenna Design & MIMO System

Course category	:	Program Elective (PE)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Know the fundamentals of antenna systems, Antenna parameters, and understand antenna radiation mechanism
2. Understand different types of antenna arrays and its applications in communication systems, Design and analyze the antenna arrays for wireless communications
3. Learn the concepts, design, operations and applications of printed antennas and wideband antennas
4. Analyze performance of the multiple-input-multiple-output (MIMO) antennas

Topics Covered

UNIT I 9

FUNDAMENTAL CONCEPTS AND RADIATION FROM WIRE ANTENNAS: Physical concept of radiation, Radiation pattern,near and far field regions, antenna theorem formulation of fundamental antenna properties, Friis transmission equation,radiation integrals and auxiliary potential functions,Infinitesimal dipole,finite length dipole,linear elements near conductors,dipoles for mobile communication,small circular loop.

UNIT II 9

ANTENNA ARRAYS AND SYNTHESIS: Linear arrays Analysis of uniformly spaced arrays with uniform and non-uniform excitation amplitudes, binomial array, phased array, synthesis of antenna arrays, Schelkunoff polynomial method, Woodward-Lawson method, Fourier transform method, Taylor method, Integral equations moment method, impedances.
APERTURE AND REFLECTOR ANTENNAS: Huygens 'Principle, radiation from rectangular and circular apertures design considerations, Babinet's principle, Radiation from sectoral and pyramidal horns-design concepts prime-focus parabolic reflector and cassegrain antennas.

UNIT III 9

BROADBAND AND MICROSTRIP ANTENNAS:Log-periodic and Yagi antennas- frequency independent antennas- helical antennas -Basic characteristics of microstrip antennas -feeding methods- methods of analysis -design of rectangular and circular patch antennas-microstrip arrays.

UNIT IV 9

Capacity and Information rates of noisy, AWGN and fading channels, Capacity of MIMO channels, Capacity of non-coherent MIMO channels,Constrained signaling for MIMO communications. Transmit diversity with two antennas: The Alamouti scheme Orthogonal and Quasi-orthogonal space-time block codes,Linear dispersion codes,Generic space-time trellis codes,Basic spacetime code design principles, Representation of space-time trellis codes for PSK constellation,Performance analysis for space time trellis codes,Comparison of space-time block and trellis codes.

Books & References:

1. C. A. Balanis, "Antenna Theory Analysis and Design", 3rd Ed., John Wiley & Sons, 2008.
2. W. L. Stutzman, and G. A. Thiele, "Antenna Theory and Design", 2nd Ed., John Wiley & Sons, 2010.
3. R. S. Elliot, "Antenna Theory and Design", Revised edition, Wiley-IEEE Press, 2005.
2. 4. R. E. Collin, "Antennas and Radio Wave Propagation", McGraw-Hill., 1985.

MEC-262 Satellite Communication

Course category	:	Program Elective (PE)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand the concepts related to satellite communication and its evolution
2. Learn the concept of satellite link design
3. Design of satellite subsystems like space segment and earth segment
4. Comparative analysis of competitive satellite services

Topics Covered

UNIT-I 9

Evolution of satellite communication, Kepler laws, Orbital elements, Orbital perturbations, Apogee perigee heights, Inclines orbits, Sun synchronous orbits, Geo stationary orbits, Limits of visibility, Sun transit outage, polar Mount antenna, Antenna Look angles, Launching orbits, Low earth orbits, Medium orbits, Constellation.

UNIT-II 9

EIRP, transmission losses, Link-power budget equation, System Noise, carrier to Noise ratio, Uplink and downlink equations, Input and Output back Off, TWTA, Inter modulation Noise.

UNIT-III 9

Space segment: power supply, attitude control, station keeping, thermal control, TT & C Subsystem, Transponders, Antenna subsystem, Earth segment: Receive-Only Home TV Systems, Master Antenna TV System, Transmit-Receive Earth Stations.

UNIT-IV 9

Indian Regional Navigation Satellite System (IRNSS) system: IRNSS system overview, IRNSS signal characterisitcs, IRNSS PRN codes. GPS Aided Geo Augmented Navigation (GAGAN) system.

Books & References:

1. Dennis Roddy: "Satellite Communications"- McGraw Hill, 2009.
2. Tri, T.Ha: "Digital Satellite Communications"- Tata McGraw-Hill Education, 2009.
3. Trimothy Pratt, Charles W. Bostian, Jeremy E. Allnutt "Satellite Communications", JohnWiley& Sons, 2002.
1. 4. Indian Regional Navigation Satellite System: Signal in space ICD for Standard Positioning Service, VERSION 1.1, ISRO satellite centre indian space research organization Bangalore.

MEC-263 Internet and Intranet

Course category	:	Program Elective (PE)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand the characteristics of Client/Server systems, protocols and networking models
2. Understand the Client/Server Architecture and Network Programming
3. Learn the protocols of transport layer in Internet
4. Understanding the concept of Internet and its infrastructue, FTP protocols and the World wide web

Topics Covered

UNIT I 9

Common characteristics of Client/Server systems and protocols, Client/Server Architecture, Strategies for concurrency, Asynchronous I/O, Processes vs. Threads Protocol Definition and Specification, Networking review: The layered networking model, Packet switched networking IP.

9

UNIT II

Client/Server Architecture and Network Programming: Socket programming, Endpoint addressing, JAVA Sockets, Sockets in C.

9

UNIT III
The Transport Layer in the Internet: The transport layer: UDP & TCP, General Characteristics of Internet Protocols; the Email Protocol, Internet protocols: Request/Response format, Document types, Simplicity, Email, Sending: SMTP, Receiving: POP3, perhaps IMAP. 9

UNIT IV
Internet Infrastructure: Domain Name Service and Routing, The Domain Name Service, Routing: routing algorithms and routing protocols,The Internet: Delay, Errors, Detection, Telnet and File Transfer Protocol: telnet (remote login and terminal emulation), FTP (File Transfer), The World Wide Web: History, Introduction and HTTP, Hypermedia, Uniform Resource Identifiers, WWW client/server model, HTTP, HTTP headers.

Books & References:
1. Daniel Minoli : "Internet & Intranet Engineering" -TMH Publication, 1997.
2. Subhashish Dasgupta: "Managing Internet and Intranet Technologies in Organizations Challenges and Opportunities" -Idea Group Publishing, 2000.

MEC-264 Body Area Network

Course category	:	Program Elective (PE)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand the basic concepts of Body area network
2. Design, analysis and monitoring of system hardwares for wirelss body area network
3. Design of network topologies and protocols for wireless body area network
4. Antenna design and analysis for body area network

Topics Covered

UNIT I 9
Introduction to BAN-Standard-Architecture-BAN layers-Drawback of BAN.

UNIT II 9
Wireless body sensors-Sensor nodes and hardware designs, Wireless systems and platforms, Wireless transceivers and microcontrollers, Existing sensor boards, Design of implanted sensor nodes for WBAN, WBAN Systems Software programs and monitoring.

UNIT III 9
Network topologies and configuration-Basics of MAC protocol, Traffic characteristics, Scheduled protocol, Random access protocol, Hybrid MAC protocol, Energy management in WBAN-Performance analysis of BAN

UNIT IV 9
Antenna Design and Propagation for BAN: Introduction-Antenna gain, Return loss, Efficiency, Reciprocity, Miniaturized, Antennas, Implanted Antennas, Volume Conduction Antennas.

Books & References:
1. Huan-Bang Li, KamyaYekehYazdandoost Bin-Zhen, "Wireless Body Area Networks",River Publishers, 2010.
2. Muhannad Quwaider SubirBiswas, "Wireless Body Area Networks"- VDM Verlag Dr. Muller, 2010.

3. Mehmet RastiYuce, JamilY.Khan, "Wireless Body Area Network:Technology, Implementation And Application" - CRC Press Taylor and Francis Group, 2012.

MEC-265 IC Design

Course category	:	Program Elective (PE)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Knowledge of Analog and Digital ICs and their design challenges
2. Able to understand IC fabrication processes
3. Able to design functions using various CMOS logics.
4. Able to design integrated circuits using different logics

Topics Covered

UNIT-I 9

Analog and Digital ICs: Basic Components of Analog and Digital ICs, its Design challenges, IC chip size and circuit complexity, Fundamentals of Monolithic and Hybrid ICs, VLSI Design Flow, VLSI Design Hierarchy, Design quality, and Design Styles, Packaging Technology and CAD Technology applications.

UNIT II 9

Introduction of IC Technology**:** Silicon Wafer Preparation, Epitaxy, Film Deposition, Lithography & Etching, Impurity Doping and Metallization process, Planar Process, Fabrication of a typical circuit

UNIT III 9

Electrical behavior of MOS transistors and its design challenges: Short channel effects, Types of scaling and its impact, High-k Technology Inverters: nMOS and CMOS inverters, its design challenges, Switching characteristics, Introduction of Pass transistors and CMOS Transmission Gates, Design of circuits using pass transistor and CMOS TG.

UNIT IV 9

Stick diagram and Layout representation of various ICs**:** Micron and λ based design rule for VLSI circuit design, Stick diagram and layout representation of a CMOS inverter, CMOS two-input NOR gate, CMOS two-input NAND gate and complex CMOS logic gates.

Books & References:

1. Kang and Leblebici: **"CMOS Digital Integrated Circuits"**- TMH Publication, 2003
2. S.M. Sze: **"Semiconductor Devices: Physics & Technology"** -Wiley India Publications, 2000.
3. Weste, Harris and Bannerjee: **"CMOS VLSI Design"** - Pearson Education Publication, 2011.
4. Douglas A Pucknell & Kamran Eshragian, **"Basic VLSI Design"** PHI 3rd Edition (original Edition – 1994)

MEC-168 HIGH SPEED DEVICES AND CIRCUITS

Course category	:	Program Elective (PE)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. To understand and draw the characteristics of semiconductor materials
2. Modelling and characterization of high-speed GaAs based device
3. To study of V-I characteristics of MESFET
4. Performance study of HEMT and SiGe HBT based devices

Topics Covered

UNIT-I 9

Introduction to Basic Concepts, Requirements of High Speed Devices, Circuits & Materials Semiconductors, Ternary Compound Semiconductor and their Application, Crystal Structures in GaAs, Dopants and impurities in GaAs and InP

UNIT-II 9

Brief Overview of GaAs Technology for High Speed, GaAs and InP Devices for Microelectronics, Ohmic Contacts on Semiconductors, Fermi Level Pinning & Schottky Barrier Diodes

UNIT-III 9

Metal Semiconductor contacts for MESFET, MESFET Operation & I-V Characteristics

UNIT-IV

Hetero Junctions & HEMT, HEMT 1-V Characteristics and Transconductance, SiGe Technology, SiGe HBT 9

Books & References:

1. S.M. Sze, "High Speed Semiconductor Devices", Wiley
2. Michael Shur, "GaAs Devices and Circuits", Plenum Press
3. C.Y. Chang and F. Kat, "Gallium Arsenide High Speed Devices: Physics Technology and Circuit Applications", Wiley
3. H. Beneking, "High Speed Semiconductor Devices: Circuit Aspects and Fundamental Behavior", Chapman and Hall, LONDON