Annexure 3.1

M. Tech. (ECE) PEO's

After quite-a-few years of completing M Tech (ECE), the students will:

PEO1 Work in educational, R&D institutes, Industry and as an Entrepreneur in Electronics & Communication Engineering field.

PEO2 Pursue their doctoral studies and research in the institutes of high repute in India & abroad and develop independent and lifelong learning skills for continuous professional development.

PEO3 Analyze the technical problems and develop feasible, optimal, environmentally and socially acceptable solutions by applying research skills, technical knowledge and modern tools while working individually and in teams.

PEO4 Demonstrate an ability to communicate effectively and practice professional ethics and social responsibility in their career.

M. Tech. (ECE) PO's

After completing M Tech (ECE), the students will have

S. No.	Graduate Attributes	Program Outcomes (PO's)
1.	GA1: Scholarship of knowledge	PO1:An ability to discriminate, evaluate, analyze & synthesize the existing and new knowledge of electronics and communication engineering and to integrate the same for enhancement of knowledge
2.	GA2: Critical Thinking	PO2:An ability to analyze a problem and formulate intellectual & creative framework for conducting research for its solution in a theoretical, practical and policy context.
3.	GA3: Problem Solving	PO3:An ability to evaluate alternative solution of an electronics & communication engineering related problems to find the feasible and optimal solution with appropriate consideration for public health and safety, cultural, societal and environmental issues.
4.	GA4: Research Skill	PO4:An ability to use research based techniques and skills including literature survey, experiments, research methodologies, analysis and interpretation of data and development of scientific/technical knowledge to provide valid conclusions by contributing individually or in groups.
5.	GA5: Usage of Modern tools	PO5:An ability to develop appropriate models, techniques, skills using modern engineering & software tools for solving electronics & communication engineering problems.
6.	GA6: Collaborate and Multidisciplinary Work	PO6:An ability to perform effectively in diverse and Multidisciplinary teams as a member / leader and take objective & rational decisions to achieve common goals.

7.	GA7: Project Management and Finance	PO7:An ability to comprehend and apply engineering and management principles to manage individual and team projects with appropriate consideration to economical & financial aspects.
8.	GA8: Communication	PO8:An ability to Communicate effectively, clearly and confidently with a range of audience through oral and written presentations.
9.	GA9: Life-long learning	PO9:An ability to recognize the need for and engage in continuous professional development and life-long learning
10.	GA10: Ethical Practices and Social Responsibility	PO10:An understanding of professional, ethical, intellectual issues, practices, and social responsibilities as a researcher and member of society.
11.	GA11: Independent and Reflective Learning	PO11:An ability for critical self analysis and self correction.

M Tech (ECE) Pending Elective Subjects' Syllabus

M. Tech (ECE) Syllabus Scheme
2014 Admission Batch Onwards

Semester-I

S. No.	Subject Code	Subject Title	Type	Schedule of Teaching			Credits
				L	P	Total	
1	MTEC-501	Advanced Mathematics for Engineers	Core	4	0	4	4
2	MTEC-502	Advanced Communication System	Core	4	0	4	4
3	MTEC-503	Advanced Optical Communication System	Core	4	0	4	4
4	MTEC-xxx	Department Elective - I	Program Elective	3	0	3	3
5	MTEC-xxx	Department Elective – II	Program Elective	3	0	3	3
6	MTEC-507	Lab – I	Core	0	4	4	2
Total				18	4	22	20

Semester II

S. No.	Subject Code	Subject Title	Type	Schedule of Teaching			Credits
				L	P	Total	
1	MTEC-504	Advanced Digital Signal Processing	Core	4	0	4	4
2	MTEC-505	Engineering Design and Project Management	Core	4	0	4	4
3	MTEC-506	Advanced Microwave Engineering	Core	4	0	4	4
4	MTEC-xxx	Department Elective - III	Program Elective	3	0	3	3
5	MTxx-xxx	Open Elective – I	Program Open	3	0	3	3
6	MTEC-508	Lab – II	Core	0	4	4	2
Total				18	4	22	20

Semester-III

S. No.	Subject Code	Subject Title	Type	Schedule of Teaching			Credits
				L	P	Total	
1	MTEC-xxx	Department Elective - IV	Program Elective	3	0	3	3
2	MTxx-xxx	Open Elective – II	Program Open	3	0	3	3
3	MTEC-509	Pre-Thesis Seminar	Core	0	1	1	1
4	MTEC-510	Pre-Thesis Project	Core	0	3	3	3
Total				6	4	10	10

Semester-IV

S. No.	Subject Code	Subject Title	Type	Schedule of Teaching			Credits
				L	P	Total	
1	MTEC-511	Thesis	Core	-	-	-	15
Total				-	-	-	15

List of Department Core Subjects

MTEC-501 Advanced Mathematics for Engineers
MTEC-502 Advanced Communication System
MTEC-503 Advanced Optical Communication System
MTEC-504 Advanced Digital Signal Processing
MTEC-505 Engineering Design and Project Management
MTEC-506 Advanced Microwave Engineering

List of Department Electives Subjects

MTEC-601 Semiconductor Devices Theory & Modeling
MTEC-602 Multimedia Communication
MTEC-603 Advanced Wireless Networks
MTEC-604 Advanced Wireless & Mobile Communication
MTEC-605 Soft Computing
MTEC-606 Error Control Coding Techniques
MTEC-607 Databases and Data Mining
MTEC-608 Bio-medical Electronics
MTEC-609 Organic Electronics
MTEC-610 VLSI Design, Verification & Testing
MTEC-611 VLSI Design Automation
MTEC-612 Low Power VLSI Design
MTEC-613 Nano-Electronics

MTEC-614	Speech & Image Processing
MTEC-615	Advanced Digital System Design
MTEC-616	Computer Communication & Networks
MTEC-617	Advanced Embedded System Design
MTEC-618	Modeling and Simulation of Communication Systems
MTEC-619	Cloud Computing

COURSE NAME: ADVANCED MATHEMATICS FOR ENGINEERS

COURSE CODE: MTEC-501

Internal Marks:	**50**	**L**	**T**	**P**
External Marks:	**100**	**4**	**0**	**-**

Numerical & Design Problems Content: 70-80%

Note: The question paper shall consist of eight questions of twenty (20) marks each, out of which five questions are required to be attempted by the candidate.

Course Outcomes

On successful completion of this course, the students should be able to:

CO1 Apply Fourier transforms in the design of analogue filters, modulation, demodulation and frequency domain filtering.

CO2 Use statistics in the analysis of engine performance data, difference in mean running times, temperatures and also in cusum control charts.

CO3 Use conformal mapping for solving the electric & magnetic fields in various applications and also, in various coplanar waveguide structures present in silicon substrate.

CO4 Derive equations of catenary shape, isoperimetric problems and other multivariable functions using calculus of variations.

CO5 Apply wavelet transform for signal processing and different applications to divide given function into different scale components.

CO6 Apply concepts of discrete algebra for problem solving.

Syllabus

Unit 1. Fourier Integral and Transform

The Fourier integral, The Fourier transform, Fourier sine and cosine transform, properties of fourier transform, Convolution theorem, Parseval's Identities, application of Fourier transform, The windowed fourier transform, The sharinon sampling theory, low pass and band pass filters.

Unit 2. Conformal Mapping

Conformal mapping and application to boundary value problems, linear Fractional transformation, Schwarz-Christoffel transformation, harmonic functions and Dirichlet's problem, solution of Dirichlet's problem by conformal mapping.

Unit 3. Statistics

Measure of central tendency, measure of variability, skewness, kurtosis, correlation, regression, sampling, level of significance, Chi square distribution, t, F, Z distribution, Theory of estimation, types of hypothesis, hill Climbing

Unit 4. Wavelets

The idea behind the wavelet, the Haar wavelet, a wavelet expansion, multiresolution analysis and Haar wavelets, general construction of wavelets and multi resolution analysis, Shannon wavelets.

Unit 5. Calculus of Variation

Euler's Lagrange's differential equation, The Brachistochrone problem, Hamilton's principle and other applications, isoperimetric problem, Rayleigh-Ritz method, Galerkin's method.

Unit 6. Discrete Algebra

Mathematical logic, Boolean algebra, logic gates, finite state machines, coding theory.

Text Books:

1. I. M. Galfand and S.V. Fomin, "Calculus of Variation", Prentice Hall.
2. A. Jaffery, "Advance Engineering Mathematics", Elsevier.
3. S. C. Gupta and V. K. Kapoor, "Fundamental of Mathematical Statistics", S. Chand & Sons.
4. Robert X Gao and Ruqiang Yan, "Wavelets", Springer Verlag.

Reference books and other resources:

1. E. Hernandez and Guido L. Weiss, "A First Course on Wavelets", CRC Press.
2. K. H. Rosen, "Discrete Mathematics", MGH Publication.
3. John A. Dossey, "Discrete Mathematics", Addison Wesley Publishing Company.
4. T. Sengadir, "Discrete Mathematics", Pearson Education.
5. G. Shanker Rao, "Discrete Mathematics", New Age International Pvt. Ltd Publishers.

Mapping of course contents with CO

Contents	CO1	CO2	CO3	CO4	CO5	CO5
Unit 1	H	-	-	-	-	-
Unit 2	L	H	-	-	-	-
Unit 3	L	-	H	-	-	-
Unit 4	-	-	-	H	-	-
Unit 5	L	-	-	-	H	-
Unit 6	-	-	-	-	-	H

Mapping of CO with PO

CO	PO										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	H	M	H	-	-	-	-	-	-	-	-
CO2	H	M	H	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-
CO4	H	M	H	-	-	-	-	-	-	-	-
CO5	H	M	H	M	-	-	-	-	-	-	-
CO6	-	-	-	-	-	-	-	-	-	-	-

COURSE NAME: ADVANCED COMMUNICATION SYSTEM

COURSE CODE: MTEC-502

Internal Marks:	**50**	**L**	**T**	**P**
External Marks:	**100**	**4**	**0**	**-**

Numerical & Design Problems Content: 10%-20 %

Note: The question paper shall consist of eight questions of twenty (20) marks each, out of which five questions are required to be attempted by the candidate.

Course Outcomes

On successful completion of this course, the students should be able to:

CO1 Comprehend various modulation, demodulation and orthogonal techniques of communication system.

CO2 Analyze errors in system using optimum receivers and detectors.

CO3 Discuss digital technology, software define radio and cognitive radio.

CO4 Explain MIMO and channel modeling.

Syllabus

Unit 1. Digital Communication Systems

Introduction to communications systems, digital communication systems, review of digital modulation techniques, BPSK, QPSK, PCM, DPCM, Delta modulation, multicarrier modulation, OFDM working and mathematical representation of OFDM signal, pulse shaping and windowing in OFDM signal and spectral efficiency.

Unit 2. Optimum Receivers

Optimum receivers for signals corrupted by additive White Gaussian noise, correlation demodulator, optimum detector. ML sequence detector, probability of error for binary modulation techniques.

Unit 3. Broadcast Networks

Introduction to broadcast networks, digital audio broadcasting, HD digital technology, direct to home (DTH).

Unit 4. Software Defined Radio

Need for software radio, general structure for transceiver for SDR, third generation SDR system architecture, trends in SDR, cognitive radio, spectrum sensing in cognitive radio.

Unit 5. MIMO Systems

Introduction, space diversity and systems based on space diversity, smart antenna system and MIMO, MIMO based system architecture, multipath and space time processing in MIMO, Antenna considerations for MIMO, channel modelling, measurement and capacity in MIMO, cyclic delay diversity.

Text Books:

1. John G. Proakis, "Digital Communication", Prentice Hall India.

Reference books and other resources:

1. Upena Dalal, "Wireless Communication", Oxford University Press.
2. Wayne Tomasi, "Advanced Communication Systems", Pearson Education.
3. Related IEEE/IEE/ Science Direct publications.

Mapping of course contents with CO

Contents	CO1	CO2	CO3	CO4
Unit 1	H	-	-	-
Unit 2	-	H	-	-
Unit 3	-	-	H	-
Unit 4	-	-	H	-
Unit 5	-	-	-	H

Mapping of CO with PO

CO	PO										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	-	-	-	L	-	-	-	-	-	-
CO2	H	M	M	-	-	-	-	-	-	-	-
CO3	H	-	-	-	L	-	-	-	-	-	-
CO4	H	-	-	-	-	-	-	-	-	-	-

COURSE NAME: ADVANCED OPTICAL COMMUNICATION SYSTEM

COURSE CODE: MTEC-503

Internal Marks:	**50**	**L**	**T**	**P**
External Marks:	**100**	**4**	**0**	**-**

Numerical & Design Problems Content: 20%-30 %

Note: The question paper shall consist of eight questions of twenty (20) marks each, out of which five questions are required to be attempted by the candidate.

Course Outcomes

On successful completion of this course, the students should be able to:

CO1 Explain the various signal propagation concepts (including losses, dispersion, scattering, nonlinear effects etc.) related to optical fibers.

CO2 Explain the basic structure design of different optical amplifier and analyze their characteristics to determine performance.

CO3 Explain the concepts related to different dispersion management techniques used in optical fiber communication.

CO4 Define the soliton system and analyze the design of soliton system in different conditions (loss, dispersion, high speed and multichannel).

CO5 Explain the modulation formats and demodulation schemes used in coherent light wave systems and analyze their performance.

CO6 Describe basic concepts related to radio over fiber system and analyze its performance in different conditions

Syllabus

Unit 1. Introduction to Optical Fibers

Wave propagation, Dispersion and its limitations, losses and non-linear effects.

Unit 2. Optical Amplifiers

Semiconductor optical amplifier, Raman amplifier, EDFA.

Unit 3. Dispersion Management

Need pre-compensation schemes, best compensation techniques, dispersion compensating fibers, optical filters, fiber Bragg grating

Unit 4. Soliton Systems

Fiber soliton, soliton based communications, loss managed solitons, dispersion-managed solitons, high speed soliton systems, WDM soliton systems.

Unit 5. Coherent Light Wave Systems

Basic concepts, modulation formats, demodulation schemes, bit error rate, sensitivity degradation.

Unit 6. Radio over Fiber

Concept, advantages of RoF in mobile communication networks, macro diversity and micro diversity in RoF, RoF for hyper LAN 2 microcellular communication networks, RoF multiplexing techniques.

Text Books:

1. G. P. Aggarwal, "Fiber-Optic Communication Systems", John Wiley & Sons.

Reference books and other resources:

1. Djafar K. Mynbaev, "Fiber-Optic Communication Systems", John Wiley & Sons.
2. Leonid Kazovsky, Sergio Benedetto and Alan Willner, "Optical Fiber Communication Systems", Artech House.
3. Hamed Al-Raweshidy and Shozo Komaki, "Radio Over Fiber Technologies for Mobile Communication Networks", Artech House.
4. Related IEEE/IEE publications.

Mapping of course contents with CO

Contents	CO1	CO2	CO3	CO4	CO5	CO6
Unit 1	H	-	-	-	-	-
Unit 2	L	H	-	-	-	-
Unit 3	L	-	H	-	-	-
Unit 4	-	-	-	H	-	-
Unit 5	L	-	-	-	H	-
Unit 6	-	-	-	-	-	H

Mapping of CO with PO

CO	PO										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	L	-	-	-	-	-	-	-	-	-	-
CO2	M	-	H	-	M	-	-	-	L	-	-
CO3	M	-	H	-	M	-	-	-	L	-	-
CO4	M	-	H	M	M	-	-	-	L	-	-
CO5	M	-	H	-	M	-	-	-	L	-	-
CO6	M	-	H	M	M	-	-	-	L	-	-

COURSE NAME: ADVANCED DIGITAL SIGNAL PROCESSING

COURSE CODE: MTEC-504

	L	T	P
Internal Marks: 50			
External Marks: 100	**4**	**-**	**-**

Numerical & Design Problems Content: 20%-30%

Note: The question paper shall consist of eight questions of twenty (20) marks each, out of which five questions are required to be attempted by the candidate.

Course Outcomes

On successful completion of this course, the students should be able to:

CO1 Design FIR & IIR filters using appropriate method depending upon the given specification.

CO2 Explain sampling rate conversion methods and design the sampling rate converters.

CO3 Adaptive filters design using LMS & RLS algorithms.

CO4 Discuss different methods of spectrum estimation and analysis.

CO5 Analyze the effects of finite-word length in DSP systems.

CO6 Explain applications of multi-rate DSP & adaptive filters.

Syllabus

Unit 1. Design of IIR Filters

Introduction to digital filters; Types of digital filters: FIR and IIR filters; Choosing between FIR and IIR filters; Filter design steps; Features of IIR filters; coefficient calculation methods for IIR filters; Pole-zero placement method of coefficient calculation, Impulse invariant method of coefficient calculation, Matched z-transform (MZT) method of coefficient calculation, Bilinear z-transform (BZT) method of coefficient calculation.

Unit 2. Design of FIR Filters

Features of FIR Filters; FIR coefficient calculation methods; Window methods; The Optimal method; Frequency sampling method; Special FIR Filter design topics.

Unit 3. Multirate Digital Signal Processing

Introduction; Concepts of multirate signal processing: Sampling rate reduction: decimation by integer factors, Sampling rate increase: interpolation by integer factors, Sampling rate conversion by non-integer factors, Multistage approach to sampling rate conversion;

Design of practical sampling rate converters; Sample rate conversion using polyphase filter structure; Applications of multirate signal processing.

Unit 4. Adaptive Digital Filters

Concepts of adaptive filtering, Basic Wiener filter theory, Basic LMS adaptive algorithm, Recursive least squares algorithm, Applications of adaptive filters.

Unit 5. Spectrum Estimation and Analysis

Principles of spectrum estimation, Traditional methods: pitfalls, windowing, The periodogram method and periodogram properties, Modified periodogram methods, The Blackman-Turkey method, and The fast correlation method, Comparison of the power spectral density estimation methods, Modern parametric estimation methods.

Unit 6. Analysis of Finite Word-length Effects in Fixed-Point DSP Systems

DSP arithmetic: Fixed-point arithmetic, Floating-point arithmetic, ADC quantization noise and signal quality, Finite word length effects in IIR and FIR digital filters.

Text Books:

1. E. C. Ifeachor and B. W. Jervis, “Digital Signal Processing”, Second Edition, Pearson Education, 2002.
2. J. G. Proakis and D. K. Manolakis, “Digital Signal Processing”, Third Edition, Pearson Education, 2003.

Reference books and other resources:

1. J. G. Proakis, C. M. Rader, F. Ling, C. L. Nikias, M. Moonen, and I. K. Proudler, “Algorithms for Statistical Signal Processing”, Pearson Education, 2002.
2. A. V. Oppenheim and R. W. Schafer, “Digital Signal Processing”, Prentice Hall, 1975.
3. Monson H. Hayes, “Statistical Digital Signal Processing and Modeling”, Wiley Publications, 1999.
4. Simon Haykin, “Adaptive Filter Theory”, Fourth Edition, Pearson Education, 2008.

Mapping of course contents with CO

Contents	CO1	CO2	CO3	CO4	CO5	CO6
Unit 1	H	-	-	-	-	-
Unit 2	H	-	-	-	-	-
Unit 3	-	H	-	-	-	H
Unit 4	-	-	H	-	-	H
Unit 5	-	-	-	H	-	-
Unit 6	-	-	-	-	H	-

Mapping of CO with PO

CO	PO										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	H	H	M	L	-	-	-	-	-	-	-
CO2	H	H	M	-	-	-	-	-	-	-	-
CO3	H	-	M	-	-	-	-	-	-	-	-
CO4	H	-	-	-	-	-	-	-	-	-	-
CO5	H	M	-	-	-	-	-	-	-	-	-
CO6	H	-	-	-	-	-	-	-	-	-	-

COURSE NAME: ENGINEERING DESIGN AND PROJECT MANAGEMENT

COURSE CODE: MTEC-505

Internal Marks:	**50**	**L**	**T**	**P**
External Marks:	**100**	**4**	**0**	**-**

Numerical & Design Problems Content: 5%-10 %

Note: The question paper shall consist of eight questions of twenty (20) marks each, out of which five questions are required to be attempted by the candidate.

Course Outcomes

On successful completion of this course, the students should be able to:

CO1 Develop ability to analyze and solve problems methodically as well as manage individual and team projects with appropriate consideration of engineering and financial aspects.

CO2 Have an understanding of professional, ethical and social responsibilities as professional Engineer and manager.

CO3 Develop an ability to communicate effectively through oral and written presentation.

CO4 Perform effectively in groups and teams as a member / leader.

Syllabus

Unit 1. Introduction to Engineering Design

Definition, Identifying requirements & analyzing needs, Exploring and evaluating concepts, Prototyping and modeling systems, Testing, Deploying and validating a design, Documentation.

Unit 2. Introduction to Project Management

Definition of a project, Why project management, Project life cycle, Organization structures (functional vs. matrix and borrowed resources), Translating needs into requirements, Survey of local & global industrial economic scenario.

Unit 3. Project Selection and Planning

Project selection approaches, Decision methodologies (decision trees, analytical hierarchy process), Project evaluation techniques, Estimation (costs, schedule and requirements), Project financing.

Unit 4. Project Management and Leadership

Special demands on project managers, selecting the project manger and the project team, Project communications, Teams and team development, Characteristics of successful project management.

Unit 5. Project Planning and Estimating

Work breakdown structure, Scheduling techniques (precedence diagrams, PERT/CPM, Gantt and milestone charts), Budgeting techniques (S-curve, earned value) Resource allocation techniques (resource loading and leveling)

Unit 6. Risk and Quality Management

Fundaments of risk (e.g., what is risk?), Methods for dealing with risk and uncertainly, Historic roots of quality management, Current approaches to quality

Unit 7. Project Execution and Control

Project execution (configuration management), Project control (measuring work performance), Financial control (activity based accounting), Integrated cost and schedule control (Earned value).

Unit 8. Ethical Project Management

Professional ethics & values, Corporate social Responsibility, Dealing within an ethical selection, Group case study & task.

Text Books:

1. K. Nagarajan, “Project Management, New Age International Publishers”, New Delhi.

Reference books and other resources:

1. Kathy Schwalbe, “An Introduction to Project Management”, Kathy Schwalbe LLC.
2. Paromeshwar P. Iyer, “Engineering Project Management with case studies”, Vikas Publishing House Pvt. Limited, New Delhi.
3. B. Blanchard and W. Fabrycky, “Systems Engineering and Analysis”, Prentice Hall.

Mapping of course contents with CO

Contents	CO1	CO2	CO3	CO4
Unit 1	M	-	-	-
Unit 2	H	-	M	-
Unit 3	H	-	-	-
Unit 4	-	-	-	H
Unit 5	H	-	-	-
Unit 6	M	-	-	-
Unit 7	H	-	-	-
Unit 8	-	H	H	H

Mapping of CO with PO

CO	PO										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	H	H	H	H	H	H	H	-	M	-	-
CO2	-	-	-	-	-	-	-	-	M	H	M
CO3	-	-	-	-	-	-	-	H	M	-	-
CO4	-	-	-	-	-	H	H	M	-	-	L

COURSE NAME: ADVANCED MICROWAVE ENGINEERING

COURSE CODE: MTEC-506

Internal Marks:	**50**	**L**	**T**	**P**
External Marks:	**100**	**4**	**0**	**-**

Numerical & Design Problems Content: 5%-10 %

Note: The question paper shall consist of eight questions of twenty (20) marks each, out of which five questions are required to be attempted by the candidate.

Course Outcomes

On successful completion of this course, the students should be able to:

CO1 Analyze microwave networks using S and mixed mode S parameters.

CO2 Design microwave filters using various methods.

CO3 Design advanced microwave amplifiers based on MIC

CO4 Explain the operation of microstrip antenna, parameters and performance improvement techniques.

Syllabus

Unit 1. Microwave Network Analysis

Concept of differential signal, coupling and crosstalk, Introduction to S parameters, properties of S parameters, Single ended, mixed mode, Single ended to mixed mode conversion.

Unit 2. Design of Microwave filters

Introduction, Microwave filter structures, Planar, Active, Superconductive , SAW and micro-machined filters etc., Pseudo-elliptic Filters, Prototype Synthesis Example, Design of Hilbert Filters, Realizations and Measured Performance.

Unit 3. Advanced Microwave Integrated Circuits

Multi-Standard Multi-Band Reconfigurable LNA, LNA Inventions, Multiband Multi-Standard LNA with CPW Transmission Line Inductor.

Unit 4. Microstrip Antenna

Microstrip Patch antennas, variations of shorted patch antenna, dual frequency shorted patch antennas, low cross polarized antennas, dual arm printed monopole antenna: Coplanar Waveguide Feeding.

Unit 5. Antennas on Impedance Substrates

High Impedance Surface (HIS), surface wave bends, reflection phase, bandwidth, Antennas on HIS, diffraction control, tunable impedance substrate, holographic artificial impedance substrate.

Text Books:

1. Allan Huynh, Magnus Karlsson and Shaofang Gong, "Advanced Microwave Circuits and Systems", In Tech.
2. Pierre Jarry and Jacques Beneat, "Design and Realizations of Miniaturized Fractal Microwave and RF Filters", Wiley-Blackwell.
3. Arjuna Marzuki, Ahmad Ismat Abdul Rahim and Mourad Loulou, "Advances in Monolithic Microwave Integrated Circuits for Wireless Systems: Modeling and Design Technologies", Information Science Reference.
4. Rod Waterhouse, "Printed Antennas for Wireless Communications", John Wiley & Sons.

Reference books and other resources:

1. Related IEEE publications

Mapping of course contents with CO

Contents	CO1	CO2	CO3	CO4
Unit 1	H	-	-	-
Unit 2	-	H	-	-
Unit 3	-	-	H	
Unit 4	-	-	-	H
Unit 5	-	-	-	H

Mapping of CO with PO

CO	PO										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	H	M	M	-	-	-	-	-	H	-	-
CO2	M	-	H	-	H	-	-	-	H	-	-
CO3	M	-	H	-	H	-	-	-	H	-	-
CO4	M	-	H	-	H	-	-	-	H	-	-

COURSE NAME: SEMICONDUCTOR DEVICES THEORY & MODELING

COURSE CODE: MTEC 601

Internal Marks:	**50**	**L**	**T**	**P**
External Marks:	**100**	**3**	**0**	**-**

Numerical & Design Problems Content: 20%-30 %

Note: The question paper shall consist of eight questions of twenty (20) marks each, out of which five questions are required to be attempted by the candidate.

Course Outcomes

On successful completion of this course, the students should be able to:

CO1 Apply basic equations like Poisson's equations, continuity equation etc. for the operation of semiconductor devices.

CO2 Explain the current-voltage characteristics and switching characteristics of p-n junctions with the use of mathematical equations.

CO3 Model low frequency and high frequency capacitance-voltage characteristics and other depletion effects on device performance.

CO4 Derive bipolar device models for circuit and time-dependent analysis.

CO5 Differentiate between long-channel and short-channel MOSFETs on the basis of characteristics and non-linear parameters.

Syllabus

Unit 1. Physics of Semiconductors

Energy bands in solids- carrier concentration in intrinsic and extrinsic semiconductors, Carrier transport in silicon-drift and diffusion current, velocity saturation, Basic equations for device operation-Poisson's equation, current-density equations, continuity equation.

Unit 2. P-N Junctions

Built-in potential, Diode equation, current-voltage characteristics-temperature dependence and diode leakage currents, Time-dependent and switching characteristics- excess charge carriers, Diffusion Capacitance.

Unit 3. MOS capacitors

Surface Potential, electrostatic Potential and charge distribution in Silicon, Capacitances in MOS structure-low frequency and high frequency C-V characteristics, polysilicon work

function and depletion effects, charge in Si-SiO_2 interface, effects of interface traps on device characteristics-surface generation and recombination.

Unit 4. Bipolar Transistors

NPN & PNP Transistors, Ideal Current-Voltage Characteristics, Bipolar Device Models for Circuit and Time-Dependent Analysis.

Unit 5. MOSFET Devices

Long-channel MOSFETs: drain current model, I-V characteristics, subthreshold characteristics, Temperature dependence of Threshold voltage, channel mobility. Short-Channel MOSFETs: short channel effects, velocity saturation, channel length modulation, source-drain series resistance.

Text Books:

1. Y. Taur and T. H. Ning, "Fundamentals of Modern VLSI Devices", Second Edition, Cambridge University Press, 2013.
2. N. Arora, "MOSFET Modeling for VLSI simulation: Theory and Practice", World Scientific, 2007.

Reference books and other resources:

1. S. M. Sze, "Physics of Semiconductor Devices", John Wiley & Sons, 3rd Edition, 2007.
2. B. G. Streetman and S. Banerjee, "Solid State Electronic Devices", Pearson Prentice Hall, 2006.
3. T. A. Fjeldly, T. Ytterdal and M. S. Shur, "Introduction to Device Modeling and Circuit Simulation", Wiley.
4. Y. Tsividis, "Operation and Modeling of the MOS Transistor", Second Edition, Oxford.
5. R. F. Pierret, "Semiconductor Device Fundamentals", Addison Wesley Publishers, 1996.

Mapping of course contents with CO

Contents	CO1	CO2	CO3	CO4	CO5
Unit 1	H	-	-	-	-
Unit 2	-	H	-	-	-
Unit 3	-	-	H	-	-
Unit 4	-	-	-	H	-
Unit 5	-	-	-	-	H

Mapping of CO with PO

CO	PO										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	H	-	-	-	-	-	-	-	-	-	-
CO2	H	H	L	-	-	-	-	-	-	-	-
CO3	H	H	L	-	H	-	-	-	-	-	-
CO4	H	H	L	-	H	-	-	-	-	-	-
CO5	H	H	L	-	H	-	-	-	H	-	-

COURSE NAME: MULTIMEDIA COMMUNICATION

COURSE CODE: MTEC-602

Internal Marks:	**50**	**L**	**T**	**P**
External Marks:	**100**	**3**	**0**	**-**

Numerical & Design Problems Content: 10%-20%

Note: The question paper shall consist of eight questions of twenty (20) marks each, out of which five questions are required to be attempted by the candidate.

Course Outcomes

On successful completion of this course, the students should be able to:

CO1 Comprehend the concepts of multimedia representation

CO2 Explain various audio, video, text and image file standards.

CO3 Apply various audio, video, text and image compression techniques

CO4 Study and analyze various security issues related to multimedia.

Syllabus

Unit 1. Multimedia Information Representation

Different types of multimedia information, Information representation: Text, Image, Audio, Video.

Unit 2. Multimedia systems and file formats/standards

Distributed MM Systems, Multimedia processors, Multimedia OS, Various files formats for multimedia and their applications, BMP, PNG, TIFF, JPEG, DFX, AVI, MPEG Audio/ Video Standards, MPEG-1, MPEG-2, MPEG-4, MPEG-7.

Unit 3. Text and Image Compression

Introduction, compression principles, Text compression techniques: GIF, TIFF, JPEG, PNG, Image compression techniques: static Huffman coding, dynamic Huffman coding, arithmetic coding, Lempel-Ziv coding.

Unit 4. Audio and Video Compression

Introduction, audio compression, DPCM, ADPCM, APC, LPC**,** video compression techniques, Huffman, Run length, Variable length, Lossy /lossless compression.

Unit 5. Security Issues

Transform audio coders, Image coding, video coding, Water marking techniques, Steganography techniques, Organization, Storage and retrieval, ANNs for MMSP.

Text Books:

1. Fred Halsall, "Multimedia communications", Prentice Hall.
2. Proakis, "Digital communications", Prentice Hall.

Reference books and other resources:

1. P. K. Andleigh and K. Thakkar, "Multimedia Systems Design", PHI, 2002.
2. Tay Vaughan, "Multimedia", 5/e, TMH, 2001.

Mapping of course contents with CO

Contents	CO1	CO2	CO3	CO4
Unit 1	H	-	-	-
Unit 2	-	H	-	-
Unit 3	-	-	H	-
Unit 4	-	-	H	-
Unit 5	-	-	-	H

Mapping of CO with PO

CO	PO										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	M	L	-	-	-	-	-	-	-	-
CO2	-	-	-	M	H	-	-	-	-	-	-
CO3	-	-	-	-	H	-	-	-	-	H	-
CO4	-	-	-	-	-	-	-	-	-	-	-

COURSE NAME: ADVANCED WIRELESS NETWORKS

COURSE CODE: MTEC-603

Internal Marks:	**50**	**L**	**T**	**P**
External Marks:	**100**	**3**	**0**	**-**

Numerical & Design Problems Content: 0%-10%

Note: The question paper shall consist of eight questions of twenty (20) marks each, out of which five questions are required to be attempted by the candidate.

Course Outcomes

On successful completion of this course, the students should be able to:

CO1 Comprehend the basics of wireless area networks.

CO2 Describe and analyse the advancements in wireless internet.

CO3 Identify and resolve issues in AD-hoc networks.

CO4 Analyze various design challenges in wireless sensor networks.

CO5 Contrast and analyze emerging ultra wideband technologies

Syllabus

Unit 1. Wireless Area Networks

WiMAX: Network architecture , protocol stack of IEEE 802.16 , physical layer, MAC layer schemes ,differences between IEEE 802.11 and IEEE 802.16; WLAN: Fundamentals, network architecture, protocol stack of IEEE 802.11 , physical layer, MAC layer mechanism; WPAN: System model, protocol stack of IEEE802.15; Bluetooth: Network architecture, operation, protocol stack, physical and MAC layer ; Radio Frequency Identification (RFID): Types and specifications.

Unit 2. Wireless Internet

Mobile IP - IPv6 advancements ,mobility management ,functions ,location management, registration and handoffs ,wireless security and standards; TCP in Wireless Domain: TCP over wireless , types , traditional , snoop , indirect , mobile , transaction oriented , impact of mobility.

Unit 3. AD-hoc Network

Ad-hoc Network: Introduction - characteristics , medium access scheme , routing schemes, multicasting , transport layer protocol , pricing scheme , QoS provisioning , self organization, security , energy management and deployment consideration.

Unit 4. Wireless Sensor Network

Wireless Sensor Network: Characteristics and architecture of wireless sensor network, layered and clustered , data dissemination , data gathering , MAC protocols , routing schemes, security , enabling technologies for sensor network and applications ,comparison with MANET - ZIGBEE standard and architecture ,WBAN standard and architecture.

Unit 5. Emerging Technologies

UWB Radio Communication: Fundamentals of UWB , operation of UWB systems, comparison with other technologies, advantages and disadvantages; Multimode 802.11 - IEEE 802.11a/b/g - software radio based multimode system, meghadoot architecture - 802.11VoIP phone - IEEE 802.11n.

Text Books:

1. William Stallings, "Wireless Communication and Networks", Second Edition, Prentice Hall, 2005.
2. K. Pahlavan and P. Krishnamurthy, "Principle of Wireless Networks - A Unified Approach", Prentice Hall of India, 2006.

Reference books and other resources:

1. C. Siva Ram Murthy and B. S. Manoj, "Ad-hoc Wireless Networks-Architecture and Protocols", 2nd Edition, Pearson education, 2007.
2. Vijay K. Garg, "Wireless Communications and Networks", Second Edition, Morgan Kaufmann Publishers (Elsevier), 2007.
3. C. K. Toh, "Ad Hoc Mobile Wireless networks", First Edition, Pearson education, 2002.
4. Upena Dalal , "Wireless Communication", Oxford University Press, 2009.

Mapping of course contents with CO

Contents	CO1	CO2	CO3	CO4	CO5
Unit 1	H	-	-	-	
Unit 2	-	H	-	-	
Unit 3	-	-	H	-	
Unit 4	-	-	-	H	
Unit 5	-	-	-	-	H

Mapping of CO with PO

CO	PO										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	H	-	-	-	-	-	-	-	-	-	-
CO2	L	L	-	-	-	-	-	-	-	-	-
CO3	L	L	H	-	-	-	-	-	-	-	-
CO4	L	L	-	-	-	-	-	-	-	-	-
CO5	H	L	H	H	-	-	-	-	H	-	H

COURSE NAME: ADVANCED WIRELESS & MOBILE COMMUNICATION

COURSE CODE: MTEC-604

Internal Marks:	**50**	**L**	**T**	**P**
External Marks:	**100**	**3**	**0**	**-**

Numerical & Design Problems Content: 10%-20 %

Note: The question paper shall consist of eight questions of twenty (20) marks each, out of which five questions are required to be attempted by the candidate.

Course Outcomes

On successful completion of this course, the students should be able to:

CO1 Comprehend the basic terminology and various generations of wireless communication systems.

CO2 Explain various types of fading techniques and associated parameters.

CO3 Explain various techniques to combat fading.

CO4 Describe multiple accesses using CDMA.

CO5 Explain latest wireless communication standards.

Syllabus

Unit 1. Review of Wireless Communication Systems

The cellular concept, handoff and system capacity, trunking and grade of service, capacity improvement techniques, Evolution and enabling technologies of cellular networks: 2G, 2.5 G, 3G-WCDMA, 3G CDMA 2000, 3G TD-SCDMA, 4G, and 5G cellular networks.

Unit 2. Small Scale Fading and Multipath

Wireless channel and fading, types of fading, Parameters of mobile multipath channels, ISI and its reduction using Pulse shaping techniques, Rayleigh fading, Rician fading and Nakagami fading distributions.

Unit 3. Diversity and Channel equalization

Introduction to diversity, types of diversity, multi antenna maximal ratio combiner, BER with diversity, fundamentals of equalization, algorithms for adaptive equalization.

Unit 4. Multiple Access

Introduction to CDMA, spread spectrum and linear feedback shift register, generation and properties of PN sequences, correlation of PN sequences and jammer margin, CDMA advantage and RAKE Receiver, Multi user CDMA.

Unit 5. Latest Wireless Standards

IEEE 802.15.6 Body area network, IEEE 802.20 Mobile Broadband Wireless Access, IEEE 802.22 Wireless Regional Area Networks, evolving IEEE 802.25 Omni-Range Area Network.

Text Books:

1. T. S. Rappaport, "Wireless Communications", Pearson Education.
2. William Stallings, "Wireless Communication and Networks", Pearson Prentice Hall.

Reference books and other resources:

1. NPTEL, "Advanced 3G and 4G Wireless Mobile Communications", http://nptel.ac.in/courses/117104099/.
2. Jochen Schiller, "Mobile Communications (2nd Edition)", Addison-Wesley.
3. Research Papers from IEEE Journals.

Mapping of course contents with CO

Contents	CO1	CO2	CO3	CO4	CO5
Unit 1	H	-	-	-	-
Unit 2	-	H	-	-	-
Unit 3	-	-	H	-	-
Unit 4	-	-	-	H	-
Unit 5	-	-	-	-	H

Mapping of CO with PO

CO	PO										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	H	-	-	-	-	-	-	-	-	-	-
CO2	H	-	-	-	-	-	-	-	-	-	-
CO3	M	-	H	-	H	-	-	-	-	-	-
CO4	M	-	H	-	M	-	-	-	-	-	-
CO5	M	-	-	-	-	-	-	-	H	-	-

COURSE NAME: SOFT COMPUTING

COURSE CODE: MTEC-605

	L	T	P
Internal Marks: 50			
External Marks: 100	**3**	**-**	**-**

Numerical & Design Problems Content: 10%-20%

Note: The question paper shall consist of eight questions of twenty (20) marks each, out of which five questions are required to be attempted by the candidate.

Course Outcomes

On successful completion of this course, the students should be able to:

CO1 Explain the concepts of soft computing, artificial intelligence and optimization problems.

CO2 Explain the principles of Artificial Neural Networks and design Artificial Neural Networks models for given problems.

CO3 Apply the fuzzy techniques for the analysis and design of specified systems.

CO4 Utilize the Genetic Algorithms and PSO Algorithm for the optimization of given problems.

CO5 Design hybrid soft computing algorithms for solving the different problems.

Syllabus

Unit 1. Soft Computing and Artificial Intelligence

Hard vs. Soft computing, constituents of soft computing, scope of soft computing, meaning of optimization, local optima, global optima, heuristic methods, stochastic methods, constrained optimization, design variables, objective function, and variable bounds. Artificial intelligence: definitions, programming models and techniques, fundamental issues, progress of artificial intelligence.

Unit 2. Artificial Neural Networks

Biological neural networks, history of development in neural networks principles, artificial neural net terminology, models of neuron, activation functions, topology, learning, types of learning: supervised, unsupervised, Re-enforcements learning, learning Rules/Methods. Back-propagation learning algorithm, architecture of back propagation networks, selection of various parameters in back propagation networks, multilayer perceptron networks, radial basis function network, Kohonen's self-organizing networks, Hopfield network, applications/case-studies.

Unit 3. Fuzzy Logic Systems

Crisp & fuzzy sets; properties, operations, and relations, membership functions, fuzzification, fuzzy rule based systems, fuzzy-inference systems, defuzzication techniques, applications/ case-studies.

Unit 4. Genetic Algorithm (GA)

GA history, biological background of GA, working principle, basic terminologies, operators: encoding, selection, cross over, mutation, stopping criteria, problem solving using GA.

Unit 5. PSO Algorithm

Biological background of PSO, working principle, basic terminologies, operators, PSO equations, problem solving using PSO.

Unit 6. Hybrid Soft Computing Techniques

Neuro-fuzzy hybrid algorithm, genetic neuro-hybrid algorithm, fuzzy genetic-hybrid algorithm, genetic fuzzy hybrid algorithm, GA-PSO hybrid algorithm.

Text Books:

1. S. Rajasekaran and G. A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis and Applications", PHI, 2010.
2. F. O. Karry and C. D. Silva, "Soft Computing and Intelligent Systems Design", Pearson Education, 2009.

Reference books and other resources:

1. S. N. Sivanandam and S. N. Deepa, "Principles of Soft Computing", Second Edition, Wiley Publications, 2007.
2. J.-S R. Jang, C.-T. Sun and E. Mizutani, "Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence", Prentice Hall India, 2010.
3. S. K. Valluru and T. N. Rao, "Introduction to Neural Networks, Fuzzy Logic & Genetic Algorithms", First Edition, Jaico, 2010.
4. N. P. Padhy, "Artificial Intelligence and Intelligent Systems", Second Edition, Oxford University Press, 2005.
5. Related IEEE/IEE/ Science Direct publications.

Mapping of course contents with CO

Contents	CO1	CO2	CO3	CO4	CO5
Unit1	H	-	-	-	-
Unit 2	-	H	-	-	-
Unit 3	-	-	H	-	-
Unit 4	-	-	-	H	-
Unit 5	-	-	-	H	-
Unit 6	-	-	-	-	H

Mapping of CO with PO

CO	PO										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	H	-	-	-	-	-	-	-	-	-	-
CO2	H	-	M	-	M	-	-	-	-	-	-
CO3	H	-	M	-	M	-	-	-	-	-	-
CO4	H	-	M	-	M	-	-	-	-	-	-
CO5	H	M	M	M	M	-	-	-	-	-	-

COURSE NAME: ERROR CONTROL CODING TECHNIQUES

COURSE CODE: MTEC 606

Internal Marks:	**50**	**L**	**T**	**P**
External Marks:	**100**	**3**	**0**	**-**

Numerical & Design Problems Content: 20%-30 %

Note: The question paper shall consist of eight questions of twenty (20) marks each, out of which five questions are required to be attempted by the candidate.

Course Outcomes

On successful completion of this course, the students should be able to:

CO1 Explain basic parameters and terminology related to coding theory.

CO2 Coding and decoding of data using Linear Codes.

CO3 Coding and decoding of data using Convolutional Codes.

CO4 Coding and decoding of data using Viterbi Codes.

CO5 Coding and decoding of data using LDPC Codes.

CO6 Coding and decoding of data using Turbo Codes.

Syllabus

Unit 1. Mathematical Preliminaries and Introduction

Groups, subgroups and equivalence relations, cosets, rings and fields, vector spaces, linear independence and basis, linear codes and independence, spanning, Basics of binary block codes for the binary symmetric channel.

Unit 2. Linear Block Codes

Linear block codes; The dual code, Systematic generation matrix, minimum distance of a linear code, Hamming distance, Bounds on the size of a block code; Bounded and maximum-likelihood decoding of binary block codes.

Unit 3. Convolutional and Viterbi Codes

Basics of convolutional codes; states and trellis, the Viterbi decoding algorithm. Catastrophic error propagation, path enumeration, viterbi decoder over AWGN channel.

Unit 4. Low Density Parity Check (LDPC) Codes

LDPC Codes terminology, Gallanger decoding algorithm, BP decoding of LDPC codes, density evolution under BP decoding, convergence and concatenation theorem, turbo codes.

Unit 5. Turbo Codes

Turbo Codes, Implementation of Turbo Decoder, From Turbo Code to Advanced Iterative Receivers, Turbo-Based Interleaving Techniques, Turbo-MIMO Techniques.

Text Books:

1. R. Bose, "Information Theory, Coding and Cryptography", Tata McGraw-Hill Education, 2008.
2. Thierry Lestable (Editor) and Moshe Ran (Editor), "Error Control Coding for B3G/4G Wireless Systems: Paving the Way to IMT-Advanced Standards", John Wiley, April 2011.

Reference books and other resources:

1. P. V. Kumar, M. Win, H-F. Lu and C. Georghiades, "Error-Control Coding Techniques and Applications", Chapter 17 in Optical Fiber Telecommunications IV-B: Systems and Impairments, Editors: Ivan P. Kaminow and Tingye Li, Elsevier Science Press, 2002.
2. F. J. MacWilliams and N. J. A. Sloane, "The Theory of Error-Correcting Codes", North-Holland, 1977.
3. NPTEL website: Error Control Code : http://nptel.ac.in/syllabus/117108044/.

Mapping of course contents with CO

Contents	CO1	CO2	CO3	CO4	CO5	CO6
Unit 1	H	-	-	-	-	-
Unit 2	L	H	-	-	-	-
Unit 3	L	-	H	H	-	-
Unit 4	L	-	-	-	H	-
Unit 5	L	-	-	-	-	H

Mapping of CO with PO

CO	PO										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	H	-	-	-	-	-	-	-	-	-	-
CO2	M	-	H	-	M	-	-	-	L	-	-
CO3	M	-	H	-	M	-	-	-	L	-	-
CO4	M	-	H	-	M	-	-	-	L	-	-
CO5	M	-	H	-	M	-	-	-	L	-	-
CO6	M	-	H	H	M	-	-	-	H	-	-

COURSE NAME: DATABASES AND DATA MINING

COURSE CODE: MTEC-607

Internal Marks: 50	**L**	**T**	**P**
External Marks: 100	**3**	**0**	**-**

Numerical & Design Problems Content: 0%-10%

Note: The question paper shall consist of eight questions of twenty (20) marks each, out of which five questions are required to be attempted by the candidate.

Course Outcomes

On successful completion of this course, the students should be able to:

CO1 Describe the concepts of database systems.

CO2 Analyze different types and characteristics involved in distributed systems.

CO3 Explain architecture and tools of data warehousing and Online Analytical Processing (OLAP).

CO4 Apply tasks and techniques of data mining.

CO5 Explain different clustering and classification techniques.

Syllabus

Unit 1. Basics of Database System

Database Systems versus File Systems, View of Data, Data Models, database languages, Database Users and Administrators. Transaction Management, Decision Support Systems, Components of a Database management, Distributed Processing and Client Basic Concepts, Keys, Design Issues, ER Diagrams, Types of databases.

Unit 2. Distributed Database Management System (DDBMS)

Introduction to distributed database, Advantages and disadvantages of distributed database, Homogenous and Heterogeneous distributed databases, Functions and architecture of DDBMS, Data fragmentation, Data allocation, Distributed transactions, Distributed concurrency control, Distributed deadlock management and Distributed database recovery.

Unit 3. Data Warehousing and Online Analytical Processing (OLAP)

Introduction to data warehousing, Data ware architecture, Data flows, warehousing tools, Data marts, Data warehouse design, Online Analytical Processing (OLAP benchmarks,

benefits, representation of multi-dimensional data applications of OLAP, OLAP tools, categories of OLAP tools).

Unit 4. Data Mining

Introduction, Process of data mining, Data mining goals, Tasks and techniques (Prediction modeling, Database segmentation, Link analysis, Deviation detection), Applications of data mining.

Unit 5. Clustering and Classification

Introduction, Issues in clustering, Types of clustering: Hierarchal and partitioning clustering, K-means clustering, Applications of clustering, Applications of classification, Classification techniques: Decision trees, Nearest neighbour.

Textbooks:

1. B. Connolly, "Database Systems: A Practical Approach to Design, Implementation and Management." Pearson Education, 2007.
2. A. K. Pujari, "Data Mining Techniques", Universities Press, 2013.

Reference books and other resources:

1. V. Pudi and P. R. Krishna "Data Mining", Oxford University Press India, 2009.
2. R. Elmasri and S. Navathe, "Fundamentals of Database Systems", Pearson Education, 2007.
3. H. F. Korth and A. Silberchatz, "Database Concepts", Tata McGraw Hill, 2010.

Mapping of course contents with CO

Contents	CO1	CO2	CO3	CO4	CO5
Unit 1	H	L	-	-	-
Unit 2	-	H	-	-	-
Unit 3	-	-	H	L	-
Unit 4	-	-	-	H	-
Unit 5	-	-	-	-	H

Mapping of CO with PO

CO	PO										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	H	-	-	-	-	-	-	-	-	-	-
CO2	H	M	-	-	-	-	-	-	-	-	-
CO3	H	-	-	-	H	-	-	-	M	-	-
CO4	H	-	-	-	H	-	-	-	-	-	-
CO5	H	-	-	-	-	-	-	-	-	-	-

COURSE NAME: BIOMEDICAL ELECTRONICS

COURSE CODE: MTEC-608

Internal Marks: 50	**L**	**T**	**P**
External Marks: 100	**3**	**0**	**-**

Numerical & Design Problems Content: 0%-10%

Note: The question paper shall consist of eight questions of twenty (20) marks each, out of which five questions are required to be attempted by the candidate.

Course Outcomes

On successful completion of this course, the students should be able to:

CO1 Describe the methods of recording and measuring various bio potentials.

CO2 Analyze medical imaging systems.

CO3 Classify and describe therapeutic equipments.

Syllabus

Unit 1. Measuring, Recording and Monitoring Instruments

Biomedical signals and electrodes, Biomedical recorders, Oximeters, Biomedical telemetry, Telemedicine technology, Blood cell counters.

Unit 2. Modern Imaging Systems

X-ray machine, Visualization of X-rays, Physical parameters for X-ray Detectors, Principle of NMR Imaging system, Image reconstruction techniques, Basic NMR components, Biological effect of NMR imaging, Advantages of NMR imaging system.

Unit 3. Ultrasonic Systems

Basics of diagnostic radiology, Diagnostic Ultrasound, Physics of Ultrasonic waves, Medical ultrasound, Three-dimensional ultrasound imaging systems, Portable ultrasound systems.

Unit 4. Therapeutic Equipment

Cardiac pacemakers, Cardiac defibrillators, Electrotherapy equipment, Capnography, Radiotherapy equipment, Laser applications in Biomedical field.

Text Book:

1. R. S. Khandpur, “Magnetic Resonance Imaging System”, in Handbook of Biomedical Instrumentation, Third Edition, New Delhi, India: McGraw Hill Education, 2014.

Reference books and other resources:

1. Joseph J. Carr and John M. Brown, “Introduction to Biomedical equipment Technology”, John Wiley and Sons, New York, 2004.
2. Leislie Cromwell, “Biomedical instrumentation and measurement”, Prentice Hall of India, New Delhi, 2007.

Mapping of course contents with CO

Contents	CO1	CO2	CO3
Unit 1	H	-	-
Unit 2	-	H	-
Unit 3	-	H	-
Unit 4	-	-	H

Mapping of CO with PO

CO	PO										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	H	-	-	-	-	-	-	-	M	-	-
CO2	H	-	-	-	-	-	-	-	M	-	-
CO3	H	-	-	-	-	-	-	-	M	-	-

COURSE NAME: ORGANIC ELECTRONICS

COURSE CODE: MTEC-609

Internal Marks: 50	**L**	**T**	**P**
External Marks: 100	**3**	**0**	**-**

Numerical & Design Problems Content: 0%-10%

Note: The question paper shall consist of eight questions of twenty (20) marks each, out of which five questions are required to be attempted by the candidate.

Course Outcomes

On successful completion of this course, the students should be able to:

CO1 Describe the architecture, fabrication and properties of organic electronic transistor.

CO2 Summarize advanced materials for organic electronics.

CO3 Comprehend different manufacturing methods in organic electronics.

CO4 Describe the fabrication and characterization of Integrated Circuits.

Syllabus

Unit 1. Introduction to Organic Electronic Materials

Organic Electronic Materials – Classification, Organic Thin-Film Transistor – Architecture, Operating Mode, Fabrication Techniques, Structure - Property Relationships, Methods of Improving Performance – Structural Perfection, Device Architecture, Electrical and Environmental Stability – Chemical Effects on Stability, Gate Dielectrics on Electrical Functionality.

Unit 2. Advanced Materials for Organic Electronics

Pentacene Transistors– Performance, Engineered Pentacenes – Reversible Functionalization–End-Substituted Derivatives, Peri-functionalized Pentacenes, Heteropentacenes, Semiconductors Based on Polythiophene and Indolo [3,2-*B*] Carbazole– Polydialkylterthiophenes, Polydialkylquaterthiophenes, Polythiophene Nanoparticles, Indocarbazole Designs.

Unit 3. Manufacturing Methods

Production of Substrates for Organic Electronics- Reel-to-Reel Vacuum Metallization, Organic Vapor Phase Deposition – Production of TFTs, OLED, Organic Photovoltaics,

Micro- and Nanofabrication Techniques – Thermal Imaging, Printing, Digital Lithography for TFT Fabrication, Solution Based Printing.

Unit 4. Devices, Applications and Products

Transistors to Integrated Circuits – Fabrication and Characterization of ICs, Non-Rigid Display – Roll-Up Active-Matrix Displays Design, Active–Matrix Light-Emitting Displays – Advantages Over LCDs, Fabrication Process, Large-Area Detectors and Sensors – Future Prospects, Organic Semiconductor-Based Chemical Sensors.

Text Book:

1. H. Klauk, "Organic Electronics: Materials, Manufacturing, and Applications" Wiley-VCH Verlag GmbH & Co. KGaA, 2006.

Reference Books and Other Resources:

1. M. Pope and C. E. Swenberg, "Electronics Processes in Organic Crystals and Polymers", Second Edition, Oxford Science Publications, 1999.
2. W. Brutling, "Physics of Organic Semiconductors", Wiley- YCH, 2005.
3. Z. H. Kafafi, "Organic Electroluminescence", CRC Press, 2005.
4. S. Sun and N. S. Sarciftci, "Organic Photovoltaics -Mechanisms, Materials and Devices", CRC Press, 2005.
5. Related IEEE/IE publications.

Mapping of course contents with CO

Contents	CO1	CO2	CO3	CO4
Unit 1	H	-	-	-
Unit 2	-	H	-	-
Unit 3	-	-	H	-
Unit 4	-	-	-	H

Mapping of CO with PO

CO	PO										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	H	-	-	L	-	-	-	-	L	-	-
CO2	M	-	-	M	-	-	-	-	L	-	-
CO3	M	-	-	M	-	-	-	-	L	-	-
CO4	M	-	-	H	-	-	-	-	L	-	-

COURSE NAME: VLSI DESIGN, VERIFICATION & TESTING

COURSE CODE: MTEC-610

Internal Marks: 50	**L**	**T**	**P**
External Marks: 100	**3**	**0**	**-**

Numerical & Design Problems Content: 0%-10%

Note: The question paper shall consist of eight questions of twenty (20) marks each, out of which five questions are required to be attempted by the candidate.

Course Outcomes

On successful completion of this course, the students should be able to:

CO1 Describe digital VLSI design flow and high level design representations.

CO2 Explain high level synthesis algorithms like scheduling, allocation and binding along with the logic optimization.

CO3 Implement Binary Decision Diagram for verification of circuits.

CO4 Apply temporal logic for verification and use model checking algorithms.

CO5 Apprehend testing of combinational and sequential circuits, fault simulations and BIST mechanism.

Syllabus

PART-A (Design)

Unit 1. Introduction

Introduction to Digital VLSI Design Flow, High Level Design Representation, Transformations for High Level Synthesis.

Unit 2. Scheduling, Allocation and Binding

Introduction to HLS: Scheduling, Allocation and Binding Problem, Scheduling Algorithms, Binding and Allocation Algorithms.

Unit 3. Logic Optimization and Synthesis

Two level Boolean Logic Synthesis, Heuristic Minimization of Two-Level Circuits, Finite State Machine Synthesis, Multilevel Implementation.

PART-B (Verification)

Unit 4. Binary Decision Diagram

Binary Decision Diagram: Introduction and construction, Ordered Binary Decision Diagram, Operations on Ordered Binary Decision Diagram, Ordered Binary Decision Diagram for Sequential Circuits.

Unit 5. Temporal Logic

Introduction and Basic Operations on Temporal Logic, Syntax and Semantics of Computational Tree Logic (CTL), Equivalence between CTL Formulas.

Unit 6. Model Checking

Verification Techniques, Model Checking Algorithm, Symbolic Model Checking.

PART-C (Testing)

Unit 7. Introduction to Digital Testing and Fault Simulation

Introduction to Digital VLSI Testing, Functional and Structural Testing, Fault Equivalence, Fault Simulation, Testability Measures (SCOAP).

Unit 8. Combinational Circuit and Sequential Circuit Testing

Introduction to Automatic Test Pattern Generation (ATPG) and ATPG Algebras, D-Algorithm, ATPG for Synchronous Sequential Circuits, Scan Chain based Sequential Circuit Testing.

Unit 9. Built in Self test (BIST)

Components of BIST**,** Memory Testing.

Text Books:

1. L. T. Wang, Y. W. Chang and K. T. Cheng, “Electronic Design Automation: Synthesis, Verification and Test”, Elsevier, 2009.
2. M. L. Bushnell and V. D. Agrawal, “Essentials of Electronic Testing for Digital, Memory & Mixed-Signal Circuits”, Kluwer Academic Publishers, 2002.

Reference Books and Other Resources:

1. L.T. Wang, C. W. Wu and X. Wen, “VLSI Test Principles and Architectures: Design for Testability”, Elsevier, 2006.
2. L. Scheffer, L. Lavagno and G. Martin, “EDA for IC System Design, Verification, and Testing”, Taylor & Francis Group, 2006.

Mapping of course contents with CO

Contents	CO1	CO2	CO3	CO4	CO5
Unit 1	H	-	-	-	-
Unit 2	-	H	-	-	-
Unit 3	-	H	-	-	-
Unit 4	-	-	H	-	-
Unit 5	-	-	-	H	-
Unit 6	-	-	-	H	-
Unit 7	-	-	-	-	H
Unit 8	-	-	-	-	H
Unit 9	-	-	-	-	H

Mapping of CO with PO

CO	PO										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	H	-	-	L	-	-	-	-	-	-	-
CO2	H	H	-	H	L	M	-	-	H	-	-
CO3	H	H	-	H	L	M	-	-	H	-	-
CO4	H	H	-	H	L	M	-	-	H	-	-
CO5	H	H	-	H	L	M	-	-	H	-	-

COURSE NAME: VLSI DESIGN AUTOMATION

COURSE CODE: MTEC-611

Internal Marks: 50	**L**	**T**	**P**
External Marks: 100	**3**	**0**	**-**

Numerical & Design Problems Content: 0%-10%

Note: The question paper shall consist of eight questions of twenty (20) marks each, out of which five questions are required to be attempted by the candidate.

Course Outcomes

On successful completion of this course, the students should be able to:

CO1 Describe the various steps involved in VLSI Design Cycle and discuss the basic algorithms of data structures.

CO2 Design the VLSI devices and explain their Fabrication process.

CO3 Understand the issues related to fabrication process, cost and power dissipation.

CO4 Analyze and Apply different algorithms for Partitioning, Floorplanning and Placement.

CO5 Classify the various Routing Algorithms and explain the Clock and power routing in Physical Design.

Syllabus

Unit 1. Introduction

VLSI Design Cycle, Physical Design Cycle, New Trends in Physical Design Cycle, Design Styles and System Packaging Styles, Basic Data Structure and basic algorithm techniques.

Unit 2. Design and Fabrication of VLSI Devices

Fabrication of VLSI Circuits: NMOS Fabrication Process, CMOS Fabrication Process, Details of Fabrication Process, Design Rules and Layout of basic devices.

Unit 3. Fabrication Process and its impact on Physical Design

Scaling Methods, Comparison of fabrication process, Issues related to Fabrication Process and other issues in interconnect power dissipation, yield and fabrication costs.

Unit 4. Partitioning, Floorplanning, Placement and Pin Assignment

NP-hard problems, design style specific partitioning problems, Partitioning algorithms:

Group migration algorithms, Floorplanning, floorplanning algorithms , floorplanning algorithms for mixed block and cell designs, Placement, Placement algorithms, Partitioning based Placement algorithms, Pin assignment, advanced heuristic soft computing techniques for Partitioning, Floorplanning and Placement.

Unit 5. Various Routing Techniques

Global Routing, Global Routing Algorithms, Detailed Routing, routing considerations, routing models, channel routing problems, switchbox routing problems, Detailed Routing Algorithms, Over –the- cell routing: cell models, Overview of Two, Three and multilayer layer over –the- cell routers and performance driven OTC routing, Clock and power routing: clocking schemes, design considerations for the clocking system, power and ground routing.

Text Books:

1. N. A., "Algorithms for VLSI Physical Design Automation", Third Edition, Springer, 2013.
2. M. Sarrafzadeh and C. K. Wong, "Introduction to VLSI Physical Design", Fourth Edition, McGraw-Hill., 1996

Reference Books and Other Resources:

1. Charles J. Alpert, Dinesh P. Mehta and Sachin S. Sapatnekar, "Handbook of Algorithms for Physical Design Automation", Auerbach Publications (CRC Press), 2008.
2. R. Dreschler, "Evolutionary Algorithms for VLSI CAD", Third Edition, Springer, 2002.
3. S. K. Lim, "Practical Problems in VLSI Physical Design Automation", Springer, 2008.
4. S. M. Sait and H. Youssef, "VLSI Physical Design Automation: Theory and Practice", World Scientific, 1999.

Mapping of course contents with CO

Contents	CO1	CO2	CO3	CO4	CO5
Unit 1	H	-	-	-	-
Unit 2	L	H	-	-	-
Unit 3	L	H	H	-	-
Unit 4	L	-	-	H	-
Unit 5	L	-	-	-	H

Mapping of CO with PO

CO	PO										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	H	M	-	-	-	-	-	-	H	-	-
CO2	H	H	-	H	M	-	-	-	H	-	-
CO3	H	M	-	H	-	-	-	-	H	-	-
CO4	H	H	-	H	H	-	-	-	H	-	-
CO5	H	M	-	H	M	-	-	-	H	-	-

COURSE NAME: LOW POWER VLSI DESIGN

COURSE CODE: MTEC-612

Internal Marks: 50	**L**	**T**	**P**
External Marks: 100	**3**	**0**	**-**

Numerical & Design Problems Content: 10%-20%

Note: The question paper shall consist of eight questions of twenty (20) marks each, out of which five questions are required to be attempted by the candidate.

Course Outcomes

On successful completion of this course, the students should be able to:

CO1 Comprehend the sources of power dissipation and important parameters and apply design approaches for low power VLSI.

CO2 Analyze the impact of device parameters and technology on performance of low power electronics.

CO3 Optimize dynamic power and static power at circuit level during standby and runtime using various techniques.

CO4 Estimate and solve power related issues during clock distribution.

CO5 Apply power analysis methodology and power estimation and power minimization techniques for the design of memory and arithmetic circuits.

Syllabus

Unit 1. Introduction

Power and Energy basics, Sources of power dissipation in Digital Integrated circuits, important parameters for low power design, Low power design approaches.

Unit 2. Device and Technology Impact on Low Power Electronics

Dynamic dissipation in CMOS, transistor Sizing & gate oxide thickness, impact of technology Scaling, Technology & Device innovation.

Unit 3. Circuit Level Power Optimization Techniques

Dynamic Power Optimization: multiple supply voltages, transistor sizing, technology mapping. Static power Optimization: Multiple thresholds, transistor stacking, Introduction to energy recovery CMOS.

Unit 4. Power Optimization at Standby and Runtime

Clock gating, power gating, body biasing, supply voltage ramping, Power reduction of memory in standby mode using voltage scaling and body biasing. Dynamic voltage and frequency scaling, adaptive body biasing, Power domains and power management.

Unit 5. Low Power Clock Distribution

Power Dissipation in Clock Distribution, Single driver vs. Distributed buffers, Buffer and device sizing, Zero skew vs. tolerant skew, chip and package co-design of clock network.

Unit 6. Logic Synthesis for Low Power

Low power design flow, power analysis methodology, Power estimation Techniques, Power Minimization Techniques.

Unit 7. Design of Low Power Memory and Arithmetic Elements

Memory architecture, SRAM cell metrics, power in cell array, power for read and write access. Design of circuits for addition, Multiplication and Division.

Text Books:

1. J. M. Rabaey and M. Pedram, “Low Power Design Methodologies”, Kluwer-Academic Publishers.
2. A. Pal, “Low Power VLSI Circuits and Systems”, Springer.

Reference Books and Other Resources:

1. N. H. Weste and D. M. Harris, “CMOS VLSI Design: A Circuits and System Perspective”, Fourth Edition, Pearson.
2. J. M. Rabaey, A. P. Chandrakasan and B. Nikolic, “Digital Integrated Circuits: A Design Perspective”, Second Edition, PH/Pearson.
3. K. Roy and S. C. Prasad, “Low-Power CMOS VLSI Circuit Design”, Wiley.
4. P. Chandrakasan and R. W. Broderson, “Low-Power CMOS Design”, IEEE Press.

Mapping of course contents with CO

Contents	CO1	CO2	CO3	CO4	CO5
Unit 1	H	-	-	-	-
Unit 2	-	H	-	-	-
Unit 3	-	-	H	-	-
Unit 4	-	-	H	-	-
Unit 5	-	-	-	H	-
Unit 6	-	-	-	-	H
Unit 7	-	-	-	-	H

Mapping of CO with PO

CO	PO										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	H	M	-	H	L	-	-	-	M	-	-
CO2	H	H	-	H	-	-	-	-	M	-	-
CO3	H	H	-	H	L	-	-	-	H	-	-
CO4	H	H	-	H	-	-	-	-	H	-	-
CO5	H	H	-	H	L	-	-	-	H	-	-

COURSE NAME: NANOELECTRONICS

COURSE CODE: MTEC-613

Internal Marks:	**50**	**L**	**T**	**P**
External Marks:	**100**	**3**	**0**	**-**

Numerical & Design Problems Content: 0%-10%

Note: The question paper shall consist of eight questions of twenty (20) marks each, out of which five questions are required to be attempted by the candidate.

Course Outcomes

On successful completion of this course, the students should be able to:

CO1 Express the fundamentals of nanoelectronics.

CO2 Illustrate Silicon MOSFETs and Quantum Transport Devices in nanoelectronics.

CO3 Identify the structure and applications of Carbon nanotubes.

CO4 Discuss molecular electronics and mass storage devices

Syllabus

Unit 1. Fundamentals of Nanoelectronics

Fundamentals of logic devices:- Requirements – dynamic properties – threshold gates; physical limits to computations; concepts of logic devices:- classifications – two terminal devices – field effect devices – coulomb blockade devices – spintronics – quantum cellular automata – quantum computing – DNA computer; performance of information processing systems;- basic binary operations, measure of performance processing capability of biological neurons – performance estimation for the human brain. Ultimate computation: power dissipation limit – dissipation in reversible computation – the ultimate computer**.**

Unit 2. Silicon Mosfets & Quantum Transport Devices

Silicon MOSFETS - Novel materials and alternate concepts:- fundamentals of MOSFET Devices- scaling rules – silicon-dioxide based gate dielectrics – metal gates – junctions & contacts – advanced MOSFET concepts. Quantum transport devices based on resonant tunneling:- Electron tunneling – resonant tunneling diodes – resonant tunneling devices; Single electron devices for logic applications:- Single electron devices – applications of single electron devices to logic circuits.

Unit 3. Carbon Nanotubes

Carbon Nanotube: Fullerenes - types of nanotubes – formation of nanotubes – assemblies – purification of carbon nanotubes – electronic properties – synthesis of carbon nanotubes – carbon nanotube interconnects – carbon nanotube FETs – Nanotube for memory applications – prospects of all carbon nanotube nanoelectronics.

Unit 4. Molecular Electronics

Electrodes & contacts – functions – molecular electronic devices – first test systems – simulation and circuit design – fabrication; Future applications: MEMS – robots – random access memory – mass storage devices.

Text Books:

1. K. Goser, JanDienstuhl and others, "Nanoelectronics & Nanosystems: From Transistor to Molecular & Quantum Devices", Springer, 2004.
2. R. Waser(Ed.), "Nanoelectronics and Information Technology: Advanced Electronic Materials and Novel Devices" Wiley-VCH , 3rd edition.

Reference Books and other resources:

1. M. Wilson, K. Kannangara, G. Smith, M. Simmons and B. Raguse, "Nanotechnology: Basic Science and Emerging Technologies", Chapman & Hall/CRC, 2002.
2. T. Pradeep, "NANO: The essentials – Understanding Nanoscience and Nanotechnology", Mc-Graw Hill Education.
3. Related IEEE/IE Publications.

Mapping of course contents with CO

Contents	CO1	CO2	CO3	CO4
Unit 1	H	-	-	-
Unit 2	L	H	-	-
Unit 3	-	-	H	-
Unit 4	M	-	-	H

Mapping of CO with PO

CO	PO										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	L	-	-	-	-	-	-	-	L	-	-
CO2	M	-	-	M	-	-	-	-	L	-	-
CO3	M	-	-	M	-	-	-	-	L	-	-
CO4	M	-	-	H	-	-	-	-	L	-	-

COURSE NAME: SPEECH AND IMAGE PROCESSING

COURSE CODE: MTEC 614

Internal Marks:	**50**	**L**	**T**	**P**
External Marks:	**100**	**3**	**0**	**-**

Numerical & Design Problems Content: 10%-20%

Note: The question paper shall consist of eight questions of twenty (20) marks each, out of which five questions are required to be attempted by the candidate.

Course Outcomes

On successful completion of this course, the students should be able to:

CO1 Explain basic parameters and quality metrics in speech and image processing.

CO2 Analyze speech signals using LPC.

CO3 Discuss digital coding of speech and speech synthesis.

CO4 Discuss various image enhancement and restoration techniques.

CO5 Discuss image segmentation and image compression techniques.

CO6 Describe speech and image processing using wavelets and curvelets.

Syllabus

Unit 1. Introduction to Digital Speech Processing

The process of speech production, acoustic phonetics, auditory models, the acoustic theory of speech production, digital models for sampled speech signals.

Unit 2. Speech Coding

linear predictive analysis of speech signals, computation of gain of model, frequency domain representation, solution of LPC equations, properties of LPC polynomial, alternative representations of LP, digital coding of speech signals, sampling speech signal, statistical model, quantization, differential quantization, delta modulation, DPCM, applications of speech coders.

Unit 3. Speech Synthesis

Sound Capturing, phonemes, Prosody, Speech Synthesis with Phonemes, Text Processing for Speech Synthesis, Letter-to-Phoneme Rules, Text-to-Phoneme Transcription, Generating Prosody, text to speech synthesis.

Unit 4. Introduction to Digital Image Processing

Image as a 2D signal, Fundamental steps in digital image processing, applications of digital image processing, quality metrics for image processing.

Unit 5. Image enhancement and restoration

Image enhancement in spatial and frequency domains, gray scale modifications, histogram equalization, image restoration, types of noises corrupting the images, denoising methods, median filtering, wiener filtering.

Unit 6. Image Compression and Image Segmentation

Image compression in spatial and transform domains, image segmentation, segmentation algorithms, edge and boundary detection, pattern recognition.

Unit 7. Advanced topics

Wavelets and curvelets in speech and image processing.

Text Books:

1. L. Rabiner and R. Schafer, "Digital speech processing", Pearson, 2011.
2. T. F. Quatieri, "Discrete time speech signal processing", Pearson education, 2004

Reference books and other resources:

1. R. C. Gonzalez and R. E. Woods, "Digital Image Processing", Pearson Education.
2. Related IEEE/IEE/Sciencedirect publications.

Mapping of course contents with CO

Contents	CO1	CO2	CO3	CO4	CO5	CO6
Unit 1	H	-	-	-	-	-
Unit 2	-	H	H	-	-	-
Unit 3	-	-	H	-	-	-
Unit 4	H	-	-	-	-	-
Unit 5	-	-	-	H	-	-
Unit 6	-	-	-	-	H	-
Unit 7	-	-	-	-	-	H

Mapping of CO with PO

CO	PO										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	H	-	-	-	-	-	-	-	-	-	-
CO2	H	-	H	-	M	-	-	-	L	-	-
CO3	H	-	H	-	M	-	-	-	L	-	-
CO4	H	-	H	-	M	-	-	-	L	-	-
CO5	H	-	H	-	M	-	-	-	L	-	-
CO6	M	-	M	H	M	-	-	-	H	-	-

COURSE NAME: ADVANCED DIGITAL SYSTEM DESIGN

COURSE CODE: MTEC-615

Internal Marks:	**50**	**L**	**T**	**P**
External Marks:	**100**	**3**	**0**	**-**

Numerical & Design Problems Content: 50%-60 %

Note: The question paper shall consist of eight questions of twenty (20) marks each, out of which five questions are required to be attempted by the candidate.

Course Outcomes

On successful completion of this course, the students should be able to:

CO1 Design the different standard combinational circuits and uses these standard circuits to implement other digital circuits.

CO2 Analyze and design the different standard synchronous sequential logic (Flip Flop, counters etc.) and other user defined synchronous sequential digital circuits using traditional approach.

CO3 Analyze and design the different multi-input system controllers.

CO4 Analyze different asynchronous sequential machines and design the standard and user-defined Asynchronous sequential logic.

CO5 Design of different combinational and sequential circuits using VHDL.

Syllabus

Unit 1. Review of Digital Electronics Concept

Design and analysis of combinational circuits (Arithmetic Circuits, Comparators, Multiplexers, Code Converters) and sequential machines (State Diagram, Design Steps For Traditional Synchronous Sequential Circuits, Counters, Shift Registers and Memory)

Unit 2. Multi Input System Controller Design

System Controllers, Design Phases And System Documentation, Defining The System, Timing And Frequency Considerations, Functional, Position And Detailed Flow Diagram Development, MDS Diagram, Generation, Synchronizing Two System And Choosing Controller, Architecture, State Assignment, Next State Decoders And Its Maps, Output Decoders, Clock And Power Supply Requirements, MSI Decoders, Multiplexers In System Controllers, Indirect Addressed Multiplexers Configurations, Programmable System Controllers, ROM, PLA And PAL Based Design.

Unit 3. Asynchronous Finite State Machines

Scope, Asynchronous Analysis, Design Of Asynchronous Machines, Cycle And Races, Plotting And Reading The Excitation Map, Hazards, Essential Hazards Map Entered Variable, MEV Approaches To Asynchronous Design, Hazards In Circuit Developed By MEV Method, Electromagnetic Interference And Electromagnetic Compatibility Grounding And Shielding of Digital Circuits. Interfacing digital system with different media like fiber cable, co-axial cable etc.

Unit 4. Digital Logic Design with VHDL

Combinational Logic Design-complex Logic Gates, One-bit Half Adder, multiplexer, Thermometer-to- binary encoder, Seven-segment display driver, tri-state buffer, Sequential Logic Design-Latches and Flip-Flops, counter design, state machine design, Memories-Random Access Memory, Read-Only Memory

Text Books:

1. W. I. Fletcher, “An Engineering Approach to Digital Design”, Prentice Hall India, 1990.

Reference books and other resources:

1. Robert L. Miller, “Designing with TTL Circuits”, McGraw Hill.
2. Richard F. Tinder, “Engineering Digital Design”, Academic Press.
3. John F. Wakerly, “Digital Design- Principles and Practices”, Pearson Education.
4. David J. Comer, “Digital Logic and State Machine Design”, Oxford University Press.
5. Stephen Brown and Zvonko Vranesic, “Fundamentals of Digital Logic with VHDL Design”, McGraw-Hill.
6. Related IEEE/IEE publications.

Mapping of course contents with CO

Contents	CO1	CO2	CO3	CO4	CO5
Unit 1	H	H	-	-	-
Unit 2	-	L	H	-	-
Unit 3	-	-	-	H	-
Unit 4	L	L	-	-	H

Mapping of CO with PO

CO	PO										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	M	-	H	-	M	-	-	-	L	-	-
CO2	M	-	H	-	M	-	-	-	L	-	-
CO3	M	-	H	-	M	-	-	-	L	-	-
CO4	M	-	H	-	M	-	-	-	L	-	-
CO5	M	-	H	-	M	-	-	-	L	-	-

COURSE NAME: COMPUTER COMMUNICATIONS AND NETWORKS

COURSE CODE: MTEC-616

Internal Marks: 50	**L**	**T**	**P**
External Marks: 100	**3**	**0**	**-**

Numerical & Design Problems Content: 0%-10%

Note: The question paper shall consist of eight questions of twenty (20) marks each, out of which five questions are required to be attempted by the candidate.

Course Outcomes

On successful completion of this course, the students should be able to:

CO1 Describe communication protocols and their operation.

CO2 Comprehend the structure of internetworking and its applications.

CO3 Classify the ATM networks and LAN technology.

CO4 Outline the techniques related to network security.

CO5 Model and analyze the communication networks.

Syllabus

Unit 1. Review of Network Protocols

Review of Data Communication and Networking, OSI and TCP/IP Protocol Suite, Error Control, Flow Control, Bit Oriented and Character Oriented Protocol, Data Link Layer Services, X.25, Virtual Circuits and Datagram's, Medium Access Control Protocols (CSMA/CD, Token Ring, FDDI, DQDB).

Unit 2. Computer Communication Structure and Networks

Internetworking, IP addressing, Structure of IP, IPv4, IPv6, Transport Layer Protocols (TCP, UDP), Application Layer Services (DNS, e-mail, www).

Unit 3. ATM Networks and LAN's

Concept and History of ATM, ATM Architecture and its Convergence, Challenges, LAN Technology: Applications, Architecture, Bus LANs, Ring LANs, Star LANs, Wireless LANs.

Unit 4. Network Security

Security Issues, Cryptography: Symmetic Key Algorithms, Public-Key Algorithms, Concept of Firewalls, Digital Signatures, Intrusion Detection Systems.

Unit 5. Modelling and Analysis of Computer Communication Networks

Pure Birth and Birth-Death Process, Bernouli Trials-Markov Chains, Poisson Process, Calculation of Delay-Little's Formula, Burke's Theorem, Queueing Models: M/M/1, M/M/1/N, M/M/S, M/M/S/N Queues, Imbedded Markov Chains-M/G/1 Queue, Network Layout and Reliability Considerations.

Text Books:

1. W. Stallings, "Data and Computer Communication", Sixth Edition, Prentice Hall, 2002.
2. J. F. Hayes, "Modelling and Analysis of Computer Communication Networks", First Edition, Springer, 1984.

Reference books and other resources:

1. A. S. Tanenbaum, "Computer Networks", Fourth Edition, Pearson Education, 2011.
2. B. A. Forouzan, "Data Communications and Networking", Third Edition, Tata Mcgraw-Hill, 2004.
3. S. Keshav, "An Engineering Approach to Computer Networking: ATM Networks, The Internet and the Telephone Network", First Edition, Pearson Education, 1987.
4. D. P. Bertsekas, "Data Networks", Second Edition, Prentice Hall, 1992.
5. Related IEEE/IE publications.

Mapping of course contents with CO

Contents	CO1	CO2	CO3	CO4	CO5
Unit 1	H	-	-	-	-
Unit 2	-	H	-	-	-
Unit 3	-	-	H	-	-
Unit 4	-	-	-	H	-
Unit 5	-	-	-	-	H

Mapping of CO with PO

CO	PO										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	L	-	-	-	-	-	-	-	L	-	-
CO2	L	-	-	-	-	-	-	-	L	-	-
CO3	L	-	-	-	-	-	-	-	L	-	-
CO4	L	-	-	-	-	-	-	-	L	M	-
CO5	H	-	-	-	-	-	-	-	L	-	-

COURSE NAME: ADVANCED EMBEDDED SYSTEM DESIGN

COURSE CODE: MTEC-617

Internal Marks:	**50**	**L**	**T**	**P**
External Marks:	**100**	**3**	**0**	**-**

Numerical & Design Problems Content: 20%-30%

Note: The question paper shall consist of eight questions of twenty (20) marks each, out of which five questions are required to be attempted by the candidate.

Course Outcomes

On successful completion of this course, the students should be able to:

CO1 Describe, classify and illustrate the use of Embedded Systems.

CO2 Explain the architecture and programmer's model of ARM microcontrollers.

CO3 Apply the embedded networking concepts.

CO4 Comprehend Real-Time Embedded System concepts.

CO5 Develop applications based on Embedded System hardware and software.

Syllabus

Unit 1. Review of Embedded Systems

Overview of embedded systems, Embedded processors in systems, Embedded hardware units and devices, Design process in embedded systems, Classification of embedded systems, Real life examples.

Unit 2. ARM 32-Bit Microcontroller Architecture

Architecture, Registers, Pipeline, Interrupts and the vector table, Architecture revisions, ARM processor families.

Unit 3. ARM Instruction Set

Instruction Set: Data processing instructions, Branch instructions, Load-store instructions, Software interrupt instruction, Program status register instructions, Conditional execution.

Unit 4. Networked Embedded Systems

Serial bus communication protocols: I^2C Bus, CAN Bus, USB Bus; Parallel Bus Communication Protocols: ISA, PCI and advanced buses; Internet Enabled Systems; Wireless and Mobile System Protocols.

Unit 5. Design Examples Using ARM7

ARM7 I/O Port Description, Interfacing Programs for UART, Timer, ADC and DAC.

Unit 6. Real-Time Embedded Systems Software

Real-time Embedded Systems, Real-Time Operating Systems (RTOS)– Key characteristics, The Scheduler, Tasks, Semaphores, Message Queues, Basic design using RTOS.

Text Books:

1. R. Kamal, "Embedded Systems, Architecture Programming and Design", Second Edition, Tata McGraw Hill, 2008.
2. N. Sloss, D. Symes, C. Wright and J. Rayfield, "ARM System Developer's Guide, Designing and Optimizing System Software", Elsevier, 2004.

Reference books and other resources:

1. T. Martin, "The Insider's Guide to The Philips ARM7-Based Microcontrollers, An Engineer's Introduction to The LPC2100 Series", Hitex, 2005.
2. Q. Li, "Real Time Concepts for Embedded Systems", CMP Books, 2003.
3. UM10139 LPC214x User manual.
4. Website: www.arm.com.

Mapping of course contents with CO

Contents	CO1	CO2	CO3	CO4	CO5
Unit 1	H	-	-	-	-
Unit 2	-	H	-	-	M
Unit 3	-	H	-	-	M
Unit 4	-	-	H	-	-
Unit 5	-	-	-	-	H
Unit 6	-	-	-	H	-

Mapping of CO with PO

CO	PO										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO 1	H	L	L	L	-	-	-	-	-	-	-
CO 2	M	M	-	M	M	-	-	-	-	-	-
CO 3	M	-	M	M	M	-	-	-	-	-	-
CO 4	M	-	H	M	M	-	-	-	-	-	-
CO 5	H	H	H	H	H	-	-	-	-	-	-

COURSE NAME: MODEING AND SIMULATION OF COMMUNICAION SYSTEMS

COURSE CODE: MTEC- 618

Internal Marks: 50	**L**	**T**	**P**
External Marks: 100	**3**	**0**	**-**

Minimum Numerical Content: 30-40%

Note: The question paper shall consist of eight questions of twenty (20) marks each, out of which five questions are required to be attempted by the candidate.

Course Outcomes

On successful completion of this course, the students should be able to:

CO1 Comprehend the concept of simulation and modeling of communication system.

CO2 Explain models involved in analog channels, digital channels and light wave systems.

CO3 Apply Random Process models on random variables.

CO4 Estimate performance metrics of analog and digital communication system.

CO5 Analyze different case studies of various communication links.

Syllabus

Unit 1. Introduction

Concept of simulation and modeling, Roles of Simulation, Types of Simulation, Limits of Simulation, Simulation Languages (High Level versus Low Level), Real-time Simulation.

Unit 2. Modeling of Communication System

Model of speech and picture signals, Pseudo noise sequences, Non-linear sequences, Analog channel model, Noise and fading, Digital channel model-Gilbert model of bustry channels, HF, Troposcatter and satellite channels, Switched telephone channels, Analog and Digital communication system models, Light wave system Models.

Unit 3. Simulation of Random Variables And Random Process

Univariate and multivariate models, Transformation of random variables, Bounds and approximation, Random process models-Markov and ARMA Sequences, Sampling rate for simulation, Computer generation and testing of random numbers.

Unit 4. Estimation of Performance Measures

Quality of an estimator, estimator of SNR, Probability density functions of analog communication system, BER of Digital communication systems, Monte Carlo method and Importance sampling method, estimation of power, Spectral density of a process.

Unit 5. Case Studies

Case Study I: 64-QAM equalized Digital Radio link in a Fading environment.

Case Study II: Lightwave communication links

Case Study III: A Satellite system Example

Text Books:

1. M. C. Jeruchim, Philip Balaban and K. Sam Shanmugam, "Simulation of communication systems", Plenum Press, New York, 1992.
2. M.Law and W. David Kelton, “Simulation Modelling and analysis”, Tata McGraw Hill, New York, 2008.

Reference books and other resources:

1. M.C. Jeruchim, Philip Balaban and K. Sam shanmugam, Simulation of communication systems: Modeling, Methodology and Techniques, Kluwer academic/Plenum press, New York, 2000.
2. K. C. Raveendranathan, “Communication Systems Modelling and Simulation Using MATLAB and Simulink”, Universities Press, 2011.

Mapping of course contents with CO

Contents	CO1	CO2	CO3	CO4	CO5
Unit 1	H	-	-	-	-
Unit 2	-	H	-	-	-
Unit 3	-	-	H	-	-
Unit 4	-	-	-	H	-
Unit 5	-	-	-	-	H

Mapping of CO with PO

CO	PO										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	H	H	-	-	-	-	-	-	-	-	-
CO2	H	H	H	H	H	-	-	-	-	-	-
CO3	-	-	H	H	H	-	-	-	-	-	-
CO4	-	H	H	H	H	-	-	-	-	-	-
CO5	-	-	H	H	H	-	-	-	H	-	-

COURSE NAME: CLOUD COMPUTING

COURSE CODE: MTEC-619

Internal Marks:	**50**	**L**	**T**	**P**
External Marks:	**100**	**3**	**0**	**-**

Numerical & Design Problems Content: 0%-10%

Note: The question paper shall consist of eight questions of twenty (20) marks each, out of which five questions are required to be attempted by the candidate.

Course Outcomes

On successful completion of this course, the students should be able to:

CO1 Discuss cloud computing paradigms and its challenges.
CO2 Explain cloud computing model, its services and deployment.
CO3 Describe concept of virtualisation and its different types.
CO4 Analyze various challenges/security issues and their possible solutions.
CO5 Explain mobile cloud computing.

Syllabus

Unit 1. Introduction of Computing Paradigms

Overview of existing computing paradigms, Cluster computing, Grid computing, Utility computing, Autonomic computing, Introduction to cloud computing, Cloud computing history and evolution, Essential characteristics of cloud computing, Cloud benefits, The NIST model of cloud computing.

Unit 2. Cloud Computing Architecture

The cloud reference model architecture, Cloud based services, Infrastructure as a service (IaaS), Platform as a service (PaaS), Software as a service (SaaS), Cloud deployment scenarios, Public cloud, Private cloud, Hybrid cloud and Community cloud.

Unit 3. Virtualization

Virtualization, Characteristics of virtualization, Virtualization in cloud computing, Types of virtualization- Resource virtualization, Server storage and Network virtualization, Hypervisors. Data center- Classic data center, Virtualized data center.

Unit 4. Challenges and Security Issues

Cloud computing issues and challenges like security, Elasticity, Service level agreement, Resource management and scheduling, Cloud security, Understanding security risks,

Cloud security reference model, Encryption and key management in the cloud, Identity management.

Unit 5. Mobile Cloud Computing

Overview of mobile cloud computing, Advantages, Challenges, using smartphones with the cloud. Offloading techniques - their pros and cons, Mobile cloud security.

Textbooks:

1. R. K. Buyya, J. Broberg and A. M. Goscinski, "Cloud Computing: Principles and Paradigms", 2011.
2. B. Sosinsky, "Cloud Computing Bible", Wiley India Pvt. Ltd, 2013.

Reference Books and other resources:

1. M. Miller, "Cloud Computing", Que Publishing, 2008.
2. A. Velte, T. Velte and R. Elsenpeter, "Cloud Computing: A practical Approach", Tata McGraw Hill, 2012.
3. J. Rittinghouse and J. F. Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press Taylor and Francis Group, 2010.

Mapping of course contents with CO

Contents	CO 1	CO 2	CO 3	CO 4	CO 5
Unit 1	H	-	-	-	-
Unit 2	-	H	-	-	-
Unit 3	-	-	H	-	-
Unit 4	-	-	-	H	-
Unit 5	-	-	-	-	H

Mapping of CO with PO

CO	PO										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	H	-	-	-	-	-	-	-	-	-	-
CO2	H	-	-	-	-	-	-	-	-	-	-
CO3	H	-	-	-	-	-	-	-	-	-	-
CO4	H	M	M	-	-	-	-	-	-	M	-
CO5	H	-	-	-	-	-	-	-	-	-	-