SCHEME OF TEACHING AND EXAMINATION 2016-17

M.Tech. in Communication Systems, Digital Communication & Networking, Digital Communication Engineering, Digital Electronics & Communication Systems, Digital Electronics & Communication

(Common to all 5 Programmes)

I SEMESTER

Sl. No	Subject Code	Title	Teaching Hours /Week		Examination				Credit
			Theory	Practical/Field Work/ Assignment	Duration	I.A. Marks	Theory/ Practical Marks	Total Marks	
1	16ELD11	Advanced Engineering Mathematics	4	-	3	20	80	100	4
2	16ECS12	Antenna Theory and Design	4	-	3	20	80	100	4
3	16EVE13	Advanced Embedded System	4	-	3	20	80	100	4
4	16ECS14	Advanced Digital Communication	4	-	3	20	80	100	4
5	16EXX15X	Elective-1	3	-	3	20	80	100	3
6	16ECSL16	Advanced Communication Lab		3	3	20	80	100	2
7	16ECS17	Seminar on advanced topics from refereed journals	-	3	-	100	-	100	1
TOTAL			**19**	**6**	**18**	**220**	**480**	**700**	**22**

Elective-1	
16ECS151	Advanced Computer Networks
16EVE152	Nanoelectronics
16ECS153	Optical Communication and Networking
16ECS154	Simulation, Modelling and Analysis

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II SEMESTER

Sl. No	Subject Code	Title	Teaching Hours /Week		Examination				Credit
			Theory	Practical/Field Work/ Assignment	Duration	I.A. Marks	Theory/ Practical Marks	Total Marks	
1	16ECS21	Advanced DSP	4	-	3	20	80	100	4
2	16ECS22	Error Control Coding	4	-	3	20	80	100	4
3	16ECS23	Wireless Communication	4	-	3	20	80	100	4
4	16ECS24	RF and Microwave Circuit Design	4	-	3	20	80	100	4
5	16EXX25X	Elective-2	3	-	3	20	80	100	3
6	16ECSL26	Advanced DSP Lab		3	3	20	80	100	2
7	16ECS27	Seminar on advanced topics from refereed journals	-	3	-	100	-	100	1
TOTAL			**19**	**6**	**18**	**220**	**480**	**700**	**22**

Elective-2	
16ELD251	Automotive Electronics
16ECS252	Multimedia Over Communication links
16ELD253	Micro Electro Mechanical Systems
16ECS254	Cryptography and Network Security

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III SEMESTER: Internship

Sl. No	Subject Code	Title	Teaching Hours /Week		Examination				Credit
			Theory	Practical/Field Work/ Assignment	Duration	I.A. Marks	Theory/ Practical Marks	Total Marks	
1	16ECS31	Seminar / Presentation on Internship (After 8 weeks from the date of commencement)	-	-	-	25	-	25	20
2	16ECS32	Report on Internship	-	-	-	25	-	25	
3	16ECS33	Evaluation and Viva-Voce of Internship	-	-	-	-	50	50	
4	16ECS34	Evaluation of Project phase -1	-	-	-	50	-	50	1
TOTAL			**-**	**-**	**-**	**100**	**50**	**150**	**21**

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IV SEMESTER

Sl. No	Subject Code	Title	Teaching Hours /Week		Examination				Credit
			Theory	Practical/Field Work/ Assignment	Duration	I.A. Marks	Theory/ Practical Marks	Total Marks	
1	16ECS41	Wireless Broadband LTE 4G	4	-	3	20	80	100	4
2	16EXX42X	Elective-3	3	-	3	20	80	100	3
3	16ECS43	Evaluation of Project phase -2	-	-	-	50	-	50	3
4	16ECS44	Evaluation of Project and Viva-Voce	-	-	-	-	100+100	200	10
TOTAL			**-**	**-**	**6**	**90**	**360**	**450**	**20**

Elective-3	
16EVE421	CMOS RF Circuit Design
16ECS422	Advances in Image Processing
16ECS423	Communication System Design using DSP Algorithms
16ECS424	Real Time Systems

Note:

1. Project Phase-1: 6-week duration shall be carried out between 2nd and 3rd Semester vacation. Candidates in consultation with the guide shall carry out literature survey/ visit industries to finalize the topic of Project.

2. Project Phase-2: 16-week duration during 4th semester**.** Evaluation shall be done by the committee constituted comprising of HoD as Chairman, Guide and Senior faculty of the department.

3. **Project Evaluation**: Evaluation shall be taken up at the end of 4thsemester. Project work evaluation and Viva-Voce examination shall be conducted.

a. Internal Examiner shall carry out the evaluation for 100 marks.

b. External Examiner shall carry out the evaluation for 100 marks.

c .The average of marks allotted by the internal and external examiner shall be the final marks of the project evaluation.

d. Viva-Voce examination of Project work shall be conducted jointly by Internal and External examiner for 100 marks.

M.Tech-Commn Stream-2016-FIRST SEMESTER SYLLABUS

ADVANCED ENGINEERING MATHEMATICS [As per Choice Based Credit System (CBCS) scheme] SEMESTER – I			
Subject Code	16ELD11	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50 (10 Hours per Module)	Exam Hours	03
CREDITS – 04			

Course objectives: This course will enable students to:

- Acquaint with principles of linear algebra, calculus of variations, probability theory and random process.
- Apply the knowledge of linear algebra, calculus of variations, probability theory and random process in the applications of electronics and communication engineering sciences.

Modules	**Revised Bloom's Taxonomy (RBT) Level**
Module -1	
Linear Algebra-I Introduction to vector spaces and sub-spaces, definitions, illustrative examples and simple problems. Linearly independent and dependent vectors-definition and problems. Basis vectors, dimension of a vector space. Linear transformations- definition, properties and problems. Rank-Nullity theorem(without proof). Matrix form of linear transformations-Illustrative examples.**(Text 1 & Ref. 1)**	**L1,L2**
Module -2	
Linear Algebra-II Computation of Eigen values and Eigen vectors of real symmetric matrices-Given's method. Orthogonal vectors and orthogonal bases. Gram-Schmidt orthogonalization process. QR decomposition, singular value decomposition, least square approximations.**(Text 1 & Ref. 1)**	**L1,L2**
Module -3	
Calculus of Variations Concept of functional-Eulers equation. functional dependent on first and higher order derivatives, functional on several dependent variables. Isoperimetric problems-variation problems with moving boundaries.**(Text 2 & Ref. 2)**	**L1,L2**
Module -4	

Probability Theory Review of basic probability theory. Definitions of random variables and probability distributions, probability mass and density functions, expectation, moments, central moments, characteristic functions, probability generating and moment generating functions-illustrations. Binomial, Poisson, Exponential, Gaussian and Rayleigh distributions-examples.**(Text 3 & Ref. 3)**	**L1,L2**
Module -5	
Joint probability distributions Definition and properties of CDF, PDF, PMF, conditional distributions. Expectation, covariance and correlation. Independent random variables. Statement of central limit theorem-Illustrative examples. Random process- Classification, stationary and ergodic random process. Auto correlation function-properties, Gaussian random process.**(Text 3 & Ref. 3)**	**L1,L2**

Course Outcomes: After studying this course, students will be able to:

- Understand vector spaces, basis, linear transformations and the process of obtaining matrix of linear transformations arising in magnification and rotation of images.
- Apply the techniques of QR and singular value decomposition for data compression, least square approximation in solving inconsistent linear systems.
- Utilize the concepts of functionals and their variations in the applications of communication systems, decision theory, synthesis and optimization of digital circuits.
- Learn the idea of random variables (discrete/continuous) and probability distributions in analyzing the probability models arising in control systems and system communications.
- Apply the idea of joint probability distributions and the role of parameter-dependent random variables in random process.

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. David C.Lay, Steven R.Lay and J.J.McDonald: Linear Algebra and its Applications, 5th Edition, Pearson Education Ltd., 2015.
2. E. Kreyszig, "Advanced Engineering Mathematics", 10th edition, Wiley, 2015.
3. Scott L.Miller, Donald G.Childers: "Probability and Random Process with application to Signal Processing", Elsevier Academic Press, 2nd Edition,2013.

Reference books:

1. Richard Bronson: "Schaum's Outlines of Theory and Problems of Matrix Operations", McGraw-Hill, 1988.
2. Elsgolts L.: "Differential Equations and Calculus of Variations", MIR Publications, 3rd Edition, 1977.
3. T.Veerarajan: "Probability, Statistics and Random Process", 3rd Edition, Tata McGraw Hill Co.,2008.

Web links:

1. http://nptel.ac.in/courses.php?disciplineId=111
2. http://www.class-central.com/subject/math(MOOCs)
3. http://ocw.mit.edu/courses/mathematics/
4. www.wolfram.com

ANTENNA THEORY AND DESIGN

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – I

Subject Code	16ECS12	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50 (10 Hours per Module)	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to:

- Introduce and discuss different types of Antennas, various terminologies, excitations.
- Study different types of Arrays, Pattern-multiplication, Feeding techniques.
- Calculate gain of aperture antennas, Reflector antennas and analyze general feed model.
- Define, describe, and illustrate principle behind antenna synthesis.
- Introduction of Method of moments, Pocklington's integral equation, Source modeling.

Modules	**Revised Bloom's Taxonomy (RBT) Level**
Module -1	
Antenna Fundamentals and Definitions: Radiation Mechanisms, Overview, EM Fundamentals, Solution of Maxwell's Equations for Radiation Problems, Ideal Dipole, Radiation patterns, Directivity and Gain, Antenna impedance, Radiation efficiency, Antenna polarization.	**L1,L2**
Module -2	
Arrays: Array factor for linear arrays, Uniformly excited equally spaced linear arrays, Pattern multiplication, Directivity of linear arrays, Non-uniformly excited equally spaced linear arrays, Mutual coupling. **Antenna Synthesis**: Formulation of the synthesis problem, Synthesis principles, Line sources shaped beam synthesis, Linear array shaped beam synthesis, Fourier series, Woodward - Lawson sampling method, Comparison of shaped beam synthesis methods, low side lobe narrow main beam synthesis methods, Dolph Chebyshev linear array, Taylor line source method.	**L1,L2,L3, L4**
Module -3	
Resonant Antennas: Wires and Patches, Dipole antenna, Yagi-Uda antennas, Micro-strip antenna. **Broadband antennas**: Traveling wave antennas Helical antennas, Biconical antennas, Sleeve antennas, and Principles of frequency independent antennas, Spiral antennas, and Log - periodic antennas.	**L1,L2,L3, L4**

Module -4	
Aperture antennas: Techniques for evaluating gain, Reflector antennas- Parabolic reflector antenna principles, Axi-symmetric parabolic reflector antenna, Offset parabolic reflectors, Dual reflector antennas, Gain calculations for reflector antennas, Feed antennas for reflectors, Field representations, Matching the feed to the reflector, General feed model, Feed antennas used in practice.	**L1,L2,L3, L4**
Module -5	
CEM for antennas: The method of moments: Introduction of the methods moments, Pocklington's integral equation, Integral equation and Kirchhoff's networking equations, Source modeling weighted residual formulations and computational consideration, Calculation of antenna and scatter characteristics.	**L1,L2**

Course Outcomes: After studying this course, students will be able to:

- Classify different types of antennas
- Define and illustrate various types of array antennas
- Design antennas like Yagi-Uda, Helical antennas and other broad band antennas
- Describe different antenna synthesis methods
- Apply methods like MOM

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Book:

Stutzman and Thiele, "Antenna Theory and Design", 2nd Edition, John Wiley, 2010.

Reference Books:

1. C. A. Balanis, "Antenna Theory Analysis and Design", John Wiley, 2nd Edition 2007.
2. J. D. Krauss, "Antennas and Wave Propagation", McGraw Hill TMH, 4th Edition, 2010.
3. A.R.Harish, M.Sachidanada, "Antennas and propagation", Pearson Education, 2015.

ADVANCED EMBEDDED SYSTEM

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – I

Subject Code	16EVE13	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50 (10 Hours per Module)	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to:

- Understand the basic hardware components and their selection method based on the characteristics and attributes of an embedded system.
- Describe the hardware software co-design and firmware design approaches
- Explain the architectural features of ARM CORTEX M3, a 32 bit microcontroller including memory map, interrupts and exceptions.
- Program ARM CORTEX M3 using the various instructions, for different applications.

Modules	**Revised Bloom's Taxonomy (RBT) Level**
Module -1	
Embedded System: Embedded vs General computing system, classification, application and purpose of ES. Core of an Embedded System, Memory, Sensors, Actuators, LED, Opto coupler, Communication Interface, Reset circuits, RTC, WDT, Characteristics and Quality Attributes of Embedded Systems (Text 1: Selected Topics from Ch -1, 2, 3).	**L1, L2, L3**
Module -2	
Hardware Software Co-Design, embedded firmware design approaches, computational models, embedded firmware development languages, Integration and testing of Embedded Hardware and firmware, Components in embedded system development environment (IDE), Files generated during compilation, simulators, emulators and debugging (Text 1: Selected Topics From Ch-7, 9, 12, 13).	**L1, L2, L3**

Module -3	
ARM-32 bit Microcontroller: Thumb-2 technology and applications of ARM, Architecture of ARM Cortex M3, Various Units in the architecture, General Purpose Registers, Special Registers, exceptions, interrupts, stack operation, reset sequence (Text 2: Ch 1, 2, 3)	**L1, L2, L3**
Module -4	
Instruction Sets: Assembly basics, Instruction list and description, useful instructions, Memory Systems, Memory maps, Cortex M3 implementation overview, pipeline and bus interface (Text 2: Ch-4, 5, 6)	**L1, L2, L3**
Module -5	
Exceptions, Nested Vector interrupt controller design, Systick Timer, Cortex-M3 Programming using assembly and C language, CMSIS (Text 2: Ch-7, 8, 10)	**L1, L2, L3**

Course Outcomes: After studying this course, students will be able to:

- Understand the basic hardware components and their selection method based on the characteristics and attributes of an embedded system.
- Explain the hardware software co-design and firmware design approaches.
- Acquire the knowledge of the architectural features of ARM CORTEX M3, a 32 bit microcontroller including memory map, interrupts and exceptions.
- Apply the knowledge gained for Programming ARM CORTEX M3 for different applications.

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. K. V. Shibu, "Introduction to embedded systems", TMH education Pvt. Ltd. 2009.
2. Joseph Yiu, “The Definitive Guide to the ARM Cortex-M3”, 2nd edn, Newnes, (Elsevier), 2010.

Reference Book:

James K. Peckol, "Embedded systems- A contemporary design tool", John Wiley, 2008.

ADVANCED DIGITAL COMMUNICATION

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – I

Subject Code	16ECS14	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50(10 Hours per Module)	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to:

- Analyze the operation of different modulation techniques and analyze the error performance of digital modulation techniques in presence of AWGN noise.
- Explain and demonstrate the model of discrete time channel with ISI.
- Explain the model of discrete time channel by equalizer.
- Explain various types of equalizers used for channel modeling and adjusting the filter coefficients
- Understand the concept of spread spectrum communication system and analyze the error performance.

Modules	**Revised Bloom's Taxonomy (RBT) Level**
Module -1	
Digital Modulation Schemes: Representation of Digitally Modulated Signals, Memoryless Modulation Methods-PAM, Phase Modulation, QAM, Multidimensional Signalling, Signalling Schemes with memory: CPFSK, CPM, MSK, OQPSK. Transmit PSD for Modulation Schemes (Chapter 3: 3.1,3.2,3.3, 3.4.1 and 3.4.2 of Text).	**L1,L2,L3**
Module -2	
Optimum Receivers for AWGN channels: Waveform and Vector channel models, Waveform and Vector AWGN channels- Optimal detection, Implementation, Optimal Detection and Error Probability for Band limited signaling, Optimal detection and error probability for power limited signaling. Non Coherent Detection (without derivations) (Chapter 4: 4.1, 4.2 - 4.2.1, 4.2.2, 4.3, 4.4, 4.5.1, 4.5.2, eqn 4.5.45 to 4.5.47, 4.5.5 up to eqn 4.5.62 of Text).	**L1,L2,L3**
Module -3	

Multichannel and Multicarrier Signalling: Multichannel Communications in an AWGN channel, Multicarrier Communications in AWGN channel (Chapter 11- 11.1, 11.2-1 to 11.2-5 of Text). **Synchronization**: Signal Parameter estimation, Carrier Phase Estimation, Symbol Timing Recovery (Chapter 5- 5.1 to 5.3 of Text).	**L1,L2,L3**
Module -4	
Digital Communication through band-limited channels: Characterization of Band-limited channels, Optimum Receiver for channels with ISI and AWGN, Linear equalization, Decision feedback equalization (Chapter 9: 9.1,9.3- 9.3.1, 9.3.2, 9.4- 9.4.1, 9.4.2, 9.4.4, 9.4.5, 9.5- 9.5.1, 9.5.3 of Text). Adaptive equalization: Adaptive linear equalizer, adaptive decision feedback equalizer, Adaptive equalization of Trellis - coded signals (Chapter 10: 10.1, 10.2, 10.3 of Text).	**L1,L2,L3**
Module -5	
Spread spectrum signals for digital communication: Model of spread spectrum digital communication system, Direct sequence spread spectrum signals, Frequency hopped spread spectrum signals, CDMA, Time hopping SS, Synchronization of SS systems (Chapter 12 of Text).	**L1,L2**

Course Outcomes: After studying this course, students will be able to:

- Acquire knowledge of application and practical implementation of various Digital Modulation techniques.
- Explain Inter symbol interference (ISI) and its channel modeling and different filtering algorithms for the ISI elimination.
- Explain different types spread spectrum system
- Identify the effect of signal characteristics on the choice of a channel model.
- Analyse the performance of Digital Modulation techniques, Different filtering algorithms and Spread spectrum communication system

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Book:

John G. Proakis, Masoud Salehi, "Digital Communications", McGraw Hill, 5th Edition, 2008.

Reference: Book:

Bernard Sklar, "Digital Communication - Fundamental and applications", Pearson education (Asia), Pvt. Ltd., 2nd edition, 2001.

ADVANCED COMPUTER NETWORKS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER –I

Subject Code	16ECS151	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40 (08 Hours Per Module)	Exam Hours	03

CREDITS – 03

Course objectives: This course will enable students to:

- Develop an awareness towards basic networking principles
- Learn various aspects involved in multiple access and multiplexing
- Develop an awareness regarding the LAN architectures and the various data switching techniques
- Learn the scheduling techniques of networks
- Learn protocols operating in at different layers of computer networks
- Develop an awareness towards the network control and traffic management

Modules	**Revised Bloom's Taxonomy (RBT) Level**
Module -1	
Introduction to networks: Computer network, Telephone networks, Networking principles (Text 1), Protocol layering (Text 2), Multiplexing- TDM, FDM, SM, WDM (Text 1). **Multiple Access:** Introduction, Choices and constraints, base technologies, centralized and distributed access schemes (Text 2).	**L1, L2, L3**
Module -2	
Local Area Networks: Ethernet - Physical layer, MAC, LLC, LAN interconnection, Token ring- Physical layer, MAC, LLC, FDDI (Text 1). Switching- introduction, circuit switching, packet switching, multicasting (Text 2). **Scheduling:** Introduction, requirements, choices, performance bounds, best- effort techniques. Naming and addressing (Text 2).	**L1, L2, L3**

Module -3	
SONET, SDH (Text 2), ATM Networks- features, signaling and routing, header and adaptation layers (Text 1), virtual circuits, SSCOP, Internet-addressing, routing, end point control (Text 2). **Internet protocols-** IP, TCP, UDP, ICMP, HTTP (Text 2).	**L1, L2, L3**
Module -4	
Traffic Management: Introduction, framework for traffic management, traffic models, traffic classes, traffic scheduling (Text 2). **Control of Networks:** Objectives and methods of control, routing optimization in circuit and datagram networks, Markov chains, Queuing models in circuit and datagram networks (Text 1).	**L1, L2, L3**
Module -5	
Congestion and flow control: Window congestion control, rate congestion control, control in ATM Networks (Text 1), flow control model, open loop flow control, closed loop flow control (Text 2).	**L1, L2, L3, L4**

Course outcomes: After studying this course, students will be able to:

- Choose appropriate multiple access and multiplexing techniques as per the requirement.
- Choose standards for establishing a computer network
- Identify switching techniques based on the applications of the network
- Identify IP configuration for the network with suitable routing, scheduling, error control and flow control
- Analyze and develop various network traffic management and control techniques

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. J. Walrand and P. Varaya, "High performance communication networks", Harcourt Asia (Morgan Kaufmann), 2000.
2. S. Keshav, "An Engineering approach to Computer Networking", Pearson Education, 1997.

Reference Books:

1. Leon-Garcia, and I. Widjaja, "Communication network: Fundamental concepts and key architectures", TMH, 2000.
2. J. F. Kurose, and K. W. Ross, "Computer networking: A top down approach featuring the Internet", Pearson Education, 2001.

NANOELECTRONICS

[As per Choice Based Credit System (CBCS) scheme]

Subject Code	16EVE152	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40 (08 Hours per Module)	Exam Hours	03

CREDITS – 03

Course objectives: This course will enable students to:

- Enhance basic engineering science and technological knowledge of nanoele ctronics.
- Explain basics of top-down and bottom-up fabrication process, devices and systems.
- Describe technologies involved in modern day electronic devices.
- Appreciate the complexities in scaling down the electronic devices in the future.

Modules	**Revised Bloom's Taxonomy (RBT) Level**
Module -1	
Introduction: Overview of nanoscience and engineering. Development milestones in microfabrication and electronic industry. Moores' law and continued miniaturization, Classification of Nanostructures, Electronic properties of atoms and solids: Isolated atom, Bonding between atoms, Giant molecular solids, Free electron models and energy bands, crystalline solids, Periodicity of crystal lattices, Electronic conduction, effects of nanometer length scale, Fabrication methods: Top down processes, Bottom up processes methods for templating the growth of nanomaterials, ordering of nanosystems (Text1).	**L1, L2**
Module -2	
Characterization: Classification, Microscopic techniques, Field ion microscopy, scanning probe techniques, diffraction techniques: bulk and surface diffraction techniques (Text1).	**L1-L3**
Module -3	

Characterization: spectroscopy techniques: photon, radiofrequency, electron, surface analysis and dept profiling: electron, mass, Ion beam, Reflectrometry, Techniques for property measurement: mechanical, electron, magnetic, thermal properties. **Inorganic semiconductor nanostructures:** overview of semiconductor physics. Quantum confinement in semiconductor nanostructures: quantum wells, quantum wires, quantum dots, super-lattices, band offsets, electronic density of states (Text1).	**L1-L3**
Module -4	
Fabrication techniques: requirements of ideal semiconductor, epitaxial growth of quantum wells, lithography and etching, cleaved-edge over growth, growth of vicinal substrates, strain induced dots and wires, electrostatically induced dots and wires, Quantum well width fluctuations, thermally annealed quantum wells, semiconductor nanocrystals, collidal quantum dots, self-assembly techniques. **Physical processes:** modulation doping, quantum hall effect, resonant tunneling, charging effects, ballistic carrier transport, Inter band absorption, intraband absorption, Light emission processes, phonon bottleneck, quantum confined stark effect, nonlinear effects, coherence and dephasing, characterization of semiconductor nanostructures: optical electrical and structural (Text1).	**L1-L3**
Module -5	
Methods of measuring properties: atomic, crystollography, microscopy, spectroscopy (Text 2). **Applications**: Injection lasers, quantum cascade lasers, single-photon sources, biological tagging, optical memories, coulomb blockade devices, photonic structures, QWIP's, NEMS, MEMS (Text 1).	**L1-L3**

Course outcomes: After studying this course, students will be able to:

- Know the principles behind Nanoscience engineering and Nanoelectronics.
- Apply the knowledge to prepare and characterize nanomaterials.
- Know the effect of particles size on mechanical, thermal, optical and electrical properties of nanomaterials.
- Design the process flow required to fabricate state of the art transistor techn ology.
- Analyze the requirements for new materials and device structure in the futur e technologies.

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Ed Robert Kelsall, Ian Hamley, Mark Geoghegan, “Nanoscale Science and Technology”, John Wiley, 2007.
2. Charles P Poole, Jr, Frank J Owens, “Introduction to Nanotechnology”, John Wiley, Copyright 2006, Reprint 2011.

Reference Book:

Ed William A Goddard III, Donald W Brenner, Sergey E. Lyshevski, Gerald J Iafrate, “Hand Book of Nanoscience Engineering and Technology”, CRC press, 2003.

OPTICAL COMMUNICATION AND NETWORKING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER –I

Subject Code	16ECS153	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40 (08 Hours per Module)	Exam Hours	03

CREDITS – 03

Course objectives: This course will enable students to:

- Mathematically analyze and conceptualize basics of optical networking and its associated nonlinear artifacts and effects.
- Develop awareness regarding optical devices and their working strategies
- Develop awareness of WDM principles, and that of power penalty issues existent in optical Networks
- Get insight into the design of various types of Lasers and understand the techniques of coherent transmission.
- Develop an awareness towards the backbone architectures of optical networking with the present trends in access networks
- Design second generation optical networks using various existent & devices like OADM, OLT and OXC and to mathematically model the problems in the design of WDM networks

Modules	**Revised Bloom's Taxonomy (RBT) Level**
Module -1	
Introduction to optical networking: Propagation of signals in optical fiber, Different losses, Nonlinear effects, Solutions, Optical sources, Detectors. **Optical Components (Part-1**): Couplers, Isolators, Circulators and Multiplexers.	**L1, L2, L3**
Module -2	
Optical Components (Part-2): Filters, Gratings, Interferometers, Amplifiers. **Modulation - Demodulation**: Formats, Ideal receivers, Practical detection receivers, Optical preamplifiers, Noise considerations, Bit error rates, Coherent detection.	**L1, L2, L3**

Module -3	
Transmission System Engineering: System model, Power penalty, Transmitter, Receiver, Different optical amplifiers **Client Layers:** Client layers of optical layer, SONET/SDH, Multiplexing, layers, Frame structure, ATM functions, Adaptation layers, Quality of Service (QoS) and flow control, ESCON, HIPPI.	**L1, L2, L3**
Module -4	
WDM network elements: Optical line terminal, Optical line amplifiers, Optical Add/ Drop Multiplexors, Optical cross connectors. **WDM Network Design**: WDM network design, Cost tradeoffs, LTD and RWA problems, Routing and wavelength assignment, Wavelength conversion.	**L1, L2, L3**
Module -5	
Control and Management (Part-1): Network management functions, management framework, Information model, management protocols, Layers within optical layer. **Control and Management (Part-2):** Performance and fault management, Impact of transparency, BER measurement, Optical trace, Alarm management, Configuration management.	**L1, L2, L3**

Course outcomes: After studying this course, students will be able to:

- Recognize and select various optical networking components according to the prescribed design specifications
- Learn the aspects of data transmission, loss hindrances and other artifacts affecting the network operation
- Learn the issues involved in setting up and maintenance of access part of optical network with the latest trends in the data communication
- Design a WDM network and study the component and network management aspects

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Book:

Rajiv Ramswami and K. N. Sivarajan, "Optical Networks", Morgon Kauffman Publishers, 3rd edition, 2010.

Reference Books:

1. John M. Senior, "Optical fiber communication", Pearson edition, 2000.
2. Gerd Kaiser, "Optical fiber Communication Systems", John Wiley, New York, 1997.
3. P. E. Green, "Optical Networks", Prentice Hall, 1994.

SIMULATION, MODELLING AND ANALYSIS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – I

Subject Code	16ECS154	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40 (08 Hours per Module)	Exam Hours	03

CREDITS – 03

Course objectives: This course will enable students to:

- Understand the process of simulation and modeling
- Learn simulation of deterministic and probabilistic models, with a focus of statistical data analysis and simulation data.

Modules	**Revised Bloom's Taxonomy (RBT)**
Module -1	
Basic Simulation Modeling: Nature of simulation, Systems, Models and Simulation, Discrete-Event Simulation, Simulation of Single Server Queuing System, Simulation of inventory system, Parallel and distributed simulation and the high level architecture, Steps in sound simulation study, and Other types of simulation, Advantages and disadvantages. (1.1, 1.2, 1.3, 1.4, 1.4.1, 1.4.2, 1.4.3, 1.5, 1.5.1, 1.5.2, 1.6, 1.7, 1.8, 1.9 of Text)	**L1,L2**
Module -2	
Review of Basic Probability and Statistics Random Variables and their properties, Simulation Output Data and Stochastic Processes, Estimation of Means, Variances and Correlations, Confidence Intervals and Hypothesis tests for the Mean **Building valid, credible and appropriately detailed simulation models**: Introduction and definitions, Guidelines for determining the level of models detail, Management's Role in the Simulation Process, Techniques for increasing model validity and credibility, Statistical procedure for comparing the real world observations and simulation output data. (4.2, 4.3, 4.4, 4.5, 5.1, 5.2, 5.4, 5.5, 5.6, 5.6.1, 5.6.2 of Text)	**L1,L2, L3**
Module -3	

Selecting Input Probability Distributions: Useful probability distributions, activity I, II and III. Shifted and truncated distributions; Specifying multivariate distribution, correlations, and stochastic processes; Selecting the distribution in the absence of data, Models of arrival process. (6.2, 6.4, 6.5, 6.6, 6.8, 6.10, 6.11, 6.12 of Text).	**L1,L2, l3**
Module -4	
Random Number Generators: Linear congruential Generators, Other kinds, Testing number generators, **Generating the Random Variates**: General approaches, Generating continuous random variates, Generating discrete random variates, Generating random vectors, and correlated random variants, Generating arrival processes (7.2, 7.3, 7.4, 8.2, 8.3, 8.4, 8.5, 8.6 of Text).	**L1,L2, L3**
Module -5	
Output data analysis for a single system: Transient and steady state behavior of a stochastic process; Types of simulations with regard to analysis; Statistical analysis for terminating simulation; Statistical analysis for steady state parameters; Statistical analysis for steady state cycle parameters; Multiple measures of performance, Time plots of important variables. (9.2, 9.3, 9.4, 9.4.1, 9.4.3, 9.5, 9.5.1, 9.5.2, 9.5.3, 9.6, 9.7, 9.8 of Text)	**L1,L2,L3**

Course Outcomes:

After studying this course, students will be able to:

- Define the need of simulation and modeling.
- Describe various simulation models.
- Discuss the process of selecting of probability distributions.
- Perform output data analysis.

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Book:

Averill Law, "Simulation modeling and analysis", McGraw Hill 4th edition, 2007.

Reference Books:

1. Tayfur Altiok and Benjamin Melamed, “Simulation modeling and analysis with ARENA”, Elsevier, Academic press, 2007.
2. Jerry Banks, "Discrete event system Simulation", Pearson, 2009
3. Seila Ceric and Tadikamalla, "Applied simulation modeling", Cengage, 2009.
4. George. S. Fishman, "Discrete event simulation", Springer, 2001.
5. Frank L. Severance, "System modeling and simulation", Wiley, 2009.

ADVANCED COMMUNICATION LAB

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – I

Laboratory Code	16ECSL16	IA Marks	20
Number of Lecture Hours/Week	01Hr Tutorial (Instructions) + 02 Hours Laboratory	Exam Marks	80
		Exam Hours	03

CREDITS – 02

Course objectives: This laboratory course enables students to get practical experience in

- Radiation pattern of antennas.
- Determining gain and directivity of a given antenna.
- Working of Klystron source.
- S-parameters of some microwave passive devices.

Laboratory Experiments: **NOTE:** Experiments can be done using Hardware tools such as Spectrum analyzers, Signal sources, Power Supplies, Oscilloscopes, High frequency signal sources, Fiber optic kits, Microwave measurement benches, DSP processor kit, FPGA kit, Logic analyzers, PC setups, etc. Software tools based experiments can be done using, FEKO or equivalent open source simulator, MATLAB etc.	**Revised Bloom's Taxonomy (RBT) Level**
1. Matlab/C implementation to obtain the radiation pattern of an antenna.	L3,L4
2. Study of radiation pattern of different antennas.	L2, L3
3. Determine the directivity and gains of Horn/ Yagi/ dipole/ Parabolic antennas.	L3,L4
4. Impedance measurements of Horn/Yagi/dipole/Parabolic antennas.	L3,L4
5. Study of radiation pattern of E & H plane horns.	L2, L3
6. Significance of Pocklington's integral equation.	L1,L2
7. Study of digital modulation techniques using CD4051 IC.	L2, L3
8. Conduct an experiment for Voice and data multiplexing using optical fiber.	L3,L4
9. Determination of the modes transit time, electronic timing range and sensitivity of Klystron source.	L3, L4
10. Determination of VI characteristics of GUNN diode, and measurement of guide wave length, frequency, and VSWR.	L3,L4

11. Determination of coupling coefficient and insertion loss of directional couplers and Magic tree.	L3,L4
12. Build a hardware pseudo-random signal source and determine statistics of the generated signal source.	L1,L2,L3,L4

Course outcomes: On the completion of this laboratory course, the students will be able to:

- Plot the radiation pattern of some antennas using Matlab and wave guide setup
- Obtain the S-parameters of Magic tee and directional couplers.
- Test the IC CD4051 for modulation techniques.
- Study multiplexing techniques using OFC kit.

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.
2. Students are allowed to pick one experiment from the lot.
3. Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
4. Change of experiment is allowed only once and Marks allotted to the procedure part to be made zero.

ADVANCED DSP

[As per Choice Based Credit System (CBCS) Scheme
SEMESTER – II

Subject Code	16ECS21	IA Marks	20
Number of Lecture Hours/Week	04	Exam marks	80
Total Number of Lecture Hours	50 (10 Hours per Module)	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to:

- Understand Multirate digital signal processing principles and its applications.
- Estimate the various spectral components present in the received signal using different spectral estimation methods such as Parametric and Nonparametric.
- Design and implement an optimum adaptive filter using LMS and RLS algorithms.
- Understand the concepts and mathematical representations of Wavelet transforms.

Modules	**RBT Level**
Module 1	
Multirate Digital Signal Processing: Introduction, decimation by a factor 'D', Interpolation by a factor 'I', sampling rate conversion by a factor 'I/D', Implementation of sampling rate conversion, Multistage implementation of sampling rate conversion, Applications of multirate signal processing, Digital filter banks, two channel quadrature mirror filter banks, M-channel QMF bank. (Text 1)	L1,L2,L3
Module 2	
Linear prediction and Optimum Linear Filters: Random signals, Correlation Functions and Power Spectra, Innovations Representation of a Stationary Random Process. Forward and Backward Linear Prediction. Solution of the Normal Equations The Levinson-Durbin Algorithm. Properties of the Linear Prediction-Error Filters. (Text 1)	L1,L2,L3
Module 3	
Adaptive filters: Applications of adaptive filters- Adaptive channel equalization,, Adaptive noise cancellation, Linear Predictive coding of Speech Signals, Adaptive direct form FIR filters-The LMS algorithm, Properties of LMS algorithm. **Adaptive direct form filters-** RLS algorithm. (Text 1)	L1,L2,L3
Module 4	
Power Spectrum Estimation: Non parametric Methods for Power Spectrum Estimation - Bartlett Method, Welch Method, Blackman and Tukey Methods. **Parametric Methods for Power Spectrum Estimation:** Relationship between the auto correlation and the model parameters, Yule and Walker methods for the AR Model Parameters, Burg Method for the AR Model parameters, Unconstrained least-squares method for the AR Model parameters, Sequential estimation methods for the AR Model parameters, ARMA Model for Power Spectrum Estimation. (Text 1)	L1, L2,L3
Module 5	

WAVELET TRANSFORMS: The Age of Wavelets, The origin of Wavelets, Wavelets and other reality transforms, History of wavelets, Wavelets of the future. **Continuous Wavelet and Short Time Fourier Transform:** Wavelet Transform, Mathematical preliminaries, Properties of wavelets. **Discrete Wavelet Transform**: Haar scaling functions, Haar wavelet function, Daubechies Wavelets. (Chapters 1, 3 & 4 of Text 2)	L1,L2,L3

Course Outcomes: After studying this course, students will be able to:

- Design adaptive filters for a given application
- Design multirate DSP Systems
- Implement adaptive signal processing algorithm
- Design active networks
- Understand advanced signal processing techniques, including multi-rate processing and time-frequency analysis techniques

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. "Digital Signal Processing, Principles, Algorithms and Applications", John G.Proakis, Dimitris G.Manolakis, Fourth edition, Pearson-2007.
2. Insight into Wavelets- from Theory to Practice", K.P Soman, Ramachandran, Resmi- PHI Third Edition-2010.

Reference Books

1. "Modern Digital signal processing", Robert. O. Cristi, Cengage Publishers, India, 2003.
2. "Digital signal processing: A Practitioner's approach", E.C. Ifeachor, and B. W. Jarvis, , Second Edition, Pearson Education, India, 2002, Reprint.
3. "Wavelet Transforms, Introduction to Theory and applications", Raghuveer. M. Rao, Ajit S.Bopardikar, Pearson Education, Asia, 2000.

ERROR CONTROL CODING

[As per Choice Based Credit System (CBCS) Scheme]

SEMESTER – II

Subject Code	16ECS22	IA Marks	20
Number of Lecture Hours/Week	04	Exam marks	80
Total Number of Lecture Hours	50 (10 Hours per Module)	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to:

- Understand the concept of the Entropy, information rate and capacity for the Discrete memoryless channel.
- Apply modern algebra and probability theory for the coding.
- Compare Block codes such as Linear Block Codes, Cyclic codes etc and Convolutional codes.
- Detect and correct errors for different data communication and storage systems.
- Implement different Block code encoders and decoders.
- Analyze and implement convolutional encoders and decoders.
- Analyze and apply soft and hard Viterbi algorithm for decoding of convolutional codes.

Modules	**RBT Level**
Module 1	
Information theory: Introduction, Entropy, Source coding theorem, discrete memoryless channel, Mutual Information, Channel Capacity Channel coding theorem.(Chap. 5 of Text 1) **Introduction to algebra**: Groups, Fields, binary field arithmetic, Construction of Galois Fields GF (2^m) and its properties, (Only statements of theorems without proof) Computation using Galois filed GF (2^m) arithmetic, Vector spaces and Matrices. (Chap. 2 of Text 2)	L1,L2,L3
Module 2	
Linear block codes: Generator and parity check matrices, Encoding circuits, Syndrome and error detection, Minimum distance considerations, Error detecting and error correcting capabilities, Standard array and syndrome decoding, Single Parity Check Codes(SPC),Repetition codes, Self dual codes, Hamming codes, Reed-Muller codes. Product codes and Interleaved codes. (Chap. 3 of Text 2)	L1,L2,L3
Module 3	
Cyclic codes: Introduction, Generator and parity check polynomials, Encoding of cyclic codes, Syndrome computing and error detection, Decoding of cyclic codes, Error trapping Decoding, Cyclic hamming codes, Shortened cyclic codes.(Chap. 4 of Text2)	L1,L2,L3
Module 4	
BCH codes: Binary primitive BCH codes, Decoding procedures, Implementation of Galois field arithmetic, Implementation of error correction. (Chap. 6 of Text 2)	

Reed -Solomon codes. (Chap. 7 of Text 2) **Majority Logic decodable codes**: One -step majority logic decoding, One-step majority logic decodable codes, Two-step majority logic, decoding, Multiple-step majority logic. (Chap. 8 of Text 2)	L1,L2,L3
Module 5	
Convolution codes: Convolutional Encoding, Convolutional Encoder Representation, Formulation of the Convolutional Decoding Problem, Properties of Convolutional Codes: Distance property of convolutional codes, Systematic and Nonsystematic Convolutional Codes, Performance Bounds for Convolutional Codes, Coding Gain. Other Convolutional Decoding Algorithms: Sequential Decoding, Feedback Decoding.(Chap. 7 of Text 3)	L1,L2,L3

Course Outcomes: After studying this course, students will be able to:

- Analyse a discrete memoryless channel, given the source and transition probabilities.
- Apply the concept of modern linear algebra for the error control coding technique.
- Construct and Implement efficient LBC, Cyclic codes etc encoder and decoders.
- Apply decoding algorithms for efficient decoding of Block codes and Convolutional codes.

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Simon Haykin, ”Digital Communication systems”, First edition, Wiley India Private. Ltd, 2014. ISBN 978-81-265-4231-4
2. Shu Lin and Daniel J. Costello. Jr, "Error control coding", Pearson, Prentice Hall, 2nd edition, 2004.
3. Bernard Sklar, ”Digital Communications - Fundamentals and Applications”, 2nd Edition Pearson Education (Asia) Ptv. Ltd, 2001.

Reference Books:

1. Blahut. R. E, "Theory and practice of error control codes", Addison Wesley, 1984.
2. Salvatore Gravano, “Introduction to Error control coding”, Oxford university press,2007.

WIRELESS COMMUNICATION

[As per Choice Based Credit System (CBCS) Scheme]

SEMESTER – II

Subject Code	16ECS23	IA Marks	20
Number of Lecture Hours/Week	04	Exam marks	80
Total Number of Lecture Hours	50 (10 Hours per Module)	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to:

- Characterize small-scale fading in terms of Doppler spectrum, coherence time, power delay profile, and coherence bandwidth.
- Apply mathematical models of radio wave propagation.
- Analyze the error probabilities for common modulation schemes.
- Describe different types of diversity and how they improve performance for mobile radio channels.
- Analyze the AWGN channel capacity.

Modules	**RBT Level**
Module 1	
The Wireless channel: Physical modeling for wireless channels, Input/output model of wireless channels, Time and frequency response, Statistical models. (Text 1)	L1,L2,L3
Module 2	
Point-to-Point Communication, Detection diversity and channel uncertainty: Detection in Rayleigh fading channels, Time diversity, Antenna diversity, Frequency diversity, Impact of the channel uncertainty. (Text 1)	L1,L2,L3
Module 3	
Diversity: Introduction Micro-diversity, Micro-diversity and Simulcast combination of signals, Error probability in fading channels with diversity reception, Transmit diversity. (Chap. 13 of Text2)	L1,L2,L3
Module 4	
Capacity of wireless channel: AWGN channel capacity, Resources of AWGN channel, Linear time invariant Gaussian channel, Capacity of fading channels. (Text 1)	L1,L2,L3
Module 5	
MIMO Systems: Introduction, Space diversity and system based on space diversity, Smart antenna systems and MIMO, MIMO based system architecture; MIMO exploits multipath, Space time processing, Antenna considerations for MIMO. MIMO channel modeling, MIMO channel measurements, MIMO channel capacity, CDD, Space time coding, advantages and applications of MIMO, MIMO application in 3G.(Chap. 15 of Text 3)	L1,L2,L3

Course Outcomes: After studying this course, students will be able to:

- Acquire knowledge of characteristics of mobile/wireless communication channels
- Apply statistical models of multipath fading
- Understand the multiple radio access techniques

- Understand the need of coding, diversity, interleaving and link techniques for mo bile/wireless communications network
- Design receiver and transmitter diversity techniques
- Identify and describe modern techniques for high-rate wireless communications, using MIMO transmission

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. David Tse, P. Vishwanath, “Fundamentals of Wireless Communication”, Cambridge University press, 2006.
2. Andreas F.Molisch “Wireless Communications” 2nd Edition John Wiley & Sons.
3. Upena Dalal, “Wireless communication”, Oxford, 2009.

Reference Book:

Ke-Lin Du, ad M.N.S. Swamy, "Wireless communication systems-From RF subsystems to 4G enabling Technologies", Cambridge.

RF AND MICROWAVE CIRCUIT DESIGN

[As per Choice Based Credit System (CBCS) Scheme]

SEMESTER – II

Subject Code	16ECS24	IA Marks	20
Number of Lecture Hours/Week	04	Exam marks	80
Total Number of Lecture Hours	50 (10 Hours per Module)	Exam Hours	03

CREDITS – 04

Course Objectives: This course will enable students to

- Understand waves propagating in Networks.
- Use the Smith Chart for various applications.
- Understand the basic considerations in active networks
- Design active networks.
- Understand RF/MW Frequency Mixer and Phase Shifter Design

Modules	**RBT Level**
Module 1	
Wave propagation in networks: Introduction, Reasons for Using RF/Microwaves, Applications, RF Waves, RF and Microwave circuit design, Introduction to Components Basics, Analysis of Simple Circuit in Phasor Domain, RF Impedance Matching, Transmission Media, High Frequency Parameters, Formulation of S-parameters, Properties of S-Parameters, Transmission Matrix, Generalized S-parameters.	L1,L2
Module 2	
Smith chart and its Applications: Introduction, Smith Chart, Derivation of Smith Chart, Smith Chart Circular and Radial Scales, Application of Smith chart.	L1,L2
Module 3	
Basic consideration in active networks: Stability Considerations, Gain Considerations and Noise Considerations.	L1,L2
Module 4	
RF/Microwave Amplifiers: Small Signal Design: Introduction, Types of amplifier, Design of different types of amplifiers **RF/Microwave Frequency Conversion: Mixers**: Introduction, Mixer Types, Conversion Losses for SSB Mixers, SSB versus DSB mixers, One diode mixers, Two diode Mixers.	L1,L2,L3
Module 5	
RF/Microwave Control Circuit Design: Introduction, PN Junction Devices, Phase shifters, Digital phase shifters, Semiconductor phase shifters, PIN diode attenuators. **RF and Microwave IC design**: MICs, MIC materials, Types of MICs, Hybrid verses Monolithic ICs, Chip mathematics	L1,L2,L3

Course Outcomes: After studying this course, students will be able to:

- Discuss and analyse waves propagation in Networks

- Apply the Smith Chart for finding various parameters in transmission lines
- Analyse the basic considerations in active networks
- Describe and design active networks
- Design RF/MW Frequency Mixers and phase shifters

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Book:

Matthew M. Radmanesh, "RF and Microwave Electronics Illustrated", Pearson Education edition, 2004.

Reference Book:

Reinhold Ludwig, and Pavel Bretchko, "RF circuit design theory and applications", Pearson Education edition, 2004.

AUTOMOTIVE ELECTRONICS [As per Choice Based credit System (CBCS) Scheme SEMESTER – II			
Subject Code	16ELD251	IA Marks	20
Number of Lecture Hours/Week	03	Exam marks	80
Total Number of Lecture Hours	40 (8 Hours per Module)	Exam Hours	03
CREDITS – 03			

Course Objectives: This course will enable students to:

- Understand the complete dynamics of automotive electronics
- Design and implement the electronics that attributes the smartness to the automobiles by way of unprecedented safety, add-on features, and comforts.

Modules	**RBT Level**
Module 1	
Automotive Fundamentals, the Systems Approach to Control and Instrumentation: Use Of Electronics In The Automobile, Antilock Brake Systems, (ABS), Electronic steering control, Power steering, Traction control, Electronically controlled suspension. (Chap.1 and 2 of Text)	L1,L2
Module 2	
Automotive instrumentation Control: Sampling, Measurement and signal conversion of various parameters. (Chap. 4 of Text)	L1,L2, L3
Module 3	
The basics of Electronic Engine control: Integrated body: Climate controls, Motivation for Electronic Engine Control, Concept of An Electronic Engine Control System, Definition of General Terms, Definition of Engine Performance Terms, Electronic fuel control system, Engine control sequence, Electronic Ignition, Sensors and Actuators, Applications of sensors and actuators, air flow rate sensor, Indirect measurement of mass air flow, Engine crankshaft angular position sensor, Automotive engine control actuators, Digital engine control, Engine speed sensor ,Timing sensor for ignition and fuel delivery, Electronic ignition control systems, Safety systems, Interior safety, Lighting, Entertainment systems. (Chap. 5 and 6 of Text)	L1,L2,L3
Module 4	

Vehicle Motion Control and Automotive diagnostics: Cruise control system, Digital cruise control, Timing light, Engine analyzer, On-board and off-board diagnostics, Expert systems. Stepper motor-based actuator, Cruise control electronics, Vacuum - antilock braking system, Electronic suspension system Electronic steering control, Computer-based instrumentation system, Sampling and Input\output signal conversion, Fuel quantity measurement, Coolant temperature measurement, Oil pressure measurement, Vehicle speed measurement, Display devices, Trip-Information-Computer, Occupant protection systems. (Chap. 8 and 10 of Text)	L1,L2, L3
Module 5	
Future automotive electronic systems: Alternative Fuel Engines, Collision Wide Range Air/Fuel Sensor, Alternative Engine, Low Tire Pressure Warning System, Collision avoidance Radar Warning Systems, Low Tire Pressure Warning System, Radio Navigation, Advance Driver information System. Alternative-Fuel Engines , Transmission Control , Collision Avoidance Radar Warning System, Low Tire Pressure Warning System, Speech Synthesis Multiplexing in Automobiles, Control Signal Multiplexing, Navigation Sensors, Radio Navigation, Sign post Navigation , Dead Reckoning Navigation Future Technology, Voice Recognition Cell Phone Dialing Advanced Driver information System, Automatic Driving Control. (Chap. 11 of Text)	L1,L2, L3

Course Outcomes: After studying this course, students will be able to:

- Understand and implement various control requirements in the automotive system.
- Comprehend dashboard electronics and engine system electronics.
- Identify various physical parameters that are to be sensed and monitored for maintaining the stability of the vehicle under dynamic conditions.
- Understand and implement the controls and actuator system pertaining to the comfort and safety of commuters.
- Design and implement sensor network for mechanical fault diagnostics in an automotive vehicle.

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Book:

William B. Ribbens , "Understanding Automotive Electronics", SAMS/Elsevier publishing, 6th Edition, 1997.

Reference Book:

Robert Bosch Gmbh, "Automotive Electrics and Automotive Electronics-Systems and Components, Networking and Hybrid Drive", Springer Vieweg, 5th Edition, 2007.

MULTIMEDIA OVER COMMUNICATION LINKS

[As per Choice Based credit System (CBCS) Scheme

SEMESTER – II

Subject Code	16ECS252	IA Marks	20
Number of Lecture Hours/Week	03	Exam marks	80
Total Number of Lecture Hours	40 (8 Hours per Module)	Exam Hours	03

CREDITS – 03

Course Objectives: This course will enable students to:

- Gain fundamental knowledge in understanding the basics of different multimedia networks, applications, media types like text and image.
- Analyse media types like audio and video and gain knowledge on multimedia systems.
- Analyse Audio compression techniques required to compress Audio.
- Analyse compression techniques required to compress video.
- Gain fundamental knowledge about the Multimedia Communications in different Networks.

Modules	**RBT Level**
Module 1	
Multimedia Communications: Introduction, Multimedia information representation, multimedia networks, multimedia applications, Application and networking terminology.(Chap. 1 of Text1) **Information Representation**: Introduction, Text, Images. (Chap. 2- Sections 2.2 and 2.3 of Text 1)	L1, L2, L3
Module 2	
Information Representation: Audio and Video. (Chap. 2 - Sections 2.4 and 2.5 of Text 1) **Distributed multimedia systems**: Introduction, main Features of a DMS, Resource management of DMS, Networking, Multimedia operating systems. (Chap. 4 - Sections 4.1 to 4.5 of Text 2)	L1,L2, L3
Module 3	
Multimedia Processing in Communication: Introduction, Perceptual coding of digital Audio signals, Transform Audio Coders, Audio Sub band Coders. (Chap. 3 - Sections 3.1, 3.2, 3.6, 3.7 of Text 2)	L1,L2, L3
Module 4	
Multimedia Communication Standards: Introduction, MPEG approach to multimedia standardization, MPEG-1, MPEG-2, Overview of MPEG-4. (Chap. 5 - Sections 5.1 to 5.4 and 5.5.1 of Text 2)	L1,L2, L3
Module 5	
Multimedia Communication Across Networks: Packet audio/video in the network environment, Video transport across generic networks, Multimedia Transport across ATM Networks.	L1,L2, L3

(Chap. 6 - Sections 6.1, 6.2, 6.3 of Text 2)	

Course Outcomes: After studying this course, students will be able to:

- Understand basics of different multimedia networks and applications.
- Analyze media types like audio and video to represent in digital form.
- Understand different compression techniques to compress audio.
- Understand different compression techniques to compress audio video.
- Describe the basics of Multimedia Communication Across Networks

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Fred Halsall, “Multimedia Communications”, Pearson education, 2001, ISBN -9788131709948.
2. K. R. Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic, “Multimedia Communication Systems”, Pearson education, 2004. ISBN - 9788120321458.

Reference Book:

Raif steinmetz, Klara Nahrstedt, “Multimedia: Computing, Communications and Applications”, Pearson education, 2002, ISBN -9788177584417.

MICRO ELECTRO MECHANICAL SYSTEMS

[As per Choice Based credit System (CBCS) Scheme]

SEMESTER – II

Subject Code	16ELD253	IA Marks	20
Number of Lecture Hours/Week	03	Exam marks	80
Total Number of Lecture Hours	40 (8 Hours per Module)	Exam Hours	03

CREDITS – 03

Course Objectives: This course will enable students to:

- Understand overview of microsystems, their fabrication and application areas.
- Working principles of several MEMS devices.
- Develop mathematical and analytical models of MEMS devices
- Know methods to fabricate MEMS devices
- Various application areas where MEMS devices can be used.

Modules	**RBT Level**
Module 1	
Overview of MEMS and Microsystems: MEMS and Microsystem, Typical MEMS and Microsystems Products, Evolution of Microfabrication, Microsystems and Microelectronics, Multidisciplinary Nature of Microsystems, Miniaturization. Applications and Markets.	L1, L2
Module 2	
Working Principles of Microsystems: Introduction, Microsensors, Microactuation, MEMS with Microactuators, Microaccelerometers, Microfluidics. Engineering Science for Microsystems Design and Fabrication. Introduction, Atomic Structure of Matters, Ions and Ionization, Molecular Theory of Matter and Inter-molecular Forces, Doping of Semiconductors, The Diffusion Process, Plasma Physics, Electrochemistry.	L1, L2
Module 3	
Engineering Mechanics for Microsystems Design: Introduction, Static Bending of Thin Plates, Mechanical Vibration, Thermomechanics, Fracture Mechanics, Thin Film Mechanics, Overview on Finite Element Stress Analysis.	L1,L2, L3
Module 4	
Scaling Laws in Miniaturization: Introduction, Scaling in Geometry, Scaling in Rigid-Body Dynamics, Scaling in Electrostatic Forces, Scaling of Electromagnetic Forces, Scaling in Electricity, Scaling in Fluid Mechanics, Scaling in Heat Transfer.	L1,L2, L3
Module 5	
Overview of Micromanufacturing: Introduction, Bulk Micromanufacturing, Surface Micromachining, The LIGA Process, Summary on Micromanufacturing.	L1,L2, L3

Microsystem Design: Introduction, Design Considerations, Process Design, Mechanical Design, Using Finite Element Method.	

Course Outcomes: After studying this course, students will be able to:

- Appreciate the technologies related to Micro Electro Mechanical Systems.
- Understand design and fabrication processes involved with MEMS devices.
- Analyze the MEMS devices and develop suitable mathematical models
- Know various application areas for MEMS device

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Book:

1. Tai-Ran Hsu, MEMS and Micro systems: Design, Manufacture and Nanoscale Engineering, 2nd Ed, Wiley.

Reference Books:

1. Hans H. Gatzen, Volker Saile, Jurg Leuthold, Micro and Nano Fabrication: Tools and Processes, Springer, 2015.
2. Dilip Kumar Bhattacharya, Brajesh Kumar Kaushik, Microelectromechanical Systems (MEMS), Cenage Learning.

CRYPTOGRAPHY AND NETWORK SECURITY [As per Choice Based credit System (CBCS) Scheme SEMESTER – II			
Subject Code	16ECS254	IA Marks	20
Number of Lecture Hours/Week	03	Exam marks	80
Total Number of Lecture Hours	40 (8 Hours per Module)	Exam Hours	03
CREDITS – 03			

Course Objectives: This course will enable students to:

- Understand the basics of symmetric key and public key cryptography.
- Understand some basic mathematical concepts and pseudorandom number generators required for cryptography.
- Authenticate and protect the encrypted data.
- Enrich knowledge about Email, IP and Web security.

Modules	**RBT Level**
Module 1	
Foundations: Terminology, Steganography, substitution ciphers and transpositions ciphers, Simple XOR, One-Time Pads, Computer Algorithms (Text 2: Chapter 1: Section 1.1 to 1.6) **SYMMETRIC CIPHERS:** Traditional Block Cipher structure, Data encryption standard (DES), The AES Cipher. (Text 1: Chapter 2: Section2.1, 2.2, Chapter 4)	L1,L2,L3
Module 2	
Introduction to modular arithmetic, Prime Numbers, Fermat's and Euler's theorem, primality testing, Chinese Remainder theorem, discrete logarithm. (Text 1: Chapter 7: Section 1, 2, 3, 4, 5) Principles of Public-Key Cryptosystems, The RSA algorithm, Diffie - Hellman Key Exchange, Elliptic Curve Arithmetic, Elliptic Curve Cryptography (Text 1: Chapter 8, Chapter 9: Section 9.1, 9.3, 9.4)	L1,L2,L3
Module 3	
Pseudo-Random-Sequence Generators and Stream Ciphers: Linear Congruential Generators, Linear Feedback Shift Registers, Design and analysis of stream ciphers, Stream ciphers using LFSRs, A5, Hughes XPD/KPD, Nanoteq, Rambutan, Additive generators, Gifford, Algorithm M, PKZIP (Text 2: Chapter 16)	L1,L2, L3
Module 4	
One-Way Hash Functions: Background, Snefru, N-Hash, MD4, MD5, Secure Hash Algorithm [SHA],One way hash functions using symmetric block algorithms, Using public key algorithms, Choosing a one-way hash functions, Message Authentication Codes. Digital Signature Algorithm, Discrete Logarithm Signature Scheme (Text 2: Chapter 18: Section 18.1 to 18.5, 18.7, 18.11 to 18.14 and Chapter 20: Section 20.1, 20.4)	L1,L2,L3
Module 5	
E-mail Security: Pretty Good Privacy-S/MIME (Text 1: Chapter 17: Section 17.1, 17.2).	L1,L2, L3

IP Security: IP Security Overview, IP Security Policy, Encapsulation Security Payload (ESP), Combining security Associations. (Text 1: Chapter 18: Section 18.1 to 18.4). **Web Security:** Web Security Considerations, SSL (Text 1: Chapter 15: Section 15.1, 15.2).	

Course Outcomes: After studying this course, students will be able to:

- Use basic cryptographic algorithms to encrypt the data.
- Generate some pseudorandom numbers required for cryptographic applications.
- Provide authentication and protection for encrypted data.

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. William Stallings , "Cryptography and Network Security Principles and Practice", Pearson Education Inc., 6th Edition, 2014, ISBN: 978-93-325-1877-3

2. Bruce Schneier, "Applied Cryptography Protocols, Algorithms, and Source code in C", Wiley Publications, 2nd Edition, ISBN: 9971-51-348-X

Reference Books:

1. Cryptography and Network Security, Behrouz A. Forouzan, TMH, 2007.
2. Cryptography and Network Security, Atul Kahate, TMH, 2003.

ADVANCED DSP LAB

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – II

Laboratory Code	16ECSL26	IA Marks	20
Number of Lecture Hours/Week	01Hr Tutorial (Instructions) + 02 Hours Laboratory	Exam Marks	80
		Exam Hours	03

CREDITS – 02

Course objectives: This laboratory course enables students to get practical experience

- Matlab implementation of LTI systems and multirate systems
- Realization of some systems using DSP 6713 processor

Laboratory Experiments:	**RBT Level**
PART-A: Experiments to be done using MATLAB	
1. Computation of Linear convolution, Circular convolution, Linear convolution using circular convolution	L1,L2, L3
2. Computation of DFT, IDFT, Circular convolution in frequency domain	
3. Comparison of DFT and DCT (in terms of energy compactness) Generate the sequence x[n]=n-64 for n=0, ...127. (a) Let X[k] = DFT{x[n]}. For various values of l, set to zero "high frequency coefficients" X[64-l]= ....X[64]= .....X[64+L]=0 and take the inverse DFT. Plot the results. (b) Let XDCT[k]=DCT(X[n]). For the same values of L, set to zero "high frequency coefficient" XDCT [127-L]= ....XDCT[127]. Take the inverse DCT for each case and compare the reconstruction with the previous case.	
4. Determination of power spectrum density of a given sequence	
5. Generation of DTMF Signals	
6. Implementation of Decimation Process and Implementation of Interpolation Process	
7. Time-Frequency Analysis with the Continuous Wavelet Transform	

8. Signal Reconstruction from Continuous Wavelet Transform Coefficients	
9.Denoising Signals and Images	
10.Haar Wavelet Image Compression	
PART-B: Experiments to be done using the DSP processor	
1. Write an ALP to obtain the response of a system using linear convolution whose input and impulse response are specified.	L1,L2, L3
2. Write an ALP to obtain the impulse response of the given system, given the difference equation.	
3. Computation of FFT when N is not a power of 2.	
4. Synthesis of Dual Tone Multi Frequency using 6713 processor	

Course outcomes: On the completion of this laboratory course, the students will be able to:

1. Realize the following using Matlab
   - Response of LTI systems.
   - DFT and DCT
   - Decimation
   - Wavelet Transforms
2. Implement the following using 6713 processor
   - Response of LTI systems and convolution.
   - FFT realization and DTMF generation.

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.
2. One experiment from the Part-A Matlab part and one experiment from the Part-B Hardware part to be set for the examination.
3. Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
4. Change of experiment is allowed only once and Marks allotted to the Procedure part will be made zero.

M.Tech Commn. Stream-2016-FOURTH SEMESTER SYLLABUS

Wireless Broadband LTE 4G [As per Choice Based Credit System (CBCS) scheme] SEMESTER – IV			
Subject Code	16ECS41	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50 (10 Hrs per Module)	Exam Hours	03
CREDITS – 04			

Course objectives: This course will enable students to:

- Explain the system architecture of LTE and E-UTRAN as per the standards
- Understand the Multiple Access process incorporated in the radio physical layer.
- Associate MAC of LTE radio interface protocols to set up, reconfigure and release the Radio Bearer and for transferring to the EPS bearer.
- Explain the mobility principles and procedures in the idle and active state.
- Analyse the main factors affecting LTE performance including mobile speed and transmission bandwidth.

Modules	**RBT Level**
Module -1	
LTE Standardization Phases, Evolution Beyond Release 8, LTE-Advanced for IMT-Advanced, LTE Specifications and 3GPP Structure. **System Architecture Based on 3GPP SAE:** Basic System Architecture Configuration with only E-UTRAN Access Network, System Architecture with E-UTRAN and Legacy 3GPP Access Networks, System Architecture with E-UTRAN and Non-3GPP Access Networks, Architecture Configuration, IMS Architecture, PCC and QoS.	**L2, L3**
Module -2	
Introduction to OFDMA, SC-FDMA and MIMO in LTE: LTE Multiple Access Background, OFDMA Basics, SC-FDMA Basics MIMO Basics. **Physical Layer:** Transport Channels and their Mapping to the Physical Channels, Modulation, Uplink User Data Transmission, Downlink User Data Transmission, Uplink Physical Layer Signaling Transmission, PRACH Structure, Downlink Physical Layer Signaling Transmission.	**L2, L3**
Module -3	

Physical Layer Procedures, UE Capability Classes and Supported Features Physical Layer Measurements, Physical Layer Parameter Configuration. **LTE Radio Protocols:** Protocol Architecture, The Medium Access Control The Radio Link Control Layer, Packet Data Convergence Protocol.	**L1, L2, L3**
Module -4	
Radio Resource Control (RRC): X2 Interface Protocols Understanding the RRC ASN.1 Protocol Definition, Early UE Handling in LTE. **Mobility:** Mobility Management in Idle State, Intra-LTE Handovers 190, Inter-system Handovers Differences in E-UTRAN and UTRAN Mobility.	**L2, L3**
Module -5	
Radio Resource Management: Overview of RRM Algorithms, Admission Control and QoS Parameters, Downlink Dynamic Scheduling and Link Adaptation, Uplink Dynamic Scheduling and Link Adaptation, Interference Management and Power Settings, Discontinuous Transmission and Reception (DTX/DRX), RRC Connection Maintenance. **Performance:** Layer 1 Peak Bit Rates, Terminal Categories Link Level Performance, Link Budgets Spectral Efficiency Latency, LTE Reframing to GSM Spectrum Dimensioning, Capacity Management Examples from HSPA Networks.	**L1, L2, L3**

Course outcomes:

- Understand the system architecture and the function standard specified components of the system of LTE 4G.
- Analyze the role of LTE radio interface protocols and EPS Data convergence protocols to set up, reconfigure and release data and voice from a number of users.
- Demonstrate the UTRAN and EPS handling processes from set up to release including mobility management for a variety of data call scenarios.
- Test and Evaluate the Performance of resource management and packet data processing and transport algorithms.

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Book:

'LTE for UMTS Evolution to LTE-Advanced' Harri Holma and Antti Toskala, Second Edition - Wiley India ISBN-978-81-265-7293-9, 2018 / Wiley ISBN: 9780470660003, 2011.

Reference Books:

1. 'Fundamentals of LTE', by Arunabha Ghosh, Jun Zhang, Jeffrey G. Andrews), Rias Muhamed, 1st Edition, Sept 2010, Prentice Hall Communications Engineering and Emerging Technologies Series from Ted Rappaport,ISBN13: 9780137033119, ISBN10: 0137033117.
2. ' EVOLVED PACKET SYSTEM (EPS) ; THE LTE AND SAE EVOLUTION OF 3G UMTS' by Pierre Lescuyer and Thierry Lucidarme, 2008, John Wiley & Sons, Ltd. Print ISBN:978-0-470-05976-0.
3. ' LTE – The UMTS Long Term Evolution ; From Theory to Practice' by Stefania Sesia, Issam Toufik, and Matthew Baker, 2009 John Wiley & Sons Ltd, ISBN 978-0-470-69716-0.

CMOS RF Circuit Design

[As per Choice Based credit System (CBCS) Scheme
SEMESTER – IV

Subject Code	16EVE421	IA Marks	20
Number of Lecture Hours/Week	03	Exam marks	80
Total Number of Lecture Hours	40 (8 Hours per Module)	Exam Hours	03

CREDITS – 03

Course Objectives: This course will enable students to:

- Learn basic concepts in RF and microwave design emphasising the effects of nonlinearity and noise.
- Able to appreciate communication system, multiple access and wireless standards necessary for RF circuit design.
- Able to deal with transceiver architecture, various receiver and transmitter designs, their merits and demerits
- Understand the design of RF building blocks such as Low Noise Amplifiers and Mixers

Modules	**RBT Level**
Module 1	
Introduction to RF Design and Wireless Technology: **Basic concepts in RF design(I):** General considerations, Effects of Nonlinearity, Noise, Sensitivity and dynamic range	L1,L2,L3
Module 2	
Basic concepts in RF design (II): Passive impedance transformation, scattering parameters, analysis of nonlinear dynamic systems	L1,L2,L3
Module 3	
Communication Concepts: General concepts, analog modulation, digital modulation, spectral re-growth, Mobile RF communications, Multiple access techniques, Wireless standards	L1,L2,L3
Module 4	
Transceiver Architecture (I): General considerations, Receiver architecture	L1,L2,L3
Module 5	
Transceiver Architecture (II): Transmitter architectures **Low Noise Amplifiers:** LNA topologies: common-source stage with inductive load, common-source stage with resistive feedback. **Mixers:** General considerations, passive down conversion mixers.	L1,L2,L3

Course Outcomes: After studying this course, students will be able to:

- Analyse the effect of nonlinearity and noise in RF and microwave design.
- Exemplify the approaches taken in actual RF products.
- Minimize the number of off-chip components required to design mixers and Low-Noise Amplifiers.

- Explain various receivers and transmitter topologies with their merits and drawbacks.
- Demonstrate how the system requirements define the parameters of the circuits and how the performance of each circuit impacts that of the overall transceiver.

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Book:

B. Razavi, "**RF Microelectronics**", PHI, second edition.

Reference Books:

1. R. Jacob Baker, H.W. Li, D.E. Boyce "**CMOS Circuit Design, layout and Simulation**", PHI 1998.
2. Thomas H. Lee "**Design of CMOS RF Integrated Circuits**" Cambridge University press 1998.
3. Y.P. Tsividis, "**Mixed Analog and Digital Devices and Technology**", TMH 1996

Advances in Image Processing

[As per Choice Based credit System (CBCS) Scheme

SEMESTER – IV

Subject Code	16ECS422	IA Marks	20
Number of Lecture Hours/Week	03	Exam marks	80
Total Number of Lecture Hours	40 (8 Hours per Module)	Exam Hours	03

CREDITS – 03

Course Objectives: This course will enable students to:

- Acquire fundamental knowledge in understanding the representation of the digital image and its properties
- Equip with some pre-processing techniques required to enhance the image for further analysis purpose.
- Select the region of interest in the image using segmentation techniques.
- Represent the image based on its shape and edge information.
- Describe the objects present in the image based on its properties and structure.

Modules	**RBT Level**
Module 1	
The image, its representations and properties: Image representations a few concepts, Image digitization, Digital image properties, Color images.	L1
Module 2	
Image Pre-processing: Pixel brightness transformations, geometric transformations, local pre-processing.	L1, L2
Module 3	
Segmentation: Thresholding; Edge-based segmentation – Edge image thresholding, Edge relaxation, Border tracing, Hough transforms; Region – based segmentation – Region merging, Region splitting, Splitting and merging, Watershed segmentation, Region growing post-processing.	L1, L2, L3
Module 4	
Shape representation and description: Region identification; Contour-based shape representation and description – Chain codes, Simple geometric border representation, Fourier transforms of boundaries, Boundary description using segment sequences, B-spline representation; Region-based shape representation and description – Simple scalar region descriptors, Moments, Convex hull.	L1, L2, L3
Module 5	
Mathematical Morphology: Basic morphological concepts, Four morphological principles, Binary dilation and erosion, Skeletons and object marking, Morphological segmentations and watersheds.	L1, L2, L3

Course Outcomes: After studying this course, students will be able to:

- Understand the representation of the digital image and its properties
- Apply pre-processing techniques required to enhance the image for its further analysis.
- Use segmentation techniques to select the region of interest in the image for analysis
- Represent the image based on its shape and edge information.
- Describe the objects present in the image based on its properties and structure.
- Use morphological operations to simplify images, and quantify and preserve the main shape characteristics of the objects.

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Book:

Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis, and Machine Vision", Cengage Learning, 2013, ISBN: 978-81-315-1883-0.

Reference Books:

1. Geoff Doughertry, Digital Image Processing for Medical Applications, Cambridge university Press, 2010
2. S.Jayaraman, S Esakkirajan, T.Veerakumar, Digital Image Processing, Tata McGraw Hill, 2011

Communication System Design using DSP Algorithms

[As per Choice Based credit System (CBCS) Scheme
SEMESTER – IV

Subject Code	16ECS423	IA Marks		20
Number of Lecture Hours/Week	03	Exam marks		80
Total Number of Lecture Hours	40 (8 Hours per Module)	Exam Hours		03

CREDITS – 03

Course Objectives: This course will enable students to:

- Understand communication systems, including algorithms that are particularly suited to DSP implementation.
- Understand Software and hardware tools, as well as FIR and IIR digital filters and the FFT.
- Discuss modulators and demodulators for classical analog modulation methods such as amplitude modulation (AM), double-sideband suppressed-carrier amplitude modulation (DSBSC-AM), single sideband modulation (SSB), and frequency modulation (FM).
- Explore digital communication methods leading to the implementation of a telephone-line modem.

Modules	RBT Level
Module 1	
Introduction to the course: Digital filters, Discrete time convolution and frequency responses, FIR filters - Using circular buffers to implement FIR filters in C and using DSP hardware, Interfacing C and assembly functions, Linear assembly code and the assembly optimizer. IIR filters - realization and implementation, FFT and power spectrum estimation: DTFT window function, DFT and IDFT, FFT, Using FFT to implement power spectrum.	**L1,L2**
Module 2	
Analog modulation scheme: Amplitude Modulation - Theory, generation and demodulation of AM, Spectrum of AM signal. Envelope detection and square law detection. Hilbert transform and complex envelope, DSP implementation of amplitude modulation and demodulation. **DSBSC:** Theory generation of DSBSC, Demodulation, and demodulation using coherent detection and Costas loop. Implementation of DSBSC using DSP hardware. **SSB:** Theory, SSB modulators, Coherent demodulator, Frequency translation, Implementation using DSP hardware. (Text 1, 2)	**L1,L2**
Module 3	
Frequency modulation: Theory, Single tone FM, Narrow band FM, FM bandwidth, FM demodulation, Discrimination and PLL methods, Implementation using DSP hardware. **Digital Modulation scheme:** PRBS, and data scramblers: Generation	**L1,L2**

of PRBS, Self -synchronizing data scramblers, Implementation of PRBS and data scramblers. RS-232C protocol and BER tester: The protocol, error rate for binary signaling on the Gaussian noise channels, Three bit error rate tester and implementation.	
Module 4	
PAM and QAM: PAM theory, baseband pulse shaping and ISI, Implementation of transmit filter and interpolation filter bank. Simulation and theoretical exercises for PAM, Hardware exercises for PAM. **QAM fundamentals:** Basic QAM transmitter, 2 constellation examples, QAM structures using passband shaping filters, Ideal QAM demodulation, QAM experiment. QAM receivers-Clock recovery and other frontend sub-systems. Equalizers and carrier recovery systems.	**L2,L3**
Module 5	
Experiment for QAM receiver frontend. Adaptive equalizer, Phase splitting, Fractionally spaced equalizer. Decision directed carrier tracking, Blind equalization, Complex cross coupled equalizer and carrier tracking experiment. Echo cancellation for full duplex modems: Multicarrier modulation, ADSL architecture, Components of simplified ADSL transmitter, A simplified ADSL receiver, Implementing simple ADSL Transmitter and Receiver.	**L2,L3**

Course outcomes: After studying this course, students will be able to:

- Implement DSP algorithms on TI DSP processors
- Implement FIR, IIR digital filtering and FFT methods
- Implement modulators and demodulators for AM,DSBSC-AM,SSB and FM
- Design digital communication methods leading to the implementation of a line communication system.

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Book:

Tretter, Steven A., "**Communication System Design Using DSP Algorithms With Laboratory Experiments for the TMS320C6713™ DSK",** Springer USA*, 2008.*

Reference Books:

1. Robert. O. Cristi, "**Modern Digital signal processing",** Cengage Publishers, India, 2003.
2. S. K. Mitra, "**Digital signal processing: A computer based approach",** 3rd edition, TMH, India, 2007.
3. E.C. Ifeachor, and B. W. Jarvis, "**Digital signal processing: A Practitioner's approach",** Second Edition, Pearson Education, India, 2002,
4. Proakis, and Manolakis, "**Digital signal processing**", 3rd edition, Prentice Hall, 1996.

Real Time Systems [As per Choice Based credit System (CBCS) Scheme SEMESTER – IV			
Subject Code	16ECS424	IA Marks	20
Number of Lecture Hours/Week	03	Exam marks	80
Total Number of Lecture Hours	40 (8 Hours per Module)	Exam Hours	03
CREDITS – 03			

Course Objectives: This course will enable students to:

- Understand basics of Real Time systems.
- Distinguish a real-time system with other systems.
- Identify the functions of operating system
- Evaluate the need for Real time operating system.
- Design and develop embedded applications by means of real-time operating systems.

Modules	**RBT Level**
Module 1	
Introduction to Real-Time Embedded Systems: Brief history of Real Time Systems, A brief history of Embedded Systems. **System Resources:** Resource Analysis, Real-Time Service Utility, Scheduling Classes, The Cyclic Executive, Scheduler Concepts, Preemptive Fixed Priority Scheduling Policies, Real-Time OS, Thread Safe Re-entrant Functions.	L1, L2
Module 2	
Processing: Preemptive Fixed-Priority Policy, Feasibility, Rate Montonic least upper bound, Necessary and Sufficient feasibility, Deadline – Monotonic Policy, Dynamic priority policies. **I/O Resources:** Worst-case Execution time, Intermediate I/O, Execution efficiency, I/O Architecture. **Memory:** Physical hierarchy, Capacity and allocation, Shared Memory, ECC Memory, Flash file systems.	L1, L2
Module 3	
Multi-resource Services: Blocking, Deadlock and livestock, Critical sections to protect shared resources, priority inversion. **Soft Real-Time Services:** Missed Deadlines, QoS, Alternatives to rate monotonic policy, Mixed hard and soft real-time services.	L1, L2
Module 4	
Embedded System Components: Firmware components, RTOS system software mechanisms, Software application components. **Debugging Components:** Exceptions assert, Checking return codes, Single-step debugging, kernel scheduler traces, Test access ports, Trace ports, Power-On self test and diagnostics.	L1, L2, L3
Module 5	
Performance Tuning: Basic concepts of drill-down tuning,	L1, L2,

hardware – supported profiling and tracing, Building performance monitoring into software, Path length. **High availability and Reliability Design:** Reliability and Availability, Similarities and differences, Reliability, Reliable software, Available software, Design tradeoffs, Hierarchical applications for Fail-safe design.	L3

Course Outcomes: After studying this course, students will be able to:

- Analyze Real time operating systems.
- Describe the functions of Real time operating systems.
- Demonstrate embedded system applications.
- Design a Real Time operating system.

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Book:

Sam Siewert, "Real-Time Embedded Systems and Components", Cengage Learning India Edition, 2007.

Reference Books:

1. Krishna CM and Kang Singh G, "Real time systems", Tata McGraw Hill, 2003, ISBN: 0-07-114243-64
2. Qing Li and Carolyn Yao, "Real-Time Concepts for Embedded Systems", CMP Books, 2003, ISBN:1578201241
3. Jane W. S. Liu, "Real Time Systems", Prentice Hall, 2000, ISBN: 0130996513
4. Phillip A. Laplante, "Real-Time Systems Design and Analysis", John Wiley & Sons, 2004.