SHARNBASVA UNIVERSITY
FACULTY OF ENGINEERING & TECHNOLOGY

CHOICE BASED CREDIT SYSTEM (CBCS) SCHEME
SCHEME OF TEACHING & EXAMINATION 2017-2018
M.Tech: DIGITAL COMMUNICATION & NETWORKING

Semester : I

Subject Code	Name of the Subject	Teaching &Learning(hours/week)		Practical/ Project/ Field Work	Duration of Exam in Hours	Marks for		Total Marks	CREDITS
		Lecture	Discourse/ Self Study/ Assignment			CIE	SEE		
17LDE11	Advanced Engineering Mathematics	3	3	-	3	50	50	100	4
17LDN12	Antenna Theory and Design	3	3	-	3	50	50	100	4
17LVE13	Advanced Embedded System	3	3	-	3	50	50	100	4
17LDN14	Advanced Digital Communications	3	3	-	3	50	50	100	4
17LXX15X	Elective-1	3	3	-	3	50	50	100	4
17LDNL16	Advanced Communication Lab	-	-	6	3	50	50	100	2
17LDN17	Project-1	-	-	6	3	50	50	100	2
Total		15	15	12		350	350	700	24

Electives-1	
17LDN151	Advanced Computer Networks
17LDN152	Optical Communication & Networking
17LDE153	ASIC
17LVE154	Advanced Computer Architecture.
17LDN155	Multimedia Over Communication links

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Semester: II

Subject Code	Name of the Subject	Teaching &Learning(hours/week)		Practical/ Project/ Field Work	Duration of Exam in Hours	Marks for		Total Marks	CREDITS
		Lecture	Discourse/ Self Study/ Assignment			CIE	SEE		
17LDE21	Advanced DSP	3	3	-	3	50	50	100	4
17LDE22	Error Control Coding	3	3	-	3	50	50	100	4
17LDN23	Wireless Communication	3	3	-	3	50	50	100	4
17LDN24	RF and Microwave Circuit Design	3	3	-	3	50	50	100	4
17LXX25X	Elective-2	3	3	-	3	50	50	100	4
17LDNL26	Advanced DSP Lab	-	-	6	3	50	50	100	2
17LDN27	Project-2	-	-	6	3	50	50	100	2
Total		15	15	12	-	350	350	700	24

Electives-2	
17LDN251	Wireless Mobile Networks
17LDE252	MEMS
17LDN253	Wireless Sensor Networks
17LDN254	Cryptography and Network Security
17LVE255	VLSI Design for Signal Processing

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Semester : III

Subject Code	Name of the Subject	Teaching &Learning(hours/week)		Practical/ Project/ Field Work	Duration of Exam in Hours	Marks for		Total Marks	CREDITS
		Lecture	Discourse/ Self Study/ Assignment			CIE	SEE		
17LDN31	Internship	-	-	40	03	50	50	25	20
17LDN32	Main Project Phase -1	-	-	2	-	50	-	50	01
Total		-	-	-	-	100	50	150	21

Note: Internship comprises following sub components:

1. Presentation on Internship(after 8 weeks from the date of commencement)(CIE) for 25Marks
2. Evaluation of Internship Report(CIE for 25Marks)

Viva-Voce on Internship (SEE) for 50Marks

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SEMESTER: IV

Subject Code	Name of the Subject	Teaching &Learning(hours/week)		Practical/ Project/ Field Work	Duration of Exam in Hours	Marks for		Total Marks	CREDITS
		Lecture	Discourse/ Self Study/ Assignment			CIE	SEE		
17LDN41	Wireless Broadband Communications	3	3	-	3	50	50	100	4
17LXX42X	Elective-3	3	3	-	3	50	50	100	4
17LDN43	Evaluation of Project Phase -2	-	-	24	3	100	200	300	12
Total		6	6			200	300	500	20

Elective-3	
17LVE421	CMOS RF Circuit Design
17LDN422	Advances in Image Processing
17LDN423	Communication System Design using DSP Algorithms
17LDE424	Reconfigurable Computing
17LDE425	Advanced Microcontrollers

Note:

1. **Project Phase-1**: 6-week duration shall be carried out between IInd and IIIrd Semester vacation. Candidates in consultation with the guide shall carry out literature survey/ visit industries to finalize the topic of Project.
2. **Project Phase-II**: 16-week duration during IVth semester. CIE 100marks evaluation done by the committee constituted comprising of Chairman of the department, Guide and Senior faculty of the department.
3. **Main Project Evaluation and Viva-Voce**: Evaluation shall be taken up at the end of IVth semester.
   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 the project work shall be conducted jointly by internal and external examiner for 100 Marks.

ADVANCED ENGINEERING MATHEMATICS

As per choice based credit system(CBCS)scheme Semester – I			
Subject Code	**17LDE11**	**CIE**	**50**
Number of Lecture Hours/Week	**03**	**SEE**	**50**
Total Number of Lecture Hours	**48**	**Exam hours**	**3Hrs**

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	Teaching Hours	Revised Bloom's Taxonomy(RBT) Level
Module-1 : Linear Algebra		
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). Gaussian Elimination Matrix form of linear transformations-Illustrative examples.	**10Hrs**	**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. Diagonalization Method QR decomposition, singular value decomposition, least square approximations.	**10 Hours (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. **Module – 4 : Probability Theory**	**10 Hours (Text 2 & Ref. 2)**	**L1,L2**
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	**10 Hours (Text 3 & Ref. 3)**	**L1,L2**

generating functions-illustrations. Binomial, Poisson, Exponential, Gaussian and Rayleigh distributions-examples.		
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. Poisson Process, Binomial Process	**10 Hours (Text 3 & Ref. 3)**	**L1, L2**

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

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

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, DonaldG. 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	**17LDN12**	**CIE**	**50**
Number of Lecture Hours/Week	**03**	**SEE**	**50**
Total Number of Lecture Hours	**48**	**Exam hours**	**3Hrs**

Credit : 04

Course objectives: This course will enable students to:

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

Modules	Teaching Hours	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	**10Hrs**	**L1, L2**
Module – 2 : Arrays & Antenna Synthesis		
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. 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.	**10Hrs**	**L1,L2,L3,L4,L5**
Module – 3: Resonant Antennas & Broadband antennas:		
Wires and Patches, Dipole antenna, Yagi-Uda antennas, Micro-strip antenna. Traveling wave antennas Helical antennas, Biconical antennas, Sleeve antennas, and Principles of frequency independent antennas, Spiral antennas, and Log - periodic antennas.	**10 Hrs**	**L1,L2**
Module – 4 : Aperture antennas		
Techniques for evaluating gain, Reflector antennas- Parabolic	**10 Hrs**	**L1,L2,L3,L5**

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.		
Module – 5 : Methods of Moments & Smart Antennas		
Introduction to methods of moments, Pocklington's Integrals equation and Kirchoff Networking equation. Smart Antennas, Multiple Input Multi Output Systems	**10 Hrs**	**L1, L2**

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

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

Text Book:

1. Stutzman and Thiele, "Antenna Theory and Design", 2nd Edition, John Wiley, 2010.
2. Andreas Molisch, 'Wireless Communication'. 2nd Edition, John Wiley.

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	**17LVE13**	**CIE**	**50**
Number of Lecture Hours/Week	**03**	**SEE**	**50**
Total Number of Lecture Hours	**48**	**Exam hours**	**3Hrs**

Credit : 04

Course objectives: This course will enable students to:

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

Modules	Teaching Hours	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).	**10Hrs**	**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)	**10 Hrs**	**L1, L2, L3, L4**
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)	**10 Hrs**	**L1, L2. L3**
Module – 4 : Instruction Sets		
Assembly basics, Instruction list and description, useful	**10 Hrs**	**L1, L2, L3, L4**

instructions, Memory Systems, Memory maps, Cortex M3 implementation overview, pipeline and bus interface (Text 2: Ch-4, 5, 6)		
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)	**10 Hrs**	**L1, L2, L3**

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

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

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:

1. 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	**17LDN14**	**CIE**	**50**
Number of Lecture Hours/Week	**03**	**SEE**	**50**
Total Number of Lecture Hours	**48**	**Exam hours**	**3Hrs**

Credit : 04

Course objectives: This course will enable students to:

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

Modules	Teaching Hours	Revised Bloom's Taxonomy(RBT) Level
Module-1 : Digital Modulation Schemes		
Representation of Digitally Modulated Signals, Memory less 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)	**10Hrs**	**L1, L2, L3, L4**
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 upto eqn 4.5.62 of Text)	**10 Hours**	**L1, L2, L3, L4**
Module – 3: Multichannel and Multicarrier Signalling & Synchronization		
Multichannel Communications in an AWGN channel, Multicarrier Communications in AWGN channel (Chapter 11- 11.1, 11.2- 1 to 11.2-5 of Text). Signal Parameter estimation, Carrier Phase Estimation, Symbol Timing Recovery (Chapter 5- 5.1 to 5.3, of Text).	**10 Hours**	**L2, L3, L4**
Module – 4 : Digital Communication through band-limited channels & Adaptive equalization		

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 linear equalizer, adaptive decision feedback equalizer, Adaptive equalization of Trellis - coded signals (Chapter 10: 10.1, 10.2, 10.3 of Text).	**10 Hours**	**L1, L2, L3, L4**
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).	**10 Hours**	**L1, L2**

Course Outcomes:

After studying this course, students will be able to:

1. Acquire knowledge of A
    a. Advanced topics on digital communication.
    b. Application and practical implementation of various Digital Modulation techniques.
    c. Inter symbol interference (ISI) and its channel modeling .
    d. Different types spread spectrum system
    e. Different filtering algorithms for the ISI elimination
    f. The effect of signal characteristics on the choice of a channel model.
2. Analyze the performance of
    a. Digital Modulation techniques.
    b. Different filtering algorithms.
    c. Spread spectrum communication system

Text Books:

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

Reference: Book:

1. 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	**17LDN151**	**CIE**	**50**
Number of Lecture Hours/Week	**03**	**SEE**	**50**
Total Number of Lecture Hours	**48**	**Exam hours**	**3Hrs**

Credit : 04

Course objectives: This course will enable students to:

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

Modules	Teaching Hours	Revised Bloom's Taxonomy(RBT) Level
Module-1 : Introduction to networks & Multiple Access		
Computer network, Telephone networks, Networking principles (Text 1), Protocol layering (Text 2), Multiplexing- TDM, FDM, SM, WDM (Text 1). Introduction, Choices and constraints, base technologies, centralized and distributed access schemes (Text 2).	**10Hrs**	**L1, L2, L3, L4**
Module – 2 : Local Area Networks & Scheduling		
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). Introduction, requirements, choices, performance bounds, best-effort techniques. Naming and addressing (Text 2).	**10 Hours**	**L1, L2, L3, L4**
Module – 3: SONET & Internet protocols-		
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). IP, TCP, UDP, ICMP, HTTP (Text 2).	**10 Hours**	**L2, L3, L4**
Module – 4 : Traffic Management		
Introduction, framework for traffic management, traffic models,	**10 Hours**	**L1, L2, L3, L4**

traffic classes, traffic scheduling (Text 2).		
Module – 5 : Control of Networks & Congestion and flow control		
Objectives and methods of control, routing optimization in circuit and datagram networks, Markov chains, Queuing models in circuit and datagram networks (Text 1). 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).	**10 Hours**	**L1, L2**

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

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

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.

OPTICAL COMMUNICATION AND NETWORKING

As per choice based credit system(CBCS)scheme Semester – I			
Subject Code	**17LDN152**	**CIE**	**50**
Number of Lecture Hours/Week	**03**	**SEE**	**50**
Total Number of Lecture Hours	**48**	**Exam hours**	**3Hrs**

Credit : 04

Course objectives: This course will enable students to:

a. Mathematically analyze and conceptualize basics of optical networking and its associated nonlinear artifacts and effects.
b. Develop awareness regarding optical devices and their working strategies
c. Develop awareness of WDM principles, and that of power penalty issues existent in optical Networks
d. Get insight into the design of various types of Lasers and understand the techniques of coherent transmission.
e. Develop an awareness towards the backbone architectures of optical networking with the present trends in access networks
f. 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	Teaching Hours	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.	**10Hrs**	**L1, L2, L3, L4**
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.	**10 Hours**	**L1, L2, L3, L4**
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	**10 Hours**	**L2, L3, L4**

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.	**10 Hours**	**L1, L2, L3, L4**
Module – 5 : Control and Management		
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.	**10 Hours**	**L1, L2**

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

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

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Text Book:

1. 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.

ASIC DESIGN

As per choice based credit system(CBCS)scheme Semester – I			
Subject Code	**17LVE153**	**CIE**	**50**
Number of Lecture Hours/Week	**03**	**SEE**	**50**
Total Number of Lecture Hours	**48**	**Exam hours**	**3Hrs**

Credit : 04

Course objectives: This course will enable students to:

a. Explain ASIC methodologies and programmable logic cells to implement a function on IC.
b. Analyze backend physical design flow, including partitioning, floor planning, and placement and routing.
c. Gain sufficient theoretical knowledge for carrying out FPGA and ASIC design.
d. Design CAD algorithms and explain how these concepts interact in ASIC design.

Modules	Teaching Hours	Revised Bloom's Taxonomy(RBT) Level
Module-1 : Introduction to ASICs		
Introduction to ASICs, Full custom, Semi-custom and Programmable ASICs, ASIC Design flow, ASIC cell libraries. **CMOS Logic:** Datapath Logic Cells: Data Path Elements, Adders: Carry skip, Carry bypass, Carry save, Carry select, Conditional sum, Multiplier (Booth encoding), Data path Operators, I/O cells.	**10 Hours**	**L1, L2**
Module – 2 : ASIC Library Design:		
ASIC Library Design: Logical effort: Predicting Delay, Logical area and logical efficiency, Logical paths, Multi stage cells, Optimum delay and number of stages. **Programmable ASIC Logic Cells:** MUX as Boolean function generators, Actel ACT: ACT 1, ACT 2 and ACT 3 Logic Modules, Xilinx LCA: XC3000 CLB, Altera FLEX and MAX.	**10 Hours**	**L1-L3**
Module – 3: Programmable ASIC I/O Cells		
Programmable ASIC I/O Cells: Xilinx and Altera I/O Block. Low-level design entry: Schematic entry: Hierarchical design, Netlist screener. **ASIC Construction:** Physical Design, CAD Tools. **Partitioning**: Goals and objectives, Constructive Partitioning, Iterative Partitioning Improvement, KL, FM and Look Ahead algorithms.	**10 Hours**	**L1- L4**
Module – 4 : Dynamic & BiCMOS Logic Circiuts		
Introduction, Basic Principles of Pass Transistor Circuits, Voltage Bootstrapping, Synchronous Dynamic Circuit Techniques, Dynamic CMOS Circuit Techniques, High Performance Dynamic CMOS Circuits. **BiCMOS Logic Circuits**: Introduction, Bipolar Junction	**10 Hours**	**L1, L2, L3, L4**

Transistor (BJT): Structure and Operation, Dynamic Behavior of BJTs, Basic BiCMOS Circuits: Static Behavior, Switching Delay in BiCMOS Logic Circuits, BiCMOS Applications.		
Module – 5 : Chip Input and Output (I/O) Circuits:		
Introduction,ESD Protection, Input Circuits, Output Circuits and L(di/dt) Noise, On-Chip Clock Generation and Distribution, Latch-Up and Its Prevention. **Design for Manufacturability**: Introduction, Process Variations, Basic Concepts and Definitions, Design of Experiments and Performance Modeling.	**10 Hours**	**L2, L3**

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

a. Analyse issues of On-chip interconnect Modelling and Interconnect delay calculation..
b. Analyse the Switching Characteristics in Digital Integrated Circuits.
c. Use the Dynamic Logic circuits in state of the art VLSI chips.
d. Study critical issues such as ESD protection, Clock distribution, Clock buffering, and Latch phenomenon
e. Use Bipolar and Bi-CMOS circuits in very high speed design.

Text Book:

1. Sung Mo Kang & Yosuf Leblebici, "CMOS Digital Integrated Circuits: Analysis and Design", Tata McGraw-Hill, Third Edition.

Reference Books:

1. Neil Weste and K. Eshragian, "Principles of CMOS VLSI Design: A System Perspective", Second Edition, Pearson Education (Asia) Pvt. Ltd. 2000.
2. Wayne, Wolf, "Modern VLSI Design: System on Silicon" Prentice Hall PTR/Pearson Education, Second Edition, 1998.

ADVANCED COMPUTER ARCHITECTURE

As per choice based credit system(CBCS)scheme Semester – I			
Subject Code	**17LVE154**	**CIE**	**50**
Number of Lecture Hours/Week	**03**	**SEE**	**50**
Total Number of Lecture Hours	**48**	**Exam hours**	**3Hrs**

Credits : 04

Course objectives: This course will enable students to:

- Understand the basic concepts for parallel processing
- Analyze program partitioning and flow mechanisms
- Apply pipelining concept for the performance evaluation
- Learn the advanced processor architectures for suitable applications.

Modules	Teaching Hours	Revised Bloom's Taxonomy(RBT) Level
Module-1 : Parallel Computer Models:		
Classification of parallel computers, Multiprocessors and multicomputers, Multivector and SIMD computers. Program and Network Properties, Conditions of parallelism, Data and resource Dependences, Hardware and software parallelism. **(Text 1)**.	**10Hrs**	**L2, L3, L4**
Module – 2 : Program Patitioning and Scheduling		
Program partitioning and scheduling, Grain Size and latency, Program flow mechanisms, Control flow versus data flow, Data flow Architecture, Demand driven mechanisms, Comparisons of flow mechanisms, Principles of Scalable Performance, Performance Metrics and Measures, Parallel Processing Applications, Speedup Performance Laws, Scalability Analysis and Approaches. **(Text 1)**	**10 Hours**	**L2, L3, L4**
Module – 3: Calculus of Variations		
Advanced Processors: Advanced processor technology, Instruction-set Architectures, CISC Scalar Processors, RISC Scalar Processors, Superscalar Processors, VLIW Architectures, Pipelining, Linear pipeline processor, nonlinear pipeline processor, Instruction pipeline design. **(Text 1)**	**10 Hours**	**L1, L2, L3**
Module – 4 : Mechanisms for instruction pipelining		
Mechanisms for instruction pipelining, Dynamic instruction scheduling, Branch Handling techniques, branch prediction, Arithmetic Pipeline	**10 Hours**	**L2, L3, L4**

Design, Computer arithmetic principles, Static Arithmetic pipeline, Multifunctional arithmetic pipelines. **(Text 1)**		
Module – 5 : Multithread and Dataflow Architecture:		
Multithread and Dataflow Architecture: Principles of Multithreading, Scalable and Multithreaded Architecture, Dataflow Architecture, Symmetric shared memory architecture, distributed shared memory architecture. **(Text 1 & 2)**	**10 Hours**	**L1, L2, L3**

Course outcomes: At the end of this course, the students will be able to:

- Understand the basic concepts for parallel processing
- Analyze program partitioning and flow mechanisms
- Apply pipelining concept for the performance evaluation
- Learn the advanced processor architectures for suitable applications

Text Books:

1. Kai Hwang, ―Advanced computer architecture‖, TMH. 2007.
2. Kai Hwang and Zu, ―Scalable Parallel Computers Architecture‖, MGH, 2008.

Reference Books:

1. M.J. Flynn, ―Computer Architecture, Pipelined and Parallel Processor Design‖, Narosa Publishing, 2002.
2. D.A.Patterson, J.L.Hennessy, ―Computer Architecture: A quantitative approach‖,Morgan Kauffmann feb,2002

MULTIMEDIA OVER COMMUNICATION LINKS

As per choice based credit system(CBCS)scheme Semester – I			
Subject Code	**17LDN155**	**CIE**	**50**
Number of Lecture Hours/Week	**03**	**SEE**	**50**
Total Number of Lecture Hours	**48**	**Exam hours**	**3Hrs**

Credit : 04

Course objectives: This course will enable students to:

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

Modules	Teaching Hours	Revised Bloom's Taxonomy(RBT) Level
Module-1 : Introduction to 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)	**10Hrs**	**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	**10 Hours**	**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)	**10 Hours**	**L2, L3, L4**
Module – 4 : Multimedia Communication Standards		
Introduction, MPEG approach to multimedia standardization,	**10 Hours**	**L1, L2, L3, L4**

MPEG-1, MPEG-2, Overview of MPEG-4. (Chap. 5 - Sections 5.1 to 5.4 and 5.5.1 of Text 2)		
Module – 5 : Multimedia Communication Across Networks		
Packet audio/video in the network environment, Video transport across generic networks, Multimedia Transport across ATM Networks. (Chap. 6 - Sections 6.1, 6.2, 6.3 of Text 2)	**10 Hours**	**L1, L2**

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

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

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 Books:

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

ADVANCED COMMUNICATION LAB

As per choice based credit system(CBCS)scheme Semester – I			
Laboratory Code	**17LDNL16**	**CEE**	**50**
Number of Lecture Hours/Week	**06**	**SEE**	**50**
		Exam hours	**3Hrs**

Credits :02

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

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

1. Matlab/C implementation of to obtain the radiation pattern of an antenna.
2. Study of radiation pattern of different antennas.
3. Determine the directivity and gains of Horn/ Yagi/ dipole/ Parabolic antennas.
4. Impedance measurements of Horn/Yagi/dipole/Parabolic antennas.
5. Study of radiation pattern of E & H plane horns.
6. Significance of Pocklington's integral equation.
7. Study of digital modulation techniques using CD4051 IC.
8. Conduct an experiment for Voice and data multiplexing using optical fiber.
9. Determination of the modes transit time, electronic timing range and sensitivity of Klystron source.
10. Determination of VI characteristics of GUNN diode, and measurement of guide wave length, frequency, and VSWR.
11. Determination of coupling coefficient and insertion loss of directional couplers and Magic tree.
12. Build a hardware pseudo-random signal source and determine statistics of the generated signal source.

Course Outcomes

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

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

Conduction of Practical Examination:

All laboratory experiments (nos) are to be included for practical examination. Students are allowed to pick one experiment from each part and execute both Strictly follow the instructions as printed on the cover page of answer script for break up Of Marks

PART –A: Procedure + Conduction + Viva: 10 + 20 +10 (40)

PART –B: Procedure + Conduction + Viva: 10 + 20 +10(40)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	**17LDE21**	**CIE**	**50**
Number of Lecture Hours/Week	**03**	**SEE**	**50**
Total Number of Lecture Hours	**48**	**Exam hours**	**3Hrs**

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	Teaching Hours	Revised Bloom's Taxonomy(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)	**10Hrs**	**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)	**10 Hours**	**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)	**10 Hours**	**L1, L2, L3**
Module – 4 : Power Spectrum Estimation:		
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,	**10 Hours**	**L1, L2, L3**

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)		
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)	**10 Hours**	**L1, L2, L3**

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

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

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:

4. "Modern Digital signal processing", Robert. O. Cristi, Cengage Publishers, India, 2003.
5. "Digital signal processing: A Practitioner's approach", E.C. Ifeachor, and B. W. Jarvis, , Second Edition, Pearson Education, India, 2002, Reprint.
6. "Wavelet Transforms, Introduction to Theory and applications", Raghuveer. M. Rao, Ajit S.Bopardikar, Pearson Education, Asia, 2000.
7.

ERROR CONTROL CODING

As per choice based credit system(CBCS)scheme Semester – II			
Subject Code	**17LDE22**	**CIE**	**50**
Number of Lecture Hours/Week	**03**	**SEE**	**50**
Total Number of Lecture Hours	**48**	**Exam hours**	**3Hrs**

Credit : 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	Teaching Hours	Revised Bloom's Taxonomy(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 (2m) and its properties, (Only statements of theorems without proof) Computation using Galois filed GF (2m) arithmetic, Vector spaces and Matrices. (Chap. 2 of Text 2)	**10Hrs**	**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)	**10Hrs**	**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).	**10 Hrs**	**L1, L2, L3**
Module – 4 : BCH Codes:		
BCH codes: Binary primitive BCH codes, Decoding procedures, Implementation of Galois field arithmetic, Implementation of error	**10 Hrs**	**L1, L2, L3**

correction. (Chap. 6 of Text 2) 28 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).		
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)	**10 Hrs**	**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.

Text Book:

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	**17LDN23**	**CIE**	**50**
Number of Lecture Hours/Week	**03**	**SEE**	**50**
Total Number of Lecture Hours	**48**	**Exam hours**	**3Hrs**

Credit : 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	Teaching Hours	Revised Bloom's Taxonomy(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)	**10Hrs**	**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)	**10 Hrs**	**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)	**10 Hrs**	**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)	**10 Hrs**	**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)	**10 Hrs**	**L1, L2, L3**

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

1. Acquire knowledge of characteristics of mobile/wireless communication channels
2. Apply statistical models of multipath fading
3. Understand the multiple radio access techniques 30
4. Understand the need of coding, diversity, interleaving and link techniques for mo bile/wireless communications network
5. Design receiver and transmitter diversity techniques
6. Identify and describe modern techniques for high-rate wireless communications, using MIMO transmission.

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:

1. 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	**17LDN24**	**CIE**	**50**
Number of Lecture Hours/Week	**03**	**SEE**	**50**
Total Number of Lecture Hours	**48**	**Exam hours**	**3Hrs**

Credit : 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	Teaching Hours	Revised Bloom's Taxonomy(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.	**10Hrs**	**L1, L2, L3**
Module – 2 : Smith chart and its Applications:		
Introduction, Smith Chart, Derivation of Smith Chart, Smith Chart Circular and Radial Scales, Application of Smith chart.	**10 Hours**	**L1, L2, L3**
Module – 3: Basic consideration in active networks:		
Stability Considerations, Gain Considerations and Noise Considerations.	**10 Hours**	**L1, L2, L3**
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	**10 Hours**	**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	**10 Hours**	**L1, L2, L3**

Microwave IC design: MICs, MIC materials, Types of MICs, Hybrid verses Monolithic ICs, Chip mathematics		

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

1. Discuss and analyse waves propagation in Networks 32
2. Apply the Smith Chart for finding various parameters in transmission lines
3. Analyse the basic considerations in active networks
4. Describe and design active networks
5. Design RF/MW Frequency Mixers and phase shifters

Text Book:

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

Reference Book:

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

WIRELESS & MOBILE NETWORKS

As per choice based credit system(CBCS)scheme Semester – I			
Subject Code	**17LDN251**	**CIE**	**50**
Number of Lecture Hours/Week	**03**	**SEE**	**50**
Total Number of Lecture Hours	**48**	**Exam hours**	**3Hrs**

Credit : 04

Course objectives: This course will enable students to:

a. Concepts and Protocols provides an explanation on the wireless network concepts, architectures, protocols, and applications.
b. It covers the wireless networks such as wireless body area network (WBAN), wireless local area networks (WLANs),
c. wireless metropolitan area networks (WMANs), wireless wide area network (WWAN), wireless sensor networks, wireless vehicle networks, and research challenges in wireless networks.
d. Addresses the design issues and explores various emerging protocols for wireless networks
e. Develop an awareness towards the network control and traffic management

Modules	Teaching Hours	Revised Bloom's Taxonomy(RBT) Level
Module-1 : Review of fundamentals of wireless communication and Networks:		
Wirelesscommunication channel specifications, Wireless communication systems, Wireless networks,Switching technology, Communication problems, Wireless network issues and standards.	**10Hrs**	**L1, L2, L3, L4**
Module – 2 : Wireless body area networks & Wireless personal area networks		
Properties, Network architectures, Components, Technologies, Design issues, Protocols and applications. Architectures, Components, Requirements, Technologies and protocols, Bluetooth and Zigbee	**10 Hours**	**L1, L2, L3, L4**
Module – 3: Wireless LANs		
Network components, design requirements, Architectures, IEEE-802.11x, WLAN protocols, 802.11p and applications.	**10 Hours**	**L2, L3, L4**
Module – 4 : WMANs, IEEE-802.16		
Architectures, Components, WiMax mobility support, Protocols. Broadband networks and applications, WWANs, cellular networks, Satellite Network, Applications	**10 Hours**	**L1, L2, L3, L4**

Module – 5 : Wireless ad-hoc networks		
Mobile ad-hoc networks, Sensor network, Mesh networks, VANETs, Research issues in Wireless networks	**10 Hours**	**L1, L2**

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

1. Develop an understanding on the basic and advanced principles of Wireless Communications and Mobile Networks.
2. The unit addresses the issues of wireless communications and mobile networks in physical, link and network layers. The wireless channels will be explained with existing mitigation techniques.
3. Multi-user communication systems will also be studied with an emphasis on the broadcast nature of wireless communications.
4. Mobile networks modelling, design and optimisation will be covered, as well as existing and future mobile networks standard

Reference books

1. S. S. Manvi, and M. S. Kakkasageri, "Wireless and Mobile network concepts and Protocols", Wiley, 1st edition, 2010.
2. P. Kaveh, Krishnamurthy, "Principles of Wireless network: A unified approach", PHI, 2006.
3. Iti Saha Mitra, "Wireless communication and network: 3G and Beyond", McGraw Hill, 2009.
4. Ivan Stojmenovic, "Handbook of Wireless networks and Mobile Computing", Wiley, 2009.
5. P. Nicopolitidis, M. S. Obaidat, et al, "Wireless Networks", Wiley, 2009.

MEMS

As per choice based credit system(CBCS)scheme Semester – II			
Subject Code	**17LDE252**	**CIE**	**50**
Number of Lecture Hours/Week	**03**	**SEE**	**50**
Total Number of Lecture Hours	**48**	**Exam hours**	**3Hrs**

Credit : 04

Course objectives: This course will enable students to:

a. Mathematically analyze and conceptualize basics of optical networking and its associated nonlinear artifacts and effects.
b. Develop awareness regarding optical devices and their working strategies
c. Develop awareness of WDM principles, and that of power penalty issues existent in optical Networks
d. Get insight into the design of various types of Lasers and understand the techniques of coherent transmission.
e. Develop an awareness towards the backbone architectures of optical networking with the present trends in access networks
f. 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	Teaching Hours	Revised Bloom's Taxonomy(RBT) Level
Module-1 : Overview of MEMS & Microsystems:		
MEMS & Microsystems, Typical MEMS and Micro system products — features of MEMS, The multidisciplinary nature of Microsystems design and manufacture, Applications of Microsystems in automotive industry, health care industry, aerospace industry, industrial products, consumer products and telecommunications.	**10Hrs**	**L1, L2, L3**
Module – 2 : Scaling Laws in Miniaturization:		
Introduction to scaling, scaling in geometry, scaling in rigid body dynamics, scaling electrostatic forces, electromagnetic forces, electricity, scaling in fluid mechanics & heat transfer. **Transduction Principles in MEMS & Microsystems:** Introduction,	**10Hrs**	**L1, L2, L3**

Micro sensors — thermal, radiation, mechanical, magnetic and bio — sensors, Micro actuation, MEMS with micro actuators		
Module – 3: Microsystems Fabrication Process:		
Introduction, Photolithography, Ion-implantation, diffusion, oxidation, CVD, PVD, etching and materials used for MEMS, Some MEMS fabrication processes: surface micro-machining, bulk micromachining, LIGA process, LASER micro machining, MUMPS, FAB-less fabrication	**10 Hrs**	**L1, L2, L3,**
Module – 4 : Micro System Design and Modelin g:		
Introduction, Design considerations: Process design, Mechanical design, Modeling using CAD tools: ANSYS / Multiphysics or Intellisuite or MEMS CAD, Features and Design considerations of RF MEMS, Design considerations of Optical MEMS (MOEMS), Design and Modeling: case studies - i) Cantilever beam ii) Micro switches iii) MEMS based SMART antenna in mobile applications for maximum reception of signal in changing communication conditions and iv) MEMS based micro mirror array for control and switching in optical communications.	**10 Hrs**	**L1, L2, L3**
Module – 5 : Micro system packaging:		
Over view of mechanical packaging of micro electronics micro system packaging, Interfaces in micro system packaging, Packaging technologies	**10 Hrs**	**L1, L2, L3**

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

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

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Reference Books

1. Tai — Ran Hsu, **"MEMS and Micro Systems : Design and Manufacture"**, Tata McGraw Hill, 2002
2. Boca Raton, **"MEMS and NEMS: Systems, Devices and Structures"**, CRC Press, 2002
3. J. W. Gardner and V. K. Vardan, **"Micro Sensors MEMS and SMART Devices"**, John Wiley, 2002
4. 4. N. Maluf **"Introduction to Micro Mechanical Systems Engineering, Artech House"**, Norwood, MA, 2000.

WIRELESS SENSOR NETWORKS

As per choice based credit system(CBCS)scheme Semester – I			
Subject Code	**17LDN253**	**CIE**	**50**
Number of Lecture Hours/Week	**03**	**SEE**	**50**
Total Number of Lecture Hours	**48**	**Exam hours**	**3Hrs**

Credit : 04

Course objectives: This course will enable students to:

- Explain sensor networks for various application setups.
- Demonstrate the design space and conduct trade-off analysis between performance and resources.
- Assess coverage and conduct node deployment planning.
- Devise appropriate data dissemination protocols and model links cost.
- Determine suitable medium access protocols and radio hardware.
- Illustrate sensor networks using commercial components.
- Discuss quality of service, fault-tolerance, security and other dependability requirements while coping with resource constraints.

Modules	Teaching Hours	Revised Bloom's Taxonomy(RBT) Level
Module-1 : Introduction:		
Overview and Applications of Wireless Sensor Networks Introduction, Basic overview of the Technology, Applications of Wireless Sensor Networks: Introduction, Background, Range of Applications, Examples of Category 2 WSN Applications, Examples of Category 1 WSN Applications, Another Taxonomy of WSN Technology. (Chapter 1: 1.1, 1.2, Chapter2: 2.1-2.6)	**10Hrs**	**L1, L2, L3**
Module – 2 : Basic Wireless Sensor Technology and Systems:		
Introduction, Sensor Node Technology, Sensor Taxonomy, WN Operating Environment, WN Trends, Wireless Transmission Technology and Systems: Introduction, Radio Technology Primer, Available Wireless Technologies (Chapter3: 3.1-3.5, Chapter 4: 4.1-4.3)	**10 Hours**	**L1, L2, L3**
Module – 3: MAC and Routing Protocols for Wireless Sensor Networks:		
Introduction, Background, Fundamentals of MAC Protocols, MAC	**10 Hours**	**L1,L2, L3**

Protocols for WSNs, Sensor-MAC case Study,IEEE 802.15.4 LR-WPANs Standard Case Study. Routing Protocols for Wireless Sensor Networks: Introduction, Background, Data Dissemination and Gathering, Routing Challenges and Design Issues in WSNs, Routing Strategies in WSNs. (Chapter 5: 5.1-5.6, Chapter 6: 6.1-6.5)		
Module – 4 : Transport Control and Middleware for Wireless Sensor Networks:		
Traditional Transport, Control Protocols, Transport Protocol Design Issues, Examples of Existing Transport Control Protocols, Performance of Transport Control Protocols. Middleware for Wireless Sensor Networks: Introduction, WSN Middleware Principles, Middleware Architecture, Existing Middleware. (Chapter 7: 7.1-7.4, Chap. 8: 8.1-8.4)	**10 Hours**	**L1, L2, L3**
Module – 5 : Network Management and Operating System for Wireless Sensor Networks:		
Introduction, Network Management Requirements, Traditional Network Management Models, Network Management Design Issues. Operating Systems for Wireless Sensor Networks: Introduction, Operating System Design Issues, Examples of Operating Systems. (Chapter 9: 9.1-9.5, Chapter 10: 10.1-10.3).	**10 Hours**	**L1, L2, L3**

Course outcomes: The students shall able to:

1. Explain existing applications of wireless sensor actuator networks
2. Apply in the context of wireless sensor networks and explain elements of distributed computing and network protocol design
3. Contrast Various hardware, software platforms that exist for sensor networks
4. Summarize various network level protocols for MAC, routing, time synchronization, aggregation, consensus and distributed tracking.

Text Book:

2. KAZEM SOHRABY, DANIEL MINOLI, TAIEB ZNATI, “Wireless Sensor Networks: Technology, Protocols and Applications:, WILEY , Second Edition (Indian) , 2014.

Reference Books:

1. Ian F. Akyildiz, Mehmet Can Vuran "Wireless Sensor Networks", Wiley 2010
2. Feng Zhao & Leonidas J. Guibas, “Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.

CRYPTOGRAPHY AND NETWORK SECURITY

As per choice based credit system(CBCS)scheme Semester – II			
Subject Code	**17LDN254**	**CIE**	**50**
Number of Lecture Hours/Week	**03**	**SEE**	**50**
Total Number of Lecture Hours	**48**	**Exam hours**	**3Hrs**

Credit : 04

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	Teaching Hours	Revised Bloom's Taxonomy(RBT) Level
Module-1 : Introduction :		
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)	**10Hrs**	**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)	**10 Hours**	**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)	**10 Hours**	**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)	**10 Hours**	**L1, L2, L3**
Module – 5 : E-mail Security:		
Pretty Good Privacy-S/MIME (Text 1: Chapter 17: Section 17.1, 17.2). **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).	**10 Hours**	**L1, L2, L3**

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

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

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.

VLSI DESIGN FOR SIGNAL PROCESSING

As per choice based credit system(CBCS)scheme Semester – II			
Subject Code	**17LDN255**	**CIE**	**50**
Number of Lecture Hours/Week	**03**	**SEE**	**50**
Total Number of Lecture Hours	**48**	**Exam hours**	**3Hrs**

Credit : 04

Course objectives: This course will enable students to:

- Learn several high-level architectural transformations that can be used to design families of architectures for a given algorithm.
- Deal with high-level algorithm transformations such as strength reduction, look-ahead and relaxed look-ahead.

Modules	Teaching Hours	Revised Bloom's Taxonomy(RBT) Level
Module-1 : Introduction to DSP Systems:		
Typical DSP Algorithms, DSP Application Demands and Scaled CMOS Technologies, Representations of DSP Algorithms. **Iteration Bounds:** Data flow graph Representations, loop bound and Iteration bound.	**10Hrs**	**L1, L2, L3**
Module – 2 : Iteration Bounds:		
Algorithms for Computing Iteration Bound, Iteration Bound of multi rate data flow graphs. **Pipelining and Parallel Processing:** pipelining of FIR Digital Filters, parallel processing, Pipelining and parallel processing for low power.	**10 Hours**	**L1, L2, L3**
Module – 3: Retiming:		
Definition and Properties, Solving Systems of Inequalities, Retiming Techniques, **Unfolding**: An Algorithm for Unfolding, Properties of Unfolding, Critical path, Unfolding and Retiming, Application of Unfolding. **Systolic Architecture Design:** systolic array design Methodology,FIR systolic array.	**10 Hours**	**L1, L2, L3**
Module – 4 : Systolic Architecture Design:		
Selection of Scheduling Vector, Matrix-Matrix Multiplication and 2D systolic Array Design, Systolic Design for space representation containing Delays.	**10 Hours**	**L1, L2, L3**

Fast convolution: Cook-Toom Algorithm, Winograd Algorithm, Iterated convolution, cyclic convolution Design of fast convolution Algorithm by Inspection.		
Module – 5 : Pipelined and Parallel Recursive and Adaptive Filter:		
Pipeline Interleaving in Digital Filter, first order IIR digital Filter, Higher order IIR digital Filter, parallel processing for IIR filter, Combined pipelining and parallel processing for IIR Filter, Low power IIR Filter Design Using Pipelining and parallel processing, pipelined adaptive digital filter	**10 Hours**	**L1, L2, L3**

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

1. Illustrate the use of various DSP algorithms and addresses their representation using block diagrams, signal flow graphs and data-flow graphs
2. Use pipelining and parallel processing in design of high-speed /low-power applications
3. Apply unfolding in the design of parallel architecture
4. Evaluate the use of look-ahead techniques in parallel and pipelined IIR Digital filters.
5. Develop an algorithm or architecture or circuit design for DSP applications

Text Books:

1. Keshab K.Parthi, "VLSI Digital Signal Processing systems, Design and implementation ", Wiley 1999.

Reference Books:

1 Mohammed Isamail and Terri Fiez, "Analog VLSI Signal and Information Processing ", Mc Graw-Hill,1994.

2 S.Y. Kung, H.J. White House, T. Kailath, " VLSI and Modern Signal Processing ", Prentice Hall, 1985.

3 Jose E. France, Yannis Tsividis, " Design of Analog - Digital VLSI Circuits for Telecommunication and Signal Processing ", Prentice Hall, 1994.

4 Lars Wanhammar, ―DSP Integrated Circuits‖, Academic Press Series in Engineering, 1st Edition.

ADVANCED DSP LAB

As per choice based credit system(CBCS)scheme Semester – I			
Laboratory Code	**17LDNL26**	**CEE**	**50**
Number of Lecture Hours/Week	**06**	**SEE**	**50**
		Exam hours	**3Hrs**

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

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.

WIRELESS BROADBAND COMMUNICATIONS

As per choice based credit system(CBCS)scheme Semester – IV			
Subject Code	**17LDN41**	**CIE**	**50**
Number of Lecture Hours/Week	**03**	**SEE**	**50**
Total Number of Lecture Hours	**48**	**Exam hours**	**3Hrs**

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	Teaching Hours	Revised Bloom's Taxonomy(RBT) Level
Module-1 : LTE		
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.	**10Hrs**	**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.	**10 Hours**	**L2, L3**

Module – 3: Physical Layer		
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.	**10 Hours**	**L1, L2, L3**
Module – 4 : Radio Resource Control (RRC:		
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.	**10 Hours**	**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.	**10 Hours**	**L1, L2, L3**

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

1. Understand the system architecture and the function standard specified components of the system of LTE 4G.
2. 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.
3. Demonstrate the UTRAN and EPS handling processes from set up to release including mobility management for a variety of data call scenarios.
4. Test and Evaluate the Performance of resource management and packet data processing and transport algorithms.

Text Book:

1. 'LTE for UMTS Evolution to LTE-Advanced' HarriHolma and Antti Toskala, Second Edition - 2011, John Wiley & Sons, Ltd. Print ISBN: 9780470660003.

Ref erence 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, IssamToufik, 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	**17LVE421**	**CIE**	**50**
Number of Lecture Hours/Week	**03**	**SEE**	**50**
Total Number of Lecture Hours	**48**	**Exam hours**	**3Hrs**

Credit : 04

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	**Teaching Hours**	**Revised Bloom's Taxonomy(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,	**10Hrs**	**L1, L2, L3**
Module – 2 :		
Basic concepts in RF design (II): Passive impedance transformation, scattering parameters, analysis of nonlinear dynamic systems	**10Hrs**	**L1, L2, L3**
Module – 3: Communication Concepts:		
General concepts, analog modulation, digital modulation, spectral re-growth, Mobile RF communications, Multiple access techniques, Wireless standards	**10 Hrs**	**L1, L2, L3**
Module – 4 : Transceiver Architecture (I):		
General considerations, Receiver architecture,	**10 Hrs**	**L1, L2, L3**
Module – 5 : Transceiver Architecture (II):		
Transmitter architectures	**10 Hrs**	**L1, L2, L3**

Low Noise Amplifiers: LNA topologies: common-source stage with inductive load, common-source stage with resistive feedback. **Mixers:** General considerations, passive down conversion mixers.		

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.

Text Book:

1. 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	**17LDN422**	**CIE**	**50**
Number of Lecture Hours/Week	**03**	**SEE**	**50**
Total Number of Lecture Hours	**48**	**Exam hours**	**3Hrs**

Credit : 04

Course objectives: This course will enable students to:

- To gain fundamental knowledge in understanding the representation of the digital image and its properties
- To equip students with some pre-processing techniques required to enhance the image for further analysis purpose.
- To enable students to select the region of interest in the image using segmentation techniques.
- To enable students to represent the image based on its shape and edge information.
- To enable student to describe the objects present in the image based on its properties and structures.

Modules	Teaching Hours	Revised Bloom's Taxonomy(RBT) Level
Module-1 : The image, its representations and properties:		
Image representations a few concepts, Image digitization, Digital image properties, Color images.	**10Hrs**	**L1**
Module–2: Image Pre-processing		
Pixel brightness transformations, geometric transformations, local pre-processing	**10 Hrs**	**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.	**10 Hrs**	**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, Bspline representation; Region-based shape representation and description – Simple scalar region descriptors, Moments, Convex hull.	**10 Hrs**	**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.	**10 Hrs**	**L1, L2, L3**

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

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

Text Book:

1. 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 Mc Graw Hill, 2011

COMMUNICATION SYSTEM DESIGN Using DSP ALGORITHMS

As per choice based credit system(CBCS)scheme Semester – IV			
Subject Code	**17LDN423**	**CIE**	**50**
Number of Lecture Hours/Week	**03**	**SEE**	**50**
Total Number of Lecture Hours	**48**	**Exam hours**	**3Hrs**

Credit : 04

Course objectives: This course will enable students to

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

Modules	Teaching Hours	Revised Bloom's Taxonomy(RBT) Level
Module-1 : Introduction		
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.	**10Hrs**	**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	**10 Hours**	**L1, L2**

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)		
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 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.	**10 Hours**	**L1, L2, L3**
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.	**10 Hours**	**L1, L2, L3**
Module – 5 : RF/Microwave Control Circuit Design:		
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.	**10 Hours**	**L1, L2, L3**

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

Upon successful completion of this course the students will be able to:

- **a.** Understand and implement DSP algorithms on TI DSP processors
- **b.** Implement and make use of FIR and IIR digital filtering. And FFT methods
- **c.** Analyse and implement modulators and demodulators for AM,DSBSCAM, SSB and FM
- **d.** Understand and design digital communication methods leading to the implementation of a line communication system.

Text Book:

1. 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.

RECONFIGURABLE COMPUTING

As per choice based credit system(CBCS)scheme Semester – IV			
Subject Code	**17LDE424**	**CIE**	**50**
Number of Lecture Hours/Week	**03**	**SEE**	**50**
Total Number of Lecture Hours	**48**	**Exam hours**	**3Hrs**

Credit : 04

Course objectives: The aim of this course is to enable the students to

- Acquire fundamental knowledge and understanding of principles and practice in reconfigurable architecture.
- Understand the FPGA design principles, and logic synthesis.
- Integrate hardware and software technologies for reconfiguration computing focusing on partial reconfiguration design.

f. Focus on different domains of applications on reconfigurable computing.

Modules	Teaching Hours	Revised Bloom's Taxonomy(RBT) Level
Module-1 : Introduction		
History, Reconfigurable Vs Processor based system, RC Architecture. **Reconfigurable Logic Devices**: Field Programmable Gate Array, Coarse Grained Reconfigurable Arrays. **Reconfigurable Computing System**: Parallel Processing on Reconfigurable Computers, A survey of Reconfigurable Computing System. Text(1)	**10Hrs**	**L1, L2**
Module – 2 : Wireless body area networks & Wireless personal area networks		
Languages and Compilation: Design Cycle, Languages, HDL, High Level Compilation, Low level Design flow, Debugging	**10 Hours**	**L1, L2**

Reconfigurable Computing Applications. Text(1)		
Module – 3: Implementation		
Implementation: Integration, FPGA Design flow, Logic Synthesis. **High Level Synthesis for Reconfigurable Devices:** Modelling, Temporal Partitioning Algorithms. (Text 2).	**10 Hours**	**L1, L2, L3**
Module – 4 : Partial Reconfiguration Design:		
Partial Reconfiguration Design, Bitstream Manipulation with JBits, The modular Design flow, The Early Access Design Flow, Creating Partially Reconfigurable Designs, Partial Reconfiguration using Hansel-C Designs, Platform Design. (Text 2)	**10 Hours**	**L1, L2**
Module – 5 : Signal Processing Applications		
Reconfigurable computing for DSP, DSP application building blocks, Examples: Beamforming, Software Radio, Image and video processing, Local Neighbourhood functions, Convolution. (Text 1) **System on a Programmable Chip:** Introduction to SoPC, Adaptive Multiprocessing on Chip. (Text 2)	**10 Hours**	**L1, L2, L3**

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

a. Simulate and synthesize the reconfigurable computing architectures.
b. Use the reconfigurable architectures for the design of a digital system.
c. Design of digital systems for a variety of applications on signal processing and system on chip configurations. Reference books

Text Books:

1. M. Gokhale and P. Graham, ―Reconfigurable Computing: Accelerating Computation with Field-Programmable Gate Arrays‖, Springer, 2005.
2. C. Bobda, ―Introduction to Reconfigurable Computing: Architectures, Algorithms and Applications‖, Springer, 2007.

Reference Books:

1. D. Pellerin and S. Thibault, ―Practical FPGA Programming in C‖, Prentice-Hall, 2005.
2. W. Wolf, ―FPGA Based System Design‖, Prentice-Hall, 2004.
3. R. Cofer and B. Harding, ―Rapid System Prototyping with FPGAs: Accelerating the Design Process‖, Newnes, 2005.

ADVANCED MICROCONTROLLERS

As per choice based credit system(CBCS)scheme Semester – IV			
Subject Code	**17LDE425**	**CIE**	**50**
Number of Lecture Hours/Week	**03**	**SEE**	**50**
Total Number of Lecture Hours	**48**	**Exam hours**	**3Hrs**

Credit : 04

Course objectives: This course will enable students to:

a. Microcontrollers have become prevalent in a number of applications such as instrumentation, industrial electronics, automotive electronics, robotics, etc.
b. Advances in VLSI technology permit the integration of not only the processor but also the analog electronics, memory and peripherals necessary for system implementation; this allows low-cost system implementation.
c. Some microcontrollers used in industrial electronics also provide some digital signal processing capability to further reduce the system cost.
d. Power dissipation is often a consideration in many systems and modern microcontrollers address it through the support of several low-power modes of operation. The aim of the course is to introduce advanced microcontrollers (16-bit and 32-bit).

Modules	Teaching Hours	Revised Bloom's Taxonomy(RBT) Level
Module-1 : Overview of Microcontrollers :		
Motivation for advanced microcontrollers – Low Power embedded systems, On-chip peripherals, low-power RF capabilities. Examples of applications.	**10Hrs**	**L1, L2, L3**
Module – 2 : MSP430 – 16-bit Microcontroller family.		
CPU architecture, Instruction set, Interrupt mechanism, Clock system, Memory subsystem, bus – architecture. The assembly language and „C" programming for MSP-430 microcontrollers. On-chip	**10Hrs**	**L1, L2, L3**

peripherals. WDT, Comparator, Op-Amp, Timer, Basic Timer, Real Time Clock (RTC), ADC, DAC, Digital I/O. Using the low-power features of MSP430. Clock system, low-power modes, Clock request feature, Low-power programming and interrupts.		
Module – 3:		
ARM -32 bit Microcontroller family. Architecture of ARM Cortex M3 – General Purpose Registers, Stack Pointer, Link Register, Program Counter, Special Register,. Nested Vector Interrupt Controller. Interrupt behavior of ARM Cortex M3. Exceptions Programming. Advanced Programming Features. Memory Protection. Debug Architecture.	**10 Hrs**	**L1, L2, L3,**
Module – 4 : Digital Input-Output and Serial Communication:		
Parallel Ports, Lighting LEDs, Flashing LEDs, Read Input from a Switch, Toggle the LED state by pressing the push button, LCD interfacing. Asynchronous Serial Communication, Asynchronous Communication with USCI_A, Communications, Peripherals in MSP430, Serial Peripheral Interface. (Text: Selected topics from Ch4 & Ch7 and Ch7- 7.1, Ch10 – 10.1, 10.2, and 10.12)	**10 Hrs**	**L1, L2, L3**
Module – 5 : Applications :		
Wireless Sensor Networking with MSP430 and Low-Power RF circuits; Pulse Width Modulation(PWM) in Power Supplies	**10 Hrs**	**L1, L2, L3**

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

a. Understand the architectural features and instruction set of 16 bit microcontroller MSP430.
b. Develop programs using the various instructions of MSP430 for different applications.
c. Understand the functions of the various peripherals which are interfaced with MSP430 microcontroller
d. Describe the power saving modes in MSP430. Explain the low power applications using MSP430 microcontroller.

Reference Books

1. Joseph Yiu " **The Definitive Guide to the ARM Cortex-M3,** , Newnes, (Elsevier), 2008.
2. John Davies, " **MSP430 Microcontorller Basics**", Newnes (Elsevier Science), 2008.
3. **MSP430 Teaching CD-ROM**, Texas Instruments, 2008.
4. **Sample Programs for MSP430** downloadable from msp430.com
5. David Patterson and John L. Henessay, "**Computer Organization and Design**", (ARM Edition), Morgan Kauffman.
6. Chris Nagy, Embedded Systems Design using TI MSP430 Series, Newnes Publications, Elsevier, 2003. 2. User Guide from Texas Instruments.