Master of Technology (Digital Communication)
2 Years Degree Program

Program Educational Objectives (PEOs)

- To prepare the students with good understanding of the respective subjects with design, analytical and problem solving skills.
- To train the students with knowledge of latest design trends.
- To inculcate in students the sense of ethics, morality, professionalism, creativity, leadership, independent thinking, self confidence, good communication skills and prepare them to become successful engineers who can work worldwide in industries and research & development laboratories.
- To introduce the research world to them so that they feel motivated for higher studies and innovation not only in their own domain but multidisciplinary domain.
- To recognize social needs and contribute effectively through self learning.

Program Outcome (POs):-

- The graduates will be able to apply the concepts of Engineering mathematics through Laplace, z-transform, linear algebra, probability and statistics, differential equations etc. and basic knowledge of engineering physics and chemistry.
- The graduates will be able to understand, interpret the problem, design and perform the experiments to meet the desired solution of the problem within the context of electronics and communication engineering.
- The graduates will have a good understanding of professional and ethical responsibility.
- The graduates will be able to express themselves effectively through written and oral communication.
- The graduates will have a good understanding and knowledge in applying the engineering solutions to society.
- The graduates will have a good understanding for the need of life long learning and will be able to work in teams.

- The graduates will show good proficiency in applying the techniques and knowledge of modern engineering skills in tackling contemporary technological challenges.
- The graduates will have good background for admission to post graduate programs (in same domain), management degree programs and also research programs in various organizations of national and international repute.
- The graduates will be able to participate and succeed in competitive examinations.
- Adapt transform in industry by understanding the need of independent and lifelong learning

Sanjeev Agrawal Global Educational (SAGE) University, Bhopal

School of Engineering & Technology
M Tech (Digital Communication)

First Year – Semester First																
Course Code	**Course Title**	**Contact Hours per Week**			**Credits**	**ETE Duration (Hours)**	**Theory**						**Practical**			
		L	**T**	**P**			**MSE**	**ASG**	**TA**	**ATTD**	**ESE**	**Total**	**CE**	**ESE**	**Total**	**Grand Total**
MA20M101	Advanced Mathematics	3	1	-	4	3	30	05	05	10	50	100	-	-	-	100
DC20M101	Micro Controller System Design	3	1		4	3	30	05	05	10	50	100	-	-	-	100
DC20M102	Advanced Digital Signal	3	1	-	4	3	30	05	05	10	50	100	-	-	-	100
	DSE – I	3	-	-	3	3	30	05	05	10	50	100	-	-	-	100
	DSE – II	3	-	-	3	3	30	05	05	10	50	100	-	-	-	100
DC20M103	Micro Controller System	-	-	4	2	2	-	-	-	-	-	-	20	30	50	50
DC20M104	Advanced Digital Signal Processing	-	-	4	2	2	-	-	-	-	-	-	20	30	50	50
PB20M101	Project Based Learning	-	-	4	2	2	-				-	-	50	50	100	100
DC20M105	System Programming	-	-	4	2	2	-				-	-	20	30	50	50
-	-	**Total**			26	-	-					500			250	750

MSE- Mid Semester Exam, ASG- Assignment, TA- Teacher's Assessment, ATTD-Attendance, ESE- End Sem Exam ,CE-continuous Evolut

First Year – Semester Second																
Course Code	**Course Title**	**Contact Hours per Week**			**Credits**	**ETE Duration (Hours)**	**Theory**						**Practical**			
		L	**T**	**P**			**MSE**	**ASG**	**TA**	**ATTD**	**ESE**	**Total**	**CE**	**ESE**	**Total**	**Grand Total**
DC20M201	Real Time Embedded System	3	1	-	4	3	30	05	05	10	50	100	-	-	-	100
DC20M202	Advanced VlSI Design	3	1	-	4	3	30	05	05	10	50	100	-	-	-	100
DC20M203	Optical Communication & Network	3	1	-	4	3	30	05	05	10	50	100	-	-	-	100
	DSE – III	3	-	-	3	3	30	05	05	10	50	100	-	-	-	100
	DSE – IV	3	-	-	3	3	30	05	05	10	50	100	-	-	-	100
GE20B201	Generic Electives I	2	-	-	2	2	30	05	05	10	50	100	-	-	-	100
DC20M204	Advanced VLSI Design	-	-	4	2	3	-	-	-	-	-	-	20	30	50	50
PB20M201	Project based learning	-	-	4	2	2	-				-	-	50	50	100	100
DC20M205	Modeling and Simulation of Computer	-	-	4	2	-	-				-	-	20	30	50	50
-	-	Total			26	-	-					600			200	800

MSE- Mid Semester Exam, ASG- Assignment, TA- Teacher's Assessment, ATTD-Attendance, ESE- End Sem Exam ,CE-continuous Evolution

Digital Communication

Second Year – Semester Third																
Course Code	**Course Title**	**Contact Hours per Week**			**Credits**	**ETE Duration (Hours)**	**Theory**						**Practical**			
		L	**T**	**P**			**MSE**	**ASG**	**TA**	**ATTD**	**ESE**	**Total**	**CE**	**ESE**	**Total**	**Grand Total**
PB20M301	MOOC –1	-	-	8	4	-	-	-	-	-	-	-	50	50	100	100
PB20M302	MOOC - 2	-	-	8	4	-	-	-	-	-	-	-	50	50	100	100
DC20M301	Dissertation Phase-I	-	-	24	12	2	-				-	-	200	200	400	400
-	-	**Total**			20		-					-	-		-	600

MSE- Mid Semester Exam, ASG- Assignment, TA- Teacher's Assessment, ATTD-Attendance, ESE- End Sem Exam ,CE-continuous Evolution

Second Year – Semester Fourth																
Course Code	**Course Title**	**Contact Hours per Week**			**Credits**	**ETE Duration (Hours)**	**Theory**						**Practical**			
		L	**T**	**P**			**MSE**	**ASG**	**TA**	**ATTD**	**ESE**	**Total**	**CE**	**ESE**	**Total**	**Grand Total**
DC20M401	Dissertation Phase-II	-	-	32	16	2	-				-	-	250	250	500	500
-	-	**Total**			16		-					-	-		-	500

MSE- Mid Semester Exam, ASG- Assignment, TA- Teacher's Assessment, ATTD-Attendance, ESE- End Sem Exam ,CE-continuous Evolution

Master of Technology (Digital Communication Engineering)

2 Years Degree Program

Curriculum Components

Components	Credits
Program Core (11Courses)	**34**
Program Electives (Discipline Specific Electives) (04Courses)	**12**
Generic Electives (01 Courses)	**02**
Project Based Learning (PBL)/MOOCs (04 courses)	**12**
Project (02 Courses)	**28**
Total	**88**

Distribution of credits across all components

SEM No.	Programme Core	Discipline Specific Electives (DSE)	Generic Electives (GE)	Project Based Learning (PBL)/ MOOCs	Project	Total Credit
I.	18	6	-	2	-	**26**
II.	16	6	2	2	-	**26**
III.	-	-	-	8	12	**20**
IV.	-	-	-	-	16	**16**
Total	**34**	**12**	**02**	**12**	**28**	**88**

M Tech (Digital Communication)

List of Program (Discipline Specific) Electives (DSE)

First Year – Semester One (DSE-I)		
SN	**Course Code**	Course Title
1.	DC20M106	Antenna theory and techniques
2.	DC20M107	High performance communication networks
3	DC20M108	DSP application
First Year – Semester One-(DSE-II)		
SN	Course Code	Course Title
1.	DC20M109	Advanced Digital Communications
2.	DC20M110	Multimedia Communication
3	DC20M111	Telecommunication switching systems and networks
First Year – Semester Second-(DSE-III)		
SN	Course Code	Course Title
1.	DC20M206	Optical Instrumentation & Measurement
2.	DC20M207	Mobile & Satellite Communication
3.	DC20M208	Network Security
First Year – Semester Second-(DSE-IV)		
1	DC20M209	Broadband Communication Systems and Networks
2	DC20M210	Nano Electronics
3	DC20M211	Error control coding

Generic Electives

List of Generic Electives

S.NO	Code	Nomenclature of the course	Offering School
1.	GE20M01	Java Programming	School of Engineering & Technology
2.	GE20M02	Python Programming	School of Advance Computing
3.	GE20M03	Matlab Programming	School of Engineering & Technology
4.	GE20M04	C++ Programming	School of Engineering & Technology
5.	GE20M05	R Programming	School of Advance Computing
6.	GE20M06	CAD/CAM Software	School of Engineering & Technology

Sanjeev Agrawal Global Educational (SAGE) University, Bhopal

Syllabus

For

M.Tech

DIGITAL COMMUNICATION

I Semester

School of Engineering & Technology

School of Engineering & Technology

Code	Advanced Mathematics	Total Lecture:45 Tutorial: 15
MA20M101		**3-1-0=4**

Course Objectives

This course is design to develop coherent understanding of various areas of Advanced Mathematics. Principle course objectives are:

- To introduce students to the theoretical distributions, sampling distributions and their applications
- To introduce the students to the solution of partial differential equation
- Demonstrate an understanding to the theory and applications of linear algebra
- To extend the concept of the computer algorithms related to dimensionality reduction and feature extraction.
- To introduce the concepts of Stochastic process and Markov process transition.

UNIT	Contents	Hours
1	Probability, compound probability and discrete random variable. Binomial, Normal and Poisson's distributions, Sampling distribution, elementary concept of estimation and theory of hypothesis, recurred relations.	10
2	Solution of Partial Differential Equation (PDE) by separation of variable method, numerical solution of PDE (Laplace, Poisson's, Parabola) using finite difference methods, Elementary properties of FT, DFT, WFT, Wavelet transform, Haas transform.	9
3	Finite differences: forward, backward and central difference operators, polynomial interpolation: equally spaced and unequally spaced data; Numerical Differentiation, Numerical integration- Trapezoidal and Simpson1/3rd and 3/8th rules; Initial value problems - Taylor series method, Euler and modified Euler methods, Runge- Kutta methods.	9
4	Solution of Linear systems– Gaussian elimination method, LU factorization method, Cholesky's factorization method. Linear least-squares problems - Normal equations, QR method (or Gram Schmidt Ortho- normalization), Singular value decomposition (SVD) for linear least-squares problems, numerical rank determination via SVD, Principal Component Analysis.	9
5	Stochastic process, Markov process transition probability transition probability matrix, just and higher order Markov process, Application of Eigen value problems in Markov Process, Markov chain. Queuing	8

	system, transient and steady state, traffic intensity, distribution queuing system, concepts of queuing models (M/M/1: Infinity/ Infinity/ FC FS), (M/M/1: N/ Infinity/ FC FS), (M/M/S: Infinity/ Infinity/ FC FS).	
Course Outcomes		
At the end of the course the students should be able to:		
CO1	Be able to understand probability, sampling distribution and discrete random variable.	
CO2	Understand the terms and their applications of Solution of Partial Differential Equations	
CO3	Understand the numerical methods and their use in obtaining approximate solutions to otherwise intractable linear/non-linear system of equations and differential equations.	
CO4	Analyse the fundamental use of matrices in the computer algorithms related to dimensionality reduction and feature extraction.	
CO5	Implement Stochastic process, Markov process transition probability transition probability matrix and Markov process.	
Text Book	• S C *Gupta* & V K *Kapoor*, 2014, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, Delhi. • Gilbert Jimmie, 2010, Gilbert, Linear Algebra And Matrix Theory, Elsevier India. • Dr B S Grewal, 2014, Numerical Methods in Engineering & Science: With Programs in C, C++ & MATLAB, 10th Edition, Khanna Publishers.	
Reference Books	• Rohatgi, V.K., and Saleh, A.K.Md. Ehsanes, 2009, An introduction to probability and statistics. Second Edition, Wiley India. • L. N. Trefethen and David Bau, 1997, Numerical Linear Algebra, SIAM, Philadelphia.	

Code	Micro controller system Design	Total Lecture:45 Tutorial: 15
DC20M101		3 – 1 – 0 = 4

Course Objective-

- To introduce students with the architecture and operation of typical microprocessors and microcontrollers.
- To familiarize the students with the programming and interfacing of microprocessors and microcontrollers.
- To provide strong foundation for designing real world applications using microprocessors and microcontrollers.
- To introduce students with the architecture and operation of DSP Processor

Unit	Contents	Hours
1	Review of 8-Bit and 16-bit microprocessor, support chips and interfacing techniques, single chip micro-computers, architecture, program and data memory, ports, input Output interfacing and programming	10
2	Single chip micro controllers- INTEL 8051/ 8751, MOTOROLA 68HC0/68HC11 architecture, instruction set and programming, Memory mapping, addressing modes, Registers, expanded modes. Interrupt handling timing and serial I / O.	10
3	Software development Modular approach, integrated software development environment, Object oriented interfacing and programming, Recursion and debugging.	10
4	ATMEL 89C51 / 52 and PIC micro-Controllers- Case studies. Design and application of Micro-Controller in Data acquisition, Embedded controllers, Process control etc.	8
5	DSP Processor architecture and sample design using TI – DSP.	7
	Course Outcomes	

	At the end of the course the students should be able to:	
CO 1	Assess and solve basic binary math operations using the microprocessor and explain the microprocessor's and Microcontroller's internal architecture and its operation within the area of manufacturing and performance..	
CO 2	Apply knowledge and demonstrate programming proficiency using the various addressing modes and data transfer instructions of the target microprocessor and microcontroller	
CO 3	Compare accepted standards and guidelines to select appropriate Microprocessor (8085 & 8086) and Microcontroller to meet specified performance requirements.	
CO 4	Analyze assembly language programs; select appropriate assemble into machine a cross assembler utility of a microprocessor and microcontroller.	
CO 5	Design electrical circuitry to the Microprocessor I/O ports in order to interface the processor to external devices. . Evaluate assembly language programs and download the machine code that will provide solutions real-world control problems.	
Text Books	• Embedded Systems 8051 By Majidi & Majid • Design With Micro-Controllers By John P. Peatman Tmh • Advance microprocessor and peripheral –A.K. Ray and K. M. Bhurchandi, Tata Mcgraw Hill • Microprocessor and Interfacing – D.V.Hall, McGraw Hill. • The Intel microprocessor - Barry B. Brey, Pearson	
Reference Books	• Embedded Micro-Computers System By Jonathan W. Valvano • Data Manuals – Intel Motorola • The 8086 & 8088 Microprocessor- LIU and Gibson, Tata McGraw Hill • The 8051 microcontroller and embedded systems-M.A. Mazidi, Janice GillispieMazidi, Pearson Prentice Hall	

Code	Advanced Digital Signal Processing	Total Lecture:45 Tutorial: 15
DC20M102		3 – 1 – 0 = 4

Course Objective:

- To make students familiar with the most important methods in DSP
- To introduce students with Overview of the signal processing of Deterministic signals
- To introduce students with the Including digital filter design,
- To introduce students with the Transform-domain processing and importance of Signal Processors.
- To make students aware about the meaning and implications of the properties of systems and signals

Unit	Contents	Hours
1	Overview of the signal processing of Deterministic signals: Time domain and frequency domain response of the linear-shift invariant systems..	12
2	IIR Filter Design: Filter Approximation, Impulse Invariant Method, Bi-linear Transformation method filter structures, Finite word length effects, limitations of IIR filters. FIR Filter Design: Linear phase response, Windowing technique, Gibb's Phenomenon, Frequency Sampling Method, FIR Filter structures.	12
3	Power Spectrum Estimation, Classical Spectral Estimation, Non parametric methods for power spectrum estimation: Bartlet method, Welch method, Blackman and Tuckey method, performance anlysis of various techniques.	12
4	Parametric Modeling - AR, MA, ARMA methods, Minimum variance spectral estimations. Filter Bank methods.	9
	Course Outcomes	

	At the end of the course the students should be able to:	
CO 1	Use concepts of trigonometry, complex algebra, Fourier transform, z-transform to analyze the operations on signals and acquire knowledge about Systems	
CO 2	Select proper tools for analog-to-digital and digital-to-analog conversion. Also select proper tools for time domain and frequency domain implementation.	
CO 3	Design, implementation, analysis and comparison of digital filters for processing of discrete time signals	
CO 4	Integrate computer-based tools for engineering applications	
CO 5	Employ signal processing strategies at multidisciplinary team activities. . Assess the techniques, skills, and modern engineering tools necessary for analysis of different electrical signals and filtering out noise signals in engineering practice. Also develop creative and innovative designs that achieve desired performance criteria within specified objectives and constraints, understand the need for lifelong learning and continuing professional education	
Text Books	• G. J. Proakis and D. G. Manolakis, "Digital Signal Processing, Principles, algorithms and • applications", 4th ed. Pearson Education. • S. K. Mitra, " Digital Signal Processing" 3rd ed. TMH.	
Reference Books	• A.V. Oppenheim and R.W. Schafer "Discrete Time Signal Processing", PHI 1992. • Steven M. Kay "Modern Spectral Estimation", PHI 1988. • Clark Cory.L, "Lab view DSP and Digital comm.", TMH 2005. • Roman Kuc "Introduction to Digital Signal Processing", McGraw Hill 1988.	

Code	Micro Controller System Lab-I	Total Lecture:30
DC20M103	**List Of Experiments**	**0– 0– 2 = 2**
1	Programs for 16 bit arithmetic operations for 8086 (using Various Addressing Modes)	
2	Program for sorting an array for 8086.	
3	Program for searching for a number or character in a string for 8086	
4	Program for string manipulations for 8086.	
5	Program for digital clock design using 8086.	
6	Interfacing ADC and DAC to 8086.	
7	Parallel communication between two microprocessors using 8255.	
8	Serial communication between two microprocessor kits using 8251.	
9	Interfacing to 8086 and programming to control stepper motor.	
10	Programming using arithmetic, logical and bit manipulation instructions of 8051.	
11	Program and verify Timer/Counter in 8051.	
12	Program and verify Interrupt handling in 8051.	
13	UART Operation in 8051	
14	Communication between 8051 kit and PC	
15	Interfacing LCD to 8051.	
16	Interfacing Matrix/Keyboard to 8051.	
17	Data Transfer from Peripheral to Memory through DMA controller 8237/8257.	
Note: Minimum of 10 experiments to be conducted.		

Code	Advanced Digital Signal Processing Lab-II	Total Lecture:30
DC20M104	**List Of Experiments**	**0 – 0– 2 = 2**
1	To find DFT / IDFT of given DT signal	
2	Program to obtain Linear Convolution of two finite length sequences 8	
3	Program for Computing auto correlation	
4	To find frequency response of a given system(transfer function/difference equation)	
5	Implementation of FFT of given sequence	
6	Determination of Power Spectrum of a given signal.	
7	Implementation of LP FIR filter for a given sequence	
8	Implementation of HP FIR filter for a given sequence	
9	Implementation of LP IIR filter for a given sequence	
10	Implementation of HP IIR filter for a given sequence	
11	Generation of Sinusoidal signal through filtering	
12	Generation of DTMF signals	
13	Implementation of Decimation Process	
14	Implementation of Interpolation Process	
15	Implementation of I/D sampling rate converters	
16	Impulse Response of First Order and Second Order Systems.	
Note: Minimum of 10 experiments to be conducted		

Code	System Programming	Total Lecture:30
DC20M105	**List Of Experiments**	**0 – 0– 2 = 2**
1	Write a program to implement the lexical analyzer.	
2	Write a Lexical Analyzer (using lex utility for UNIX).	
3	Write a program to left factor the given grammar.	
4	Write a program to remove the Left Recursion from a given grammar.	
5	Aim: Implement Recursive Descendent Parsing for the given Grammar.	
6	E -> T + E / T T -> F * T / F F -> (E) / i	
7	Implement Predictive Parser for the given grammar. E -> T + E / T T -> F * T / F F -> (E) / i	
8	Write a SAL program in text file and generate SYMTAB and LITTAB	
9	Use macro features of C language	
10	Write a program which generates Quadruple Table for the given postfix String	
11	Write a C program to parse a given string using Predictive parsing for given	
12	grammar. type → simple | ↑id | array [simple] of type	
13	simple → integer | char | num dotdot num	
Note: Minimum of 10 experiments to be conducted		

Code	Discipline Specific Elective- I	Total Lecture:45
DC20M106	Antenna Theory and Techniques	3 – 0 – 0 = 3

Course Objective-

Students will be introduced to antennas, their principle of operation Antenna analysis and their applications.

- Introduce the student to wave propagation over ground
- Introduce the student to through troposphere and ionosphere
- Introduce the student to diversity principles,
- Introduce the student to Propagation effects in microwave systems,
- Introduce the student to satellite, space, and radar links

Unit	Contents	Hours
1	Review of the theory of electromagnetic radiation. Introduction to various antenna types wire, loop and helical antennas, analysis using assumed current distribution.	10
2	Aperture antennas: slot, wave guide, horn, and reflector antennas. Analysis using field equivalence principle and Fourier transform methods. Linear arrays. Traveling wave & broadband antennas. Antenna measurements.	11
3	Printed antennas: Feeding methods, transmission line & cavity models, analysis and design of rectangular & circular microstrip antenna. Arrays: pattern synthesis, planar arrays, phased arrays. Active antennas and arrays.	12
4	Paraboloidal reflector antenna, different feed configurations, shaped beam antennas, lens antenna. Antennas for biomedical applications. Smart antennas for mobile communications. Antenna for infrared detectors.	12

Course Outcomes

	At the end of the course the students should be able to:	
CO 1	Define various antenna parameters	
CO 2	Analyze radiation patterns of antennas CO3. CO4 CO5	
CO 3	Evaluate antennas for given specifications	

CO 4	Illustrate techniques for antenna parameter measurements	
CO 5	To understand the various applications of antennas .Discuss radio wave propagation	
Text Books	• Antennas,John Kraus, Ronald Marhefka,Tmh • Electromagnetic Waves And Radiating Systems,E.C. Jordan And K.G. Balmain, ,Phi • Antenna Theory: Analysis And Design,Constantine A. Balanis , John Wiley & Sons • Antenna Theory & Design,Robert S. Elliott, John Wiley & Sons	
Reference Books	• Antennas And Wave Propagation,G. S. N. Raju , Pearson. • Antennas And Wave Propagation,A.R. Harish, M. Sachidananda, Oxford • Antenna Handbook: Antenna Theory,Y. T. Lo, S. W. Lee, Springer . • Antenna Theory And Practice,Chatterjee, R., New Age International.	

Code	Discipline Specific Elective- I	Total Lecture:45
DC20M107	High Performance Communication Networks	3 – 0 – 0 = 3

Course Objective-

- To understand the basic concepts of data communication,
- Introduce the student to layered model, protocols and interworking between. computer networks and switching components in telecommunication systems.
- Discuss the nature, uses and implications of internet technology.
- To understand the functioning of Frame Relay, ATM.
- An overview of security issues related to data communication in networks

Unit	Contents	Hours
1	Basics of Networks: Telephone, computer, cable television and wireless network, networking principles, digitization: Service integration, network services and layered architecture, traffic characterization and QOS, networks services, network elements and network mechanisms.	10
2	Packet switched networks: OSI and IP models, Fast and Gigabit Ethernets, FDDI, DQDB, frame relay, SMDS, internet working with SMDS. Internet and TCP IP networks: overview, internet protocols, TCP and VDP, performance of TCP/IP networks circuit switched networks, SONET, DWDM, fibre to home, DSL, intelligent networks, CATV.	11
3	ATM and Wireless networks: Main features, addressing, signaling and routing, ATM header structure, adaptation layer, management and control, BISDN, interworking with ATM, wireless channel, link level design, channel access, network design and wireless networks.	12
4	Optical networks and Switching: Optical links, WDM systems, cross-connects, optical LANs, optical paths and networks, TDS and SDS, modular switch designs, packet switching, distribution, shared, input and output buffers.	12

Course Outcomes

	At the end of the course the students should be able to:	
CO 1	Understand the basics of data communication, networking, internet and their importance.	
CO 2	Analyze the services and features of various protocol layers in data networks.	
CO 3	Differentiate wired and wireless computer networks	
CO 4	Analyse TCP/IP and their protocols.	
CO 5	Recognize the different internet devices and their functions	
Text Books	• J. Warland and P. Varaiya, "High performance communication networks", Harcourt and Morgan Kauffman, London 2000 • Sumit Kasera and Pankaj Sethi, "ATM networks", Tata McGraw Hill, 2000.	
Reference Books	• Behrouz. A. Forouzan, "Data Communication and networking,4TH edition. • Leon Garacia Widjaja, "Communication networks", Tata McGraw Hill, 2000.	

Code	Discipline Specific Elective- I	Total Lecture:45 Tutorial: 00
DC20M108	DSP Application	3 – 0 – 0 = 3

Course Objective :

- Understand basic tradeoffs in digital representation of signals: sampling rate, bandwidth, bit rate, fidelity
- Analyse minimum phase, linear phase, and all-pass discrete-time systems
- Check the stability of filters
- Choose filter structures according to their performance characteristics: sensitivity, complexity, delay, etc
- Program digital signal processors to perform DSP in real-time.

Unit	Contents	Hours
1	Review of Discrete time signals: sequences, representation. Discrete time systems: linear, time in variant, LTI systems, properties, and constant coefficients difference equations. Frequency Domain representation of discrete time signals and systems	10
2	Review of Z Transform – Properties, ROC, Stability, Causality, Criterion. Inverse Z Transform, Recursive and Non Recursive systems, Realization of discrete time system	10
3	DFT: Properties, Linear and Circular convolution, Discrete Cosine Transform, Relationship between DFT and DCT. Computation of DFT: FFT/Decimation in Time and Decimation in Frequency	10
4	FIR and IIR systems: Basic structure of FIR and IIR, Bilinear Transformation, Design of Discrete time IIR filter-Butterworth , Chebychev , Inverse Chebychev , Elliptic etc. Design of FIR filters by windowing – Rectangular, Bartlett, Hann, Hamming, Kaiser, Window filter, Design method relationship of Kaiser to other window. Application of MATLAB for Design of Digital filter. Effect of Finite register length in filter Design	8
5	Discrete time Random signals: Discrete time random process, Averages, Spectrum Representation of finite energy signals, response of linear systems to random signals. power spectrum estimation: Basic principals of spectrum estimation, estimate of auto con variance, power spectrum ,cross con variance and cross spectrum. Advance signal processing technique and transforms: multi rate signal processing- down sampling/up sampling, introduction to discrete Hilberts Transform, Wavelet Transform, Haar Transform etc.	7

Course Outcomes		
At the end of the course the students should be able to:		
CO 1	Demonstrate the concept of Conductors, Insulators, and Semiconductors based on energyband theory and analyze relevant problems	
CO 2	Explain the working principles of P-N Junction Diode, zener diode and analyze their applications in the rectifier, clipper, clamper, regulator etc.	
CO 3	Analyze characteristics of Bipolar junction transistor(BJT) under CE, CE, CC mode of operation and its biasing therein	
CO 4	Distinguish the operations of JFET, MOSFET and demonstrate their operations under CG, CS, CD configurations	
CO 5	Determine parameters in Operational Amplifier circuit design for various applications	
Text Books	• Discreate time signal Processing by Opperenheim & Schaffer PHI 2nd Edition • Digital Signal Processing using MATLAB by S.Mitra	
Reference Books	• Digital Signal Processing By Proakis Pearson Education • Theory & application of Digital Signal Processing by L.R.Rabiner & B. Gold PHI	

Code	Discipline Specific Elective- II	Total Lecture:45
DC20M109	Advance Digital Communication	3 – 0 – 0 = 3

Course Objective

Students will try to learn:

- Aim is to identify the functions of different components
- Learn about theoretical bounds on the rates of digital communication system
- Introduce the student to represent a digital signal using several modulation methods
- Draw signal space diagrams compute spectra of modulated signals and apply redundancy for reliable communication.
- Introduce the student to Turbo codes, Trellis codes

Unit	Contents	Hours
1	Waveform coding Techniques: Discretization in time and amplitude, linear quantizer, quantization noise power calculations, signal to quantization noise ratio, non-uniform quantizer, a-Law & μ-law, companding, encoding and PCM, Channel noise and error probability, DPCM and DM, Coding speech at low bit rates, PredMEion and adaptive filters, Baseband shaping for data transmission, PAM signals and their power spectra, Nyquist criterion, ISI and eye pattern.	10
2	Digital modulation techniques: Binary and M-ary modulation techniques, Bit vs. symbol error probability and bandwidth efficiency, ASK, FSK, PSK Modulation techniques, comparison of QPSK, MSK & GMSK systems, Coherent and Non-Coherent detection techniques, Phase-Locked loops, Probability of error calculation for M-ary systems.	11
3	Equalization: Optimal Zero-Forcing Equalization, Fractionally Spaced and Transversal Filter Equalizers, Adaptive Linear Equalizer, Pass band Equalization. Fading & Diversity: Types of diversity, Receiver Diversity, Performance analysis for Rayleigh Fading, The Diversity-Interference Trade-off. The Gaussian MIMO Channel, Basics of MIMO systems.	12
4	Error control coding: Concept of channel coding, Channel coding & Channel capacity theorems, Linear block codes, cyclic codes and convolution codes, Vitoria decoding algorithm, Turbo codes, Trellis codes, TCM. Spread-spectrum modulation: Pseudo noise sequences, direct sequence and frequency-Hop spread spectrum, Signal-space dimensionality and processing gain	12

Course Outcomes		
At the end of the course the students should be able to:		
CO 1	Understand the basics of information theory, source coding techniques and calculate Entropy of source	
CO 2	Describe and determine the performance of line codes and methods to mitigate inter symbol interference	
CO 3	Learn the generation and detection of base band system.	
CO 4	Understand the generation, detection signal space diagram, spectrum, bandwidth efficiency, and probability of error analysis of different band pass modulation techniques.	
CO 5	Describe and determine the performance of different error control coding schemes for the reliable transmission of digital representation of signals and information over the channel. Understand various spreading techniques and determine bit error performance of various digital communication systems.	
Text Books	• Communication Systems By Simon Haykin, John Wiley and Sons,4th Edition, 2006 • Digital Communication-Fundamentals and Applications By Sklar, 2nd edition, Pearson Education India. Reference Books	
Reference Books	• Electronic Communication Systems, Fundamentals through Advanced, By Wayne Tomasi, 4th edition, Pearson Education India. • Digital communication by John R. Barry, Third edition, Springer International Edition • :Communication Systems Engineering, By J. G. Proakis, Prentice Hall, 2nd Edition.	

Code	Discipline Specific Elective- II	Total Lecture:45
DC20M110	Multimedia Communication	3 – 0 – 0 = 3

Course Objective-

- To learn and understand technical aspect of Multimedia Systems.
- To understand the standards available for different audio, video and text applications.
- To Design and develop various Multimedia Systems applicable in real time
- To learn various multimedia authoring systems.
- To understand various networking aspects used for multimedia applications.
- To develop multimedia application and analyze the performance of the same

Unit	Contents	Hours
1	Introduction, multimedia information representation, multimedia networks, multimedia applications, Application and networking terminology, network QoS and application QoS, Digitization principles,. Text, images, audio and video.	10
2	Text and image compression,, compression principles, text compression- Runlength, Huffman, LZW, Document Image compression using T2 and T3 coding, image compression- GIF, TIFF and JPEG.	10
3	Audio and video compression, audio compression – principles, DPCM, ADPCM, Adaptive and Linear predictive coding, Code-Excited LPC, Perceptual coding, MPEG and Dolby coders video compression, video compression principles.	10
4	Video compression standards: H.261, H.263, MPEG, MPEG 1, MPEG 2, MPEG-4 and Reversible VLCs, MPEG 7 standardization process of multimedia content description, MPEG 21 multimedia framework	8

Course Outcomes

At the end of the course the students should be able to:

CO 1	Developed understanding of technical aspect of Multimedia Systems	
CO 2	Understand various file formats for audio, video and text media.	

CO 3	Develop various Multimedia Systems applicable in real time	
CO 4	Design interactive multimedia software	
CO 5	Apply various networking protocols for multimedia applications. . To evaluate multimedia application for its optimum performance.	
Text Books	• Fred Halsall, "Multimedia Communications", Pearson education, 2001. • Raif Steinmetz, Klara Nahrstedt, "Multimedia: Computing, Communications and Applications", Pearson education, 2002.	
Reference Books	• K. R. Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic, "Multimedia Communication Systems", Pearson education, 2004. • John Billamil, Louis Molina, "Multimedia : An Introduction", PHI, 2002.	

Code	Discipline Specific Elective- II	Total Lecture:45
DC20M111	Telecommunication-Switching and Networks	3 – 0 – 0 = 3

Course Objective-

- This subject aims at introducing to the students the knowledge about the telecommunication industry
- its services and market, the theoretical basis about performance (queuing theory) and operation (multiplexing, switching, routing, and signaling) in telecom networks
- Introduce the student to telecommunications Transmission
- Introduce the student to speech digitization and transmission
- introduce the student to telephone networks and signalling

Unit	Contents	Hours
1	Telecommunications Transmission: Basic Switching System, Simple Telephone Communication, evolution of switching systems -Stronger switching systems Switching Used in telecommunications cross bar switching, Electronic Switching – Space Division Switching, Time Division Switching –Time Division space switching, Time Division Time Switching, Time multiplexed space switching, Time multiplexed Time Switching, Combination Switching Control of Switching Systems: Call processing functions, common control, stored program control (For all type of switching systems)	15
2	Speech Digitization and Transmission: Quantization Noise, Companding, Differential Coding, Vocodors, Pulse Transmission, Line Coding, NRZ and RZ Codes, Manchester Coding, AMI Coding, Walsh Codes, TDM. Traffic Engineering: Grade of Service and Blocking Probabity – Telephone Networks, Subscriber Loops, Switching Hierchy and Routing, Transmission Plans and Systems, Signaling Techniques, In Channel,Common Channel.	15
3	Telephone Networks and Signaling: Introduction, subscriber loops systems, switching hierarchy, transmission and numbering plans, common channel signaling principles, CCITT signaling systems. Data Networks: Data transmission in PSTNs, Switching Techniques for data transmission, Data communication architecture, Satellite based Data networks	15

Course Outcomes

At the end of the course the students should be able to:		
CO 1	Understand basic techniques and fundamental concepts used in the design of digital system	
CO 2	Apply the different switching algebra theorems and apply for logic functions.	
CO 3	To manipulate design numeric information in different forms,such as different bases,signed integers,varies codes such as a ASCII, gray and BCD.	
CO 4	Design and analyze small combinational and sequential circuits	
CO 5	Design and using standard or building blocks to build larger more complex circuits	
Text Books	• Flood J E, "Telecommunications switching, traffic and networks" first Indian reprint, Pearson education Asia, (2001). • Viswanathan T, "Telecommunication switching systems and networks" 17th Indian reprint, PHI, India, (2003).	
Reference Books	• Bosse J G van, Bosse John G., "Signaling in Telecommunication Networks" Wiley, John & Sons, (1997) • Bruce S. Davie, Paul Doolan, Yakov Rekhtor, "Switching in IP Networks: IP Switching, Tag Switching, and Related Technologies" Elsevier Science & Technology Books, (1998). • Joseph Yu Hui, "Switching and Traffic Theory for Integrated Broadband Networks", Kluwer Academic Publishers, (1990).	

Syllabus

For

M.Tech

DIGITAL COMMUNICATION ENGINEERING

II Semester

School of Engineering & Technology

School of Engineering Technology

SAGE University, Bhopal

Code	Real Time Embedded System	Total Lecture:45 Tutorial: 15
DC20M201		3 – 1 – 0 = 4

Course Objectives

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

Unit	Contents	Hours
1	Introduction to Real-Time Embedded Systems: Brief history of Real Time Systems, A brief history of Embedded Systems. System Resources: Resource Analysis, Real-Time Service Utility, Scheduling Classes, The Cyclic Executive, Scheduler Concepts, Preemptive Fixed Priority Scheduling Policies, Real-Time OS, Thread Safe Re-entrant Functions.	10
2	Processing: Preemptive Fixed-Priority Policy, Feasibility, Rate Montonic least upper bound, Necessary and Sufficient feasibility, Deadline – Monotonic Policy, Dynamic priority policies. I/O Resources: Worst-case Execution time, Intermediate I/O, Execution efficiency, I/O Architecture. Memory: Physical hierarchy, Capacity and allocation, Shared Memory, ECC Memory, Flash file systems.	10
3	Multi-resource Services: Blocking, Deadlock and livestock, Critical sections to protect shared resources, priority inversion. Soft Real-Time Services: Missed Deadlines, QoS, Alternatives to rate monotonic policy, Mixed hard and soft real-time services.	10
4	Embedded System Components: Firmware components, RTOS system software mechanisms, Software application components. Debugging Components: Exceptions assert, Checking return codes, Single-step debugging, kernel scheduler traces, Test access ports, Trace ports, Power-On self test and diagnostics.	8
5	Performance Tuning: Basic concepts of drill-down tuning, hardware – supported profiling and tracing, Building performance monitoring into software, Path length. High availability and Reliability Design: Reliability and Availability,	7

	Similarities and differences, Reliability, Reliable software, Available software, Design tradeoffs, Hierarchical applications for Fail-safe design	

Course Outcomes	
At the end of the course the students should be able to:	
CO 1	Analyze Real time operating systems
CO 2	Describe the functions of Real time operating systems
CO 3	Demonstrate embedded system applications
CO 4	Design a Real Time operating system
CO 5	Analyze performance tuning: basic concepts
Text Books	• Sam Siewert, "Real-Time Embedded Systems and Components", Cengage Learning India Edition, 2007.
Reference Books	• Krishna CM and Kang Singh G, "Real time systems", Tata McGraw Hill, 2003, • Qing Li and Carolyn Yao, "Real-Time Concepts for Embedded Systems", CMP Books, 2003, • Jane W. S. Liu, "Real Time Systems", Prentice Hall, 2000 • 4. Phillip A. Laplante, "Real-Time Systems Design and Analysis", John Wiley & Sons, 2004.

Code	Advanced VLSI Design	Total Lecture:45 Tutorial: 15
DC20M202		3 – 1– 0 = 4

Course Objectives

- To understand the impact of the physical and chemical processes of integrated circuit fabrication technology on the design of integrated circuits
- To understand physics of the Crystal growth, wafer fabrication and basic properties of silicon wafers
- To learn the various lithography techniques and concepts of wafer exposure system
- To understand Concepts of thermal oxidation and Si/SiO2 interface.
- To learn concepts of dopant solid solubility, diffusion macroscopic point, different solutions to diffusion equation. Design and evaluation of diffused layers and its measurement methods

Unit	Contents	Hours
1	Electronic Grade Silicon, Czochralski crystal growing, Silicon Shaping, processing consideration, Vapor Phase Epitaxy, Molecular Beam Epitaxy, Silicon on Insulators, Epitaxial Evaluation, Growth Mechanism And kinetics, Thin Oxides, Oxidation Techniques and Systems, Oxide properties, Redistribution of Dopant At interface, Oxidation of Poly Silicon, Oxidation inducted Defects.	10
2	Optical Lithography, Electron Lithography, X-Ray Lithography, Ion Lithography, Plasma properties, Feature Size control and Anisotropic Etch mechanism, relative Plasma Etching techniques and Equipments,	10
3	Deposition process, Polysilicon, plasma assisted Deposition, Models of Diffusion in Solids, Flick's one Dimensional Diffusion Equation – Atomic Diffusion Mechanism – Measurement techniques – Range Theory- Implant equipment. Annealing Shallow junction – High energy implantation – Physical vapors Deposition – Patterning.	10
4	Ion implantation – Diffusion and oxidation – Epitaxy – Lithography – Etching and Deposition NMOS IC Technology – CMOS IC Technology – MOS Memory IC technology - Bipolar IC Technology – IC Fabrication.	8
5	Analytical Beams – Beams Specimen interactions - Chemical methods – Package types – banking design consideration – VLSI assembly technology – Package fabrication technology.	7

Course Outcomes

At the end of the course the students should be able to:	
CO 1	Understand the basic physics of semiconductor devices and the basics theory of PN junction.
CO 2	Understand the basic theory of MOS transistors.
CO 3	Understand the basic steps of fabrication
CO 4	Learn the basics theory of Crystal Growth and Wafer Preparation
CO 5	Learn the basics theory of analytical beams
Text Books	• Kevin F Brennan "Introduction to Semi Conductor Device", Cambridge publications • .Eugene D Fabricius "Introduction to VLSI Design", McGraw-Hill publications
Reference Books	• S.M.Sze, "VLSI Technology", McGraw Hill, 2nd Edition. 2008. • . James D Plummer, Michael D. Deal, Peter B.Griffin, "Silicon VLSI Technology: fundamentals practice and Modeling", Prentice Hall India, 2009. • Wai Kai Chen, "VLSI Technology" CRC press, 2003.

Code	Optical Communication and Network	Total Lecture:45 Tutorial: 15
DC20M203		3 – 1 – 0 = 4

Course Objectives

- To study about the various optical fiber modes,
- To study about the various configuration and transmission characteristics of optical fibers
- To learn about the various optical sources, detectors and transmission techniques
- To explore various idea about optical fiber measurements and various coupling techniques
- To enrich the knowledge about optical communication systems and networks

Unit	Contents	Hours
1	Introduction-general optical fibre communication system- basic optical laws and definitions optical modes and configurations -mode analysis for optical propagation through fibers.modes in planar wave guide-modes in cylindrical optical fibre-transverse electric and transverse magnetic modes- fiber materials-fiber fabrication techniques-fiber optic cables.classification of optical fiber-single mode fiber-graded index fiber.	10
2	Attenuation-absorption –scattering losses-bending losses-core and cladding losses-signal dispersion –inter symbol interference and bandwidth-intra model dispersion-material dispersion- waveguide dispersion-polarization mode dispersion-intermodal dispersion.dispersion optimization of single mode fiber-characteristics of single mode fiber-R-I Profile.cutoff wave length-dispersion calculation-mode field diameter.	10
3	Sources: Intrinsic and extrinsic material-direct and indirect band gaps-LED-LED structures. surface emitting LED-Edge emitting LED-quantum efficiency and LED power-light source materials-modulation of LED-LASER diodes-modes and threshold conditions-Rate equations-external quantum efficiency-resonant frequencies-structures and radiation patterns-single mode laser-external modulation-temperature effort. Detectors: PIN photo detector-Avalanche photo diodes-Photo detector noise-noise sources-SNR-detector response time-Avalanche multiplication noise-temperature effects comparisons of photo detectors.	10
4	Fundamental receiver operation-preamplifiers-digital signal transmission-error sources-Front end amplifiers-digital receiver performance-probability of error-receiver sensitivity-quantum limit.Optical power measurement-attenuation measurement-dispersion measurement- Fiber Numerical Aperture Measurements-Fiber cut- off Wave length Measurements- Fiber diameter measurements-Source	8

	to Fiber Power Launching-Lensing Schemes for Coupling Management-Fiber to Fiber Joints-LED Coupling to Single Mode Fibers-Fiber Splicing..Optical Fiber connectors.	
5	System design consideration Point – to –Point link design –Link power budget – rise time budget, WDM –Passive DWDM Components-Elements of optical networks-SONET/SDH.Optical Interfaces-SONET/SDH Rings and Networks-High speed light wave Links-OADM configuration-Optical ETHERNET-Soliton.	7

Course Outcomes

At the end of the course the students should be able to:

CO 1	Explain the passive and active components of optical communication
CO 2	Describe the principle and operation of the optical sources and detectors such as LASER & APD K2
CO 3	Summarize the basic concepts of optical networks K2
CO 4	Describe about the SONET/SDH and architecture of Optical Transport Network K2
CO 5	Discuss the elements of WDM networks and its potential applications
Text Books	• Rajiv Ramaswami and Kumar Sivarajan, "Optical Networks Practical Perspective" • 2nd Edition, Morgan - Kaufmann Publishers. 2. Uyless N. Black, Front Royal, Virginia, “Optical Networks, Third Generation Transport Systems”, Prentice Hall Publishers.
Reference Books	• Achyut K. Dutta, Niloy K. Dutta, Masahiko Fujiwara, “WDMTechnologies: Optical Networks” Elsevier Academic Press • Mukherjee, Biswanath, “Optical WDM Networks”, Springer Books, 2006 • Joseph C Patios, "Fiber Optical Communications", Prentice Hall International 2004, 5th Edition • G.P.Agrawal: `Nonlinear Fiber Optics’, Academic Press. 2001 ,3rd Edition

Code	Advanced VLSI Design Lab-II	Total Lecture:30
DC20M204	**List Of Experiments**	**0-0-2=2**
1	Designing of continuous electronics controllers, (P, I, D, PI, PD, PID)	
2	Study of Electro – Pneumatic Trainer kit and Pneumatic control valves.	
3	Controlling of Temperature of water by continuous controllers (P, I, D, PI, PD, PID).	
4	Study of P to I converter and it's Interfacing to electro-pneumatic kit.	
5	Study of I to P converter and it's Interfacing to electro-pneumatic kit.	
6	Study of PLC and ladder diagram programming.	
7	Controlling of flow meter through PLC.	
8	Controlling of Bottling plant through PLC.	
9	Controlling of Water level through PLC.	
10	Implementation of traffic light control through PLC.	
11	Controlling of stepper motor through PLC.	
12	Study of rotary encoder and its controlling through PLC.	
Note: Minimum of 10 experiments to be conducted.		

Code	Modeling and Simulation of Computer	Total Lecture:30
DC20M205	**List Of Experiments**	**0-0-2=2**
1	System Models & System Simulation	
2	Vrification And Validation Of Model	
3	Differential Equations In Simulation	
4	Discrete System Simulation	
5	Continuous Simulation	
6	Simulation Language	
7	Vii Use Of Database	
8	A.I. In Modelling And Simulation	

Code	Discipline Specific Electives – III	Total Lecture:45
DC20M206	Optical Instrumentation & Measurement	3 – 0 – 0 = 3

Course Objectives

- To make the students able to understand different aspects of optical instrumentation
- Ability to explore the design, installation & operation of the basic instrumentation systems used in industrial environments
- Ability to use scientific & engineering fundamentals, skills & tools to formulate, solve & analyze instrumentation problems related to industry & research.
- To make the students able to understand Light Sourcing
- To make the students able to understand Fiber optic fundamentals

Unit	Contents	Hours
1	Light Sourcing, Transmitting and Receiving: Concept of light, classification of different phenomenon based on theories of light, basic light sources and its characterization, polarization, coherent and incoherent sources, grating theory, application of diffraction grating, electro-optic effect, acousto-optic effect and magneto-optic effect.	10
2	Opto –Electronic devices and Optical Components: Photo diode, PIN, photo-conductors, solar cells, phototransistors, materials used to fabricate LEDs and lasers design of LED for optical communication, response times of LEDs, LED drive circuitry, lasers classification ruby lasers, neodymium lasers, CO2 lasers, dye lasers, semiconductors lasers, lasers applications.	10
3	Interferometry: Interference effect, radiometry, types of interference phenomenon and its application, michelson's interferometer and its application refractometer, rayleigh's interferometers, spectrographs and monochromators, spectrophotometers, calorimeters, medical optical instruments	10
4	Optical Fiber Sensors: Active and passive optical fiber sensor, intensity modulated, displacement type sensors, multimode active optical fiber sensor (micro bend sensor) single mode fiber sensor-phase modulates and polarization sensors	8
5	Fiber optic fundamentals and Measurements: fundamental of fibers, fiber optic communication system, optical time domain reflectometer (OTDR), time domain dispersion measurement, frequency domain dispersion measurement.	7

Course Outcomes	
At the end of the course the students should be able to:	
CO 1	Explain the basic concepts of optical transmitting and receiving
CO 2	Describe different opto- electronic devices
CO 3	Elucidate different methods of interferometry
CO 4	Describe selection of the appropriate optical fiber sensors for industrial application
CO 5	Describe selection of the Fiber optic fundamentals
Text Books	• J.Wilson&J F B Hawkes, Opto Electronics: An Introduction, Prentice Hall of India, (2011),3rd ed. • RajpalS.Sirohi , Wave Optics and its Application, (2001),1st ed. • A Yariv , Optical Electronics/C.B.S. Collage Publishing, New York, (1985 • Pollock ,Fundamentals of OPTOELECTRONICS,(1994)
Reference Books	• G. Hebbar, Optical Fiber Communication, Cengage. • J. Wilson & J. F. B. Hawkes, Optoelectronics: An Introduction PHI/ Pearson • Rajpal S. Sirohi Wave Optics and its Application, Hyderabad, Orient longman Ltd. • A. Yariv, Optical Electronics, C. B. S. Collage Publishing, New York, 1985.

Code	Discipline Specific Electives – III	Total Lecture:45
DC20M207	Mobile & Satellite Communication	3-0-0=3

Course Objectives

- This is a required course for students at a senior year.
- The goal of the course is to introduce students to the fundamentals of satellite communication.
- To provide them with a sound understanding of how a satellite communication system successfully transfers information from one earth station to another.
- To expose them to examples of applications and tradeoffs that typically occurring engineering system design, and to ask them to apply the knowledge in design problems

Unit	Contents	Hours
1	Introduction to Satellite Communication: Historical background, Basic concepts of Satellite Communications, Communication Networks and Services, Comparison of Network Transmission technologies, Orbital and Spacecraft problems, Growth of Satellite communications.	10
2	Introduction, Kepler's First Law,Kepler's Second Law, Kepler's Third Law, Definitions of Terms for Earth-Orbiting Satellites, Orbital Elements, Apogee and Perigee Heights, Orbit Per turbations, Effects of a non spherical earth, Atmospheric drag.	10
3	The Geostationary Orbit: Introduction, Antenna Look Angles, The Polar Mount Antenna, Limits of Visibility, Near Geostationary Orbits, Earth Eclipse of Satellite, Sun Transit Outage, Launching Orbits	10
4	Radio Wave Propagation: Introduction, Atmospheric Losses, Ionospheric Effects, Rain Attenuation, Other Propagation Impairments	8
5	Polarization: Introduction, Antenna Polarization, Polarization of Satellite Signals, Cross Polarization, Discrimination, Ionospheric Depolarizaon, Rain Depolarization, Ice Depolarization	7

Course Outcomes	
At the end of the course the students should be able to:	
CO 1	Understand principle, working and operation of various sub systems of satellite as well as the earth station
CO 2	Apply various communication techniques for satellite applications
CO 3	Analyze and design satellite communication link
CO 4	Learn advanced techniques and regulatory aspects of satellite communication
CO 5	Understand role of satellite in various applications
Text Books	• T. pratt, Ch. Bostain, J.Allnutt, Satellite Communications, 2nd edition, John Wiley & Sons, 1986
Reference Books	• D. Roddy, Satellite Communications, 3rd ed., McGraw-Hill, 2001. • B. Elbert, Introduction to Satellite Communications, 2nd ed., Artech House1999. • G.Maral, M. Bousquet, Satellite Communications systems, 2nd edition, John Wiley & Sons, 2002.

Code	Discipline Specific Electives – III	Total Lecture:45
DC20M208	Network Security	3-0-0=3

Course Objectives

- To understand basics of Cryptography and Network Security.
- To be able to secure a message over insecure channel by various means.
- To learn about how to maintain the Confidentiality, Integrity and Availability of a data.
- To understand various protocols for network security to protect against the threats in the networks.
- To understand various IP Security: Architecture

Unit	Contents	Hours
1	Introduction to security attacks - services and mechanism - introduction to cryptography - Conventional Encryption: Conventional encryption model - classical encryption techniques - substitution ciphers and transposition ciphers – cryptanalysis – steganography - stream and blockciphers - Modern Block Ciphers: Block ciphers principals - Shannon's theory of confusion anddiffusion - fiestal structure - data encryption standard(DES) - strength of DES - differential and linearcrypt analysis of DES - block cipher modes of operations - triple DES – AES.	10
2	Confidentiality using conventional encryption - traffic confidentiality - key distribution - random number generation - Introduction to graph - ring and field - prime and relative prime numbers - modular arithmetic - Fermat's and Euler's theorem - primality testing - Euclid's Algorithm - Chinese Remainder theorem - discrete algorithms.	10
3	Principles of public key crypto systems - RSA algorithm - security of RSA - key management – Diffle-Hellman key exchange algorithm - introductory idea of Elliptic curve cryptography – Elgamel encryption - Message Authentication and Hash Function: Authentication requirements - authentication functions - message authentication code - hash functions - birthday attacks – security of hash functions and MACS.	10
4	(Integrity checks and Authentication algorithms) MD5 message digest algorithm - Secure hash algorithm (SHA) Digital Signatures: Digital Signatures - authentication protocols - digital signature standards (DSS) - proof of digital signature algorithm - Authentication Applications: Kerberos and X.509 -	8
5	IP Security: Architecture - Authentication header - Encapsulating security payloads - combining security associations - key management.	7

Course Outcomes	
At the end of the course the students should be able to:	
CO 1	Provide security of the data over the network.
CO 2	Do research in the emerging areas of cryptography and network security.
CO 3	Implement various networking protocols
CO 4	Protect any network from the threats in the world.
CO 5	Integrity checks and Authentication algorithms
Text Books	• William Stallings, "Crpyptography and Network security Principles and Practices", Pearson/PHI • Wade Trappe, Lawrence C Washington, " Introduction to Cryptography with coding theory", Pearson.
Reference Books	• W. Mao, "Modern Cryptography – Theory and Practice", Pearson Education. • Charles P. Pfleeger, Shari Lawrence Pfleeger – Security in computing – Prentice Hall of India.

Code	Discipline Specific Electives – IV	Total Lecture:45
DC20M209	Broadband Communication Systems and Networks	3 – 0 – 0 = 3

Course Objectives

- To study various concepts related to broadband communication. To understand digital satellite links,
- To understand the frequencies and channel allocations.
- To understand the multi-carrier communication systems. Course
- To understand the components of broadband
- To understand the digital subscriber line

Unit	Contents	Hours
1	Components of Broadband Communication Systems, Network Architecture, Cable Broadband, Data Network Architecture, Importance of Broadband Network, Future of Broadband Telecommunications. X.25 Technology & Frame Relay.	12
2	DIGITAL SUBSCRIBER LINE: DSL Technology, ADSL, HDSL, SDSL, SHDSL. Cable - Modem Technology, Cable Internet Access, Comparison Between Broadband DSL and Cable Modem Technologies, Future of DSL and Broadband Systems – XDSL. ISDN & BISDN, ISDN Standards, ISDN Applications. ATM Technology, ATM Network, ATM Service Class, ATM Standards, ATM LAN Emulation, ATM Applications	12
3	SYCHRONOUS OPTICAL NETWORK (SONET): SONET Signal, SONET Frame, SONET Components, SONET Topologies, Advantages and Disadvantages of SONET & SDH, SONET and SDH Standards. WDM Network Elements- Optical Line Terminals, Optical Line Amplifiers, Optical Add/Drop Multiplexers, OADM Architectures, Reconfigurable OADMs, Optical Crossconnects, All-Optical OXC Configurations	12
4	NETWORK MANAGEMENT: Network Management Architecture - Network Management Protocols - Simple Management Information Protocol (SNMP) Management - Information Base (MIB) - Structure of Management Information (SMI) - Remote Network Monitoring (RMON). Network Security Requirements, Network Threats, Access Control Methods.	9

Course Outcomes

At the end of the course the students should be able to:

CO 1	This course provides an introductory overview on broadband communication networks
CO 2	The course covers major aspects of communication networks, such as network design, performance evaluation, protocols and technologies.
CO 3	This course focuses on the network modelling by using mathematical tools, such as queuing theory and stochastic processes, and network optimization, which can provide guaranteed transmission performance with efficient usage of network resources.
CO 4	The course covers network management architecture
Text Books	• Broadband Communication Systems by Cajetan Akujuobi and Matthew Sadiku, Scitech Publishing. • Introduction to broadband Communication Systems By Cajetan M. Akujuobi and MNO Sadiku, Chapman & Hall.
Reference Books	• Fixed Broadband Wireless System Design: The Creation of Global Mobile Communications By Harry R. Anderson; Wiley Blackwell.) Optical Networks A Practical • Perspective by Rajiv Ramaswami, Kumar N. Sivarajan, Galen H. Sasaki.

Code	Discipline Specific Electives – IV	Total Lecture:45
DC20M210	Nano Electronics	3 – 0 – 0 = 3

Course Objectives

- Enhance basic engineering science and technological knowledge of nano electronics.
- Explain basics of top-down and bottom-up fabrication process, devices an systems.
- Describe technologies involved in modern day electronic devices.
- Appreciate the complexities in scaling down the electronic devices in the future.
- Explain basics of epitaxial growth of quantum wells

Unit	Contents	Hours
1	Overview of nanoscience and engineering. Development milestones in microfabrication and electronic industry. Moores' law and continued miniaturization, Classification of Nanostructures, Electronic properties of atoms and solids: Isolated atom, Bonding between atoms, Giant molecular solids, Free electron models and energy bands, crystalline solids, Periodicity of crystal lattices, Electronic conduction, effects of nanometer length scale, Fabrication methods: Top down processes, Bottom up processes methods for templating the growth of nanomaterials, ordering of nanosystems	10
2	Classification, Microscopic techniques, Field ion microscopy, scanning probe techniques, diffraction techniques: bulk and surface diffraction techniques,spectroscopy techniques: photon, radiofrequency, electron, surface analysis and dept profiling: electron, mass, Ion beam, Reflectrometry, Techniques for property measurement: mechanical, electron, magnetic, thermal properties	10
3	norganic semiconductor nanostructures: overview of semiconductor physics. Quantum confinement in semiconductor nanostructures: quantum wells, quantum wires, quantum dots, super-lattices, band offsets, electronic density of states (Text1). Carbon Nanostructures:Carbon molecules, Carbon Clusters, Carbon Nanotubes, application of Carbon Nanotubes	10
4	epitaxial growth of quantum wells, lithography and etching, cleavededge over growth, growth of vicinal substrates, strain induced dots and wires, electrostatically induced dots and wires, Quantum well width fluctuations, thermally annealed quantum wells, semiconductor nanocrystals, collidal quantum dots, self-assembly techniques. Physical processes: modulation doping, quantum hall effect, resonant tunneling, charging effects, ballistic carrier transport, Inter band absorption, intra band absorption, Light emission processes, phonon	8

	bottleneck, quantum confined stark effect, nonlinear effects, coherence and dephasing, characterization of semiconductor nanostructures: optical electrical and structural	
5	atomic, crystollography, microscopy, spectroscopy (Text 2). Applications: Injection lasers, quantum cascade lasers, singlephoton sources, biological tagging, optical memories, coulomb blockade devices, photonic structures, QWIP's, NEMS, MEMS	7

Course Outcomes

At the end of the course the students should be able to:

CO 1	Know the principles behind Nanoscience engineering and Nano electronics.
CO 2	Apply the knowledge to prepare and characterize nonmaterial.
CO 3	Know the effect of particles size on mechanical, thermal, optical and electrical
CO 4	properties of nonmaterial. Design the process flow required to fabricate state of the art transistor technology
CO 5	Analyze the requirements for new materials and device structure in the future technologies
Text Books	• Introduction to Nano Technology by Charles. P. Poole Jr& Frank J. Owens. Wiley India Pvt. Ltd. • Solid State physics by Pillai, Wiley Eastern Ltd. • Introduction to solid state physics 7th edition by Kittel. John Wiley & sons (Asia) Pvt Ltd.
Reference Books	• Nano Technology and Nano Electronics – Materials, devices and measurement . Techniques by WR Fahrner – Springer • Encyclopedia of Nano Technology by M.Balakrishna Rao and K.Krishna Reddy, Vol I to X Campus books. • Nano Technology - Science, innovation and opportunity by Lynn E. Foster. Prentice Hall Pearson education. Hand book of Nano structured materials Vol I & V 6. Encyclopedia of Nano Technology by H.S.Nalwa

Code	Discipline Specific Electives – IV	Total Lecture:45
DC20M211	Error Control Coding	3 – 0 – 0 = 3

Course Objectives

- 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**.**

Unit	Contents	Hours
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.	12
2	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.	12
3	BCH codes: Binary primitive BCH codes, Decoding procedures, Implementation of Galois field arithmetic. Majority Logic decodable codes: One -step majority logic decoding, Multiple-step majority logic.	12
4	Convolution codes: Encoding of convolutional codes: Systematic and Nonsystematic Convolutional Codes, Feedforward encoder inverse, A catastrophic encoder, Structural properties of convolutional codes: state diagram, state table, state transition table, tree diagram, trellis diagram. Viterbi algorithm, Sequential decoding: Log Likelihood Metric for Sequential Decoding.	9

Course Outcomes

At the end of the course the students should be able to:	
CO 1	Analyse a discrete memoryless channel, given the source and transition probabilities
CO 2	Apply the concept of modern linear algebra for the error control coding technique.
CO 3	Construct and Implement efficient LBC, Cyclic codes etc encoder and decoders.
CO 4	Apply decoding algorithms for efficient decoding of Block codes and Convolutional codes.
Text Books	• David C.Lay, Steven R.Lay and J.J.McDonald: "LinearAlgebra and its Applications", • thEdition, Pearson Education Ltd., 2015 5. Elsgolts, L.:"Differential Equations and Calculus of Variations", MIR Publications, 3rd Edition, 1977 • .T.Veerarajan: "Probability, Statistics and Random Process",3rd Edition,Tata Mc-Graw Hill Co.,2016.
Reference Books	• Gilbert Strang: Introduction to Linear Algebra, 5thEdition, WellesleyCambridge Press., 2016 • Richard Bronson: "Schaum's Outlines of Theory and Problems of Matrix Operations", McGraw-Hill, 1988. • Scott L.Miller,DonaldG.Childers: "Probability and Random Process with application to Signal Processing", Elsevier Academic Press,2nd Edition,2013. • E. Kreyszig, "Advanced Engineering Mathematics", 10th edition, Wiley, 2015