KLS Gogte Institute of Technology, Belagavi-08
Department of Electronics and Communication Engineering

M. Tech. (Digital Communication & Networking)

Scheme of Teaching & Syllabus

2016 – 17

Scheme of Teaching for M.Tech.
Curriculum frame work:

S.No.	Subject Area		Credits
1	Professional Core (Theory & Practicals)	PC	36
2	Professional Elective	PE	16
3	Lab	PC	4
4	Seminar	PC	2
5	Internship	SS	10
6	Project	PR	22
7	Term Assignment		4
	Total		94

Lecture (L): One Hour /week – 1 credit
Practicals (P): Three Hours /week – 2 credits

Distribution of credits

Semester	Credits
1	25
2	25
3	26
4	18
Total	94

Department of Electronics and Communication Engineering

M. Tech. (Digital Communication & Networking)

First Semester								
Subject Code	**Subject**		**Credits**	**Total credits**	**Contact Hours/ week**	**Marks**		
			L – T - P			**CIE**	**SEE**	**TOTAL**
16DCN11	Probability and Random Processes	PC1	4 – 0 – 0	4	4	50	50	100
16DCN12	Advanced Digital Communication	PC2	4 – 0 – 0	4	4	50	50	100
16DCN13	Network Programming	PC3	3 – 1 – 0	4	4	50	50	100
16DCN14	Advances in Antenna and Microwave Engineering	PC4	4 – 0 – 0	4	4	50	50	100
16DCN15Ax	Elective – A	PE- A	4 – 0 – 0	4	4	50	50	100
16DCN16L	Lab-1: Advanced Communication Lab		0 – 0 – 2	2	3	25	25	50
16DCN17S	Seminar-1		0 – 0 – 1	1		25		25
16PTA18	Term Assignment – 1	Mandatory	0 – 0 – 2	2	4	25		25
	Total			25	27	325	275	600

Elective – A: List of subjects

Subject Code	Subjects
16DCN15A1	Multi-Media Communication
16DCN15A2	Communication Network Security
16DCN15A3	Ad-hoc Networks
16DCN15A4	Soft Computing

- SEE: SEE (Theory exam) will be conducted for 100 marks of 3 hours duration. It is reduced to 50 marks for the calculation of SGPA and CGPA.
- Term Assignment: The performance is continuously evaluated by the faculty member and Grade is given.

Department of Electronics and Communication Engineering

M. Tech. (Digital Communication & Networking)

Second Semester								
Subject Code	**Subject**		**Credits** L – T - P	**Total Credits**	**Contact Hours/ week**	**Marks**		
						CIE	**SEE**	**TOTAL**
16DCN21	Cloud Computing	PC1	4 – 0 – 0	4	4	50	50	100
16DCN22	High Speed Switching Networks	PC2	4 – 0 – 0	4	4	50	50	100
16DCN23	Sensor Networks	PC3	4 – 0 – 0	4	4	50	50	100
16DCN24	Advanced Wireless Communication	PC4	4 – 0 – 0	4	4	50	50	100
16DCN25Bx	Elective – B	PE-B	4 – 0 - 0	4	4	50	50	100
16DCN26L	Networks and Programming Lab		0 – 0 – 2	2	3	25	25	50
16DCN27S	Seminar – 2		0 – 0 - 1	1		25		25
16PTA28	Term Assignment – 2	Mandatory	0 – 0 – 2	2	4	25		25
	Total			25	27	325	275	600

Elective – B: List of subjects

Subject Code	Subjects
16DCN25B1	Advanced Communication Networks
16DCN25B2	Optical Networks
16DCN25B3	Connected Devices
16DCN25B4	Remote Sensing and GIS

- SEE: SEE (Theory exam) will be conducted for 100 marks of 3 hours duration. It is reduced to 50 marks for the calculation of SGPA and CGPA.
- Term Assignment: The performance is continuously evaluated by the faculty member and Grade is given.

Third Semester								
Subject Code	**Subject**		**Credits**	**Total Credits**	**Contact Hours/ week**	**Marks**		
			L – T – P			**CIE**	**SEE**	**TOTAL**
16DCN31	Long Term Evolution	PC1	4 – 0 - 0	4	4	50	50	100
16DCN32Cx	Elective – C	PE-C	4 – 0 - 0	4	4	50	50	100
16DCN33Dx	Elective – D	PE-D	4 – 0 – 0	4	4	50	50	100
16DCN34I	[#] Internship			10				
16DCN35P1	[*] Dissertation Phase-1	PR		4		25		25
	Total			26	12	175	150	325

[#] Internship report and presentation to be submitted at the end of semester

[*] Finalization of Project Title and Literature Review

** Term assignments to be added in the scheme

Elective – C: List of subjects

Subject Code	Subjects
16DCN32C1	Statistical Signal Processing
16DCN32C2	Communication Networks Modeling and Simulation
16DCN32C3	Advanced Architectures
16DCN32C4	Object Oriented Analysis and Design

Elective – D: List of subjects

Subject Code	Subjects
16DCN33D1	Business Analytics
16DCN33D2	Industrial Process Control Systems
16DCN33D3	Automotive Networking
16DCN33D4	Broadband Communication

- SEE: SEE (Theory exam) will be conducted for 100 marks of 3 hours duration. It is reduced to 50 marks for the calculation of SGPA and CGPA.

Department of Electronics and Communication Engineering
M. Tech. (Digital Communication & Networking)

Fourth Semester								
Subject Code	**Subject**		**Credits**	**Total Credits**	**Contact Hours/ week**	**Marks**		
			L – T – P			**CIE**	**SEE**	**TOTAL**
16DCN41P2	$ Dissertation Phase-2	PR		4		25		25
16DCN42P3	# Dissertation Phase-3	PR		4		25		25
16DCN43P4	Viva – Voce	PR		10			100	100
	Total			18		50	100	150

$ Project progress report and presentation after 4 weeks of beginning of the semester.
# Project report and demo after 8 weeks.

SEMESTER I
PROBABILITY AND RANDOM PROCESS

Subject Code:	16DCN11	**Credits:**	4
Course Type:	PC	**CIE Marks:**	50
Hours/week: L – T – P	4 – 0 – 0	**SEE Marks:**	50
Total Hours:	45	**SEE Duration:**	3 Hours

Course Learning Objectives (CLOs):

1. To introduce the fundamentals of Probability and random process.
2. To understand the various distribution and density functions.
3. Define and characterize Random processes.
4. Apply the principles of Probability and Random process to communication and signal processing.

UNIT 1

Introduction to probability theory:
Experiments, Sample space, Events, Axioms, Assigning probabilities, Joint and conditional, Baye's theorem, Independence, Discrete random variables, Engineering examples. **9 Hours**

UNIT II

Random variables, Distributions, Density functions:
CDF, PDF, Gaussian random variable, Uniform, Exponential, Laplace, Gamma, Erlang, Chi-square, Rayleigh, Rician and Cauchy types of random variables.
9 Hours

UNIT III

Operation on a single random variable:
Expected value, EV of random variables, EV of functions of random variables, Central moments, Conditional expected values.
Characteristics functions:
Probability generating functions, Moment generating function, Engineering applications, Scalar quantization, Entropy and source coding.
9 Hours

UNIT IV

Pairs of random variables:
Joint PDF, Joint probability mass functions, Conditional distribution, Density and mass functions, EV involving pairs of random variables, Independent random variables, Complex random variables, Related engineering applications. **9 Hours**

UNIT V

Multiple random variables:

Joint and conditional PMF, CDF, PDF, EV involving multiple random variables, Gaussian random variable in multiple dimension, Engineering application, Linear prediction.

Random process: Definition and characterization, Mathematical tools for studying random processes, Stationery and Ergodic random processes, Properties of ACF.

Example Processes: Markov processes, Gaussian processes, Poisson processes, Engineering application, Computer networks, Telephone networks.

9 Hours

Text Books:

1. S.L.Miller and D.C.Childers, "Probability and Random Processes with Application to Signal Processing and Communication", Academic Press/ Elsevier 2004.

Reference Books:

1. A.Papoullis and S.U.Pillai, "Probability, Random Variables and Stochastic Processes", McGraw-Hill, 2002.
2. Peyton Z. Peebles, "Probability, Random Variables and Random Signal Principles", 4th ed., TMH, 2007.
3. H Stark and Woods, "Probability, Random Processes and Application", PHI, 2001.

Course Outcomes (COs):

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

1. Explain fundamentals of probability theory, random variables and random processes.
2. Understand the mathematical concepts related to probability theory and random processes.
3. Understand the characterization of random processes and their properties.
4. Formulate and solve the engineering problems involving random processes.
5. Analyze the given probabilistic model of the problem.

Program Outcomes (POs):

1. PO 1: Fundamentals of Engineering

Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.

2. PO 2: Design of Experiments

Graduates shall possess the ability to design and conduct experiments, analyse and interpret data.

3. PO 4: Engineering Cognizance

Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.

4. PO 5: Modern tool Usage

Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.

5. PO 12: Self-motivated Learning

Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two tests out of three	**Average of two assignments/ activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks	30	10	10	50

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

2. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. **(Kindly incorporate/mention the changes in the pattern of SEE question paper, if required, based on the content of course**)

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SEMESTER I
ADVANCED DIGITAL COMMUNICATION

Subject Code:	16DCN12	**Credits:**	4
Course Type:	PC	**CIE Marks:**	50
Hours/week: L – T – P	4 – 0 – 0	**SEE Marks:**	50
Total Hours:	45	**SEE Duration:**	3 Hours

Course learning objectives (CLOs):

1. To understand the basics of signal space analysis and digital transmission.
2. To understand the coherent and noncoherent receivers and its impact on different channel characteristics.
3. To understand Orthogonal Frequency Division Multiplexing.
4. To understand the different block coded and convolutional coded digital communication systems.
5. To understand the different Equalizers.

UNIT I

Coherent and Non Coherent Communication:
Coherent receivers Optimum receivers in WGN-IQ modulation & demodulation Non-coherent receivers in random phase channels; MFSK receivers-Rayleigh and Rician channels-Partially coherent receivers–DPSK; MPSK; M-DPSK-BER Performance analysis. Carrier Synchronization-Bit synchronization.

9 Hours

UNIT II

Equalization Techniques:
Band Limited Channels-ISI-Nyquist CriterionControlled ISI-Partial Response signals-Equalization algorithms-Viterbi Algorithm-Linear equalizer-Decision feedback equalization-Adaptive Equalization algorithms.

9 Hours

UNIT III

Block Coded Digital Communication:
Architecture and performance
–Binary block codes; Orthogonal; Biorthogonal; Transorthogonal–Shannon's channel coding theorem; Channel capacity; Matched filter; Concepts of Spread spectrum communication

–Coded BPSK and DPSK demodulators
–Linear block codes; Hammning; Golay; Cyclic; BCH ; Reed-Solomon codes
- Space time block codes

9 Hours

UNIT IV

Convolutional Coded Digital Communication:

Representation of codes using Polynomial, State diagram, Tree diagram, and Trellis diagram. Decoding techniques using Maximum likelihood, Viterbi algorithm, Sequential and Threshold methods
–Error probability performance for BPSK and Viterbi algorithm, Turbo Coding.

9 Hours

UNIT V

Orthogonal Frequency Division Multiplexing:

Generation of sub-carriers using the IFFT; Guard Time and Cyclic Extension; Windowing; OFDM signal processing; Peak Power Problem: PAP reduction schemes-Clipping, Filtering, Coding and Scrambling.

9 Hours

Reference Books:

1. M.K.Simon, S.M.Hinedi and W.C.Lindsey, Digital communication techniques; Signalling and detection, Prentice Hall India, New Delhi. 1995.
2. Simon Haykin, Digital communications, John Wiley and sons, 1998
3. Bernard Sklar., 'Digital Communications', second edition, Pearson Education,2001.
4. John G. Proakis., 'Digital Communication', 4 th edition, Mc Graw Hill Publication, 2001
5. Theodore S.Rappaport., 'Wireless Communications', 2nd edition, Pearson Education, 2002.
6. Stephen G. Wilson., 'Digital Modulation and Coding', First Indian Reprint ,Pearson Education, 2003.
7. Richard Van Nee & Ramjee Prasad., 'OFDM for Multimedia Communications' Artech House Publication,2001.

Course Outcomes (COs):

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

1. Develop the ability to understand the concepts of signal space analysis coherent and non-coherent receivers [L].
2. Comprehend the generation of OFDM signals and the processing of the signals.
3. Possess knowledge on different block codes and convolutional codes.
4. Conceptually appreciate different Equalization techniques.

Program Outcomes (POs):

1. PO 1: Fundamentals of Engineering

Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.

2. PO 2: Design of Experiments

Graduates shall possess the ability to design and conduct experiments, analyse and interpret data.

3. PO 4: Engineering Cognizance

Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.

4. PO 5: Modern tool Usage

Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.

5. PO 12: Self-motivated Learning

Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two tests out of three	**Average of two assignments/ activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks	30	10	10	50

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

2. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. **(Kindly incorporate/mention the changes in the pattern of SEE question paper, if required, based on the content of course**)

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SEMESTER I
NETWORK PROGRAMMING

Subject Code:	16DCN13	**Credits:**	4
Course Type:	PC	**CIE Marks:**	50
Hours/week: L – T – P	3 – 1 – 0	**SEE Marks:**	50
Total Hours:	45	**SEE Duration:**	3 Hours

Course learning objectives (CLOs):

1. To understand the fundamentals of Network Programming.
2. To acquire knowledge on sockets.
3. To understand TCP / IP client-server communication.
4. To explore the concepts of Multicasting and Threads.

UNIT I

Introduction:

A Simple Daytime Client, Protocol Independence, Error Handling: Wrapper Functions, A Simple Daytime Server, OSI Model, Unix Standards, 64-bit Architectures.

The Transport Layer - TCP and UDP:

Introduction, The Big Picture, UDP, TCP, TCP Connection Establishment and Termination, TIME_WAIT State, Port Numbers, TCP Port Numbers and Concurrent Servers, Buffer Sizes and Limitations, Protocol Usage by Common Internet Applications.

9 Hours

UNIT II

Sockets:

Introduction, Socket Address Structures, Value-Result Arguments, Byte Ordering Functions, Byte Manipulation Functions, inet_aton, inet_addr, inet_ntoa, inet_pton, inet_ntop, sock_ntop and Related Functions, readn, written and readline Functions, isfdtype function.

Elementary TCP Sockets:

Introduction, *socket, connect, bind, listen, accept, fork* and *exec* Functions, Concurrent Servers, *close* Function, *getsockname* and *getpeername* Functions.

9 Hours

UNIT III

TCP Client/Server Example:

Introduction, TCP Echo Server: *main* and *str_echo* Functions, TCP Echo Client: *main* and *str_cli* Functions, Normal Startup, Normal Termination, Posix Signal Handling, Handling *SIGCHLD* Signals, *wait* and *waitpid* Functions, Connection Abort before *accept* Returns, Termination of Server Process, *SIGPIPE* Signal, Crashing of Server Host, Crashing and Rebooting of Server Host, Shutdown of Server Host, Data Format.

9 Hours

UNIT IV

Elementary UDP Sockets:

Introduction, *recvfrom* and *sendto* Functions, UDP Echo Server: *main* and *dg_echo* Functions, UDP Echo Client: *main* and *dg_cli* Functions, Lost datagrams, Verifying Received Response, Server Not Running, Summary of UDP Example, *connect* Function with UDP, Lack of Flow Control with UDP, Determining Outgoing Interface with UDP, TCP and UDP Echo Server Using *select*.

Elementary Name and Address Conversions:

Introduction, Domain Name System, *gethostbyname, gethostbyname2, gethostbyaddr, uname, gethostname, getservbyname,* and *getservbyport* Functions, *RES_USE_INET6* Resolver Option, IPv6 Support, Other Networking Information.

9 Hours

UNIT V

Multicasting:

Introduction, Multicast Addresses, Multicasting on a WAN, Multicast Socket Options, *mcast_join* and Related Functions, *dg_cli* Function using Multicasting, Receiving MBone Session Announcements, Sending and Receiving, SNTP: Simple Network Time Protocol.

Threads:

Introduction, Basic Thread Functions: Creation and Termination, *str_cli* Function using Threads, TCP Echo Server using Threads, Thread-Specific Data, Mutexes: Mutual Exclusion, Condition Variables.

9 Hours

Text Books:

1. W. Richard Stevens, Bill Fenner, Andrew M. Rudoff: “UNIX Network Programming”, 3rd edn., Volume 1, Pearson Education, , 2004.

Reference Books:

1. W. Richard Stevens: “UNIX Network Programming”, 2nd edn., Volume 1, Pearson Education, 2002.
2. Barry Nance: “Network Programming in C”, PHI, 2002.

Course Outcomes (COs):

1. Write applications that communicate with each other using TCP and IP [L2].
2. Evaluate socket programming APIs [L4].

Program Outcomes (POs):

1. PO 4: Engineering Cognizance

Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.

2. PO 12: Self-motivated Learning

Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two tests out of three	**Average of two assignments/ activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks	30	10	10	50

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

2. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. **(Kindly incorporate/mention the changes in the pattern of SEE question paper, if required, based on the content of course**)

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SEMESTER I

ADVANCES IN ANTENNA AND MICROWAVE ENGINEERING

Subject Code:	16DCN14	**Credits:**	4
Course Type:	PC	**CIE Marks:**	50
Hours/week: L – T – P	4 – 0 – 0	**SEE Marks:**	50
Total Hours:	45	**SEE Duration:**	3 Hours

Course Learning Objectives (CLOs):

1. Define specifications for a communications system based on a set of requirements.
2. Design computer codes for moment method of moment analysis of wire antennas
3. Design antenna numerical analysis method to analyze antennas
4. Derive and understand properties of various microwave components (both passive and active), circuits, and learn how to apply these properties for particular designs.
5. Design basic RF/microwave frontend functional blocks using both analytical tools and advanced computer-aided design tools.
6. Apply the ZY Smith chart to design microwave matching networks, stability circles, stability criteria to solve stable and potentially unstable networks, and
7. Design microwave small signal and power amplifiers, microwave oscillators and microwave detectors and mixers

UNIT I

Linear Array Antenna:

N-Element Linear Array: Uniform Amplitude and Spacing, N-Element Linear Array: Directivity, Design Procedure, N-Element Linear Array: Three-Dimensional Characteristics, Rectangular-to-Polar Graphical Solution, N-Element Linear Array: Uniform Spacing, Non-uniform Amplitude, Superdirectivity, Planar Array Design Considerations, Circular Array. (Textbook 1)

Passive Microwave Circuit Design Fundamentals:

Introduction, Smith chart and applications (Textbook 3)

9 Hours

UNIT II

Antenna Synthesis:

Formulation of the synthesis problem, synthesis principles, line sources shaped beam synthesis, linear array shaped beam synthesis — Fourier Series, Woodward — Lawson sampling method, comparison of shaped beam synthesis methods, low side lobe narrow main beam synthesis methods Dolph

Chebyshev linear array, Taylor line source method.(Textbook 2)

9 Hours

UNIT III

Antenna Synthesis: Method of Moments: Introduction to method of Moments, Pocklington's integral equation, integral equations and Kirchoff's Networking Equations, Source Modeling Weighted residuals formulations and computational consideration, calculation of antenna and scatter characteristics.(Textbook 2)

9 Hours

UNIT IV

Matching Networks:
Design of matching networks, Definition of impedance matching, Matching using lumped and distributed elements.
Basic consideration in active networks: Stability consideration, gain consideration, Noise consideration. (Textbook 3)

9 Hours

UNIT V

Design of amplifiers, oscillators and detector:
Linear and nonlinear design: Introduction, Types of amplifier, Design of different types of amplifiers, Multistage small signal amplifiers, Design of transistor oscillators, Detector losses, detector design.

9 Hours

Laboratory session on design of RF amplifier using Agilent Advanced Design System (ADS).

Text Books:

1. C. A. Balanis, "Antenna Theory Analysis and Design", 3rd Edition, John Wiley, 2005.
2. Stutzman and Thiele, "Antenna Theory and Design", 2nd Edition, John Wiley and Sons Inc.
3. Matthew M. Radmanesh, "RF and Microwave Electronics Illustrated", Pearson Education, Edition, 2004.
4. Reinhold Ludwig, and Pavel Bretchko, **"RF circuit design theory and applications",** Pearson Education, edition, 2004

Reference Books:

1. John D. Kraus: "Antennas", 3rd/4th Edition, McGraw Hill.
2. R. Garg, P. Bhartia, I. Bahl, and A. Ittipiboon, "Microstrip Antenna Design Handbook", Norwood, MA: Artech House, 2001.

3. D. Pozar, Microwave Engineering, J. Wiley and Sons, 3rd Edition, 2004.
4. K. Chang, I. Bahl, and V. Nair, RF and Microwave Circuit and Component Design for Wireless Systems, J. Wiley & Sons, 2002
5. G. Gonzalez, Microwave Transistor Amplifiers, 2nd Edition, Prentice Hall, 1997.

Course Outcomes (COs):

1. Explain the basic function of a given antenna based on the geometry and give a general description of the performance, e.g. the approximate shape of radiation pattern, bandwidth, and polarization [L1].
2. Design an antenna from a given specification and be able to judge, by using physical constraints, if it is possible to fulfill the goals of a specification [L5].
3. Use measurement equipment to measure antenna performance [L4].
4. Use numerical software to design and evaluate antennas [L4].
5. Design RF control, amplifier and mixer circuits by fabricating a microwave front end circuit using microwave components [L5].
6. Use the Smith Chart to solve impedance transformation, transmission line matching and amplifier design (general amplifier and LNA) problems [L3].
7. Design, simulate and measure microwave/RF circuits and antenna [L6].
8. Apply modern microwave/RF design packages such as Agilent ADS [L4].

Program Outcomes (POs):

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3. PO 4: Engineering Cognizance

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Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two tests out of three	**Average of two assignments/ activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks	30	10	10	50

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

2. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. **(Kindly incorporate/mention the changes in the pattern of SEE question paper, if required, based on the content of course**)

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SEMESTER I
ELECTIVE A: MULTIMEDIA COMMUNICATION

Subject Code:	16DCN15A1	**Credits:**	4
Course Type:	PE-A	**CIE Marks:**	50
Hours/week: L – T – P	4 – 0 – 0	**SEE Marks:**	50
Total Hours:	45	**SEE Duration:**	3 Hours

Course learning objectives (CLOs):

1. To understand the Concepts and Fundamentals of digital information compression
2. To apply and analyze mathematical transform for Multimedia information
3. To understand the design procedure of Video CoDec
4. To analyze JPEG, JPEG 2000 still image standards
5. To analyze and evaluate MPEG 4 and H.264 AVC and SVC CoDec standards

UNIT I

Fundamentals:
Practical need for Audio, image and video compression, statistical and psychovisual redundancy, Quantization - uniform, non-uniform and adaptive, Audio compression - Psychoacoustics, Audio CoDec - Lossless Compression MPEG-4, Lossy Compression G.719, G.722,AC3,

9 Hours

UNIT II

Coding and Still Image Compression standard:
Transform coding - DFT, DHT, DCT and DWT, Variable length coding - Huffman codes, Arithmetic codes, Dictionary codes - LZ77 and LZ78, International standards for lossless still image compression - lossless bi-level and lossless multilevel, Still image compression coding standards - JPEG, JPEG 2000

9 Hours

UNIT III

Video Compression:
Motion estimation and motion compensation, Block matching, fundamentals of digital video coding, High resolution video coding - low complexity technique, High resolution DCT coding

9 Hours

UNIT IV

Digital video coding standard and applications:

MPEG 1/2 video coding, MPEG-4 video standards (Content - Based video coding), Introduction and fundamentals

9 Hours

UNIT V

ITU-T Video Coding standards:

H.261, H.263, H.264 AVC and SVC standards, Comparative study of MPEG-4 and H.264 AVC, satellite based video broadcasting, wireless video system design principles. **9 Hours**

Text Books:

1. Yun Q. Shi, Huifang Sun, "Image and Video Compression for Multimedia Engineering: Fundamentals, Algorithms, and Standards, Second Edition", CRC Press , 2008
2. Lajos L. Hanzo, Peter Cherriman, Jurgen Streit, "Video Compression and Communications: From Basics to H.261, H.263, H.264, MPEG4 for DVB and HSDPA-Style Adaptive Turbo-Transceivers", Wiley-IEEE Press, September 2007, ISBN: 978-0-470-51849-6
3. "A Practical Guide to Video and Audio Compression: From Sprockets and Rasters to Macro Blocks", Paperback – Import, 6 Jun 2005
4. T. Wiegand, G. J. Sullivan, G. Bjontegaard, and A. Luthra, "Overview of the H.264/AVC video coding standard", *IEEE Trans. on Circuits and systems for video Technology*, vol. 13, no. 7, pp. 560-576, July 2003.
5. G. Sullivan and T. Wiegand, "Video Compression - From Concepts to the H.264/AVC Standard", *Proceedings of the IEEE*, Special Issue on Advances in Video Coding and Delivery, December 2004, ISBN 9780849373640 - CAT# 7364.
6. Schwarz, H. Berlin, Marpe, D. and Wiegand, T., "Overview of the Scalable Video Coding Extension of the H.264/AVC Standard" *IEEE Transactions On Circuits And Systems For Video Technology*, vol. 17, no. 9, September 2007.

Course Outcomes (COs):

1. Identify and describe multimedia signal processing and communications [L1]
2. In the coding aspect, state-of-the-art compression technologies will be presented. Emphasis will be given to a number of standards, including H.26x, Moving Picture Expert Group (MPEG), and Joint Photographic Expert Group (JPEG) [L3].
3. Carry out, analyze and report different transforms for video coding [L4].
4. Describe and motivate to design Video CoDec [L3].
5. Provide insight into satellite based video broadcasting, wireless video system design principles [L2].

Program Outcomes (POs):

1. PO 1: Fundamentals of Engineering
Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.

2. PO 2: Design of Experiments
Graduates shall possess the ability to design and conduct experiments, analyse and interpret data.

3. PO 4: Engineering Cognizance
Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two tests out of three	**Average of two assignments/ activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks	30	10	10	50

Scheme of Semester End Examination (SEE):
1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

2. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. **(Kindly incorporate/mention the changes in the pattern of SEE question paper, if required, based on the content of course**)

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SEMESTER I
ELECTIVE A: NETWORK SECURITY

Subject Code:	16DCN15A2	**Credits:**	4
Course Type:	PE – A	**CIE Marks:**	50
Hours/week: L – T – P	4 – 0 – 0	**SEE Marks:**	50
Total Hours:	45	**SEE Duration:**	3 Hours

Course Learning Objectives (CLOs):

1. To explain the network security model
2. To demonstrate use of various private and public key encryption techniques used in modern cryptosystems
3. To explain the concept of digital signatures and authentication protocols
4. To explain the concept of secured electronic transaction with web security considerations
5. To analyze the security issues with Kerberos and E-mails
6. To analyze the internet security issues
7. To explain firewall design principles and trusted systems

UNIT I

Introduction on Security:
Security Goals, Types of Attacks: Passive attack, active attack, attacks on confidentiality, attacks on Integrity and availability, Security services and mechanisms, Techniques: Cryptography, Steganography, Revision on Mathematics for Cryptography.
Case study : Any two watermarking techniques

9 Hours

UNIT II

Symmetric & Asymmetric Key Algorithms:
Substitutional Ciphers, Transposition Ciphers, Stream and Block Ciphers, Data Encryption Standards (DES), Advanced Encryption Standard (AES), RC4, principle of asymmetric key algorithms, RSA Cryptosystem
Case study: Elliptic curve cryptography

9 Hours

UNIT III

Integrity, Authentication and Key Management:

Message Integrity, Hash functions : SHA, Digital signatures : Digital signature standards. Authentication : Entity Authentication: Biometrics, Key management Techniques.

Case study: Any two Biometric authentication techniques

9 Hours

UNIT IV

Network Security, Firewalls and Web Security

Introduction on Firewalls, Types of Firewalls, Firewall Configuration and Limitation of Firewall. IP Security Overview, IP security Architecture, authentication Header, Security payload, security associations, Key Management. Web security requirement, secure sockets layer, transport layer security, secure electronic transaction, dual signature

Case study: VoIP security

9 Hours

UNIT V

Wireless Network Security:

Security Attack issues specific to Wireless systems: Worm hole, Tunneling, DoS. WEP for Wi-Fi network, Security for 4G networks: Secure Ad hoc Network, Secure Sensor Network

Case study: Any two techniques for Ad hoc Network security

9 Hours

Reference Books:

1. Behrouz A. Fourcuzan ," Cryptography and Network security" Tata McGraw- Hill, 2008
2. William Stallings,"Cryptography and Network security: principles and practice",2nd Edition,Prentice Hall of India,New Delhi,2002
3. Atul Kahate ," Cryptography and Network security", 2nd Edition, Tata McGraw- Hill, 2008
4. R.K.Nichols and P.C. Lekkas ," Wireless Security",
5. H. Yang et al., Security in Mobile Ad Hoc Networks: Challenges and Solution, IEEE Wireless Communications, Feb. 2004.

Course Outcomes (COs):

1. Identify and describe different techniques in modern cryptography, in particular in private and public key cryptosystems [L2]
2. Analyze the techniques in the field of elliptic curve cryptography [L4].
3. Describe and motivate the fact that the implementation and development of modern communication technology requires security with reference to the data transmitted [L2].
4. Study the security issues related to internet and networks [L2].
5. Analyze the various techniques for securing the wireless networks [L4].

Program Outcomes (POs):

1. PO 1: Fundamentals of Engineering
Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.

2. PO 2: Design of Experiments
Graduates shall possess the ability to design and conduct experiments, analyse and interpret data.

3. PO 4: Engineering Cognizance
Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two tests out of three	**Average of two assignments/ activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks	30	10	10	50

Scheme of Semester End Examination (SEE):
1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

2. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. **(Kindly incorporate/mention the changes in the pattern of SEE question paper, if required, based on the content of course**)

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SEMESTER I
ELECTIVE A: AD-HOC NETWORKS

Subject Code:	16DCN15A3	**Credits:**	4
Course Type:	PE-A	**CIE Marks:**	50
Hours/week: L – T – P	4 – 0 – 0	**SEE Marks:**	50
Total Hours:	45	**SEE Duration:**	3 Hours

Course Learning Objectives (CLOs):

UNIT I

AD-HOC MAC:
Introduction , Issues in Ad-Hoc Wireless Networks. MAC Protocols – Issues, Classifications of MAC protocols, Multi-channel MAC & Power control MAC protocol.

9 Hours

UNIT II

AD-HOC NETWORK ROUTING & TCP:
Issues, Classifications of routing protocols – Hierarchical and Power aware. Multicast routing – Classifications, Tree based, Mesh based. Ad Hoc Transport Layer Issues. TCP Over Ad Hoc – Feedback based, TCP with explicit link, TCP-Bus, Ad Hoc TCP, and Split TCP.

9 Hours

UNIT III

WSN –MAC:
Introduction, Sensor Network Architecture, Data dissemination, Gathering. MAC Protocols – self-organizing, Hybrid TDMA/FDMA and CSMA based MAC.

9 Hours

UNIT IV

WSN ROUTING, LOCALIZATION & QOS Issues in WSN routing: OLSR, AODV. Localization, Indoor and Sensor Network, Localization. QoS in WSN.

9 Hours

UNIT V

MESH NETWORKS:

Necessity for Mesh Networks – MAC enhancements – IEEE 802.11s Architecture – Opportunistic routing – Self configuration and Auto configuration – Capacity Models – Fairness – Heterogeneous Mesh Networks – Vehicular Mesh Networks.

9 Hours

Program Outcomes (POs):

1. PO 1: Fundamentals of Engineering

Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.

2. PO 2: Design of Experiments

Graduates shall possess the ability to design and conduct experiments, analyse and interpret data.

3. PO 4: Engineering Cognizance

Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.

REFERENCES:

1. C.Siva Ram Murthy and B.Smanoj, " Ad Hoc Wireless Networks – Architectures and Protocols", Pearson Education, 2004.
2. Feng Zhao and Leonidas Guibas, "Wireless Sensor Networks", Morgan Kaufman Publishers, 2004.
3. C.K.Toh, "Ad Hoc Mobile Wireless Networks", Pearson Education, 2002.
4. Thomas Krag and Sebastin Buettrich, "Wireless Mesh Networking", O'Reilly Publishers, 2007.

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two tests out of three	**Average of two assignments/ activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks	30	10	10	50

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

2. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. **(Kindly incorporate/mention the changes in the pattern of SEE question paper, if required, based on the content of course**)

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SEMESTER I
ELECTIVE A: SOFT COMPUTING

Subject Code:	16DCN15A4	**Credits:**	4
Course Type:	PE-A	**CIE Marks:**	50
Hours/week: L – T – P	4 – 0 – 0	**SEE Marks:**	50
Total Hours:	45	**SEE Duration:**	3 Hours

Course Learning Objectives:

1. To introduce the ideas of fuzzy sets, fuzzy logic and use of heuristics based on human experience.
2. To become familiar with neural networks that can learn from available examples and generalize to form appropriate rules for inference systems.
3. To provide the mathematical background for carrying out the optimization associated with neural network learning.
4. To familiarize with genetic algorithms and other random search procedures useful while seeking global optimum in self-learning situations.

UNIT I

Introduction to Soft Computing: What is Soft Computing? Fuzzy Systems, Artificial Neural Networks, Evolutionary Search Strategies
Fuzzy Set Theory: Crisp Sets- A Review, Fuzzy Sets, Fuzzy Membership Functions, Operations on Fuzzy Sets, Fuzzy Relations, Fuzzy Extension Principle
Fuzzy Logic: Crisp Logic- A Review, Fuzzy Logic Basics, Fuzzy Truth in Terms of Fuzzy Sets, Fuzzy Rules, Fuzzy Reasoning

9 Hours

UNIT II

Fuzzy Inference Systems: Introduction, Fuzzification of the Input Variables, Application of Fuzzy, Operators on the Antecedent Parts of the Rules, Evaluation of the Fuzzy Rules, Aggregation of Output Fuzzy Sets Across the Rules, Defuzzification of the Resultant Aggregate Fuzzy Set, Fuzzy Controllers

9 Hours

UNIT III

Artificial Neural Networks: Basic Concepts- Introduction, Computation in Terms of Patterns, The McCulloch–Pitts Neural Model, The Perceptron, Neural Network Architectures, Activation Functions, Learning by Neural Nets

9 Hours

UNIT IV

Pattern Classifiers: Hebb Nets, Perceptrons, ADALINE, MADALINE
Pattern Associators: Hopfield Networks, Bidirectional Associative Memory
Competitive Neural Nets: Kohonen's Self-organizing Map (SOM), Learning Vector Quantization (LVQ), Adaptive Resonance Theory (ART)
Backpropagation: Multi-layer Feedforward Net, The Generalized Delta Rule, The Backpropagation Algorithm

9 Hours

UNIT V

Elementary Search Techniques: State Spaces, State Space Search, Exhaustive Search, Heuristic Search, Production Systems
Advanced Search Strategies: Natural Evolution- A Brief Review, Genetic Algorithms (GAs), Multi-objective Genetic Algorithms, Simulated Annealing

9 Hours

Text Book:

1. Samir Roy and Udit Chakraborty, "Introduction to Soft Computing- Neuro-Fuzzy and Genetic Algorithms", Pearson, 2013.

References:

1. J.S.R.Jang, C.T.Sun and E.Mizutani, “Neuro-Fuzzy and Soft Computing”, PHI, 2004, Pearson Education 2004.
2. Timothy J.Ross, “Fuzzy Logic with Engineering Applications”, McGraw-Hill, 1997.
3. Davis E.Goldberg, “Genetic Algorithms: Search, Optimization and Machine Learning”, Addison Wesley, N.Y., 1989.
4. S. Rajasekaran and G.A.V.Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithms”, PHI, 2003.
5. R.Eberhart, P.Simpson, and R.Dobbins, “Computational Intelligence - PC Tools”, AP Professional, Boston, 1996.

Course Outcomes:

1. Identify and describe soft computing techniques and their roles in building intelligent machines [L2]
2. Recognize the feasibility of applying a soft computing methodology for a particular problem [L2]
3. Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems [L5]
4. Apply neural networks to pattern classification and other engineering problems [L5]
5. Apply genetic algorithms to combinatorial optimization problems [L5]
6. Effectively use existing software tools to solve real problems using a soft computing approach [L2]
7. Evaluate and compare solutions by various soft computing approaches for a given problem [L4]

Program Outcomes (POs):

1. PO 1: Fundamentals of Engineering
Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.

2. PO 3: Social Engineering
Graduates shall possess the ability to identify societal problems and meaningfully contribute with optimal solutions.

3. PO 5: Modern tool Usage
Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.

4. PO 11: Research and Innovation
Graduates shall have the ability to pursue research and provide innovative solutions.

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two tests out of three	**Average of two assignments/ activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks	30	10	10	50

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

2. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. **(Kindly incorporate/mention the changes in the pattern of SEE question paper, if required, based on the content of course**)

SEMESTER I

LAB-1: ADVANCED COMMUNICATION LAB

Subject Code:	16DCN16L	**Credits:**	2
Course Type:	PC – L	**CIE Marks:**	25
Hours/week: L – T – P	0 – 0 - 2	**SEE Marks:**	25
Total Hours:	3	**SEE Duration:**	3 Hours

List of Experiments:

1. Write a MATLAB program to produce randomly generated number that follows Bernoulli distribution for an arbitrary parameter
2. Write a MATLAB program to generate a large number of samples from a Gaussian distribution with mean = 20 & variance = 4
3. Write a MATLAB program to simulate M/M/1 queuing system
4. Generate the eye pattern and study ISI
5. Experiment on Cyclic codes
6. Experiment on Hamming code
7. Study of OFDM
8. Simulate simple circuits comprised of lumped components and transmission lines using Advanced Design System.
9. Calibrate a network analyzer and measure its S- parameters.
10. Build a microwave amplifier and deduce its Frequency, Gain and Noise. Further, simulate non-linear response of an amplifier under multitone excitations.

SEMESTER II
CLOUD COMPUTING

Subject Code:	16DCN21	**Credits:**	4
Course Type:	PC	**CIE Marks:**	50
Hours/week: L – T – P	4 – 0 – 0	**SEE Marks:**	50
Total Hours:	45	**SEE Duration:**	3 Hours

Course Learning Objectives:

1. To learn how to use Cloud Services.
2. To implement Virtualization
3. To implement Task Scheduling algorithms.
4. Apply Map-Reduce concept to applications.
5. To build Private Cloud.

UNIT I

Introduction, Cloud Infrastructure:

Cloud computing, Cloud computing delivery models and services, Ethical issues, Cloud vulnerabilities, Cloud computing at Amazon, Cloud computing the Google perspective, Microsoft Windows Azure and online services, Open-source software platforms for private clouds, Cloud storage diversity and vendor lock-in, Energy use and ecological impact, Service level agreements, User experience and software licensing. Exercises and problems.

9 Hours

UNIT II

Cloud Computing: Application Paradigms:

Challenges of cloud computing, Architectural styles of cloud computing, Workflows: Coordination of multiple activities, Coordination based on a state machine model: The Zookeeper, The Map Reduce programming model, A case study: The GrepTheWeb application , Cloud for science and engineering, High-performance computing on a cloud, Cloud computing for Biology research, Social computing, digital content and cloud computing.

9 Hours

UNIT III

Cloud Resource Virtualization:

Virtualization, Layering and virtualization, Virtual machine monitors, Virtual Machines, Performance and Security Isolation, Full virtualization and paravirtualization, Hardware support for virtualization, Case Study: Xen a VMM based paravirtualization, Optimization of network virtualization, vBlades, Performance comparison of virtual machines, The dark side of virtualization, Exercises and problems.

9 Hours

UNIT IV

Cloud Resource Management and Scheduling:

Policies and mechanisms for resource management, Application of control theory to task scheduling on a cloud, Stability of a two-level resource allocation architecture, Feedback control based on dynamic thresholds, Coordination of specialized autonomic performance managers, A utility-based model for cloud-based Web services, Resourcing bundling: Combinatorial auctions for cloud resources, Scheduling algorithms for computing clouds, Fair queuing, Start-time fair queuing, Borrowed virtual time, Cloud scheduling subject to deadlines, Scheduling Map Reduce applications subject to deadlines, Resource management and dynamic scaling, Exercises and problems.

9 Hours

UNIT V

Cloud Security, Cloud Application Development:

Cloud security risks, Security: The top concern for cloud users, Privacy and privacy impact assessment, Trust, Operating system security, Virtual machine Security, Security of virtualization, Security risks posed by shared images, Security risks posed by a management OS, A trusted virtual machine monitor, Amazon web services: EC2 instances, Connecting clients to cloud instances through firewalls, Security rules for application and transport layer protocols in EC2, How to launch an EC2 Linux instance and connect to it, How to use S3 in java, Cloud-based simulation of a distributed trust algorithm, A trust management service, A cloud service for adaptive data streaming, Cloud based optimal FPGA synthesis. Exercises and problems.

9 Hours

Course Outcomes:

The students will be able to:

1. Demonstrate and experiment simple Cloud Applications -Apply resource allocation, scheduling algorithms.
2. Implement Map-Reduce concept.
3. Create virtual machines from available physical resources.
4. Setup a private cloud.
5. Familiarize with Open Stack.

Text Book:

1. Dan C Marinescu: Cloud Computing Theory and Practice. Elsevier (MK) 2013.

References:

1. Rajkumar Buyya, James Broberg, Andrzej Goscinski: Cloud Computing Principles and Paradigms, Willey 2014.
2. John W Rittinghouse, James F Ransome:Cloud Computing Implementation, Management and Security, CRC Press 2013.

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two tests out of three	**Average of two assignments/ activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks	30	10	10	50

Scheme of Semester End Examination (SEE):
1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

2. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. **(Kindly incorporate/mention the changes in the pattern of SEE question paper, if required, based on the content of course**)

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SEMESTER II
HIGH SPEED SWITCHING NETWORKS

Subject Code:	16DCN22	**Credits:**	4
Course Type:	PC	**CIE Marks:**	50
Hours/week: L – T – P	4 – 0 – 0	**SEE Marks:**	50
Total Hours:	45	**SEE Duration:**	3 Hours

Course Learning Objectives (CLOs):

1. Understand the basics of high speed networks.
2. Enable students to know techniques involved in traffic and congestion control.
3. Understand the different QOS

Detailed Syllabus:

UNIT I

High Speed Networks:
Frame Relay Networks – Asynchronous transfer mode – ATM Protocol Architecture, ATM logical Connection, ATM Cell – ATM Service Categories – AAL, High Speed LANs: Fast Ethernet, Gigabit Ethernet, Fiber Channel – Wireless LANs: applications, requirements – Architecture of 802.11

9 Hours

UNIT II

Congestion And Traffic Management:
Queuing Analysis- Queuing Models – Single Server Queues – Effects of Congestion – Congestion Control – Traffic Management – Congestion Control in Packet Switching, Networks – Frame Relay Congestion Control

9 Hours

UNIT III

TCP and ATM Congestion Control:

TCP Flow control – TCP Congestion Control – Retransmission – Timer Management – Exponential RTO backoff – KARN's Algorithm – Window management – Performance of TCP over ATM. Traffic and Congestion control in ATM – Requirements – Attributes – Traffic Management Frame work, Traffic Control – ABR traffic Management – ABR rate control, RM cell formats, ABR Capacity allocations – GFR traffic management

9 Hours

UNIT IV

Integrated And Differentiated Services:

Integrated Services Architecture – Approach, Components, Services- Queuing Discipline, FQ, PS, BRFQ, GPS, WFQ – Random Early Detection, Differentiated Services

. **9 Hours**

UNIT V

Protocols for QoS Support:

RSVP – Goals & Characteristics, Data Flow, RSVP operations, Protocol Mechanisms – Multiprotocol Label Switching – Operations, Label Stacking, Protocol details – RTP – Protocol Architecture, Data Transfer Protocol, RTCP.

9 Hours

Text Books

1. William Stallings, "HIGH SPEED NETWORKS AND INTERNET", Pearson Education, Second Edition, 2002

References:

1. Warland, Pravin Varaiya, "High performance communication networks", Second Edition , Jean Harcourt Asia Pvt. Ltd., , 2001.
2. Irvan Pepelnjk, Jim Guichard, Jeff Apcar, "MPLS and VPN architecture",Cisco Press, Volume 1 and 2, 2003.
3. Abhijit S. Pandya, Ercan Sea, "ATM Technology for Broad Band Telecommunication Networks", CRC Press, New York, 2004.

Course Outcomes:

1. Explain, describe, and understand the notion of a high speed network [L2].
2. Characterize queuing models [L4].
3. Discuss the principles of congestion control [L2].
4. Discuss protocols for QOS support [L2].

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two tests out of three	**Average of two assignments/ activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks	30	10	10	50

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

2. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. **(Kindly incorporate/mention the changes in the pattern of SEE question paper, if required, based on the content of course**)

SEMESTER II
SENSOR NETWORKS

Subject Code:	16DCN23	**Credits:**	4
Course Type:	PC	**CIE Marks:**	50
Hours/week: L – T – P	4 – 0 – 0	**SEE Marks:**	50
Total Hours:	45	**SEE Duration:**	3 Hours

Course learning objectives (CLOs):

1. To prepare for the challenges in Networking tools.
2. To understand the concept of Architecture and Operating systems.
3. To analyze the concept of physical layer and protocols.
4. To understand Energy Efficient Routing and Geographic Routing.

UNIT I

OVERVIEW OF WIRELESS SENSOR NETWORKS:
Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks**.**

9 Hours

UNIT II

ARCHITECTURES:
Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes , Operating Systems and Execution Environments, Network Architecture -Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts.

9 Hours

UNIT III

NETWORKING SENSORS
Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC , The Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols-Energy-Efficient Routing, Geographic Routing.

9 Hours

UNIT IV

INFRASTRUCTURE ESTABLISHMENT:
Topology Control , Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control.

9 Hours

UNIT V

SENSOR NETWORK PLATFORMS AND TOOLS:
Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators, State-centric programming.

9 Hours

Energy Aware System Design

This is a post graduate-level, research-oriented course. In addition to attending lectures, you will be expected to read papers, make presentations or reviews on them and come up with critiques to current solutions or new solutions to open problems. A lot of emphasis will be placed on class discussions, interaction and Q&A sessions during paper survey presentations. Several thrusts will be addressed during the entire semester and will be available for further study within projects:

- Circuit, gate and register-transfer level power modeling and optimization
- Microarchitecture-driven power modeling and management
- Compiler-driven power management and software power analysis
- OS-driven power management
- System-level power modeling and management, including multi-core and SoC systems

Special topics:

- Energy awareness and uncertainty in design • Partially asynchronous systems
- Ambient Intelligent Systems

Sample Abstract

Energy Aware System Design

Modern design of wireless devices requires the designers to have a special focus on power consumption to prolong the battery life of the final system. The designer therefore needs power consumption information very early in the process to be able to decide on system parameters, design methods, communication protocols, functionality restrictions. Typically, this is done by running simulations of the system to be developed and performing design space exploration. However, there is a tradeoff between speed and accuracy of simulation, therefore the designer has to be aware of available tools and simulation methods he can choose from to achieve the best possible solution for his case.

Course Outcomes:

After completing this course the students should be able to:

1. Demonstrate familiarity with common wireless sensor node architectures.
2. Be able to carry out simple analysis and planning of WSN.
3. Demonstrate knowledge of MAC protocols developed for WSN.
4. Demonstrate knowledge of routing protocols developed for WSN.
5. Demonstrate familiarity with mobile data-centric networking principles.
6. Demonstrate familiarity with WSN standards.

Text Books:

1. Holger Karl & Andreas Willig, " Protocols And Architectures for Wireless Sensor Networks" , John Wiley, 2005.
2. Feng Zhao & Leonidas J. Guibas, “Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.

References:

1. Kazem Sohraby, Daniel Minoli, & Taieb Znati, “Wireless Sensor Networks-
Technology, Protocols, And Applications”, John Wiley, 2007.
2. Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003.

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two tests out of three	**Average of two assignments/ activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks	30	10	10	50

Scheme of Semester End Examination (SEE):
1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

2. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. **(Kindly incorporate/mention the changes in the pattern of SEE question paper, if required, based on the content of course**)

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SEMESTER II
ADVANCED WIRELESS COMMUNICATION

Subject Code:	16DCN24	**Credits:**	4
Course Type:	PC	**CIE Marks:**	50
Hours/week: L – T – P	4 – 0 –0	**SEE Marks:**	50
Total Hours:	45	**SEE Duration:**	3 Hours

Course Learning Objectives (CLOs):

1. To introduce the basic concepts of wireless communication and wireless devices.
2. To familiarize the effects of interference and to analyze traffic for wireless communication;.
3. To wireless fading channel modeling and characterization.
4. Introduction to modulation and detection schemes and their performance over fading channels.

Detailed Syllabus:

UNIT I

Wireless Transmission:
Frequencies for Radio transmission, signals, Antennas, Signal propagation, Multiplexing, Modulation [Ref.1, Ch.2].
Technical Challenges of Wireless Communications: Multipath propagation, Spectrum limitations, Limited energy, User mobility [Ref.2, Ch.2]

9 Hours

UNIT II

The Wireless Channel:
Physical Modeling for Wireless Channels, Input and Output model of the wireless channel, Time and frequency coherence , statistical models [Ref.3, Ch.2].

9 Hours

UNIT III

Point –to – point Communication:-detection, and diversity: Detection of Rayleigh fading Channel [Ref.3, Ch.3].

Diversity: Introduction**,** Micro-diversity, Macro-diversity and simulcast, Combination of signals, transmit diversity [Ref.2, Ch.13]. Time Diversity, Antenna diversity, Frequency diversity, Other diversity scenarios [Ref.3, Ch.3].

9 Hours

UNIT IV

Capacity of wireless channels: AWGN channel capacity, Resources of the AWGN Channel, LTI Gaussian Channels, Capacity of fading Channels [Ref. 3, Ch.5]. Multiple Input- Multiple Output systems, Advantages and applications of MIMO, MIMO applications in 3G [Ref. 2, Ch. 20.2, Ref. 4, Ch.5].

9 Hours

UNIT V

MIMO I :- Spatial multiplexing and Channel modeling:

Multiplexing capacity of deterministic MIMO channels, Physical modeling of MIMO channels, Modeling of MIMO fading channels, The V-Blast architecture, Fast fading MIMO channel, Receiver architectures, Slow fading MIMO channel, D-Blast : an outage optimum architecture [Ref. 3, Ch.7 and Ch.8]
Smart antennas, Multiuser MIMO [Ref.2 Ch.20.1&20.3]

9 Hours

Text Books:

1. Jochen Schiller, “Mobile communications”, Second Edition, Pearson Education,Inc,2011
2. Andreas Molisch, “Wireless Communications”, Second Edition, john Wiley & Sons, Ltd. 2013
3. David Tse & P. Vishwanath, “Fundamentals of Wireless Communication”, Cambridge University Press, 2010.
4. William C Y Lee, “Mobile Communications Engineering Theory and applications”, Tata McGraw Hill, 2008.

Course Outcomes (COs):

Having successfully completed this course, students should be able to:

1. Understand the basic concepts and challenges of wireless communication such as radio frequencies, multipath propagation, wireless devices including multiplexing, modulation, and demodulation techniques [L1].
2. Describe current and future wireless communication systems [L2].
3. Analyze the propagation effects such as fading, time delay spread, and Doppler spread, and describe how to measure and model the impact that signal bandwidth and motion have on the instantaneous received signal through the multipath channel [L4].
4. Describe the types of modeling methods of a wireless channel under different propagation effects [L2].
5. Understand the information theoretical aspects (such as the capacity and resources) of wireless channels [L1].
6. Describe and evaluate receiver and transmitter diversity techniques [L2].
7. Interpret the knowledge and awareness of the basic spread spectrum techniques in wireless system [L1].

8. Understand the concept of orthogonal frequency division modulation techniques [L1].

Course Outcomes (COs):

1. PO 1: Fundamentals of Engineering

Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.

2. PO 2: Design of Experiments
Graduates shall possess the ability to design and conduct experiments, analyse and interpret data.

3. PO 4: Engineering Cognizance
Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.

4. PO 9: Soft skills
Graduates shall possess proficiency in oral and written communication skills.

5. PO 12: Self-motivated Learning
Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.
Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two tests out of three	**Average of two assignments/ activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks	30	10	10	50

Scheme of Semester End Examination (SEE):
1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

2. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. **(Kindly incorporate/mention the changes in the pattern of SEE question paper, if required, based on the content of course**)

SEMESTER II

Elective B: ADVANCED COMMUNICATION NETWORKS

Subject Code:	16DCN25B1	**Credits:**	4
Course Type:	PE-B	**CIE Marks:**	50
Hours/week: L – T – P	4 – 0 – 0	**SEE Marks:**	50
Total Hours:	45	**SEE Duration:**	3 Hours

Course learning objectives (CLOs):

1. To learn the architecture of high performance networks.
2. To study mathematical models related to network performance analysis.
3. To focus on current and emerging networking technologies.

UNIT I

Introduction: Overview of Communication Networks: Telephone networks, Computer networks, Cable television networks, Wireless networks - networking principles - digitalization - network externalities - service integration; Network Services and Layered Architecture: Traffic characterization and QoS - network services - network elements - network mechanisms - layered architecture - network bottlenecks

9 Hours

UNIT II

Broadband Networks: Introduction: Multihop wireless broadband networks, Mesh networks - MANET importance of routing protocols - classification of routing protocols in MANET - routing metrics - packet scheduling algorithms - admission control mechanism.

9 Hours

UNIT III

Internet and TCP / IP Networks: Internet: Internet protocol - technology trends in IP networks - IP packet communications in mobile communication networks; TCP and UDP - Internet success and limitation - performance of TCP/ IP networks; Circuits Switched Networks: SONET - DWDM - fiber to home - DSL - intelligent network (IN) scheme - comparison with conventional systems - merits of the IN scheme - CATV and layered network - services over CATV.

9 Hours

UNIT IV

ATM Networks: Introduction: ATM reference model - addressing - signaling - routing- ATM Adaptation Layer (AAL) - traffic classes - traffic management and quality of service - traffic descriptor - traffic shaping - management and control - traffic and congestion control - network status monitoring and control - user/ network signaling - internetworking with ATM - IP over ATM - multiprotocol over ATM.

9 Hours

UNIT V

High Performance Networks: Introduction: WiMAX overview - competing technologies - overview of the physical layer - PMP mode - mesh mode - multihop relay mode; Introduction: UWB overview - time hopping UWB - direct sequence UWB - multiband UWB; Introduction: LTE and LTE– A overview - system model - specifications - frame structure - comparison with broadband technologies.

9 Hours

Course Outcomes (COs):

The student will be able to /have developed the various topologies; services offered by broadband, TCP/ IP, ATM, WiMAX and UWB networks [L3, L4], .

Program Outcomes (COs):

1. PO 1: Fundamentals of Engineering

Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.

2. PO 4: Engineering Cognizance

Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.

3. PO 6: Impact of Engineering

Graduates shall be able to understand the impact of engineering solutions in a global, economic, environmental and societal context.

4. PO 12: Self-motivated Learning

Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.

Text books:

1. Jean Warland and Pravin Varaiya, “High Performance Communication Networks”, 2nd Edition, Harcourt and Morgan Kanffman Publishers, London, 2008.
2. Leon Gracia and Widjaja, “Communication Networks”, Tata McGraw Hill, 2008.
3. Lumit Kasera and Pankaj Sethi, “ATM Networks: Concepts and Protocols”, Tata McGraw Hill, 2007.
4. Jeffrey G. Andrews, Arunabha Ghosh and Rias Muhamed, “Fundamentals of WiMAX Understanding Broadband Wireless Networking”, Prentice Hall of India, 2008.
5. Amitabha Ghosh and Rapeepat Ratasuk, “Essentials of LTE and LTE-A”, Cambridge University, 2011.
6. David Tung Chong Wong, Peng-Yong Kong, Ying-Chang Liang, Kee Chaing

Hyperlinks:

1. http:// www.ece.gmu.edu/.../high performance communication networks_1.pdf
2. http://www.cs.cmu.edu/~prs/wirelessS12.html
3. http://www.amazon.com/dp/1558605746/ref=rdr_ext_tmb

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two tests out of three	**Average of two assignments/ activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks	30	10	10	50

Scheme of Semester End Examination (SEE):
1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

2. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. **(Kindly incorporate/mention the changes in the pattern of SEE question paper, if required, based on the content of course**)

SEMESTER II
Elective B: OPTICAL NETWORKS

Subject Code:	16DCN25B2	**Credits:**	4
Course Type:	PE-B	**CIE Marks:**	50
Hours/week: L – T – P	4 – 0 – 0	**SEE Marks:**	50
Total Hours:	45	**SEE Duration:**	3 Hours

Course Learning Objectives:

1. To learn the basic elements of optical fiber transmission link, fiber modes configurations and structures
2. To understand the different kind of losses, signal distortion in optical wave guides and other signal degradation factors .
3. To learn the various optical source materials, LED structures, quantum efficiency, Laser diodes
4. To learn the fiber optical receivers such as PIN APD diodes, noise performance in photo detector, receiver peration and configuration.
5. To learn the fiber optical network components, variety of networking aspects, FDDI, SONET/SDH and operational principles of WDM.
6. To acquire knowledge about fault and congestion management.

UNIT I

Client Layers of the Optical Layer: SONET/SDH: Multiplexing, CAT and LCAS, Sonnet/SDH Layers, SONET Frame Structure, SONET/SDH Physical Layer, Elements of a SONET/SDH Infrastructure, Optical Transport Network: Hierarchy, Frame Structure, Multiplexing, Generic Framing Procedure Ethernet: Frame Structure, Switches, Ethernet Physical Layer, Carrier Transport IP: Routing and Forwarding, Quality of Service.
Multiprotocol Label Switching: Labels and Forwarding, Quality of Service, Signaling and Routing, Carrier Transport, Resilient Packet Ring: Quality of Service, Node Structure, Fairness Storage-Area Networks: Fiber Channel.

9 Hours

UNIT II

WDM Network Elements: Optical Line Terminals, Optical Line Amplifiers, Optical Add/Drop Multiplexers: OADM Architectures, Reconfigurable OADMs Optical Cross connects: All-Optical OXC Configurations.

9 Hours

UNIT III

Control and Management Network Management Functions: Management Framework, Information Model, Management Protocols. Optical Layer Services and Interfacing, Layers within the Optical Layer, Multivendor Interoperability.

Performance and Fault Management: The Impact of Transparency, BER measurement, Optical Trace, Alarm Management, Data Communication Network (DCN) and Signaling, Policing, Optical Layer Overhead, Client Layers.

Configuration Management: Equipment Management, Connection Management, Adaptation Management. Optical Safety: Open Fiber Control Protocol.

9 Hours

UNIT IV

Protection in SONET/SDH: Point-to-Point Links, Self-Healing Rings, Unidirectional Line-Switched Rings, Bidirectional Line-Switched Rings, Ring Interconnection and Dual Homing. Protection in the Client Layer: Protection in Resilient Packet Rings, Protection in Ethernet, Protection in IP, Protection in MPLS, Why Optical Layer Protection: Service Classes Based on Protection. Optical Layer Protection Schemes: 1+1 OMS Protection, 1:1 OMS Protection, OMS-DPRing, OMS-SPRing, 1:N Transponder

Protection, 1+1 OCh Dedicated Protection, OCh-SPRing, OCH-Mesh Protection, GMPLS Protection, Interworking between Layers.

9 Hours

UNIT V

WDM Network Design: Cost Trade-OFFS: A Detailed Ring Network Example LTD and RWA Problems, Light path Topology Design, Routing and Wavelength Assignment, Wavelength Conversion. Dimensioning Wavelength- Routing Networks, Statistical Dimensioning Models: First-Passage Model, Blocking Model, Maximum Load Dimensioning Models: Offline Light path Requests, Online RWA in Rings

9 Hours

Course Outcomes:

At the end of the course the student will be able to:

1. Design a system, component or process as per needs and specification.
2. Gain knowledge on optical network architectures ranging from optical access networks to backbone optical transport networks.
3. Gain the knowledge on methodologies of optical network design optimization;
4. Explore techniques of optical network survivability.
5. Solve the Problems in the discipline of optical networks.

Text Books:

1. Optical Networks by Rajeev Ramaswamy, Kumar N Sivarajan, Galen H Sasaki, Elsevier Publication 3rd Edition, 2009.

References:

1. Uyless Black, Optical Networks-Third generation transport system: Pearson 2013.

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two tests out of three	**Average of two assignments/ activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks	30	10	10	50

Scheme of Semester End Examination (SEE):
1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

2. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. **(Kindly incorporate/mention the changes in the pattern of SEE question paper, if required, based on the content of course**)

SEMESTER II
ELECTIVE B: CONNECTED DEVICES

Subject Code:	15DCN25B3	**Credits:**	4
Course Type:	PE – B	**CIE Marks:**	50
Hours/week: L – T – P	4 – 0 – 0	**SEE Marks:**	50
Total Hours:	45	**SEE Duration:**	3 Hours

Course learning objectives (CLOs):

1. To introduce to basic design aspects of IoT.
2. To abreast with recent developments in Internet of Things.
3. To apply the concepts of IoT using several case study examples.

UNIT I

Introduction to Internet of Things: Physical design of IoT, Logical design of IoT, IoT Enabling Technologies, IoT levels and deployment templates.

9 Hours

UNIT II

Domain Specific IoT's: Home automation , Cities, Environment, Energy, Retail, Logistics, Agriculture Industries, Health and Lifestyle

9 Hours

UNIT III

IoT and Machine to Machine(M2M): Introduction, M2M, difference between IoT and M2M

9 Hours

UNIT IV

IoT Platforms design methodology: Introduction, IoT Design Methodolgy, IoT systems Logical Design , Case study using Python

9 Hours

UNIT V

Data analytics for IoT: Introduction, Apache Hadoop, Using Hadoop for data analytics, Tools for IoT, Case Study.

9 Hours

Reference Books:

1. Internet of Things: A Hands-On Approach, by Arsheep Bahga, Vijay Madisetti, 2015 edition

Course Outcomes (COs):

1. Build a couple of applications that will communicate with iot hardware and software [L6]
2. Perform research a specific iot domain and provided insight on current work [L5]
3. Explain how IOT, cloud computing and big data analytics can work together [L5]

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two tests out of three	**Average of two assignments/ activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks	30	10	10	50

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

2. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. **(Kindly incorporate/mention the changes in the pattern of SEE question paper, if required, based on the content of course**)

SEMESTER II
ELECTIVE B: REMOTE SENSING AND GIS

Subject Code:	16DCN25B4	**Credits:**	4
Course Type:	PE-B	**CIE Marks:**	50
Hours/week: L – T – P	4 – 0 – 0	**SEE Marks:**	50
Total Hours:	50	**SEE Duration:**	3 Hours

Course Objectives:

1. To understand the Remote Sensing and GIS
2. To be aware of the classification and identification data using RS and GIS tools
3. To build application of GIS

UNIT I

Electromagnetic Radiation Theory and Spectral Signatures: Introduction and Basic Concepts of Remote Sensing Systems, The Digital Image

9 Hours

UNIT II

Radiometric Preprocessing and Atmospheric Correction: Geometric Image Correction, Spectral Image Enhancement - Operations in Spatial and Frequency Domain

9 Hours

UNIT III

I**mage Classification** – Supervised and Unsupervised Classification, Accuracy Assessment, Artificial Intelligence, Object Oriented Classification

9 Hours

UNIT IV

Multispectral, Hyperspectral Image Analysis and application in remote sensing

9 Hours

UNIT V

Geographic Information Systems (GIS), Integration of Remote Sensing and Geographic Information Systems (GIS)
Urban Landscape Characterization and Analysis, Urban Feature Extraction, Applications of GIS

9 Hours

10hr

Course Outcomes:

The students will be able to:

1. Apply the design and development principles of Remote sensing and GIS [L5].
2. Design and implement application of RS and GIS in real time [L6]
3. Demonstrate the understanding of need for distributed systems and their applications [L6]

Text Books:

1. Jensen, John R., 2007, *Remote Sensing of the Environment: An Earth Resource Perspective*, 2nd Ed, Prentice Hall
2. Paul M. Mather, Computer Processing of Remotely-Sensed Images: An Introduction, Wiley; 3 edition ISBN-13: 978-0470849194
3. John R Jensen, **Introductory Digital Image processing (3rd Edition),** Prentice Hall; 2004
4. Qihao Weng, Remote Sensing and GIS Integration Theories, Methods, and Applications; The McGraw-Hill , ISBN: 978-0-07-160654-7.

Reference Books:

1. Gary L. Prost, G. L. Prost, Remote Sensing for Geoscientists: Image Analysis and Integration, Third Edition, Taylor & Francis, 2013
2. John A. Richards · Xiuping Jia, Remote Sensing Digital Image Analysis An Introduction 4th Edition Springer, 2005
3. Chen Ch, Signal and Image Processing For Remote Sensing Taylor & Francis, 2006
4. Liu, Essential Image Processing and GIS For Remote Sensing, John Wiley & Sons, 2009

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two tests out of three	**Average of two assignments/ activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks	30	10	10	50

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

2. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. **(Kindly incorporate/mention the changes in the pattern of SEE question paper, if required, based on the content of course**)

SEMESTER II

LAB 2: NETWORKS & PROGRAMMING LAB

Subject Code:	16DCN26L	**Credits:**	2
Course Type:	PC – L	**CIE Marks:**	25
Hours/week: L – T – P	0 – 0 – 2	**SEE Marks:**	25
Total Hours:	3	**SEE Duration:**	3 Hours

Design oriented experiments to be set for the subjects:

1. Cloud Computing
2. High Speed Switching Networks
3. Sensor Networks
4. Advanced Wireless Communication

SEMESTER III
LONG TERM EVOLUTION

Subject Code:	16DCN31	**Credits:**	4
Course Type:	PC	**CIE Marks:**	50
Hours/week: L – T – P	4 – 0 – 0	**SEE Marks:**	50
Total Hours:	45	**SEE Duration:**	3 Hours

Course Learning Objectives (CLOs):

1. To provide a broad and comprehensive perspective on the evolution to next generation wireless networks.
2. To examine 3G and 4G wireless standards along with resource management and quality of service (QoS) in these networks.
3. To examine the architecture of LTE interface.
4. To identify key enabling technologies for wireless network evolution.

Detailed Syllabus:

UNIT I

Introduction: Architectural Review UMTs and GSM, History of Mobile telecommunication systems, The need for LTE, From UMTs to LTE, From LTE-to –LTE-Advanced, The 3GPP specifications for LTE.
System Architecture Evolution: High level architecture of LTE, User Equipment, Evolved UMTs terrestrial radio access network, Evolved packet core, Communication protocols, signaling flows-Examples, Bearer management, state diagrams, spectrum allocation.

9 Hours

UNIT II

The Wireless Channel:
Digital wireless communications: Radio Transmission and Reception, Radio Transmission in Mobile Cellular network, Impairments to the received signal, Error management.
Orthogonal Frequency Division Multiple Access (OFDMA): Principles, Benefits and additional features, Single carrier Frequency division multiple access.
.

9 Hours

UNIT III

Multiple Antenna Techniques: Diversity processing, Spatial Multiplexing, Beam forming, Downlink Multiple User MIMO- revisited.

Architecture of the LTE Air- Interface: Air interface protocol stack, Logical, transport, and physical Channels, the resource grid, Multiple antenna transmission, Resource element mapping.
Cell Acquisition: Acquisition Procedure, Synchronization Levels, Downlink Reference signals, Physical broadcast channel, Physical control format indicator Channel, System information, procedures after acquisition.

9 Hours

UNIT IV

Data Transmission and Reception: Data Transmission procedures, Transmission of Scheduling messages on the PDCCH, Data Transmission on the PDSCH and PUSCH, Transmission of Hybrid ARQ indicators on the PHICH, uplink control information, Transmission of uplink control information on the PUCCH, Uplink Reference signals, power control, Discontinuous reception.
Random Access: Transmission of random access preambles on the PRACH, Non-contention Based procedure, Contention Based Procedure.

9 Hours

UNIT V

Air interface layer-2: Medium Access control protocol, Radio link control protocol, Packet data Convergence Protocol.
Power-on and Power-off procedures: Power on sequence, network and cell selection, RRC connection establishment, Attach procedure, detach procedure.
Security Procedures: Network access security, Network domain security.
Mobility management: Transition between mobility management states, cell reselection in RRC_IDLE, Measurements in RRC_CONNECTED, Handover in RRC_CONNECTED.

9 Hours

Text Books:

1. An Introduction to LTE, Christopher Cox, Second Ed. John Wiley & sons Ltd. 2014.
2. Fundamentals of LTE, Arunabha Ghosh, Juh Jhang, Jeffery G. Andrews, Rias Muhamed , Pearson, 2010

Reference Books:

1. LTE: The UMTs Long Term Evolution, Stefania sesia, Issam Toufik,Matthew Baker, 2nd Edition, John Wiley & Sons Ltd. 2011.
2. 4G LTE/LTE Advanced for Mobile Broadband, Erik Dahlman, Stefan Parkvall, Johan skold, 2nd Edition, Academic Press, Elsivier Ltd. 2014.
3. Advanced wireless networks, 4G Technologies, Savo G. Glisic, John Wiley & sons Ltd.

Course Outcomes (COs):

1. Understand LTE Network Architecture and Protocols [L1]
2. Understand the importance of QoS and resource management in next generation wireless networks [L2]
3. Describe and compare the network and protocol architectures of GPRS and EDGE and the two principle 3G cellular based wireless standards: UMTS and cdma2000 [L2]
4. List and provide a high-level discussion on the key enabling technologies for next generation wireless networks [L3]
5. Identify the relationship between WiFi, WiMAX, and 3G cellular-based wireless networks. In addition, the student will be able to outline and discuss the potential impact of these technologies upon wireless network evolution [L3]

Program Outcomes (POs) of the course:

1. PO 4: Engineering Cognizance

Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.

2. PO 11: Research and Innovation

Graduates shall have the ability to pursue research and provide innovative solutions.

3. PO 12: Self-motivated Learning

Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two tests out of three	**Average of two assignments/ activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks	30	10	10	50

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

2. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. **(Kindly incorporate/mention the changes in the pattern of SEE question paper, if required, based on the content of course**)

SEMESTER III
ELECTIVE C: STATISTICAL SIGNAL PROCESSING

Subject Code:	16DCN32C1	**Credits:**	4
Course Type:	PE – C	**CIE Marks:**	50
Hours/week: L – T – P	4 – 0 – 0	**SEE Marks:**	50
Total Hours:	45	**SEE Duration:**	3 Hours

Course Learning Objectives (CLOs):

1. Explain the Filtering of Random processes at the receiver end of a communication system.
2. Model any given signal using various signal modeling techniques and justify which method is the best.
3. Design optimum FIR & IIR Wiener Filters, Discrete Kalman Filters theoretically and practically using MATLAB.
4. Estimate the various spectral components present in the received signal using various spectral estimation methods like Parametric and Nonparametric.
5. Design and Implement an optimum filter that gets adapted to various changes using various LMS and Recursive methods

Detailed Syllabus:

UNIT I

Digital Filter design using least-square method: Least Square error criterion in the design of Pole-zero filters, FIR least squares inverse filters.

9 Hours

UNIT II

Spectral Estimation and Analysis - Non parametric methods: Periodogram, Bartlett and Welch modified periodogram, Blackman-Tukey Methods

9 Hours

UNIT III

Spectral estimation and analysis - Parametric methods: wide sense stationary random process, rational power spectra: Auto Regressive (AR) Process, Moving Average (MA) Process, ARMA Process, Relationship between the Filter Parameters and the auto correlation sequence.

9 Hours

UNIT IV

Forward and backward Linear Prediction: Forward Linear Prediction, Backward Linear Prediction, Relationship of an AR process to Linear Prediction: Yule–Walker Method, Levinson–Durbin Algorithm

9 Hours

UNIT V

Wiener Filters for Filtering and Prediction: FIR wiener filter, Orthogonality principle in the Linear Mean-square error (MSE) estimation, IIR Wiener Filter.
Adaptive Algorithms to adjust coefficients of digital filters: Least Mean Square (LMS), Recursive Least Square (RLS) and Kalman Filter Algorithms

9 Hours

Text Books:

1. Proakis, John G., Dimitris G. Manolakis, and D. Sharma, "Digital Signal Processing, Principles, Algorithms, and Applications", Pearson Education, 2006.
2. Vinay K. Ingle and John G. Proakis, "Digital Signal Processing Using MATLAB", Brooks/Cole/Thomson Learning, 2001.
3. Emmanuel C. Lfeachor, Barrie W Jervis, "Digital Signal processing: A Practical Approach", Pearson education, 2002.
4. Mitra Sanjit.K, "Digital Signal Processing: A computer Based approach", Tata McGraw-Hill, 2001.

References:

1. Simon Haykin: Adaptive Filter Theory ,Pearson Education, 2002.
2. B. Widrow & S Stearns, "Adaptive Signal Processing", PHI, 1985.
3. Dimitris, Manolakis: Statistical and Adaptive Signal Processing, McGraw Hill, 2000.
4. Monson H. Hayes, "Statistical Digital Signal Processing and Modeling, John Wiley & Sons (Asia) Pte. Ltd., 2002.

Course Outcomes (COs):

1. Explain, describe, and understand the notion of a random process and statistical time series [L1]
2. Characterize random processes in terms of its statistical properties, including the notion of stationary and ergodicity [L3].
3. Analyze and manipulate power spectral densities, analyze in both time and frequency the affect of transformations and linear systems on random processes, both in terms of the density functions and statistical moments [L4].
4. Discuss the principles of estimation theory, define basic properties of estimators, and be able to analyze and calculate the properties of a given estimator [L3].
5. Apply least squares, maximum likelihood, and Bayesian estimators to model based signal processing problems [L6].

Program Outcomes (POs) of the course:

PO 1: Fundamentals of Engineering
Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.
PO 2: Design of Experiments
Graduates shall possess the ability to design and conduct experiments, analyse and interpret data.
PO 4: Engineering Cognizance
Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.
PO 5: Modern tool Usage
Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two tests out of three	**Average of two assignments/ activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks	30	10	10	50

Scheme of Semester End Examination (SEE):
1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

2. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. **(Kindly incorporate/mention the changes in the pattern of SEE question paper, if required, based on the content of course**)

SEMESTER III

ELECTIVE C: COMMUNICATION NETWORK SIMULATION AND MODELLING

Subject Code:	16DCN32C2	**Credits:**	3
Course Type:	PE – C	**CIE Marks:**	50
Hours/week: L – T – P	4 – 0 – 0	**SEE Marks:**	50
Total Hours:	45	**SEE Duration:**	3 Hours

Course Learning Objectives (CLOs):

1. To study general computer network model with time related concepts.
2. To study how access the medium connectivity in multiple user models and evaluation of its throughput.
3. Routing of data in the network and finding the stability of network against the link and flow.
4. Optimization of routing schemes.
5. To study data flow and rate control mechanism in the network.

Detailed Syllabus:

UNIT I

Delay Models in Data Networks : Queuing models , Little theorem and Application , M/M/1, M/M/m/m and other Markov System , Network Transmission Lines Time Reversibility, Network of Queues.

9 Hours

UNIT II

Multi-access Communication : Slotted Multi Access and the Aloha System , Splitting Algorithms, Carrier Sensing, Multi –access reservations, Packet Radio Networks.

9 Hours

UNIT III

Routing in Data Networks : Introduction, Network Algorithms and Shortest Path Routing, Broadcasting Routing Information : Coping with Link Failures, Flow Models, Optimal Routing and Topological Design, Characterization of Optimal Routing, Feasible Direction Methods for Optimal Routing, Projection Methods for Optimum Routing, Routing in the Codex Network.

9 Hours

UNIT IV

Optimization in Routing : Optimal Routing and Topological Design, Characterization of Optimal Routing, Feasible Direction Methods for Optimal Routing, Projection Methods for Optimum Routing, Routing in the Codex Network.

9 Hours

UNIT V

Flow and Rate Control : Introduction, Window Flow Control, Rate Control Schemes, Overview of Flow Control in Practice , Rate Adjustment Algorithms .

9 Hours

Text Books:

1. Dimitri Bertsekas and Robert Gallanger " Data Networks", 2nd Edition, Prentice Hall of India. 2003.

References:

1. William Stallings " High Speed Networks and Internets", Pearson Education (Asia) PVT. Ltd. 2004.
2. J Warland and P. Varaya, " High Perform,ance Communication Networks", 2nd edition Harcourt India Pvt. Ltd. & Morgan Kaufman, 2000.

Course Outcomes (COs):

1. Understand computer network model with time related concepts [L2].
2. Apply how access the medium connectivity in multiple user models and evaluation of its throughput [L4].
3. Design optimization of routing schemes [L5].
4. Analyze data flow and rate control mechanism in the network [L3].

Program Outcomes (POs):

1. PO 1: Fundamentals of Engineering

Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.

2. PO 4: Engineering Cognizance

Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.

3. PO 12: Self-motivated Learning
Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two tests out of three	**Average of two assignments/ activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks	30	10	10	50

Scheme of Semester End Examination (SEE):
1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

2. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. **(Kindly incorporate/mention the changes in the pattern of SEE question paper, if required, based on the content of course**)

SEMESTER III
ELECTIVE C: ADVANCED ARCHITECTURES

Subject Code:	16DCN33C3	**Credits:**	3
Course Type:	PE – C	**CIE Marks:**	50
Hours/week: L – T – P	4 – 0 – 0	**SEE Marks:**	50
Total Hours:	45	**SEE Duration:**	3 Hours

Course Learning Objectives (CLOs):

1. To impart overview of Parallel Processing and Pipelining Processing
2. To introduce to Principles and implementation of Pipelining
3. To Study and compare of Vector and array processors
4. To introduce to massively parallel processors
5. To Study of Architecture of Multithreaded processors

Detailed Syllabus:

UNIT I

Overview of Parallel Processing and Pipelining Processing: study and comparison of uni-processors and parallel processors. Conventional and EPIC architecture. Evolution of parallel processors, future trends and there architecture. Overview of Parallel Processing and Pipelining Processing Necessity of high performance, Constraints of conventional architecture, Parallelism in uni-processor system, Evolution of parallel processors, future trends, Architectural Classification, Applications of parallel processing, Instruction level Parallelism and Thread Level Parallelism, Explicitly Parallel Instruction Computing (EPIC) Architecture, Case study of Intel Itanium Processor. Principles of scalable performance: Performance Metrics and Measures, Speedup Performance Laws. Programming aspects for Intel Itanium Processor

9 Hours

UNIT II

Principles and implementation of Pipelining: Classification of pipelining processors, Pipeline Architecture, Study and comparison of processors with and without pipelining. General pipelining reservation table, Design aspect of Arithmetic and Instruction pipelining, Pipelining hazards and resolving techniques, Data buffering techniques, Job sequencing and Collision, Advanced pipelining techniques, loop unrolling techniques, out of order execution, software scheduling, trace scheduling, Predicated execution, Speculative loading, Register Stack Engine, Software pipelining, VLIW (Very Long Instruction Word) processor, Case study: Super scalar Architecture- Pentium, Ultra SPARC. Super scalar architecture of Pentium, Ultra SPARC, Advances in pipeline architectures. Implementation issues of a program on any pipelined processor their analysis

9 Hours

UNIT III

Study and comparison of Vector and array processors: Vector and Array Processor, Basic vector architecture, Issues in Vector Processing, Vector performance modeling, vectorizers and optimizers, Case study: Cray Arch. SIMD Computer Organization Masking and Data network mechanism, Inter PE Communication, Interconnection networks of SIMD, Static Vs Dynamic network, cube hyper cube and Mesh Interconnection network. Parallel Algorithms For Array Processors: Matrix Multiplication. Sorting, SIMD computer organization. Implementation issues of Matrix multiplication and sorting on array processor and their analysis.

9 Hours

UNIT IV

Microprocessor Architectures: study and comparison of Loosely and Tightly coupled multiprocessors. Loosely and Tightly coupled multiprocessors, Processor characteristics of multiprocessors, Inter Processor communication network, Time shared bus, Crossbar switch, Multiport Memory Model, Memory contention and arbitration techniques, Cache coherency and bus snooping, Massively Parallel Processors (MPP), Cow's and NOW's Cluster and Network of Work Stations), Chip Multiprocessing (CMP), Case Study of IBM Power4 Processor Inter Processor Communication and Synchronization, Implementation issues of a program on multiprocessor system.

9 Hours

UNIT V

Study of Architecture of Multithreaded processors: Latency hiding techniques, Principles of multithreading, Issues and solutions. Parallel Programming Techniques: Message passing program development, Synchronous and asynchronous message passing, Message passing parallel programming, Shared Memory Programming, Data Parallel Programming. Implementation issues of a multithreaded program.

9 Hours

Text Books:

1. Kai Hwang, Faye A. Briggs, "Computer Architecture and Parallel Processing" McGrawHill international Edition
2. Kai Hwang, "Advanced Computer Architecture", Tata McGraw-Hill

References:

1. V.Rajaraman, L Sivaram Murthy, "Parallel Computers", PHI.
2. William Stallings, "Computer Organization and Architecture, Designing for performance" Prentice Hall, Sixth edition.
3. Kai Hwang, Scalable Parallel Computing.
4. Harrold Stone, High performance computer Architecture.
5. Richard Y. Kain, Advanced Computer Architecture 6. http://www.intel.com/products/processor (for Intel Itanium Processor)
6. J.L. Hennessy, and D.A. Patterson, Computer Architecture: A quantitative approach, Fifth Edition, Morgan Kaufman Publication, 2012
7. J.P. Shen and M.H. Lipasti, Modern Processor Design, MC Graw Hill, Crowfordsville, 2005
8. Current Literature (Papers from ISCA, Micro, HPCA, ICCD, and IEEE Trans. on Computers, IEEE Architecture Letters)

Course Outcomes (COs):

1. To study and compae uni-processors and parallel processors [L3]
2. To classify pipelining processors [L3]
3. To analyze issues in Vector Processing [L4]
4. To understand principles of multithreading [L2]

Program Outcomes (POs):

1. PO 1: Fundamentals of Engineering

Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.

2. PO 4: Engineering Cognizance

Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.

3. PO 8: Collaboration

Graduates shall have the ability to collaborate productively in multidisciplinary teams with leadership attributes.

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two tests out of three	**Average of two assignments/ activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks	30	10	10	50

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

2. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. **(Kindly incorporate/mention the changes in the pattern of SEE question paper, if required, based on the content of course**)

SEMESTER III

ELECTIVE C: OBJECT ORIENTED ANALYSIS AND DESIGN

Subject Code:	16DCN33C4	**Credits:**	3
Course Type:	PE – C	**CIE Marks:**	50
Hours/week: L – T – P	4 – 0 – 0	**SEE Marks:**	50
Total Hours:	45	**SEE Duration:**	3 Hours

Course Learning Objectives (CLOs):

1. To introduce to the basics of object, classes and inheritance.
2. To analyze utilization of software objects.
3. To familiarize the Object Oriented Analysis and Design (OOAD) concepts for developing Object Oriented Projects.
4. To understand the quality and testing issues.
5. To use UML for requirements, designs and component interfaces.

Prerequisites:

Control Systems, Microprocessor and Interfacing Techniques

Detailed Syllabus:

UNIT I

Introduction: Categories of information systems, traditional paradigm vs. object oriented paradigm, objects and classes, inheritance, object relationship, examples of UML class modeling, unified process, iteration and incrementation within the unified process.

9 Hours

UNIT II

UML and the Unified Process: Overview of requirements, initial understanding of the domain, business model, requirements workflow, osbert oglesby case study, MSG foundation case study, revising the requirements, MSG foundation case study, continuing the requirements workflow, MSG foundation case study, refining the revised requirements, MSG foundation case study.

9 Hours

UNIT III

Object Oriented Analysis: Extracting entity classes, initial dynamic model, extracting control classes refining use cases, incrementing the class diagram, initial dynamic model, MSG foundation case study, revising the entity classes, extracting , USE case realization, MSG Foundation case study, incrementing the class diagram, more on use cases, risk.

9 Hours

UNIT IV

Object oriented design workflow: Design workflow, format of the attributes, allocation of operations, osbert oglesby case study, workflows of the unified process, phases of the unified process, class diagrams, use case diagrams, interaction diagrams, state charts, package diagrams, deployment diagrams.

9 Hours

UNIT V

Testing and management issues: Quality issues, non execution based testing, execution based testing, cost benefit analysis, risk analysis, improving the process, metrics CPM/PERT, choice of programming language, reuse case studies, portability planning, estimating duration and cost, testing the project management plan, maintenance and the object oriented paradigm, case tools for maintenance.

9 Hours

Text books:

1. John Deacon, “Object Oriented Analysis and Design”, Pearson Education, First Edition, 2009.

References:

1. Grady Booch, James Rumbaugh, Ivar Jacobson, “The unified modeling Language user Guide”, Pearson Education, Third Edition, 2012.
2. Grady Booch, “Object Oriented Analysis and Design with application”, Pearson Education, Third Edition, 2012.
3. Coad P, Yourdon E., “Object oriented analysis”, Yourdon Press, Second Edition, 1991.

Course Outcomes:

At the end of the course the student will be able to,

1. Describe object basics, classes and inheritance [L2].
2. Analyze the utilization of software objects to build systems that are more robust [L4].
3. Identify and describe the Object Oriented Analysis and Design (OOAD) concepts for developing Object Oriented Projects [L3]
4. Recognize the quality and testing issues [L3]
5. Effectively use UML in requirement collection, designing and component interfaces [L5].

1. PO 1: Fundamentals of Engineering

Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.

2. PO 5: Modern tool Usage

Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.

3. PO 8: Collaboration

Graduates shall have the ability to collaborate productively in multidisciplinary teams with leadership attributes.

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two tests out of three	**Average of two assignments/ activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks	30	10	10	50

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

2. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. **(Kindly incorporate/mention the changes in the pattern of SEE question paper, if required, based on the content of course**)

SEMESTER III
ELECTIVE D: BUSINESS ANALYTICS

Subject Code:	16DCN33D1	**Credits:**	3
Course Type:	PE - D	**CIE Marks:**	50
Hours/week: L – T – P	3 – 0 – 2	**SEE Marks:**	50
Total Hours:	45	**SEE Duration:**	3 Hours

Course Learning Objectives (CLOs):

1. To use data to develop insights and predictive capabilities using machine learning, data mining and forecasting techniques
2. To understand the use of optimization to support decision-making in the presence of a large number of alternatives and business constraints.
3. To explore the challenges that can arise in implementing analytical approaches within an organization.

Detailed Syllabus:

UNIT I

Business Statistics:

Different types of data; Data Visualization; Data summarization methods; Tables, Graphs, Charts, Histograms, Frequency distributions, Relative frequency measures of central tendency and dispersion; Box Plot; Chebychev's Inequality on relationship between the mean and the standard deviation of a probability distribution. Basic probability concepts, Conditional probability, Bayes Theorem, Probability distributions, Continuous and discrete distributions, Sequential decision-making Sampling and estimation: Estimation problems, Point and interval estimates Hypothesis testing: Null and alternate hypotheses; Types of errors, Level of significance, Power of a test, ANOVA Test for goodness of fit, Non-parametric tests.

9 Hours

UNIT II

Predictive analytics:

Simple linear regression: Coefficient of determination, Significance tests, Residual analysis, Confidence and Prediction intervals Multiple linear regression: Coefficient of multiple coefficient of determination, Interpretation of regression coefficients, Categorical variables, heteroscedasticity, Multi-collinearity, outliers, Autoregression and Transformation of variables Logistic and Multinomial Regression: Logistic function, Estimation of probability using logistic regression, Deviance, Wald Test, HosmerLemshow Test Forecasting: Moving average, Exponential smoothing, Trend, Cyclical and seasonality components, ARIMA (autoregressive integrated moving average). Application of predictive analytics in retail, direct marketing, health care, financial services, insurance, supply chain, etc.

9 Hours

UNIT III

Optimization Analysis:

Introduction to Operations Research (OR), linear programming (LP), formulating decision problems using linear programming, interpreting the results and sensitivity analysis.Multi-period LP models. Applications of linear programming in product mix, blending, cutting stock, transportation, transshipment, assignment, scheduling, planning and revenue management problems. Network models and project planning. Integer Programming (IP) problems, mixed-integer and zero-one programming.Applications of IP in capital budgeting, location decisions, contracts. Multi-criteria decision making (MCDM) techniques: Goal Programming (GP) and analytic hierarchy process (AHP) and applications of GP and AHP in solving problems with multiple objectives. Non-linear programming, portfolio theory.

9 Hours

UNIT IV

Stochastic Models:

Introduction to stochastic models, Markov models, Classification of states, Steady-state probability estimation, Brand switching and loyalty modeling, Market share estimation and Customer lifetime value estimation Poisson process, Cumulative Poisson process, Applications of Poisson and cumulative Poisson in operations, marketing and insurance Renewal theory, Applications of renewal theory in operations and supply chain management Markov decision process, Applications of Markov decision process in sequential decision making.

UNIT V

Advanced analytics

Principal component analysis, Factor analysis, Conjoint analysis, Discriminant analysis, ARCH (autoregressive conditional heteroscedasticity) and GARCH (autoregressive conditional heteroscedasticity), Monte Carlo simulation Survival analysis and its applications: Life tables, KapMeier estimates, Proportional hazards, Predictive hazard modeling using customer history data Six Sigma as a problem solving methodology, DMAIC and DMADV methodology, Six Sigma Tool Box: Seven quality tools, Quality function deployment (QFD), SIPOC, Statistical process control, Value stream mapping, TRIZ Classification and regression trees (CART), Chi-squared automatic interaction detector (CHAID) Lean thinking: Lean manufacturing, Value stream mapping

9 Hours

Text Books:

1. Data Science for Business, Provost and Fawcett: O'Reilly
2. Data Mining for Business Intelligence, Concepts, Techniques and Applications, Shmueli, Patel, and Bruce: Wiley
3. Management Science: The Art of Modeling with Spreadsheets, Powell and Baker: Wiley

References:

1. The New Science of Retailing, Fisher and Raman: Harvard Business Press
2. Big data: The next frontier for innovation, competition, and productivity: http://www.mckinsey.com/insights/mgi/research/technology_and_innovation/big_data_the_next_frontier_for_innovation

Course Outcomes (COs):

1. To identify, evaluate, and capture business analytic opportunities that create value [L4].
2. To explain basic analytic methods and analyze case studies on organizations that successfully deployed these techniques [L3].

Program Outcomes (POs):

1. PO 3: Social Engineering

Graduates shall possess the ability to identify societal problems and meaningfully contribute with optimal solutions.

2. PO 6: Impact of Engineering

Graduates shall be able to understand the impact of engineering solutions in a global, economic, environmental and societal context.

3. PO 7: Ethics

Graduates shall imbibe the professional and ethical responsibilities of their profession.

4. PO 8: Collaboration

Graduates shall have the ability to collaborate productively in multidisciplinary teams with leadership attributes.

5. PO 12: Self-motivated Learning

Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two tests out of three	**Average of two assignments/ activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks	30	10	10	50

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

2. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. **(Kindly incorporate/mention the changes in the pattern of SEE question paper, if required, based on the content of course**)

SEMESTER III
ELECTIVE D: INDUSTRIAL PROCESS CONTROL SYSTEMS

Subject Code:	16DCN33D2	**Credits:**	4
Course Type:	PE – D	**CIE Marks:**	50
Hours/week: L – T – P	4 – 0 – 0	**SEE Marks:**	50
Total Hours:	45	**SEE Duration:**	3 Hours

Course Learning Objectives (CLOs):

1. Study of the operating principles of electric motors and discrete control systems with an introduction to process control.
2. Introduce to methods of controlling, protecting and specifying motors and their controls.

Prerequisites:

Control Systems, Microprocessor and Interfacing Techniques

Detailed Syllabus:

UNIT I

Introduction to Process Control Systems: Introduction, Types of Process Control Systems, Components of Process Control Systems, Sensors, Actuators
Programmable Logic Controllers: Controllers, Hardware**,** Internal Architecture, PLC Systems

9 Hours

UNIT II

Input – Output Devices: Input devices, Output devices, Examples of Applications
I/O processing: Input/output units, Signal conditioning, Remote connections, Networks, Processing inputs, I/O addresses.
Ladder and functional block programming: Ladder diagrams, Logic functions, Latching, Multiple outputs, Entering programs, Function blocks, Program examples, Multiple outputs, Entering programs, Function blocks, Program examples

9 Hours

UNIT III

IL, SFC and ST programming methods: Instruction lists, Sequential function charts, Sequential function charts, Structured Text

Internal relays: Internal relays, Ladder programs, Battery-backed relays, One-shot operation, Set and reset, Master control relay

9 Hours

UNIT IV

Jump and Call: Jump, Subroutines

Timers: Types of timers, Programming timers, Off-delay timers, Pulse timers, Programming Examples

Counters: Forms of counter, Programming, Up and down counting, Timers with counters, Sequencer, Performance Criteria, ON-OFF Controllers.

9 Hours

UNIT V

Designing systems & Programs: Program development, Safe systems, Commissioning, Fault finding, Temperature control, Valve sequencing

Designing systems & Programs: Conveyor belt control, Control of a process

Text Books:

1. Curtis D. Johnson, "Process Control Instrumentation Technology"
2. Kilian, "Modern Control Technology: Components and Systems"
3. W. Bolton, "Programmable Logic Controllers"

Optional Practical Topics

1. Introduction of PLC and basic symbol of ladder diagram.
2. To study the working principle of ladder diagram.
3. To study the DVP-PLC (software) function and application.
4. Simulation of control logics using LOGO for implementation on PLC's.
5. To study the SFC (sequence function chart) editing environment.
6. To implement and run the simulation of ladder diagrams
7. To control the TRAFFIC LIGHT module with PLC
8. To control the WATER LEVEL module with PLC
9. To control the LIFT/ELEVATOR module with PLC

10. To control home appliances with PLC
11. To control the motor drives module with PLC
12. To design and implement Pneumatic Control System applications
13. To study the industrial process control used in different industries
14. To implement industrial process control used in some industry using PLC simulation Program
15. To study the control circuit of different drives with relays and timers used in industrial process control

Course Outcomes (COs):

1. Design and implement industrial process control applications through ladder diagrams using industrial process input and output devices [L6].

Program Outcomes (POs)

1. PO 2: Design of Experiments

Graduates shall possess the ability to design and conduct experiments, analyse and interpret data.

2. PO 4: Engineering Cognizance

Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.

3. PO 8: Collaboration

Graduates shall have the ability to collaborate productively in multidisciplinary teams with leadership attributes.

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two tests out of three	**Average of two assignments/ activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks	30	10	10	50

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

2. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. **(Kindly incorporate/mention the changes in the pattern of SEE question paper, if required, based on the content of course**)

SEMESTER III
ELECTIVE D: AUTOMOTIVE NETWORKING

Subject Code:	15DCN33D3	**Credits:**	4
Course Type:	PE – D	**CIE Marks:**	50
Hours/week: L – T – P	4 – 0 – 0	**SEE Marks:**	50
Total Hours:	45	**SEE Duration:**	3 Hours

Course Learning Objectives (CLOs):

1. To analyze, simulate and implement automotive communication protocols.
2. To impart in depth knowledge on data communication and networking, automotive communication and diagnostic protocols and their working.
3. The conceptual studies of this module will be complemented with laboratory sessions on simulation and analysis of In-Vehicle Networks (IVN) using appropriate Tools

Detailed Syllabus:

UNIT I

Basics of Data Communication Networks and Automotive Communication Protocols:

Need for networks, Types of networks, Need for standards, TCP/IP model, Topologies, Error detection and correction mechanisms, Encoding schemes, Serial/parallel transmission, Bits, Baud and bandwidth, Synchronous and asynchronous, Need and benefits of IVN, Classes of IVN protocols, Multiplexed electrical systems, Vehicle multiplexing, Bitwise contention, Network elasticity, Error processing and management and Case Study

9 Hours

UNIT II

Controller Area Network (CAN) Protocol:

History and foundation of CAN, CAN Applications, Main characteristics of CAN, CAN in OSI Reference Model, CAN Data Link Layer, Principles of data exchange in CAN, Arbitration, Data Frame, Remote Frame, Error detection and management in CAN, CAN physical Layer, Bit encoding, Bit timing and synchronization, Relationship between data rate and bus length, Single wire and twin wire media, CAN repeaters, Medium-to-medium gateway, Protocol handlers, Micro-controllers and line drivers, Time-Triggered CAN (TTCAN), Comparison with other IVN protocols, CANoe based applications development

9 Hours

UNIT III

CAN Higher Layer Protocols and LIN:

CAN Higher Layer Protocols: CAN in Automation (CiA), CANopen, CANopen device model, CANopen features, DeviceNet, DeviceNet Model, Device Object Model, DeviceNet Features, SAEJ1939, SAE J1939 Reference Model, CANKingdom and Case Study

Local Interconnect Network (LIN) Protocol: Introduction to LIN, LIN consortium, LIN specification, LIN features, Technical overview, Work flow concept, LIN operation, LIN frame format, Scheduling table, Network management of LIN cluster, LIN Transport Layer, LIN node configuration and identification, LIN diagnostics, LIN physical layer, Comparison with other IVN protocols and Case Study

9 Hours

UNIT IV

FlexRay and MOST Protocol:

FlexRay Protocol: Future on board systems, Need for FlexRay, Origin of FlexRay, FlexRay consortium, FlexRay Objectives, FlexRay Features, Application requirements, Working of FlexRay, Network topologies, ECU architecture, Segment Configuration, Communication Cycles, FlexRay frame format, Timing of configuration protocol, Error control, and FlexRay core mechanisms, Coding and Decoding, Medium Access Control, Frame and Symbol Processing, Clock Synchronization, FlexRay Components, Comparison with other IVN protocols and Case Study

Media Oriented System Transport (MOST) Protocol: Emerging in car systems, Introduction to MOST, MOST goals, Features, Cables and Connectors, Data Types, Topology, Frame Format, Application Areas, System Description, Specification, Device Model, Device Implementation, Diagnostics and Case Study

9 Hours

UNIT V

In Vehicle Network Diagnostics:

Process of Automotive Fault Diagnostics, Fault Codes, Vehicle Systems (open-loop and closed-loop)

On- and Off- Board Diagnostics, OBD-I, OBD-II, Engine Analyzers, Steps taken to diagnose a fault, Diagnostics Protocol-KWP2000, SAE-J1587, SAE-J1708 and Case Study

9 Hours

Text Books

1. Gilbert Held. (2007) Inter- and Intra-Vehicle Communications, CRC Press.
2. Behrouz Forouzan. (2003) Data Communications and Networking, McGraw-Hill.
3. Ronald k. Jurgen. (1999) Automotive Electronics Handbook, McGraw-Hill.

Course Outcome (COs):

1. Establish the need of Networking in an Automobile [L2]
2. Explain and analyze the principles and functionalities of various Automotive Communication Protocols (ACPs) [L2]
3. Design, simulate, emulate and analyze CAN and LIN based automotive embedded networks [L4]
4. Design ACP based In-Vehicle Networks (IVNs) [L5]
5. Proficiently use CANoe tool to develop IVN applications as well as to simulate, analyze and Troubleshoot ACP based IVNs [L4]

Program Outcomes (POs) of the course:

1. PO 4: Engineering Cognizance

Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.

2. PO 8: Collaboration

Graduates shall have the ability to collaborate productively in multidisciplinary teams with leadership attributes.

3. PO 12: Self motivated Learning

Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two tests out of three	**Average of two assignments/ activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks	30	10	10	50

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

2. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. **(Kindly incorporate/mention the changes in the pattern of SEE question paper, if required, based on the content of course**)

SEMESTER III
ELECTIVE D: BROADBAND COMMUNICATION

Subject Code:	16DCN33D4	**Credits:**	4
Course Type:	PE – D	**CIE Marks:**	50
Hours/week: L – T – P	4 – 0 – 0	**SEE Marks:**	50
Total Hours:	45	**SEE Duration:**	3 Hours

Course Learning Objectives (CLOs):

1. To understand the three primary components of a fiber-optic communication system.
2. To understand the system design issues and the role of WDM components in advanced light wave systems.
3. To understand the basics of orbital mechanics and the look angles from ground stations to the satellite.
4. To apply their subject understanding in Link Design.

Detailed Syllabus:

UNIT I

Light wave System Components: Key Elements of Optical Fiber Systems, Optical Fibers as a Communication Channel: Optical Fiber Modes and Configurations , Mode Theory for Circular Waveguides , Single-mode Fibers, Graded-index Fiber Structure, Signal Degradation in Optical Fibers.Optical Sources: Basic Concepts and characteristics of LEDs and LASERs. Photodetectors: Basic Concepts, Common Photodetectors.

9 Hours

UNIT II

Lightwave Systems: System Architectures, Point-to-Point Links: System Considerations, Design Guidelines: Optical Power Budget, Rise Time Budget, Long-Haul Systems

9 Hours

UNIT III

Multichannel Systems: Overview of WDM, WDM Components: 2 x 2 Fiber Coupler, Optical Isolators and Circulators, Multiplexers and De-multiplexers, Fiber Bragg Grating, FBG applications for multiplexing and De-multiplexing function, Diffraction Gratings, Overview of Optical Amplifiers: SOA, EDFA and RFA in brief.

9 Hours

UNIT IV

Orbital Mechanics and Launchers: History of Satellite Communication, Orbital Mechanics, Look angle determination, Orbital perturbations, Orbital determination, Launchers and Launch Vehicles, Orbital effects in communication system performance.

9 Hours

UNIT V

Satellites: Satellite Subsystems, Attitude and control systems (AOCS), Telemetry, Tracking, Commandand Monitoring, Power systems, Communication subsystems, Satellite antennas, EquipmentReliability and space qualification.

Satellite Communication Link Design: Introduction, Basic transmission Theory, System Noise Temperature and G/T Ratio, Designof Downlinks, Satellite Systems using Small Earth Stations, Uplink Design, Design ofSpecified C/N : Combining C/N and C/I values in Satellite Links, System Design Examples

Text Books:

1. Gerd Keiser, "Optical fiber Communications", Tata McGraw Hill, 4th edition.
2. Timothy Pratt, Charles Bostian, Jeremy Allnutt "Satellite Communications", John Wiley & Sons.

Reference Books:

1. Govind P. Agrawal, Fiber-Optic Communication Systems, Wiley, 3rd edition.
2. Dennis Roody, "Satellite Communications", McGraw Hill

Course Outcomes (COs):

1. Carry out Link power budget and Rise Time Budget by proper selection of components and check its viability [L3]
2. Carry out Satellite Link design for Up Link and Down Link [L4]

Program Outcomes (POs) of the course:

1. PO 4: Engineering Cognizance

Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.

2. PO 6: Impact of Engineering

Graduates shall be able to understand the impact of engineering solutions in a global, economic, environmental and societal context.

3. PO 8: Collaboration

Graduates shall have the ability to collaborate productively in multidisciplinary teams with leadership attributes.

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two tests out of three	**Average of two assignments/ activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks	30	10	10	50

Scheme of Semester End Examination (SEE):

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