KARNATAK LAW SOCIETY'S

GOGTE INSTITUTE OF TECHNOLOGY

UDYAMBAG, BELAGAVI-590008

(An Autonomous Institution under Visvesvaraya Technological University, Belagavi)

(APPROVED BY AICTE, NEW DELHI)

Department of Electronics and Communication Engineering

Scheme and Syllabus

M. Tech. (Digital Communication and Networking)

INSTITUTION VISION

Gogte Institute of Technology shall stand out as an institution of excellence in technical education and in training individuals for outstanding caliber, character coupled with creativity and entrepreneurial skills.

MISSION

To train the students to become Quality Engineers with High Standards of Professionalism and Ethics who have Positive Attitude, a Perfect blend of Techno-Managerial Skills and Problem solving ability with an analytical and innovative mindset.

QUALITY POLICY

- Imparting value added technical education with state-of-the-art technology in a congenial, disciplined and a research oriented environment.
- Fostering cultural, ethical, moral and social values in the human resources of the institution.
- Reinforcing our bonds with the Parents, Industry, Alumni, and to seek their suggestions for innovating and excelling in every sphere of quality education.

DEPARTMENT VISION

The Electronics & Communication Engineering department shall impart quality technical education and entrepreneurship skills to develop creative individuals to face changing global scenario.

MISSION

To augment the national talent pool, with Electronics and Communication Engineers having all-encompassing technical knowledge, principled practices and nationalistic outlook.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

1. The graduates will acquire core competence in basic science and Digital Communication and Networking fundamentals necessary to formulate, analyze, and solve engineering problems and to pursue advanced study or research.
2. The graduates will engage in the activities that demonstrate desire for ongoing personal and professional growth and self-confidence to adapt to rapid and major changes.
3. The graduates will maintain high professionalism and ethical standards, effective oral and written communication skills, work as part of teams on multidisciplinary projects under diverse professional environments, and relate engineering issues to the society, global economy and to emerging technologies.

PROGRAM OUTCOMES (POs)

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. **Design of Experiments:** Graduates shall possess the ability to design and conduct experiments, analyse and interpret data.
3. **Social Engineering:** Graduates shall possess the ability to identify societal problems and meaningfully contribute with optimal solutions.
4. **Engineering Cognizance:** Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.
5. **Modern tool Usage:** Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.
6. **Impact of Engineering:** Graduates shall be able to understand the impact of engineering solutions in a global, economic, environmental and societal context.
7. **Ethics:** Graduates shall imbibe the professional and ethical responsibilities of their profession.
8. **Collaboration:** Graduates shall have the ability to collaborate productively in multidisciplinary teams with leadership attributes.
9. **Soft skills**: Graduates shall possess proficiency in oral and written communication skills.
10. **Entrepreneurship**: Graduates shall imbibe project management and finance skills to pursue entrepreneurial endeavours.
11. **Research and Innovation:** Graduates shall have the ability to pursue research and provide innovative solutions.
12. **Self motivated Learning:** Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.

PROGRAM SPECIFIC OUTCOMES (PSOs)

1. Understanding and applying the mathematical and scientific concepts, for analysis and design of basic Electronics and Communication systems.
2. Developing critical thinking abilities coupled with competence in use of computational tools for professional growth; complimented with communication skills and leadership attributes.
3. Identifying societal needs and sensitizing individuals towards finding innovative solutions to contemporary issues with multidisciplinary outlook.

Scheme of Teaching
Semester I

S. No.	Code	Course		Contact Hours	Contact Hours/ week	Total credits	Marks		
				L – T - P			CIE	SEE	Total
1.	17DCN11	Probability and Random Processes	PC	4 – 0 – 0	4	4	50	50	100
2.	17DCN12	Advanced Digital Communication	PC	4 – 0 – 0	4	4	50	50	100
3.	17DCN13	Advanced computer networks	PC	4 – 0 – 0	4	4	50	50	100
4.	17DCN14	Advances in Antenna and Microwave Engineering	PC	3 – 1 – 0	4	4	50	50	100
5.	17DCN15x	Elective – I	PE – I	4 – 0 – 0	4	4	50	50	100
6.	17DCN16	Lab-1: Advanced Communication Lab	L2	0 – 0 – 3	3	2	25	25	50
7.	17DCN17	Seminar-1		0 – 0 – 1		1	25		25
8.	17PTA18	Term Assignment-1	Mini Project	0 – 0 – 2	4	2	25		25
		Total			**28**	**25**	**325**	**275**	**600**

Elective – I: List of subjects

Subject Code	Subjects
17DCN151	Advances in Multi-Media Communication
17DCN152	Information Security
17DCN153	Remote Sensing and GIS
17DCN154	Machine Learning Algorithms

Semester II

S. No.	Code	Course		Contact Hours	Contact Hours/ week	Total credits	Marks		
				L – T - P			CIE	SEE	Total
1.	17DCN21	Connected Devices	PC	4 – 0 – 0	4	4	50	50	100
2.	17DCN22	Network Programming	PC	3 – 1 – 0	4	4	50	50	100
3.	17DCN23	Advanced Communication Networks	PC	4 – 0 – 0	4	4	50	50	100
4.	17DCN24	Advanced Wireless Communication	PC	4 – 0 – 0	4	4	50	50	100
5.	17DCN25x	Elective – II	PE-II	4 – 0 – 0	4	4	50	50	100
6.	17DCN26	Lab – 2: IoT Lab	L2	0 – 0 – 3	3	2	25	25	50
7.	17DCN27	Seminar-2		0 – 0 – 1		1	25		25
8.	17PTA28	Term Assignment-2	Mini Project	0 – 0 – 2	4	2	25		25
		Total			**28**	**25**	**325**	**275**	**600**

Elective – II: List of subjects

Subject Code	Subjects
17DCN251	Cloud Computing
17DCN252	Optical Networks
17DCN253	Cyber Physical Systems
17DCN254	Ad-hoc Networks

Semester III

S. No.	Course Code	Course		Contact Hours L – T - P	Contact Hours/week	Total credits	Marks CIE	Marks SEE	Marks Total
1.	??	Internship#				14	50	50	100
2.		*Project Phase-1	PR			2	25		25
		Total			**12**	**16**	**75**	**50**	**125**

Internship report and presentation.
* Selection of topic and Literature Review

Semester IV

S. No.	Course Code	Course		Contact Hours L – T - P	Contact Hours/ week	Total credits	Marks CIE	Marks SEE	Marks Total
1	17DCN41	Error Control Coding	PC1	3 – 1 – 0	4	4	50	50	100
2	17DCN42x	**Elective – III**	PE-III	4 – 0 – 0	4	4	50	50	100
3		Project Phase -2	PR			2	50(25+25)		50
4		Project Phase -3	PR			2	50(25+25)		50
5		Project Viva-voce	PR			12		150(50+100)	150
		Total			**24**	**24**	**200**	**250**	**450**

Elective – III: List of subjects

Elective – III	
17DCN421	Speech Processing
17DCN422	Communication Networks Modeling and Simulation
17DCN423	Sensor Networks
17DCN424	Big Data/ Data Mining

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

- Project Phase -2 and 3: CIE- 100 marks (50 marks –Internal guide + 50 marks-presentation) Project Viva-voce: SEE- 150 marks (50 marks for report evaluation by external examiner+ 100 marks viva- voce)

Probability and Random Processes

Course Code	17DCN11	**Credits**	4
Course type	PC1	**CIE Marks**	50 marks
Hours/week: L-T-P	4 – 0 – 0	**SEE Marks**	50 marks
Total Hours:	45	**SEE Duration**	3 Hours for 100 marks

Course Learning Objectives (CLOs)

1. Introduce the fundamentals of Probability and random process.
2. 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.
5. Introduce the fundamentals of Probability and random process.

Unit – I 9Hours

Introduction to probability theory:

Experiments, Sample space, Events, Axioms, Assigning probabilities, Joint and conditional, Baye's theorem, Independence, Discrete random variables, Engineering examples.

Unit – II 9 Hours

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.

Unit – III 9 Hours

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.

Unit – IV 9 Hours

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.

Unit –V 9 Hours

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.

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 and onwards

Reference Books

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

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Explain fundamentals of probability theory, random variables and random processes.	L2
2. Understand the mathematical concepts related to probability theory and random processes.	L1
3. Understand the characterization of random processes and their properties.	L2
4. Formulate and solve the engineering problems involving random processes.	L4
5. Analyze the given probabilistic model of the problem.	L5

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Digital Communication and Networking.	1
2. **Design of Experiments:** Graduates shall possess the ability to design and conduct experiments, analyse and interpret data.	2
3. **Engineering Cognizance:** Graduates shall be able to stay abreast with recent developments in the field of Digital Communication and Networking.	4
4. **Modern tool Usage:** Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.	5
5. **Research and Innovation:** Graduates shall have the ability to pursue research and provide innovative solutions.	11

Course delivery methods	Assessment methods
1. Classroom Teaching (Blackboard)	1. IA test
2. Presentation	2. Assignment
3. Video presentations	3. Activity

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	**Average of assignments (Two) / activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks: 50	30	10	10	50
➢ Writing two IA tests is compulsory. ➢ **Minimum marks required to qualify for SEE:** 20				

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

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. **Minimum marks required in SEE to pass:**40
3. 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.

Advanced Digital Communication

Course Code	17DCN12	**Credits**	4
Course type	PC2	**CIE Marks**	50 marks
Hours/week: L-T-P	4 – 0 – 0	**SEE Marks**	50 marks
Total Hours:	45	**SEE Duration**	3 Hours for 100 marks

Course Learning Objectives (CLOs)

1. Understand the generation , demodulation of coherent and non coherent digital modulation techniques and wireless channels.
2. Study ISI, give solution to suppress ISI and exposure to channel equalization.
3. Study single and multiple error correction codes, spread spectrum techniques and matched filter concepts.
4. Study polynomial and turbo coding techniques.
5. Study OFDM and multicarrier modulation techniques

Unit – I 9Hours

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.

Unit – II 9 Hours

Equalization Techniques:

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

Unit – III 9 Hours

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

Unit – IV 9 Hours

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.

Unit - V 9 Hours

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.

Text Books

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

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Analyze various digital modulation techniques , the problems associated with each technique and methods to minimize the problems.	L4
2. Suggest techniques to minimize ISI and channel equalization methods.	L5
3. Design single and multiple error correction codes, matched filter to maximize SNR at the receiver.	L6
4. Design polynomial codes for error detection and correction.	L6
5. Analyze OFDM systems and suggest methods to maximize capacity and SNR.	L4

Program Outcome of this course (POs)	**PO No.**
1. **Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Digital Communication and Networking.	1
2. **Design of Experiments:** Graduates shall possess the ability to design and conduct experiments, analyse and interpret data.	2
3. **Engineering Cognizance:** Graduates shall be able to stay abreast with recent developments in the field of Digital Communication and Networking.	4
4. **Modern tool Usage:** Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.	5
5. **Self-motivated Learning:** Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.	12

Course delivery methods	**Assessment methods**
1. Classroom Teaching (Blackboard)	1. IA test
2. Presentations	2. Assignment
	3. Activity

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	**Average of assignments (Two) / activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks: 50	30	10	10	50
➢ Writing two IA tests is compulsory. ➢ **Minimum marks required to qualify for SEE:** 20				

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

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. **Minimum marks required in SEE to pass:**40
3. 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.

Advanced Computer Networks

Course Code	17DCN13	**Credits**	4
Course type	PC3	**CIE Marks**	50 marks
Hours/week: L-T-P	4 – 0 – 0	**SEE Marks**	50 marks
Total Hours:	45	**SEE Duration**	3 Hours for 100 marks

Course Learning Objectives (CLOs)

1. To become familiar with the basics of Computer Networks
2. To understand various Network architectures
3. To study metrics of internetwork and routing among autonomous systems
4. Study concepts of fundamental protocols
5. To understand the network traffic, congestion, controlling and resource allocation.

Unit – I 9Hours

Foundation: Building a Network, Requirements, Perspectives, Scalable Connectivity, Cost-Effective Resource sharing , Support for Common Services, Manageability, Protocol layering, Performance, Bandwidth and Latency, Delay X Bandwidth Product, Perspectives on Connecting, Classes of Links, Reliable Transmission, Stop-and-Wait , Sliding Window, Concurrent Logical Channels.
T1: Chapter 1.1, 1.2, 1.5.1, 1.5.2., 2.1, 2.5 **T2:** Chapter 4

Unit – II 9Hours

Internetworking- I: Switching and Bridging, Datagram's, Virtual Circuit Switching, Source Routing, Bridges and LAN Switches, Basic Internetworking (IP), What is an Internetwork ?, Service Model, Global Addresses, Datagram Forwarding in IP, sub netting and classless addressing, Address Translation(ARP), Host Configuration(DHCP), Error Reporting(ICMP), Virtual Networks and Tunnels.
T1: Chapter 3.1, 3.2,

Unit – III 9Hours

Internetworking- II: Network as a Graph, Distance Vector(RIP), Link State(OSPF), Metrics, The Global Internet, Routing Areas, Routing among Autonomous systems(BGP), IP Version 6(IPv6), Mobility and Mobile IP T2
T1: Chapter 3.3, 4.1.1,4.1.3**, T2:**Chapter 13.1 to 13.18, Ch 18.

Unit – IV 9Hours

End-to-End Protocols: Simple Demultiplexer (UDP), Reliable Byte Stream(TCP), End-to-End Issues, Segment Format, Connecting Establishment and Termination, Sliding Window Revisited, Triggering Transmission, Adaptive Retransmission, Record Boundaries, TCP Extensions, Queuing Disciplines, FIFO, Fair Queuing, TCP Congestion Control, Additive Increase/ Multiplicative Decrease, Slow Start, Fast Retransmit and Fast Recovery.
T1: Chapter 5.1, 5.2.1 to 5.2.8, 6.2, 6.3

Unit – V **9Hours**

Congestion Control and Resource Allocation: Congestion-Avoidance Mechanisms, DEC bit, Random Early Detection (RED), Source-Based Congestion Avoidance. The Domain Name System(DNS),Electronic Mail(SMTP,POP,IMAP,MIME), World Wide Web(HTTP), Network Management(SNMP) .

T1: Chapter 6.4 **T2:** Chapter 23.1 to 23.16, Chapter 24, Chapter 25, Chapter 27.1 to 27.8

Text Books

1. T1: Larry Peterson and Bruce S Davis, "Computer Networks :A System Approach" 5th Edition , Elsevier -2014.
2. T2: Douglas E Comer, "Internetworking with TCP/IP, Principles, Protocols and Architecture" 6th Edition, PHI – 2014.

Reference Books

1. Uyless Black "Computer Networks, Protocols , Standards and Interfaces" 2nd Edition – PHI.
2. Behrouz A Forouzan "TCP/IP Protocol Suite" 4th Edition – Tata McGraw-Hill.

Other Resources

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

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. List and classify network services, protocols and architectures, explain why they are layered..	L4
2. Choose key Internet applications and their protocols, and apply to develop their own applications (e.g. Client Server applications, Web Services) using the sockets API.	L5
3. Explain develop effective communication mechanisms using techniques like connection establishment, queuing theory, recovery Etc.	L2
4. Explain various congestion control techniques.	L1

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Digital Communication and Networking.	1
2. **Impact of Engineering:** Graduates shall be able to understand the impact of engineering solutions in a global, economic, environmental and societal context.	6
3. **Self motivated Learning:** Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.	12

Course delivery methods	Assessment methods
1. Blackboard Teaching	1. Assignments
2. Presentation	2. Internal Assessment Tests
3. Notes	3. Tutorials

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	**Average of assignments (Two) / activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks: 50	30	10	10	50
➢ Writing two IA tests is compulsory. ➢ **Minimum marks required to qualify for SEE:** 20				

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

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. **Minimum marks required in SEE to pass:**40
3. 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.

Advances in Antenna and Microwave Engineering

Course Code	17DCN14	**Credits**	4
Course type	PC4	**CIE Marks**	50 marks
Hours/week: L-T-P	3 –1 – 0	**SEE Marks**	50 marks
Total Hours:	45	**SEE Duration**	3 Hours for 100 marks

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.

Unit – I 9 Hours

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)

Unit –II 9 Hours

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)

Unit –III 9 Hours

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)

Unit –IV 9 Hours

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)

Unit –V 9 Hours

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.

Study of RF amplifier design using Agilent Advanced Design System (ADS).

Text Books

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

Reference Books

1. John D. Kraus: "Antennas", 3rd/4th Edition and onwards, McGraw Hill.
2. R. Garg, P. Bhartia, I. Bahl, and A. Ittipiboon, "Microstrip Antenna Design Handbook", Norwood, MA: Artech House, 2001 and onwards.
3. D. Pozar, Microwave Engineering, J. Wiley and Sons, 3rd Edition, 2004 and onwards.
4. K. Chang, I. Bahl, and V. Nair, RF and Microwave Circuit and Component Design for Wireless Systems, J. Wiley & Sons, 2002 and onwards
5. G. Gonzalez, Microwave Transistor Amplifiers, 2nd Edition, Prentice Hall, 1997 and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
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

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Digital Communication and Networking.	1
2. **Design of Experiments:** Graduates shall possess the ability to design and conduct experiments, analyse and interpret data.	2
3. **Engineering Cognizance:** Graduates shall be able to stay abreast with recent developments in the field of Digital Communication and Networking.	4
4. **Modern tool Usage:** Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.	5
5. **Self motivated Learning:** Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.	12

Course delivery methods	Assessment methods
1. Blackboard Teaching	1. Internal Assessment
2. Presentations	2. Assignment
	3. Activity

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	**Average of assignments (Two) / activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks: 50	30	10	10	50
➢ Writing two IA tests is compulsory. ➢ **Minimum marks required to qualify for SEE:** 20				

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

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. **Minimum marks required in SEE to pass:**40
3. 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.

Elective I: Advances in Multi-Media Communication

Course Code	17DCN151	**Credits**	4
Course type	PE – I	**CIE Marks**	50 marks
Hours/week: L-T-P	4 – 0 – 0	**SEE Marks**	50 marks
Total Hours:	45	**SEE Duration**	3 Hours for 100 marks

Course Learning Objectives (CLOs)

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

Unit – I 9Hours

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

Unit – II 9Hours

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

Unit – III 9Hours

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

Unit – IV 9Hours

Digital video coding standard and applications:

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

Unit – V 9Hours

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.

Text Books

1. Yun Q. Shi, Huifang Sun, "Image and Video Compression for Multimedia Engineering: Fundamentals, Algorithms, and Standards, Second Edition", CRC Press , 2008 and onwards
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 and onwards

Reference Books

1. 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 .
2. 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.
3. 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 Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
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 Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Digital Communication and Networking.	1
2. **Design of Experiments:** Graduates shall possess the ability to design and conduct experiments, analyse and interpret data.	2
3. **Engineering Cognizance:** Graduates shall be able to stay abreast with recent developments in the field of Digital Communication and Networking.	4

Course delivery methods	Assessment methods
1. Blackboard	1. Internal Assessment Tests
2. Presentations	2. Activity
	3. Assignments

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	**Average of assignments (Two) / activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks: 50	30	10	10	50
➢ Writing two IA tests is compulsory. ➢ **Minimum marks required to qualify for SEE:** 20				

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

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. **Minimum marks required in SEE to pass:**40
3. 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.

Elective I: Information Security

Course Code	17DCN152	**Credits**	4
Course type	PE – I	**CIE Marks**	50 marks
Hours/week: L-T-P	4 – 0 – 0	**SEE Marks**	50 marks
Total Hours:	45	**SEE Duration**	3 Hours for 100 marks

Course Learning Objectives (CLOs)

1. Explain the network security model
2. Demonstrate use of various private and public key encryption techniques used in modern cryptosystems
3. Explain the concept of digital signatures and authentication protocols
4. Explain the concept of secured electronic transaction with web security considerations
5. Analyze the security issues with Kerberos and E-mails

Unit - I — 9 Hours

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

Unit – II — 9 Hours

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

Unit – III — 9 Hours

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

Unit – IV — 9 Hours

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

Unit – V — 9 Hours

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

Text Books

1. Behrouz A. Fourcuzan ," Cryptography and Network security" Tata McGraw- Hill, 2008 and onwards
2. William Stallings,"Cryptography and Network security: principles and practice",2nd Edition,Prentice Hall of India,New Delhi,2002 and onwards
3. Atul Kahate ," Cryptography and Network security", 2nd Edition, Tata McGraw- Hill, 2008 and onwards
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 Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
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.	L5

Program Outcome of this course (POs)	**PO No.**
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.	1
2. **Research and Innovation**: Graduates shall have the ability to pursue research and provide innovative solutions.	11
3. **Self motivated Learning**: Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.	12

Course delivery methods	**Assessment methods**
1. Black board	1. IA Tests
2. Presentation	2. Assignment
	3. Activity

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	**Average of assignments (Two) / activity**	**Seminar/ Mini Project**	Total Marks

Maximum Marks: 50	30	10	10	50
➢ Writing two IA tests is compulsory. ➢ **Minimum marks required to qualify for SEE:** 20				

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

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. **Minimum marks required in SEE to pass:**40
3. 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.

Elective I: Remote Sensing and GIS

Course Code	17DCN153	**Credits**	4
Course type	PE – I	**CIE Marks**	50 marks
Hours/week: L-T-P	4 – 0 – 0	**SEE Marks**	50 marks
Total Hours:	45	**SEE Duration**	3 Hours for 100 marks

Course Learning Objectives (CLOs)

1. Understand the Remote Sensing and GIS.
2. Be aware of the classification and identification data using RS and GIS tools.
3. Build application of GIS.
4. Understand and develop to classify data using supervised and unsupervised classification
5. Build application of GIS.

Unit – I **9 Hours**

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

Unit – II **9 Hours**

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

Unit - III **9 Hours**

Image Classification: Supervised and Unsupervised Classification, Accuracy Assessment, Artificial Intelligence, Object Oriented Classification.

Unit - IV **9 Hours**

Multispectral and Hyper-spectral Image: Analysis and Application in remote sensing.

Unit - V **9 Hours**

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

Text Books

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

Reference Books

1. Gary L. Prost and G. L. Prost, "Remote Sensing for Geoscientists: Image Analysis and Integration",Taylor & Francis,3rd Edn. (onwards), 2013.
2. John A. Richards and Xiuping Jia, "Remote Sensing Digital Image Analysis An Introduction",

Springer, 4thEdn. (onwards), 2005.
3. Chen Ch, "Signal and Image Processing for Remote Sensing", Taylor & Francis, 2006 and onwards
4. Liu, "Essential Image Processing and GIS For Remote Sensing", John Wiley and Sons, 2009 and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
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
4. Analyze Multispectral and Hyper-spectral Image in remote sensing applications.	L4
5. Analyse GIS and also able to integrate Remote Sensing and Geographic Information Systems (GIS).	L4

Program Outcome of this course (POs)	PO No.
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.	1
2. **Design of Experiments**: Graduates shall possess the ability to design and conduct experiments, analyse and interpret data	2
3. **Research and Innovation**: Graduates shall have the ability to pursue research and provide innovative solutions.	11
4. **Self motivated Learning**: Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.	12

Course delivery methods	Assessment methods
1. Black board	1. IA Tests
2. Presentation	2. Assignment
	3. Activity

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	**Average of assignments (Two) / activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks: 50	30	10	10	50
➢ Writing two IA tests is compulsory. ➢ **Minimum marks required to qualify for SEE:** 20				

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

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. **Minimum marks required in SEE to pass:**40
3. 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.

Elective I: Machine Learning Algorithms

Course Code	17DCN154	**Credits**	4
Course type	PE – I	**CIE Marks**	50 marks
Hours/week: L-T-P	4 – 0 – 0	**SEE Marks**	50 marks
Total Hours:	45	**SEE Duration**	3 Hours for 100 marks

Course Learning Objectives (CLOs)

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

Unit – I 9 Hours

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

Unit – II 9 Hours

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

Unit - III 9 Hours

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

Unit - IV **9 Hours**

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

Unit - V **9 Hours**

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

Text Books

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

Reference Books

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

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
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

Program Outcome of this course (POs)	PO No.
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.	1
2. **Design of Experiments**: Graduates shall possess the ability to design and conduct experiments, analyse and interpret data	2
3. **Research and Innovation**: Graduates shall have the ability to pursue research and	11

provide innovative solutions.

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

Course delivery methods	Assessment methods
3. Black board	1. IA Tests
4. Presentation	2. Assignment
	3. Activity

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	**Average of assignments (Two) / activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks: 50	30	10	10	50
➢ Writing two IA tests is compulsory. ➢ **Minimum marks required to qualify for SEE:** 20				

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

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. **Minimum marks required in SEE to pass:**40
3. 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.

Lab: Advanced Communication Lab

Course Code	17DCN16	**Credits**	2
Course type	L1	**CIE Marks**	25 marks
Hours/week: L-T-P	0 – 0 – 3	**SEE Marks**	25 marks
Total Hours:	30	**SEE Duration**	3 Hours for 50 Marks

Course Learning Objectives (CLOs)

1. Enable the student understand the various Basic Digital Modulation techniques and their simulation
2. Enable the student understand advanced digital communication techniques and their simulation
3. Enable the student understand the concept of BER in digital communication techniques.
4. Compare different digital modulation techniques
5. Study Least Mean Square algorithm

List of Experiments

1. Amplitude Shift Keying
2. Frequency Shift Keying
3. Phase Shift Keying signal
4. Quadrature Phase Shift Keying (QPSK)
5. QPSK with Rayleigh fading & AWGN
6. M-ary QAM with AWGN fading
7. BER For BPSK Modulation With ZFE Equalizer In 3 Tap ISI Channel
8. BER for BPSK modulation with Minimum Mean Square Error (MMSE) equalization in 3 tap ISI channel.
9. Comparative analysis of BER for BPSK modulation in 3 tap ISI channel with ZFE and MMSE Equalization
10. Least Mean Square (LMS) Algorithm

Experiments 1, 2 3 and 4 shall be performed using Hardware and MATLAB
Experiments 5 to 10 shall be simulated using MATLAB

Text 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 Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Explain basic digital modulation techniques	L1
2. Discuss advanced digital modulation techniques and simulate	L2
3. Apply the knowledge digital modulation techniques and analyze them	L3
4. Explain the effect of BER in digital modulation	L5
5. Compare the modulation techniques on the basis of BER	L4/L5

Program Outcome of this course (POs)	PO No.
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.	1
2. **Design of Experiments**: Graduates shall possess the ability to design and conduct experiments, analyse and interpret data	2
3. **Research and Innovation**: Graduates shall have the ability to pursue research and provide innovative solutions.	11
4. **Self motivated Learning**: Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.	12

Assessment methods

1. Internal Test
2. Activity
3. Quiz

Scheme of Continuous Internal Evaluation (CIE):

Components	Conduct of the lab	Journal submission	Lab test	Total Marks
Maximum Marks: 25	10	10	5	25
➢ **Minimum marks required to qualify for SEE:** 13				

Scheme of Semester End Examination (SEE):

1. It will be conducted for 50 marks of 3 hours duration**. It will be reduced to 25 marks for the calculation of SGPA and CGPA.**

Initial write up	2*10 = 20 marks	
Conduct of experiments	2*10 = 20 marks	50 marks
Viva- voce	10 marks	

- **Submission and certification of lab journal is compulsory to qualify for SEE.**
- **Minimum marks required in SEE to pass: 20/50 (10/25)**
  - **Viva-voce shall be conducted for individual student and not in a group.**

Connected Devices

Course Code	17DCN21	**Credits**	4
Course type	PC1	**CIE Marks**	50 marks
Hours/week: L-T-P	4 – 0 – 0	**SEE Marks**	50 marks
Total Hours:	45	**SEE Duration**	3 Hours for 100 marks

Course Learning Objectives (CLOs)

1. Appreciate the importance of connected devices in the world of mobility.
2. Introduce to basic design aspects of IoT..
3. Abreast with recent developments in Internet of Things.
4. Provide insight into the design aspects of IoT applications
5. Introduce to the fundamental programming used to develop IoT applications

Unit – I **9 Hours**

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

Unit – II **9 Hours**

Domain Specific IoT's: Home automation , Cities, Environment, Energy, Retail, Logistics, Agriculture Industries, Health and Lifestyle, Python Programming, Case Study using Python.

Unit - III **9 Hours**

IoT and Machine to Machine(M2M): Introduction, M2M, difference between IoT and M2M, Protocol : MQTT, COAP and 6LowPAN

Unit - IV **9 Hours**

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

Unit - V **9 Hours**

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

Text Books

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

Reference Books

1. Carlos Pereira and Ana Aguiar,Towards Efficient Mobile M2M Communications: Survey and Open Challenges, Sensors 2014, 14, 19582-19608; doi:10.3390/s141019582
2. White Paper on "Machine-to-Machine Communication (M2M)"
3. Ernesto García Davis *, Anna Calveras and Ilker Demirkol " Improving Packet Delivery Performance of Publish/Subscribe Protocols in Wireless Sensor Networks "
4. *Sensors* **2013**, *13*, 648-680; doi:10.3390/s130100648
5. L.F. Schrickte, C. Montez and R. de Oliveira, Alex R. Pinto"Integration of Wireless Sensor Networks to the Internet of Things using a 6LoWPAN Gateway", IEEE Conference on Wireless Sensor Network, 2013

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Discuss the basics of IoT with reference to physical, logical and technological design.	L2
2. Describe the various IoT real time examples and write Python code for them.	L3,L4
3. Explain the M2M systems and Compare them with IoT systems	L2
4. Illustrate the IoT methodology for real time applications with Python programming	L4
5. Explain the various data analytics for IoT: Apache, Hadoop, YANG	L2

	Program Outcome of this course (POs)	PO No.
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 1**
2.	**Engineering Cognizance:** Graduates shall be able to stay a breast with recent developments in the field of Electronics and Communication Engg.	**PO 4**
3.	**Modern tool Usage**: Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.	**PO 5**
4.	**Soft Skills:** Graduates shall possess proficiency in oral and written communication skills.	**PO 9**
5.	**Self motivated Learning**: Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.	**PO 12**

Course delivery methods	**Assessment methods**
1.Black board 2.Presentation	1. IA Tests 2. Assignment 3. Activity

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	**Average of assignments (Two) / activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks: 50	30	10	10	50
➢ Writing two IA tests is compulsory. ➢ **Minimum marks required to qualify for SEE:** 20				

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

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. **Minimum marks required in SEE to pass:**40

3. 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.

Network Programming

Course Code	17DCN22	**Credits**	4
Course type	PC2	**CIE Marks**	50 marks
Hours/week: L-T-P	3 – 1 – 0	**SEE Marks**	50 marks
Total Hours:	45	**SEE Duration**	3 Hours for 100 marks

Course learning objectives (CLOs):

1. Understand the fundamentals of Network Programming.
2. Acquire knowledge on sockets.
3. Understand TCP / IP client-server communication.
4. Understand Elementary UDP sockets.
5. Understand Name/Address conversions, and interoperability between IPv4 and IPv6.

UNIT – I 9 Hours

Introduction:

Introduction, A Simple Daytime Client, Protocol Independence, Error Handling: Wrapper Functions, A Simple Daytime Server, OSI Model.

The Transport Layer – TCP, UDP, and SCTP:

Introduction, The Big Picture, UDP, TCP, SCTP, TCP Connection Establishment and Termination, TIME_WAIT State, SCTP Association Establishment and Termination, Port Numbers, TCP Port Numbers and Concurrent Servers, Buffer Sizes and Limitations.

UNIT – II 9 Hours

Sockets Introduction:

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.

Elementary TCP Sockets:

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

UNIT – III 9 Hours

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.

UNIT – IV **9 Hours**

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*.

UNIT – V **9 Hours**

Elementary Name and Address Conversions:

Introduction, Domain Name System, gethostbyname, gethostbyaddr, getservbyname,getservbyport, getaddrinfo, gai_strerror, freeaddrinfo, getaddrinfo, host_serv, tcp_connect, tcp_listen, udp_client, udp_connect, udp_server, getnameinfoFunctions, Re-entrant Functions, gethostbyname_r and gethostbyaddr_r Functions, Obsolete IPv6 Address Lookup Functions.

IPv4 and IPv6 Interoperability:

Introduction, IPv4 Client-IPv6 Server, IPv6 Client-IPv4 Server, IPv6 Address-Testing Macros, Source Code Portability.

Text Books:

1. W. Richard Stevens, Bill Fenner, Andrew M. Rudoff: "UNIX Network Programming", 3rd edition, Volume 1, Pearson Education, 2004 and onwards.

Reference Books:

1. W. Richard Stevens: "UNIX Network Programming", 2nd edition, Volume 1, Pearson Education, 2002 and onwards.
2. Barry Nance: "Network Programming in C", PHI, 2002 and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to		Bloom's Level
1.	Explain the fundamentals of Network Programming. Compare and Contrast TCP and UDP.	L2, L4
2.	Explain sockets and functions. Design concurrent servers.	L2, L6
3.	Examine and Explain TCP client / server example.	L2, L4
4.	Compare TCP and UDP sockets.	L4
5.	Explain the Importance of DNS, and interoperability between IPv4 and IPv6.	L2

	Program Outcome of this course (POs)	**PO No.**
1.	**Engineering Cognizance:** Graduates shall be able to stay abreast with recent developments in the field of Digital Communication and Networking.	4
2.	**Self motivated Learning:** Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.	12

	Course delivery methods		**Assessment methods**
1.	Chalk / Blackboard	1.	Assignments
2.	Presentations	2.	Internal Assessment Tests
3.	Notes	3.	Tutorials

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two tests out of three	Average of two assignments	Quiz / Seminar / 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.

Tutorials

Download, install and study features & commands of CYGWIN software. Implement following programmes using CYGWIN software.

1. Implement daytime client program using TCP sockets.
2. Implement daytime server program using TCP sockets.
3. Write a program to simulate a TCP client that performs two simultaneous connections to server. Design the server as a concurrent server.
4. Develop a TCP client/server in which client sends two numbers to the server in a single message. Server returns sum, difference and product as a result in a single message. Client program should print the results appropriately.
5. Write a program to implement a file transfer protocol using socket programming.

.

Advanced Communication Networks

Course Code	17DCN23	**Credits**	4
Course type	PC3	**CIE Marks**	50 marks
Hours/week: L-T-P	4 – 0 – 0	**SEE Marks**	50 marks
Total Hours:	45	**SEE Duration**	3 Hours for 100 marks

Course Learning Objectives (CLOs)

1. Learn the architecture of high performance networks.
2. Study mathematical models related to network performance analysis.
3. Understand Internet and TCP / IP Networks.
4. Learn and understand ATM networks.
5. Learn and understand High Performance Networks such as WiMAX, LTE etc.

Unit – I 9Hours

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.

Unit – II 9Hours

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.

Unit – III 9Hours

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.

Unit – IV 9Hours

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.

Unit – V 9Hours

High Performance Networks: WiMAX overview, Competing technologies, Overview of the physical layer, PMP mode, Mesh mode, Multihop relay mode, UWB overview, Time hopping UWB, Direct sequence UWB, Multiband UWB,

LTE and LTE–A: Overview, System model, Specifications, Frame structure, Comparison with broadband technologies.

Text Books

1. Jean Warland and Pravin Varaiya, "High Performance Communication Networks", 2nd Edn. (onwards), Harcourt and Morgan Kanffman Publishers, London, 2008 and onwards.
2. Leon Gracia and Widjaja, "Communication Networks", Tata McGraw Hill, 3rd Edn. (onwards), 2008 and onwards.
3. LumitKasera and Pankaj Sethi, "ATM Networks: Concepts and Protocols", Tata McGraw Hill, 2007 and onwards.
4. Jeffrey G. Andrews, Arunabha Ghosh and Rias Muhamed, "Fundamentals of WiMAX Understanding Broadband Wireless Networking", Prentice Hall of India, 2008 and onwards.
5. Amitabha Ghosh and RapeepatRatasuk, "Essentials of LTE and LTE-A", Cambridge University, 2011 and onwards.

Other Resources

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

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Explain Network Services and Layered Architecture	L2
2. Explain MANET	L2
3. Develop the various topologies.	L3
4. Understand services offered by broadband, TCP/ IP, ATM.	L2
5. Develop the fundamentals WiMAX and UWB networks.	L3

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Digital Communication and Networking.	1
2. **Engineering Cognizance:** Graduates shall be able to stay abreast with recent developments in the field of Digital Communication and Networking.	4
3. **Impact of Engineering:** Graduates shall be able to understand the impact of engineering solutions in a global, economic, environmental and societal context.	6
4. **Self motivated Learning:** Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.	12

Course delivery methods	Assessment methods
1. Blackboard	1. Internal Assessment Tests
2. Presentations	2. Activity
	3. Assignments

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	**Average of assignments (Two) / activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks: 50	30	10	10	50
➢ Writing two IA tests is compulsory. ➢ **Minimum marks required to qualify for SEE:** 20				

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

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. **Minimum marks required in SEE to pass:**40
3. 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.

Advanced Wireless Communication

Course Code	17DCN24	**Credits**	4
Course type	PC4	**CIE Marks**	50 marks
Hours/week: L-T-P	4 – 0 – 0	**SEE Marks**	50 marks
Total Hours:	45	**SEE Duration**	3 Hours for 100 marks

Course Learning Objectives (CLOs)

1. Introduce the basic concepts of wireless communication and wireless devices.
2. Familiarize the effects of interference and to analyze traffic for wireless communication.
3. Study Wireless fading channel modeling and characterization.
4. Introduce the modulation and detection schemes and their performance over fading channels.
5. Understand the working of future generation of Wireless Systems.

Unit – I 9 Hours

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].

Unit –II 9 Hours

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].

Unit –III 9 Hours

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].

Unit –IV 9 Hours

Capacity of wireless channels: AWGN channel capacity, Resources of the AWGN Channel, LTI Gaussian Channels, Capacity of fading Channels [Ref. 3, Ch.5].

MIMO I: Multiple Input-Multiple Output systems, Advantages and applications of MIMO, MIMO applications in 3G [Ref. 2, Ch. 20.2, Ref. 4, Ch.5].

Unit –V 9 Hours

MIMO II: 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].

Text Books

1. Jochen Schiller, "Mobile communications",PearsonEducationInc., 2nd Edn. (onwards),2011.
2. Andreas Molisch, "Wireless Communications", John Wiley and Sons Ltd., 2nd Edn. (onwards), 2013.
3. David Tseand P. Vishwanath, "Fundamentals of Wireless Communication", Cambridge University Press, 2nd Edn. (onwards), 2010.
4. William C Y Lee, "Mobile Communications Engineering Theory and applications", Tata McGraw Hill, 2nd Edn. (onwards), 2008.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
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. Understand the information theoretical aspects (such as the capacity and resources) of wireless channels.	L1
5. Describe and evaluate receiver and transmitter diversity techniques and Interpret the knowledge and awareness of the basic spread spectrum techniques in wireless system.	L2, L4

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Digital Communication and Networking.	1
2. **Design of Experiments:** Graduates shall possess the ability to design and conduct experiments, analyse and interpret data.	2
3. **Engineering Cognizance:** Graduates shall be able to stay abreast with recent developments in the field of Digital Communication and Networking.	4
4. **Soft skills:** Graduates shall possess proficiency in oral and written communication skills.	9
5. **Self motivated Learning:** Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.	12

Course delivery methods	Assessment methods
1. Blackboard Teaching	1. Internal Assessment
2. Presentations	2. Assignment
	3. Activity

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	**Average of assignments (Two) / activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks: 50	30	10	10	50
➢ Writing two IA tests is compulsory. ➢ **Minimum marks required to qualify for SEE:** 20				

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

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. **Minimum marks required in SEE to pass:**40
3. 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.

Elective II: Cloud Computing

Course Code	17DCN251	**Credits**	4
Course type	PE – II	**CIE Marks**	50 marks
Hours/week: L-T-P	4 – 0 – 0	**SEE Marks**	50 marks
Total Hours:	45	**SEE Duration**	3 Hours for 100 marks

Course Learning Objectives (CLOs)

1. Learn how to use Cloud Services.
2. Implement Virtualization.
3. Implement Task Scheduling algorithms.
4. Apply Map-Reduce concept to applications.
5. Build Private Cloud.

Unit – I 9Hours

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.

Unit – II 9 Hours

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 Grep The Web application , Cloud for science and engineering, High-performance computing on a cloud, Cloud computing for Biology research, Social computing, digital content and cloud computing.

Unit – III 9 Hours

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

Unit – IV 9 Hours

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.

Unit –V **9 Hours**

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.

Text Books

1. Dan C Marinescu, "Cloud Computing Theory and Practice", Elsevier (MK),1st Edn. (onwards), 2013 and onwards.

Reference Books

1. RajkumarBuyya, James Broberg and Andrzej Goscinski,"Cloud Computing Principles and Paradigms", Willey, 2nd Edn. (onwards), 2014 and onwards.
2. John W Rittinghouse and James F Ransome, "Cloud Computing Implementation, Management and Security", 1st Edn. (onwards), CRC Press 2013 and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Demonstrate and experiment simple Cloud Applications and apply resource allocation, scheduling algorithms.	L5
2. Implement Map-Reduce concept.	L6
3. Create virtual machines from available physical resources.	L6
4. Setup a private cloud.	L5
5. Familiarize with Open Stack.	L2, L3

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Digital Communication and Networking.	1
2. **Design of Experiments:** Graduates shall possess the ability to design and conduct experiments, analyse and interpret data.	2
3. **Engineering Cognizance:** Graduates shall be able to stay abreast with recent developments in the field of Digital Communication and Networking.	4
4. **Modern tool Usage:** Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.	5
5. **Research and Innovation:** Graduates shall have the ability to pursue research and provide innovative solutions.	11

Course delivery methods	Assessment methods
1. Classroom Teaching (Blackboard)	1. IA test
2. Presentation	2. Assignment
3. Video presentations	3. Activity

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	**Average of assignments (Two) / activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks: 50	30	10	10	50
➢ Writing two IA tests is compulsory. ➢ **Minimum marks required to qualify for SEE:** 20				

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

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. **Minimum marks required in SEE to pass:**40
3. 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.

Elective II: Optical Networks

Course Code	17DCN252	**Credits**	4
Course type	PE – II	**CIE Marks**	50 marks
Hours/week: L-T-P	4 – 0 – 0	**SEE Marks**	50 marks
Total Hours:	45	**SEE Duration**	3 Hours for 100 marks

Course Learning Objectives (CLOs)

1. Learn the basic elements of optical fiber transmission link, fiber modes configurations and structures.
2. Understand the different kind of losses, signal distortion in optical wave guides and other signal degradation factors.
3. Learn the various optical source materials, LED structures, quantum efficiency, Laser diodes.
4. Learn the fiber optical network components, variety of networking aspects, FDDI, SONET/SDH and operational principles of WDM.
5. Acquire knowledge about fault and congestion management.

Unit - I 9 Hours

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.

Unit – II 9 Hours

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

Unit – III 9 Hours

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.

Unit – IV **9 Hours**

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

Unit – V **9 Hours**

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.

Text Books

1. Rajeev Ramaswamy, Kumar N Sivarajan and Galen H Sasaki, "Optical Networks", Elsevier Publication 3rd Edn. (onwards), 2009.

Reference Books

1. Uyless Black, "Optical Networks-Third generation transport system", Pearson, 2013 and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Design a system, component or process as per needs and specification. .	L6
2. Gain knowledge on optical network architectures ranging from optical access networks to backbone optical transport networks.	L2, L3
3. Gain the knowledge on methodologies of optical network design optimization;	L2, L3
4. Explore techniques of optical network survivability.	L2
5. Solve the Problems in the discipline of optical networks.	L5

Program Outcome of this course (POs)	PO No.
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.	1
2. **Design of Experiments**: Graduates shall possess the ability to design and conduct experiments, analyze and interpret data	2
3. **Research and Innovation**: Graduates shall have the ability to pursue research and provide innovative solutions.	11
4. **Self motivated Learning**: Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.	12

Course delivery methods	Assessment methods
1.Black board 2.Presentation	1. IA Tests 2. Assignment 3. Activity

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	**Average of assignments (Two) / activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks: 50	30	10	10	50
➢ Writing two IA tests is compulsory. ➢ **Minimum marks required to qualify for SEE:** 20				

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

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. **Minimum marks required in SEE to pass:**40
3. 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.

Elective II: Cyber Physical Systems

Course Code	17DCN253	**Credits**	4
Course type	PE – II	**CIE Marks**	50 marks
Hours/week: L-T-P	4 – 0 – 0	**SEE Marks**	50 marks
Total Hours:	45	**SEE Duration**	3 Hours for 100 marks

Course Learning Objectives (CLOs)

1. Understand the concept of cyber physical systems (CPS) and know the fundamentals research challenges in this area.
2. Understand the networked interoperability in heterogeneous CPS systems.
3. Improving critical reading, presentation, and research skills
4. Understand feedback control and closed loop design in new CPS systems

Pre-requisites: Background in embedded systems and computer networking is necessary.

Unit – I **9 Hours**

Introduction, Modeling Dynamic Behaviors, Basics of Discrete systems, Hybrid systems,Hierarchical State machines.

Self learning Topics: Data flow and timed models of computation.

Unit – II **9 Hours**

Embedded processors, Types and parallelism ,Memory Architecture, Technology Heirarchy and Models.

Unit - III **9 Hours**

I/O, I/O hardware, Sequential Software, Analog/Digital Interface, Multitasking, Imperative programs and threads, Processes and Message passing, Scheduling bascis, Rate monotonic,Earliest Deadline first

Self learning Topics: Scheduling and Mutual Exclusion ,Multiprocessor scheduling

Unit - IV **9 Hours**

Invariants and temporal logic, linear temporal logic, equivalence and refinement, Models as specifications, Type equivalence and refinement

Unit - V **9 Hours**

Open and closed systems, Reachability analysis, Abstraction in model checking, Quantitative analysis, Factors determining execution time, Execution time analysis.

Text Books

1. Introduction to Embedded Systems - A Cyber-Physical Systems Approach, Edition 1.5, by E. A. Lee and S. A. Seshia, 2014 and onwards.
   The book is available in two forms: a free PDF download and low-cost paperback.
2. Other readings for this course will be in the form of research papers which will be made available to students during course delivery.

Course Outcome (COs)

At the end of the course, the student will be able to		Bloom's Level
1.	Understand the concept of cyber physical systems	L2
2.	Examine the current state of art in CPS systems and applications.	L3
3.	Recognize how to model sensor and actuators in system design	L3
4.	Learn system-modeling techniques and timed automata.	L2
5.	Examine real-time scheduling method and know how to analyze timing properties with physical constraints	L4

	Program Outcome of this course (POs)	**PO No.**
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.	1
2.	**Design of Experiments**: Graduates shall possess the ability to design and conduct experiments, analyse and interpret data	2
3	**Engineering Cognizance:** Graduates shall be able to stay abreast with recent developments in the field of Digital Communication and Networking.	4
4.	**Research and Innovation**: Graduates shall have the ability to pursue research and provide innovative solutions.	11
5.	**Self motivated Learning**: Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.	12

Course delivery methods

1.Black board

2.Presentation

Assessment methods

1. IA Tests
2. Assignment
3. Activity

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	**Average of assignments (Two) / activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks: 50	30	10	10	50
➢ Writing two IA tests is compulsory. ➢ **Minimum marks required to qualify for SEE:** 20				

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

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. **Minimum marks required in SEE to pass:**40

3. 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.

Elective II: Ad-hoc Networks

Course Code	17DCN254	**Credits**	4
Course type	PE – II	**CIE Marks**	50 marks
Hours/week: L-T-P	4 – 0 – 0	**SEE Marks**	50 marks
Total Hours:	45	**SEE Duration**	3 Hours for 100 marks

Course Learning Objectives (CLOs)

1. Understand the constraints of the wireless physical layer that affect the design and performance of ad hoc and sensor networks, protocols, and applications.
2. Get skilled in wireless networks technology platforms and standards.
3. Learn real time traffic support in wireless networks with working principles of wireless LAN.
4. Understand the Principles of Ad hoc networks.
5. Realize the necessity for mesh networks

Unit – I 9 Hours

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

Unit – II 9 Hours

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.

Unit - III 9 Hours

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

Unit - IV 9 Hours

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

Unit - V 9 Hours

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.

Text Books

1. C.SivaRamMurthyandB.Smanoj,"AdHocWirelessNetworks–ArchitecturesandProtocols" ,PearsonEducation, 2004 and onwards.
2. FengZhaoandLeonidasGuibas,"WirelessSensor Networks",MorganKaufman Publishers, 2004 and onwards.
3. C.K.Toh,"AdHocMobileWirelessNetworks",PearsonEducation,2002 and onwards.
4. ThomasKragandSebastinBuettrich,"WirelessMeshNetworking",O'Reilly Publishers, 2007 and

onwards.

Course Outcome (COs)

At the end of the course, the student will be able to		Bloom's Level
1.	Describe the issues in Ad-Hoc Wireless Networks.	L2
2.	Understand current technology trends for the implementation and deployment of wireless ad-hoc network routing.	L2,L3
3.	Describe sensor network architecture and MAC.	L2
4.	Comprehend QoS Issues in WSN Routing.	L3
5.	Understand the necessity for mesh networks.	L2

	Program Outcome of this course (POs)	**PO No.**
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.	1
2.	**Design of Experiments**: Graduates shall possess the ability to design and conduct experiments, analyse and interpret data	2
3.	**Research and Innovation**: Graduates shall have the ability to pursue research and provide innovative solutions.	11
4.	**Self motivated Learning**: Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.	12

Course delivery methods	**Assessment methods**
1.Black board	1. IA Tests
2.Presentation	2. Assignment
	3. Activity

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	**Average of assignments (Two) / activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks: 50	30	10	10	50
➢ Writing two IA tests is compulsory. ➢ **Minimum marks required to qualify for SEE:** 20				

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

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. **Minimum marks required in SEE to pass:**40

3. 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.

Lab: IoT Lab

Course Code	17DCN26	**Credits**	2
Course type	L2	**CIE Marks**	25 marks
Hours/week: L-T-P	0 – 0 – 3	**SEE Marks**	25 marks
Total Hours:	30	**SEE Duration**	3 Hours for 50 Marks

Course Learning Objectives (CLOs)

1. Understand various standard IoT platforms.
2. Study specialized IoT platforms.
3. Study and understand Communication and data protocols in IoT.
4. Study identification and semantic protocols.
5. Introduce to the fundamental programming used to develop IoT applications.

List of Experiments:

1. Experiment to understand Amazon IoT platform
2. Experiment to understand Google IoT platform
3. Experiment to understand ThingSpeak IoT platform
4. Experiment to understand Ubidots IoT platform
5. Experiment to understand IoTData Protocols (ex: MQTT, CoAP, AMQP, Websocket, Node)
6. Experiment to understand IoTComms / Transport protocols (ex: Wifi, Bluetooth, LPWAN)
7. Experiment to understand IoTIdentification protocols (ex: EPC, uCode, IPv6, URIs)
8. Experiment to understand IoTSemantic protocols (ex: JSON-LD, Web Thing Model)
9. Mini project – 1 (Application based)
10. Mini project – 2 (Application based)

Books

1. Wang, Yongheng., "Internet of Things", Springer Berlin Heidelberg
2. Zhou, Honbo., "The internet of things in the cloud" , Boca Raton : CRC Press, 2013 and onwards

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Discuss various standard IoT platforms	L2
2. Compare specialized IoT platforms	L5
3. Illustrate Communication and data protocols in IoT	L2
4. Illustrate identification and semantic protocols	L2
5. Develop IoT application model through mini projects	L6

	Program Outcome of this course (POs)	PO No.
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 1**
2.	**Design of Experiments:** Graduates shall possess the ability to design and conduct experiments, analyse and interpret data.	**PO 2**
3.	**Modern tool Usage:** Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.	**PO 5**

Assessment methods

1. Internal Test
2. Activity

Scheme of Continuous Internal Evaluation (CIE):

Components	Conduct of the lab	Journal submission	Lab test	Total Marks
Maximum Marks: 25	10	10	5	25
➢ **Minimum marks required to qualify for SEE:** 13				

Scheme of Semester End Examination (SEE):

1. It will be conducted for 50 marks of 3 hours duration**. It will be reduced to 25 marks for the calculation of SGPA and CGPA.**

Initial write up	2*10 = 20 marks	
Conduct of experiments	2*10 = 20 marks	50 marks
Viva- voce	10 marks	

- **Submission and certification of lab journal is compulsory to qualify for SEE.**
- **Minimum marks required in SEE to pass: 20/50 (10/25)**
- **Viva-voce shall be conducted for individual student and not in a group.**

Error Control Coding

Course Code	17DCN41	**Credits**	4
Course type	PC1	**CIE Marks**	50 marks
Hours/week: L-T-P	3 – 1 – 0	**SEE Marks**	50 marks
Total Hours:	45	**SEE Duration**	3 Hours for 100 marks

Course Learning Objectives (CLOs)

1. Understand the concepts of modern algebra that are necessary to understand the Error Control Coding, also, Linear Block is introduced and develops error detection capability of linear codes.
2. Appreciate Several important classes of linear codes in communication along with Reed-Muller codes are presented and the basic structure and properties of cyclic codes are explained with syndrome-based decoding methods.
3. Design the error detection and correction system using BCH codes for error detection and implement hardware and software for BCH decoders.
4. Understand the importance of majority-logic decodable codes and learn basic state diagram to study convolutional code structure and distance properties along with Viterbi decoding algorithm.
5. Provide comprehensive introduction to new advanced coding techniques namely, concatenated codes, parallel concatenation or turbo coding, and presents methods for correcting the burst errors and combinations of burst and random errors commonly encountered on fading channels.

Pre-requisites:

1. Digital Communication
2. Information Theory Coding

Unit – I 9Hours

Introduction to algebra: Groups, Fields, binary fields arithmetic, Construction of Galois Fields GF (2^m) and its properties, Computation using Galois filed GF (2^m) arithmetic, Vector spaces and Matrices.

Linear block codes: Generator and parity check matrices, Encoding circuits, Syndrome and error detection, Minimum distance considerations, Error detecting and error correcting capabilities, Standard array and syndrome decoding, decoding circuits

Unit – II 9 Hours

Important Linear block codes: Hamming codes, Reed-Muller codes. Golay codes, Product codes and interleaved codes.

Cyclic codes: Introduction, Generator and parity check polynomials, Encoding using multiplication circuits, Systematic cyclic codes - Encoding using feedback shift register circuits, generator matrix for cyclic code, Syndrome computing and error detection, Meggitt decoder.

Unit – III 9 Hours

BCH codes: Binary primitive BCH codes, Decoding procedures, Implementation of Galois fields arithmetic, Implementation of error correction.

Non-binary BCH codes: q-ary linear block codes, Primitive BCH codes over GF(q), Reed -Solomon codes, decoding of non-binary BCH and RS codes: The Berlekamp - Massey Algorithm.

Unit – IV 9 Hours

Majority Logic decodable codes: One -step majority logic decoding, One-step majority logic decodable codes, Two-step majority logic decoding, Multiple-step majority logic decoding.

Convolution codes: Encoding of convolutional codes, Structural properties, Distance properties,

Viterbi decoding algorithm for decoding, Majority logic decoding.

Unit –V **9 Hours**

Concatenated codes and Turbo codes: Single level concatenated codes, Multilevel concatenated codes, Introduction to Turbo coding and their distance properties, design of Turbo codes.

Burst - error - Correcting codes: Introduction, Decoding of Single-Burst-Error-Correcting Codes Cyclic codes, Single-Burst-Error-Correcting Codes, Burst and random error correcting codes, Burst-Error-Correcting Convolutional Codes.

Text Books

1. Shu Lin and Daniel J. Costello, Jr., "Error Control Coding: Fundamentals and Applications," Pearson Education, Prentice Hall.

Reference Books

1. Blahut R. E, "Theory and Practice of Error Control Codes", Addisson Wesley.
2. Stephen B. Wicker, "Error Control Systems for Digital Communication and Storage," Prentice Hall.
3. Peterson, W. W. and E.J. Weldon, Jr., "Error-Correcting Codes", the M.I.T. Press, Cambridge.

Tutorial

1. Write MATLAB program to verify that $1 + X + X^3$ is a primitive polynomial; that is, it divides $X^7 - 1$ but not $X^n - 1$ for $0 < n < 7$.
2. Write MATLAB program to convert the power representation to the polynomial representation for Galois field.
3. Encoding messages for a forward error correction system with a given **Linear block code,** decode the encoded messages and verify through MATLAB simulation.
4. Encoding the messages for a communication system with a given **Cyclic polynomial code,** decode the encoded messages and verify through simulation.
5. Demonstrate the use of **Binary Cyclic code** in communication system using Simulink.
6. Write a MATLAB program to perform **BCH** encoding and decoding.
7. Write a MATLAB program to perform **RS** encoding and decoding.
8. Write a MATLAB program that **convolutionally** encodes a given binary data sequence and decode binary convolutional codes using the **Viterbi algorithm**.
9. Write MATLAB program to demonstrate other **Channel coding** schemes and compare the performance.
10. Simulate the performance of concatenation of the (2,1,3) **convolutional code** and the (7,4) **RS code**. Compare the error probability with that of the individual codes.
11. Demonstrate the **Burst-error correcting** codes applicable to communication systems
12. Write a MATLAB program to underline the importance of **Turbo codes** in communication system.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Apply the concept of modern linear algebra for the error control coding technique and demonstrate efficient optimized linear block coder and decoder for communication systems.	L2, L3

2.	Develop and analyze the encoding and decoding procedures of cyclic codes.	L4, L3
3.	Apply linear block code and BCH code for error detection and correction.	L3
4.	Analyze the performance of majority logic decoder and study applicability to convolutional codes.	L4
5.	Outline the application of concatenated, turbo, burst-error corrections codes in fading channel.	L2

Program Outcome of this course (POs)	**PO No.**
1. **Fundamentals of Engineering:**Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Digital Communication and Networking.	1
2. **Design of Experiments:** Graduates shall possess the ability to design and conduct experiments, analyse and interpret data.	2
3. **Engineering Cognizance:** Graduates shall be able to stay abreast with recent developments in the field of Digital Communication and Networking.	3
4. **Research and Innovation:**Graduates shall have the ability to pursue research and provide innovative solutions.	11

Course delivery methods	**Assessment methods**
1. Classroom Teaching	1. Internal Assessment Tests
2. Presentation	2. Assignments
3. Animations	3. Seminar
4. Videos	4. IEEE paper implementation

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	**Average of assignments (Two) / activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks: 50	30	10	10	50
➢ Writing two IA tests is compulsory. ➢ **Minimum marks required to qualify for SEE:** 20				

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

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. **Minimum marks required in SEE to pass:**40
3. 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.

Elective – III: Speech Processing

Course Code	17DCN421	**Credits**	4
Course type	PE – III	**CIE Marks**	50 marks
Hours/week: L-T-P	4 – 0 – 0	**SEE Marks**	50 marks
Total Hours:	45	**SEE Duration**	3 Hours for 100 marks

Course Learning Objectives (CLOs)

1. Introduce speech production and related parameters of speech.
2. Show the computation and use of techniques such as short time Fourier transform, linear predictive coefficients and other coefficients in the analysis of speech.
3. Understand different speech modeling procedures such as Markov and their implementation issues.
4. Study large large vocabulary continuous speech recognition system and its architecture.
5. Study various text-to-speech synthesis methods and its applications.

Unit – I **9Hours**

Basic Concepts: Speech Fundamentals: Articulatory Phonetics – Production and Classification of Speech Sounds; Acoustic Phonetics – Acoustics of speech production; Review of Digital Signal Processing concepts; Short-Time Fourier Transform, Filter-Bank and LPC Methods.

Unit – II **9Hours**

Speech Analysis: Features, Feature Extraction and Pattern Comparison Techniques: Speech distortion measures– mathematical and perceptual – Log–Spectral Distance, Cepstral Distances, Weighted Cepstral Distances and Filtering, Likelihood Distortions, Spectral Distortion using a Warped Frequency Scale, LPC, PLP and MFCC Coefficients, Time Alignment and Normalization – Dynamic Time Warping, Multiple Time – Alignment Paths.

Unit – III **9Hours**

Speech Modeling: Hidden Markov Models: Markov Processes, HMMs – Evaluation, Optimal State Sequence – Viterbi Search, Baum-Welch Parameter Re-estimation, and Implementation issues.

Unit – IV **9Hours**

Speech Recognition: Large Vocabulary Continuous Speech Recognition: Architecture of a large vocabulary continuous speech recognition system – acoustics and language models – n-grams, context dependent sub-word units; Applications and present status.

Unit – V **9Hours**

Speech Synthesis: Text-to-Speech Synthesis: Concatenative and waveform synthesis methods, sub-word units for TTS, intelligibility and naturalness – role of prosody, Applications and present status.

Text Books

1. Lawrence Rabiner and Biing-Hwang Juang, "Fundamentals of Speech Recognition", Pearson Education, 2003 and onwards.
2. Daniel Jurafsky and James H Martin, "Speech and Language Processing – An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", Pearson Education, 2002 and onwards .
3. Frederick Jelinek, "Statistical Methods of Speech Recognition", MIT Press, 1997 and onwards.

Reference Books

1. Steven W. Smith, "The Scientist and Engineer"s Guide to Digital Signal Processing", California Technical Publishing, 1997 and onwards.

2. Thomas F Quatieri, "Discrete-Time Speech Signal Processing – Principles and Practice", Pearson Education, 2004 and onwards.
3. Claudio Becchetti and Lucio Prina Ricotti, "Speech Recognition", John Wiley and Sons, 1999 and onwards.
4. Ben Gold and Nelson Morgan, "Speech and Audio Signal Processing, Processing and Perception of Speech and Music", Wiley- India Edition, 2006 and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Model speech production system and describe the fundamentals of speech	L6
2. Extract and compare different speech parameters.	L5
3. Choose an appropriate statistical speech model for a given application.	L3
4. Design a speech recognition system	L6
5. Use different speech synthesis techniques	L4

Program Outcome of this course (POs)	PO No.
1. **Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Digital Communication and Networking.	1
2. **Design of Experiments:** Graduates shall possess the ability to design and conduct experiments, analyse and interpret data.	2
3. **Modern tool Usage:** Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.	5
4. **Self motivated Learning:** Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.	12

Course delivery methods	Assessment methods
1. Blackboard Teaching	1. Internal Assessment
2. Presentation and Simulation	2. Case Study
3. Videos	3. Assignment

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	**Average of assignments (Two) / activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks: 50	30	10	10	50
➢ Writing two IA tests is compulsory. ➢ **Minimum marks required to qualify for SEE:** 20				

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

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. **Minimum marks required in SEE to pass:**40

3. 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.

Elective – III: Communication Network Modeling and Simulation

Course Code	17DCN422	**Credits**	4
Course type	PE – III	**CIE Marks**	50 marks
Hours/week: L-T-P	4 – 0 – 0	**SEE Marks**	50 marks
Total Hours:	45	**SEE Duration**	3 Hours for 100 marks

Course Learning Objectives (CLOs)

1. Study general computer network model with time related concepts.
2. 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. Study data flow and rate control mechanism in the network.

Unit – I **9 Hours**

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.

Unit –II **9 Hours**

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

Unit –III **9 Hours**

Routing in Data Networks : Introduction, Network Algorithms and Shortest Path Routing, Broadcasting Routing Information : Coping with Link Failures,.

Unit –IV **9 Hours**

Optimization in Routing : 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.

Unit –V **9 Hours**

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

Text Books

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

Reference Books

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

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
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
5. Develop improved shortest path routing algorithms.	L3

Program Outcome of this course (POs)	**PO No.**
1. **Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Digital Communication and Networking.	1
2. **Engineering Cognizance:** Graduates shall be able to stay abreast with recent developments in the field of Digital Communication and Networking.	4
3. **Self motivated Learning:** Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.	12

Course delivery methods	**Assessment methods**
1. Blackboard Teaching	1. Internal Assessment
2. Presentations	2. Assignment
	3. Quiz

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	**Average of assignments (Two) / activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks: 50	30	10	10	50
➢ Writing two IA tests is compulsory. ➢ **Minimum marks required to qualify for SEE:** 20				

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

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. **Minimum marks required in SEE to pass:**40
3. 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.

Elective – III: Sensor Networks

Course Code	17DCN423	**Credits**	4
Course type	PE – III	**CIE Marks**	50 marks
Hours/week: L-T-P	4 – 0 – 0	**SEE Marks**	50 marks
Total Hours:	45	**SEE Duration**	3 Hours for 100 marks

Course Learning Objectives (CLOs)

1. Prepare for the challenges in Networking tools.
2. Understand the concept of Architecture and Operating systems.
3. Analyze the concept of physical layer and protocols.
4. Understand Energy Efficient Routing and Geographic Routing.
5. Prepare for the challenges in Networking tools.

Unit – I **9Hours**

Overview of Wireless Sensor Networks: Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks.

Unit – II **9Hours**

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.

Unit – III **9Hours**

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.

Unit – IV **9Hours**

Infrastructure Establishment: Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control.

Unit – V **9Hours**

Sensor Network Platforms and Tools: Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators, State-centric programming.

Text Books

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

Reference Books

1. KazemSohraby, Daniel Minoli, andTaiebZnati, “Wireless Sensor Networks-Technology, Protocols, And Applications”, John Wiley, 2007 (onwards).
2. Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003 and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to		Bloom's Level
1.	Demonstrate familiarity with common wireless sensor node architectures.	L5
2.	Be able to carry out simple analysis and planning of WSN.	L3, L4
3.	Demonstrate knowledge of MAC protocols developed for WSN.	L5
4.	Demonstrate knowledge of routing protocols developed for WSN.	L5
5.	Demonstrate familiarity with mobile data-centric networking principles.	L5
6.	Demonstrate familiarity with WSN standards.	L5

	Program Outcome of this course (POs)	**PO No.**
1.	**Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Digital Communication and Networking.	1
2.	**Design of Experiments:** Graduates shall possess the ability to design and conduct experiments, analyse and interpret data.	2
3.	**Engineering Cognizance:** Graduates shall be able to stay abreast with recent developments in the field of Digital Communication and Networking.	4
4.	**Modern tool Usage:** Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.	5
5.	**Self motivated Learning:** Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.	12

	Course delivery methods		**Assessment methods**
1.	Blackboard Teaching	1.	Internal Assessment
2.	Presentation	2.	Activity
		3.	Assignment

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	**Average of assignments (Two) / activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks: 50	30	10	10	50
➢ Writing two IA tests is compulsory. ➢ **Minimum marks required to qualify for SEE:** 20				

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

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. **Minimum marks required in SEE to pass:**40
3. 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.

Elective – III: Big Data

Course Code	17DCN424	Credits	4
Course type	PE – III	CIE Marks	50 marks
Hours/week: L-T-P	4 – 0 – 0	SEE Marks	50 marks
Total Hours:	45	SEE Duration	3 Hours for 100 marks

Course Learning Objectives (CLOs)

1. Learn tips and tricks for Big Data use cases and solutions.
2. Learn to build and maintain reliable, scalable, distributed systems with Apache Hadoop.
3. Study hadoop architecture and anatomy of file read and write.
4. Apply hadoop ecosystem components.
5. Learn Hive Architecture and Installation.

Unit – I 9Hours

Introduction to Big Data: Introduction – distributed file system – Big Data and its importance, Four Vs, Drivers for Big data, Big data analytics, Big data applications. Algorithms using map reduce, Matrix-Vector Multiplication by Map Reduce.

Unit – II 9Hours

Introduction Hadoop: Big Data – Apache Hadoop & Hadoop EcoSystem – Moving Data in and out of Hadoop – Understanding inputs and outputs of MapReduce - Data Serialization.

Unit – III 9Hours

Hadoop Architecture: Hadoop Architecture, Hadoop Storage: HDFS, Common Hadoop Shell commands , Anatomy of File Write and Read., NameNode, Secondary NameNode, and DataNode, Hadoop MapReduce paradigm, Map and Reduce tasks, Job, Task trackers - Cluster Setup – SSH & Hadoop Configuration – HDFS Administering –Monitoring & Maintenance.

Unit – IV 9Hours

Hadoop Ecosystem and Yarn: Hadoop ecosystem components - Schedulers - Fair and Capacity, Hadoop 2.0 New Features-NameNode High Availability, HDFS Federation, MRv2, YARN, Running MRv1 in YARN.

Unit – V 9Hours

Hive and Hiveql, HBase: Hive Architecture and Installation, Comparison with Traditional Database, HiveQL - Querying Data - Sorting And Aggregating, Map Reduce Scripts, Joins & Subqueries, HBase concepts-Advanced Usage, Schema Design, Advance Indexing - PIG, Zookeeper - how it helps in monitoring a cluster, HBase uses Zookeeper and how to Build Applications with Zookeeper.

Text Books

1. Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, “Professional Hadoop Solutions”, Wiley, ISBN: 9788126551071, 2015.
2. Chris Eaton, Dirk deroos et al. , “Understanding Big data ”, McGraw Hill, 2012 and onwards.

Reference Books

3. Tom White, “HADOOP: The definitive Guide” , O Reilly 2012 and onwards.
4. Vignesh Prajapati, “Big Data Analytics with R and Haoop”, Packet Publishing 2013 and onwards.

Other Resources

1. Tom Plunkett, Brian Macdonald et al, "Oracle Big Data Handbook", Oracle Press, 2014.
2. http://www.bigdatauniversity.com/
3. Jy Liebowitz, "Big Data and Business analytics", CRC press, 2013.

Course Outcome (COs)

At the end of the course, the student will be able to		Bloom's Level
1.	Use necessary for utilizing tools (including deploying them on Hadoop/MapReduce) to handle a variety of big data analytics.	L4
2.	Apply the analytics techniques on a variety of applications.	L5
3.	Understand of Big Data application areas and approaches used,	L3
4.	Develop in depth understanding of the key technologies in data science and business analytics: data mining, predictive modeling, and statistics.	L6
5.	Apply HBase concepts to Build Applications with Zookeeper	L5

	Program Outcome of this course (POs)	**PO No.**
1.	**Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Digital Communication and Networking.	1
2.	**Modern tool Usage:** Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.	5
3.	**Impact of Engineering:** Graduates shall be able to understand the impact of engineering solutions in a global, economic, environmental and societal context.	6
4.	**Self motivated Learning:** Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.	12

Course delivery methods	**Assessment methods**
1. Blackboard	1. Internal Assessment Tests
2. Presentations	2. Activity
	3. Assignments

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of three	**Average of assignments (Two) / activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks: 50	30	10	10	50
➢ Writing two IA tests is compulsory. ➢ **Minimum marks required to qualify for SEE:** 20				

Self Study topics shall be evaluated during CIE (Assignments and IA tests) and 10% weightage shall be given in SEE question paper.

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. **Minimum marks required in SEE to pass:**40
3. 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.