NOIDA INTERNATIONAL UNIVERSITY
GAUTAM BUDH NAGAR, UP

EVALUATION SCHEME & SYLLABUS

FOR

MASTER OF TECHNOLOGY

In

Information & Communication Technology (Weekend)

AS PER
AICTE MODEL CURRICULUM
[Effective from the Session: 2019-20]

Program Outcomes (POs)

Students will be able to

1. Ability to apply the knowledge of science, mathematics, and engineering principles for developing problem solving attitude.

2. Ability to identify, formulate and solve engineering problems in the broad areas like Systems Design using communication and networking platforms and tools. Explore recent developments in areas like wireless communication, networking, measurements and standards in communication.

3. Ability to understand and use different software tools for Design, Analysis and Verification in the domain of communication and networking. System results are obtained through progressive steps such as Design entry, Synthesis, Functional and Timing Simulation.

4. Ability to design and conduct experiments, analyse and interpret data, imbibe programming skills for development of simulation experiments.

5. Ability to function as a member of a multidisciplinary team with sense of ethics, integrity and social responsibility.

Semester-1

Paper code	Subject	L	T	P	Marks(ISA)	Marks(ESE)	Total	Credit
DPCT1	Advanced Communication Networks	3	0	0	40	60	100	3
DPCT2	Wireless and Mobile Communication	3	0	0	40	60	100	3
DPCL1	Advanced Communication Networks Lab	0	0	4	40	60	100	2
DPCL2	Wireless and Mobile Communication Lab	0	0	4	40	60	100	2
Total							**400**	**10**

Semester-2

Paper code	Subject	L	T	P	Marks(ISA)	Marks(ESE)	Total	Credit
SPCT3	Advanced algorithm	3	0	0	40	60	100	3
SPCT4	Soft Computing	3	0	0	40	60	100	3
SPCL3	Advanced Algorithm Lab	0	0	4	40	60	100	2
SPCL4	Soft Computing Lab	0	0	4	40	60	100	2
Total							**400**	**10**

Semester-3

Paper code	Subject	L	T	P	Marks(ISA)	Marks(ESE)	Total	Credit
DPE1x	Program Elective-1 (1) Wireless Sensor Networks (2) Optical Networks (3) Statistical Information Processing	3	0	0	40	60	100	3
SPE2x	Program Elective-2 1. Data Science 2.Distributed Systems 3. Advanced Wireless and Mobile Networks 4. Advanced Software Engineering	3	0	0	40	60	100	3
MTC01	Research Methodology and IPR	2	0	0	40	60	100	2
	Audit Course-1	2	0	0	40	60	100	0
Total							**400**	**8**

Semester-4								
Paper code	**Subject**	**L**	**T**	**P**	**Marks(ISA)**	**Marks(ESE)**	**Total**	**Credit**
VPE3x	Program Elective-3 (1) Memory Technologies (2) SoC Design (3) Low power VLSI Design	3	0	0	40	60	100	3
VPE4x	Program Elective-4 (1) Communication Buses and Interfaces (2) Network Security and Cryptography (3) Physical design automation	3	0	0	40	60	100	3
	Audit Course-2	2	0	0	40	60	100	0
MTC02	Mini Project with Seminar	0	0	4	100	0	100	2
Total							**400**	**8**

Audit course 1 & 2

MAC01. English for Research Paper Writing
MAC02. Disaster Management
MAC03. Sanskrit for Technical Knowledge
MAC04. Value Education
MAC05. Constitution of India
MAC06. Pedagogy Studies
MAC07. Stress Management by Yoga
MAC08. Personality Development through Life Enlightenment Skills

Semester-5								
Paper code	**Subject**	**L**	**T**	**P**	**Marks(ISA)**	**Marks(ESE)**	**Total**	**Credit**
DPE5x	Program Elective-5 (1) High Performance Networks (2) Pattern Recognition and Machine Learning (3) Remote Sensing	3	0	0	40	60	100	3
	Open Elective	3	0	0	40	60	100	3
MTC03	Dissertation Phase-1	0	0	20	500	0	500	10
Total							**700**	**16**

Semester-6								
Paper code	**Subject**	**L**	**T**	**P**	**Marks(ISA)**	**Marks(ESE)**	**Total**	**Credit**
MTC04	Dissertation Phase-2	0	0	32	500	200	700	16
Total							**700**	**16**

GRAND TOTAL	**3000**	**68**

Open Elective

MOE01. Business Analytics
MOE02. Industrial Safety
MOE03. Operations Research
MOE04. Cost Management of Engineering Projects
MOE05. Composite Materials
MOE06. Waste to Energy

Course Code: DPCT1 **Course Name: Advanced Communication Networks**
Course Credit: 3 **Total Contact Hour: 40hr**

Course Objective:

- To develop understanding of some fundamental techniques used to model and analyze communication networks.
- To expose students to additional depth in computer communication systems and networks topics.

Course Description:

This course provides the understanding this material can help one to develop intuition about some of the important issues in networking and provide the background needed to do research in this field. It includes the key issues and challenges in the use of technology, including scale, performance (and measurement), and security / privacy.

Course Contents:

Unit 1: Overview of Internet-Concepts, challenges and history, overview of ATM, TCP/IP Congestion and Flow Control in Internet-Throughput analysis of TCP congestion control. TCP for high bandwidth delay networks. Fairness issues in TCP.

Unit 2: Real Time Communications over Internet, Adaptive applications, Latency and throughput issues, Integrated Services Model (intServ), Resource reservation in Internet, RSVP, Characterization of Traffic by Linearly Bounded Arrival Processes (LBAP), Leaky bucket algorithm and its properties.

Unit 3: Packet Scheduling Algorithms-requirements and choices. Scheduling guaranteed service
Connections, GPS, WFQ and Rate proportional algorithms, High speed scheduler design, Theory of Latency Rate servers and delay bounds in packet switched networks for LBAP traffic, Active Queue Management - RED, WRED and Virtual clock. Control theoretic analysis of active queue management.

Unit 4: IP address lookup-challenges, Packet classification algorithms and Flow Identification-
Grid of Tries, Cross producting and controlled prefix expansion algorithms.

Unit 5: Admission control in Internet, Concept of Effective bandwidth, Measurement based admission control, Differentiated Services in Internet (DiffServ), DiffServ architecture and framework.

Unit 6:IPV4, IPV6, IP tunnelling, IP switching and MPLS, Overview of IP over ATM and its evolution to IP switching, MPLS architecture and framework, MPLS Protocols, Traffic engineering issues in MPLS.

Course Learning Outcomes (CLOs):

- Understand advanced concepts in Communication Networking.

- Design and develop protocols for Communication Networks.
- Understand the mechanisms in Quality of Service in networking.
- Optimise the Network Design

Text books:

- Jean Wairand and PravinVaraiya, "High Performance Communications Networks", 2nd edition, 2000.
- Jean Le Boudec and Patrick Thiran, "Network Calculus A Theory of Deterministic Queueing Systems for the Internet", Springer Veriag, 2001.

Reference books:

- Anurag Kumar, D. Manjunath and Joy Kuri, "Communication Networking: An Analytical Approach", Morgan Kaufman Publishers, 2004.

Online links for study & reference materials :
https://nptel.ac.in/courses/117/105/117105076/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: DPCT2 **Course Name: Wireless & Mobile Communication**
Course Credit: 03 **Total Contact Hour:** 40hr

Course Objective:

- To provide an overview of Wireless Communication networks area and its applications in communication engineering.
- To appreciate the contribution of Wireless Communication networks to overall technological growth.
- To explain the various terminology, principles, devices, schemes, concepts, algorithms and different methodologies used in Wireless Communication Networks.
- To enable students to compare and contrast multiple division techniques, mobile communication systems, and existing wireless networks.

Course Description:

This course builds an understanding of the core issues encountered in the design of wireless (vs wired) networks. It also exposes students to fairly recent paradigms in wireless communication.

Course Contents:

Unit 1: Cellular Communication Fundamentals: Cellular system design, Frequency reuse, cell splitting, handover concepts, Co channel and adjacent channel interference, interference reduction techniques and methods to improve cell coverage, Frequency management and channel assignment. GSM architecture and interfaces, GSM architecture details, GSM subsystems, GSM
Logical Channels, Data Encryption in GSM, Mobility Management, Call Flows in GSM.2.5 G Standards: High speed Circuit Switched Data (HSCSD), General Packet Radio Service (GPRS), 2.75 G Standards: EDGE

Unit 2: Spectral efficiency analysis based on calculations for multiple access technologies: TDMA, FDMA and CDMA, Comparison of these technologies based on their signal separation techniques, advantages, disadvantages and application areas. Wireless network planning (Link budget and power spectrum calculations)

Unit 3: Mobile Radio Propagation: Large Scale Path Loss, Free Space Propagation Model, Reflection, Ground Reflection (Two-Ray) Model, Diffraction, Scattering, Practical Link Budget Design using Path Loss Models, Outdoor Propagation Models, Indoor Propagation Models, Signal Penetration into Buildings. Small Scale Fading and Multipath Propagation, Impulse Response Model, Multipath Measurements, Parameters of Multipath channels, Types of Small Scale Fading: Time Delay Spread; Flat, Frequency selective, Doppler Spread; Fast and Slow fading.

Unit 4: Equalization, Diversity: Equalizers in a communications receiver, Algorithms for adaptive equalization, diversity techniques, space, polarization, frequency diversity, Interleaving.

Unit 5: Code Division Multiple Access: Introduction to CDMA technology, IS 95 system Architecture, Air Interface, Physical and logical channels of IS 95, Forward Link and Reverse link operation, Physical and Logical channels of IS 95 CDMA, IS 95 CDMA Call Processing, soft Handoff, Evolution of IS 95 (CDMA One) to CDMA 2000, CDMA 2000 layering structure and channels.

Unit 6: Higher Generation Cellular Standards:3G Standards: evolved EDGE, enhancements in 4G standard, Architecture and representative protocols, call flow for LTE, VoLTE, UMTS, introduction to 5G.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Understand fundamentals of wireless communications.
- Analyze security, energy efficiency, mobility, scalability, and their unique characteristics in wireless networks.
- Demonstrate basic skills for cellular networks design.
- Apply knowledge of TCP/IP extensions for mobile and wireless networking.

Text books:

- V.K.Garg, J.E.Wilkes, "Principle and Application of GSM", Pearson Education, 5th edition, 2008.
- V.K.Garg, "IS-95 CDMA & CDMA 2000", Pearson Education, 4th edition, 2009.

Reference books:

- T.S.Rappaport, "Wireless Communications Principles and Practice", 2nd edition, PHI, 2002.
- William C.Y.Lee, "Mobile Cellular Telecommunications Analog and Digital Systems", 2nd edition, TMH, 1995.
- Asha Mehrotra, "A GSM system Engineering" Artech House Publishers Boston, London, 1997.

Online links for study & reference materials:

https://nptel.ac.in/courses/106/106/106106167/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: DPCL1 **Course Name: Advanced Communication Networks Lab**
Course Credit: 2 **Total Contact Hour:** 40hr

1. Study of Networking Commands (Ping, Tracert, TELNET, nslookup, netstat, ARP, RARP) and Network Configuration Files.
2. Linux Network Configuration.
    a. Configuring NIC's IP Address.
    b. Determining IP Address and MAC Address using if-config command.
    c. Changing IP Address using if-config.
    d. Static IP Address and Configuration by Editing.
    e. Determining IP Address using DHCP.
    f. Configuring Hostname in /etc/hosts file.
3. Design TCP iterative Client and Server application to reverse the given input sentence.
4. Design a TCP concurrent Server to convert a given text into upper case using multiplexing system call "select".
5. Design UDP Client Server to transfer a file.
6. Configure a DHCP Server to serve contiguous IP addresses to a pool of four IP devices with a default gateway and a default DNS address. Integrate the DHCP server with a BOOTP demon to automatically serve Windows and Linux OS Binaries based on client MAC address.
    a. Configure DNS: Make a caching DNS client, and a DNS Proxy; implement reverse DNS and forward DNS, using TCP dump/Wireshark characterise traffic when the DNS server is up and when it is down.
7. Configure a mail server for IMAP/POP protocols and write a simple SMTP client in C/C++/Java client to send and receive mails.
8. Configure FTP Server on a Linux/Windows machine using a FTP client/SFTP client characterise file transfer rate for a cluster of small files 100k each and a video file of 700mb.Use a TFTP client and repeat the experiment.
9. Signaling and QoS of labeled paths using RSVP in MPLS.
10. Find shortest paths through provider network for RSVP and BGP.
11. Understand configuration, forwarding tables, and debugging of MPLS.

Course Code: DPCL2 **Course Name: Wireless &Mobile Communication Lab**
Course Credit: 2 **Total Contact Hour:** 40hr

1. Understanding Cellular Fundamentals like Frequency Reuse, Interference, cell splitting, multi path environment, Coverage and Capacity issues using communication software.

2. Knowing GSM and CDMA architecture, network concepts, call management, call setup, call release, Security and Power Control, Handoff Process and types, Rake Receiver etc.

3. Study of GSM handset for various signalling and fault insertion techniques (Major GSM handset sections: clock, SIM card, charging, LCD module, Keyboard, User interface).

4. To study transmitters and receiver section in mobile handset and measure frequency band signal and GMSK modulating signal.

5. To study various GSM AT Commands their use and developing new application using it. Understating of 3G Communication System with features like; transmission of voice and video calls, SMS, MMS, TCP/IP, HTTP, GPS and File system by AT Commands in 3G network.

6. Study of DSSS technique for CDMA, observe effect of variation of types of PN codes, chip rate, spreading factor, processing gain on performance.

7. To learn and develop concepts of Software Radio in real time environment by studying the building blocks like Base band and RF section, convolution encoder, Interleaver and De-Interleaver.

To study and analyze different modulation techniques in time and frequency domain using SDR kit.

Course Code: SPCT3 **Course Name: Advanced Algorithms**
Course Credit: 3 **Total Contact Hour:** 30hr

Course Objective:

- Analyze the asymptotic performance of algorithms.
- Write rigorous correctness proofs for algorithms.
- Demonstrate a familiarity with major algorithms and data structures.
- Apply important algorithmic design paradigms and methods of analysis.
- Synthesize efficient algorithms in common engineering design situations.

Course Description:

This course is concerned with the study of algorithms for solving practical problems efficiently, and the theoretical analysis of their behavior. There will also be a brief introduction to complexity theory, the formal study of algorithm performance.

A large variety of algorithms are candidates for study. These include, but are not limited to, the following: greedy algorithms, dynamic programming, network flow algorithms, algorithms for string matching, parallel algorithms, graph algorithms and approximation algorithms.

Course Contents:

Unit-I

Sorting: Review of various sorting algorithms, topological sorting

Graph: Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge- weighted case (Dijkasra's), depth-first search and computation of strongly connected components, emphasis on correctness proof of the algorithm and time/space analysis, example ofamortized analysis.

Unit-II

Matroids: Introduction to greedy paradigm, algorithm to compute a maximum weight maximalindependent set. Application to MST.

Graph Matching: Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path.

Unit-III

Flow-Networks: Maxflow-mincut theorem, Ford-Fulkerson Method to compute maximum flow,Edmond-Karp maximum-flow algorithm.

Matrix Computations: Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations,LUP-decomposition

Unit-IV

Shortest Path in Graphs: Floyd-Warshall algorithm and introduction to dynamic programmingparadigm. More examples of dynamic programming.

Modulo Representation of integers/polynomials: Chinese Remainder Theorem, Conversion between base-representation and modulo-representation. Extension to polynomials. Application:Interpolation problem.

Discrete Fourier Transform (DFT): In complex field, DFT in modulo ring. Fast Fourier Transform algorithm. Schonhage-Strassen Integer Multiplication algorithm

Unit-V

Linear Programming: Geometry of the feasibility region and Simplex algorithm
NP-completeness: Examples, proof of NP-hardness and NP-completeness.
One or more of the following topics based on time and interest
Approximation algorithms, Randomized Algorithms, Interior Point Method, Advanced NumberTheoretic Algorithm

Unit-VI

Recent Trands in problem solving paradigms using recent searching and sorting techniques byapplying recently proposed data structures.

Course Learning Outcomes (CLOs) :

At the end of this course students will demonstrate the ability to

- Argue the correctness of algorithms using inductive proofs and invariants.
- Analyze worst-case running times of algorithms using asymptotic analysis.
- Describe the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it. Recite algorithms that employ this paradigm. Synthesize divide-and-conquer algorithms. Derive and solve recurrences describing the performance of divide-and-conquer algorithms.

Text books:

- Dasgupta, Sanjoy, Christos Papadimitriou, and Umesh Vazirani. *Algorithms*. McGraw-Hill, 2006. ISBN: 9780073523408.
- Kleinberg, Jon, and Eva Tardos. *Algorithm Design*. Addison-Wesley, 2005. ISBN: 9780321295354.

Reference books:

- Even, Shimon. *Graph Algorithms*. Computer Science Press, 1979. ISBN: 9780914894216.

Online links for study & reference materials:

https://nptel.ac.in/courses/106/105/106105157/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: SPCT4 **Course Name:** Soft Computing
Course Credit: 3 **Total Contact Hour:** 35hr

Course Objective:

- The primary objective of this course is to provide an introduction to the basic principles, techniques, and applications of soft computing.
- Upon successful completion of the course, students will have an understanding of the basic areas of Soft Computing including Artificial Neural Networks, Fuzzy Logic, Genetic Algorithms and Deep Learning.
- Provide the mathematical background for carrying out the optimization associated with neural network learning.

Course Description:

- The course introduces fundamental concepts in Soft Computing including Artificial Neural Networks, Fuzzy Logic, Genetic Algorithms and Deep Learning. The properties of these concepts will be studied and various rigorous techniques for analyzing and comparing them will be discussed and implemented by using Python and MATLAB.

Course Contents:

Unit-1

INTRODUCTION TO SOFT COMPUTING AND NEURAL NETWORKS: Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence: Machine Learning Basics.

Unit-2

FUZZY LOGIC: Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making.

Unit-3

NEURAL NETWORKS: Machine Learning Using Neural Network, Adaptive Networks, Feed forward Networks, Supervised Learning Neural Networks, Radial Basis Function Networks : Reinforcement Learning, Unsupervised Learning Neural Networks, Adaptive Resonance architectures, Advances in Neural networks.

Unit-4

GENETIC ALGORITHMS: Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning : Machine Learning Approach to Knowledge Acquisition.

Unit-5

Matlab/Python Lib: Introduction to Matlab/Python, Arrays and array operations, Functions and Files, Study of neural network toolbox and fuzzy logic toolbox, Simple implementation of Artificial Neural Network and Fuzzy Logic.

Unit-6

Recent Trends in deep learning, various classifiers, neural networks and genetic algorithm. Implementation of recently proposed soft computing techniques.

Course Learning Outcomes (CLOs) :

Students will be able to**:**

- CLO-1: Describe human intelligence and AI Explain how intelligent system works.
- CLO-2: Apply basics of Fuzzy logic and neural networks.

- CLO-3 : Discuss the ideas of fuzzy sets, fuzzy logic and use of heuristics based on human experience
- CLO-4 : Relate with neural networks that can learn from available examples and generalize to form appropriate rules for inference systems
- CLO-5: Implement Fuzzy logic and ANN methods using Python/MATLAB.

Text books:

- J.S.R.Jang, C.T.Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing", Pearson Education.
- Simon O. Haykin "Artificial Neural Network", PHI.
- Elaine Rich, Kevin Knight, Artificial Intelligence, TMH.

Reference books:

- Timothy J.Ross, "Fuzzy Logic with Engineering Applications", McGraw-Hill.
- Davis E.Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley.
- S. Rajasekaran and G.A.V.Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI.

Online links for study & reference materials:

https://nptel.ac.in/courses/106/105/106105173/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	- 20%
Assignment-4	- 05%
Assignment-5/Quiz	- 05%
Total Internal Assessment	**- 40%**

Course Code: SPCL3 **Course Name: Advanced Algorithms Lab**

Experiments based on SPCT3

Course Code: SPCP4 **Course Name:** Soft Computing Lab

Experiments based on SPCT4

Course Code: DPE11 **Course Name:** Wireless Sensor Network
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To understand architecture and application of wireless sensor network.
- To analyze the hardware and software required.
- To understand the programming and related tools.
- To understand data transmission, data processing, energy conservation, and sensor development mechanism.

Course Description:

This course emphasizes on the fundamental of wireless sensor networks. This course starts with the architecture and then focus on hardware and software requirements. This course contains programming and application of wireless sensor networks. This course give an understanding of data processing, data transmission ,energy conservation, and sensor development.

Course Contents:

Unit 1: Introduction and overview of sensor network architecture and its applications, sensor network comparison with Ad Hoc Networks, Sensor node architecture with hardware and software details.

Unit 2: Hardware: Examples like mica2, micaZ, telosB, cricket, Imote2, tmote, btnode, and Sun SPOT, Software (Operating Systems): tinyOS, MANTIS, Contiki, and RetOS.

Unit 3: Programming tools: C, nesC. Performance comparison of wireless sensor networks simulation and experimental platforms like open source (ns-2) and commercial (QualNet, Opnet)

Unit 4: Overview of sensor network protocols (details of atleast 2 important protocol per layer):Physical, MAC and routing/ Network layer protocols, node discovery protocols, multi-hop and cluster based protocols, Fundamentals of 802.15.4, Bluetooth, BLE (Bluetooth low energy), UWB.

Unit 5: Data dissemination and processing; differences compared with other database management systems, data storage; query processing.

Unit 6: Specialized features: Energy preservation and efficiency; security challenges; fault tolerance, Issues related to Localization, connectivity and topology, Sensor deployment mechanisms; coverage issues; sensor Web; sensor Grid, Open issues for future research, and enabling technologies in wireless sensor network.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Design wireless sensor network system for different applications under consideration.

- Understand the hardware details of different types of sensors and select right type of sensor for various applications.
- Understand radio standards and communication protocols to be used for wireless sensor network based systems and application.
- Use operating systems and programming languages for wireless sensor nodes, performance of wireless sensor networks systems and platforms.
- Handle special issues related to sensors like energy conservation and security challenges.

Text books:

- H. Karl and A. Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons, India, 2012.
- C. S. Raghavendra, K. M. Sivalingam, and T. Znati, Editors, "Wireless Sensor Networks", Springer Verlag, 1st Indian reprint, 2010.

Reference books:

- F. Zhao and L. Guibas, "Wireless Sensor Networks: An Information Processing Approach", Morgan Kaufmann, 1st Indian reprint, 2013.
- YingshuLi, MyT. Thai, Weili Wu, "Wireless sensor Network and Applications", Springer series on signals and communication technology, 2008.

Online links for study & reference materials:

https://nptel.ac.in/courses/106/105/106105160/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: DPE12 **Course Name:** Optical Network
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To understand optical network architecture.
- To analyze different network elements and their functions.
- To understand characteristics of network management.
- To understand the access and use of optical networks.

Course Description:

This course emphasizes on the fundamental of optical networks. This course contains architecture, elements, management and application of optical network. This course provides an basic idea of implementation of an optical network

Course Contents:

Unit 1: SONET/SDH: optical transport network, IP, routing and forwarding, multiprotocol label switching.

Unit 2: WDM network elements: optical line terminals and amplifiers, optical add/drop multiplexers, OADM architectures, reconfigurable OADM, optical cross connects.

Unit 3: Control and management: network management functions, optical layer services and interfacing, performance and fault management, configuration management, optical safety.

Unit 4: Network Survivability: protection in SONET/SDH & client layer, optical layer protection schemes

Unit 5: WDM network design: LTD and RWA problems, dimensioning wavelength routing networks, statistical dimensioning models.

Unit 6: Access networks: Optical time division multiplexing, synchronization, header processing, buffering, burst switching, test beds, Introduction to PON, GPON, AON.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Understand the architecture of optical network
- Implement and Manage optical network.
- Design & analyze optical networks.

Text books:

- Rajiv Ramaswami, Sivarajan, Sasaki, “Optical Networks: A Practical Perspective”, MK, Elsevier, 3 rd edition, 2010.

Reference books:

- C. Siva Ram Murthy and Mohan Gurusamy, “WDM Optical Networks: Concepts Design, and Algorithms”, PHI, EEE, 2001.

Online links for study & reference materials:

https://nptel.ac.in/courses/117/101/117101054/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: DPE13 **Course Name:** Statistical Information Processing
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To understand random variables and their application.
- To analyze random signal modelling.
- To understand statistical detection theory and spectral analysis.
- To understand concepts of information theory and coding.

Course Description:

This course emphasizes on the fundamental of statistical information processing. The course starts with random variable and the application are introduced. This course contains signal modelling, detection theory, and spectral analysis. This course focus on information theory and coding and various algorithm related.

Course Contents:

Unit 1: Review of random variables: Probability Concepts, distribution and density functions, moments, independent, uncorrelated and orthogonal random variables; Vector-space representation of Random variables, Vector quantization, Tchebaychef inequality theorem, Central Limit theorem, Discrete &Continuous Random Variables. Random process: Expectations, Moments, Ergodicity, Discrete-Time Random Processes Stationary process, autocorrelation and auto covariance functions, Spectral representation of random signals, Properties of power spectral density, Gaussian Process and White noise process.

Unit 2: Random signal modelling: MA(q), AR(p), ARMA(p,q) models, Hidden Markov Model & its applications ,Linear System with random input , Forward and Backward Predictions, Levinson Durbin Algorithm.

Unit 3: Statistical Decision Theory: Bayes' Criterion, Binary Hypothesis Testing, M-ary Hypothesis Testing, Minimax Criterion, Neyman-Pearson Criterion, Composite Hypothesis Testing. Parameter Estimation Theory: Maximum Likelihood Estimation, Generalized Likelihood Ratio Test, Some Criteria for Good Estimators, Bayes' Estimation Minimum Mean-Square Error Estimate, Minimum, Mean Absolute Value of Error Estimate Maximum A Posteriori Estimate, Multiple Parameter Estimation Best Linear Unbiased Estimator, Least-Square Estimation Recursive Least-Square Estimator.

Unit 4: Spectral analysis: Estimated autocorrelation function, Periodogram, Averaging the periodogram (Bartlett Method), Welch modification, Parametric method, AR(p) spectral estimation and detection of Harmonic signals.

Unit 5: Information Theory and Source Coding: Introduction, Uncertainty, Information and Entropy, Source coding theorem, Huffman, Shanon Fano, Arithmetic, Adaptive coding, RLE, LZW Data compaction, , LZ-77, LZ-78. Discrete Memory less channels,

Mutual information, channel capacity, Channel coding theorem, Differential entropy and mutual information for continuous ensembles.

Unit 6: Application of Information Theory: Group, Ring & Field, Vector, GF addition, multiplication rules. Introduction to BCH codes, Primitive elements, Minimal polynomials, Generator polynomials in terms of Minimal polynomials, Some examples of BCH codes & Decoder, Reed- Solomon codes & Decoder, Implementation of Reed Solomon encoders and decoders.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Characterize and apply probabilistic techniques in modern decision systems, such as information systems, receivers, filtering and statistical operations.
- Demonstrate mathematical modelling and problem solving using such models.
- Comparatively evolve key results developed in this course for applications to signal processing, communications systems.
- Develop frameworks based in probabilistic and stochastic themes for modelling and analysis of various systems involving functionalities in decision making, statistical inference, estimation and detection.

Text books:

- Papoulis and S.U. Pillai, "Probability, Random Variables and Stochastic Processes", 4th Edition, McGraw-Hill, 2002.
- D.G. Manolakis, V.K. Ingle and S.M. Kogon, "Statistical and Adaptive Signal Processing", McGraw Hill, 2000.

Reference books:

- Mourad Barkat , "Signal Detection and Estimation", Artech House, 2nd Edition, 2005.
- Rosen K.H, "Elementary Number Theory", Addison-Wesley, 6th edition, 2010.

Online links for study & reference materials:

https://nptel.ac.in/courses/108/103/108103158/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: SPE24 **Course Name:** Advanced Software Engineering
Course Credit: 3 **Total Contact Hour:** 35hr

Course Objective:

- To provide an advanced understanding and knowledge of the software engineering techniques, techniques to collect software requirements from client, testing , design and CASE tools and to understand the importance of these case tools in software development

Course Description:

- The course introduces advanced concepts in advanced software engineering including Introduction, Software Requirement Specification, Architecture and Design, Testing and CASE study. Not only do they form basic models of computation, they are also the foundation of many branches of computer science.

Course Contents:

UNIT-1

Introduction: Software engineering concepts – Development activities – Software lifecycle models - Classicalwaterfall - Iterative waterfall – Prototyping – Evolutionary - Spiral – Software project management – Project planning – Estimation – Scheduling – Risk management – Software configuration management.

UNIT-2:

Software Requirement Specification: Requirement analysis and specification – Requirements gathering and analysis – Software Requirement Specification – Formal system specification – Finite State Machines – Petrinets – Object modelling using UML – Use case Model – Class diagrams – Interaction diagrams – Activity diagrams – State chart diagrams – Functional modelling – Data Flow Diagram**.**

UNIT-3

Architecture and Design: Software design – Design process – Design concepts – Coupling – Cohesion – Functional independence – Design patterns – Model-view-controller – Publish-subscribe – Adapter – Command – Strategy – Observer – Proxy – Facade – Architectural styles – Layered - Client- server - Tiered - Pipe and filter.- User interface design.

UNIT-4:

Testing: Testing – Unit testing – Black box testing– White box testing – Integration and System testing– Regression testing – Debugging - Program analysis – Symbolic execution – Model Checking.

UNIT-5:

DEVOPS: DevOps: Motivation-Cloud as a platform-Operations- Deployment Pipeline: Overall Architecture - Building and Testing-Deployment- Case study: Migrating to Micro services.

Course Learning Outcomes (CLOs):

- CLO-1: Analyze the software life cycle models
- CLO-2: Identify the importance of the software development process
- CLO-3: Able to understand business requirements pertaining to software development.
- CLO-4: Analyze the importance of CASE tools
- CLO-5: Able to understand business requirements pertaining to software development.

Text books:

- Roger S. Pressman, Software Engineering a Practitioners Approach, McGraw-Hill.
- J. Bowan, Formal Specification and Documentation using Z - A Case Study Approach, International Thomson Computer Press.
- Antoni Diller, Z., an Introduction to Formal Methods, Wiley.

Reference books:

- M. Dyer, The Cleanroon Approach to Quality Software Development, Wiley.
- Prowell, S., Trammell, C.J. and Poore, J.H, Cleanroom Software Engineering: Technology and Process, Addison-Wesley.

Online links for study & reference materials:

https://nptel.ac.in/courses/106/105/106105182/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	- 20%
Assignment-4	- 05%
Assignment-5/Quiz	- 05%
Total Internal Assessment	**- 40%**

Course Code: MTC01 **Course Name**: Research Methodology and IPR
Course Credit: 2 **Total Contact Hour** : 20 hr

Course Objective :

- Identify an appropriate research problem in their interesting domain
- To explain various research designs and their characteristics
- To explain the art of interpretation, art of writing research reports and presentation skills
- To explain various forms of intellectual property, its relevance and business impact in the changing global business environment

Course Description:

This course emphasizes on the fundamental of research. The student first taught about research formulation and then what are the research designs needed according to research formulation. To understand and formulate the research problem the student should be aware of the aspect of effective literature review and the sources of information.to be taken to conduct literature review. Students are exposed to application of research design through which they understand that how, when and which design is required. In concurrence with this , the analysis part will be taught. Finally concepts related to patents, trademark and copyright will be taught.

Course Content:

UNIT1: Meaning of research problem, sources of research problem, characteristics of good research problem, errors in selecting a research problem, scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation. Necessary instrumentation

UNIT2: Effective literature studies approaches, analysis, plagiarism and research ethics

UNIT3: Effective technical writing, how to write report, paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT4: Nature of Intellectual property; patents, designs, trade and copyright. Process of patenting and development: technological research, innovation, patenting, development, International Scenario; International cooperation on Intellectual Property. Procedure for grants of patents, patenting under PCT.

UNIT5: Patent Rights; Scope of Patents Rights, Licensing and transfer of technology; Patent information and databases, geographical Indications.

UNIT6: New development in IPR, Administration of patent system, New developments in IPR, IPR of Biological system, Computer software etc. Traditional knowledge case studies, IPR and IITs.

Course Learning Outcomes (CLOs):

- Understand the characteristics, objects of good research problem.
- Understand concepts of data collection, analysis

- Understand significance, effective technical writing and report
- Understand the patent rights and transfer of technology

Text books:

- Stuart Melville and Wayne Goddard,'' Research methodology: an introduction for science and engineering student''
- Wayne Goddard and Stuart Melville, '' Research Methodology: An Introduction''

Reference books:

- Ranjit Kumar, 2nd Edition,''Research Methodology: A step by step Guide for beginners''
- Halbert, '' Resisting Intellectual Property'', Taylor and Francis Ltd, 2007
- Mayali,'' Industrial Design'', McGraw Hill, 1992.

Online links for study and reference materials:

https://nptel.ac.in/courses/121/106/121106007/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: MAC04 **Course Name:** Value Education
Course Credit: 0 **Total Contact Hour:** 20hr

Course Objective:

1. To make students understand the relevance of individual values in everyday lives
2. To help students imbibe different individual values in their personality
3. To help students develop good moral values and positive character
4. To help students learn the significance of self-management and self-control

Course Description:

The course is an appropriate combination of theoretical and industry specific contents on values and works ethics aimed at developing students into professionals. The course enables students learn concepts related to values and description of different types of values like individual values, social values, organizational values, etc. The course emphasizes on significance of cultivation of individual values that are essential in a personality and lists out various individual values to be imbibed in a student preparing for professional world. The course also describes various practical aspects of value education like managing good health, self-control, science of reincarnation, religious tolerance and role of women, which are pre-requisites for good moral character and competence.

Course Contents: The course is divided into 4 broad units namely:

1. **Unit-1: Values and Self-development**, Social Values and Individual attitudes, work ethics and Indian vision of humanism, moral and non-moral valuation, standards and principles, value judgments
2. **Unit-2: Importance of cultivation of values**, sense of duty, devotion, self-reliance, confidence, concentration, truthfulness, cleanliness, honesty, humanity, power of faith, national unity, patriotism, love for nature, discipline
3. **Unit-3: Personality and Behavior Development,** soul and scientific attitude, positive thinking, integrity and discipline, punctuality, love and kindness, avoid fault thinking, freedom from anger, dignity of labour, universal brotherhood, religious tolerance, true friendship, happiness vs suffering, love for truth, aware of self-destructive habits, association and cooperation, doing best for saving nature
4. **Unit-4: Character and Competence,** holy book vs blind faith, self-management and good health, science of reincarnation, equality, non-violence, humility, role of women, all religions and same message, mind yourself, self-control, honesty, studying effectively

Course Learning Outcomes (CLOs):

CLO-1: The students will be able to relate to concepts related to value education in their everyday lives.

CLO-2: The students will be able to demonstrate individual values cultivated in their respective workplaces or professional world.

CLO-3: The students will be able to differentiate between the different types of values and imbibe them as part of their self-development.

CLO-4: The students will be able to learn and practice techniques of managing good health, self-control, gender sensitivity and religious tolerance.

Text books:

1. Indrani Majhi, Ganesh Das, VALUE EDUCATION, 1, 2017, Laxmi Publications Pvt Ltd, ISBN: 9789352741120, 9352741129
2. Sharma Sandeep, Encyclopedia of Indian Ethos and Values in Management, Anmol Publications Pvt Ltd, ISBN: 9788126139187, 9788126139187

Reference books:

1. UN-HABITAT**,** Human Values And Ethics In Workplace: Improving Leadership And Performance In The Water Education, Water Supply And Sanitation Sector, 2006, United Nations Human Settlements Programme (UN-HABITAT)
2. Ganesh A. Gayatri, Values Attitude and Practices, Publisher: Discovery Publishing Pvt. Ltd, ISBN: 9789350561287, 9789350561287
3. Atkinson Camille E., Women, Ethics and the Workplace, ABC-CLIO, ISBN: 9780275960919, 9780275960919
4. Green Connie Ragen, Rethinking the Work Ethic, Hunter's Moon Publishing, ISBN: 9781937988333, 9781937988333

Online links for study & reference materials:

1. https://www.researchgate.net/publication/228079327
2. https://www.researchgate.net/publication/49586890
3. https://www.researchgate.net/publication/258040203
4. https://www.enterpreneur.com/amphtml/310254
5. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3705678

Assessment method :(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid-term exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: VPE31 **Course Name:** Memory Technologies
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- Apply their knowledge to analyze the operations of a single memory bit-cell and its related stability, variability and reliability issues.
- Understand the scaling trend of the mainstream memory technologies and the motivation for the emerging technologies.

Course Description:

In the last four decades, the number of transistors in a chip has increased from few thousands to few billions. In order to utilize the available transistors in a chip to improve computational power, various micro-architectural techniques have been proposed, which lead to the design of variety of processors, from simple in-order pipeline processors to recent multi-core processors.

Course Contents:

Unit 1

Random Access Memory Technologies: Static Random Access Memories (SRAMs), SRAM Cell Structures, MOS SRAM Architecture, MOSSRAM Cell and Peripheral Circuit, Bipolar SRAM, Advanced SRAM Architectures, Application Specific SRAMs.

Unit 2

DRAMs, MOS DRAM Cell, BiCMOS DRAM, Error Failures in DRAM, Advanced DRAM Design and Architecture, Application Specific DRAMs .SRAM and DRAM Memory controllers.

Unit 3

Non-Volatile Memories: Masked ROMs, PROMs, Bipolar & CMOS PROM, EEPROMs, Floating Gate EPROM Cell, OTP EPROM, EEPROMs, Non-volatile SRAM, Flash Memories.

Unit 4

Semiconductor Memory Reliability and Radiation Effects: General Reliability Issues, RAM Failure Modes and Mechanism, Nonvolatile Memory, Radiation Effects, SEP, Radiation Hardening Techniques. Process and Design Issues, Radiation Hardened Memory Characteristics, Radiation Hardness Assurance and Testing.

Unit 5

Advanced Memory Technologies and High-density Memory Packing Technologies: Ferroelectric Random Access Memories (FRAMs), Gallium Arsenide (GaAs) FRAMs, Analog Memories, Magneto Resistive Random Access Memories (MRAMs), Experimental Memory Devices.

Unit 6

Memory Hybrids (2D & 3D), Memory Stacks, Memory Testing and Reliability Issues, Memory Cards, High Density Memory Packaging

Course Learning Outcomes (CLOs):

- Select architecture and design semiconductor memory circuits and subsystems.
- Identify various fault models, modes and mechanisms in semiconductor memories and their testing procedures.
- Knowhow of the state-of-the-art memory chip design

Text books:

- Ashok K Sharma, "Advanced Semiconductor Memories: Architectures, Designs and Applications", Wiley Interscience
- KiyooItoh, "VLSI memory chip design", Springer International Edition

Reference books:

- Ashok K Sharma," Semiconductor Memories: Technology, Testing and Reliability, PHI

Online links for study & reference materials:

https://nptel.ac.in/courses/106/106/106106134/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code : VPE32 **Course Name : SoC Design**
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective :

In this course the students will learn SOC design processes, ASIc design flow, EDA tools, architecture design and test optimization with system integration issues

Course Description :

Students will understand the ASIC Design flow and EDA tools and also acquire knowledge about Top-down SoC design flow, Front-end and back-end chip design and will also learn interpret the design methodologies for SoC.

Course Contents :

Unit 1

ASIC:Overview of ASIC types, design strategies, CISC, RISC and NISC approaches for SOC architectural issues and its impact on SoC design methodologies, Application Specific Instruction Processor (ASIP) concepts.

Unit 2

NISC:NISC Control Words methodology, NISC Applications and Advantages, Architecture Description Languages (ADL) for design and verification of Application Specific Instruction set, Processors (ASIP), No-Instruction-Set-computer (NISC)- design flow, modeling NISC architectures and systems, use of Generic Netlist Representation - A formal language for specification, compilation and synthesis of embedded processors.

Unit 3

Simulation:Different simulation modes, behavioural, functional, static timing, gate level, switch level, transistor/circuit simulation, design of verification vectors, Low power FPGA, Reconfigurable systems, SoC related modeling of data path design and control logic, Minimization of interconnects impact, clock tree design issues.

Unit 4

Low power SoC design / Digital system, Design synergy, Low power system perspective-power gating, clock gating, adaptive voltage scaling (AVS), Static voltage scaling, Dynamic clock frequency and voltage scaling (DCFS), building block optimization, building block memory, power down techniques, power consumption verification.

Unit 5

Synthesis:Role and Concept of graph theory and its relevance to synthesizable constructs, Walks, trails paths, connectivity, components, mapping/visualization, nodal and admittance graph. Technology independent and technology dependent approaches for synthesis, optimization constraints, Synthesis report analysisSingle core and Multi core systems, dark silicon issues, HDL coding techniques for minimization of power consumption, Fault tolerant designs

Unit 6

Case study for overview of cellular phone design with emphasis on area optimization, speed improvement and power minimization.

Course Learning Outcomes(CLOs) :

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

- Identify and formulate a given problem in the framework of SoC based design approaches
- Design SoC based system for engineering applications
- Realize impact of SoC on electronic design philosophy and Macro-electronics thereby incline towards entrepreneurship & skill development.

Text books :

- Hubert Kaeslin, "Digital Integrated Circuit Design: From VLSI Architectures to CMOS Fabrication", Cambridge University Press, 2008.
- B. Al Hashimi, "System on chip-Next generation electronics", The IET, 2006

Reference books :

- RochitRajsuman, "System-on- a-chip: Design and test", Advantest America R & D Center, 2000
- P Mishra and N Dutt, "Processor Description Languages", Morgan Kaufmann, 2008
- Michael J. Flynn and Wayne Luk, "Computer System Design: System-on-Chip". Wiley, 2011

Online links for study & reference materials :

https://www.youtube.com/watch?v=3KLOXUYGo9s

Assessment method : (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: VPE33 **Course Name:** Low Power VLSI
Course Credit: 3 **Total Contact Hour:** 30hr

Course Objective:

- To learn fundamentals of power dissipation in microelectronic devices.
- To identify system performance and reliability

Course Description:

This course deals with issues and models to design low-power VLSI circuits, fundamentals of power dissipation in microelectronic devices, will be able to estimate power dissipation due to switching, short circuit.

Course Contents:

Unit 1

Technology & Circuit Design Levels: Sources of power dissipation in digital ICs, degree of freedom, recurring themes in low-power, emerging low power approaches, dynamic dissipation in CMOS, effects of Vdd & Vt on speed, constraints on Vt reduction, transistor sizing & optimal gate oxide thickness, impact of technology scaling, technology innovations.

Unit 2

Low Power Circuit Techniques: Power consumption in circuits, flip-flops & latches, high capacitance nodes, energy recovery, reversible pipelines, high performance approaches.

Unit 3

Low Power Clock Distribution: Power dissipation in clock distribution, single driver versus distributed buffers, buffers & device sizing under process variations, zero skew vs. tolerable skew, chip & package co-design of clock network.

Unit 4

Logic Synthesis for Low Power estimation techniques: Power minimization techniques, low power arithmetic components- circuit design styles, adders, multipliers.

Unit 5

Low Power Memory Design: Sources & reduction of power dissipation in memory subsystem, sources of power dissipation in DRAM & SRAM, low power DRAM circuits, low power SRAM circuits.

Unit 6

Low Power Microprocessor Design System: power management support, architectural tradeoffs for power, choosing the supply voltage, low-power clocking, implementation problem for low power, comparison of microprocessors for power & performance.

Course Learning Outcomes (CLOs) :

At the end of this course students will demonstrate the ability to

- Identify the sources of power dissipation in digital IC systems & understand the impact of power on system performance and reliability.
- Characterize and model power consumption & understand the basic analysis methods.
- Understand leakage sources and reduction techniques.

Text books:

- Gary Yeap, “Practical low power digital VLSI design”, Kluwer, 1998.

Reference books:

- P. Rashinkar, Paterson and L. Singh, “Low Power Design Methodologies”, Kluwer Academic, 2002
- Kaushik Roy, Sharat Prasad, “Low power CMOS VLSI circuit design”, John Wiley sons Inc.,2000.
- J.B.Kulo and J.H Lou, “Low voltage CMOS VLSI Circuits”, Wiley, 1999.
- A.P.Chandrasekaran and R.W.Broadersen, “Low power digital CMOS design”, Kluwer,1995

Online links for study & reference materials:

https://nptel.ac.in/courses/117/101/117101004/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: VPE41 **Course Name:** Communication Buses & Interfaces
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- Explain why a parallel interface is needed in an embedded system.
- List the names of common parallel bus standards along with their important features.

Course Description:

Interfaces in the sector of system and process control include those that serve to exchange information in the form of physical (e.g. electrical voltage) or logical (data) parameters. Transmission can be either analog or digital. There are various types of interface depending on the level at which communication takes place.

Course Contents:

Unit 1

Serial Buses, Physical interface, Data and Control signals, features

Unit 2

limitations and applications of RS232, RS485, I^2C, SPI

Unit 3

CAN - Architecture, Data transmission, Layers, Frame formats, applications

Unit 4

PCIe - Revisions, Configuration space, Hardware protocols, applications

Unit 5

USB - Transfer types, enumeration, Descriptor types and contents, Device driver

Unit 6

Data Streaming Serial Communication Protocol- Serial Front Panel Data Port (SFPDP) using fibre optic and copper cable

Course Learning Outcomes (CLOs):

- Select a particular serial bus suitable for a particular application.
- Develop APIs for configuration, reading and writing data onto serial bus.
- Design and develop peripherals that can be interfaced to desired serial bus.

Text books:

- Jan Axelson, "Serial Port Complete - COM Ports, USB Virtual Com Ports, and Ports for Embedded Systems ", Lakeview Research, 2nd Edition.
- Mike Jackson, Ravi Budruk, "PCI Express Technology", Mindshare Press.

Reference books:

- Wilfried Voss, "A Comprehensible Guide to Controller Area Network", Copperhill Media Corporation, 2nd Edition, 2005.

Online links for study & reference materials:

https://nptel.ac.in/courses/108/103/108103157/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%

Assessment-3(Mid exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: VPE42 **Course Name:** Network Security and Cryptography
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To know about various encryption techniques.
- To understand the concept of Public key cryptography.
- To study about message authentication and hash functions
- To impart knowledge on Network security

Course Description:

The aim of this course is to introduce the student to the areas of cryptography and cryptanalysis. This course develops a basic understanding of the algorithms used to protect users online and to understand some of the design choices behind these algorithms. Our aim is to develop a workable knowledge of the mathematics used in cryptology in this course.

Course Contents:

Unit 1

Security- Need, security services, Attacks, OSI Security Architecture, one time passwords, Model for Network security, Classical Encryption Techniques like substitution ciphers, Transposition ciphers, Cryptanalysis of Classical Encryption Techniques.

Unit 2

Number Theory- Introduction, Fermat's and Euler's Theorem, The Chinese Remainder Theorem, Euclidean Algorithm, Extended Euclidean Algorithm, and Modular Arithmetic.

Unit 3

Private-Key (Symmetric) Cryptography- Block Ciphers, Stream Ciphers, RC4 Stream cipher, Data Encryption Standard (DES),Advanced Encryption Standard (AES), Triple DES, RC5, IDEA, Linear and Differential Cryptanalysis.

Unit 4

Public-Key (Asymmetric) Cryptography- RSA, Key Distribution and Management, Diffie-Hellman Key Exchange, Elliptic Curve Cryptography, Message Authentication Code, hash functions, message digest algorithms:MD4 MD5, Secure Hash algorithm, RIPEMD-160, HMAC.

Unit 5

Authentication- IP and Web Security Digital Signatures, Digital Signature Standards, Authentication Protocols, Kerberos, IP security Architecture, Encapsulating Security Payload, Key Management, Web Security Considerations, Secure Socket Layer and Transport Layer Security, Secure Electronic Transaction.

Unit 6

System Security- Intruders, Intrusion Detection, Password Management, Worms, viruses, Trojans, Virus Countermeasures, Firewalls, Firewall Design Principles, Trusted Systems.

Course Learning Outcomes (CLOs):

- Identify and utilize different forms of cryptography techniques.
- Incorporate authentication and security in the network applications.
- Distinguish among different types of threats to the system and handle the same.

Text books:

- William Stallings, "Cryptography and Network Security, Principles and Practices", Pearson Education, 3rd Edition.
- Charlie Kaufman, Radia Perlman and Mike Speciner, "Network Security, Private Communication in a Public World", Prentice Hall, 2nd Edition

Reference books:

- Richard Bejtlich, "The Practice of Network Security Monitoring: Understanding Incident Detection and Response", William Pollock Publisher, 2013.

Online links for study & reference materials :
https://nptel.ac.in/courses/106/105/106105162/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: VPE43 **Course Name:** Physical Design Automation
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- Understand the concepts of Physical Design Process such as partitioning, Floor planning, Placement and Routing.
- Discuss the concepts of design optimization algorithms and their application to physical design automation.
- Understand the concepts of simulation and synthesis in VLSI Design Automation
- Formulate CAD design problems using algorithmic methods

Course Description:

The course will introduce the participants to the basic design flow in VLSI physical design automation, the basic data structures and algorithms used for implementing the same. The course will also provide examples and assignments to help the participants to understand the concepts involved, and appreciate the main challenges therein.

Course Contents:

Unit 1: Introduction to VLSI Physical Design Automation.
Unit 2: Standard cell, Performance issues in circuit layout, delay models Layout styles.
Unit 3: Discrete methods in global placement.
Unit 4: Timing-driven placement. Global Routing Via Minimization.
Unit 5: Over the Cell Routing - Single layer and two-layer routing, Clock and Power Routing.
Unit 6: Compaction, algorithms, Physical Design Automation of FPGAs..

Course Learning Outcomes(CLOs) :

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

- Study automation process for VLSI System design.
- Understanding of fundamentals for various physical design CAD tools.
- Develop and enhance the existing algorithms and computational techniques for physical design process of VLSI systems.

Text books:

- S.H. Gerez, "Algorithms for VLSI Design Automation", John Wiley ,1998.
- N.A.Sherwani , "Algorithms for VLSI Physical Design Automation", (3/e), Kluwer,1999.

Reference books:

- S.M. Sait , H. Youssef, "VLSI Physical Design Automation", World scientific, 1999.
- M.Sarrafzadeh, "Introduction to VLSI Physical Design", McGraw Hill (IE), 1996.

Online links for study & reference materials:

https://nptel.ac.in/courses/106/105/106105161/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: DPE51 **Course Name:** High Performance Networks
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To reinforce an understanding of LAN technologies which have lead to high speed LANs.
- To understand ATM technology.
- To introduce high speed switching concepts.
- To consider Quality of Service and congestion control issues.

Course Description:

High Performance Networks replaces the Local Area Networks course which was the second course in a group of graduate courses introduced under the CCN initiative. This introductory course in the networking sequence is a prerequisite for this course. This change was made to provide a course which includes emerging technologies outside the LAN realm.

Course Contents:

Unit 1: Types of Networks, Network design issues, Data in support of network design. Network design tools, protocols and architecture, Streaming stored Audio and Video, Best effort service, protocols for real time interactive applications, beyond best effort, scheduling and policing mechanism, integrated services, and RSVP-differentiated services.

Unit 2: VoIP system architecture, protocol hierarchy, Structure of a voice endpoint, Protocols for the transport of voice media over IP networks, Providing IP quality of service for voice, signalling protocols for VoIP, PSTN gateways, VoIP applications.

Unit 3:VPN-Remote-Access VPN, site-to-site VPN, Tunneling to PPP, Security in VPN. MPLS operation, Routing, Tunneling and use of FEC, Traffic Engineering, MPLS based VPN, overlaynetworks-P2P connections.

Unit 4: Traffic Modeling: Little's theorem, Need for modeling, Poisson modeling, Non-poisson models, Network performance evaluation.

Unit 5: Network Security and Management: Principles of cryptography, Authentication, integrity, key distribution and certification, Access control and fire walls, attacks and counter measures, security in many layers.

Unit 6: Infrastructure for network management, internet standard management framework –SMI, MIB, SNMP, Security and administration, ASN.1.

Course Learning Outcomes (CLOs):

- Demonstrate the knowledge of network planning and optimization.
- Develop an in-depth understanding, in terms of architecture, protocols and applications, of major high performance networking technologies.

- Evaluate various technologies and identify the most suitable one to meet a given set of requirements for a hypothetical corporate network

Text books:

- Kershenbaum A., "Telecommunications Network Design Algorithms", Tata McGraw Hill,1993.
- Larry Peterson & Bruce David, "Computer Networks: A System Approach", Morgan Kaufmann, 2003.

Reference books:

- Warland J., Varaiya P., "High-Performance Communication Networks", Morgan Kaufmann, 1996.

Online links for study & reference materials:

https://nptel.ac.in/courses/106/108/106108055/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: DPE52 **Course Name:** Pattern Recognition & Machine Learning
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To equip students with basic mathematical and statistical techniques commonly used in pattern recognition.
- To introduce students to a variety of pattern recognition algorithms.
- Enable students to apply machine learning concepts in real life problems.

Course Description:

This course will serve as a comprehensive introduction to various topics in machine learning. At the end of the course the students should be able to design and implement machine learning solutions to classification, regression, and clustering problems; and be able to evaluate and interpret the results of the algorithms.

Course Contents:

Unit 1: Introduction to Pattern Recognition: Problems, applications, design cycle, learning and adaptation, examples, Probability Distributions, Parametric Learning - Maximum likelihood and Bayesian Decision Theory- Bayes rule, discriminant functions, loss functions and Bayesian error Analysis

Unit 2: Linear models: Linear Models for Regression, linear regression, logistic regression Linear Models for Classification.

Unit 3: Neural Network: perceptron, multi-layer perceptron, back propagation algorithm, error surfaces, practical techniques for improving back propagation, additional networks and training methods, Adaboost, Deep Learning

Unit 4: Linear discriminant functions - decision surfaces, two-category, multi-category, minimum squared error procedures, the Ho-Kashyap procedures, linear programming algorithms, Support vector machine

Unit 5: Algorithm independent machine learning – lack of inherent superiority of any classifier, bias and variance, re-sampling for classifier design, combining classifiers

Unit 6: Unsupervised learning and clustering – k-means clustering, fuzzy k-means clustering, hierarchical clustering

Course Learning Outcomes (CLOs):

- Understand machine learning concepts and range of problems that can be handled by machine learning.
- Compare and parameterize different learning algorithms.
- Apply the machine learning concepts in real life problems.

Text books:

- Richard O. Duda, Peter E. Hart, David G. Stork, “Pattern Classification”, 2nd Edition John Wiley & Sons, 2001.

- Trevor Hastie, Robert Tibshirani, Jerome H. Friedman, "The Elements of Statistical Learning", 2nd Edition, Springer, 2009.

Reference books:

- C. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.

Online links for study & reference materials:

https://nptel.ac.in/courses/117/108/117108048/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: DPE53 **Course Name:** Remote Sensing
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To provide background knowledge and understanding of principles of RS, RS Sensors and systems.
- Overview of information retrieval of earth surface features using multi-resolution, multi-scale and multi-temporal imagery.
- Introduction of image processing and classification techniques

Course Description:

The course provides basic understanding about satellite based Remote Sensing technology. Presently, remote sensing datasets available from various earth orbiting satellites are being used extensively in various domains including in civil engineering, water resources, earth sciences, transportation engineering, navigation etc.

Course Contents:

Unit 1: Physics Of Remote Sensing: Electro Magnetic Spectrum, Physics of Remote Sensing-Effects of Atmosphere-Scattering–Different types–Absorption-Atmospheric window-Energy interaction with surface features –Spectral reflectance of vegetation, soil and water atmospheric influence on spectral response patterns-multi concept in remote sensing.

Unit 2: Data Acquisition: Types of Platforms–different types of aircrafts-Manned and Unmanned spacecrafts–sun synchronous and geo synchronous satellites –Types and characteristics of different platforms LANDSAT, SPOT, IRS, INSAT, IKONOS, QUICKBIRD etc

Unit 3: Photographic products, B/W, color, color IR film and their characteristics –resolving power of lens and film -Opto mechanical electro optical sensors –across track and along track scanners-multispectral scanners and thermal scanners–geometric characteristics of scanner imagery -calibration of thermal scanners.

Unit 4: Scattering System: Microwave scatterometry, types of RADAR –SLAR –resolution –range and azimuth –real aperture and synthetic aperture RADAR. Characteristics of Microwave images topographic effect-different types of Remote Sensing platforms –airborne and space bornesensors -ERS, JERS, RADARSAT, RISAT -Scatterometer, Altimeter-LiDAR remote sensing, principles, applications.

Unit 5: Thermal And Hyper Spectral Remote Sensing: Sensors characteristics-principle of spectroscopy-imaging spectroscopy–field conditions, compound spectral curve, Spectral library, radiative models, processing procedures, derivative spectrometry, thermal remote sensing –thermal sensors, principles, thermal data processing, applications.

Unit 6: Data Analysis: Resolution–Spatial, Spectral, Radiometric and temporal resolution-signal to noise ratio-data products and their characteristics-visual and digital

interpretation–Basic principles of data processing –Radiometric correction–Image enhancement–Image classification–Principles of LiDAR, Aerial Laser Terrain Mapping.

Course Learning Outcomes (CLOs):

- Analyse the principles and components of photogrammetry and remote sensing.
- Describe the process of data acquisition of satellite images and their characteristics.
- Compute an image visually and digitally with digital image processing techniques.

Text books:

- Lillesand T.M., and Kiefer,R.W. Remote Sensing and Image interpretation, John Wiley &Sons-2000, 6thEdition
- John R. Jensen, Introductory Digital Image Processing: A Remote Sensing Perspective,2nd Edition, 1995.

Reference books:

- Charles Elachi and Jakob J. van Zyl , Introduction To The Physics and Techniques of Remote Sensing , Wiley Series in Remote Sensing and Image Processing, 2006.

Online links for study & reference materials:

https://nptel.ac.in/courses/121/107/121107009/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Dissertation

Dissertation Phase – I and Phase - II

Teaching Scheme **Paper Code: MTC03 & MTC04**

Lab work: 20 and 32 hrs/week

Course Outcomes:

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

- Ability to synthesize knowledge and skills previously gained and applied to an in depth study and execution of new technical problem.
- Capable to select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design.
- Ability to present the findings of their technical solution in a written report.
- Presenting the work in International/ National conference or reputed journals.

Syllabus Contents:

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The dissertation should have the following

- Relevance to social needs of society
- Relevance to value addition to existing facilities in the institute
- Relevance to industry need
- Problems of national importance
- Research and development in various domain

The student should complete the following:

- Literature survey Problem Definition
- Motivation for study and Objectives
- Preliminary design / feasibility / modular approaches
- Implementation and Verification
- Report and presentation

The dissertation stage II is based on a report prepared by the students on dissertation allotted to them. It may be based on:

- Experimental verification / Proof of concept.
- Design, fabrication, testing of Communication System.
- The viva-voce examination will be based on the above report and work.

Guidelines for Dissertation Phase – I and II:

- As per the AICTE directives, the dissertation is a yearlong activity, to be carried out and evaluated in two phases i.e. Phase – I: July to December and Phase – II: January to June.
- The dissertation may be carried out preferably in-house i.e. departments laboratories and centers OR in industry allotted through departments T & P coordinator.

After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives. The referred literature should preferably include IEEE/IET/IETE/ Springer/Science Direct/ACM journals in the areas of Computing and Processing (Hardware and Software), Circuits-Devices and Systems, Communication-Networking and Security, Robotics and Control Systems, Signal Processing and Analysis and any other related domain. In case of Industry sponsored projects, the relevant application notes, while papers, product catalogues should be referred and reported.