**Civil Engineering Open Elective**

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| **101839**  | **Metro Systems and Engineering**  | **3L:0T:0P**  | **3 credits**  |

GENERAL: Overview of Metro Systems; Need for Metros; Routing studies; Basic Planning and Financials

CIVIL ENGINEERING-Overview and construction methods for: Elevated and underground Stations; Viaduct spans and bridges; Underground tunnels; Depots; Commercial and Service buildings. Initial Surveys & Investigations; Basics of Construction Planning & Management, Construction Quality & Safety Systems. Traffic integration, multimodal transfers and pedestrian facilities; Environmental and social safeguards; Track systems-permanent way. Facilities Management

ELECTRONICS AND COMMUNICATION ENGINEERING- Signaling systems; Automatic fare collection; Operation Control Centre (OCC and BCC); SCADA and other control systems; Platform Screen Doors.

MECHANICAL & TV + AC: Rolling stock, vehicle dynamics and structure; Tunnel Ventilation systems; Air conditioning for stations and buildings; Fire control systems; Lifts and Escalators

ELECTRICAL: OHE, Traction Power; Substations- TSS and ASS; Power SCADA; Standby and Back-up systems; Green buildings, Carbon credits and clear air mechanics.

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| **101838** | **Economic Policies in India** | **3L:0T:0P** | **3 Credits** |

**Detailed contents**

**Module 1 Lecture 10 hrs.**

Framework of Indian Economy: National Income - Trends and Structure of National Income, Demographic Features and Indicators of Economic Growth, Development Rural-Urban Migration and issues related to Urbanization, Poverty debate and Inequality, Nature, Policy and Implications, Unemployment-Nature, Central and State Government’s policies, policy implications, Employment trends in Organized and Unorganized Sector

**Module 2 Lecture 10 hrs.**

Development Strategies in India: Agricultural- Pricing, Marketing and Financing of Primary Sector, Economic Reforms- Rationale of Economic Reforms, Liberalization, Privatization and Globalization of the Economy, Changing structure of India’s Foreign Trade, Role of Public Sector- Redefining the role of Public Sector, Government Policy towards Public Sector, problems associated with Privatization, issues regarding Deregulation-Disinvestment and future of Economic Reforms

**Module 3 Lecture 10 hrs.**

The Economic Policy and Infrastructure Development: Energy and Transport, Social Infrastructure- Education, Health and Gender related issues, Social Inclusion, Issues and policies in Financing Infrastructure Development, Indian Financial System- issues of Financial Inclusion, Financial Sector Reforms-review of Monetary Policy of R.B.I. Capital Market in India.

**Module 4 Lecture 10 hrs.**

The Economic Policy and Industrial Sector: Industrial Sector in Pre-reforms period, Growth and Pattern of Industrialization, Industrial Sector in Post-reform period- growth and pattern of Micro, Small, Medium Enterprises s, problems of India’s Industrial Exports, Labor Market- issues in Labor Market Reforms and approaches to Employment Generation.

**Text Books**

1. Dhingra, Ishwar C. [2006],’Indian Economy,’ Sultan Chand and Sons, New Delhi.
2. Datt, Ruddar and Sundaram, K.P.M. [Latest edition] ,’Indian Economy,’ S. Chand and Co, New Delhi.

**Reference Books**

1. Brahmananda, P.R. and V.A. Panchmukhi. [2001], Ed. ‘Development Experience in Indian Economy, Inter-state Perspective,’ Bookwell, New Delhi.

2. Gupta,S.P. [1989],’Planning and Development in India: A Critique,’ Allied Publishers Private Limited, New Delhi.

3. Bhagwati, Jagdish. [2004],’In Defense of Globalization,’ Oxford University Press, U.K.

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**Mechanical Engineering**

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| **102806** | **Computational Fluid Dynamics** | **3L:0T:0P** | **3 credits** |

**Pre-requisite:** Heat Transfer and Numerical Analysis Techniques.

**Objective:** To introduce the CFD techniques and tools for modelling, simulating and analysing practical engineering problems with hands on experience using commercial software packages used in industry.

**Outcome:** Students are able to understand the use of different CFD techniques and tools for modelling, simulation and analysis of complex engineering problems.

**Module: 1**

Introduction: Philosophy of Computational Fluid Dynamics, Computational Fluid Dynamics as a research tool, Computational Fluid Dynamics as a design tool, the impact of Computational Fluid Dynamics on automobile and engine applications, Industrial manufacturing applications, environmental engineering applications. (**Lectures 9)**

**Module: 2**

Governing equations of Computational Fluid Dynamics: Models of the flow, the substantial derivative, divergence of velocity, continuity equation, momentum equation, energy equation, Physical boundary conditions. (**Lectures8)**

**Module: 3**

Partial differential equations: General method of determining the classification of partial differential equations, The impact of different equation on Computational Fluid Dynamics: Hyperbolic equations, Parabolic equations and Elliptic equations. (**Lectures 6)**

**Module: 4**

Basic aspects of Discretization: Introduction to finite differences, Difference equations, Explicit and implicit approaches. (**Lectures 6)**

**Module: 5**

Grids with appropriate transformation: General transformation of the equations, Matrices and Jacobians, Stretched (compressed) grids. (**Lectures 5)**

**Module: 6**

Some Simple Computational Fluid Dynamics Techniques: Lax-Wendroff Technique, Mac Cormack’s Technique, Relaxation Technique, Pressure Correction Technique, etc.

(**Lectures 8)**

**Text/Reference Books:**

1. John D. Anderson, Jr. “Computational Fluid Dynamics”, McGraw-Hill, Inc.
2. Date, A. W., “Introduction to Computational Fluid Dynamics”, Cambridge University Press, 2005.
3. Sengupta, T. P. “Fundamental of Computational Fluid Dynamics”, Orient Longman, Hyderabad, India, 2004.

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| **102807** | **Safety Management** | **3L:0T:0P** | **3 credits** |

**Objectives:** This course is directed towards creating safety awareness, identifying hazards and mitigation of accidents along with introduction of legal requirements and following up action.

**Outcome:** After reading the course an engineer may develop confidence of over safe operations.

**Module: 1**

Need, Modern safety concepts, OSHA norms. (**Lectures 3)**

**Module: 2**

Safety Management function, Cost analysis of accidents, system safety analysis. (**Lectures 6)**

**Module: 3**

Hazards identification and control. Pressure hazard, fire hazard and Electrical hazard. **(Lectures 12)**

**Module: 4**

Hazard in construction industry, Hazard due to acceleration and fall, Mechanical hazard, Hazard due to heat and temperature. (**Lectures 11)**

**Module: 5**

Safe practices rules, Personal protective equipment. (**Lectures 4)**

**Module: 6** Ergonomics. (**Lectures 6)**

**Text/Reference Books:**

1. Safety Management - John V. Grimaldi & Rollin H Simmands.
2. Ergonomics at work - Osborne, D. J, John wiley & Sons.s
3. Industrial safety Handbook - Handey, W, Mcgraw Hill.
4. Designer’s Guide to OSHA - Mcgraw Hill.
5. Handbook of occupational safety and Health – Johnwiley & Sons.
6. Industrial Accident Prevention – Heinrich, Hetal, Mcgraw Hill.

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| **102808** | **Non-Conventional Manufacturing** | **3L:0T:0P** | **3 credits** |

**Objective:** To understand how the material removal by using various energy and to know how the new materials and complex parts are produced with high accuracy by using new technology.

**Module: 1**

Introduction: Historical background of non-conventional machining processes, Classification, Basic fundamentals of various process and related comparison. (**Lectures 4)**

**Module: 2**

Mechanical Machining Process: Principle and working and applications of mechanical machining processes such as ultrasonic machining, water jet cutting. (**Lectures 7)**

**Module: 3**

Thermal and Chemical Machining Process: Principle and working and applications of thermal and chemical machining processes such as electro-discharge machining, electro-chemical machining. (**Lectures 7)**

**Module: 4**

Non-conventional welding process: Principle and working and application of non-conventional welding processes such as laser beam welding, electron beam welding, ultrasonic welding, plasma arc welding. explosive welding, cladding under water welding, metallising.

 (**Lectures 10)**

**Module: 5**

Non-conventional forming process: Principle, working and applications of high energy forming processes such as explosive forming, electro-magnetic forming, electro-discharge forming, water hammer forming, explosive compaction. (**Lectures 10)**

**Module: 6**

Introduction to Micro Manufacturing: Micro manufacturing fundamentals, significance, application of NCMPs for micro manufacturing, Micro to Nano finishing processing information. (**Lectures 4)**

**Text Books/ References Books:**

1. P.C. Pandey and H.S. Shah, *Modern Machining Processes*, Tata Mcgraw-Hill Publishing Co. Ltd, New Delhi, 1980.
2. A. Ghosh and A.K. Mallik, *Manufacturing Science,* 2nd edition, Affiliated East West Press, New Delhi.
3. G.F. Benedict, *Nontraditional Manufacturing Processes*, Marcel Dekker Inc., New York (ISBN 0-8247-7352-7), 1987.
4. V.K. Jain, *Advanced Machining Processes*, Allied Publishers, 2009.
5. J. A. Mc Geough, *Micromachining of Engineering Materials*, Taylor & Francis, 2001.

**Outcome:** Students will be able to understand the fundamentals of various non-conventional machining processes and their influence on performance and their applications.

**Electrical Engineering**

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| **103804** | **Computer Networks** | **3L:0T: 0P** | **3 Credits** |

**Objectives of the course**

* To develop an understanding of modern network architectures from a design and performance perspective.
* To introduce the student to the major concepts involved in wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs).
* To provide an opportunity to do network programming
* To provide a WLAN measurement ideas.

**Detailed contents**

**Module 1 Lecture 8 hrs.**

**Data communication Components:** Representation of data and its flow Networks , Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum.

**Module 2 Lecture 8 hrs.**

**Data Link Layer and Medium Access Sub Layer:** Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA, CSMA/CD,CDMA/CA

**Module 3 Lecture 8 hrs.**

**Network Layer:** Switching, Logical addressing – IPV4, IPV6; Address mapping - ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.

**Module 4 Lecture 8 hrs.**

**Transport Layer:** Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

**Module 5 Lecture 8 hrs.**

**Application Layer:** Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography.

**Suggested books**

1. Data Communication and Networking, 4th Edition, Behrouz A. Forouzan, McGraw- Hill.
2. Data and Computer Communication, 8th Edition, William Stallings, Pearson Prentice Hall India.

**Suggested reference books**

1. Computer Networks, 8th Edition, Andrew S. Tanenbaum, Pearson New International Edition.
2. Internetworking with TCP/IP, Volume 1, 6th Edition Douglas Comer, Prentice Hall of India.
3. TCP/IP Illustrated, Volume 1, W. Richard Stevens, Addison-Wesley, United States of America.

**Course Outcomes**

 After the completion of course, students can able to able to:

1. Explain the functions of the different layer of the OSI Protocol.
2. Draw the functional block diagram of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs) and can able to describe the function of each block.
3. Program for a given problem related TCP/IP protocol.
4. Configure DNS DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls using open source available software and tools.

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| **100813 Common Paper (EE/CSE)** | **Digital Image Processing** | **3L:0T:0P** | **3 Credits** |

**Detailed contents**

**Module 1 Lecture 8 hrs.**

**Introduction**: Background, Digital Image Representation, Fundamental Steps in Image Processing, Elements of a Digital Image Processing System.

**Digital Image Fundamentals:** Elements of Visual Perception, a Simple Image Model, Sampling and Quantization, Some Basic Relationships between Pixels, Imagining Geometry.

**Module 2 Lecture 8 hrs.**

**Image Transforms:** Introduction to the Fourier Transform, The Discrete Fourier Transform, Some Properties of the Two-Dimensional Fourier Transform, Other Separable Image Transforms.

**Module 3 Lecture 8 hrs.**

**Image Enhancement:** Spatial Domain Methods, Frequency Domain Methods, Some Simple Intensity Transformations, Histogram Processing, Image Subtraction, Image Averaging, Background, Smoothing Filters, Sharpening Filters, Lowpass Filtering, Highpass Filtering, Generation of Spatial Masks from Frequency Domain Specifications.

**Module 4 Lecture 8 hrs.**

**Image Restoring:** Degradations Model - Definitions, Degradation Model for Continuous Functions, Diagonalization of Circulant and Block-Circulant Matrices, Circulant Matrices, Block Circulant Matrices, Effects of Diagonalization on the Degradation Model, Algebraic Approach to Restoration, Unconstrained Restoration, Constrained Restoration, Inverse Filtering – Formulation, Removal of Blur Caused by Uniform Linear Motion, Restoration in the Spatial Domain, Geometric Transformation.

**Module 5 Lecture 8 hrs.**

**Image Compression:** Fundamentals – Coding Redundancy, Interpixel Redundancy, Psychovisual Redundancy, Fidelity Criteria. Image Compression Models – The Source Encoder and Decoder, The Channel Encoder and Decoder. Elements of Information Theory – Measuring Information, The Information Channel, Fundamental Coding Theorems, Using Information Theory. Error-Free Compression – Variable-Length Coding, Bit-Plane Coding, Lossless Predictive Coding. Lossy Compression – Lossy Predictive Coding, Transform Coding.

**Text Book:**

1. Rafael. C. Gonzalez & Richard E.Woods.- Digital Image Processing, 2/e Pearson Education, New Delhi - 2006

**Reference Books:**

1. W.K.Pratt.-Digital Image Processing, 3/e Edn., John Wiley & sons, Inc. 2006

2. M. Sonka et.al Image Processing, Analysis and Machine Vision, 2/e, Thomson, Learning, India Edition, 2007

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| **103807** | **Strength of Materials** | **3L:0T:0P** | **3 credits** |

###### Objectives:

1. To understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams, shafts, cylinders and spheres for various types of simple loads.
2. To calculate the elastic deformation occurring in various simple geometries for different types of loading.

###### Contents:

###### Module:1 (8 lectures)

Deformation in solids- Hooke’s law, stress and strain- tension, compression and shear stresses- elastic constants and their relations- volumetric, linear and shear strains- principal stresses and principal planes- Mohr’s circle, theories of failure,

###### Module:2 (8 lectures)

Beams and types transverse loading on beams- shear force and bend moment diagrams- Types of beam supports, simply supported and over-hanging beams, cantilevers. Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads.

###### Module:3 (8 lectures)

Moment of inertia about an axis and polar moment of inertia, deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell’s reciprocal theorems.

###### Module:4 (8 lectures)

Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of helical springs.

###### Module:5 (8 lectures)

Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure.

###### **Text Books:**

1. Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall of India, New Delhi,2001.
2. R. Subramanian, Strength of Materials, Oxford University Press, 2007.
3. Ferdinand P. Been, Russel Johnson Jr. and John J. Dewole, Mechanics of Materials, Tata GrawHill Publishing Co. Ltd., New Delhi2005.

**Practical:**

1. Hooke’s Law
2. Hardness Test: Rockwell, Brinell, Vicker
3. Izod & Charpy Impact Test
4. Bending Test
5. Torsion Test
6. Shear test
7. Compressive strength test
8. Fatigue Test
9. Verification of Maxwell’s reciprocal theorem
10. Continuous beam deflection test
11. Strain Measurement

***\*Atleast 8 experiments should be performed from above list***

**Course Outcomes:**

1. After completing this course, the students should be able to recognize various types loads applied on machine components of simple geometry and understand the nature of internal stresses that will develop within the components
2. The students will be able to evaluate the strains and deformation that will result due to the elastic stresses developed within the materials for simple types of loading

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| **103808** | **Fluid Machinery** | **3L:0T:0P** | **3 Credits** |

###### **Objectives:**

The objective is to present the mathematical and physical principles in understanding the linear continuum behavior of solids.

###### **Contents:**

**Module: 1**

Introduction – Classification of fluid machinery. **(Lectures: 2)**

**Module: 2**

Dynamic action of fluid jet – Impact of fluid jet on fixed and moving flat places, impact of jet on fixed and moving curved vanes, flow over radial vanes, jet propulsions. **(Lectures: 4)**

**Module: 3**

Euler’s fundamental equation, degree of reaction. **(Lectures:2)**

**Module: 4**

Hydraulic turbines, introduction, classification, impulse turbine, construction details, velocity triangles, power and efficiency calculations, reaction turbines; constructional details, working principle, velocity triangles, power and efficiency calculations, draft tube, cavitation, governing. **(Lectures: 10)**

**Module: 5**

Principle of similarity in fluid machinery; unit and specific quantities, testing models and selection of hydraulic turbines. **(Lectures: 3)**

**Module: 6**

Positive displacement pumps: Reciprocating pump; working principle, classification, slip, indicator diagram, effect of friction and acceleration, theory of air vessel, performance characteristics gas gear oil pump and screw pump. **(Lectures: 4)**

**Module: 7**

Rotodynamic pumps: Introduction, classification, centrifugal pump; main components, working principle velocity triangle, effect of shape of blade specific speed, heats, power and efficiency, calculations minimum steering speed, multi stage pumps, performance characteristic, comparison with reciprocating pump. **(Lectures: 7)**

###### **Course Outcomes:**

Upon completion of this course, students will be able understand the deformation behavior of solids under different types of loading and obtain mathematical solutions for simple geometries.

###### **Text Books:**

1. G. T. Mase, R. E. Smelser and G. E. Mase, Continuum Mechanics for Engineers, Third Edition, CRC Press,2004.
2. Y. C. Fung, Foundations of Solid Mechanics, Prentice Hall International,1965.
3. Lawrence. E. Malvern, Introduction to Mechanics of a Continuous Medium, Prentice Hall international,1969.
4. Hydrantic Machine by Jagdish Lal
5. Hydraulics & Hydraulic Machines by Vasandari
6. Hydrantic Machine by RD Purohit

**Practical:**

1. Performance on hydraulic turbines:
	1. Pelton wheel
	2. Francis turbine
	3. Kaplan turbine.
2. Performance on hydraulic pumps:
	1. Single stage and multi stage centrifugal pumps
	2. Reciprocating pump.
3. Performance test of a two stage reciprocating air compressor
4. Performance test on an air blower

**OPTIONAL**

1. Visit to hydraulic power station/Municipal water pump house and case studies.
2. Demonstration of cut section models of hydraulic turbines and pumps.

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**Electronics & Communication Engineering**

**104808 Machine Learning 3L: 0T: 0P 3 Credits**

1. Introduction: Basic definitions, types of learning, hypothesis space and inductive bias, evaluation, cross-validation. Linear regression, Decision trees, over fitting 8

2. Instance based learning, Feature reduction, Collaborative filtering based recommendation. Probability and Bayes learning. 8

3. Logistic Regression, Support Vector Machine, Kernel function and Kernel SVM 8

4. Neural Network: Perceptron, multilayer network, back propagation, introduction to deep neural network 8

5. Computational learning theory, PAC learning model, Sample complexity, VC Dimension, Ensemble learning. Clustering: k-means, adaptive hierarchical clustering, Gaussian mixture model. 8

**Sl. No. Name of Authors / Books /Publishers**

1 Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997, 1997

2 Introduction to Machine Learning Edition 2, by Ethem Alpaydin

**104809 Introduction to MEMS 3L:0T:0P 3 Credits**

1. Introduction to Micro electromechanical Systems (MEMS) and MEMS Fabrication Technologies, Materials and Substrates for MEMS, Processes for Micro- machining - Basic Process Tools, Advanced Process Tools 8

2. MEMS Structure and Systems: General Design Methodology, Techniques for Sensing and Actuation, Passive MEM Structures, Sensors. Actuators, Mechanical Vibrations, Computer Aided Design of MEMS and tools 7

3. Applications of MEMS in RF/Microwave: The MEMS Switch and its Design Consideration. The MEM Resonator and its Design Considerations, Micromachining Enhanced Planar Microwave Passive Elements. Other MEMS Based RF/Microwave Circuits and System 15

4. Packaging and Reliability for MEMS: Key Design and Packaging Considerations. Die Attach Processes. Wiring and Interconnects. Types of Packaging Solutions. Reliability and Failure Analysis 10

**Sl. No. Name of Authors / Books /Publishers**

1. Nadim Maluf and Kirt Williams, “An Introduction to Micro electromechanical

Systems Engineering”, Artech, 2nd Edition (2004).

1. Hector J. De Los Santos “ Introduction to Micro electromechanical Microwave

Systems”, Artech, 2nd Edition (2004).

**100808 Common Paper (EE/ECE)**

 **Internet of Things 3L:0T:0P 3 Credits**

1. Introduction: Internet of Things Promises Definition Scope Sensors for IoT Applications Structure of IoT IoT Map Device 9

2. SEVEN GENERATIONS OF IOT SENSORS TO APPEAR: Industrial sensors Description & Characteristics–First Generation – Description & Characteristics–Advanced Generation – Description & Characteristics–Integrated IoT Sensors – Description & Characteristics–Polytronics Systems – Description & Characteristics–Sensors Swarm – Description &Characteristics–Printed Electronics – Description & Characteristics–IoT Generation Roadmap 9

3 TECHNOLOGICAL ANALYSIS: Wireless Sensor Structure–Energy Storage Module–Power Management Module–RF Module–Sensing Module 9

4 IOT DEVELOPMENT EXAMPLES: ACOEM Eagle – En Ocean Push Button – NEST Sensor – Ninja Blocks -Focus on Wearable Electronics 9

5 PREPARING IOT PROJECTS: Creating the sensor project: Preparing Raspberry Pi-Clayster libraries - Hardware- Interacting with the hardware - Interfacing the hardware- Internal representation of sensor values - Persisting data - External representation of sensor values - Exporting sensor data - Creating the actuator project- Hardware - Interfacing the hardware - Creating a controller - Representing sensor values - Parsing sensor data - Calculating control states - Creating a camera - Hardware -Accessing the serial port on Raspberry Pi - Interfacing the hardware - Creating persistent default settings Adding configurable properties - Persisting the settings - Working with the current settings Initializing the camera 9

**Sl. No. Name of Authors / Books /Publishers**

1 Dr. Guillaume Girardin, Antoine Bonnabel, Dr. Eric Mounier, ’Technologies & Sensors for the Internet of Things Businesses & Market Trends 2014 - 2024’,Yole Development Copyrights, 2014

2 Peter Waher, ’Learning Internet of Things’,Packt Publishing, 2015

3 Editors OvidiuVermesan Peter Friess,’Internet of Things – From Research and Innovation to Market

4 Deployment’, River Publishers, 2014

5 N. Ida, Sensors, Actuators and Their Interfaces, Scitech Publishers, 2014

**104810 Power Electronics 3L:0T:0P 3 Credits**

1. Semiconductor Switching Devices: Review of Thyristor, two transistor Model of SCR, classification and V-I characteristics, junction temperature, gate circuit ratings, triggering process, UJT and characteristics, UJT as a relaxation oscillator, triggering UJT using SCR, turn off methods, fast recovery diodes, schottky diodes, Series and parallel connections of SCR, DIAC, TRIAC, Power MOSFETS, application of SCR. 7

2. Power Rectification: Classification of rectifiers, half, full, three-phase rectifier, semi converters, full converters, freewheeling diodes, circuits using SCR, voltage multiplying rectifier circuits, transformer utility factor 5

3. Regulated Power Supplies: Classification of voltage regulators, short period and long period accuracy of voltage regulator, D.C. voltage regulators, complete series voltage regulator circuit with ICs, SMPS basic principles, step up and step down circuits, UPS. 5

4. Inverters: Introduction, simple Inverters and Power Inverter using SCR, output voltage control in inverter waveform control, PWM inverters, reduction of harmonies with the help of PWM inverters. 5

5. Induction and Dielectric Heating: Induction heating effect of frequency power requirements, merits and application of induction heating, Dielectric heating, dielectric properties of a few typical materials, thermal losses, appli- cation of dielectric heating, skin effect, high frequency sources for induction and dielectric heaters. 6

6. Electronic Control of D.C. Motors: Introduction, control of D.C. shunt motor, full wave D.C. shunt motor control overload projection, universal motor control, electronic control for reversing motor control using SCR, choppers, their classifications and applications. 6

7. Electronic Control of A.C. Motors: Instability of D.C. motors, variable speed induction motor drives, T.N. characteristics of I.M. invertors for driving the motor, speed control of I.M. using various methods, cyclo-converters, their classifications and applications. 6

**Sl. No. Name of Authors / Books /Publishers**

1. M H Rashid, “Power electronics”, PHI, 2nd Edition (1998).
2. G K Mithal, “Industrial electronics”, Khanna Publishers, Delhi, 18th Edition (1998).
3. S N Biswas, “Industrial electronics”, Dhanpat Rai and Company, Delhi, 3rd Edition (2000).
4. P S Bhimbra, “Power electronics”, Khanna Publishers, Delhi, 3rd Edition (2002).
5. M D Singh, Khanchandani K B, “Power electronics”, TMH, 6th reprint (2001).

**100813 Big Data Analytics 3L:0T:0P 3 Credits**

**Common Paper (ECE/EEE)**

1. Simple linear regression: Fit a simple linear regression between two variables in R; Interpret output from R; Use models to predict a response variable; Validate the ssumptions of the model. Modelling data: Adapt the simple linear regression model in R to deal with multiple variables; Incorporate continuous and categorical variables in their models; Select the best-fitting model by inspecting the R output. 10

2.Many models: Manipulate nested dataframes in R; Use R to apply simultaneous linear models to large data frames by stratifying the data; Interpret the output of learner models. Classification: Adapt linear models to take into account when the response is a categorical variable; Implement Logistic regression (LR) in R; Implement Generalised linear models (GLMs) in R; Implement Linear discriminant analysis (LDA) in R. 10

3. Prediction using models: Implement the principles of building a model to do prediction using classification; Split data into training and test sets, perform cross validation and model evaluation metrics; Use model selection for explaining data with models; Analyse the over fitting and bias-variance trade-off in prediction problems. 10

4. Deep learning: Use massive amounts of data to train multi-layer networks for classification; Understand some of the guiding principles behind training deep networks, including the use of auto encoders, dropout, regularization, and early termination; Use sparklyr and H2O to train deep networks. 10

**Sl. No. Name of Authors / Books /Publishers**

1. Data Science for Business by F. Provost and T. Fawcett

2. Data Mining for the Masses by M. North

**104812 Transducers and Sensors 3L:0T:0P 3 Credits**

1 GENERALISED CONFIGURATIONS, FUNCTIONAL DISCRIPTION & PERFORMANCE CHARACTERISTICS OF MEASURING INSTRU- MENTS: Functional elements of an instrument; active & passive transducers; analog & digital modes of operation; null & deflection methods; I/O configuration of measuring instruments & instrument system – methods of correction for interfering & modifying inputs. Static characteristics; Meaning of static calibration, accuracy, precision & bias. Combination of component errors in overall system-accuracy calculation. Addition, subtraction, division & multiplication. Static sensitivity, linearity, threshold, resolution, hysteresis and dead pace. Scale readability. Span. Generalized static stiffness & input impedance.

2 MEASUREMENT OF DISPLACEMENT, FORCE, TORQUE & SHAFT POWER: Principle of measurement of displacement. Resistive potentiometers, variable inductance & variable reluctance pickups, LVDT, capacitance pickup. Principle of measurement of Force, Torque, Shaft power standards & calibration; basic methods of force measurement; characteristics of elastic force transducer-Bonded strain gauge, differential transformer, piezo electric transducer, variable reluctance/FM-oscillator, digital systems. Loading effects; Torque measurement on rotating shafts, shaft power measurement (dynamometers).

3 TEMPERATURE MEASUREMENT: Standards & calibration; thermal expansion methods bimetallic thermometers, liquid-in-glass thermometers, pressure thermometers; thermoelectric sensor (thermocouple) common thermo- couple, reference junction considerations, special materials, configuration & techniques; electrical resistance sensors conductive sensor (resistance thermometers), bulk semiconductor sensors (thermistors), bulk semiconductor sensors (thermistors); junction semiconductor sensors; digital thermometers. Radiation Methods radiation fundamentals, radiation detectors, unchopped (dc) broadband radiation thermometers. Chopped (AC) selective band (photon) radiation thermometers, automatic null balance radiation thermometers (optical pyrometers). Two color radiation thermometers. Black body-tipped fibre optic radiation thermometer, IR imaging systems. Fluoroptic temperature measurement.

4 PRESSURE MEASUREMENT: Standards & calibration; basic methods of pressure measurement; dead weight gauges & manometer, manometer dynamics; elastic transducers; high pressure measurement; low pressure (vaccum) measurement Mcleod gage, Knudsen gage, momentum-transfer (viscosity) gages, thermal conductivity gages, ionization gages, dual gage technique

5 FLOW MEASUREMENT; Local flow velocity, magnitude and direction. Flow visualization. Velocity magnitude from pilot static tube. Velocity direction from yaw tube, pivoted vane, servoed sphere, dynamic wind vector indicator. Hot wire and hot film anemometer. Hot-film shock-tube velocity sensor. Laser Doppler velocimeter; gross volume flow rate: calibration and standards. Constant-area, variable-pressure-drop meters (obstruction meters). Averaging pitot tubes. Constant pressure drop, variable area meters (rotameters), turbine meters, positive displacement meters. Metering pumps. Electromagnetic flow meters. Drag force flow meters. Ultrasonic flow meters, vortex shedding flow meters.

6 LEVEL MEASUREMENT: Capacitance probe; conductivity probes; diaphragm level detector, deferential pressure level detector, radiation level sensors, RADAR level gauges, level transmitter, ultrasonic level detector.

7 LEVEL MEASUREMENT: Capacitance probe; conductivity probes; diaphragm level detector, deferential pressure level detector, radiation level sensors, RADAR level gauges, level transmitter, ultrasonic level detector.

**Sl. No. Name of Authors / Books /Publishers**

1. Measurement systems application and design, ERNEST DOEBELIN, IV Edn. (Chapter 1, 2, 3, 4, 5).
2. Instrument Engineers Hand Book (process measurement), LIPTAK (Chapter 6).
3. Electronic Instrumentation – by H S Kalsi TMH 2nd Ed 2004

**Computer Science Engineering**

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| **100809 Common Paper (CSE/IT)** | **VLSI System Design** | **3L:0T:0P** | **3 Credits** |

**Detailed contents**

**Module 1 Lectures 6 hrs.**

**Introduction to VLSI design:** Moore’s Law; Scale of Integration; Types of VLSI Chips; Design principles (Digital VLSI); Design Domains(Y-Chart), Challenges of VLSI design- power, timing area, noise, testability reliability, and yield; CAD tools for VLSI design

**Module 2 Lectures 7 hrs.**

**Introduction to VLSI Technology:** VLSI Technology - An Overview - Wafer Processing, Oxidation, Epitaxial Deposition, Ion-implantation and Diffusion; The Silicon Gate Process- Basic CMOS Technology; basic n-well CMOS process, p-well CMOS process; Twin tub process, Silicon on insulator; CMOS process enhancement-Interconnect; circuit elements; 3-D CMOS

**Module 3 Lectures 7 hrs.**

**Analysis of CMOS logic Circuits:** MOSFET as Switch; Recapitulation of MOS; CMOS Inverter, CMOS logic circuits; NAND gate and NOR Gate; Complex logic circuits; Pass transistor logic; CMOS Transmission gate; CMOS full adder

**Module 4 Lectures 4 hrs.**

Advanced Techniques in CMOS logic circuit: Pseudo nMOS; Tri-state; Clocked CMOS; Dynamic CMOS logic- Domino, NORA, Zipper, etc.; Dual rail logic networks

**Module 5 Lectures 2 hrs.**

Memories: Static RAM; SRAM arrays; Dynamic RAMs; ROM arrays; Logic arrays

**Module 6 Lectures 8 hrs.**

Timing issues in VLSI system design: Timing classification- synchronous timing basics, skew and jitter, latch based clocking, self-timed circuit design; self-timed logic; completion signal generation; self-timed signaling–synchronizers and arbiters

**Module 7 Lectures 6 hrs.**

Verilog Hardware Description language: Overview of digital design with Verilog HDL; Hierarchical modeling concepts; Modules and port definitions; Gate level modeling; Data flow modeling; Behavioral modeling; Task & functions; Test bench

**Text Books:**

1. Neil H. E. Weste and Kamran Eshraghian, “Principles of CMOS VLSI Design”, 2nd edition, Pearson Education Asia, 2000.
2. John P. Uyemura, “Introduction to VLSI Circuits and Systems”, John Wiley and Sons, Inc., 2002.
3. Samir Palnitkar, “Verilog HDL”, 2nd Edition, Pearson Education, 2004.

**Reference Books:**

1. Eugene D. Fabricius, “Introduction to VLSI Design”, TMH International Editions, 1990.
2. Bhasker J., “A Verilog HDL Primer”, 2nd Edition, B. S. Publications, 2001.
3. Pucknell, “Basic VLSI Design”, Prentice Hall of India Publication, 1995.
4. Wayne Wolf, “Modern VLSI Design System on chip”, Pearson Education, 2002.

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| **105816** | **Embedded Systems** | **3L:0T:0P** | **3 Credits** |

**Detailed contents**

**Module 1 Lecture 10 hrs.**

**Embedded Computing:** Introduction, Complex systems and Microprocessors, The embedded system design process, Formalization for system design.

**Module 2 Lecture 10 hrs.**

**Instruction Sets CPUs:** Instruction and preliminaries ARM and SHARC Processors, Programming I/O CPU performance and Power consumption.

**Module 3 Lecture 10 hrs.**

**The embedded Computing Platform and program design:** Introduction, the CPU bus, Component interfacing, designing with microprocessors, development and debugging.

**Module 4 Lecture 10 hrs.**

**Program Design and Analysis:** Introduction program design, Assembly, Linking, Basic compilation techniques, and Analysis optimization of executive time.

**Text Book:**

1. Wayner Wolf., “Computers as components – Principle of Embedded Computing System Design”, Morgan Kaufmann/ Hercourt India Pvt. Ltd.

**Reference Books:**

1. Raj Kamal - Embedded Systems, TMH, New Delhi 2004.

2. F. Vahid& T. givargis- Embedded system Design, John wiley, India Edition, 2005.

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| **100810 Common Paper (CSE/IT)** | **Digital Signal Processing** | **3L:0T:0P** | **3 Credits** |

**Detailed contents**

**Module 1 Lecture 8 hrs.**

**Introduction:** Characterization and classification of signals, typical signal processing operations, Review of discrete-time signal and system analysis; Advantages and typical applications of DSP.

**Module 2 Lecture 8 hrs.**

**Sampling and Quantization:** Sampling and discrete-time processing of continuous time signals, Sampling of low-pass and band-pass signals; Uniform and non-uniform quantization, Lloyd-Max algorithm, Log-companding, A-law, µ-law; Adaptive quantization and prediction

**Module 3 Lecture 8 hrs.**

**Orthogonal transforms:** Properties and applications of DFT, implementing linear time invariant systems using DFT, circular convolution, linear convolution using DFT; Fast Fourier Transform, FFT algorithms: Decimation in time, decimation in frequency; Goertzel algorithm; Application of transform in speech, audio, image and video coding, Karhunen-Loeve Transform, DCT, JPEG and MPEG coding standards

**Module 4 Lecture 8 hrs.**

**Digital Filter design techniques:** IIR and FIR filters, filter design specifications; Design of digital IIR filters: Impulse invariant, and bilinear transformation techniques for Butterworth and Chebyshev filters; Design of FIR filters: Windowing, frequency sampling filter design, optimum approximations of FIR filters

**Module 5 Lecture 6 hrs.**

**Multi-rate Signal Processing:** Fundamentals of multirate systems, Decimation and interpolation, application of Multirate DSP in sampling rate conversion; Filter banks; Polyphase structures; Quadrature-mirror filter bank; Wavelet transform and its relation to multi-rate filter banks; applications to speech and audio coding.

**Module 6 Lecture 4 hrs.**

**Basic concept of Adaptive Digital Signal Processing:** Adaptive Wiener filter and LMS algorithm; Applications of adaptive filtering to echo cancellation and equalization.

**Text Books:**

1. Digital Signal Processing-A Computer Based Approach, Mitra, S.K.,
2. Discrete Time Signal Processing, Oppenheim, A.V. and Schafer, R.W. with Buck, J.R
3. Digital Signal Processing: A Practical Approach, Ifeachor, E.C. and Jervis, B.W

**Reference Books:**

1. Digital Signal Processing: Principles, Algorithm and Applications, Proakis, J.G. and Manolakis, D.G
2. Multirate Systems and Filter Banks ,Vaidyanathan, P.P

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| **105818** | **High Performance Computing** | **3L:0T:0P** | **3 Credits** |

**Detailed contents**

**Module 1 Lectures 10 hrs.**

Introduction to parallel computing. Parallel processing terminology, Pipelining Vs Data parallelism, Control parallelism, Scalability, Control parallel approach, Data parallel approach, Data parallel approach with I/O Parallel reduction, Prefix sums, List ranking, Preorder tree traversal, Merging two sorted lists, Graph coloring, Reducing the number of processors, Problems defying fast solutions on PRAMS

**Module 2 Lectures 10 hrs.**

Thread and process level parallel architectures: MIMD, multi-threaded architectures. Distributed and shared memory MIMD architectures.

**Module 3 Lectures 8 hrs.**

Dynamic interconnection networks.

Mapping and scheduling: Mapping data to processors on processor arrays and multicomputers, Dynamic Load Balancing on multicomputers, Static scheduling on UMA multiprocessors, Deadlock.

**Module 5 Lectures 12 hrs.**

Parallel programming and parallel algorithms: Programming models, parallel programming on multiprocessors and multicomputers. Parallel algorithm structure, analyzing parallel algorithm.

Elementary parallel algorithms, Matrix algorithms, sorting, Graph algorithms.

**Text Book:**

1. Quinn, Parallel computing – theory and practice, Tata McGraw Hill.

**Reference Books:**

1. Selim G. Akl, The Design and Analysis of Parallel Algorithms, PH International

2. Ghosh, Moona and Gupta, Foundations of parallel processing, Narosa

3. Mehdi R. Zargham, Computer Architectures single and parallel systems, PHI. publishing.

4. Ed. Afonso Ferreira and Jose’ D. P. Rolin, Parallel Algorithms for irregular problems - State of the art, Kluwer Academic Publishers.

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| **100811 Common Paper (CSE/IT)** | **Introduction to Communication Systems** | **3L:0T:0P** | **3 Credits** |

**Detailed contents**

**Module 1 Lectures 8 hrs.**

**Introduction:** Communication model, Transmission line, Data Communication Concepts, Data Transmission: Parallel Transmission, Serial Transmission, Asynchronous Transmission, Synchronous Transmission, Data Encoding, Non-Return to Zero (NRZ), Return to Zero (RZ), Modem Concept, Modem Operation

**Module 2 Lectures 6 hrs.**

**Basic signal processing operations in Digital communication:** Analog Pulse Modulation: Sampling theorem for base-band and pass-band signals, quadrature sampling of band pass signal Reconstruction of message from its samples, signal distortion in sampling

 **Module 3 Lectures 8 hrs.**

**Pulse Amplitude modulation:** Modulation generation and demodulation, PAM/TDM system. **Digital Pulse modulation:** Quantization, PCM, DPCM, Delta modulation, Adaptive delta modulation-Design of typical systems and performance analysis.

**Signal space concepts:** Geometric structure of the signal space, vector representation, distance, norm and inner product, orthogonality, Gram-Schmidt orthogonalization procedure.

**Module 4 Lectures 8 hrs.**

**Filtering and receivers:** Matched filter receiver, Inter symbol interference, Pulse Shaping, Nyquist criterion for zero ISI, Eye diagram, Equalizer, Scrambling and descrambling, Review of Gaussian random process, Optimum threshold detection, Optimum Receiver for AWGN channel, Matched filter and Correlation receivers

**Module 5 Lectures 10 hrs.**

**Decision Procedure:** Maximum aposteriori probability detector- Maximum likelihood detector, Error probability performance of binary signaling.

**Digital Band Pass Modulation Schemes:** ASK, FSK, PSK, MSK – Digital M-ary modulation schemes – signal space representation.

**Error in Communication:** Detection of signals in Gaussian noise - Coherent & non-coherent detection – Differential modulation schemes – Error performance of binary and M-ary modulation schemes – Probability of error of binary DPSK. Performance of M-ary signaling schemes in AWGN channels - Power spectra of digitally modulated signals, Performance comparison of digital modulation schemes

**Text Books:**

1. Digital Communications, Simon Haykin John Wiley & Sons, Indian edition

2. Modern Digital and Analog Communication Systems, fourth edition by B.P. Lathi and Zhi Ding, Oxford University Press

3. Introduction to data communications and networking, Behrouz Forouzan

**Reference Books:**

1. Fundamentals of Communication Systems by J Proakis and M Salehi

2. Signals and Systems, second edition, by A. Oppenheim and A. Willsky

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| **105819** | **Ad-hoc and Sensor Networks** | **3L:0T:0P** | **3 Credits** |

**Objectives:**

* + Understand the design issues in Ad Hoc and Sensor Networks.
	+ Learn the different types of MAC protocols.
	+ Be familiar with different types of Ad-hoc routing protocols.
	+ Be expose to the TCP issues in Ad-hoc networks.
	+ Learn the architecture and protocols of wireless sensor networks.

**Detailed contents**

**Module 1: Introduction Lectures 8 hrs.**

**Fundamentals of wireless communication technology** – the electromagnetic spectrum – radio propagation mechanisms – characteristics of the wireless channel – Mobile Ad-hoc Networks (MANETS) and Wireless Sensor Networks (WSNs): concepts and architectures. Applications of Ad-hoc and sensor networks. Design challenges in Ad-hoc and sensor networks.

**Module 2: Mac Protocols for Ad-hoc Wireless Networks Lectures 8 hrs.**

 Issues in designing a MAC Protocol- Classification of MAC Protocols- Contention based protocols Contention based protocols with Reservation Mechanisms- Contention based protocols with Scheduling Mechanisms – Multi channel MAC-IEEE 802.11

**Module 3: Routing Protocols and Transport Layer in Ad-hoc Networks Lectures 8 hrs.**

Issues in designing a routing and Transport Layer protocol for Ad hoc networks- proactive routing, reactive routing (on-demand), hybrid routing- Classification of Transport Layer solutions-TCP over Ad hoc wireless Networks.

**Module 4: Wireless Sensor Networks (WSNs) And MAC Protocols Lectures 8 hrs.**

Single node architecture: hardware and software components of a sensor node - WSN Network architecture: typical network architectures-data relaying and aggregation strategies -MAC layer protocols: self-organizing, Hybrid TDMA/FDMA and CSMA based MAC- IEEE 802.15.4

**Module 5: Security in Ad Hoc and Sensor Networks Lectures 8 hrs.**

Security Attacks – Key Distribution and Management – Intrusion Detection – Software based Anti-tamper techniques – Water marking techniques – Defense against routing attacks – Secure Ad hoc routing protocols – Broadcast authentication WSN protocols – TESLA – Biba – Sensor Network Security Protocols – SPINS

**Text Book:**

1. C. Siva Ram Murthy and B.S.Manoj, ―Ad Hoc Wireless Networks – Architectures and Protocols, Pearson Education, 2006.

2. Holger Karl and Andreas Willig, “Protocols and Architectures for Wireless Sensor Networks”, Wiley, 2005

**References Book:**

1. Carlos De Morais Cordeiro, Dharma Prakash Agrawal “Ad Hoc & Sensor Networks: Theory and Applications”, World Scientific Publishing Company, 2006.

2. Feng Zhao and Leonides Guibas, "Wireless Sensor Networks", Elsevier Publication - 2002.

**Course Outcomes:**

Upon completion of the course, the student should be able to:

1. Identify different issues in wireless ad hoc and sensor networks.

2. Analyze protocols developed for ad hoc and sensor networks.

3. Identify and understand security issues in ad hoc and sensor networks.

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Information Technology

**100812 Cyber Security Common Paper (IT/EEE) 3 CREDIT**

Module I

Cyber Security Fundamentals: Introduction, cybercrime and Information Security, Classification of Cybercrimes, Cybercrime the legal Perspective, Cyber offences,, Cyber-attacks, Social engineering, Cyberstalking, Botnets, Attack Vector, Cybercrime and cloud computing, Cybercrimes on mobile and wireless devices, Attacks on mobile/cell phones, Authentication service security, Organizational security policies and measures in mobile computing

Module II

Ethics in Cyber Security: Privacy, Intellectual Property in the cyberspace, Professional Ethics, Freedom of Speech, Fair User and Ethical Hacking, Trademarks, Internet Fraud, Electronic Evidence, forensic Technologies, Digital Evidence collection.

Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Phishing and Identity Theft, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer overflows.

Module III

Cybercrimes and Cybersecurity: Cybercrime and Legal Landscape around the world, Cyber laws, The Indian IT Act, Challenges, Digital Signatures and Indian IT Act, Amendments to the Indian IT Act, Cybercrime and punishment, Cost of Cybercrimes and IPR Issues, Web threats for Organizations, Social Computing and associated Challenges for Organizations.

Module IV

Cybercrime Examples and Mini-Cases: Career Paths in Cybersecurity, Honeypots, Case study (Official Website Hacking, E-mail spoofing, Banking related Frauds, Credit Card related Frauds).

**Text Books:**

1. Cyber Security by Nina Godhole, SunitBelapure, Wiley India.

2. Cyber Security Essentials by James Graham, Ryan Olson, Rick Howard CRC Press, Taylor & Francis Group, 2011

**Reference Books:**

1. Rhodes-Ousley, Mark. Information Security: The Complete Reference, Second Edition, Information Security Management: Concepts and Practice. New York, McGraw-Hill, 2013.

2. Whitman, Michael E. and Herbert J. Mattord. Roadmap to Information Security for IT and Infosec Managers. Boston, MA: Course Technology, 2011.

**106808 Computer Graphics 3 - Credit**

Module I Lectures: 8

Introduction and Line Generation: Types of computer graphics, Graphic Displays- Random scan displays, Raster scan displays, Frame buffer and video controller. RGB color model, direct coding, lookup table; storage tube graphics display, Raster scan display, 3D viewing devices, Plotters, printers, digitizers, Light pens etc.; Active & Passive graphics devices; Computer graphics software.

Module II Lectures: 8

Points and lines, Line drawing algorithms; DDA algorithm, Bresenham’s line algorithm, Circle generating algorithms, Mid-point circle generating algorithm, and parallel version of these algorithms. Ellipse generating algorithm; scan line polygon, fill algorithm, boundary fill algorithm, flood fill algorithm. Transformations: Basic transformation, Matrix representations and homogenous coordinates, Composite transformations, Reflections and shearing.

Module III Lectures: 10

Windowing and Clipping: Viewing pipeline, Viewing transformations, 2-D Clipping algorithms- Line clipping algorithms such as Cohen Sutherland line clipping algorithm, Liang Barsky algorithm, Line clipping against non-rectangular clip windows; Polygon clipping – Sutherland Hodgeman polygon clipping, Weiler and Atherton polygon clipping, Curve clipping, Text clipping

Three Dimensional: 3-D Geometric Primitives, 3-D Object representation, 3-D Transformation, 3-D viewing, projections, 3-D Clipping.

Module IV Lectures: 8

Curves and Surfaces: Quadric surfaces, Spheres, Ellipsoid, Blobby objects, introductory concepts of Spline, Bspline and Bezier curves and surfaces.

Module V Lectures: 8

Hidden Lines and Surfaces: Back Face Detection algorithm, Depth buffer method, A- buffer method, Scan line method, basic illumination models– Ambient light, Diffuse reflection, Specular reflection and Phong model, Combined approach, Warn model, Intensity Attenuation, Color consideration, Transparency and Shadows.

**Reference Books:**

1. Donald Hearn and M Pauline Baker, “Computer Graphics C Version”, Pearson Education

2. Foley, Vandam, Feiner, Hughes – “Computer Graphics principle”, Pearson Education.

3. Rogers, “ Procedural Elements of Computer Graphics”, McGraw Hill

4. Donald Hearn and M Pauline Baker, “Computer Graphics with OpenGL”, Pearson education

**106809 Bitcoin and Crypto Currencies 3- Credit**

Module I

Introduction to Cryptography, Cryptographic Hash Functions, SHA‐256, Hash Pointers and Data Structures, Merkle tree.

Module II

Digital Signatures, Elliptic curve group, Elliptic Curve Digital Signature Algorithm (ECDSA). Public Keys as Identities, A Simple Crypto currency.

Module III

Centralization vs. Decentralization, Distributed consensus, Consensus without identity using a block chain, Incentives and proof of work. Bitcoin transactions, Bitcoin Scripts, Applications of Bitcoin scripts, Bitcoin blocks, The Bitcoin network.

Module IV

Simple Local Storage, Hot and Cold Storage, Splitting and Sharing Keys, Online Wallets and Exchanges, Payment Services, Transaction Fees, Currency Exchange Markets.

Module V

Bitcoin Mining, Mining pools, Mining incentives and strategies. Bitcoin and Anonymity: Anonymity Basics, Mixing, Zerocoin and Zerocash.

**Text Book**

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies, 2016.

1. Robot Engineering : An lntegrated Approach, Klafter, R. D, Chmielewski, T. A. and Noggin, h, Prentice Hall of India Pvt. Lt
2. Robotics control, sensing, vision and intelligence, Fu, K. S., Gonealez, R. C, &Lee, C.S.G, McGrawHill
3. lntroduction to Robotics mechanics and control, Craig, J. J., Addison-W

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| **106810** | **Cloud Computing** | **3L:0T:0P** | **3 Credits** |

**Objective**: This course will cover the study of various cloud services, deployment model, resource provisioning and scheduling algorithms involved in better implementing the cloud-based systems.

**Detailed contents**

**Module 1 Lecture 4 hrs.**

**Introduction:** Distributed Computing and Enabling Technologies, Cloud Fundamentals: Cloud Definition, Evolution, Architecture, Applications, deployment models, and service models.

**Module 2 Lecture 5 hrs.**

**Virtualization**: Issues with virtualization, virtualization technologies and architectures, Internals of virtual machine monitors/hypervisors, virtualization of data centers, and Issues with Multi-tenancy.

**Module 3 Lecture 6 hrs.**

**Implementation:** Study of Cloud computing Systems like Amazon EC2 and S3, Google App Engine, and Microsoft Azure, Build Private/Hybrid Cloud using open source tools, SLA management.

**Module 4 Lecture 12 hrs.**

**Resource Management**: Cloud resource provisioning plan (advance reservation, on demand plan, spot instances), various scheduling and load balancing techniques to improve QoS parameters, Resource Optimization algorithms, task migration and VM migration technique.

**Module 5 Lecture 7 hrs.**

**Security:** Vulnerability Issues and Security Threats, Application-level Security, Data level Security, and Virtual Machine level Security, Infrastructure Security, and Multi-tenancy Issues.

**Module 6 Lecture 6 hrs.**

**Advances**: Green Cloud, Mobile Cloud Computing, Fog Computing, Internet of Things

**Suggested Books:**

1. Cloud Computing Principles and Paradigms, Rajkumar Buyya, James Broberg, Andrzej Goscinski, Wiley Publishers 2011
2. Cloud Computing Bible, Barrie Sosinsky, Wiley Publishers 2010
3. Mastering Cloud computing, Rajkumar Buyya, Christian Vacchiola, S Thamarai Selvi, McGraw Hill 2013
4. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, Tim Mather, Subra Kumaraswamy, Shahed Latif, O’Reilly 2010
5. Cloud Computing by Shailendra Singh 2018

**Course outcomes:**

1. Articulate the main concepts, key technologies, strengths, and limitations of cloud computing and the possible applications for state-of-the-art cloud computing
2. Identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc.
3. Identify problems, and explain, analyze, and evaluate various cloud computing solutions
4. Provide the appropriate cloud computing solutions and recommendations according to the applications used.
5. Attempt to generate new ideas and innovations in cloud computing

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**106812 Probability and Statistical Inference 3-Credit**

Module I

Probability: Properties of Probability, Methods of Enumeration, Conditional Probability, Independent Events, Bayes’ Theorem.

Module II

Discrete Distributions: Random Variables of the Discrete Type, Mathematical Expectation, Special Mathematical Expectations, the Binomial Distribution, the Negative Binomial Distribution, the Poisson distribution.

Module III

Continuous Distributions: Random Variables of the Continuous Type, the Exponential, Gamma, and Chi-Square Distributions, the Normal Distribution, Additional Models.

Module IV

Bivariate Distributions: Bivariate Distributions of the Discrete Type, the Correlation Coefficient, Conditional Distributions, Bivariate Distributions of the Continuous Type, the Bivariate Normal Distribution.

Module V

Distributions of Functions of Random Variables: Functions of One Random Variable, Transformations of Two Random Variables, Several Random Variables, The Moment-Generating Function Technique, Random Functions Associated with Normal Distributions, The Central Limit Theorem, Approximations for Discrete Distributions, Chebyshev’s Inequality and Convergence in Probability, Limiting Moment-Generating Functions.

Module VI

Point Estimation: Descriptive Statistics, Exploratory Data Analysis, Order Statistics, Maximum Likelihood Estimation, A Simple Regression Problem, Asymptotic Distributions of Maximum Likelihood Estimators, Sufficient Statistics, Bayesian Estimation, More Bayesian Concepts.

Module VII

Interval Estimation: Confidence Intervals for Means, Confidence Intervals for the Difference of Two Means, Confidence Intervals For Proportions, Sample Size, Distribution-Free Confidence Intervals for Percentiles, More Regression, Resampling Methods.

**Text Book:**

1. “Probability And Statistical Inference”, Robert V. Hogg, Elliot A. Tanis, Dale L. Zimmerman; Pearson Education, Inc. Ninth Edition-2015.

**Reference Books:**

1. “Statistical Inference”, M. Rajagopalan, P. Dhanavanthan, PHI Learning – 2012

2. “Probability Distribution Theory and Statistical Inference”, Kartick Chandra Bhuyan, NCBA Publication - 2010.

**106813 - Simulation and Modelling 3-Credit**

**Module 1: Introduction**

System, environment, input and output variables, State variables; Static and Dynamic systems; Hierarchy of knowledge about a system and Modelling Strategy.

**Module 2: Physical Modelling**

 Dimensions analysis, Dimensionless grouping of input and output variables of find empirical relations, similarity criteria and their application to physical models.

**Module 3: Modeling of System with Known Structure**

 Review of conservation laws and the governing equation for heat, mass and momentum transfer, Deterministic model-(a) distributed parameter models in terms of partial identification and their solutions and (b) lumped parameter models in terms of differential and difference equations, state space model, transfer functions block diagram and sub systems, stability of transfer functions, modelling for control

**Module 4. Optimizations and Design of Systems**

Summary of gradient based techniques: Nontraditional Optimizations techniques (1) genetic Algorithm (GA) - coding, GA operations elitism, Application using MATLAB :( ii) Simulated Annealing

**Module 5: Neural Network Modelling of Systems only with Input-output Database:** Neurons, architecture of neural networks, knowledge representation, learning algorithm. Multilayer feed forward network and its back propagation learning algorithm, Application to complex engineering systems and strategy for optimum output.

**Module 6. Modelling Based on Expert Knowledge**

 Fuzzy sets, Membership functions, Fuzzy Inference systems, Expert Knowledge and Fuzzy Models, Design of Fuzzy Controllers

**Module 7. Simulation of Engineering Systems**

 Monte-Carlo simulation, Simulation of continuous and discrete processes with suitable examples from engineering problems.

**Text Books:**

1. Theory of modeling and simulation, Zeigler B.P. Praehofer. H. and Kim I.G.
2. System Simulation: the Art and Science, Shannon, R. E.

**Reference Books:**

1. Modern control Engineering, Ogata K
2. Neuro-Fuzzy and soft Computing ", Jang J.S.R. sun C.T and Mizutani E

Electrical Electronics Engineering

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| **110807** | **Power Plant Engineering** | **3L:0T:0P** | **3 credits** |

###### Objectives:

To provide an overview of power plants and the associated energy conversion issues

###### Contents:

**Module: 1**

Coal based thermal power plants, basic Rankine cycle and its modifications, layout of modern coal power plant, super critical boilers, FBC boilers, turbines, condensers, steam and heating

rates. Sub systems of thermal power plants, fuel and ash handling, draught system, feed water treatment, binary cycles and cogeneration systems.  **(Lectures 8)**

**Module : 2**

Gas turbine and combined cycle power plants, Brayton cycle analysis and optimization, components of gas turbine power plants, combined cycle power plants, **(Lectures 4)**

**Module : 3**

Basics of nuclear energy conversion, Layout and subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, safety measures for nuclear power plants.  **(Lectures 8)**

**Module : 4**

Hydroelectric power plants, Hydrological cycle, Rainfall & run-off measurement & plotting of various curves for estimating stream flow, site selection, classification, comparison with other types of power plant, typical layout and components, principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems.  **(Lectures 8)**

**Module: 5**

Energy, economic and environmental issues, power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants, Geothermal power plants, Ocean thermal electric conversion,, M.H.D power generation. **(Lectures 6)**

**Course Outcomes:**

Upon completion of the course, the students can understand the principles of operation for different power plants and their economics.

**Text Books:**

1. Power Plant Engineering, 5th Edition,, Laxmi Publications(P) Ltd
2. Nag P.K., Power Plant Engineering, 3rd ed., Tata McGraw Hill, 2008.
3. El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010.
4. Elliot T.C., Chen K and Swanekamp R.C., Power Plant Engineering, 2nd ed., McGraw Hill, 1998.

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| **110809** | **Automobile Engineering** | **3L:0T:0P** | **3 credits** |

###### Objectives:

To understand the construction and working principle of various parts of an automobile

###### Contents:

**Module: 1**

Types of automobiles, vehicle construction and layouts, Car body Style, chassis, frame and body, vehicle aerodynamics, IC engines-components, function and materials, variable valve timing (VVT), Front engine front wheel drive, Front engine Rear wheel drive, foure wheel drive.  **(Lectures 6)**

**Module: 2**

Engine auxiliary systems, electronic injection for SI and CI engines, unit injector system, rotary distributor type and common rail direct injection system, transistor based coil ignition & capacitive discharge ignition systems, turbo chargers (WGT, VGT), engine emission control by 3-way catalytic converter system, Emission norms (Euro & BS). **(Lectures 6)**

**Module: 3**

Transmission systems, clutch types, cone clutch, Single plate, multi plate, diaphragm spring & centrifugal clutch, electromagnetic clutch & construction, gear boxes- manual and automatic gear shift mechanisms, over drive principles, transfer box, Transaxles, flywheel, torque converter, propeller shaft, slip joints, universal joints, differential and rear axle, Hotchkiss drive and Torque tube drive**. (Lectures 8)**

**Module: 4**

Steering geometry and types of steering gear box, power steering, types of front axle, types of suspension systems, constructional details & characteristics of Leaf spring, pneumatic and hydraulic braking systems, antilock braking system (ABS), electronic brake force distribution (EBD) and traction control. **(Lectures 8)**

**Module: 5**

Caster, Camber, King pin inclination Toe in Toe out, Full Floating, three quarter floating &semi Floating rear axles. **(Lectures 5)**

**Module: 6**

Alternative energy sources, natural gas, LPG, biodiesel, bio-ethanol, gasohol and hydrogen fuels in automobiles, modifications needed, performance, combustion & emission characteristics of alternative fuels in SI and CI engines, Electric and Hybrid vehicles, application of Fuel Cells. **(Lectures 7)**

**Course Outcomes:**

Upon completion of this course, students will understand the function of each automobile component and also have a clear idea about the overall vehicle performance.

**Text books:**

1. Kirpal Singh, Automobile Engineering, 7th ed., Standard Publishers, New Delhi, 1997.
2. Jain K.K. and Asthana R.B., Automobile Engineering, Tata McGraw Hill, New Delhi, 2002.
3. Heitner J., Automotive Mechanics, 2nd ed., East-West Press, 1999.
4. Heisler H., Advanced Engine Technology, SAE International Publ., USA, 1998.

**Practical:**

1. To study and prepare report on the constructional details, working principles and operation of the Automotive Clutches.
2. To study and prepare report on the constructional details, working principles and operation of the Automotive Transmission systems.
3. To study and prepare report on the constructional details, working principles and operation of the Automotive Drive Lines & Differentials.
4. To study and prepare report on the constructional details, working principles and operation of the Multi-cylinder: Diesel and Petrol Engines.
5. To study and prepare report on the constructional details, working principles and operation of the Fuels supply systems.
6. To study and prepare report on the constructional details, working principles and operation of the Engine cooling & lubricating Systems.
7. To study and prepare report on the constructional details, working principles and operation of the Automotive Suspension Systems.
8. To study and prepare report on the constructional details, working principles and operation of the Automotive Steering Systems.
9. To study and prepare report on the constructional details, working principles and operation of the Automotive Brake systems.

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| **110810** | **Electrical Materials** | **3L:0T:0P** | **3 credits** |

**MODULE 1 ELECTRICAL ENGINEERING MATERIALS (6H)**

Introduction to Electrical Engineering Materials, Classification of materials, Material of importance- carbonated beverages container, Advanced Materials, Modern Material need, Atomic Structure and Interatomic Bonding, bonding forces and energies, secondary bonding and van-der-waals bonding,

**MODULE II THE STRUCTURE OF CRYSTALLINE SOLIDS (8H)**

The structure of crystalline solids, crystallographic points, directions and planes, X-Ray diffraction, determination of crystalline structure, imperfections and defects in solids, diffusion mechanisms, steady state diffusion, diffusion in semiconducting materials, material of importance- Aluminum for integrated circuit interconnects, mechanical properties of material, stress strain behavior. Structure and properties of ceramics, crystal ceramics, silicate ceramics, material of importance- carbon nano-tubes, Imperfections in ceramics, application and processing of ceramics, Glass ceramics, refractories, abrasives, cements, materials of importance –piezoelectric ceramics

**MODULE III** **INSULATING PROPERTIES OF MATERIAL (8H)**

Insulating materials; General Properties, Electrical Properties: Volume resistivity, surface resistance, dielectric loss, dielectric strength (breakdown voltage) dielectric constant, Thermal conductivity, Electro-thermal breakdown in solid dielectrics Insulating Materials and their applications:

**Plastics, Definition and classification**, Thermosetting materials, Phenol-formaldehyde resins (i.e. Bakelite) amino resins (urea formaldehyde and Malamine-formaldehyde), epoxy resins – their important properties and applications, Thermo-plastic materials: Polyvinyl chloride (PVC), polyethelene, silicons, their important properties and applications, Bitumen - Mineral and insulating oil for transformers switchgear capacitors, high voltage insulated cables, insulating varnishes for coating and impregnation - Enamels for winding wires, Glass fiber sleeves, SF6 their properties and applications

**MODULE IV ELECTRICAL PROPERTIES OF MATERAILS (6H)**

Electrical conduction ,electronic and ionic conduction, energy band structures in solids ,conduction in terms of band and atomic bonding models, electron mobility ,electrical resistivity of metals, materials of importance—aluminum electrical wires, semi conductivity , intrinsic semi conduction, extrinsic semi conduction, carrier mobility , semiconductor devices, electrical properties of polymers dielectric behavior, capacitance , field vectors and polarization, types of polarization, frequency dependence of the dielectric constant, dielectric materials, ferroelectricity, piezoelectricity.

**MODULE V OPTICAL AND MAGNETIC PRPERTIES OF MATERIALS (10 H)**

Optical properties,basic concepts, electromagnetic radiation, light interactions with solids atomic and electronic interactions optical properties of metals, optical properties of nonmetals, refraction, reflection, absorption, transmission, applications of optical phenomena, luminescence, Materials of importance—light-emitting diodes, photoconductivity , lasers , optical fibers in communications Diamagnetism and Paramagnetism Ferromagnetism , Antiferromagnetism and Ferrimagnetism , The Influence of Temperature on Magnetic Behavior, Domains and Hysteresis, Magnetic Anisotropy, Soft Magnetic Materials, Materials of Importance—An Iron–Silicon Alloy That Is Used in Transformer Cores, Hard Magnetic Materials Magnetic Storage , Superconductivity

**MODULE VI** **SUPERCONDUCTIVITY (6H)**

Properties of superconductors, London equations, Quantum explanation of superconductivity, Applications of superconductors. Nanomaterials: Introduction to nanotechnology, Nanowire and Nanotube, Carbon nanotubes, Single wall carbon nanotubes, Multiwall carbon nanotubes, Fabrications, Properties and applications

**Economic, Environmental, and Societal Issues in Materials Science and Engineering**  introduction , economic considerations , component design , materials , manufacturing techniques, environmental and societal considerations , recycling issues in materials science and engineering, materials of importance—biodegradable and biorenewable polymers/ plastics

**110814 Satellite Communication 3L: 0T: 0P 3 Credits**

1 Introduction to Satellite Communication: Principles and architecture of satellite Communication, Brief history of Satellite systems, advantages, disadvantages, applications and frequency bands used for satellite communication.

2 Orbital Mechanics: Orbital equations, Kepler’s laws, Apogee and Perigee for an elliptical orbit, evaluation of velocity, orbital period, angular velocity etc. of a satellite, concepts of Solar day and Sidereal day

3 Satellite sub-systems: Study of Architecture and Roles of various sub systems of a satellite system such as Telemetry, tracking, command and monitoring (TTC and M), Attitude and orbit control system (AOCS), Communication sub-system.

4 Typical Phenomena in Satellite Communication: Solar Eclipse on satellite, its effects, remedies for Eclipse, Sun Transit Outage phenomena, its effects and remedies, Doppler frequency shift Phenomena and expression for Doppler shift

5 Flux density and received signal power equations, Calculation of System noise temperature for satellite receiver, noise power calculation, C/N ratio calculations in clear air and rainy conditions

**Sl. No. Name of Authors / Books /Publishers**

1. Timothy Pratt Charles W. Bostian, Jeremy E. Allnutt: Satellite Communications; Wiley
2. Tri T. Ha: Digital Satellite Communications: Tata McGraw Hill
3. Dennis Roddy: Satellite Communication: 4th Edition, McGraw Hill.

**110817 Biomedical Instrumentation 3L:0T:0P 3 Credits**

1 Biomedical signals and Physiological transducers : Source of biomedical

signal, Origin of bioelectric signals, recording electrodes, Electrodes for ECG, EMG and EEG Physiological transducers: Pressure, Temperature, photoelec- tric and ultrasound Transducers. Measurement in Respiratory system: Physi- ology of respiratory system, Measurement of breathing mechanics Spiro meter, Respiratory therapy equipments Inhalators ventilators and Respirators, Hu- midifiers, Nebulizers Aspirators, Biomedical recorders: ECG, EEG and EMG.

2 Patient Monitoring systems and Audiometers : Cardiac monitor, Bed-side patient monitor, measurement of heart rate, blood pressure, temperature, respiration rate, Arrhythmia monitor, Methods of monitoring fatal heart rate, Monitoring labor activity. Audiometers: Audiometers, Blood cell counters, Oximeter, Blood flow meter, cardiac output measurement, Blood gas analyz- ers.

3 Modern Imaging systems : Introduction, Basic principle and Block diagram of x-ray machine, x- ray Computed Tomography (CT), Magnetic resonance imaging system (NMR), ultrasonic imaging system. Eco-Cardiograph, Eco Encephalography, Ophthalmic scans, MRI. Therapeutic Equipments: Cardiac pacemakers, cardiac defibrillators, Hemodialysis machine, Surgical diathermy machine.

4 Patient’s safety : Precaution, safety codes for electro medical equipment, Electric safety analyzer, Testing of biomedical equipment, Ultrasound therapy unit. Electrotherapy Equipments, Ventilators.

**Sl. No. Name of Authors / Books /Publishers**

1. “Hand book of Biomedical Instrumentation”, R.S.Khandpur, TMH
2. “Biomedical Instruments: Theory and Design”, Walter Welko- Witiz and Sid Doutsch, Wiley
3. “Biomedical Instrumentation and Measurements”, Lesile Cromwell, Fred J. Weibell and Erich A. Pfeiffer, PHI
4. “Introduction to Biomedical Equipment Technology”, Joseph J. Carr and John M. Brown, Pearson
5. “Textbook of Biomedical Instrumentation System”, Shakti Chatterjee, Cengage Learning

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| **110819** | **E-Commerce and ERP** | **3L:0T:0P** | **3 Credits** |

**Module 1 Lecture: 10 hrs.**

Introduction to E- Commerce: Evolution of E-commerce, Advantage and Disadvantage of E Commerce, Roadmap of E-Commerce in India. Business Models of E–Commerce: Model Based On Transaction Party: B2B, B2C, C2B, C2C.

**Module 2 Lecture: 10 hrs.**

**E marketing:** The scope of E-Marketing, Identifying Web Presence goals, Uniqueness of the web, Meeting the need of website visitors, Website Design Issues: Factors that make People Return to Your Site, Strategies for Website Development. Site Adhesion: Content, format and access: maintaining a Website, E- Advertising, E-Branding,

**Module 3 Lecture: 10 hrs.**

**E–Payment System**: Digital Payment Requirement, Digital Token based E-Payment System, Electronic Cash, Smart card and Electronics payment system: Credit and Debit Card, Virtual Currency, Digital wallet, Risk of Electronics payment system, Digital Signature.

**E Security**: Security On the Internet: Network and Website Security Risk: Denial-of-Service attack, Viruses, Unauthorized access to computer Network. Security Standards: Firewall, Cryptography, Key Management, Password Systems, Digital certificates, Digital signatures.

**Module 4 Lecture: 10 hrs.**

**Enterprise Resource Planning (ERP)**: Introductory Concepts, Advantages & disadvantages of ERP, ERP and Related Technologies: - Business Process Reengineering, Data Warehousing, Data Mining, Supply Chain Management. **ERP Implementation:**  ERP Implementation Life Cycle –Implementation Methodology, Hidden Costs , Organizing Implementation – Contracts with Vendors, Consultants and Users , Project Management and Monitoring.

**Module 5 Lecture: 7 hrs.**

**ERP Business Modules:** Introduction to basic Modules of ERP System, Business Modules in an ERP Package- Finance – Manufacturing – Human Resource – Plant Maintenance – Materials Management – Quality Management – Sales and Distribution.

**Case Study:** Recent business issues on E-Commerce Perspective**.**

**Text Books:**

1. Alexis Leon, “ERP Demystified”, Tata McGraw Hill.
2. E-Commerce An Indian Perspective by P.T.Joseph, PHI

**Reference Books**

1. K.K. Bajaj, D. Nag “E-Commerce”, 2nd Edition, McGraw-Hill Education, New Delhi.
2. Bhaskar Bharat, “Electronic Commerce-Technology and Application”, McGraw-Hill Education, New Delhi.
3. Mary Sumner, “Enterprise Resource Planning”, 2005, PHI Learning India Pvt. Ltd. /Pearson Education, New Delhi.
4. Chan, “E-Commerce fundamentals and Applications”, Wiley India, New Delhi.
5. Vinod Kumar Garg and N.K .Venkata Krishnan, “Enterprise Resource Planning – concepts and Planning”, Prentice Hall, 1998.

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