VECTOR SPACES: Real vector spaces, subspaces, linear independence – basis and dimension of a vector space - inner product space, orthonormal bases, Gram-Schmidt process. 

LINEAR TRANSFORMATIONS: General linear transformations, kernel and range, inverse linear transformations, matrices of general linear transformations, eigenvalues and eigenvectors. 


REFERENCES: 

21EA02 ADVANCED DIGITAL SYSTEM DESIGN


CPLD and FIELD PROGRAMMABLE GATE ARRAYS: Complex PLDs (CPLDs) –Xilinx cool runner architecture. Types of FPGA - Xilinx XC4000 series - Logic Cell Array (LCA) – Configurable Logic Blocks (CLB) - Input/output Blocks (IOB) - Programmable Interconnection Point(PIP) Implementing Functions in FPGAs Dedicated Memory in FPGAs – Dedicated Multipliers in FPGAs - Mapping, Placement and Routing - Verilog based design flow for FPGA. 


SYSTEM VERILOG ADVANCED VERIFICATION: Clocking Block – Program Block - Verification guidelines - Inter-process communication and Synchronization -Random Constraints Generation- Assertions: Immediate assertions – Concurrent assertions – Functional coverage - System verilog Test bench.

REFERENCES: 

21EA03 EMBEDDED SYSTEM DESIGN

Introduction to Embedded Systems: Introduction – Embedded systems versus general computing systems – Classification – Major application areas – Hardware and Software components: CPU of an embedded system – Memory – Input/Output devices, Sensors and actuators, Firmware, other system components–, Characteristics and quality attributes (Design Metric) of embedded system. Real time system’s requirements, real time issues, interrupt latency. Embedded Product development life cycle. 

Embedded Hardware and Design : ARM7TDMI: Architecture overview - Processor modes – Data types – Registers – Program status registers – ARM Instruction Set – Thumb Instruction Set. ARM Cortex-Mx: Processor Core overview -
Embedded Software Development Environments: Challenges and issues in embedded software development, Co-design. Real time operating systems, kernel architecture: Hardware, task/process control subsystem, device drivers, file subsystem, system calls, Embedded operating systems, task scheduling in embedded systems: task scheduler, first-in-first-out, shortest job first, round robin, priority based scheduling, context switch: task synchronization: mutex, semaphore, timers, types of embedded operating systems.

Validation and Debugging: Validation Types and Methods - Cross-compilers - ROM Emulator - Logical Analyzer - JTAG - In-Circuit Emulator -- Hardware-software co-design and program modeling - Issues in co-design -- Introduction to UML -- Hardware-software trade-offs -- Code optimization, Fixed point and floating point implementation of algorithms -- Analysis and Optimization of CPU Power Consumption.

REFERENCES:
5. Cortex-M4 Devices, Generic User Guide by ARM

21EA04 ADVANCED DIGITAL SIGNAL PROCESSING


FILTER BANKS: Analysis and Synthesis of Filter Banks-- Quadrature Mirror Filter (QMF) banks-- Filter bank with perfect reconstruction-- 2-Channel and M-channel-- Paraurinary filter banks-- Biorhogonal and Linear phase filter banks-- Tree and parallel structured filter banks-- Transmultiplexer filter banks-- Multi resolution analysis -- Subband coding and its applications (12+4)

WAVELET TRANSFORM: Short-TimeFourier Transform -- limitations - time-frequency scaling- Heisenberg's uncertainty -- Continuous Wavelet Transform -- Discrete Wavelet Transform -- Haar, Daubechy’s wavelets – Multi Resolution Analysis of audio signal. (11+4)


Total L: 45 + T:15=60

REFERENCES:

21EA05 SYSTEM THEORY

MODELLING: Introduction to state space modeling , modeling of physical systems, State-space realization of SISO systems using controllable, observable canonical forms (phase-variable approach), Diagonal and Jordan's canonical forms. Development of linear state-space models for nonlinear systems. (10+4)

ANALYSIS: Solution of LTI state-equation, state-transition matrix - properties and computational techniques -Eigen values, Eigen vectors, Diagonalization - Forced response of LTI Systems-- State transition matrix and solutions of LTV system -. Controllability and Observability - Tests. (12+4)

SYNTHESIS: Relationship between pole location and system's dynamic performance, control specifications, choice of desired closed loop poles based on dominant pole pair approach from controller specifications, regulation and reference tracking problems. State feedback control design and Observer Design using Ackermann's formula, Kalman filter algorithm. LQR and LQG controller design. Introduction to Eigen structure assignment. (13+4)

REFERENCES:

21EA06 / 21EE06 / 21ED06 / 21EM06 RESEARCH METHODOLOGY AND IPR
vide Automotive Engineering 21AE06

21EA72 AUDIT COURSE I
vide Automotive Engineering 21AE72

21EA51 / 21EE52 / 21ED52 OBJECT COMPUTING AND DATA STRUCTURES LABORATORY

Object Computing (Using C++):

Implementation of the following problems:

Implementation of basic programming concepts like conditionals and loops
Implementation of function and operator overloading
Creation of classes and objects.
Implementation of constructors and destructors
Implementation of array of objects and dynamic objects.
Implementation of friend functions, inline functions and default arguments.
Implementation of inheritance and its types
Implementation of polymorphism and its types.

Data Structures (Using C++):

Programs using arrays.
Implementation of various sorting algorithms.
Implementation of Stacks using array.
Application of Stack
Implementation of queue using array.
Implementation of Linked Lists: Singly linked, doubly linked and Circular lists and applications.

REFERENCES:

21EA52 EMBEDDED SYSTEM DESIGN LABORATORY

LIST OF EXPERIMENTS
1. Data acquisition using analog and digital sensors
2. Implementation of PWM and PLL techniques for control applications
3. Implementation of communication protocols in embedded applications
4. Study on different power saving modes of embedded processors
5. Implementation of multitasking control systems using RTOS.
6. Mini project

Total P= 60
BASIC ELECTRICAL PROPERTIES OF MOS AND CMOS CIRCUITS: VLSI design process -Introduction to MOS devices-characteristics - Second order effects - MOS models - NMOS inverter - Depletion mode and enhancement mode pull ups – CMOS inverter - DC characteristics - Inverter delay - Pass transistor - Transmission gate – Power consumption in CMOS gates.

LAYOUT DESIGN RULES AND LOGIC DESIGN: CMOS based design rules - Simple layout examples - Sheet resistance - Area capacitance - Wiring capacitance - Driving large capacitive loads. Switch logic - Pass transistor and transmission gate based design - Gate logic - Other forms of CMOS logic. Structured design - Combinational logic design examples - Parity generator - Multiplexers; Clocked sequential circuits - Two phase clocking - Charge storage - Dynamic register element - NMOS and CMOS - Dynamic shift register - Semistatic register - JK flip flop circuit. Design of a ALU subsystem - Implementing ALU functions with an adder - Multipliers


DELAY TEST AND DESIGN FOR TESTABILITY: Delay test problem – Path delay test – Transition faults – Delay test methodologies. Adhoc design for testability techniques - Controllability and Observability by means of scan registers – Storage cells for scan designs – Level Sensitive Scan Design (LSSD) - Partial Scan – Boundary scan – BIST concepts and architectures

REFERENCES:

TOTAL L: 45 + T:15= 60

21EA07 VLSI DESIGN AND TESTING


REFERENCES:

TOTAL L:45 + T:15= 60

21EA08 INTERNET OF THINGS

21EA82 AUDIT COURSE II
vide Automotive Engineering 21AE82
21EA61 MODELING AND SIMULATION LABORATORY

LIST OF EXPERIMENTS
1. Simulation of CMOS Digital Circuits using SPICE
2. Simulation of CMOS Analog circuits using SPICE
3. Design and implementation of state feedback controller for regulatory and tracking applications.
4. Implementation of state estimator on the simulated model.
5. Generation, visualization, spectral analysis, and filtering of DT signals
6. Mini project

Total P= 60

21EA62 ELECTRONIC SYSTEM DESIGN LABORATORY

LIST OF EXPERIMENTS
2. Layout of Simple NMOS/CMOS Circuits.
5. Verification of Digital circuits using System Verilog
6. Mini Project.

Total P= 60

21EA63 INDUSTRIAL VISIT AND TECHNICAL SEMINAR
vide Automotive Engineering 21AE63

21EA71 PROJECT WORK – I
vide Automotive Engineering 21AE71

21EA81 PROJECT WORK – II
Vide Automotive Engineering 21AE81

PROFESSIONAL ELECTIVE THEORY COURSES (Four to be opted)

21EA21 ALGORITHMS FOR VLSI DESIGN AUTOMATION

INTRODUCTION TO DESIGN METHODOLOGIES: VLSI Design problem-The Design Domains-Design methods and Technologies. (3)

ALGORITHMIC GRAPH THEORY AND COMPUTATIONAL COMPLEXITY: Data structures for the representation of graphs - Computational Complexity - Graph Algorithms - Depth first search - Breadth first search - Dijkstra's shortest path algorithm - Prim's algorithm. (8)

PLACEMENT, PARTITIONING AND FLOOR PLANNING: Circuit representation - Types of Placement Problem- Placement Algorithms- Constructive Placement, Iterative Improvement - Partitioning - Kernighan - Lin Partitioning algorithm - Floor Planning - Representation - Shape functions and floor plan sizing. (11)


SIMULATION: Gate level modeling and simulation - Compiler driven simulation - Event driven simulation - Switch-level modeling and simulation. (6)

HIGH LEVEL SYNTHESIS: Hardware models - Allocation - Assignment - Scheduling - Assignment Problem - High level transformation. (6)

Total L: 45

REFERENCES:

21EA22 ANALOG VLSI DESIGN

3 0 0 3


CMOS SINGLE STAGE AMPLIFIERS: MOS inverting amplifier, Improving the performance of inverting amplifier. Single stage MOS amplifiers. T- CS stage, CG stage , Source Follower, Frequency response of amplifiers (11)


SWITCHED CAPACITOR FILTERS: Introduction to Switched capacitor filters, Switched capacitor resistors. (3)

DATA CONVERTERS: Data Converter fundamentals, DAC Architectures: Current Switched, Resistive, charge redistribution, Hybrid, Segmented D/A Converters. ADC architectures: Flash, Pipeline, Integrating, Successive Approximation and folding A/D Converters. (8)

FIELD PROGRAMMABLE ANALOG ARRAY (FPAA): Overview of analog design – Introduction to Field Programmable analog array (FPAA) and its advantages – Role of EDA tool in Analog Design process. (3)

Total L : 45

REFERENCES:

21EA23 HARDWARE DESIGN VERIFICATION TECHNIQUES

3 0 0 3


VERIFICATION PLAN: Levels of verification – Verification Strategies – Test cases – Test benches. (13)


Total L: 45

REFERENCES:

21EA24 ASIC DESIGN

3 0 0 3

INTRODUCTION TO ASICS, CMOS LOGIC AND ASIC LIBRARY DESIGN: Types of ASICs - Design flow - CMOS transistors CMOS Design rules - Combinational Logic Cell – Sequential Logic cell - Data path logic cell - Transistors as Resistors - Transistor Parasitic Capacitance- Logical effort - Library cell design - Library architecture. (11)
PROGRAMMABLE ASICs: Anti fuse - static RAM - EPROM and EEPROM technology - PREP benchmarks - Actel ACT - Xilinx LCA - Altera FLEX - Altera MAX DC & AC inputs and outputs - Clock & Power inputs - Xilinx I/O blocks. (11)

PROGRAMMABLE ASIC INTERCONNECT, PROGRAMMABLE ASIC DESIGN SOFTWARE AND LOW LEVEL DESIGN ENTRY: Actel ACT - Xilinx LCA - Xilinx EPLD - Altera MAX 5000 and 7000 - Design systems - Logic Synthesis - Half gate ASIC - Schematic entry - Low level design language – Introduction to PLA tools. (7)

LOGIC SYNTHESIS, SIMULATION AND TESTING: VHDL and logic synthesis - types of simulation - boundary scan test - fault simulation - automatic test pattern generation. (6)

ASIC CONSTRUCTION, FLOOR PLANNING, PLACEMENT AND ROUTING: System partition - FPGA partitioning - partitioning methods - floor planning - placement - physical design flow - global routing - detailed routing - special routing - circuit extraction - EMI/EMC considerations - ASIC failures and work arounds. (10)

REFERENCES:

21EA25 SYSTEM ON CHIP

3 0 0 3

INTRODUCTION: System trade-offs and evolution of ASIC Technology – System on chip concepts and methodology – SoC design issues – SoC challenges and components. (4)


DESIGN METHODOLOGY FOR MEMORY AND ANALOG CORES: Embedded memories – Simulation modes – Specification of analog circuits – A to D converter – D to A converter – Phase-locked loops – High speed I/O (11)

DESIGN VALIDATION: Core level validation – Test benches- SoC design validation – Co-simulation – Hardware/software co-verification. (11)


REFERENCES:

21EA26 / 21EE24 COMPUTER ARCHITECTURE AND PARALLEL PROCESSING

3 0 0 3


INSTRUCTION-LEVEL PARALLELISM: Trends towards parallel processing - Parallelism in uniprocessor systems - Parallel processing mechanisms - Parallel computer structure - Architectural classification schemes – Instruction level parallelism: Pipelining and Handling Hazards - Instruction Scheduling - Static and Dynamic Branch Prediction - Hardware Based Speculation – Multi-threading- Limitations of ILP. (11)

VECTOR, SIMD AND GPU ARCHITECTURES: Basics of vector processing Architecture - Issues in vector processing- SIMD architecture- SIMD Instruction Set -GPU Architecture - Detecting and Enhancing Loop Level Parallelism. (11)
MULTIPROCESSOR AND MULTICORE ARCHITECTURES: Functional structures: Loosely and Tightly coupled
Multiprocessors – Processor characteristics for multiprocessing – Symmetric Multiprocessors (SMP) – Non-Uniform Memory
Access (NUMA) – Interconnection structures for multiprocessors – Cache coherence– Symmetric and distributed shared
memory architecture – Homogeneous and Heterogeneous Multi-core architectures–INTEL Multi-core architecture. (11)

REFERENCES:

21EA27 / 21EE35 INTERNET WORKING AND ITS APPLICATIONS


REFERENCES:

21EA28 REAL-TIME OPERATING SYSTEMS


Total L : 45

95
REFERENCES:

21EA29 LINUX ARCHITECTURE AND DEVICE DRIVERS

INTRODUCTION: Evolution of Linux OS – Main characteristics of Linux – Typical Linux distributions – Linux directory structure – User and super/root users – access rights – Home directory – Vi editor - Commands – Overview of shell and GUI. (11)


Total L: 45

REFERENCES:
3. Daniel P.Bovet, Marco Cesati "Understanding the Linux kernel", Shroff publishers & distributors Pvt Ltd, 2005

21EA30 / 21EM30 VIRTUAL INSTRUMENTATION SYSTEMS

INTRODUCTION: Concept of virtual instrumentation, virtual instrumentation model, design flow with graphical system design, graphical data flow programming - Modular programming, repetition and loops, arrays, clusters, plotting data, structures, strings, state machines –file I/O- creating LabVIEW executables and projects. (12)

DATA ACQUISITION: DAQ hardware configuration, DAQ hardware- Sampling and grounding techniques- analog I/O, digital I/O, counter/timer, DAQ software architecture, network data acquisition. Application design using Real Time Targets: PXI, cRIO. (11)

INSTRUMENT INTERFACES: Virtual Instrumentation Software Architecture (VISA), instrument drivers, serial and parallel interfaces: RS232, USB, firewire, controller area network (CAN), GPIB, Industrial Ethernet. OLE for Process Control (OPC) (11)

ADVANCED FEATURES IN LabVIEW: System identification and control design, signal processing, image acquisition and processing, data logging and supervisory control, LabVIEW Interface for processor, case studies on machine vision, control, GSD applications. (11)

Total: L: 45

REFERENCES:

21EA31/21EM31 ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING


MACHINE LEARNING: Definition of learning systems, problems, data, Visualization tools, Goals and applications, types of learning, hypothesis space and inductive bias, Decision tree learning, Linear regression, Model representation for single variable, Single variable Cost Function, Gradient Decent for Linear Regression. (11)


REFERENCES:

21EA32 / 21EE42 / 21ED34 / 21EM32 OPTIMIZATION TECHNIQUES


DYNAMIC PROGRAMMING: Multistage decision process, Suboptimization and Principle of Optimality, Computational procedure, Final value problem to initial value problem, Linear Programming as a Case of Dynamic Programming, Continuous dynamic programming. (11)

REFERENCES:

21EA33 / 21EE36 WIRELESS SENSOR NETWORKS

CHARACTERISTICS OF WSN: Characteristic requirements for WSN, Challenges for WSNs, WSN vs Adhoc Networks, Sensor node architecture, Commercially available sensor nodes, Physical layer and transceiver design considerations in WSNs, Energy usage profile, Choice of modulation scheme, Dynamic modulation scaling, Antenna considerations. (11)


REFERENCES:

21EA34 BIOSIGNAL PROCESSING

3003

BIO SIGNALS: Nature of Biomedical signals, Types: Action Potential, Electroneurogram (ENG), Electromyogram (EMG), Electrocardiogram (ECG), Electroencephalogram (EEG), Electrogastrogram (EGG), Phonocardiogram (PCG), Photoplethysmography (PPG).


SIGNAL COMPRESSION: Direct Digital compression Techniques, Transformation Compression Techniques, Other Compression Techniques and Comparison.

REFERENCES:

21EA35 WAVELETS AND APPLICATIONS

3003


APPLICATIONS: Review and demonstration of different wavelet applications: Compression–Denoising–Analysis of biomedical signals and power signals.

REFERENCES:

21EA36 ELECTRONIC PRODUCT DESIGN


Total L: 45

REFERENCES:
3. Tim Williams “EMC for Product Designers” 5th Edition, Copyright@2017 Elsevier Ltd.

21EA37 DIGITAL IMAGE PROCESSING

IMAGE FORMATION AND ENHANCEMENT: Human visual system--Sampling and Quantization--Color fundamentals--Spatial domain processing--Simple image operations--Point wise intensity transformations- Histogram processing - Linear and non-linear noise smoothing- Sharpening-Derivatives–Laplacian–Combining spatial enhancement methods. (11)

FREQUENCY TRANSFORMS AND APPLICATIONS: Frequency domain processing-- 2-D transforms: DFT, DCT, and DWT--Properties--Frequency domain filtering techniques--Sub band coding of image compression-- Coding techniques: Huffman, Run length, and Block transform–JPEG–Performance metrics. (11)


SEGMENTATION AND FEATURE EXTRACTION: Edge detection: Gradient operators-edge linking and boundary detection: Global processing via Hough transforms, Graph theoretic techniques – Thresholding techniques–K-means Clustering–Feature extraction: Boundary feature descriptors–Region feature descriptors–Principal components– SIFT.Object Recognition applications. (12)

Total L: 45

REFERENCES:


REFERENCES:


VECTOR CONTROL OF INDUCTION MOTOR DRIVES: Introduction to Park’s and Clarke’s transformation- Principle of vector control-Direct vector control-indirect vector control- stator flux oriented vector control- rotor flux oriented vector control– sensorless control- Direct torque control.

SPECIAL DRIVES: BLDC-principle, controllers; PMSM-principle-PMSM flux density distribution-Controller– SynRM-principle-magnetic flux density and operating point- converter VA requirements.

CONFIGURATIONS OF I/O CONTROL: AC drive Hardware Blocks – Control Blocks – Automatic Motor Adaptation – Parameterization of Drives (Local and Remote) Digital input and output- Analog input and Output control-word access- motion control- sequential logic control(SLC)- parameterization of different communication protocol: RS 485 – MODBUS – PROFIBUS.

REFERENCES:
3. Peter Vas, "Vector Control of AC Machines", Oxford University Press, 1990
4. John Park, Steve Mackey and Edwin Wright, "Data Communications for Instrumentation and Control", Elsevier 2003

REFERENCES:

REFERENCES:

REFERENCES:
OBJECT ORIENTED FEATURES AND I/O HANDLING: Classes - Principles of Object Orientation - Creating Classes – Instance Methods – Special Methods - Class Variables – Inheritance – Polymorphism - Type Identification – Data Streams - Access Modes - Writing Data to a File - Reading Data from a File - Additional File Methods - Using Pipes as Data Streams. (10)


APPLICATIONS USING PYTHON: Network programming-Database Access- Creating simple Graphical User Interfaces - Sending e-mail using SMTP Library-Multithreading-CGI Programming - Extensions- Micropython - Web application development: opening an URL-creating a simple web page- Overview of webapp2 and Flask (12)

REFERENCES:

21EA41 / 21EE31 / 21EM41 AUTOMOTIVE EMBEDDED SYSTEMS

3 0 0 3

INTRODUCTION: Current trends in modern automobiles – – Drive by wire Systems -Vehicle functional domains and their requirements - Components of an Automobile Electronic system and their functions: Sensors, Actuators, Control Units and Software structure of Control units (9)


REFERENCES:

21EA42 / 21EM42 MACHINE VISION

3 0 0 3

LOW-LEVEL VISION -Images and Imaging Operations -Basic Image Filtering Operations - -Thresholding Techniques - Edge Detection - Corner and Interest Point - Mathematical Morphology Texture. (9)


REAL-TIME PATTERN RECOGNITION SYSTEMS - Automated Optical Inspection - Inspection of Cereal Grains -In-Vehicle Vision Systems Statistical Pattern Recognition -Image Acquisition -Real-Time Hardware and Systems Design Considerations Epilogue. (12)

REFERENCES:

21EA43 / 21EM43 DIGITAL CONTROL ENGINEERING

BASIC DIGITAL SIGNAL PROCESSING IN CONTROL SYSTEMS: Sampling theorem, quantization, aliasing and quantization error, hold operation, mathematical model of sample and hold, zero and first order hold, factors limiting the choice of sampling rate, reconstruction.

MODELING OF SAMPLED DATA CONTROL SYSTEM: Difference equation description, Z-transform method of description, pulse transfer function, time and frequency response of discrete time control systems, stability of digital control systems, Jury's stability test, state space description, first companion, second companion, Jordan canonical models, discrete state variable models (elementary principles only).

DESIGN OF DIGITAL CONTROL ALGORITHMS: Review of principle of compensator design, Z-plane specifications, digital compensator design using frequency response plots, discrete integrator, discrete differentiator, development of digital PID controller, transfer function, design in the Z-plane.

PRACTICAL ASPECTS OF DIGITAL CONTROL ALGORITHMS: Algorithm development of PID control algorithms, standard programmes for microcontroller implementation, finite word length effects, choice of data acquisition systems, microcontroller based temperature control systems, microcontroller based motor speed control systems, DSP implementation of motor control system.

REFERENCES:

21EA44 / 21EM44 ROBOTICS AND ITS APPLICATIONS


APPLICATIONS: Robots and their applications in industry, mobile and service applications. Robotic material handling, material transfer, machine loading and unloading. Application of Robots in continuous arc welding, Spot welding, Spray painting, assembly operation, cleaning, robot for underwater applications, Robot centered cell and factors influencing the choice of a robot.

REFERENCES:

21EA45 / 21EM45 SENSORS, ACTUATORS AND INTERFACE ELECTRONICS

RESISTIVE AND REACTIVE SENSORS: General concepts and terminology, measurement systems, Resistive sensors: potentiometers, strain gages, resistive temperature detectors, magneto resistors, light-dependent resistors, Signal conditioning for resistive sensors: Wheatstone bridge, sensor bridge calibration and compensation, Instrumentation amplifiers, sources of interference and interference reduction, Reactance variation and electromagnetic sensors, capacitive sensors, differential, inductive sensors, linear variable differential transformers (LVDT), magneto elastic sensors, hall effect sensors, Signal conditioning for reactance-based sensors & application to the LVDT.


ACTUATORS DRIVE CHARACTERISTICS AND APPLICATIONS: Relays, Solenoid drive, Stepper Motors, Voice-Coil actuators, Servo Motors, DC motors and motor control, 4-to-20 mA and 0 -10 V Drive, Hydraulic actuators, variable transformers: synchros, resolvers, Inductosyn, resolver-to-digital and digital-to-resolver converters.

DIGITAL SENSORS AND SEMICONDUCTOR DEVICE SENSORS: Digital sensors: position encoders, variable frequency sensors – quartz digital thermometer, vibrating wire strain gages, vibrating cylinder sensors, saw sensors, digital flow meters, Sensors based on semiconductor junctions: thermometers based on semiconductor junctions, magneto diodes and magnetoe transistors, photodiodes and phototransistors, sensors based on MOSFET transistors, CCD/CMOS imaging sensors, ultrasoi n sensors, fiber-optic sensors, biometric sensors.

TOTAL L : 45

REFERENCES:

21EA46 / 21EM46 ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY


EMI COUPLING PRINCIPLES: Conducted, radiated and transient coupling-Common ground impedance coupling –Common mode and ground loop coupling -Differential mode coupling –Near field cable to cable coupling-Field to cable coupling –Power mains and Power supply coupling-Cross talk in transmission lines-Transients in transmission lines.

EMI MITIGATION TECHNIQUES: Shielding-Filtering-Grounding-Electrical Bonding-EMI Suppression Cables-EMC connectors-Isolation transformer-Transient suppressors and Surge Suppression Devices – EMI Mitigation techniques for PCB.


TOTAL L : 45

REFERENCES:
OPEN ELECTIVES

21EA91 / 21ED91 / 21EE91 BUSINESS ANALYTICS


Data Mining and Decision Analysis: Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes.

Data Mining: Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modeling, nonlinear Optimization.

Decision Analysis: Formulating Decision Problems, Decision Strategies with without Outcome Probabilities-Decision Trees, The Value of Information, Utility and Decision Making


Total: 45 Periods

References:

21EA92 / 21ED92 / 21EE92 ELECTRONIC WASTE MANAGEMENT


E-Waste Collection systems: Collection Channels: Retailer Take Back and Storage, Producer Take Back and Storage, Municipal Collection and Storage, Other Collection Points - Collection Infrastructure - Guiding principles for design and formulation of technical specifications of Ewaste collection points


Total: 45 Periods

References:
4. Electronic Waste Management Rules 2016, Govt. of India, available online at CPCB website.

Toxicology: Hazards identification-toxicity, fire, static electricity, noise and dust concentration; Material safety data sheet, hazards indices- Dow and Mond indices, hazard operability (HAZOP) and hazard analysis (HAZAN). Electrical Hazards - Hazardous area classification and classification of electrical equipments for hazardous areas - Electrical Hazards - Energy leakage - Clearance and insulation - Excess energy - Current surges – Electrical causes of fire and explosion – National electrical Safety code.


Total L : 45 hours

REFERENCES:


Total : 45 periods

References: